



City Research Online

City St George's, University of London

Citation: Ramachandran, A. (2023). Self-reported voice problems and coping strategies in Western Classical and Carnatic singers: A mixed-methods study. (Unpublished Doctoral thesis, City, University of London)

This is the accepted version of the paper.

This version of the publication may differ from the final published version. To cite this item please consult the publisher's version.

Permanent repository link: <https://openaccess.city.ac.uk/id/eprint/32019/>

Copyright and Reuse: Copyright and Moral Rights remain with the author(s) and/or copyright holders. Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge, unless otherwise indicated, provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way. For full details of reuse please refer to [City Research Online policy](#).

Self-reported voice problems and coping strategies in Western Classical and Carnatic singers: A mixed-methods study

Volume 1

by

Aparna Ramachandran

Thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy



Department of Health Services Research and Management

School of Health and Psychological Sciences,

City University of London, London, UK

December 2023

DECLARATION

I grant powers of discretion to the University Librarian to allow this thesis to be copied in whole or in part without further reference to me. This permission covers only single copies made for study purposes, subject to normal conditions of acknowledgement.

ABSTRACT

Background and aims: Singers report high prevalence and increased impact of self-reported voice problems. The impact of genre on self-reported voice problems is unclear and studies comparing voice problems between genres is limited. Research suggests that adequately adapted coping strategies can help in management and prevention of health problems; however, this is relatively unexplored in the context of voice disorders, particularly in singers. This thesis aimed to identify self-reported voice problems, factors influencing vocal health and coping strategies in Western classical and Carnatic singers.

Methods: A mixed methods approach was used. Two systematic reviews explored self-reported voice problems and coping strategies respectively. Next, a qualitative study using framework principles gathered perceptions of three participant groups (Speech and Language Therapists, singing teachers and singers) regarding voice problems and coping in Western classical and Carnatic singers. Finally, an online survey investigated the research aims on a wide population of singers of both groups. The constructs measured were vocal impact (using Singing Voice Handicap Index-SVHI), vocal symptoms, coping (using Voice Disability Coping Questionnaire), illness perceptions (using Brief Illness perception questionnaire), and variables which may impact the voice. Bivariate and multivariate analyses were carried out to identify variables associated with vocal impact.

Results: The systematic reviews reported vocal symptoms (among classical singers) and coping strategies (among teachers); vocal fatigue and social support were the most frequently reported vocal symptom and coping strategy respectively. The qualitative study (n=19) and the survey (n=165) reported that the most frequently reported symptoms were vocal fatigue, reduced pitch range and vocal strain/effortful singing. Carnatic singers scored higher on all SVHI outcomes and reported more frequent symptoms. Information seeking was the most frequently used coping strategy among both groups; some group differences were also noted (e.g., reliance on religion for Carnatic singers). Frequency of vocal symptoms, coping, illness perception, positive attitude towards voice and performance anxiety were predictors of vocal impact. Strategies employed by singers to maintain vocal health are reported.

Conclusion: This research is the first of its kind to study self-reported voice problems and coping by comparing genres. An increased vulnerability among Carnatic singers, reporting more frequent vocal symptoms and higher levels of vocal impact is indicative of genre impacting vocal health. Influences of genre and culture were also evident in the choice of coping strategies between the

groups. The predictors of vocal impact identified will promote better understanding for prevention of voice problems and maintaining vocal health.

Contents

1	CHAPTER 1: INTRODUCTION	17
1.1	SINGING	17
1.1.1	<i>History and cultural significance</i>	17
1.1.2	<i>Physiology of voice production</i>	17
1.1.3	<i>Physiological processes unique to singing</i>	19
1.2	WESTERN CLASSICAL MUSIC	19
1.2.1	<i>Background and historical aspects</i>	19
1.2.2	<i>Training and pedagogical details</i>	20
1.3	CARNATIC MUSIC.....	20
1.3.1	<i>Background and historical aspects</i>	20
1.3.2	<i>Training and pedagogical details</i>	21
1.4	COMPARING WESTERN CLASSICAL AND CARNATIC SINGERS	21
1.4.1	<i>Vocal characteristics and training</i>	21
1.5	JUSTIFICATION FOR CHOOSING CARNATIC AND WESTERN CLASSICAL SINGERS FOR THE PRESENT STUDY	23
1.6	ANALYSIS OF THE NORMAL CLASSICAL SINGING VOICE.....	24
1.7	VOICE PROBLEMS IN SINGERS	25
1.7.1	<i>Prevalence of voice problems in singers</i>	26
1.8	UNIQUE RISK FACTORS OF SINGERS LEADING TO VOICE PROBLEMS	27
1.8.1	<i>Performance demands</i>	27
1.8.2	<i>Frequent Travel</i>	27
1.8.3	<i>Stress and anxiety</i>	28
1.8.4	<i>Venue acoustics and allergens</i>	28
1.8.5	<i>Medication use</i>	29
1.8.6	<i>Improper vocal technique</i>	29
1.8.7	<i>Singing style</i>	29
1.9	ASSESSMENT OF VOICE PROBLEMS IN SINGERS.....	30
1.9.1	<i>Special considerations for evaluating the singing voice</i>	30
1.10	CLINICAL CHARACTERISTICS OF VOICE PROBLEMS IN SINGERS	38
1.10.1	<i>Voice disorders identified through comprehensive assessment</i>	39
1.10.2	<i>Voice disorders identified through self-assessment</i>	39
1.11	COPING AND VOICE	40
1.11.1	<i>Definition</i>	40
1.11.2	<i>Literature on generic factors affecting coping</i>	41
1.11.3	<i>Measurement of coping</i>	42
1.12	CONCEPTUAL MODELS AND THEORETICAL FRAMEWORKS TO STUDY VOICE PROBLEMS AND COPING IN SINGERS	49
1.12.1	<i>Common sense model of self-regulation (CSM)</i>	50
1.13	RATIONALE FOR USING PRINCIPLES OF COMMON-SENSE MODEL FOR THE CURRENT PROGRAMME OF RESEARCH	52
1.13.1	<i>Approach undertaken by current programme of research</i>	55
1.14	AIMS AND OBJECTIVES OF THE CURRENT PROGRAMME OF RESEARCH.....	60
1.15	PERSONAL MOTIVATION TO UNDERTAKE THE THESIS	61
2	CHAPTER 2: SELF REPORTED VOICE PROBLEMS IN CLASSICAL SINGERS-A SYSTEMATIC REVIEW	62
2.1	INTRODUCTION	62
2.2	METHODS.....	64
2.2.1	<i>Eligibility criteria</i>	64
2.2.2	<i>Information sources</i>	65
2.2.3	<i>Search strategy</i>	65
2.2.4	<i>Selection process</i>	65
2.2.5	<i>Data collection process</i>	66
2.2.6	<i>Data Extraction</i>	66

2.2.7	<i>Methodological quality and risk of bias assessment</i>	66
2.2.8	<i>Data synthesis</i>	67
2.3	RESULTS	67
2.3.1	<i>Study selection</i>	67
2.3.2	<i>Study Characteristics</i>	68
2.3.3	<i>Participant characteristics</i>	69
2.3.4	<i>Singing related characteristics</i>	69
2.3.5	<i>Methodological quality</i>	73
2.3.6	<i>Review objective 1: How are self-reported voice problems assessed in classical singers?</i>	73
2.3.7	<i>Review objective 2: What is the type, nature, and frequency of self-reported voice problems in classical singers?</i>	79
2.3.8	<i>Review objective 3: What are the factors associated with self-reported voice problems in classical singers?</i>	103
2.4	DISCUSSION	109
2.4.1	<i>Study characteristics</i>	109
2.4.2	<i>Methodological quality</i>	110
2.4.3	<i>Self-reported voice problems assessment/measurement</i>	110
2.4.4	<i>Results obtained from validated measures</i>	111
2.4.5	<i>Results of non-validated assessment measures</i>	113
2.4.6	<i>Comparison of self-reported voice problems across genres</i>	114
2.4.7	<i>Duration, onset and nature of voice problems in classical singers</i>	114
2.4.8	<i>Factors associated with self-reported voice problems in classical singers</i>	115
2.4.9	<i>Limitations and strengths</i>	118
2.4.10	<i>Conclusions and future directions</i>	118
3	CHAPTER 3: VOICE-RELATED COPING IN PROFESSIONAL VOICE USERS-A SYSTEMATIC REVIEW	120
3.1	ABSTRACT	121
3.2	INTRODUCTION AND OBJECTIVES	122
3.3	METHODS	123
3.3.1	<i>Eligibility Criteria</i>	123
3.3.2	<i>Information sources</i>	124
3.3.3	<i>Search strategy</i>	124
3.3.4	<i>Selection process</i>	124
3.3.5	<i>Data collection process</i>	124
3.3.6	<i>Data items</i>	125
3.3.7	<i>Risk of bias assessment</i>	125
3.3.8	<i>Data synthesis</i>	126
3.4	RESULTS	126
3.4.1	<i>Study selection</i>	126
3.4.2	<i>Study Characteristics</i>	126
3.4.3	<i>Participant characteristics</i>	127
3.4.4	<i>Methodological quality</i>	128
3.4.5	<i>Assessment of coping</i>	128
3.4.6	<i>Coping strategies used by professional voice users to manage voice problems</i>	129
3.4.7	<i>Factors associated with coping in professional voice users</i>	137
3.5	DISCUSSION	143
3.5.1	<i>Limitations and strength of evidence</i>	146
3.6	CONCLUSION AND FUTURE DIRECTIONS	147
3.6.1	<i>Implications for the present programme of research</i>	147
4	CHAPTER 4: QUALITATIVE STUDY TO EXPLORE PERCEPTIONS OF WESTERN CLASSICAL AND CARNATIC SINGERS, SINGING TEACHERS AND SPEECH AND LANGUAGE THERAPISTS REGARDING SELF-REPORTED VOICE PROBLEMS AND VOICE-RELATED COPING IN SINGERS	149
4.1	INTRODUCTION AND NEED FOR THE STUDY	149
4.2	AIMS	151

4.3	METHODS.....	153
4.3.1	<i>Design.....</i>	153
4.3.2	<i>Participants.....</i>	154
4.3.3	<i>Inclusion/Exclusion criteria.....</i>	155
4.3.4	<i>Recruitment.....</i>	156
4.3.5	<i>Development of interview guide.....</i>	156
4.3.6	<i>Interview process.....</i>	158
4.3.7	<i>Data protection.....</i>	159
4.3.8	<i>Data Analysis.....</i>	159
4.3.9	<i>Monitoring, supervision, and quality control.....</i>	160
4.4	RESULTS.....	161
4.4.1	<i>Participant characteristics.....</i>	161
4.4.2	<i>Themes and subthemes of the study.....</i>	163
4.5	DISCUSSION.....	194
4.5.1	<i>How do singers, SLTs and vocal coaches describe a normal and pathological voice?.....</i>	195
4.5.2	<i>What are the vocal problems commonly seen in singers and what are the potential risk factors/causes?.....</i>	196
4.5.3	<i>What are the factors impacting the voice?.....</i>	197
4.5.4	<i>How do voice problems impact singers?.....</i>	201
4.5.5	<i>How do the two groups of singers cope with voice problems?.....</i>	201
4.5.6	<i>Assessing the singing voice-challenges and future directions.....</i>	203
4.5.7	<i>What strategies do the two groups of singers use to maintain vocal health?.....</i>	204
4.6	STRENGTHS AND LIMITATIONS OF EVIDENCE.....	204
4.7	REFLEXIVITY AND POSITIONING.....	205
4.7.1	<i>How does my background influence my relationship with my participants? (Personal reflexivity).....</i>	205
4.7.2	<i>How does my background (personal and professional) influence my judgments while making methodological decisions? (Functional reflexivity).....</i>	207
4.7.3	<i>How do my personal beliefs influence data analysis (e.g., do they make me predisposed to align my data to reach a particular conclusion? (Epistemological reflexivity).....</i>	207
4.8	CONCLUSION.....	208
5	CHAPTER 5- A SURVEY TO EXPLORE SELF-REPORTED VOICE PROBLEMS AND COPING STRATEGIES IN WESTERN CLASSICAL AND CARNATIC SINGERS: INTRODUCTION AND METHODS.....	210
5.1	INTRODUCTION.....	210
5.2	SURVEY OBJECTIVES.....	212
5.3	METHODS.....	212
5.3.1	<i>Design and setting.....</i>	212
5.3.2	<i>Inclusion criteria.....</i>	212
5.3.3	<i>Recruitment and data collection.....</i>	213
5.3.4	<i>Survey instrument.....</i>	213
5.3.5	<i>Procedure.....</i>	218
5.3.6	<i>Statistical strategy.....</i>	224
5.3.7	<i>Sample size.....</i>	228
6	CHAPTER 6- A SURVEY TO EXPLORE SELF-REPORTED VOICE PROBLEMS AND COPING STRATEGIES IN WESTERN CLASSICAL AND CARNATIC SINGERS - RESULTS PART 1.....	231
6.1	PARTICIPANT CHARACTERISTICS.....	231
6.2	MISSING VALUE ANALYSES.....	233
6.3	OBJECTIVE 1: IDENTIFY THE SELF-REPORTED VOICE PROBLEMS, ILLNESS PERCEPTIONS, COPING STRATEGIES AND VARIABLES WHICH ARE LIKELY TO INFLUENCE VOCAL HEALTH IN WESTERN CLASSICAL AND CARNATIC SINGERS.....	239
6.3.1	<i>Description of self-reported voice problems.....</i>	239
6.3.2	<i>Description of Illness perceptions.....</i>	244
6.3.3	<i>Coping with voice problems.....</i>	247
6.3.4	<i>Variables which are likely to influence the voice.....</i>	252

6.4	OBJECTIVE 2: COMPARE THE SELF-REPORTED VOICE PROBLEMS, COPING STRATEGIES, ILLNESS PERCEPTIONS AND VARIABLES WHICH ARE LIKELY TO INFLUENCE VOCAL HEALTH BETWEEN WESTERN CLASSICAL AND CARNATIC SINGERS TO ASCERTAIN THE IMPACT OF GENRE ON VOCAL HEALTH (COMPARATIVE).	263
6.4.1	<i>Self-reported voice problems</i>	263
6.4.2	<i>Illness perceptions</i>	266
6.4.3	<i>Coping with voice problems</i>	267
6.4.4	<i>Variables which are likely to impact voice</i>	267
6.4.5	<i>Summary of Objective 2</i>	270
6.5	OBJECTIVE 3: EXPLORE STRATEGIES EMPLOYED BY THE TWO SINGING GROUPS TO MAINTAIN VOCAL HEALTH (DESCRIPTIVE AND QUALITATIVE).	271
6.5.1	<i>Warm-up</i>	271
6.5.2	<i>Other practices followed by singers to maintain vocal health</i>	272
6.6	DISCUSSION	274
6.6.1	<i>Sample characteristics-representativeness and generalisability</i>	274
6.6.2	<i>Section 1: Identify the self-reported voice problems, illness perceptions and coping strategies in Western classical and Carnatic professional singers</i>	276
6.6.3	<i>Section 2: Compare the self-reported voice problems and coping styles between Western Classical and Carnatic singers to ascertain the impact of genre on vocal health</i>	281
6.6.4	<i>Section 3: Variables which are likely to impact the voice</i>	285
6.6.5	<i>Section 4: what are the strategies employed by singers to maintain vocal health?</i>	288
6.7	CONCLUDING REMARKS	289
7	CHAPTER 7- A SURVEY TO EXPLORE SELF-REPORTED VOICE PROBLEMS AND COPING STRATEGIES IN WESTERN CLASSICAL AND CARNATIC SINGERS - RESULTS PART 2	290
7.1	OBJECTIVE 4: EXAMINE IF THERE IS AN ASSOCIATION BETWEEN ILLNESS PERCEPTIONS, COPING, DEMOGRAPHIC, SINGING, MEDICAL AND LIFESTYLE FACTORS AND SELF-REPORTED VOICE PROBLEMS BY CARRYING OUT CORRELATION ANALYSIS (BIVARIATE ANALYSIS)	290
7.1.1	<i>Correlation between SVHI subscales</i>	290
7.1.2	<i>Vocal impact and demographic factors</i>	291
7.1.3	<i>Vocal impact and singing related characteristics</i>	292
7.1.4	<i>Vocal impact and medical factors</i>	294
7.1.5	<i>Vocal impact and vocal symptoms</i>	295
7.1.6	<i>Vocal impact and illness perceptions</i>	295
7.1.7	<i>Vocal impact and coping</i>	296
7.1.8	<i>Vocal impact and lifestyle factors</i>	297
7.1.9	<i>Vocal impact and singing related factors</i>	298
7.1.10	<i>Vocal impact and other variables</i>	299
7.1.11	<i>Summary of variables which correlated with vocal impact</i>	299
7.2	OBJECTIVE 5: IDENTIFY THE PREDICTORS OF VOCAL IMPACT BY CARRYING OUT REGRESSION ANALYSIS (MULTIVARIATE ANALYSIS)	302
7.2.1	<i>Stepwise regression for outcomes which did not meet the required case to variable ratio</i>	302
7.2.2	<i>Hierarchical regression analysis</i>	305
7.3	DISCUSSION	320
7.3.1	<i>Examination of methodological considerations for regression analysis</i>	320
7.3.2	<i>Demographic variables and vocal impact</i>	321
7.3.3	<i>Singing related characteristics and vocal impact</i>	321
7.3.4	<i>Medical factors and vocal impact</i>	323
7.3.5	<i>Lifestyle factors and vocal impact</i>	323
7.3.6	<i>Singing related factors and vocal impact</i>	324
7.3.7	<i>Vocal symptoms and vocal impact</i>	325
7.3.8	<i>Illness perceptions and vocal impact</i>	327
7.3.9	<i>Coping and vocal impact</i>	328
7.4	STRENGTHS AND LIMITATIONS OF THE SURVEY	331
7.5	CONCLUSION	333
8	CHAPTER 8 - DISCUSSION	335

8.1	INTERGRATED FINDINGS - SELF-REPORTED VOICE PROBLEMS	335
8.1.1	<i>The survey instrument - points to consider</i>	338
8.2	INTEGRATED FINDINGS - ILLNESS PERCEPTIONS AND COPING WITH VOICE PROBLEMS	339
8.3	INTEGRATED FINDINGS - PREDICTORS OF VOICE PROBLEMS IN SINGERS	342
8.4	INTEGRATED FINDINGS - MAINTAINING VOCAL HEALTH.....	344
8.5	A RETROSPECTIVE ANALYSIS OF THE IMPACT OF GENRE ON VOCAL HEALTH	344
8.6	GENERALISABILITY AND REPLICABILITY OF THE FINDINGS	346
8.7	REVISITING THE THEORETICAL FRAMEWORK	348
8.8	IMPACT OF COVID-19 ON THE THESIS.....	351
8.9	METHODOLOGICAL CONSIDERATIONS - STRENGTHS AND LIMITATIONS.....	352
8.10	CLINICAL IMPLICATIONS	354
8.11	FUTURE DIRECTIONS.....	355
8.12	SUMMARY AND CONCLUSION	361
9	REFERENCES.....	362

List of Tables

Table 1.1: Comparison of training and vocal characteristics of Western Classical and Carnatic singers	23
Table 1.2: Description of self-assessment tools developed to assess various constructs related to voice problems (Francis et al, 2017)	35
Table 1.3: Subscales of Voice Disability Coping Questionnaire (VDCQ) and items (Epstein et al, 2009)	46
Table 1.4: Details pertaining to subscales of the Utrecht Coping List (UCL) (McAuliffe et al, 2005)	47
Table 2.1: Study and participant characteristics of studies included in the systematic review.....	71
Table 2.2: Methodological quality assessment of cross-sectional studies included in the systematic review	74
Table 2.3: Methodological quality assessment of all other study designs.....	75
Table 2.4: Description of the validated measures (outcomes) reported in this review with their established normative scores.....	81
Table 2.5: Synthesis of objectives, measures and outcomes of the systematic review on self-reported voice problems	83
Table 2.6: Combined means and Standard Deviations of the subscales of the Classical Singing Handicap Index (CSHI, n=5 studies).....	96
Table 2.7: Weighted scores of the 41 symptoms identified in the present review.....	99
Table 2.8: Categorisation of vocal symptoms reported in the systematic review	101
Table 2.9: Factors associated with voice problems	106
Table 3.1: Description of study characteristics.....	131
Table 3.2: Quality assessment of the selected articles using the Joanna Briggs Institute Critical Appraisal tools	133
Table 3.3: Details of coping subscales measured by UCL and VDCQ	135
Table 3.4: Coping patterns seen in teachers with high vocal handicap based on UCL subscales	136
Table 3.5: Synthesis of outcomes reported in the included studies.....	138
Table 3.6: Combined frequencies of 10 VDCQ items with highest scores reported by Zambon et al (2014) and Ferracciu et al (2015) and classification of items into relevant subscales of the original validated version of the VDCQ (Epstein et al, 2007)	142
Table 4.1: Contribution of each research question towards the overall aims of the thesis	152
Table 4.2: Distribution of study participants in the qualitative study	155

Table 4.3: Description of various stages of Framework analysis in the context of the current study (Iliffe et al, 2015)	161
Table 4.4 Participant characteristics in the qualitative study (n=19)	162
Table 5.1: Description of items in the survey instrument	219
Table 5.2: Description of regression assumptions, methods used to assess them and implications for the study (Pallant, 2020)	228
Table 6.1 Demographic characteristics of the participants for total sample and per singing group.	234
Table 6.2: List of imputed variables for the survey	238
Table 6.3: Frequencies of the attributes used by both groups to describe their own voices	239
Table 6.4: Description of the frequency of symptoms' subscales and Cronbach's alpha values	242
Table 6.5: Descriptive mean scores of the frequency of symptoms' subscales for each group	243
Table 6.6: Description of the SVHI subscales and Cronbach's alpha values	245
Table 6.7: Descriptive mean scores of the SVHI subscales for each group	247
Table 6.8: Descriptive mean scores of the IPQ subscales for each group	247
Table 6.9: VDCQ subscales, descriptions and Cronbach's alpha values	250
Table 6.10: Descriptive mean scores of VDCQ subscales for both groups	252
Table 6.11: Frequency of vocal behaviours which are likely to negatively impact the voice reported by the two groups	254
Table 6.12: Consumption of items which are likely to negatively impact the voice reported by the two groups	256
Table 6.13: Lifestyle variables which are likely to impact voice problems in singers	257
Table 6.14: Frequencies of reasons contributing to work related stress among both groups of singers	258
Table 6.15: Frequencies of hormonal variables of both groups	259
Table 6.16: Frequency of medical variables likely to impact the voice reported by participants	260
Table 6.17: Frequencies of singing related variables of both groups	261
Table 6.18: Comparison of mean scores of the survey measures (subscales) between the two groups	264
Table 6.19: Comparison (inferential test results) of variables likely to impact voice between the two groups	269
Table 6.20: Summary of Objective 2-comparison of frequency of symptoms, vocal impact, illness perceptions and coping between the two groups	271
Table 6.21: Frequency of warm-up and cool-down among participant groups	272
Table 6.22: Warm up strategies used by the two groups	272
Table 6.23: Practices reported by Western classical and Carnatic singers to maintain vocal health	273
Table 7.1: Correlations between the SVHI subscales (including SVHI-Overall mean)	291
Table 7.2: Correlations between vocal impact (SVHI) and demographic factors	292
Table 7.3: Correlations between vocal impact (SVHI) and singing related characteristics	293
Table 7.4: Correlations between vocal impact (SVHI) and medical factors	294
Table 7.5: Correlations between vocal impact (SVHI) and vocal symptoms (Frequency of symptoms scale)	295
Table 7.6: Correlations between vocal impact (SVHI) and Illness Perception (IPQ items)	296
Table 7.7: Correlations between vocal impact (SVHI) and coping (VDCQ)	296
Table 7.8: Correlations between vocal impact (SVHI) and lifestyle factors	297
Table 7.9: Correlations between vocal impact (SVHI) and singing related factors	299

Table 7.10: List of variables which moderately/strongly correlated with SVHI outcomes	300
Table 7.11: Results of the stepwise regression highlighting the significant predictors for the three outcome measures	303
Table 7.12: List of variables entered in the hierarchical regression model for each SVHI outcome.....	305
Table 7.13: Regression model summary of SVHI-Overall Mean.....	308
Table 7.14: Regression coefficients of the predictor variables of SVHI- Overall Mean	308
Table 7.15: Regression model summary of SVHI-Physical-Auditory perceptual	309
Table 7.16: Regression coefficients of the predictor variables of SVHI-Physical-Auditory Perceptual	310
Table 7.17: Regression model summary of SVHI-Functional.....	311
Table 7.18: Regression coefficients of the predictor variables of SVHI-Functional.....	311
Table 7.19: Regression model summary of SVHI-Vocational	312
Table 7.20: Regression coefficients of the predictor variables of SVHI-Vocational	313
Table 7.21: Regression model summary of SVHI-Emotional	314
Table 7.22: Regression coefficients of the predictor variables of SVHI-Emotional	314
Table 7.23: Regression model summary of SVHI Physical-Consistency	315
Table 7.24: Regression coefficients of the predictor variables of SVHI Physical-Consistency	316
Table 7.25: Variables that significantly predicted the SVHI outcomes and direction of effect.	319
Table 8.1: Outline of planned publications with corresponding aims and findings	358

List of Figures

Fig 1.1: Representation of the common-sense model by Hagger et al, 2017	53
Fig 1.2: The framework proposed by Shaw (1999) to study coping, illness behaviour and outcomes	54
Fig 1.3: Theoretical model of current study based on the Common-sense model (Leventhal et al, 1980) and framework proposed by Shaw (1999)	57
Fig 2.1 - PRISMA Flow Diagram illustrating the study selection process of the systematic review	68
Fig 2.3: Ten most frequently reported vocal symptoms by classical singers based on composite scores	101
Fig 2.4: Frequencies of the vocal symptom categories reported by classical singers	101
Fig 3.1: Figure explaining the mediating role of coping	123
Fig 3.2 - PRISMA Flow Diagram illustrating the study selection process	127
Fig 3.3: Comparison of UCL scores of teachers with low and high vocal handicap and normative scores	129
Fig 4.1: Themes and subthemes of the qualitative study.....	165
.....	165
Fig 6.1: Summary of missing values, per item (values), variables and participants (cases).....	237
Fig 6.2: Mean scores of the ten most frequently reported symptoms by group	241
Fig 6.3: Mean scores of the ten most frequently reported coping strategies by each singing group.....	249
Fig 6.4: Median frequency scores of vocal behaviours for both groups	253
Fig 6.5: Median frequency scores of consumptions of various items which are likely to negatively impact the voice..	255
Figure 6.6: Beliefs of participants pertaining to variables negatively impacting the voice-Top 15 variables.....	262
Fig 6.7 Comparison of mean scores of frequency of symptoms' subscales between the two groups	264

Fig 6.8: Comparison of mean scores of SVHI subscales between the two groups	266
Fig 6.9: Comparison of mean scores of IPQ items between the two groups	266
Fig 6.10: Comparison of mean scores of VDCQ subscales between groups	267
Fig 7.1 Order of blocks entered in the regression model – with details of specific variables per block	307
Fig 8.1: Modifications made to the original theoretical framework.....	350

COVID-19 Impact Statement

This statement is provided for the aid and benefit of future readers to summarise the impact of the COVID-19 pandemic on the scope, methodology, and research activity associated with this thesis. The academic standards for a research degree awarded by City, University of London and for which this thesis is submitted remain the same regardless of this context.

Title of the research project: SELF-REPORTED VOICE PROBLEMS AND COPING STRATEGIES IN WESTERN CLASSICAL AND CARNATIC SINGERS- A MIXED METHODS STUDY

1. Summary of how the research project, scope or methodology has been revised because of COVID-19 restrictions

Interviews of participants residing in the UK were planned to be conducted face to face; however due to COVID 19, all interviews were carried out virtually. In addition, timelines were extended to allow for participants recruitment, while they were in difficult circumstances themselves.

2. Summary of how research activity and/or data collection was impacted because of COVID-19 restrictions, and how any initially planned activity would have fitted within the thesis narrative

COVID-19 significantly slowed the data collection process and it was particularly challenging to request participants to take part in the study during these difficult times. Many of the potential participants had also contracted COVID-19 which brought further delays in data collection. Additionally, members within the supervisory team (and the researcher) contracted COVID-19 (multiple occasions) which slowed the research process and caused undue delays.

3. Summary of actions or decisions taken to mitigate for the impact of data collection or research activity that was prevented by COVID-19

The primary impact of COVID-19 was on the data collection process where adjustments had to be incorporated into the methodology to mitigate the restrictions imposed by COVID-19 (e.g., planning virtual interviews). By the time data collection commenced, most of the participants were adjusted to the “new normal” and comfortable to be interviewed via video conferencing. Data collection for the second half of the thesis was undertaken in November-December 2021 and by this time, singers (participant group) were resuming their busy schedules and making up

for all the lost work during the pandemic, posing challenges for data collection. To mitigate this, the survey was extended for an extra month.

4. Summary of how any planned work might have changed the thesis narrative, including new research questions that have arisen from adjusting the scope of the research project

Since the thesis involved overseas participants, the methodology involved a variety of online/virtual modalities. Therefore, the impact of COVID-19 was minimal as no major/significant amendments had to be made to the research objectives or methodology. However, the impact of COVID-19 on the singing voice was added to the survey instrument as the survey provided a good opportunity to explore this crucial aspect, given its relevance to the study population.

Date of statement: 30/04/2023

ACKNOWLEDGEMENTS

It feels surreal to realise that the journey which began as a vague idea five years ago has now culminated into a thesis. This would not have been possible without the arduous efforts of many individuals who have directly or indirectly contributed to see this project into fruition; I would like to take the opportunity to acknowledge them here.

Firstly, my heartfelt gratitude to my enviable supervisory team for their inordinate support, encouragement and guidance whenever I needed it and their belief in me. I would like to thank Dr Shashi Hirani for excusing all my mistakes (there have been too many!), particularly during data analysis and his calm and composed demeanour when I have been flustered. You have taught me more than I could ever give you credit for here, about scientific research. I'm very grateful to Prof Katerina Hilari for holding this project together and always being available for support. I have gained a great deal of professional and personal wisdom from you which has had a significant impact on me. Sincere thanks to Dr Ruth Epstein for encouraging me to pursue this project and her unfaltering professionalism and expertise.

Thank you to Dr Niamh Devane for her assistance with the systematic reviews and accommodating all my last-minute requests. Thank you to Dr Becky Moss for sharing her useful insights and guidance on qualitative research methods. Thank you to Tracy Rowson for always being available to answer any query. Thank you to Steve O'Driscoll for all his help in designing the search strategy for the systematic reviews.

I am grateful to the School of Health Sciences at City, University of London whose funding made this research possible.

My sincere gratitude to the 18 participants of my qualitative study for their time and sharing their insights and experiences. Thank you to all the singers who took time off their busy schedules to take part in the survey. Thank you to my singing teacher, Dr Baby Sreeram for all her help with data collection. Thanks to British Voice Association and British Association of Performing Arts Medicine for their efforts in disseminating the survey.

Thank you to the PhD ECR group, especially Katie Monnelley and Sally Morgan for their support and empathy when I needed it the most! Thank you to Mary Heritage and Tracey Day for carrying me on their shoulders and giving me the bare minimum to do at University of Lincoln to accommodate my thesis requirements.

Finally, all my love and gratitude to my family, without whom this journey would have been impossible to complete. Thank you to Achan and Amma for passing down all the values I possess today which has made me who I am. Nothing gives me more joy than making you proud. Thank you to my dearest Manjumma for always encouraging me to do better and all the prayers. Thank you to Ammu chechi and Akosoto for their unwavering belief in me even when I didn't believe in myself. Thank you to Medu for making me smile! Thank you to my husband, Aravind, my Achu for picking up the pieces after several of my meltdowns and single handedly parenting our daughter when I wasn't physically or emotionally available. Thank you to Shivani, Amma's bibikutty for being the most understanding daughter in the world and the hundred thousand million cuddles! You are my motivation, my strength.

1 CHAPTER 1: INTRODUCTION

The first chapter provides a detailed explanation of all topics relevant to self-reported voice problems and coping, with a focus on the singing voice. The latter part of the chapter will introduce the conceptual model developed for the thesis and outline the research objectives.

1.1 SINGING

1.1.1 History and cultural significance

Humans have engaged in singing activities since prehistoric times, despite the lack of a biological necessity (Hoch, 2019). Physiologically, neither singing nor speaking is the primary function of the larynx or any of the associated subsystems and is considered an overlaid function (Gray, 1934). Voice production and the physiological processes involved in singing are universal; however, the interplay of the various subsystems and cultural underpinnings, religion being a significant one, led to the development of various singing styles. Boominathan (2012) suggested that the diversity in singing styles can be attributed to differences in “intellectual status, scientific consciousness, social awareness, philosophical pursuits, religious trends, culture and ways of living”. Singing is an evolutionary process that is constantly changing to fit in with cultural and societal adaptations.

1.1.2 Physiology of voice production

Speaking and singing mechanisms are composed of three subsystems- the air pressure or respiratory system (power), the vibratory or phonatory system (source) and the resonatory system (filter) (The Voice Foundation, 2020). The respiratory system comprises of the lungs and the lower airway, which supply the required air pressure and airflow to set the vocal folds into motion. The phonatory system comprises of the larynx and the vocal folds which modulate the airflow by opening and closing the glottis (space between the vocal folds). This enables the release of short puffs of air at high speed which is converted into sound waves and leads to the production of the voiced sound in various pitches. The resonatory system is made up of the vocal tract which modifies the voice to produce various desired sounds (Zhang, 2016). Depending on the size and shape of the vocal tract, the size of the opening of the mouth and the density of the vocal tract walls, different frequencies are enhanced, leading to the production of formants. Therefore, formants are concentrations of acoustic energy around a particular frequency, depending on the resonance of the vocal tract.

The following steps occur during voice production (Zhang, 2016 and the Voice Foundation, 2020):

- a. A column of air is directed towards the vocal folds

- b. The diaphragm, abdominal muscles, thoracic muscles and accessory muscles of the rib cage act in a coordinated manner to build subglottic pressure and eventually expel air out of the lungs when a certain threshold is reached.
- c. This column of air opens (abduction) the lower part of the vocal folds and gradually moves to the upper regions thereby opening the top of the vocal folds (called open phase).
- d. The fast movement of the air column produces the Bernoulli effect (lowering of pressure where velocity of flow is increased) which then causes the inferior part of the vocal folds to close first, followed by the superior part (adduction).
- e. Glottal closure releases a puff of air by cutting off the air column supply (called closed phase)
- f. Steps c to e constitute a vibratory cycle where the vocal folds are excited into a self-sustained vibration (the steps are repeated rapidly) to produce a buzzing sound.
- g. This sound undergoes modifications within the vocal tract producing a desired voice.

1.1.2.1 Physiological processes underlying pitch production

Alteration of pitch is arguably one of the most crucial aspects of the singing voice and therefore warrants special emphasis in this section. Pitch is generally determined by three components- length, tension and mass of the vibrating body. The Fundamental frequency of the voice denoted as F_0 (defined as the average number of oscillations per second) increases with increasing tension, decreasing mass and decreasing vocal fold length (Zhang, 2016). Additionally, a fourth element called stiffness (which represents the elastic restoring force of the vocal folds following deformation) also influences F_0 where an increase in stiffness raises F_0 .

The muscles responsible for pitch alteration are the cricothyroid muscle, medial belly (vocalis) and lateral belly or 'thyroarytenoid'. The cricothyroid, the only tensor within the intrinsic laryngeal muscles, plays an important role in altering the stiffness and the tension of the vocal folds. An increase in activity of the cricothyroid muscle increases the F_0 . An increase in the activity of the vocalis muscle also increases F_0 . The cricothyroid and vocalis muscles work in a coordinated manner and the ratio of activation of these muscles results in transition between vocal registers (range of vocal tones produced by specific vibratory patterns of the vocal folds). These are modal voice, vocal fry, falsetto and whistle register (Hirano, 1988).

1.1.3 Physiological processes unique to singing

Singers have always fascinated voice researchers primarily due to the uniqueness of the way in which they use their vocal mechanism to produce sounds that are complex and aesthetic. Hirano (1988) provided one of the earliest accounts to physiologically explain the versatility in the singing voice and summarised that the vocal folds of singers have unique structural capacities to undergo delicate and intricate adjustments which are executed by the central nervous system, the laryngeal muscles, appropriate breathing manoeuvres and adequately controlled shaping of the resonance cavity. Sundberg (1990) reported that singers showed 'special' respiratory, phonatory and articulatory behaviours. He identified that singers are able to modify the subglottal pressure to produce not only the desired loudness, as seen in speaking, but also to produce desired pitch for each note. This is achieved by changing the subglottal pressure to zero from a target value and then build it up to a different target value for the next pitch in the exercise. Therefore, there is greater independence between various phonatory parameters. He also explained the physiology of the singer's formant, which will be discussed further in section 1.4. He concluded that vocal training enhances the ability to independently control breathing, phonation and articulation where a singer only makes necessary changes to achieve a desired tone, thereby ensuring minimal effort while singing. These physiological attributes and production styles/parameters are suggestive of unique vocal abilities, but also needs and subsequent voice-related problems in singers; and imply the need to consider them as a separate group or entity during clinical and research endeavours.

Singing has been expressed differently across cultures and regions globally, leading to the development of various genres such as folk, classical, and more recently, contemporary commercial music.

In this study, two classical forms were compared- Western Classical and Carnatic singing. Both are traditional classical artforms with a lineage that can be traced back many centuries. The background and historical aspects of both singing styles will be presented in the next section. Additionally, the similarities and differences between the genres (e.g., training, desired vocal attributes, etc.) will be explored.

1.2 WESTERN CLASSICAL MUSIC

1.2.1 Background and historical aspects

Western Classical music refers to a style of music that originated during the "classical period" (1730-1820) encompassing a vast range of music styles most of which were closely linked to the religious

beliefs and practises of that era (Palsule, 2015). Western Classical music underwent considerable development under the Roman catholic church (Koopman, 1999). It developed the music from simple chants carried out in unison to more complex polyphonic choral singing styles. Polyphonic singing continues to remain a characteristic feature of Western Classical singing and some of the pedagogical approaches such as Solmization (system of attributing a syllable to each note of a musical scale such as Do Re Mi) is still used to date (Koopman, 2020). Further, introduction of vocal ornaments which are defined as modulations imposed over the original musical piece which accentuate the purpose, meaning and artistry singing (Neumann, 1970) are still characteristic of trained Western Classical singing (Boominathan, 2012).

1.2.2 Training and pedagogical details

Teachers have various approaches in pedagogy and varying opinions on the effectiveness of these approaches (Miller, 1997). An aspiring Western Classical singer can receive training at a music conservatorium or academy, a university or privately (Haddon, 2009). Training methods primarily focus on developing a healthy, full, resonant and ergonomically sustainable singing across the widest range (pitch and loudness) available to a singer. A Western Classical singing student is taught specific skills to produce the desired vocal quality and achieve high levels of vocal endurance to meet the demands of a challenging singing career (Dayme, 2009) such as prolonged singing, singing in extreme pitches, singing in loud intensities and so on (covered in section 1.6.2.1).

Western classical singing is distinguished by substantially loud singing, which is emphasised during training (Sharma, 2015). The training methods vary across teachers and there are no universally accepted approaches as these would depend on the singer in training. If a singer is specialising in Operatic style, then they should possess large powerful voices that can be heard over loud orchestras in large theatres, which are trained to possess significantly high endurance. On the other hand, a singer who is training to sing in a choir, trains to blend into an ensemble with their sound and breathing (Lingas, personal communication, February 2, 2020). In general, there is considerable focus on the tone of the voice or timbre, and most of the training revolves around developing vocal tone (Sharma, 2015).

1.3 CARNATIC MUSIC

1.3.1 Background and historical aspects

Carnatic music, belonging to South India, emerged from ancient Hindu traditions, and has a strong religious influence. Even though references of Indian music can be found in ancient scriptures (1200-

600 BCE) such as *Samaveda* (Rammohan, 2002), the emergence of Carnatic music as a separate musical entity occurred about 600 years ago (Boominathan, 2012). Carnatic music is generally performed using a small ensemble of musicians of which the vocal performer is the central component (Sharma, 2015). The singer is supported by a melodic accompaniment which is usually a violin, a rhythm accompaniment such as mridangam (South Indian drum) and a tanpura which provides a constant drone. The drone is set to provide the '*shruthi*' that determines the note in which the singer will perform the various scales, which are called '*raagams*'.

1.3.2 Training and pedagogical details

Carnatic tradition has theoretical rules regarding many aspects of performance which are bound to be followed by performers (Boominathan, 2012) and emphasised during training. Traditionally, a *gurukula sampradaayam*¹ was practised to learn music where the student resided with the teacher, commonly referred to as a guru and vocal lessons were imparted orally (Jithin, 2014). Training in Carnatic singing involves lessons that begin from learning to sing simple combinations of notes which progressively increase in difficulty. All students learning Carnatic music, irrespective of their teacher's singing and training lineage are taught a fixed set of basic vocal rudiments. Following this, the guru teaches a variety of compositions and provide training on improvisation, depending on the calibre of the student. *Kalpitha sangeetham* (compositions already created by various composers) and *Kalpana Sangeetham* (improvisations by the singer) are of equal importance in Carnatic music (Chandramowli, 2015).

Carnatic vocal training mainly focuses on developing a low-pitched steady voice and great emphasis is provided to developing vocal ornaments which are called *gamakams* (Boominathan, 2012). *Gamakams* are defined as graceful modulations in the pitch contour of a note which results in alterations of pitch from its actual position (Rajan et al, 2019). These alterations can be made in many ways making the production of each note unique and dynamic.

1.4 COMPARING WESTERN CLASSICAL AND CARNATIC SINGERS

1.4.1 Vocal characteristics and training

Although Western Classical and Carnatic music are classical artforms and essentially provide vocal training to aspiring singers, the training goals are different. While the vocal tone is of prime importance in Western Classical music, the actual style of rendition takes precedence over voice quality or vocal tone in Carnatic music (Boominathan, 2012) which implies differences in training

¹ gurukula literally means 'residence of a teacher' and sampradaya means tradition

goals. This could also extend to how problems in voice quality are viewed by Western classical and Carnatic singers with the former identifying issues with voice quality as atypical or unacceptable and the latter not giving much consideration to the same.

A general observation is that Carnatic singing training follows a more rigid and fixed tutelage where there is consistency in the taught content, whereas Western classical singing training is flexible and depends on the artistic aspirations of the singer and the teacher. Contrary to Carnatic music styles, Western Classical music adopts a classification system based on voice types which are largely determined by vocal range. Women are classified into soprano, mezzo-soprano and contralto while men are divided into countertenor, tenor, baritone and bass. Soprano constitutes voices with highest pitches while contralto refers to voices with lowest pitches in women. In men, the countertenor and the bass constitute the highest and lowest pitches respectively (Sharma, 2015). Depending on the voice type, the vocal characteristics of the singer would be different. This classification is a marked variation from the Carnatic tradition, as Carnatic musicians tend to choose their *aadhaara shruthi* (relative pitch in which scales are sung), whereas Western music vocalists adhere to the pitch associated with their voice type (soprano, baritone etc).

Historically, Carnatic singers are famed to be able to traverse through three octaves, however, a study by Boominathan et al (2006) revealed that none of the singers in their participant group (n=20) demonstrated three octave singing and could comfortably cover only 2-2.5 octaves. The study also reported that Carnatic singers, in general, used a non-falsetto modal-like tonal quality throughout their singing range. The authors suggested that the modal register was possibly extended in Carnatic singers due to training, which was employed to sing at higher pitches, while Western Classical singing employed the head register to generate higher pitches.

Another vocal attribute strongly associated with Carnatic singing is developing a low-pitched and “strong” singing voice. This association has been consistently indicated in the literature (Chandra, 2001; Supraja & Savithri 2007). This would indicate that vocal difficulties resulting in reduced lower range would be detrimental to a Carnatic singer. Another vocal attribute commonly associated with Carnatic singing is the ability to sing straight notes without any wobble (in other words, vibrato, commonly associated with Western classical singing is not a desired vocal attribute in Carnatic singing). This point was highlighted by Shankar (1999) who suggested that Carnatic singers present with voices that can sustain long notes without any wobble.

Vocal embellishments are a very important element in all forms of classical music. Boominathan (2012) opines that execution of gamakams, which is an important vocal ornament in Carnatic music,

are acquired through training and the singer's creativity. Several vocal ornaments have been recognised in Western classical singing tradition as well. Early experimental studies have mostly researched the vocal vibrato (Seashore, 1931) while other ornaments such as tremolo, trill, trillo received attention much later (Hakes, Shipp and Doherty, 1987). These embellishments are primarily variations in frequency amplitude; however, the rate, extent and regularity of these variations differentiate the ornaments (Sundberg, 1994). Most of these vocal ornaments are acquired through training. A summary of comparison of training and vocal characteristics of Western Classical and Carnatic singers is provided in Table 1.1

To summarise, Western Classical and Carnatic singing are deeply rooted to their respective cultures and traditions and illustrate significant differences in singing manoeuvres, training, and vocal dimensions. This could, in turn, imply variations in the onset, development, maintenance and nature of voice problems between these two groups of singers.

Table 1.1: Comparison of training and vocal characteristics of Western Classical and Carnatic singers

Western classical singing tradition	Carnatic singing tradition
Training is flexible and depends on the aspirations of the singer (opera, choir etc)	Basic training content is fixed, and end goals are same for all aspiring singers
Performed with a large accompanying orchestra	Performed with 3-4 accompanying instruments
Emphasis is laid on vocal tone	Emphasis is laid on singing style than tone
Polyphonic singing	Singing is mainly homophonic
Traditional composed pieces are taught and presented with minimal improvisation	Pre composed pieces and improvisations have equal importance
Singers are classified based on voice type	No classification-All singers sing across the vocal range and choose their pitch
Presence of singer's formant	Singer's formant is not noticed
Vocal characteristics depend on the voice type	Low pitched loud voices

1.5 JUSTIFICATION FOR CHOOSING CARNATIC AND WESTERN CLASSICAL SINGERS FOR THE PRESENT STUDY

A question bound to arise is pertaining to the groups of participants included in this study. With so many singing genres recognised today, a justification for choosing Western classical and Carnatic singers is warranted. One of the questions this body of research hoped to answer was if genre and culture influenced coping and vocal health. Therefore, it made sense to choose genres that had

sufficient common ground, but at the same time were different in terms of singing style and cultural beliefs. Since the researcher is a Carnatic singer and therefore had sufficient ties with the Carnatic fraternity, this was an obvious choice. Western classical could be viewed as the Carnatic counterpart of the west, as they both represent the broader “classical” genre with a historical lineage and strong beliefs pertaining to training. A cultural overlay between the two genres was also unlikely as their origins and traditions are starkly different, thereby giving an opportunity to observe the outcomes between two “similar but different” groups.

1.6 ANALYSIS OF THE NORMAL CLASSICAL SINGING VOICE

To recognise vocal pathologies in singers, it is important to understand the functional capacities of the singing voice under normal conditions (LaPine, 2008). This knowledge will help clinicians and researchers alike to distinguish normal and deviant singing voices and enhance their ability to identify vocal deviations in singers. In research, analysis of clinically normal singing voices can be carried out using acoustic or aerodynamic measurements as objective measures make it easier and more “obvious” to study and report the minute and unique nuances. Acoustic analysis provides an objective identification and description of various vocal parameters (Greene and Mathieson, 2002) such as frequency, amplitude and signal to noise ratio using computerised software. Aerodynamic measurements assess respiratory and laryngeal function and coordination and estimate the mean airflow, subglottal pressure, vocal resistance, efficiency and power (Awan, Novaleski and Yingling, 2013). This section focuses on the description of various acoustic and aerodynamic parameters of the normal singing voice.

Cepstrum, an acoustic assessment measure, is an inverse Fourier transformation of a spectrum that provides information regarding the periodicity and energy of a signal by quantifying the fundamental frequency and harmonic organisation in voice (Sujitha and Pebbili, 2020). One of the most commonly used cepstral measures is cepstral peak prominence (CPP). CPP is a measure of the amplitude of the cepstral peak corresponding to the fundamental period, which is normalised for overall signal amplitude (Krom, 1993). Balasubramaniam et al (2015) analysed and compared the cepstral characteristics of 30 female Carnatic singers and 30 non-singers and reported that the mean CPP value was 21.862 and 15.76 for Carnatic singers and non-singers respectively with a statistically significant difference between the two groups. The authors attributed this difference to training received by Carnatic singers which strengthened the control between the respiratory, phonatory and resonatory muscles, thereby enhancing the harmonic organisation in their voices. This implies

that the degree of periodicity and overall energy of the cepstrum is higher in Carnatic singers than non-singers.

Johann Sundberg did seminal research in understanding various intricacies of the Western classical singing voice. Sundberg (1974) reported the presence of an increased spectral energy between 2500 and 3000 Hz in all Western classical male singers. This increase was irrespective of pitch, vowel or the dynamic level and was called the 'singer's formant' and occurred due to a lowering of the larynx. He concluded that Western Classical singers developed a singer's formant to prevent their voices being drowned in an orchestra since the energy levels of an orchestra is weak at higher frequencies. Boominathan (2004) analysed the voices of Carnatic singers to identify the presence of singer's formant and concluded that Carnatic singers did not present with a singer's formant.

Superior levels have been reported among singers for various vocal measures such as pitch range compared to non-singers. Nazer and Vishnu (2016) studied the pitch ranges of amateur singers, trained singers and non-singers using PRAAT (Boersma, 2001) voice analysis software and indicated that trained singers showed a statistically larger pitch range compared to the other two groups; amateur singers also showed a significantly greater pitch range compared to non-singers indicating higher vocal performance among singers.

Petekaya, Polat and Yücel (2018) compared aerodynamic parameters between twenty trained singers and twenty non-singers by calculating the subglottal air pressure, subglottal airflow and sound pressure levels. They reported that the subglottal air pressure and sound pressure levels were higher in trained singers (14.36 ± 2.99 and 108.53 ± 3.48). They reported that a higher subglottal pressure is a predictor in increase of sound pressure level and concluded that singing training enabled an efficient use of laryngeal structures.

These results suggest that normal trained singing voices show superior acoustic and aerodynamic traits compared to non-singers, reflecting a need to study singing voices as a separate entity.

1.7 VOICE PROBLEMS IN SINGERS

Due to the nature of voice use and the demands placed on the vocal mechanism, singers are often considered 'vocal athletes' (Phyland et al, 2013). Therefore, singers represent the most demanding vocal group among professional voice users (Devadas, Kumar & Maruthy, 2020). Rigorous training, long rehearsals, lack of voice rest, extreme voice use and heavy vocal load increase the propensity of singers to develop voice problems (Benninger, Jacobson and Johnson, 1994; Davies and Jahn,

2004). The prevalence of voice disorders in singers is discussed next in this section with a special focus on classical singers.

1.7.1 Prevalence of voice problems in singers

Pestana, Vaz-freitas and Manso et al (2017) conducted a systematic review and meta-analysis to estimate the prevalence of self-reported voice problems in singers. They analysed the results of 11 studies and estimated that the pooled prevalence of self-reported voice problems in singers was 46.09%. Singing students and teachers showed an overall prevalence of 21.76% and 55.15% respectively. For comparison purposes, the prevalence of voice problems among the general population (which does not include professional voice users such as singers) is reported to be 16.9% (Ahlander et al, 2018) in a Swedish study and 29.9% (Roy et al, 2005) in an American based study; both figures indicate a higher prevalence of voice problems among singers.

1.7.1.1 *Classical singers as a group*

The systematic review conducted by Pestana et al (2017) the prevalence of voice disorders in classical singers was 40.53, which was slightly less than non-classical styles such as traditional and popular singers (46.96%). Similarly, Phyland, Oates and Greenwood (1999) studied 171 professional singers from three different singing styles, namely opera, musical theatre and contemporary (excluding rock) and reported that the prevalence of voice problems was lesser in the opera group (40.5%), and the contemporary music group (39.3%) than the musical theatre group (51.9%), albeit statistically insignificant.

Devadas, Kumar and Maruthy (2020) conducted a cross-sectional study of the self-reported voice problems among 190 Carnatic singers based in Karnataka state, India. They estimated the point prevalence and career prevalence to be 23% and 35% respectively. The results are indicative of a lower prevalence of voice problems among Carnatic singers compared to the prevalence rates reported for other classical singing styles such as opera. The authors accounted this to possible differences in how voice problems were operationally defined in these studies or to variations in vocal demands between the singing styles. Differences in prevalence rates between Western classical and Carnatic singers can be indicative of the varying impact of singing styles on the vocal mechanism and raises a need for comparative studies between genres. The possible risk factors resulting in voice problems in singers are explored in the following sub-section.

1.8 UNIQUE RISK FACTORS OF SINGERS LEADING TO VOICE PROBLEMS

Singers place great physical demands on their voices to produce voices in varying pitches and loudness levels. Additionally, they strive to achieve significant vocal endurance enabling them to sing flawlessly for long periods of time. Kwok and Eslick (2019) undertook a systematic review and reported that performance demands, environments, peak seasons and breakdown of time schedules are risk factors to develop voice problems in singers. Similarly, Davies and Jahn (2004) suggested that singers should be studied as a special group as they have unique needs and associated lifestyle and environmental characteristics which can have a significant impact on their voices. These factors are described below.

1.8.1 Performance demands

Davies and Jahn (2004) indicated that most singers have highly demanding performance schedules, posing varying levels of stress on the vocal mechanism. For some singers, work is seasonal, while others have a schedule that runs all year long. Performance demands also increase with success where accomplished singers can often have performances and tours lasting many weeks. This provides little to no opportunity for singers to rest their voices making their vocal mechanisms more vulnerable to injury (Davies and Jahn, 2004). The tradition of ‘music season’ which is hosted every mid-November to January is still prevalent in South India, with musicians, particularly Carnatic musicians, having a very busy singing period with back-to-back concerts, each lasting about 3 hours (Wikipedia, 2020). Moreover, most Carnatic singers are soloists which may place additional stress on their voices as opposed to a group performance. During time off concerts, most musicians are involved in recordings, media interactions or professional and social meetings, thereby enhancing their voice use.

1.8.2 Frequent Travel

Musical styles are becoming universally appealing, thereby providing musicians opportunities to perform across the globe. There is great demand for classical musicians enabling them to showcase their talent at various parts of the world. In the UK, there are numerous Carnatic music concerts organised each year by reputed associations such as Darbar and Southbank centre, London. Western classical music, being prevalent across the west also provides ample opportunities to sing in various geographical locations. However, air travel could have a considerable effect on the voice. Davies and Jahn (2004) suggested that since the noise levels are particularly high in airplanes, singers would experience the Lombard effect (Lombard, 1911), where they unknowingly increase

their vocal intensities in order to be heard over background noise. The noise levels can be as high as 85-90dB, which would force the singer to speak at high intensities causing considerable tension to the laryngeal muscles and placing strain on the vocal apparatus. Additionally, the air quality in the airplane cabin is under-humidified, causing further distress to the voice through dehydration. Frequent travel can also cause fatigue in singers, particularly with time zone changes, causing disruptions in the circadian rhythm and adversely affecting the voice. The authors also indicated that singers often travel on tour buses which pose similar problems such as increased noise levels and dry air quality. Prebil, Boltezar and Bahar (2020) also identified loud speaking as a risk factor to develop voice problems in singers.

1.8.3 Stress and anxiety

Creative industries such as music can be highly competitive, making singers susceptible to self-imposed stress. Since vocalists rely entirely on their vocal capacities to maintain reputation, gain income and to attain fulfilment from life, the fear of developing a voice problem is high and causes anxiety and stress. Lack of stability, undue professional demands from conductors, managers and even singing teachers or parents and negative reviews can further aggravate stress levels in singers (Davies and Jahn, 2004). Moreover, all singers experience performance anxiety which is present at varying levels causing further strain. At low levels, performance anxiety could enable performance capabilities, however excessive anxiety can adversely affect singing. Stress on the voice manifests as excessive muscle tension leading to hyperfunctional voice use. Additionally, there is an increase in gastro-oesophageal or more specifically, Laryngo-pharyngeal reflux following stress in singers (Davies and Jahn, 2004), which causes vocal difficulties. Psychogenic voice problems, where the underlying cause is inorganic (no structural cause), is the most common manifestation of stress and anxiety in singers' voices (Davies and Jahn, 2004).

1.8.4 Venue acoustics and allergens

Davies and Jahn (2004) suggested that lack of auditory feedback while singing (during performances and rehearsals) is a common problem faced by singers and often overlooked by singers, particularly those with limited experience. Singers performing in large concert halls with poor monitor speakers (speakers which aid in enhancing the volume of the singer's voice) often use their voice in an abusive manner due to the Lombard effect. Additionally, most of the venues are abundant in environmental allergens, as well as smoke, which is commonly used during performances and can cause severe irritation to the vocal apparatus.

1.8.5 Medication use

Medications can interfere with the uninhibited movement of the vocal folds aided by dehydrating side effects causing the mucus of the vocal folds to be sticky or inadequate. Lack of lubrication presents in singers with vocal problems. According to Davies and Jahn (2004), one of the main drug groups decreasing mucus secretion are antihistamines which singers are often prescribed, mostly to combat inhalant allergens. Cough suppressants, particularly those containing codeine and a few anti-depressants also produce similar effects which can significantly impact vocal performance. Miller and Verdolini (1995) reported similar findings in a large study involving singing teachers and controls (n=125 and 49 respectively) where they reported that drying medications increased the likelihood of developing voice problems three-fold.

1.8.6 Improper vocal technique

Generally, research indicates that training can help prevent vocal problems. In a study of 72 Acapella singers, singing training was negatively associated with a voice disorder. In 65% of the singers, singing training increased the odds of not developing a voice disorder by 1.92 (Watts, 2016). Training prepares the voice of a budding singer by developing endurance, proper use of the vocal mechanism and improving vocal range. An untrained or amateur singer with minimal or no training is unequipped with these pre-requisites and is likely to encounter vocal problems later in life (Davies and Jahn, 2004).

1.8.7 Singing style

Kwok and Eslick (2017) found that classical singers may have reduced likelihood to develop voice problems because of employing warm up and cool down routines regularly, and maintaining a neutral posture, as opposed to contemporary and musical theatre performers who frequently vary their postures or dance simultaneously. Additionally, the desired vocal quality across different genres could also contribute to increased risk. For example, country singers may prefer a nasal tone which is generally produced with a higher laryngeal placement. Pop singers are likely to desire a harsh voice, whereas musical theatre performers often use belting where there is significant contraction of the arytenoid and thyroarytenoid muscles.

In terms of risk factors to develop voice problems specifically in Carnatic singers, a large study (n=190) reported that clenching of teeth, frequent colds, difficulty in hearing, stress related to the profession and regular intake of medications for various medical reasons had a significant

association with high prevalence of self-reported voice problems (Devadas, Kumar and Maruthy, 2020).

To summarise, singers have unique vocal risk factors related to performance and lifestyle, reinforcing that singers should be considered a separate vocal group and the unique predictors of vocal health, or alternatively vocal handicap/impact, should be investigated specifically for singers. Further, these distinctive characteristics should be explored in detail during case history taking as part of voice assessment. Treatment should place significant focus on dealing with these causal factors to ensure complete recovery and prevent relapse of symptoms. The aforementioned factors should also be accounted for, while carrying out research to study voice problems in singers. Finally, studies comparing different singing styles will enable understanding of risk factors associated with each style thereby providing specific guidelines for genres to maintain vocal health. Research drawing on various methods used to assess the singing voice are presented in the next section.

1.9 ASSESSMENT OF VOICE PROBLEMS IN SINGERS

1.9.1 Special considerations for evaluating the singing voice

A multifaceted approach is often undertaken to assess the voice of singers. This includes physical, functional and psychosocial dimensions which are assessed using appropriate measures. Sandage and Emerich (2002) outline that clinical assessment of singers' voices should include most, if not all of the following elements:

- A detailed case history which includes a thorough medical, behavioural and social history
- Videostroboscopic assessment to evaluate the structure and function of the larynx
- Auditory/visual perceptual assessment
- Objective voice measures (acoustic and aerodynamic assessment measures).

The European Laryngological society (Dejonckere et al, 2001) also mentions the subjective rating of voice by the patient as an important consideration during voice assessment.

Sandage and Emerich (2002) highlight that clinical evaluation of 'singing voice disorders' share many similarities with 'speaking voice evaluation' and the measures, as such, are not too different. However, special considerations need to be made to understand voice problems in singers better. For example, singers use singing vocabulary such as registers, passaggio etc while describing their voice problems; therefore, voice specialists handling singers can make specific judgments regarding the description of the voice problem by the singer if they are familiar with these terms. Singers often experience difficulties only in their singing voice and not in their speaking voice. For instance, many

singers report voice breaks in higher pitches that do not occur during speaking or report specific singing concerns such as unstable mid-range etc.; voice specialists should be prepared to address these unique complaints during assessment.

In this section, the various assessment methods have been categorised into clinician administered assessments and self-assessment. The clinician administered assessments will be highlighted in brief before focusing on the self-assessment of voice which was used in this study.

1.9.1.1 Clinician administered assessments

1.9.1.1.1 Case history

Case history is considered one of the most important steps of singing voice assessment because most often, a comprehensive case history reveals the aetiology of a singer's problem even before any formal assessments are performed (Sataloff, 1997). Sapienza and Ruddy (2016) suggest that information pertaining to singing training, performance schedule, warm-up practice, allergies, performance or rehearsal environment, use of amplification and monitors, types of costumes worn should be asked to professional singers to gain valuable information regarding vocal use and lifestyle.

1.9.1.1.2 Laryngeal imaging

Good vocal quality is achieved when there is good integrity of the vibratory margins of the vocal folds which perform very complex motions (Sataloff, 1997). In the presence of a voice disorder, there is a significant likelihood of vocal fold damage and/or compensatory involvement of surrounding vocal structures which could interfere with the quality of the produced sound (Sapienza and Ruddy, 2016). These abnormalities can be effectively viewed using laryngeal imaging techniques such as laryngoscopy and laryngostroboscopy and stroboscopy. Stroboscopic analysis identifies vibratory asymmetries, structural abnormalities, small masses, submucosal scars, and other conditions which cannot be viewed under normal light (Sataloff, 1997).

1.9.1.1.3 Auditory perceptual assessment

Perceptual assessment is arguably the most commonly used assessment method by voice specialists across clinics (Behrman, 2005) and is often considered as a gold standard for documenting voice problems (Kreiman et al, 1993). This is probably because, voice is essentially a perceptual entity and is therefore likely to have greater shared reality among a wide range of listeners (Wuyts et al, 1999).

Many approaches have been proposed to perceptually analyse vocal dysfunction. Oates (2009) suggests that the most commonly used perceptual evaluation systems are the GRBAS-Grade, Roughness, Breathiness, Asthenia and Strain (Hirano, 1981), Consensus Auditory Perceptual Evaluation of Voice (Kempster et al, 2009), Stockholm Voice Evaluation Approach (SVEA, Gauffin and Hammarberg, 1991) and the Perceptual Voice Profile (Oates and Russell, 1998). While the GRBAS and the SVEA focus only on analysing vocal quality, the CAPE-V and the Perceptual Voice Profile assesses pitch and loudness aspects. All approaches use Likert scales except the CAPE-V which uses a 100 mm visual analogue scale VAS). The SVEA provides an option to use either a 100 mm VAS or a 5-point Likert scale. Another rarely used approach is the Buffalo III voice profile (Wilson, 1987) which has components related to laryngeal tone and resonance.

To specifically suit the needs of the singing voice, Shrivastav and Wingate (2015) described a format to perceptually analyse the singing voice and recognised that a variety of vocalisation tasks should be elicited, depending on the singer and their type of performance. The following parameters were considered for perceptual assessment using a nominal scale using terms which best represent the parameter: intonation, vibrato, voice quality, voice onset, passaggio, resonance, dynamics, rhythmic accuracy, phrasing, diction, posture, gesture and facial expression.

1.9.1.1.4 Acoustic and aerodynamic assessment

Acoustic analysis, which is non-invasive, has been clinically used to differentiate normal and abnormal voices, help in differential diagnosis, assess relative treatment efficacy and to monitor treatment progress (Hillenbrand, 2011). Gunjawate, Ravi and Bellur (2018) carried out a systematic review to explore and analyse literature on acoustic analysis of voice in singers. They reported that the most commonly used measures were fundamental frequency, perturbation, cepstral, spectral, dysphonia severity index and singing power ratio. They reported significant heterogeneity with respect to population, tasks, instruments and measurement parameters and identified a lack of standardised criteria for evaluating the singing voice.

Normal voice production is reliant on adequate interaction between the aerodynamic input to the larynx from the lungs, the resulting vibration of the vocal folds and the consequential acoustic output (Jiang and Maytag, 2014). Therefore, changes in aerodynamics would result in perceptual deviation of vocal quality and abnormal results in acoustic assessment. (Jiang and Maytag, 2014). This makes it important to assess aerodynamic functioning in singers. Aerodynamic assessment is generally assessed by measuring the glottal airflow, the subglottal air pressure and by calculating

the mean vocal Sound pressure Level (SPL)² and fundamental frequency (F_0). Since training significantly enhances respiratory support and efficient use of airflow, aerodynamic efficiency can be expected to be greater in singers.

In summary, a need to develop a set of norms for the singing population to interpret clinician-administered measurements has been identified (Awan and Elssen, 2010; Maruthy and Ravibabu, 2014). This is because, singers, particularly trained singers can have improved vocal characteristics than non-singers resulting in a greater dynamic range, endurance, and enhanced control over their laryngeal movements; therefore, a singer with vocal dysfunction may still show scores within normal limits because of increased vocal capacities (Awan and Ensslen, 2010).

1.9.1.2 Self-assessment of voice

It has been suggested that the perspective of the patient about their voice problem supersedes all other assessments (Francis et al, 2017). This is particularly true in case of singers because the singer's perception of a 'normal voice' may not concur to the norms of various vocal assessments. Francis et al (2017) confirm this statement by suggesting that some individuals may inherently have a rough voice which is their perception of a normal voice despite what any acoustic or aerodynamic measure may indicate. This has led to practitioners realising that in the absence of a negative health outcome (e.g., malignancy), an intervention is unjustified if a client feels that their voice is normal even if the practitioner feels otherwise. This elevates the importance of self-report measures over any other assessment and reaffirms their importance in guiding assessment and treatment related decisions. Several self-assessment tools are available across a broad range of constructs, which provide a variety of outcomes. These outcomes can range from measurement of physical symptoms such as vocal fatigue or discomfort to activity limitation or psychosocial constructs such as quality of life or vocal handicap. Francis et al (2017) conducted a systematic review to assess the measurement characteristics of all currently available adult voice-related patient reported outcome measures. They reported that various measures have been introduced to tap into different facets of voice assessment. A summary of self-assessment tools of varied constructs, as described by Francis et al (2017), is provided in Table 1.2 (tools developed to assess voice difficulties following laryngeal cancer are not included). Since this systematic review did not include singing specific tools, a construct called 'singing voice' has been added to the list to represent these tools which are of particular relevance in the present study.

² Sound Pressure Level (SPL) is used to measure the loudness of a sound and represented in dB

While there is an abundance of self-report measures which are used to assess voice problems in general, as seen in Table 1.2, self-report measures specifically to suit the needs of singers are still limited. However, there is an emergence of a trend to develop normative scores and assessment tools specifically for singers. One of the first attempts in this regard was by Rosen and Murry (2000) where they administered the Voice Handicap Index (VHI) to 106 singers and 369 non-singers. Contrary to what was expected, singers showed lower VHI scores indicating lower levels of handicap.

The authors attributed this to the following reasons:

- The VHI items are not specific to the unique problems of the singing voice.
- The VHI focuses on problems related to speaking rather than singing; singers are more likely to have singing problems.
- Singers may present to clinics far sooner than non-singers with earlier symptoms because of enhanced sensitivity to their voices.

Following this, Cohen et al (2007) developed the Singing Voice Handicap Index (SVHI) for use in patients with singing problems. The SVHI consists of 36 items which have been chosen to provide a well-rounded perspective by addressing the physical, emotional, social and economic impact of singing problems. A 5-point Likert scale ranging from “never” (score of 0) to “always” (score of 4) is used to individually rate each item. Unlike the VHI, the SVHI does not have subscales, so a total score is calculated. The raw score ranges from 0-144 and a higher score represents higher vocal handicap. The final SVHI score is then converted into a percent score. SVHI is, therefore a very useful tool to measure patient perceived impact of singing voice problems. The applicability of SVHI has been reflected in the tool being validated and adapted into various languages such as Egyptian (Abou-Elsaad et al, 2017), Italian (Baracca et al, 2013), Turkish (Denizoğlu et al, 2016), Spanish (Nunez et al, 2010), Persian (Ghaemi et al, 2020), Kannada (Gunjawate et al, 2017), German (Lorenz et al, 2013), Tamil (Rangarajan et al, 2020), and Polish (Sielska-Badurek, 2017). SVHI has also been extensively used in research to assess singing voice handicap since its development (Achey, He and Akst, 2016; Castelblanco et al, 2014; Gunjawate et al, 2017, Pinheiro et al, 2017).

Additionally, Cohen et al (2009) also developed a shortened version of the SVHI called SVHI-10 which consists of only 10 questions to assess handicap in singers with reduced respondent burden. The test showed good internal consistency, (Cronbach Alpha values=0.94 and the item-total correlation for each of the ten items<0.6) and correlated well with the VHI-10 which has already been tested for validity and reliability.

Table 1.2: Description of self-assessment tools developed to assess various constructs related to voice problems (Francis et al, 2017)

Construct	Measure	Developers	Purpose of the measure	Test description
Coping	Voice disability coping questionnaire (VDCQ)	Epstein et al (2009)	Disease-specific measure to assess coping strategies in individuals with voice disorders	15 items in 4 subscales-Information seeking, Avoidance, Passive coping and Social support measured using 6-point Likert scale (frequency scale ranging from “never” to “always”)
Quality of life	Voice Outcome Survey (VOS)	Gliklich, Glovsky & Montgomery (1999)	Measure health related quality of life in relation to vocal health status	5 items measured using 5-point scale (4 items) and 3-point scale (1 item) (varied response labels)
	Voice-related Quality of Life (V-RQOL)	Hogikyan & Sethuraman (1999)	Clinically assess voice-related quality of life	10 items in 2 subscales-Social emotional and Physical Functioning measured using 5-point Likert Scale (severity scale ranging from “none, not a problem” to “as bad as it can be”)
	Voice Disorder Outcome Profile (Voice-DOP)	Konnai et al (2010)	Scale developed in India to assess culture-specific quality of life in patients with voice disorders	32 items in 3 subscales-Physical, Emotional, Functional measured using a Visual Analogue Scale (frequency scale ranging from “never” to “always”)
	Evaluating Voice Disability-Quality of Life Questionnaire (EVD-QOL)	Smith et al (1996)	Evaluation of functional difficulties experienced by people with voice disorders	28 items in 5 subscales-Work, Social, Psychological, Physical and Communicative measured using a 5-point Likert scale (response anchors unavailable).
	3-item Outcome scale (3-IOS)	Speyer, Wienke & Dejonckere, (2004)	Determine treatment efficacy	3 items measured using a Visual Analogue Scale (ranging from “normal” to “extreme impairment”)
Handicap	Voice Handicap Index (VHI)	Jacobson et al, (1997)	Evaluation of voice disability/handicap in patients with voice disorders	30 items in 3 subscales-Functional, Physical, Emotional using 5-point Likert scale (frequency scale ranging from “never” to “always”)
	VHI-10	Rosen et al (2004)	Shortened version of VHI to assess vocal handicap	10 items measured using 5-point Likert scale (frequency scale ranging from “never” to “always”)

Construct	Measure	Developers	Purpose of the measure	Test description
Vocal performance	Vocal Performance Questionnaire (VPQ)	Carding and Horsley, (1992)	Evaluate treatment efficacy in patients with voice disorders	12 items and subjects respond by choosing the most appropriate statement from 5 given options.
Vocal fatigue	Self-evaluation of Voice as Treatment Outcome Measure (SEVTOM)	Laukkanen, Leppanen and Ilomaki (2009)	Evaluate the impact of vocal loading on voice	6 items measured using a Visual Analogue Scale (variable response labels)
	Vocal Fatigue Handicap Questionnaire (VFHQ)	Paolillo and Pantaleo (2015)	Identify and evaluate vocal fatigue symptoms	30 items in 3 subscales-Emotional, Physical and Functional measured using a 5-point Likert scale (frequency scale ranging from “never” to “always”)
Self-efficacy	Voice self-efficacy Questionnaire (VSEQ)	Gillespie & Abbott (2010)	Evaluate self-efficacy in individuals with voice disorders before and after intervention	4 items measured using a Visual Analogue Scale (“not confident” to “extremely confident”)
Activity Limitation	Voice Activity Participation Profile (VAPP)	Ma and Yiu (2001)	To assess voice activity limitation and participation in individuals with voice disorders	28 items in 5 subscales-self-perceived severity, Job, Daily communication, Social communication and Emotion measured using a Visual Analog Scale (first item=“normal” to “severe”, remainder=“never” to “always”)
Disability	Speech Disability Questionnaire (SDQ)	Epstein, Stygall and Neuman (1997)	To assess the disability arising from voice disorders	28 items in 5 subscales-Social isolation, Negative communication, Public avoidance, Limited understanding, Communication difficulty measured using a 5-point Likert scale (agreement scale ranging from “strongly agree” to “strongly disagree”)
Voice symptoms	Voice Symptom Scale (VoiSS)	Deary et al (2003)	Evaluate self-reported vocal symptoms	43 items in 5 subscales-Communication problems, Throat infection, Psychosocial distress, Voice sound and variability, Phlegm measured using a 5-point Likert scale (frequency scale ranging from “never” to “all the time”)

Construct	Measure	Developers	Purpose of the measure	Test description
	Voice Symptom Questionnaire (VSQ)	Lehto et al, (2003)	Identify subjective vocal symptoms reported by individuals	11 items measured using a 4-point frequency scale (ranging from “never/not even once a year” to “very often/almost every week”)
Vocal Tract Discomfort	Vocal Tract Discomfort (VTD)	Matheison et al (1993)	Clinically determine qualitative perception of vocal tract discomfort	8 items measured using dichotomous (yes/no) responses
Screening for voice disorders	SIVD	Ghirardi et al (2013)	Screening tool to assess voice problems.	12 items measured using a 4-point Likert scale (frequency scale ranging from “never” to “always”)
Singing voice	Singing Voice Handicap Index	Cohen et al (2007)	Evaluation of singing vocal handicap in singers	36 items measured using 5-point Likert scale (frequency scale ranging from “never” to “always”)
	Evaluation of the Ability to Sing Easily (EASE)	Phyland et al (2013)	Evaluate a singer’s perceptions of the current status of their singing voice	10 items in 2 subscales-vocal fatigue and pathologic-risk indicators measured using 4-point Likert scale (ranging from “not at all” to “extremely”)

Phyland et al (2013) argued that most of the tools to assess voice have been developed based on a disorder framework and therefore are not sensitive enough to test singers with subtle and transient vocal problems, who continue to perform with or without impairment. Evaluation of Ability to Sing Easily (EASE) was consequently developed to serve as a vocal function self-report instrument which is sensitive to the subtleties of singers' voices and is clinically appropriate, valid and reliable and relatively quick to administer. The EASE has two subscales-subscale 1 represents physical symptoms of vocal fatigue (e.g., my throat muscles feel overworked) and also had positive descriptors (my voice is ready for performance, if required), whereas items of subscale 2 relate to mucosal changes associated with chronic overuse, common cold or vocal fold pathology (e.g., I have difficulty changing registers). The EASE is therefore a useful tool to assess vocal function in singers related to vocal load and investigates changes to the physical functioning of the singing voice. Since EASE is not developed based on a disease framework, it could potentially predict singers 'at risk' for developing voice problems. The EASE has been translated into Kannada (Devadas, Vinod and Maruthy, 2019) and Brazilian Portuguese (Rocha et al, 2014).

Studying self-reported voice problems of singers belonging to different singing traditions makes it feasible to make relevant comparisons and offers an opportunity to meaningfully identify and reflect on the assessment and interventional demands of a singer in general, as well as providing genre specific needs. Even though the SVHI and the EASE provide singer specific evaluation of voice, there is still paucity of assessment tools for singers, particularly to assess constructs such as quality of life and activity limitation. Therefore, researchers and clinicians resort to using general self-assessment scales to study singing voices; however, they should do so, cautiously. Care should be advocated to understand the sensitivity, specificity, validity, and reliability characteristics of self-report measures mentioned here in assessing the voice problems in singers, until robust context specific measurement tools are available.

1.10 CLINICAL CHARACTERISTICS OF VOICE PROBLEMS IN SINGERS

Aronson and Bless (2009) suggest that an abnormal voice calls attention to itself, does not meet the occupational and social needs of the individuals or may not be appropriate in terms of age, gender or situation. Various classification systems have been proposed to categorise voice disorders. The most common classification is organic vs functional. Organic disorders are physiological in nature, i.e., resulting from an alteration in the respiratory, laryngeal or vocal tract mechanism. Functional disorders arise due to inefficient use of the vocal mechanism despite the physical structures being normal (ASHA, 2020). In order to determine if a disorder is organic or functional in nature, both

clinician administered, and self-report vocal assessments should be used. Since researchers studying voice disorders in singers may not adopt a comprehensive assessment protocol comprising both in their methodology, this section will cover separately studies using comprehensive assessment (including both clinician administered and self-assessment) versus self-assessment only.

1.10.1 Voice disorders identified through comprehensive assessment

Kwok and Eslick (2017) carried out a systematic review and analysed 24 studies which included both clinician-administered and self-assessment methods, to profile the symptoms commonly seen in singers. They reported that singers were more likely to present with hoarseness, Gastro Oesophageal Reflux Disorder (GERD), Reinke's oedema and polyps. In Carnatic singers (n=45), Arunachalam et al (2014) used a comprehensive voice assessment protocol (interviews, videostroboscopy, perceptual, acoustic and aerodynamic assessments) and reported that laryngopharyngeal reflux (n=13), muscle tension dysphonia (n=10), vocal fold nodules (n=9), chronic laryngitis (n=8), vocal fold oedema (n=3), vocal fold polyp (n=1) and presbylarynx (n=1) was present. They added that the most reported symptoms were change in voice (42.2%) and difficulty in singing higher pitches (35.5%). Difficulty in singing lower octaves, discomfort and pain while singing, difficulty in sustaining voice for longer duration, throat tightness, strain while singing, vocal fatigue and dryness were also reported in some singers. Perceptual assessment results ranged from normal to severe deviation in voices. The Dysphonia Severity Index scores ranged from -3.5 to 4.91 indicating severe deviation to normal voice quality. The self-perception using the V-DOP showed the overall severity to be 5.1 indicating that the participants experienced voice problems.

These studies indicate that singers develop both structural (mass lesions such as vocal nodules and polyps) and functional (such as muscle tension dysphonia) voice problems with the severity of voice problems spanning across the spectrum from mild to severe. This calls for a suitably developed assessment protocol to adequately reflect the wide variation in symptoms, diagnoses and severity while assessing voice problems in singers.

1.10.2 Voice disorders identified through self-assessment

Miller and Verdolini (1995) studied the most frequently seen vocal symptoms in 125 singing teachers and revealed that loss of high notes, tired voice, hoarseness and effortfulness were most commonly reported. Similar symptoms were reported by Sapienza and Ruddy (2016) in singers which included unstable midrange, difficulty singing softly or loudly, loss of vocal flexibility, shortness of breath, decreased phase duration, physical discomfort, and increased physical effort and strain. Hoarseness

resulting from reflux has also been frequently reported in singers (Cammarota et al, 2007 and Hočevár-Boltežar et al, 2012)

An increased perception of vocal handicap has been reported in singing students (Watson et al, 2013 and Achey, He and Akst, 2016) indicating an increased risk of dysphonia in singing students.

Understanding the diversity in voice problems experienced by singers belonging to different genres is essential and this can be justifiably achieved by carrying out comparative studies. Such studies would help in exploring the causal mechanisms of voice problems and suggesting appropriate preventive and interventional strategies to preserve and maintain vocal health in singers.

Previous sections have focused on the risk factors, clinical characteristics and assessment of voice problems in singers which lay a foundation for understanding physical, functional and psychosocial aspects. However, it is equally essential to explore how a singer responds when confronted with a voice problem. These responses are referred to as coping which determines how a singer is likely to manage voice problems. Coping with a voice problem can have behavioural and emotional consequences (Epstein et al, 2009) which makes its exploration necessary. The following sections will examine general concepts underlying coping and specifically review voice-related coping in singers. A framework suitable to study self-reported voice problems and coping in singers will also be discussed.

1.11 COPING AND VOICE

1.11.1 Definition

It is undisputed that singers constantly encounter voice problems (as described in previous sections). These vocal symptoms can cause stress and anxiety in individuals for whom voice is an essential tool for their livelihood (Thomas et al, 2006). A study by Sapir, Mathers-Schmidt and Larson (1996) reported that 76% of their singer subjects indicated that singing was the most or one of the three most important things in their lives and further suggested that what might be a trivial voice problem for a non-singer could be a major problem and a constant source of stress for singers. Scherer et al (1986) carried out acoustic analysis of voice of subjects undergoing similar stressful situations and revealed individual differences in fundamental frequency, despite the stress situation being the same. The authors attributed these differences to the coping mechanisms used by these individuals, which differed between the subjects.

Coping is a major concept in psychological medicine (Epstein et al, 2007) and various attempts have been made to operationally define it (Folkman and Lazarus, 1984; Leventhal et al, 1980). In the field

of voice, Epstein et al (2007) defined coping as the individual's cognitive and behavioural efforts to manage the stress of an illness. They viewed coping as a process rather than a goal that aims to reduce the imbalance between the stressors and the capacities of the individual. Faham et al (2019) recognised coping as a mediating factor between the manner in which individuals with voice disorders perceive their disorder and therapeutic outcomes.

The term voice-related coping refers to coping efforts undertaken by individuals to specifically deal with voice problems and will be frequently used in this thesis.

1.11.2 Literature on generic factors affecting coping

This section focuses on exploring the evidence presented in the literature on the various factors which influence coping. This information is valuable in identifying the variables to be explored in the current programme of research to account for similarities and differences in the coping behaviours of singers and provides more supporting evidence for the relevance of the constructs described in the earlier sections.

A systematic review by White et al (2018), to identify the predictors of positive coping outcomes in individuals with chronic illnesses revealed factors such as age, gender, ethnicity/cultural background, values and beliefs, social support, health status, severity of symptoms socio-economic status, and personality traits to have an impact on coping outcomes. Additionally, hardiness, high self-esteem, dispositional optimism (Weinert et al, 2008) and hope (White et al, 2018) were identified as positive dispositions. Kiebles, Doerfler and Keefer (2010) reported that age of diagnosis, severity of the disease, interference with plans for the future, beliefs about health and disease and emotional state could influence coping outcomes. Iglesias-Rey (2013) added that psychological factors such as anxiety and depression may influence the coping process.

1.11.2.1 Literature specific to factors affecting voice-related coping

Research identifying factors which could potentially affect coping with voice problems is limited. Hugh-Munier et al (1997) compared coping strategies, personality and voice quality in patients with vocal nodules and polyps and a control group. They reported that the patient groups showed greater altruism and lesser depression and more internal locus of control than the control group. This surprising finding was justified with the hypothesis that more internal control may have led to increased tension because the patients believed they were responsible for the state of things transferring this tension to the vocal musculature, leading to vocal misuse. A systematic analysis will

be conducted, in this programme of research, to review the literature on factors affecting coping in individuals with voice disorders, particularly singers.

1.11.3 Measurement of coping

1.11.3.1 Theoretical dichotomies in generic coping measurement

Coping is not a recent concept and various theories have been employed to explore different facets of the coping mechanism. Theoretical dichotomies can be identified as recurring themes across the numerous coping measures introduced for clinical and research purposes (Greenaway et al, 2015 and Schwarzer and Schwarzer, 1996). The relevance and implications of these dichotomies in the context of singing voice research will be discussed at the end of this section.

1.11.3.1.1 State versus trait measures

One of the most ubiquitous arguments pertaining to coping research would revolve around measuring coping as a dispositional style or a trait versus situational or state strategies. Dispositional style conceptualises coping as an individualised habitual trait and indicates that people have dominant strategies which they use to deal with a variety of stressful situations (Kronenberg et al, 2015). The trait approach enables the measurement of relatively constant and predictable coping styles across individuals and helps in identifying inter and intra-personal patterns across and within individuals (Greenaway et al, 2015). Schwarzer and Schwarzer (1996) suggest that the dispositional implication increases stability of the assessment, however, it underestimates the complexity of the dynamic coping process which is constantly evolving and does not take into account, the uniqueness of each situation. Alternatively, coping strategies or state measures define coping as a transactional response and take into account the dynamism of the coping process which is adapted in response to the distinctive situational demands (Greenaway et al, 2015). The fundamental assumption is that coping is contextual and varies over time in response to situational changes resulting in subsequent changes in appraisal (Moos and Holahan, 2003) and the focus is not on how individuals cope in general (Greenaway et al, 2015). However, it is unlikely that individuals use completely novel ways to react to different situations (Greenaway et al, 2015). Also, from a practical perspective, coping can only be fruitfully measured if it is assumed that there is a certain degree of generalisability across situations and if the number of strategies used by individuals is finite and reapplied (Schwarzer and Schwarzer, 1996). Therefore, both state and trait measures pose limitations that must be considered when either of these measures are applied for clinical or research purposes.

1.11.3.1.2 Binary vs multidimensional categorisation

Earlier attempts made to categorise coping used binary classifications. Some of the most commonly used classifications are described below.

Lazarus and Folkman (1984) classified coping into problem-focused and emotion-focused domains. Problem-focused coping involves active efforts to manage stressful situations by eliminating or modifying the stress source, whereas emotion-focused coping are efforts employed to curb the emotional consequences generated as a result of the stressful situation (Schoenmakers, Tilburg and Fokkema, 2015). Folkman (2007) further expanded this classification by introducing a third category called meaning-focused coping which draws on beliefs, values and existential goals to encourage and maintain coping.

Another distinctive classification is assimilative and accommodative coping (Brandtstädter, 1992). While assimilative coping involves changing the environment to suit one's needs and desires, accommodative coping enables individuals to alter their desires to suit the situational restrictions.

According to Krohne's coping theory (Krohne, 1993), a classification into vigilant coping and cognitive avoidance is feasible. Vigilant coping involves facing a potentially threatening stimulus whereas cognitive avoidance is characterised by moving away or avoiding a threatening situation which can be likened to the active-passive coping dichotomy.

Binary categorisation is helpful to draw conclusions or identify patterns and provides an easy means to compare and evaluate the effect of coping and related outcomes. However, relying only on two-dimensional categorisations may be simplistic and restricts the scope of coping by limiting the situational and individualistic variations. Skinner (2003) reviewed literature pertaining to coping and identified 400 different ways of coping. Given this vast and potentially endless scope of coping responses, classifying coping using multiple logical dimensions is essential to make measurement of coping feasible (Schwarzer and Schwarzer, 1996).

1.11.3.1.3 Generic vs specific

McElfatrick et al (2000) suggested that measures of coping can have multiple weaknesses, one of which is poor clinical relevance. They attributed this lack of clinical relevance to using measures that were not developed to specifically suit the needs of a population. They suggested that coping can only be effectively measured if the uniqueness of coping required by that population was taken into account. Further, they analysed the coping skills of mental health nurses using a generic measure

(Cooper's Occupational Stress Indicator) and a context-specific questionnaire (PsychNurse Methods of Coping Scale, McElfatrick et al, 2000) and reported that the context-specific measure had better inter-factor correlations, higher internal consistency and item discriminative validity thereby proving that it was more psychometrically robust while assessing coping skills in health nurses. This is an important decisive factor for researchers and clinicians alike while choosing the right measure to suit their objectives. Implications for this study are discussed below.

1.11.3.2 Implications for singing voice research

Distinguishing coping strategies using binary classifications such as problem focused and emotion focused domains albeit useful, may prove to be challenging in singers. This is because identifying whether a strategy is problem or emotion focused would largely depend on the context in which the singer adopts it. For instance, not singing for a period of time (voice rest) could be a problem focused strategy if a singer adopts it after a lengthy performance to avoid vocal damage. On the other hand, if a singer avoids singing at a concert due to performance anxiety would be an emotion focused strategy, which will impact his career and ultimately quality of life. Therefore, an appropriate methodology would be to adopt a multidimensional approach (using a range of appropriate subscales) to assess coping in singers to provide the breadth required to effectively categorise the coping responses and then attempt to classify the subscales (or individual items) into problem and emotion focused modes. This would mean that some subscales (for example, social support) should be considered as either problem or emotion focused depending on the rationale of the singer to employ it. For example, a singer may seek social support to gain more information about the symptoms, in which case it may be deemed problem focused. Alternatively, if social support is sought to gain empathy or emotional solace, then it should be considered emotion focused. Additionally, both examples illustrated here indicate that a context specific assessment of voice-related coping, using tools specifically designed to assess voice problems would prove to be beneficial in assessing voice-related coping in singers.

1.11.3.3 Assessment of voice-related coping

Epstein et al (2009) identified a few limitations pertaining to assessing voice-related coping. Firstly, they questioned the applicability of using self-report coping inventories which have not been developed or standardised using clinical populations, which is the case with many questionnaires such as the Ways of Coping (Lazarus and Folkman, 1980). Additionally, there would be specificity issues with dispositional style questionnaires since they do not take the specific situation (event of

a voice disorder in this case) into account. Further, a disease specific tool that contains coping strategies relevant to vocal symptoms would aid in better understanding adaptive and maladaptive coping in individuals with voice problems. They also recognised that a lengthy questionnaire was counter-productive, particularly in clinical situations where clinician and client burden should be minimised. To overcome these limitations, they developed the Voice Disability Coping Questionnaire (VDCQ), a context specific coping scale designed to assess voice-related coping in clinical situations.

The items used in VDCQ were constructed based on interviews with dysphonic patients, existing coping scales, particularly the Ways of Coping questionnaire (Lazarus and Folkman, 1988) and inputs from an expert panel comprising of speech and language therapists and laryngologists. Initially, 28 statements were generated, and patients answered each item using a 6-point Likert scale ranging from “never” to “always”. Two groups of dysphonic participants were used for the development of the scale; 40 patients diagnosed with Adductor Spasmodic Dysphonia (ASD) and 40 With Muscle Tension Dysphonia (MTD). The disease characteristics of these disorders are different; therefore, it was hypothesised that the coping strategies used by the two groups would be different. These statement responses were subjected to Principal Component Analysis to assess the latent structure and to refine the measurement components of the VDCQ. Following this, four coping subscales were generated: information seeking (two items, Cronbach’s alpha score=0.866), passive coping (four items, Cronbach’s alpha score=0.728), avoidance (three items, Cronbach’s alpha score=0.779) and social support (six items, Cronbach’s alpha score=0.819), bringing the total number of items to 15. Good correlation was observed between the social support and information seeking subscales and similarly between passive coping and avoidance subscales. The definition and items included in each subscale is provided in Table 1.3.

The correlations found between the subscales have interpretative value. Positive correlation between emotion focused social support and problem focused information seeking is suggestive of individuals with voice problems obtaining information from their social circles or people with similar problems as well as consulting professionals and is considered adaptive. Similarly, individuals using passive coping who do nothing about their problem and simply wish for it to go away are more likely to use avoidance strategies, later on, when dysphonia becomes more evident. VDCQ was also able to distinguish between the two groups of patients based on its scores suggesting good discriminate validity.

A generic coping scale often used in voice research is the Utrecht Coping List developed by Schreurs et al (1988). This scale has 47 questions and assesses coping across seven subscales which are ‘active confrontation or dealing with the problem’ (ACT), ‘avoidance/waiting’ (AV-W), ‘passive reaction pattern’ (PAS), ‘reassuring thoughts’ (REAS), ‘palliative reactions’ (PAL), ‘emotional expression’, (EXP) and ‘seeking for social support’ (SOC). UCL assumes coping styles to be consistent across different stressful situations for an individual, making it a trait measure. The responses are rated on a 4-point ordinal scale and the possible answers are seldom or never (1), sometimes (2), often (3) and very often (4). If the subscales of the UCL and VDCQ are compared, several similarities arise. Table 1.4 presents the items representing the subscales of the UCL (McAuliffe et al, 2005).

Table 1.3: Subscales of Voice Disability Coping Questionnaire (VDCQ) and items (Epstein et al, 2009)

Subscale	Definition	Item numbers and statements
Information seeking	“Problem solving coping through seeking information about the condition”	4. I try to find as much information as possible about my voice problem 8. I find it easier to cope with my voice problem by finding out as much as I can
Passive coping	“Individuals who do not embrace or reject any proactive coping strategy”	3. I find myself wishing I never had a voice problem 6. I find it easier to cope with my voice problem by telling myself not to think about it 10. I take the view that there is little I can do about my voice problem 14. I find it easier to cope with my voice problem by wishing that it would go away and somehow be over with
Avoidance	“Use of denial, withdrawal, and reorganisation of routine activities in the face of dysphonia”	2. I try to avoid situations where my voice problem would become evident 11. I find it easier to live with my voice problem, if I do not use my voice 14. I find it easier to cope with my voice problem by avoiding being with people in general
Social support	“Range of interpersonal exchanges that provide the individual with information, emotional reassurance, material assistance and self-esteem”	1. It helps me to cope with my voice problem if other people are sympathetic 5. I find it easier to cope with my voice problem by expressing my feelings outwardly 7. I find talking with friends and family about my voice problem helpful 9. I keep any worries I may have about my voice to myself 12. Having a voice problem has helped me to find some important truth about my life 13. I find it easier to cope with my voice problem if I ask the doctor questions about it

Table 1.4: Details pertaining to subscales of the Utrecht Coping List (UCL) (McAuliffe et al, 2005)

Subscale	Description	Number of Items	Coping Dimension	Example test items within the subscale
Active handling	- Active approach to solve a problem. - Problem is thought about and approached directly	7	Active and assertive coping style	- Finding out more about the problem - Making several alternate plans for handling a problem
Palliative Reactions	- Efforts directed at changing the feelings elicited by a problem - Avoidance strategies such as distraction, timeout	8	Combination	- Directing thoughts towards other matters - Trying to dispel one's worries temporarily by taking a break
Avoidance/ waiting	- No effort to change the problem itself - Avoiding the problem or situation	8	Reactive and defensive coping style	- Waiting for the problem to solve itself - Avoids difficult situations
Seek social support	Worries are shared with someone	6	Active and assertive coping style	- Asking someone for help - Seeking sympathy and comfort from others
Passive reactions	- Feelings of helplessness - Pessimistic and overwhelmed by the problem	7	Reactive and defensive coping style	- Withdrawing from other people - Worrying about the past
Expression of emotions	Expressing feelings about the problem to others	3	Reactive and defensive coping style	- Showing one's anger with those responsible for the problem - Showing one's annoyance
Reassuring thoughts	Engaging in self-encouragement and comforting thoughts	5	Active and assertive coping style	- It could be worse - Other people have problems too

A comparison of the constructs used in UCL and VDCQ reflects many similarities. Social support and avoidance are distinguished as subscales in both tests. Information seeking which is a subscale in the VDCQ is included under a more generic construct called 'active handling' in UCL. However, the UCL has a few additional constructs such as palliative reactions, expression of emotions and reassuring thoughts which are likely to be used by individuals with voice disorders, including singers. For instance, Meulenbroek et al (2009) administered the VHI and UCL on 755 student teachers to

assess the biopsychosocial impact of the voice in relation to psychological features. They concluded that student teachers with relatively high VHI scores (indicating higher vocal handicap) showed higher scores on the passive reactions, palliative reactions, avoidance-waiting attitude and expression of emotions. Therefore, it is likely that singers could potentially be using any of the additional subscales in the UCL which is not present in the VDCQ, thereby not providing a complete picture of coping in singers. Also, the application of VDCQ in a different context (assessing voice-related coping in singers) is likely to produce additional scales which may be relevant to the present study. Therefore, the original 28-item questionnaire could be re-examined to analyse if any further logical and useful constructs can be generated.

Currently, the VDCQ is the only known tool available to specifically assess voice-related coping. VDCQ has also been culturally adapted and translated to Brazilian Portuguese (Oliveira et al, 2016) and Persian (Faham et al, 2019).

Singers have repeatedly shown higher impact of voice problems. Additionally, the vocal needs of singers are more demanding and the stakes of a voice problem on their performance and career is high. For instance, a non-singer may not recognise a subtle change in voice quality and therefore not act on the mild vocal deviation. A singer, on the other hand will experience greater impact even during minimal change in vocal quality and would perhaps seek help immediately or avoid performances depending on how they prefer to cope with the 'stressor'. Therefore, it is reasonable to expect that singers may employ coping strategies which could vary from the non-singing population and require further exploration, for instance, by using more context specific questions.

1.11.3.4 Literature related to coping with voice problems in singers

Studies have indicated that singers, in general, are reluctant to seek medical help when confronted with voice problems (Gunjawate et al, 2016 and Gilman et al, 2009). Gender differences have been observed in help-seeking behaviours among singers. Petty (2011) studied 151 self-identified Western Classical singers and 49 controls and reported that female singers were more likely to consult their singing teachers first and male singers, a physician or a speech and language therapist. Further, younger singers were also likely to consult a singing specialist rather than a physician. He also reported a higher propensity among female singers to search for medical information regarding voice problems than male singers and similar results have been reported by Gunjawate et al (2016) in Indian Classical singers (n=55). Singers also resorted to home remedies when faced with voice problems (Petty, 2011). Reluctance to seek medical help can be attributed to lack of awareness of

vocal healthcare options (Gillman et al, 2009; Gunjawate et al, 2016), fear for outcome of a medical investigation following a visit to the doctor (Gunjawate et al, 2016) and lack of insurance coverage (Gillman et al, 2009). It is plausible that the expansion of internet and availability of resources surrounding vocal health may influence treatment seeking behaviours; whilst, there are no studies directly looking at this influence within the context of voice disorders, studies from a wider context indicate that literacy level, sex (women are more likely) and individuals with access to high speed internet are more likely to seek health related information on the web (Higgins et al, 2011)

These results highlight important implications pertaining to voice-related treatment and health information seeking behaviours in singers, particularly the involvement of singing teachers and differences pertaining to age, gender and cost of care, and further confirm the individualistic and situation related uniqueness of voice-related coping in singers. However, only a limited aspect of coping, namely treatment and health information seeking behaviour have been explored in singers. Additionally, assessment of coping using context specific coping measures would contribute to understanding specific coping behaviours in singers and shed light on factors affecting voice-related coping. Finally, qualitative studies could provide rich descriptive details regarding how singers cope with voice problems thereby providing a gateway to further explore options to improve assessment and treatment of the singing voice. Additionally, they can also inform the development of methodologies for quantitative studies by highlighting the relevant areas to be considered to obtain data from larger groups of participants.

1.12 CONCEPTUAL MODELS AND THEORETICAL FRAMEWORKS TO STUDY VOICE PROBLEMS AND COPING IN SINGERS

Conceptual models are representational illustrations that can visually portray and link ideas, concepts and theories of a study and outline the possible courses of action, thereby providing rigour to the research process (Elangovan and Rajendran, 2015). The current study can be split into two sections-the first section examining the self-reported voice problems of singers and the second identifying the coping strategies adopted by these singers to deal with their voice problems. While the two segments are not mutually exclusive and will have considerable overlap, particularly during data analysis, the framework developed for the study should be able to represent both sections effectively.

The next section will outline the approach undertaken for this study which is primarily based on Leventhal's common-sense model of self-regulation. The following sections will describe the common-sense model of self-regulation, constructs relevant to the model, the rationale for its use

in the current study, environmental and individualistic factors considered in the framework of the present study and will finally illustrate the conceptual model devised for this study along with the hypotheses drawn from it.

1.12.1 Common sense model of self-regulation (CSM)

The common-sense model (Leventhal, Meyer and Nerenz, 1980) is also known as the Illness Perceptions Model, Illness Representations Model, Self-regulatory Model, Parallel Process Model or Leventhal's Model (Hale, Treharne and Kitas, 2007). The central concept in the CSM is that of illness representation which is defined as the beliefs and expectations of a patient about an illness or a symptom (Leventhal, Meyer and Nerenz, 1980). Appraisal, which is the primary construct in the transactional model of stress and coping by Folkman and Lazarus (1984) is also an important construct within the CSM. Illness representation and appraisal are described below.

1.12.1.1 Appraisal

Folkman and Lazarus (1984) suggest that appraisal simply represents the phenomenon where humans constantly evaluate their current experience in relation to their well-being and determines whether and how an individual copes with a stressor/stressful circumstance. Cognitive appraisal is one of the fundamental concepts in the Transactional model of stress and coping proposed by Folkman and Lazarus in 1984. The authors recognise two stages of appraisal-primary and secondary. Primary appraisal concerns with how the encounter with a potential stressor is viewed. This can lead to three outcomes where the stressor is viewed as a harm, threat or a challenge. Harm appraisal is made when the individual has already experienced some level of damage or loss. Threat appraisal is made in situations where harm is anticipated, whereas challenge appraisals are made in situations where a positive outcome is anticipated. Secondary appraisal involves evaluating whether any action can be taken to deal with the stressor and what coping options were available. This is determined by the availability of coping resources for an individual to choose from which can be internal or external (Greenaway et al, 2015). Internal factors include personality factors such as hardiness, or optimism, whereas external factors are environmental features such as availability of social support, money etc. to cope with stress (Greenaway, et al 2015). Secondary appraisal will depend on how much control one perceives to have over the outcomes (Folkman and Lazarus, 1984) and determines how individuals handle the stress or its effects.

Appraisal is an important concept that is recognised by many other models in health psychology (Shaw, 1999) such as the health belief model (Becker, 1974) and protection motivation theory

(Maddux and Rogers, 1983). Both these models suggest that individuals start making behavioural choices based on the perception of health threat (Shaw, 1999). According to the framework proposed by Shaw (1999), appraisal is dependent on illness representation which is described next.

1.12.1.2 Illness representation

Illness representation is defined as an individual's cognitive representation of their illness (Edgar and Skinner, 2003) and is the central concept of the common-sense model of illness representation (Leventhal, Meyer and Nerenz, 1980), which will be described in detail, later in this chapter. Leventhal, Meyer and Nerenz (1980) proposed that in order to make sense of and manage the problem, individuals use both abstract and concrete sources of information and create a mental representation of their illness. Five attributes of illness representation were described by the authors:

- Identity: abstract labels or symptoms which describe the illness (e.g.: laryngeal cancer, laryngitis)
- Cause: the causal factors which led to the illness (e.g.: voice abuse, smoking)
- Consequence: physical and socioeconomic effects of the illness (e.g.: permanent loss of pitch range, reduced performances)
- Timeline: duration and time frame for development of the illness
- Control: if any actions can be taken to control the threat (is the voice problem curable?)

A literature review carried out by Sawyer, Harris and Koenig (2019) suggested that favourable illness representation was associated with better health outcomes. Hagger and Orbell (2003) reported associations between positive health outcomes and perception of an illness as curable and controllable. On the other hand, chronic timeline and more perceives symptoms were associated with negative illness outcomes.

1.12.1.3 Processes and pathways involved in the common-sense model

Figure 1.1 illustrates the components and their connections of the common-sense model (Hagger et al, 2017). According to the common-sense model, illness representation directly influences coping behaviours and strategies which, in turn, influence outcomes. In other words, an individual uses his common-sense to interpret health threats and uses his internal logic to react to the threat and manage the illness (Benyamini and Karademas, 2019). The model proposes that this internal logic is mainly shaped by information available from three sources: information already available to

the individual from previous social communication and cultural knowledge about the illness, information collected from external sources both authoritative and significant others and finally from their current experience with the illness (represented as situational stimuli in the figure).

The model proceeds to postulate a dynamic self-regulatory process where two parallel pathways are represented- one which involves cognitive representation of the illness which is formed by the five attributes (identity, cause, consequence, timeline and control) and the other which deals with emotional representations. The cognitive representation will enable development of required actions and coping strategies to manage the symptom or illness whereas the emotional representation will help in managing the concomitant emotional consequences of the symptom. The pathway adopted and coping strategies implemented will determine the impact on the outcomes.

Emotional representation pathway will produce emotional outcomes whereas cognitive representation pathway will result in outcomes that directly influence the illness presentation and symptomatology. Finally, the individual 'appraises' the success of the implemented coping behaviours and evaluates if the intended goals following adaptation were met. Therefore, the entire process is ongoing and frequent revisions to original beliefs and actions are possible. The model also highlights that socio-cultural contexts and individual traits such as personality can influence the self-regulation process.

1.13 RATIONALE FOR USING PRINCIPLES OF COMMON-SENSE MODEL FOR THE CURRENT PROGRAMME OF RESEARCH

Since the introduction of the CSM, it has generated interest among researchers and clinicians alike and is recognized as a reliable framework to study patient-illness related and external factors which could influence adaptation to illness and various health outcomes, making it one of the most frequently applied theories in health research (Benyamini and Karademas, 2019).

Hill et al (2007) posits that there is often a mismatch between the objective assessment findings and the impact of the illness on an individual and argued that this could possibly be because of varied perception of the illness influencing health outcomes directly or indirectly by its effect on coping. They suggested that the CSM could offer means to understand this link between perception of the patient regarding his illness and its impact on outcomes. They carried out a two-stage cross sectional survey to investigate illness perceptions associated with health and behaviour by adopting the CSM

and reported a clear association between patient perception and health related outcomes, establishing the validity of CSM as a reliable model for similar studies.

Fig 1.1: Representation of the common-sense model by Hagger et al, 2017

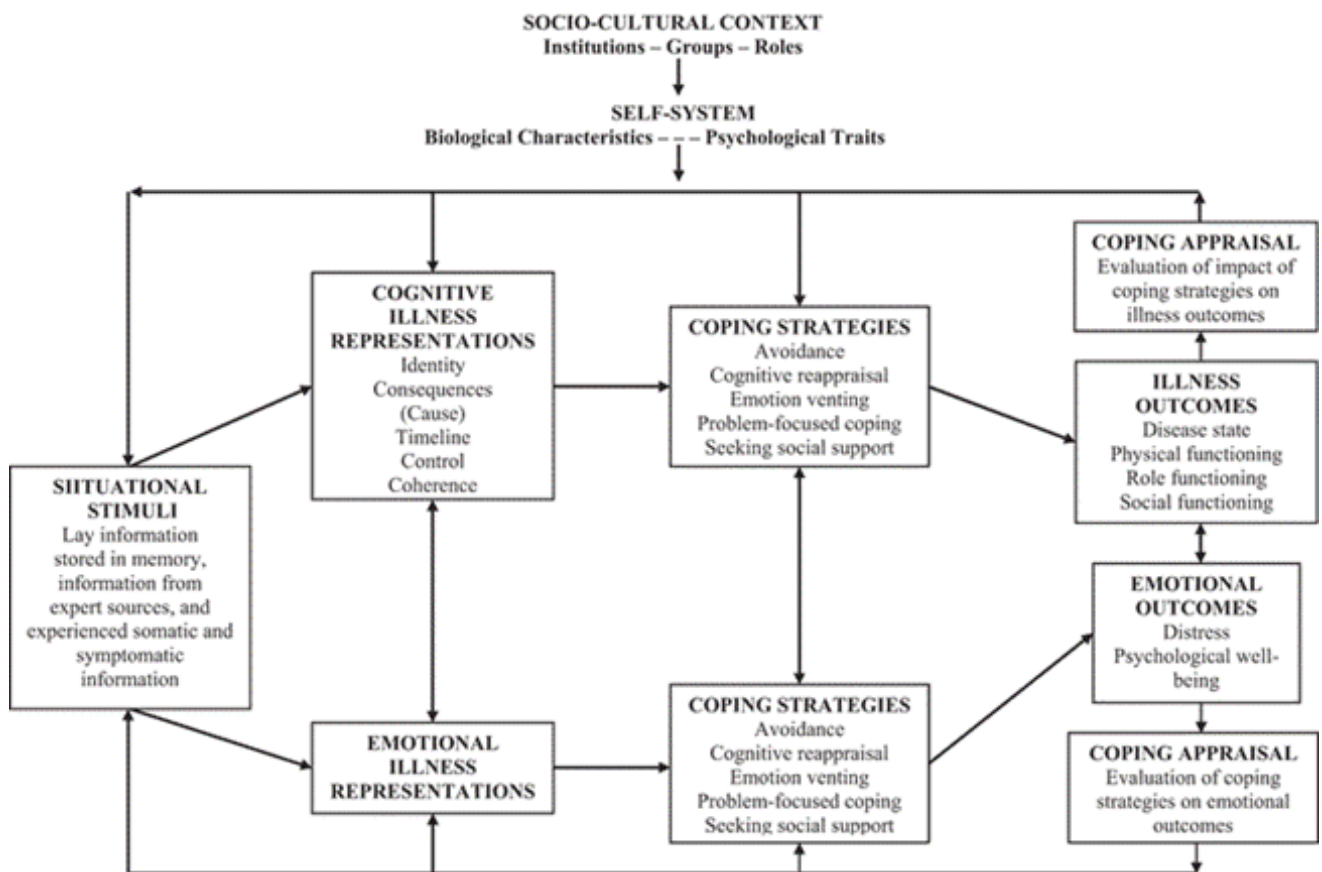


Fig 1.1: Copyright © [2017] by [American Psychological Association]. Reproduced with permission. [Hagger, M. S., Koch, S., Chatzisarantis, N. L. D., & Orbell, S. (2017). The common sense model of self-regulation: Meta-analysis and test of a process model. Psychological Bulletin, 143(11), 1117–1154.]

Since the current study will also be exploring perceptions of singers regarding voice problems and the effect of coping on a variety of outcome measures, principles of the CSM will be appropriate to achieve the aims of the study.

Hagger and Orbell (2003) carried out a meta-analysis of 45 empirical studies adopting the CSM and examined the relationship between illness representation, coping and illness outcomes. They concluded that there was evidence for theoretically predictable relations between illness representations, coping and outcomes across studies, further supporting the use of the model in the present study.

Fig 1.2: The framework proposed by Shaw (1999) to study coping, illness behaviour and outcomes

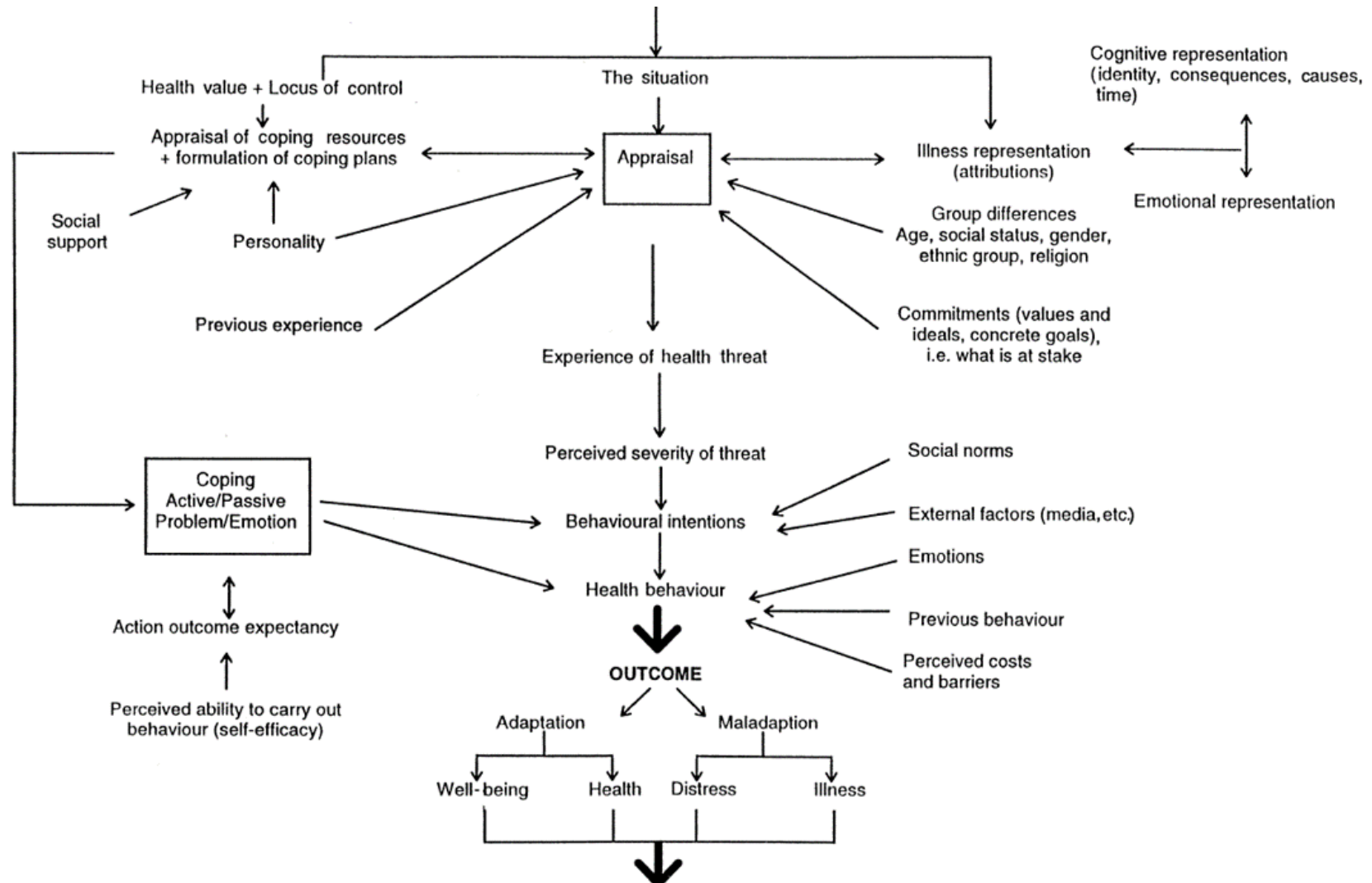


Fig 1.2: Copyright © [2001] by [John Wiley and Sons]. Reproduced with permission. [Shaw, C., 1999. A framework for the study of coping, illness behaviour and outcomes. *Journal of Advanced Nursing*, 29(5), pp.1246-1255.]

1.13.1 Approach undertaken by current programme of research

Shaw (1999) proposed a theoretical framework to study coping, illness behaviour and outcomes (Fig 1.2) by incorporating concepts from various models used in health psychology, particularly the transactional model of stress and coping (Folkman and Lazarus, 1984) and common-sense model of illness representation (Leventhal, Meyer and Nerenz, 1980). The model shows the relationship between appraisal and illness representation and their influence on the coping process and ultimately on health outcomes. It also considers both situational and individual variables and is therefore well suited to studies aimed at identifying predictors of outcome and providing causal explanations. Therefore, the conceptual model developed for the present study is based on the common-sense model of illness representation but has environmental and individualistic factors presented in Shaw's (1999) framework such as group differences (age, ethnic group, religion), perceived support, personality, severity of the voice problem etc.

1.13.1.1 Description of components of the model developed for the current project

Figure 1.3 illustrates the conceptual model developed for the current project. The model begins by identifying the predisposing factors (classified as demographic and singing related factors) which are associated with developing a voice problem and describe the vocal symptoms experienced by singers. The predisposing factors have a moderating effect on the development of vocal symptoms which is represented using the symptom presentation section. This will enable the identification of risk factors and the most reported voice problems in singers.

Following the development of symptoms, an appraisal of the situation occurs (primary appraisal as postulated in the Transactional model of Stress and Coping by Folkman and Lazarus, 1984) which would determine if the symptom should be considered as harm, threat, or challenge. This appraisal, along with various situational and individual constructs such as illness representation, appraisal, personality and perceived support will determine if a singer would adopt problem solving or emotion focused coping strategies to manage their voice problem. The four subscales described in VDCQ are represented under both problem and emotion focused strategies in the model; therefore, the model takes into account the context under which these strategies have been adopted which would determine the representation (as problem/emotion) of the coping strategy. An arrow also connects predisposing factors and the constructs (mainly illness representation); this connection between various situational and individualistic factors and illness representation is represented in the CSM.

The coping route and strategies adopted by the singer, will be reflected in the outcomes which are represented using physical, vocational and psychosocial variables (proposed in the CSM as cognitive and emotional outcomes), measured in terms of singing handicap, activity limitation and participation and voice-related quality of life. These provide an overall impact of the voice problem on the singer. Three outcomes are represented-physical, vocational and psychosocial which are measured in this study.

Finally, an arrow feeding back to the symptom presentation from the outcome segment represents the feedback loop which evaluates the success of the coping strategies adopted by the singer to resolve the voice problem, also providing a system for revisions. This illustrates the ongoing nature of the coping process as postulated in the CSM.

1.13.1.2 Need for a theoretical framework for the present study

Studying self-reported voice problems, coping strategies and factors impacting the voice is uncommon in voice literature; therefore, the main purpose of the theoretical model was to provide a “blueprint” which acted as an aid to develop the empirical arms of the present study. Moreover, it also provided some direction on the correlations which can be theoretically postulated between the main elements of the study (e.g., relationship between coping and self-reported voice problems). Understanding these correlations also provided useful information to plan the analyses which needed to be undertaken to effectively address the aims. However, this research does not aim to test the theoretical models used to guide this research.

Fig 1.3: Theoretical model of current study based on the Common-sense model (Leventhal et al, 1980) and framework proposed by Shaw (1999)

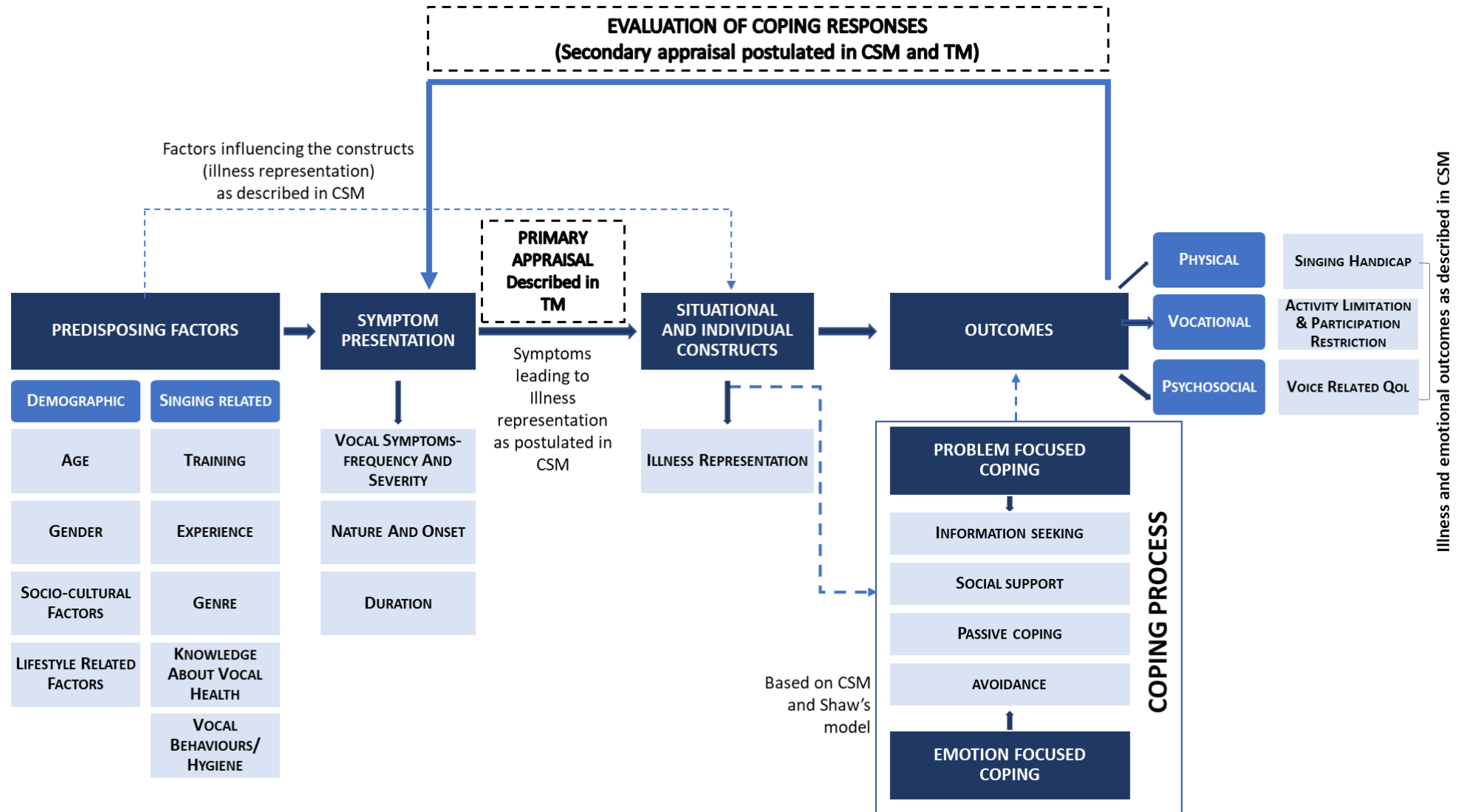


Fig 1.3: CSM=Common Sense Model, TM=Transactional Model of Stress and Coping

1.13.1.3 Feasibility of the proposed model in studying voice problems and coping in singers

To check if the proposed model will be suitable for the present study, an example is presented. According to the model, when singers encounter vocal symptoms (as a result of a predisposition), the first stage which is the primary appraisal would enable them to determine if the voice problem should be viewed as harm, threat, or a challenge based on their interpretation of the symptoms. For instance, a singer who has experienced a sudden and significant change in vocal quality following a long and vocally stressful performance is likely to make a harm or threat appraisal, following which, the singer would evaluate his options (coping resources) to deal with the voice problem. He may decide to act on it by taking control and seeking medical help to know more about the problem, which is likely to culminate in a positive outcome that is reflected in any or all outcomes of the model. Alternatively, he may undertake a passive approach and continue performing, hoping that the voice problem would resolve on its own, thereby creating a situation where more serious and permanent vocal damage is possible. These choices are essentially made based on the representation of the illness by the singer formed using the five attributes of illness representation. They are also dependent on various individualistic and situational factors such as personality and perceived support. Therefore, an established singer may have the liberty and finances to take some time off to seek help whereas an upcoming singer may be obliged to take up every opportunity for financial and professional reasons and unable to seek help if healthcare is expensive, even if he wishes to do so. Hence, exploring these constructs and influencing factors presented in the model could contribute towards understanding behavioural choices undertaken by singers when faced with a voice problem and its impact on physical, vocational and psychosocial outcomes.

A clarification on why conventional terminologies such as impairment, activity limitation and participation restriction based on WHO definitions were not used in the current study was warranted as these are often used in the literature. This is because, the primary focus of the empirical arms of the present study was not to classify the results based on these terminologies; moreover, such classifications may not be possible with the methodology(ies) adopted in the current study as an objective/instrumental assessment (e.g., laryngoscopy) would be required to correctly differentiate impairment from activity limitation and participation restriction. The current study only used self-report making this classification unsuitable.

1.13.1.4 Hypotheses from the model pertaining to the current programme of research

1. There will be correlations between demographic and singing related factors (risk factors) and voice problems (symptom presentation) and illness representations developed by singers.
2. There will be relationships between predisposing factors, illness representations and voice-related coping in singers.
3. There will be a relationship between voice-related coping and outcome measures such as QOL, and vocal handicap.
4. Coping strategies adopted by singers can be predictors of vocal handicap.

1.13.1.5 Some definitions of important terminologies related to the thesis

To improve objectivity and transparency, definitions of the core constructs considered in this thesis is provided below.

Self-reported voice problems: This term encompasses the frequency, severity and duration of *vocal symptoms* and the nature and extent of *vocal impact* reported by singers who have participated in this thesis.

Vocal symptoms: Any symptom related to the vocal mechanism which interferes with the optimal functioning of the voice.

Vocal impact: Encompasses all the consequences experienced by singers as a result of their voice problem (e.g., physical, emotional, vocational etc.).

Illness perceptions: Refers to beliefs and representations singers reported by singers regarding the symptoms, consequences, timelines, controllability, impact, level of concern and comprehensibility of the voice problem they are currently experiencing/experienced in the past.

Voice-related coping (sometimes simply referred to as coping in the thesis): Thoughts and behaviours reported by singers to manage their voice problems as well as the consequences experienced due to the voice problem.

Variables influencing the voice: These include items reported by the singers which are likely to influence the voice.

Factors influencing the voice: These include variables which have been statistically determined to influence the voice.

1.14 AIMS AND OBJECTIVES OF THE CURRENT PROGRAMME OF RESEARCH

This chapter has indicated that singers experience self-reported voice problems and highlighted some unique risk factors associated with singing voice problems. Similarly, the impact of coping on vocal health has also been indicated. Lack of genre specific studies while examining voice problems and dearth of studies on voice-related coping is evident. Therefore, the current thesis aimed to explore self-reported voice problems and coping strategies in Western classical and Carnatic singers.

More specifically, this thesis aimed to:

1. Examine relevant areas of self-reported voice problems and coping styles in singers and identify physiological, behavioural and socio-cultural risk factors (two systematic reviews).
2. Explore perceptions of singers, vocal coaches and speech and language therapists regarding self-reported voice problems in singers and voice-related coping by carrying out detailed semi-structured interviews (qualitative study).
3. Create a self-assessment battery using findings from the qualitative study and the systematic reviews and identify the self-reported voice problems and coping styles of Western classical and Carnatic professional singers (survey, descriptive).
4. Describe and compare the frequency, severity and nature of self-reported voice problems and coping styles between Western Classical and Carnatic singers and within groups to ascertain the impact of culture, demographic and singing related variables on vocal health (survey, comparative).
5. Examine if there is an association between coping, illness perceptions, demographic, singing medical and lifestyle factors, and self-reported voice problems (survey, correlation and regression analyses).

1.15 PERSONAL MOTIVATION TO UNDERTAKE THE THESIS

The researcher previously worked as a speech and language therapist specialising in voice disorders and identified several gaps in the evidence base (e.g., lack of genre specific studies reporting self-reported voice problems of singers, research related to voice related coping and factors impacting vocal health etc.). Due to these gaps, the researcher believed that the services offered to singers in the voice clinic did not take their specific needs into account while carrying out assessment or planning intervention sufficiently. This was the main motivation to carry out this thesis. Moreover, the researcher is also a trained Carnatic singer who had experienced voice problems in the past; this added a personal motivation and prompted the researcher to undertake the present thesis.

2 CHAPTER 2: SELF REPORTED VOICE PROBLEMS IN CLASSICAL SINGERS-A SYSTEMATIC REVIEW

The previous chapter provided an overview of the core topics related to the current programme of research. The present chapter will describe the methodology, results and implications of a systematic review undertaken to examine all relevant areas of self-reported voice problems in singers.

2.1 INTRODUCTION

Singers use their voices in very intricate and challenging ways and are often considered vocal athletes (Phyland et al, 2013). This poses physical and emotional stress on the voice, which may lead to vocal difficulties (Tepe et al, 2002). Various studies have indicated a high prevalence of self-reported voice problems among singers (Tepe et al, 2002; Phyland, Oates & Greenwood, 1999). This was confirmed by a systematic review carried out by Pestana et al (2017) where the overall prevalence of voice problems among singers was calculated to be 46.09% compared to 6% in younger adults (Bainbridge et al, 2017) and between 4.8% to 29.1% in older adults (de Araújo Pernambuco et al, 2014). Phyland et al (2012) reported that singers used descriptors such as breathy, husky, hoarse, raspy, difficulties with high notes to name a few, to indicate how they perceived their own voices after a performance. Neto and Meyer et al (2017) reported that choral singers reported symptoms such as vocal fatigue, tickling and choking sensation in the throat, loss of upper range and complete loss of voice. From a clinical perspective, vocal symptoms in singers can range from subtle, transient changes in vocal fold mucosa to more severe voice pathologies with physiological, aerodynamic and acoustic consequences (Phyland et al, 2012). Studies also report higher sensitivity among singers to perceive voice problems (Lee & Sim, 2013; Rangarajan, Santhanam & Selvaraj, 2018)

Along with increased vulnerability of developing voice problems, the impact of voice problems will be higher among singers compared to non-singers (Cohen et al, 2007; Ahmadi, et al, 2022). Rangarajan, Selvaraj and Santhanam (2019) administered the Tamil version of Voice-related Quality of Life and reported that singers scored higher in both physical-functional and social-emotional subscales indicating impact on quality of life compared to non-singers. The same authors also reported higher impact among singers while administering the Tamil Singing Voice Handicap Index. The higher prevalence and increased impact of voice problems among singers makes it important to evaluate self-reported voice problems in this group.

To effectively assess voice problems among singers, the importance of employing self-report measures to assess voice problems in singers cannot be underestimated (Cohen et al, 2007; Rosen and Murry, 2000, Francis et al, 2016). A systematic review conducted by Francis et al (2016) categorised self-report voice measures into 16 constructs such as handicap (e.g., Voice Handicap Index), vocal symptoms (e.g., Voice Symptom Scale), quality of life (e.g., Voice-related Quality of Life), coping (e.g., VDCQ) and others (please refer to Chapter 1 Table 1.2 for further details). While some measures such as the SVHI and VRQOL are suitable to assess disordered voices, measures such as EASE can account for the more subtle vocal changes (Phyland, 2013). Therefore, identifying the self-assessment tools reported in literature will be useful in determining the scope and appropriateness of using these measures in a clinical or research setting.

Devadas, Kumar & Maruthy (2020) reported that the prevalence of self-reported voice problems is highly variable across singing styles. A systematic review by Pestana et al (2017) confirmed differences in prevalence rates across genres with classical singers reporting a slightly lower prevalence (40.53%) compared to non-classical singers (46.96%). This could be attributed to differences in training, vocal demands and lifestyle factors.

Classical singing encompasses various genres within itself but generally involves rigorous training of the voice to develop vocal technique, projection and richness of vocal quality (Avila, Oliveira & Behlau, 2010). Classical singing requires complex adjustments of the vocal mechanism to produce the desired vocal effects (e.g., singing without amplification, use of vocal ornaments, poor execution) which can contribute to development of voice problems if not well executed (Avila, Oliveira & Behlau, 2010). This suggests that classical singers have specific vocal needs, training regimes and performance demands making them a specialised cohort among the singing population.

Davies and Jahn (2004) reported that performance demands, frequent travel, stress and anxiety, venue acoustics and allergens, medications and abuse and improper vocal technique can influence vocal health. An exploration of factors that may impact the classical singing voice can assist in developing preventive and rehabilitative programmes and positively influence maintenance of vocal health in this “elite vocal group”.

Pestana et al (2017) conducted a systematic review to identify the prevalence of self-reported voice problems in singers. Albeit useful, this review only provided details related to the prevalence and did

not provide further information about the type and nature of self-reported voice problems (e.g., frequently occurring symptoms). Also, the review gave a generic account of prevalence among singers and did not give genre specific information. Moreover, information related to how self-reported voice problems were assessed or factors impacting the voice were not reported which were relevant to the present thesis. Finally, some of the key papers in the field (e.g., Avila et al 2010; Arunachalam et al, 2014) were not included in the review. Therefore, the undertaking of the current systematic review is justified.

The objective of this chapter was to identify and analyse research evidence pertaining to self-reported voice problems in classical singers by conducting a systematic review. The review questions were:

1. How are self-reported voice problems assessed in classical singers?
2. What is the type, nature, and frequency of self-reported voice problems in classical singers?
3. What are the factors associated with self-reported voice problems in classical singers?

2.2 METHODS

The methods and reporting of this review complied with the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines (Moher et al, 2009). PROSPERO and Cochrane databases were searched to establish that a systematic review in the present topics was not previously or currently undertaken.

2.2.1 Eligibility criteria

To be eligible studies had to examine self-reported voice problems in classical singers and be published in a peer-reviewed journal. Studies involving singing teachers and singing students were included. Studies involving other genres were included if data on classical singers was reported separately or if classical singers comprised more than 25% of the participant group. This threshold was chosen based on similar thresholds adopted by previous systematic reviews (e.g., Sparks et al, 2023) thereby setting a precedent for study selection. For studies where the genre of the singers was not explicitly mentioned, authors were contacted to confirm if participants were classical singers. Studies where multiple categories of professional voice users were recruited (such as singers, teachers etc.) and the results were not reported separately for each category of professional voice users were excluded as the data was not representative of classical singers. No restrictions were placed with respect to publication date

or study design. Only studies where the mean age of participants was reported to be 18 or over were included.

Studies with the primary aim of validating or adapting an existing self-report voice measure (e.g., SVHI, VAPP etc.) were also excluded as their primary objective was validating a measure rather than exploring self-reported voice problems and factors affecting them. Also, studies published in non-English languages and studies on reflux which do not include a voice assessment measure were excluded.

2.2.2 Information sources

A subject librarian was consulted to recommend databases that could potentially provide relevant articles. A systematic search using 10 electronic databases (Medline Complete, Academic Search Complete, CINAHL, EMBASE, Music Periodicals, Communication Source, PsycINFO, SCOPUS, Web of Science and NICE) was carried out in February 2021 and a follow up search was done in August 2022 to ensure no recent publications were excluded from the review. Grey literature was also searched using OpenGrey and BASE databases. Citation and reference tracking were carried out for all the included studies at the end of the selection process to check for articles that may not have been picked up during database searching.

2.2.3 Search strategy

The search strategy was developed with the assistance of a subject librarian. Each database was searched separately using a customised search strategy which included keywords and subject terms using EBSCO Host and Ovid platforms. The basic search strategy is provided in Appendix 2.1.

2.2.4 Selection process

The studies retrieved were first imported into Rayyan (Ouzzani et al, 2016) for duplicate removal and study selection; following which, the selected articles were transferred into EPPI-Reviewer (Thomas et al, 2010), for data extraction and data synthesis. The entire screening process was carried out by A.R. and 25% of the screening was double coded by N.D. The title and abstract of the articles were screened against the eligibility criteria to identify studies to include in the review and reasons for exclusion were clearly documented. The full text of all the articles which fulfilled the eligibility criteria were retrieved and reviewed. 25% of articles were screened at both title and abstract and full text level by a second reviewer (N.D) who worked independently and was blinded to decisions made by the first reviewer.

Disagreements surrounding study selection were discussed by the reviewers for resolution. For papers where a consensus could not be reached between the reviewers, a senior member of the research team (S.P.H) was consulted for a final decision. If full text articles were unavailable, authors were contacted to procure a copy, if their contact details were available. If no response was received or if authors were unable to share the full text version, the papers were excluded.

2.2.5 Data collection process

Data was extracted by A.R following which 25% of studies were double screened to check for consistency of extracted data (N.D). A data extraction table was created to collect information pertaining to study and participant characteristics, assessment measures, voice-related outcomes and factors affecting voice. Disagreements in decisions surrounding data extraction were discussed by the reviewers for resolution. When a consensus could not be reached, a senior member of the research team (S.P.H) was consulted for advice regarding reconciliation.

2.2.6 Data Extraction

Data extracted included study name, study type, country, study population, eligibility criteria, sample size, response rate, sex/gender, age, singing related details, training related details, objectives, validated voice measures, non-validated measures (which includes customised questionnaires/checklists developed by authors to suit the aims of their study), statistical analysis, main outcomes (categorised as self-reported voice problems based on non-validated measures, self-reported voice problems- based on validated measures), factors affecting voice and their implications and key conclusions. Authors were contacted (n=25) if more information or clarification was required to aid in data synthesis. After the initial email, two more reminders were sent to the authors.

2.2.7 Methodological quality and risk of bias assessment

The Joanna-Briggs Institute (JBI) Critical Appraisal checklists were used for assessing methodological quality and risk of bias. Since not all the selected studies had the same design, different JBI critical appraisal tools suitable for specific study designs were adopted. The JBI does not provide clear guidelines on assessing the overall quality of a study; therefore, a scoring system was developed to aid in quantifying the decision-making process. The responses outlined in JBI were assigned values as follows: - All responses marked yes were given a value of 2, responses marked no were given a value of

0 and those marked unclear or inadequate were assigned a value of 1. For each study, the total percentage score was calculated, and this value was compared across studies. The scores were interpreted as follows:

- Scores > 80%= Good methodological quality
- Scores between 60-80%= Fair methodological quality
- Scores < 60%= Poor methodological quality

Twenty five percent of included studies were assessed by a second reviewer (N.D) who worked independently and was blinded to decisions made by the first reviewer. Disagreements surrounding quality scores were discussed by the reviewers for resolution. For papers where a consensus could not be reached between the reviewers, a senior member of the research team (S.P.H) was consulted for a final decision.

2.2.8 Data synthesis

A narrative synthesis was performed. The first step was for the researcher to familiarise herself with the included studies. This was done by systematically and comprehensively reading each study and highlighting important characteristics. Each study was described in detail and all key features were summarised for each study. The studies were then tabulated to identify patterns across the included studies. Between and within study differences were explored and this data was used to highlight assessment methods, describe the self-reported voice problems, and identify risk factors associated with the development of voice problems in singers.

2.3 RESULTS

2.3.1 Study selection

The final search was run in August 2022 (with automatic searches scheduled until January 2023) and identified 5512 articles. Following deduplication and title and abstract screening, and full text screening, 35 studies were included in the review. There was 88% agreement at abstract screening level and 73% at full text level. Following reconciliation, the agreement was 100%. Figure 2.1 provides the PRISMA flow diagram and further details regarding the study selection process and reasons for study exclusions. Appendix 2.2 presents the reasons for exclusion for each of the 55 excluded studies.

2.3.2 Study Characteristics

A detailed description of study characteristics is provided in Table 2.1. After being arranged alphabetically each study was assigned a number (column 1 of Table 2.1) which will be used while referring to the studies in this chapter. The publication dates of the studies ranged from 1993 (34)-2021 (16) spanning a period of 28 years. Twelve took place in USA (1,5,10,11,13,14,21,26,27,31,33,34), six in Brazil (3,20,22,23,25,28), three each in Australia (17,24,32) and India (2,12,16), two in Spain (8,9) and Belgium (5,35) and two in Germany (6,30), Romania (29), the Netherlands (4), Canada (19), United Kingdom (18), Japan (15) and South Africa (35). Twenty-seven studies employed a cross-sectional study design (1-14,16,17,19-25,28,29,31,33,34) while a pre-post design was used by four studies (15,26,27,30). A longitudinal design was used by one study (32). One study employed a qualitative study design (18) and one study was a Randomised Controlled Trial (35).

Fig 2.1 - PRISMA Flow Diagram illustrating the study selection process of the systematic review

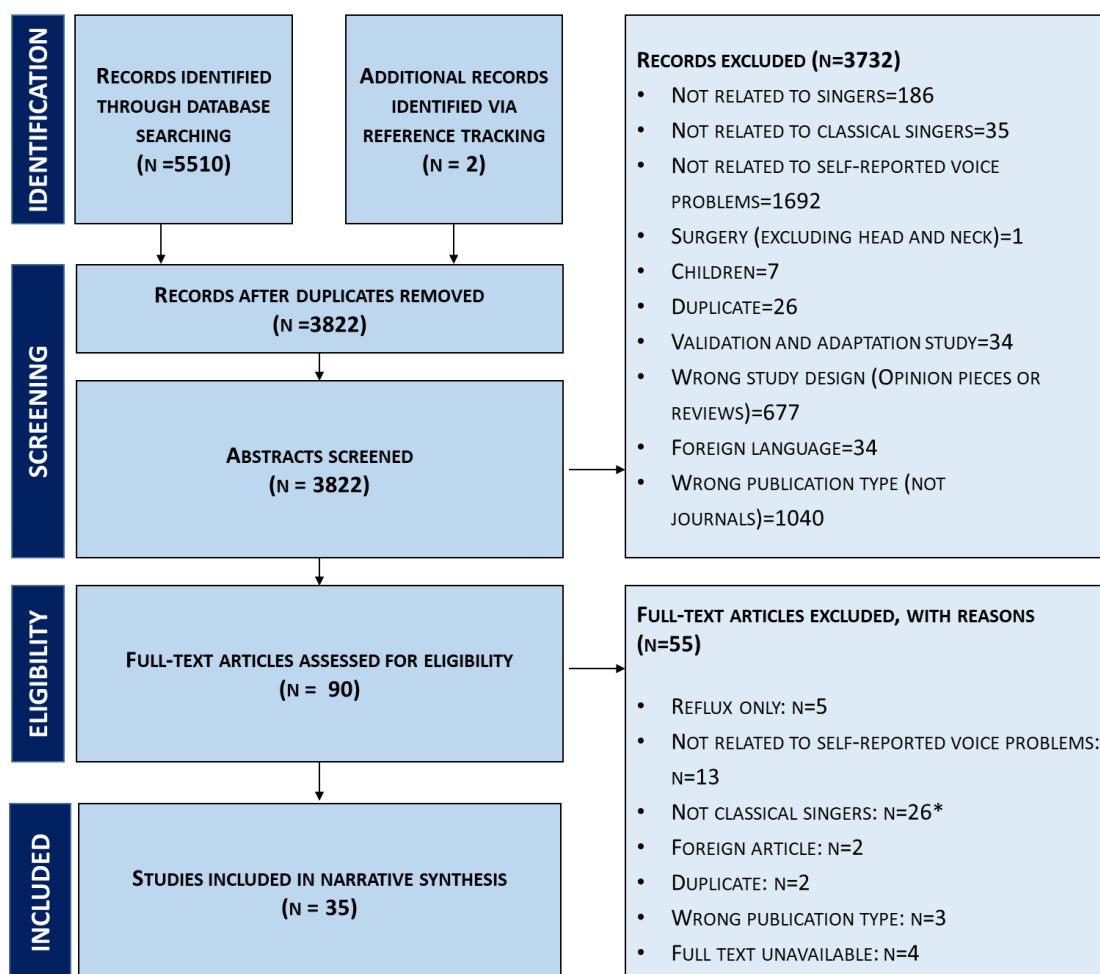


Fig 2.1: *includes n=11 studies where authors were contacted to ascertain whether their study population included Classical singers and no response was received.

2.3.3 Participant characteristics

A detailed description of participant characteristics is provided in Table 2.1. All studies included in the review involved classical singers. The total number of singers in the review were 1822. Three studies (15,24,31) employed non-singers as control groups totalling to 463. Twelve studies (10,13,15,17,20-24,27,30,31) employed singers from other genres as well; however only results pertaining to classical singers are reported here. The sample sizes ranged from two (33) to 407 (31). The mean age reported ranged from 22 years (1) to 50 years (14) and the age range, in the studies that reported it, was 11-85. Information pertaining to sex of classical singers was available in n=27 studies; there were 1117 female singers and 395 male singers.

The participants included classical singing students, singing teachers and performers, ranging from amateur to professional levels. The specific classical genres studied in this review were Western classical (n=5 studies), Opera (n=5 studies), Carnatic classical (n=2 studies), and classical choir (n=2 studies); Four studies involved classical singing students and one study involved classical singing teachers. The study by Karulkar et al (2021) employed Hindustani classical singers. Fifteen studies classified participants only as classical singers without providing any further details.

There was significant heterogeneity in the eligibility criteria across studies. Three studies included singers representing a particular singing style or genre (2,12,16), five studies recruited singers from a certain age group (4,12,19,24,35), three studies defined eligibility based on amount of singing (12,19,24). Six studies described eligibility in terms of professional experience (11,17,20,24,25,28) while two studies included singers who received an income from singing (24,31) Three studies included singers with a specific medical diagnosis or condition (6,8,9). Six studies recruited singers from a certain geographical location or establishment (1,3,28,29,32,34). Six studies mentioned exclusion of males in the eligibility criteria (11,25,26,33,34,35). Seven studies excluded singers with voice problems, surgeries or other medical conditions (7,8,9,19,21,28,35). Further details are presented in Appendix 2.3

2.3.4 Singing related characteristics

Eleven studies reported the vocal type of the singers in their study (3,4,9,11,14,20,21,25,29,32,34). Among the female voice types, the highest number of participants were classified as sopranos (n=85) whereas tenors (n=42) were most common among males. There was significant heterogeneity in the

reporting of singing related details such as experience, type of singing (solo/group singing), hours of singing and type and duration of training. Four studies (1,4,5,19) reported type of singing of which 185 were indicated to be solo performers. Eight studies reported the singing experience of participants (2,7,17,21,25,28,32,34). Of these, three studies (2,21,34) reported the mean (in years) experience of the participants, and their mean was 19.87 years. Two studies (17,32) reported the experience in range which extended from two years to 40 years, while three studies (7,25,28) reported it categorically using ranges in years. Average voice use was reported by seven studies (16,17,21,24,25,34,35). The mean of these studies (including performance, rehearsal and singing lessons) was 8.40 hours per week. Six studies (1,4,7,16,17,19,26,34) reported training related details of which four studies (4,17,19,34) reported details pertaining to university education. In these studies (total n=176) 134 singers had a relevant undergraduate degree and 41 had graduate degrees. All further details pertaining to singing and training characteristics is presented in Appendix 2.3

Table 2.1: Study and participant characteristics of studies included in the systematic review

Study no:	Study name	Study type	Country	Population	Sample size (n)	Sex		Age in years Mean (SD) Range As applicable
						M	F	
1.	Achey (2016)	Cross- sectional	USA	Classical singing students	104	35	69	Mean=22 Range=17-63
2.	Arunachalam (2014)	Cross-sectional	India	Carnatic singers	45	9	36	Mean=39.7 (13.43) Range=18-74
3.	Avila (2010)	Cross-sectional	Brazil	Opera singers	59	26	31	Mean=32.82 Range=20-75
4.	Berghs (2013)	Cross-sectional	NL	Classical choir	47	16	31	Range=21-60
5.	Boulet (1996)	Cross-sectional	Belgium	Western Classical singers	72	24	48	Range=40-74
6.	Caffier (2017)	Cross-sectional	Germany	Western Classical singers	24	NR	NR	Mean age (SD)=38 (12)
7.	Castelblanco (2014)	Cross-sectional	USA	Western Classical singers	47	NR	NR	Mean=31 Range=19-62
8.	Clarós (2018)	Retrospective review	Spain	Opera singers	250	124	121	Mean=38.54 Range=18-85
9.	Clarós (2019)	Retrospective review	Spain	Opera singers	18	2	16	Mean=28 Range=20-40
10.	Cohen (2008)	Cross-sectional	USA	Classical singers	61	24	37	Mean=38.7 Range=18-81
11.	Davis (1993)	Cross-sectional	USA	Classical singers	104	0	104	Range=21-42
12.	Devadas (2018)	Cross-sectional	India	Carnatic singers	190	41	149	Mean=38.1 (15.1) Range: 16-78
13.	Elliott (2017)	Cross-sectional	USA	Classical singers	80	0	80	Range*=47-79
14.	Heman-Ackah (2002)	Cross-sectional	USA	Singing teachers	20	3	17	Mean=50 Range=22-76
15.	Kaneko (2019)	Pre-post design	Japan	Classical singers	8 singers 8 non singers	4	4	Mean=64 Range=19-74
16.	Karulkar (2021)	Cross-sectional	India	Hindustani singers	61	13	48	Mean=37.8 (12.9) Range=18–68
17.	Kitch (1994)	Cross-sectional	Australia	Classical singers	10	2	8	Mean=29.8

Study no:	Study name	Study type	Country	Population	Sample size (n)	Sex		Age in years Mean (SD) Range As applicable
						M	F	
18.	Lă Filipa (2007)	Qualitative	UK	Classical singers	1	0	1	Participant's age=27
19.	Lam (2008)	Cross-sectional	Canada	Classical singers	8	0	8	Range=19-35
20.	Loiola-Barreiro (2016)	Cross-sectional	Brazil	Western Classical singers	58	29	29	Mean =31.8
21.	Lundy (1999)	Longitudinal	USA	Classical singing students	27*	Unav*	Unav*	Mean*=23.52 Range*= 18-39
22.	Moreti (2012)	Cross-sectional	Brazil	Western Classical singers	59	Unav*	Unav*	Mean=29.5
23.	Paoliello (2019)	Cross-sectional	Brazil	Classical singers	All genres=47 Classical=12	Unav*	Unav*	Mean=28.93
24.	Phyland (1999)	Cross-sectional	Australia	Opera singers	Opera=84	Unav*	Unav*	Mean=36.97 Range=18-72
25.	Prior (2020)	Cross-sectional	Brazil	Classical singers	55	0	55	Mean=37±11 years
26.	Ragan (2016)	Pre-post design	USA	Female classical singers	19	0	19	Mean=22.85 (3.54)
27.	Randolph (2015)	Pre-post design	USA	Classical singers	12	Unav*	Unav*	Mean*=44.8
28.	Rezende (2015)	Cross-sectional	Brazil	Classical choir	32	12	20	Range=20-60
29.	Rodica-Elena (2017)	Prospective Cross-sectional	Romania	Classical Canto students	40	16	24	Mean=20 Range=19-24
30.	Ropero (2018)	Cross-sectional	Germany	Classical singers	50	9	41	Range*=17-64 years
31.	Rosen (2000)	Cross-sectional	USA	Classical singers	Singers=38 Controls=369	NR	NR	Mean*=35 Range*=11-71
32.	Ryan (2009)	Longitudinal	Australia	Western Classical singers	27	6	21	Males Age range=19-29 Females Age Range=18-27
33.	Schloneger (2011)	Case study	USA	Opera singers	2	0	2	NR
34.	Sapir (1993)	Cross-sectional	USA	Classical singing students	74	0	74	Mean=20.5 (2.7) Range=18-31
35.	Vermeulen (2020)	Randomised pre post design	Belgium South Africa	Female classical singers	24	0	24	Mean=21.38 (2.6)

Table 2.1: *=Values are not pertaining to classical singers only and represents the entire study population-therefore includes other genres as well; Unav=Unavailable for classical singers only; NR=Not Reported; NA=Not Applicable; SD=Standard Deviation

2.3.5 Methodological quality

The cross-sectional studies, the RCT study and the qualitative study were assessed using the JBI tool designed specifically for these study designs. Since a critical appraisal tool specifically designed for longitudinal studies could not be found, the JBI cohort design tool was used for assessing the quality of the longitudinal study. The tool designed for Quasi-Experimental study designs was employed for studies with the pre-post design. Double coding was carried out for 25% of the included papers (n=8). The initial agreement between the reviewers was 83%. The items with disagreements were discussed between the raters and consensus was reached (100% agreement) for all items. Most of the studies were rated as fair in quality (n=16). The rest of the studies were rated either poor quality (n=8) or good quality (n=11). Table 2.2 describes the results of the quality assessment with individual item scores for the cross-sectional studies and Table 2.3 outlines the results for all other study designs.

2.3.6 Review objective 1: How are self-reported voice problems assessed in classical singers?

2.3.6.1 Objectives of included studies

Though all studies measured self-reported voice problems in classical singers, their objectives encompassed a range of research questions with 11 studies (1,3,5,10-12,17,20,25,32,34) exploring associations between self-reported voice problems and other factors (eg: age, gender, adherence to vocal hygiene, genre, COVID-19, etc.). A few studies (n=5) assessed the impact of specific factors, i.e., menopause/PMS (5,11,13,18,34) and surgery (n=3) (8,9,27) on the singing voice. Three studies evaluated the effectiveness of a therapy programme or voice care approach on the voice (15,26,35)

Table 2.2: Methodological quality assessment of cross-sectional studies included in the systematic review

	Inclusion criteria clearly defined	Subjects and setting described in detail	Exposure measurement valid & reliable	Objective, Standard criteria for measuring condition	Confounding factors identified	Strategies to deal with confounders stated	Outcome measurement valid & reliable	Appropriate statistical analysis	Total score	Total score %	Quality level
Achey (2016)	1	2	1	NA	1	0	2	2	9	64%	Fair
Arunachalam (2014)	1	2	NA	NA	NA	NA	2	2	7	88%	Good
Avila (2010)	0	1	NA	NA	NA	NA	2	2	5	63%	Fair
Berghs (2013)	1	1	NA	NA	NA	NA	1	2	5	63%	Fair
Boulet (1996)	1	2	NA	NA	NA	NA	2	2	7	88%	Good
Caffier (2017)	0	0	2	2	0	0	2	2	8	50%	Poor
Castelblanco (2014)	2	2	NA	NA	NA	NA	2	2	8	100%	Good
Clarós (2018)	2	1	NA	NA	NA	NA	2	0	5	63%	Fair
Clarós (2019)	2	2	NA	NA	NA	NA	2	0	6	75%	Fair
Cohen (2008)	0	1	NA	NA	NA	NA	2	2	5	63%	Fair
Davis (1993)	2	2	1	NA	0	0	1	1	7	50%	Poor
Devadas (2018)	2	2	NA	NA	NA	NA	2	2	8	100%	Good
Elliott (2017)	0	1	NA	NA	NA	NA	1	1	3	38%	Poor
Heman- Ackah (2002)	0	1	NA	NA	NA	NA	1	0	2	25%	Poor
Karulkar (2021)	1	1	NA	NA	NA	NA	2	2	6	75%	Fair
Kitch (1994)	2	1	1	1	1	0	2	2	10	63%	Fair
Lam (2007)	2	1	NA	NA	NA	NA	2	2	7	88%	Good
Loiola Barreiro (2016)	1	1	NA	NA	NA	NA	2	2	6	75%	Fair
Lundy (1999)	1	2	NA	NA	NA	NA	2	2	7	88%	Good
Moreti (2012)	0	1	NA	NA	NA	NA	2	1	4	50%	Poor
Paoliello (2019)	1	1	NA	NA	NA	NA	2	2	6	75%	Fair

	Inclusion criteria clearly defined	Subjects and setting described in detail	Exposure measurement valid & reliable	Objective, Standard criteria for measuring condition	Confounding factors identified	Strategies to deal with confounders stated	Outcome measurement valid & reliable	Appropriate statistical analysis	Total score	Total score %	Quality level
Phyland (1999)	2	1	NA	NA	NA	NA	2	2	7	88%	Good
Prior (2020)	2	2	NA	NA	NA	NA	2	2	8	100%	Good
Rezende (2015)	2	2	NA	NA	NA	NA	2	2	8	100%	Good
Rodica-Elena	1	2	NA	NA	NA	NA	2	2	7	88%	Good
Rosen (2000)	0	1	NA	NA	NA	NA	2	2	5	63%	Fair
Schloneger (2011)	1	2	NA	NA	NA	NA	2	2	7	88%	Good
Sapir (1993)	1	1	NA	NA	NA	NA	1	0	3	38%	Poor

Table 2.2: NA=Not Available

Table 2.3: Methodological quality assessment of all other study designs

LONGITUDINAL STUDY DESIGN	Ryan (2009)
Were the two groups similar and recruited from the same population?	1
Were the exposures measured similarly to assign people to both exposed and unexposed groups?	2
Was the exposure measured in a valid and reliable way?	1
Were confounding factors identified?	1
Were strategies to deal with confounding factors stated?	0
Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	2
Were the outcomes measured in a valid and reliable way?	1
Was the follow up time reported and sufficient to be long enough for outcomes to occur?	2
Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	1

Were strategies to address incomplete follow up utilized?	2			
Was appropriate statistical analysis used?	2			
Total score	15			
Total Score (%)	68			
Quality Level	Fair			
PRE-POST STUDY DESIGN	Kaneko (2019)	Randolph (2015)	Ragan (2015)	Ropero (2018)
Is it clear in the study what is the 'cause' and what is the 'effect'?	2	2	2	2
Were the participants included in any comparisons similar?	2	2	2	2
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	0	0	0	0
Was there a control group?	0	0	0	0
Were there multiple measurements of the outcome both pre and post the intervention/exposure?	2	2	2	2
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?	0	2	2	2
Were the outcomes of participants included in any comparisons measured in the same way?	2	2	2	2
Were outcomes measured in a reliable way?	2	2	2	2
Was appropriate statistical analysis used?	1	1	1	1
Total Score	11	11	11	11
Total Score (%)	61%	61%	61%	61%
Quality Level	Fair	Fair	Fair	Fair
QUALITATIVE STUDY DESIGN	Lă Filipa (2007)			
Is there congruity between the stated philosophical perspective and the research methodology?	1			
Is there congruity between the research methodology and the research question or objectives?	1			
Is there congruity between the research methodology and the methods used to collect data?	1			

Is there congruity between the research methodology and the representation and analysis of data?	0
Is there congruity between the research methodology and the interpretation of results?	0
Is there a statement locating the researcher culturally or theoretically?	0
Is the influence of the researcher on the research, and vice- versa, addressed?	0
Are participants, and their voices, adequately represented?	2
Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	2
Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	2
Total Score	9
Total Score (%)	45%
Quality Level	Poor
RCT	Vermulen (2020)
Was true randomization used for assignment of participants to treatment groups?	1
Was allocation to treatment groups concealed?	0
Were treatment groups similar at the baseline?	2
Were participants blind to treatment assignment?	0
Were those delivering treatment blind to treatment assignment?	0
Were outcomes assessors blind to treatment assignment?	1
Were treatment groups treated identically other than the intervention of interest?	2
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?	0
Were participants analysed in the groups to which they were randomised?	0
Were outcomes measured in the same way for treatment groups?	2
Were outcomes measured in a reliable way?	2
Was appropriate statistical analysis used?	2

Was the trial design appropriate for the topic, and any deviations from the standard RCT design accounted for in the conduct and analysis?	1
Total Score	13
Total Score (%)	50%
Quality Level	Poor

2.3.6.2 Data Collection methods and measures

All quantitative studies employed a questionnaire or a validated self-report measure. Twenty studies used a validated questionnaire (1,2,3,6,7,9,10,15,19,20,22,23,25-31,33,35) and 13 studies (4,5,8,11-14,16,17,21,24,32,34) developed a customised questionnaire to suit their objectives. Five studies (2,3,9,33,35) used a combination of validated and non-validated measures. One study (Lă Filipa, 2007) used semi-structured interviews to elicit qualitative data.

Seventeen studies (1,3,6,7,9,10,15,19,20,22,25-31,33) used validated measures related to vocal handicap. Measures used comprised the Classical Singing Handicap Index (3,20,22,25,28) (n=5), Singing Voice handicap Index (7,10,26,29,30,33) (n=6), Voice Handicap Index (19,27,20,31) (n=4), Singing voice Handicap Index-10 (1,15,29) (n=3) and Voice Handicap Index-10 (6,9,15) (n=3).

Other measures employed by studies were the Voice Symptom scale or VoiSS (23,28), the Voice Disorder Outcome Profile or V-DOP (2), the Evaluation of the Ability to Sing Easily or EASE (27) and Voice Fatigue Index or VFI (35).

The non-standardised instruments used by the studies in this review collected demographic information, singing related information, and details regarding voice use and lifestyle. Items on vocal symptoms were included by all the studies which employed non-standardised questionnaires. Other details collected were changes in voice, severity of voice problem and impact of voice problem.

2.3.7 Review objective 2: What is the type, nature, and frequency of self-reported voice problems in classical singers?

Since the studies included in the review used both validated and non-validated measures to assess voice, the results were synthesised separately for the two categories.

2.3.7.1 Results of validated measures

The Singing Voice Handicap Index (SVHI) was used by five studies (7,10,29,30,33). Of the five studies which used SVHI, two studies (29,33) reported the SVHI range scores which extended from zero to 72. Among the other three studies (7,10,30), there were discrepancies regarding the calculation of the score as Castelblanco et al (2014) calculated and reported the raw score (sum of scores), Cohen et al (2008) reported the scaled scores and the method used by Ropero et al (2018) was unclear. Therefore, no further syntheses of SVHI results could be performed.

The Voice Handicap Index was utilised by four studies in this review (19,27,31,30). Two studies (19,30) reported the total VHI scores and their combined mean and SD were 10.66 and 7.47 respectively. The Singing Voice Handicap Index-10 was used by three studies (1,15,29). Of these, two studies (1,15) reported the mean (SD) scores; their combined scores were 13.12 (7.58). The two studies (6,9,15) which used VHI-10 had a combined mean (SD) of 11.77 (5.69). All individual scores are provided in Table 2.5.

A single sample t test comparing the SVHI-10 and VHI-10 mean scores of classical singers (calculated in this review) to their respective normative score revealed a statistically significant difference for SVHI-10 (SVHI-10: $t=6.61$, $df=111$, $p=0.000$), but not for VHI-10 ($t=0.86$, $df=49$, $p=0.38$).

Table 2.4: Description of the validated measures (outcomes) reported in this review with their established normative scores.

Scale	Developers	Brief description	Scale	No: of items	Scoring	Normative-mean
Classical singing Handicap Index (CSHI)	Fussi (2005)	Evaluation of vocal handicap in classical singers	Five-point Likert scale (0-never, 1-almost never, 2-sometimes, 3-almost always, 4-always	30 items with 3 subscales (10 items each)- Impairment, Disability, Handicap	0-120 (each of the three subscales could yield a maximum of 40 points)	NA
Voice Handicap Index	Jacobson et al, (1997)	Evaluation of voice disability/handicap in patients with voice disorders	Five-point Likert scale (0-never, 1-almost never, 2-sometimes, 3-almost always, 4-always	30 items with 3 subscales (10 items each)-Physical, Functional and Emotional	0-120 (each of the three subscales could yield a maximum of 40 points)	NA
Singing Voice Handicap Index	Cohen et al (2007)	Evaluation of voice disability/handicap in singers with voice disorders	Five-point Likert scale (0-never, 1-almost never, 2-sometimes, 3-almost always, 4-always	36 items	0-144	20.35 (Sobol et al, 2019)
Voice Handicap Index-10	Rosen et al (2004)	Shortened version of VHI to assess vocal handicap	Five-point Likert scale (0-never, 1-almost never, 2-sometimes, 3-almost always, 4-always	10 items	0-40	>11 is abnormal (Arffa et al, 2012)
Singing Voice Handicap Index-10	Cohen et al (2009)	Shortened version of SVHI to assess vocal handicap in singers	Five-point Likert scale (0-never, 1-almost never, 2-sometimes, 3-almost always, 4-always	10 items	0-40	8.38 (Sobol et al, 2020)
Evaluation of Ability to Sing Easily	Phyland et al (2013)	Assess singers' perception of singing voice following a performance	Four-point Likert scale (0-not at all, 1-mildly, 2-moderately, 3-extremely	20 items with 2 factors (10 items each)-Factor 1 and Factor 2	Total score=0-60 (each of the two subscales could	NA

Scale	Developers	Brief description	Scale	No: of items	Scoring	Normative-mean
					yield a maximum of 30 points	
Voice Symptom Scale	Deary et al (2003)	Evaluate self-reported vocal symptoms	Five-point Likert scale (1-never, 2-occasionally, 3-some of the time, 4-most of the time, 5-all of the time.	44 items with 5 factors-Communication problems, throat infection, psychosocial distress, voice sound and variability and phlegm	Total score-44-220	NA
Voice Disorder Outcome Profile	Konnai et al (2010)	Scale developed in India to assess culture-specific quality of life in patients with voice disorders	100 mm Visual Analogue Scale	32 items with 3 subscales-physical (10 items), emotional (10 items) and functional (12 items)	Total score=0-300 (each subscale could have scores ranging from 0-100)	Zero
Vocal Fatigue Index	Nanjundeswaran (2014)	Identify individuals with vocal fatigue	Five-point Likert scale (0-never, 1-almost never, 2-sometimes, 3-almost always, 4-always)	19 items with 3 factors-Tiredness of voice and avoidance with voice use (11 items), physical discomfort associated with voicing (5 items), improvement of symptoms with rest (3 items)	Total score range=0-76 Subscale 1 score range=0-44 Subscale 2 range=0-20 Subscale 3 range=0-12	Subscale 1: 5.16 (4.58) Subscale 2: 1.44 (1.92) Subscale 3: 5.8 (4.05)

Table 2.4: NA= Not available

Table 2.5: Synthesis of objectives, measures and outcomes of the systematic review on self-reported voice problems

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
Achey (2016)	1. Explore the relationship between self-reported vocal hygiene practice and self-reported vocal health	1. The Vocal Hygiene Index 2. SVHI-10	NA	1. Mean SVHI-10 (SD, range) =12 (6.1, 0 to 29) a. 41 (39%) had an SVHI-10 score >14, indicating possible vocal problems. b. 4 (3.8%) had scores >21.5, the mean value for dysphonic singers in the original validation study.	Conservatory classical students report a moderately elevated degree of vocal handicap
Arunachalam (2014)	1. Report the nature of voice problems in Carnatic singers	1. Voice Disability Outcome Profile-V-DOP 2. Non validated Questionnaire	Subjective vocal symptoms-% and (avg. duration-months) 1. Change in voice=42.2% (2.5) 2. Difficulty in singing higher pitches=35.5% (2) 3. Difficulty in reaching lower pitches=31.1% (1.5) 4. Discomfort and pain while singing =26.7% (2) 5. Difficulty in sustaining voice for a long duration=22.2% (3) 6. Throat tightness and strain=22.2% (2) 7. Dryness of throat and vocal fatigue =20% (6) Range of duration of symptoms =1.5 to 6 months	I. V-DOP overall severity=5.1/10 II. Individual domain scores-mean and (SD) 1. Severity=5.1 (2.7) 2. Physical=40.4 (21.5) 3. Emotional=39 (23.1) 4. Functional=31 (24.2) 5. Total=110.24 (73.20)	1. Symptoms commonly reported by singers were profiled. 2. V-DOP revealed self-perceived severity in overall voice quality.
Avila (2010)	1. Determine which handicaps are produced by a vocal problem	1. Classical Singing Handicap Index (CSHI) 2. Non validated Questionnaire	1. Presence of vocal complaint-n (%) a. Singers with at least 1 vocal complaint=17 (27.86%) b. Singers with no vocal complaints/less than 2 vocal symptoms=42 (72.18%)	(I) CSHI scores of groups with and without complaints: Mean and [SD] 1. Disability Group without VC=2.83 [2.7] Group with VC=11.71 [6.43] p value: 0.044* Combined: 5.39 [5.74] 2. Handicap	1. The vocal symptoms experienced by operatic singers are presented

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
			2. Only 36.36% of participants from the group without vocal complaints reported symptoms a. Fatigue (22.72%) b. itch (6.81%) 4. All participants from the group with vocal complaints reported symptoms: a. Tiredness (76.47%) b. Dryness (41.17%) c. Pain (35.29%)	Group without VC: 1.62 [2.52] Group with VC: 7.59 [6.29] Combined: 3.34 [4.78] 3. Impairment Group without VC: 4.14 [3.94] Group with VC: 11.94 [6.15] Combined: 6.39 [5.84] 4. Total score Group without VC: 8.6 [6.94] Group with VC: 31.24 [17.47] Combined: 15.12 [15.01]	
Berghs (2013)	1. Investigate to what extent easily obtainable voice parameters were age-related	Non validated Questionnaire	Negative developments in singing over the years like more vocal fatigue and limitations in the higher notes: n=21 (44%)	NA	Vocal fatigue and difficulties singing higher notes are reported in relation to age.
Boulet (1996)	1. Determine whether women experience voice changes at around the time of menopause	Non validated Questionnaire	1. Respondents' perceptions regarding voice changes around age 50: % and (n) a. Voice generally changes: Women: 77% (37) Men: 71% (17) b. Voice does not change: Women: 15% (7) Men: 17% (4) c. Do not know/No opinion: Women: 8% (4) Men: 13% (3) 2. Types of voice changes associated with fifth decade of life-% and (n) a. Husky: Women: 25% (9) Men: 6% (1) b. Loss of top notes: Women: 69% (25) Men: 47% (8) c. Change in timbre:	NA	The indicated voice problems occur more typically in women than in men (not statistically determined)

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
			Women: 44% (16) Men: 47% (8) d. Less supple vocal cords: Women: 72% (26) Men: 47% (8) e. Voice less steady: Women: 36% (13) Men: 24% (4)		
Caffier (2017)	Quantify results after phono microsurgery for nodules in professional voice users	VHI-10	NA	VHI scores Mean (SD)=16 (7)	Singers with vocal nodules indicate elevated levels of vocal handicap
Castelblanco (2014)	Correlate SVHI results with videostroboscopy findings of healthy professional singers.	1. SVHI	NA	SVHI scores a. Mean (SD)=22.4 (16.33) b. Range= 0 to 72 c. The standard deviation in the SVHI total scores (by individual) was 16.33.	The SVHI scores were as expected from healthy classical singers
Clarós (2018)	Evaluate the impact of arytenoid asymmetry on the voice	Non validated Questionnaire	Symptoms related to arytenoid asymmetry 1. occasional dysphonia: (n=4%) 2. pharyngeal dryness:(n=2%) 3. vocal fatigue (n=2%)	NA	Arytenoid asymmetry does not correlate with vocal symptoms
Clarós (2019)	Identify the effect of rhinoplasty on professional opera singers' perception of their voice.	1. VHI-10 (Spanish) 2. Non validated Questionnaire	a. Hyponasal character prior to surgery: n=5 (27.7%)-normalised post-surgery	VHI-10 scores before and after surgery-Mean and [SD] a. Before surgery: 5.3 [2.6] b. After surgery: 5 [1.2]	1. 27.7% of singers perceived hypernasality prior to surgery. 2. VHI-10 score did not show a significant change pre and post-surgery.

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
Cohen (2008)	Examine potential predictors of perceived voice handicap among singers.	SVHI	NA	SVHI SCORES Mean 39.2, SD 19.2	Singers experienced impaired voice handicap as a result of their voice problem
Davis (1993)	Evaluate vocal changes associated with Pre menstrual Syndrome (PMS) experienced by trained female singers.	Non validated Questionnaire	1. 8 most cited vocal symptoms in descending order a. Difficulty singing high notes b. Flexibility impairment c. Husky quality d. Fuzzy quality e. Decreased volume f. Breathy quality g. Difficulty bridging the passaggio(s) h. Intonation problems. 2. The average singer had experienced 3 vocal symptoms of PMS. a. Frequency- "sometimes" b. Degree of life disruption-"moderate"	NA	1. Vocal symptoms may manifest as a result of PMS. 2. Some singers' personal and professional lives have been disrupted by the effects of PMS
Devadas (2018)	Determine the current and past prevalence and nature of VPs, vocal symptoms and variables that may be associated with increased risk of voice problems in	Non validated Questionnaire	1. Self-reported voice problems in Carnatic singers (descending order of frequency) a. Vocal fatigue b. Trouble reaching higher notes c. Change in voice quality d. Reduced pitch range e. Discomfort in the throat f. Effortful production of voice g. Loss of vocal endurance h. Dryness in throat i. Hoarseness in higher pitch range j. Trouble singing loudly k. Difficulty in register transition	NA	1. Carnatic singers are at risk of developing voice problems 2. Most singers reported multiple vocal symptoms with vocal fatigue, trouble reaching higher notes,

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
	Carnatic singers.		l. Tightness in throat m. Reduced breath support n. Momentary loss of voice o. Pain in throat p. Frequent coughing q. Complete loss of voice 2. Career Prevalence=35.26% 3. Point prevalence=22.6% 3.) Nature of VP a. static: 76.1% (n=51) b. progressive: 23.9% (n=16) 3. Onset of VP a. sudden: 40.3% (n = 27) b. gradual: 59.7% (n = 40)		change in voice quality, reduced pitch range and discomfort in the throat being most prevalent.
Elliott (2017)	Examine voice changes of singers going through menopause	Non validated Questionnaire	I. Most common vocal changes post menopause a. Flexibility: n=78.90% b. Colour: n= 70.09% c. Power: n=79.44% d. Stiffness: n=71.15 e. Upper passaggio: n=75.00 f. Vibrato: n=71.70 II. How long after you stopped menstruating did you notice vocal changes? n(%) 1. 1-3 months: 16 (17%) 2. 3-6 months: 16 (17%) 3. 6-12 months: 13 (14%) 4. 1-3 years: 26 (27%) 5. 3-5 years: 11 (11%) 6. Longer: 14 (15%) 7. Total: 96 (100%)	NA	1. Many female singers experience voice changes as they transition through menopause. 2. Symptoms include decreased range, strength flexibility, vibrancy and endurance, changes to vibrato and sound quality.

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
Heman-Ackah (2002)	1. Examine the incidence of laryngeal pathology among singing teachers.	Non validated Questionnaire	1. Vocal complaints (n=4) a. Volunteer 1: Hoarse, Fatigue, Trouble with soft phonation and high range b. Volunteer 2: Trouble with high range c. Volunteer 3: Fatigue, Trouble with low range d. Volunteer 4: Fatigue, trouble with high range 2. Technical complaints of volunteers a. Volunteer 5 Fatigue, Trouble with soft phonation b. Volunteer 6 trouble with soft phonation c. Volunteer 7 Trouble with register transition	NA	Singers complained of a variety of vocal issues pertaining to fatigue, range, volume and voice quality.
Kaneko (2019)	Evaluate vocal tract function and voice quality in singers and nonsingers with dysphonia after SOVTE.	VHI-10 SVHI-10	NA	VHI-10 Mean and SD=14 (± 10) CI: 20.9-7.2 SVHI-10 Mean and SD=27.8 (± 10) CI: 34.7-20.8	1. Baseline scores showed an increased level of vocal handicap
Karulkar (2021)	Profile voice-related complaints and vocal and non-vocal habits among Hindustani classical singers	Non validated Questionnaire	1. Vocal symptoms in descending order of frequency a. Out of breath while singing=46 b. Feeling tired after singing=37 c. Tension=36 d. Feeling tired after talking=29 e. Loss of voice=23 f. Out of breath while talking=15	NA	Vocal symptoms reported by Hindustani singers are reported with the most common symptom being out of breath

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
			2. Singers reporting at least three vocal symptoms-41%		while singing and vocal fatigue
Kitch (1994)	Delineate performers' perceptual experiences during an episode of vocal in singers	Non validated Questionnaire	1. Percentage of singers with voices moderately to severely affected when experiencing vocal fatigue (up to 50% freq.) a. Pitch range=90% b. Optimal Quality: 80% c. Hoarseness: 70% d. Pitch flexibility: 60% e. degree of pushing voice: 60% f. brightness: 60% g. Constriction while sustaining: 60% h: Pitch note: 60% i: Place voice: 60% j: Energy levels: 50% k: Constriction while singing: 50% l: Sustain long notes: 50% m: Sustain long phrases: 50% n: Tone termination: 50% o: fine adjustment in loudness: 50% p: Loudness range: 50%	NA	1. A large percentage of singers experience vocal fatigue 2. Vocal fatigue causes changes in various vocal attributes
Lă Filipa (2007)	1. Examine impact of menstrual cycle and oral contraceptives on voice	NA	Analysed using thematic analysis: Vocal issues described: Less focussed; less 'bright' voice; heaviness creating difficulties singing staccatos; less vocal flexibility; reduced vocal support; increased muscle tension; singing high notes; long sustained phrases; less vocal control during menstrual cycle	NA	Hormonal variations affected physiological and psychological aspects of the singer's performance
Lam (2008)	Examine laryngeal and respiratory behaviour during tasks that required pitch	VHI	NA	Combined VHI scores of participants who showed a static pitch variation pattern (n=4) and a dynamic pattern (n=4) VHI Functional: 4.25 (3.24) VHI Physical: 3.84 (1.79)	Participants did not demonstrate a significant handicap in their total scores.

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
	modifications in professional singers.			VHI Emotional: 0.96 (1.08) VHI Total 9.06 (4.14)	
Loiola-Barreiro (2016)	Compare the voice handicap index of popular and erudite professional singers according to gender, age, professional experience time, and presence or absence of self-reported vocal complaints.	Classical Singing Handicap Index (CSHI)	NA	I. Descriptive analysis of CSHI Mean (SD) 1. Without complaint (N=44) A. Total score=12.7 (14.5) B: Disability=4.5 (5.2) C: Handicap=3.3 (4.1) D: Impairment=4.9 (6.0) 2. With complaint (N=14) A. Total score=43.5 (25.0) B: Disability=14.9 (8.1) C: Handicap=12.2 (8.1) D: Impairment=16.4 (9.3) II. p values comparing groups with and without vocal complaint (Mann Whitney U test) a. Disability, Handicap, impairment and Total score: $p < 0.001$	Significant differences were observed in all domains between singers with and without vocal complaints
Lundy (1999)	Investigate the incidence of laryngeal abnormalities in asymptomatic singing students.	Non validated Questionnaire	1. History of vocal symptoms-Frequency (%) a. Hoarseness: 48 (84.2) b. Breathiness: 22 (38.6) c. Volume difficulties: 14 (24.6) d. Pitch range: 28 (49.1) e. Voice worse in morning: 29 (50.9) f. Voice worse in evening: 12 (21.1) g. Throat clearing: 21 (36.8)	NA	Vocal symptoms were reported by asymptomatic singing students
Moreti (2012)	Investigate whether there are differences	CSHI	NA	I. CSHI mean (SD) scores 1. Classical singers with vocal complaints (n=17)	1. Highest scores were reported for Impairment,

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
	between popular and classical singing styles			A. Disability=11.7 (6.4) B. Handicap=7.6 (6.3) C. Impairment=11.9 (6.1) D. Total=31.2 (17.5) 2. Classical singers without vocal complaints (n=42) A. Disability=2.7 (2.7) B. Handicap=1.6 (2.5) C. Impairment=4.1 (3.9) D. Total=8.6 (6.9)	followed by disability and handicap. 2. Higher scores were observed in Classical singers with vocal complaint
Paoliello (2019)	Identify relationship between vocal symptoms and auditory processing skills	1. VoiSS	NA	Mean value of VoiSS score=20.5	The VoiSS scores of classical singers are slightly elevated (normative <15.5)
Phyland (1999)	Determine the prevalence of vocal impairment, disability and handicap in three groups of singers and a friendship-matched group of non-singers.	Non validated Questionnaire	I. Vocal Impairment: 1. Frequency of Symptoms of Vocal Impairment: n (%) a. Hoarseness: n=193 (75.1%) b. Voice-fatigue: n=178 (69.3%) c. Tickling/choking sensation while speaking: n=138 (53.6%) d. Pain in throat: n=135 (52.5%) e. Change in pitch of speaking voice: n=114 (44.3%) f. Difficulty with volume/projection: n=90 (35%) g. Lump in throat feeling while speaking: n=73 (28.4%) h. Strained or strangled voice: n=73 (28.4%) i. Voice breaks or stops when talking: n=71 (27.6%)	NA	1. Singers reported significantly higher prevalence rates of vocal disability and of diagnosed vocal conditions than non-singers. 2. Opera singers reported high prevalence rates of vocal disability and handicap

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
			j. Complete loss of voice: n=30 (11.6%) 2. The mean number of symptoms reported by the Opera group=6.33 II. Vocal Disability 1. Number of opera singers experiencing voice problems over past 12 months=67.1%		
Prior (2020)	Verify the impact of vocal deviation in the quality of life of classical female singers over the quarantine imposed by the COVID-19 pandemic	CSHI	NA	I. Distribution and comparison (using Friedman's test) between the average scores obtained in the CSHI protocol 1. Disability a. Mean (SD): 17.5(9.2) 2. Handicap a. Mean (SD): 15.9 (8.7) 3. Impairment a. Mean (SD): 14.2(10.0) 4. Total a. Mean (SD): 47.7 (25.2)	1. Singers maintained a standard of vocal quality and reported reduced vocal handicap despite social isolation.
Ragan (2016)	Determine impact of vocal cooldown on perception of vocal health	SVHI	NA	Mean SVHI score= 22.75	Singers experienced elevated levels of vocal handicap
Randolph (2015)	Examine subjective and objective voice recovery following neural	VHI EASE	NA	VHI (mean) Physical=4.63 Functional=3.37 Emotional=3.26 Total=4.15 SVHI (mean)=11.26	1. No handicap reported by singers

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
	monitored thyroid surgery			EASE (mean) Total score=6.19 Subscale 1=3.93 Subscale 2=2.63	
Rezende (2015)	Compare the voice handicap index with the propensity to dysphonia among choral singers	1. CSHI 2. VoiSS (Brazilian Portuguese)	NA	CSHI scores: Impairment=28.75% Disability=15.79% Handicap=12.27% VoiSS scores Physical=25.23% Activity limitation=19.64 Emotional=6.84%	Impairment subscale of CSHI and Physical subscale of the VoiSS showed elevated scores.
Rodica-Elena (2017)	Evaluate accuracy of SVHI and SVHI-10 in identifying vocal problems in professional singers.	1. SVHI 2. SVHI-10	NA	1. SVHI a. Mean: 17.81 b. Min-Max score: 9-45 2. SVHI-10 a. Mean: 5.93 b. Min-Max scores: 1-12	1. SVHI scores are as expected for healthy singers.
Ropero (2018)	Evaluate outcomes of voice therapy or phono microsurgery	1. VHI 2. SVHI	NA	1. Patients' subjective self-assessment of their own voice= mild to moderate impairment a. VHI=11 ± 8 b. SVHI=70 ± 29	Elevated SVHI scores were reported by singers
Rosen (2000)	Compare the VHI in singers and non singers with voice disorders.	VHI	NA	1. Total VHI score for classical singers=29.8 2. Total VHI score for non-singers=53.2	1. Classical singers had lower VHI scores than non-singers.
Ryan (2009)	Investigate the perceived effects of the female	Non validated Questionnaire	I. Marginal Mean Values for Voice Quality in Males and Females 1. Gender effect A. Peak form mean- (SE)	NA	1. There was a significant difference in 'peak form' and

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
	hormonal cycle on young female classical singers		a. Males: 6.8 (0.3) b. Females: 5.4 (0.2) c. p value=<0.0001 B. Weak- mean (SE) a. Males: 7.0 (0.4) b. Females: 6.2 (0.2) c. Difference (CI): 0.8 (-0.1, 1.6) C. Sluggish-mean (SE) a. Males: 7.0 (0.4) b. Females: 6.2 (0.2) c. Difference (CI): 0.8 (-0.1, 1.6) p value for weak and sluggish voice=0.07 2. Cycle effect A. Fatigued- mean (SE) c. p value=0.004 B: Effort-Mean (SE) c. p value=0.03		marginal significance in 'weak and sluggish voice' between males and females. 2. Voice quality was significantly low during days 24-4 compared to days 5-23
Schloneger (2011)	Document graduate voice students' voice use before, during, and after an intense week of opera rehearsals	1. SVHI 2. Non validated Questionnaire	1. I am doing a good job taking care of my voice today: a. Mean score during baseline period=Case 1: 5.0; Case 2: 6.75 2. Overall scores a. Pre-baseline days= Case 1: 2.22; Case 2: 1.50 3. Today, my voice feels tired a. Intensive week=Case 1: 3.6; Case 2: 5.6 b. Postbaseline days=Case 1: 7; Case 2: 3	1. Case 1 a. SVHI range: 5.6-7.6 2. Case 2 a. SVHI range: 2.1-2.8	Both singers remained vocally healthy, throughout the opera production/study periods
Sapir (1993)	Survey the symptoms of vocal attrition (reduction in vocal function due to	Non validated Questionnaire	I. Prevalence of symptoms 1. Free of symptoms: n=10 (13%) 2. Few (one or two) n=19 (26%) 3. Multiple (three or more) symptoms: n=45 (61%)	NA	1. Vocal attrition is prevalent among voice students.

Study name	Objectives	Voice measures	Self-reported voice problems-non-validated measures	Self-reported voice problems-validated measures	Key conclusions
	behavioural, biological l or psychosomatic factors) and possible factors contributing to it		II. Frequency of symptoms 1. Dryness of the throat: (81%) 2. Throat tightness: (66%) 3. Vocal fatigue (64%) 4. Throat discomfort (58%) 5. Hoarseness (48%) 6. Reduced pitch range (36%) 7. Pain in the throat (19%)		2 Some students indicated that they experience problems or changes in their voice prior to or during menstruation
Vermulen (2020)	Describe the effect of superficial hydration and systemic hydration, on voice quality and vocal fatigue	1. Voice Fatigue Index (VFI) 2. Non validated Questionnaire	87.5% (n = 21) reported a negative change in their voices after rehearsals 1. breathiness (n = 6) 2. Painful voice production (n = 2) 3. Grade of voice disorder (n = 12) 4. Roughness (n = 5) 5. Loss of voice (n = 3) 6. Generally softer voice (n = 7) 7. Weaker voice on certain pitch levels (n=5)	VFI: Mean (SD) Factor 1=Tiredness of voice: 21.83 (9.13) Factor 2=7.5 (4.49) Factor 3=9.62 (1.68)	Use of superficial hydration resulted in positive outcomes of perceptual parameters of voice quality and symptoms of vocal fatigue in future female professional singers.
Table 2.5: SVHI: Singing Voice Handicap Index; SVHI-10: Singing Voice Handicap Index-10; VHI: Voice Handicap Index; VoISS: Voice Symptom Scale; CSHI: Classical Singing Handicap Index; V-DOP: Voice Disorder Outcome Profile; EASE: Evaluation of Ability to Sing Easily; VAS: Visual Analogue Scale; SD: Standard Deviation; NA: Not Applicable; NR: Not Reported; VC: Vocal complaints					

The Classical Singing Handicap Index (CSHI, Fussi, 2005) was used by five Brazilian studies (3,20,22,25,28). The CSHI assesses voice across 3 subscales which are disability, impairment, and handicap. Additionally, it also enables the calculation of a total composite score. Three studies (3,20,22) reported the mean and Standard Deviation (SD) of the various subscales of CSHI separately for singers with and without voice problems. These results were combined using the following formula described by Altman et al (2000)

Combined mean = tx / tn

Combine SD = $\sqrt{((txx-tx^2/tn) / (tn-1))}$

Where tn = sum of all (n); tx = sum of all Σx ; txx = sum of all Σx^2

The calculation involves decomposition of means and SD which was carried out using a Javascript program (www.statstodo.com). These values are presented in Table 2.6. Additionally, the scores were also presented for all classical singers (which included singers with and without voice problems) by three studies (3,25,28). For the two studies which did not provide the CSHI score for all classical singers (combined score for the entire cohort including both singers with and without voice problems), it was calculated by combining the means of singers with and without voice problems. Combined scores for all five studies were then calculated using the formula described earlier and are also presented in Table 2.6. The impairment subscale had the highest score followed by the disability and handicap subscales.

Table 2.6: Combined means and Standard Deviations of the subscales of the Classical Singing Handicap Index (CSHI, n=5 studies)

	Impairment Mean (SD)	Disability Mean (SD)	Handicap Mean (SD)	Total score Mean (SD)
With voice problems (n=83)	13.22 [7.34]	12.63 [6.94]	8.93 [7.04]	34.80 [20.29]
Without voice problems (n=128)	4.38 [4.71]	3.36 [3.81]	2.19 [3.22]	10.0 [10.29]
All classical singers (n=231)	8.57 [8.28]	8.68 [8.66]	6.85 [8.13]	24.13 [23.75]
<i>Table 2.6: SD=Standard Deviation</i>				

Only two studies (23,28) used the Voice Symptom scale (VoiSS). However, the combined scores could not be calculated since Rezende et al (2015) reported the results in terms of percentage (to identify which subscale was reported the most among the participants) rather than mean and SD scores. Arunachalam et al (2014) used the VDOP to assess self-reported vocal function and reported

that singers obtained a score of 5.1 (SD=2.7). The Voice Fatigue Index (VFI) and the Evaluation of Ability to Sing Easily (EASE) were used by one study each. The VFI provides scores across three factors and the mean (SD) scores reported by Vermulen et al (2020) for factor 1, 2 and 3 were 21.83 (9.13), 7.5 (4.49) and 9.62 (1.68) respectively. Randolph et al (2015) reported the total EASE scores to be 6.19, the factor scores are outlined in Table 2.5 (refer to Table 2.4 for normative of the validated measures).

2.3.7.2 Synthesis of results of other measures

Seventeen studies utilised a self-developed or customised measure. Looking at the questions/content of each measure and their results, four themes emerged, which are described below.

2.3.7.2.1 Vocal symptoms

A total of 42 symptoms were reported across the studies included in this review which are presented in Figure 2.2. An arbitrary number of 1 was assigned to the symptom which was most frequently reported in a study; the second frequently occurring symptom was assigned 2 and so on till all the symptoms were represented. The number of studies which assigned this rank to a symptom was represented in brackets. The symptom which was reported to be most frequent (which was assigned a score of 1) across studies (n=7) was vocal fatigue, followed by difficulty reaching higher pitches (n=3) and dysphonia and hoarseness (n=2). Difficulty reaching higher pitches was reported to be the second most frequent symptom (which was assigned a score of 2) by four studies followed by dryness, which was reported by two studies. Similarly, two studies each reported change in voice/dysphonia and difficulty reaching lower pitches as their third most frequent symptom (which was assigned a score of 3).

Vocal fatigue was also reported across the greatest number of studies in this review (n=12), followed by difficulty reaching higher pitches which was reported by seven studies. Change in voice/dysphonia, laryngeal pain, transitioning between registers and vocal dryness were reported by five studies each. Reduced breath support/out of breath while singing/talking and complete loss of voice was reported by two studies each. Many symptoms such as changes in nasality, brightness, breathiness, intonation, laryngeal itching, tickling sensation, throat clearing, frequent coughing, vocal strain, wobble in voice, difficulties with vibrato, loss of form, colour, difficulty sustaining notes, tone termination and onset, singing accuracy and singing stressed/unstressed notes were reported only by one of the studies.

Fig 2.2: Synthesis of vocal symptoms reported across studies with ranking from most frequent to least frequent

Pitch Related	Difficulty reaching higher pitches	Difficulty reaching lower pitches	Reduced pitch range				
	1(3), 2(4)	3(2)	1(1), 4(2), 6(1)				
Loudness Related	Difficulty singing loudly	Difficulty singing softly	Reduced loudness range	Making fine adjustments			
	5(1), 6(1), 10(1)	3(1)	3(1), 13(1)	12(1)			
Vocal Effort	Increased vocal effort	Tightness / Tension	Strain	Vocal fatigue			
	1(1), 4(1), 6(1)	2(1), 3(1), 6(1), 12(1)	8(1)	1(7), 2(3), 3(1), 6(1)			
Singing Related 2	Sustaining notes	Tone termination	Singing accuracy	Stressed / Unstressed notes	Tone onset		
	5(1)	11(1)	8(1)	15(1)	16(1)		
Change in Voice quality/ Resonance	Change in voice quality / Dysphonia	Husky	Hoarseness	Nasality	Brightness	Breathiness	
	1(2), 2(1), 3(2)	2(1), 3(1)	1(2), 3(1), 5(1)	1(1)	6(1)	2(1), 17(1)	
Singing Related 1	Transitioning between registers	Intonation	Wobble in voice	Vibrato	Loss of form	Colour	
	3(1), 4(1), 5(1), 11(1), 14(1)	6(1)	4(1)	5(1)	1(1)	2(1)	
Vocal Discomfort	Pain	Dryness	Throat clearing	Lump in throat	Tickling	Itch	Frequent coughing
	3(1), 4(3), 5(1)	1(1), 2(2), 7(1), 8(1)	7(1)	7(2)	3(1)	4(1)	15(1)
Other	Momentary loss of voice	Complete loss of voice	Out of breath while singing	Problems with speaking voice	Voice worse in the morning	Voice worse in the evening	Weak voice
	14(1)	5(1), 16(1)	1(1), 13(1)	4(1), 5(1)	5(1)	6(1)	1(1)

Fig 2.2: The ranking is depicted first (1=most frequent) followed by the number of studies reporting it in brackets (). Singing related symptoms have been split across two rows for ease of representation

To further synthesise these results and ascertain the frequency of the symptoms across studies, an equation was developed to calculate a weighted score using the following steps:

- a. The ranks assigned to symptoms (described in the first paragraph of this section) were scored in a descending fashion where a score of 17 was given to rank 1, 16 for rank 2 and so on
- b. This value was then multiplied by the number of studies that reported the symptom to get a composite score for each symptom.

An illustration is provided below:

For instance, reduced pitch range was reported in this review as follows:

Rank 1 (score of 17): n=1

Rank 4 (Score of 14): n=2

Rank 6 (Score of 12): n=1

So the weighted score for “reduced pitch range” was $(17*1)+(14*2)+(12*1)=57$

The weighted score was calculated similarly for all the symptoms which were then arranged in descending order to identify the most frequently occurring symptom. These scores are presented in descending order in Table 2.7.

Table 2.7: Weighted scores of the 41 symptoms identified in the present review

Vocal symptom	Weighted score
Vocal fatigue	194
Difficulty reaching higher pitches	115
Change in voice quality/dysphonia	80
Pain	70
Dryness	70
Hoarseness	62
Reduced pitch range	57
Tightness/tension	49
Transitioning between registers	43
Increased vocal effort	43
Difficulty singing loudly	33
Husky	31
Difficulty reaching lower pitches	30
Problems with speaking voice	27
Out of breath while singing	22
Lump in throat	22

Vocal symptom	Weighted score
Reduced loudness range	20
Nasality	17
Breathiness	17
Weak voice	17
Loss of form	17
Colour	16
Difficulty singing softly	15
Complete loss of voice	15
Tickling	15
Wobble in voice	14
Itch	14
Voice worse in the morning	13
Vibrato	13
Sustaining notes	13
Brightness	12
Voice worse in the evening	12
Intonation	12
Throat clearing	11
Singing accuracy	10
Strain	10
Tone termination	7
Making fine adjustments	6
Momentary loss of voice	4
Stressed/unstressed notes	3
Frequent coughing	3

Following the calculation of the weighted score, the most frequent symptom was vocal fatigue followed by difficulty in reaching higher pitches and change in voice quality. The 10 most frequently reported symptoms in this review are illustrated in Figure 2.3.

Additionally, an attempt was made to group the symptoms into categories, to enable efficient synthesis of the data. This is presented in Table 2.8. The categories were change in voice quality, symptoms related to pitch, symptoms related to loudness, vocal tract discomfort, vocal effort, singing related symptoms and other symptoms. Using the composite score of the individual symptoms, a total score was also calculated for the categories which is presented in Figure 2.4. Vocal effort was the most frequently reported category followed by change in voice quality/resonance, vocal discomfort and pitch related changes. Fig 2.2 shows the synthesis of the vocal symptoms into categories and the number of studies (with ranking) for each symptom.

Fig 2.3: Ten most frequently reported vocal symptoms by classical singers based on composite scores

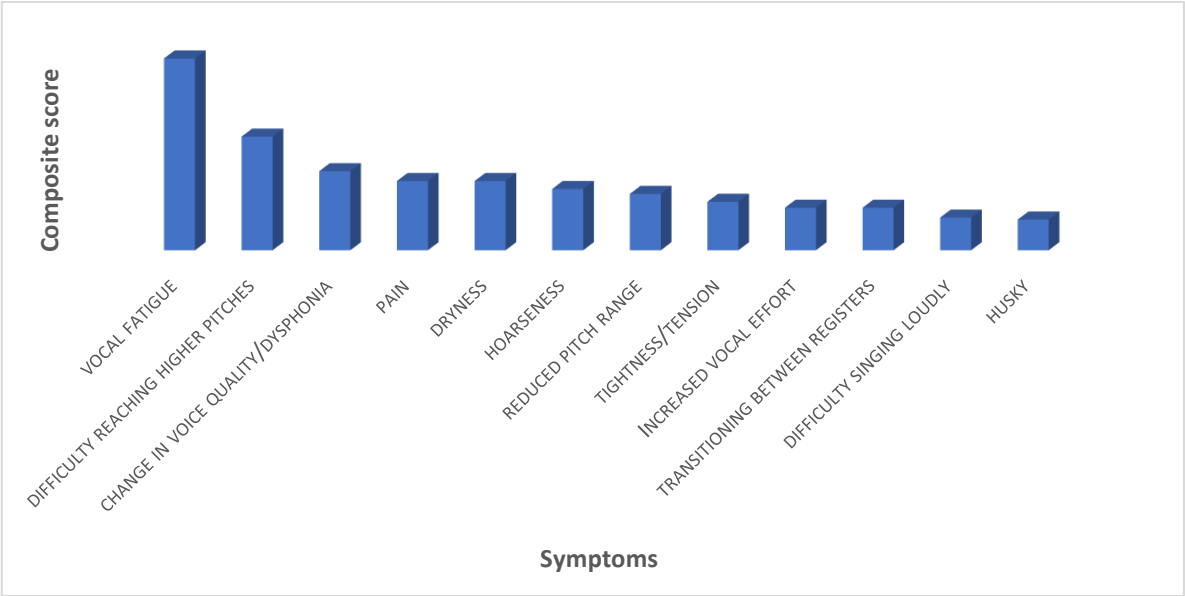


Fig 2.4: Frequencies of the vocal symptom categories reported by classical singers

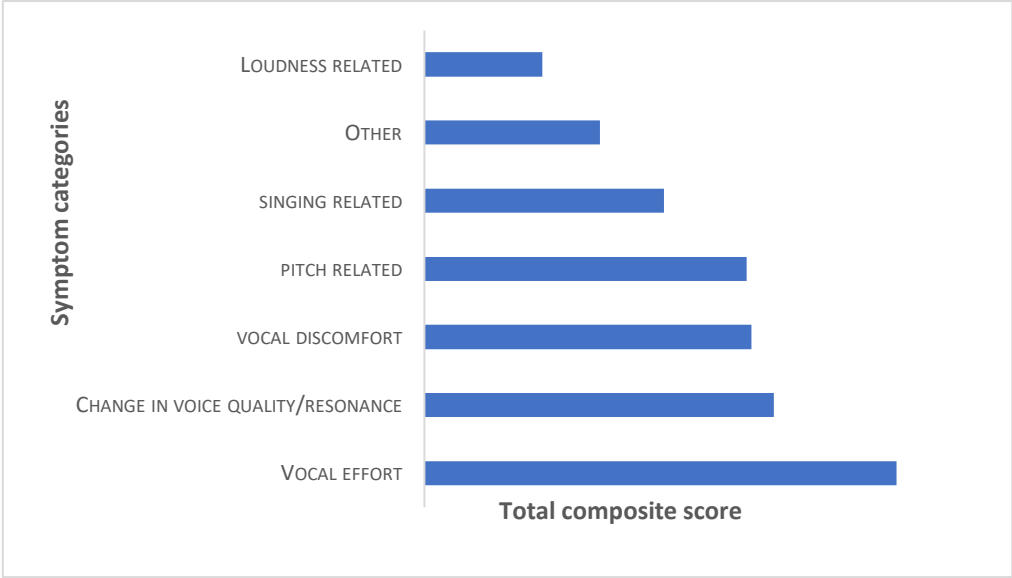


Table 2.8: Categorisation of vocal symptoms reported in the systematic review

Category	Individual Symptoms
Change in voice quality/resonance	Breathiness
	Brightness
	Change in voice quality/ dysphonia
	Hoarseness
	Husky
	Nasality
Volume related	Difficulty singing loudly

Category	Individual Symptoms
	Difficulty singing softly
	Making fine adjustments
	Reduced loudness range
Other	Complete loss of voice
	Momentary loss of voice
	Out of breath while singing
	Problems with speaking voice
	Voice worse in the evening
	Voice worse in the morning
	Weak voice
Pitch related	Difficulty reaching lower pitches
	Difficulty reaching higher pitches
	Reduced pitch range
Singing related	Colour
	Intonation
	Loss of form
	Singing accuracy
	Stressed/unstressed notes
	Sustaining notes
	Tone onset
	Tone termination
	Transitioning between registers
	Vibrato
	Wobble in voice
Vocal tract discomfort	Dryness
	Frequent coughing
	Throat clearing
	Itch
	Lump in throat
	Pain
	Tickling
Vocal effort	Increased vocal effort
	Strain
	Tightness/tension
	Vocal fatigue

2.3.7.2.2 Duration of symptoms

Two studies reported the duration of voice problems in classical singers. Arunachalam et al (2014) reported that the range of duration was 1.5-6 months (45-180 days) in Carnatic singers and Phyland et al (1999) indicated that the mean duration of vocal problems in opera singers was 23.27 days.

2.3.7.2.3 Severity of symptoms

Two studies reported severity using 3-point severity scales which ranged from mild to severe (Devadas et al, 2019) and mild to very severe (Kitch et al, 1994). Devadas et al (2019) reported that 60.4% of their participants reported mild symptoms and 30.2% reported moderate symptoms while these were reported to be 30% and 50% respectively by Kitch et al, (1994). Severe and very severe symptoms were reported by 9.3% of Carnatic singers (Devadas et al, 2019) and 20 % of Classical singers (Kitch et al, 1994).

2.3.7.2.4 Onset and nature of voice problems

Only Devadas et al (2019) reported data pertaining to onset and nature and indicated that 40.3% had a sudden onset while 59.7% had a gradual onset. They also reported that 76.1% of Carnatic singers reported their symptoms to be static while 23.9% had progressive vocal symptoms.

Further details pertaining to research question 2 is provided in Table 2.5. A more detailed presentation of outcomes is presented in Appendix 2.4.

2.3.8 Review objective 3: What are the factors associated with self-reported voice problems in classical singers?

Eleven studies reported factors that had a significant effect on the voice. The most frequently reported factor associated with voice problems in classical singers was stress or burnout (Achey et al, 2016; Devadas et al, 2018 & Kitch et al, 1994), where high level of stress was positively associated with presence of voice problems or greater vocal handicap. The study by Kitch et al (1994) did not statistically determine the association between stress and burnout with voice but reported that singers who were “run down” physically and emotionally were more likely to experience vocal fatigue.

Similarly, voice use was also reported as a risk factor for voice problems by three studies (Avila et al, 2010; Prior et al, 2020 and Kitch et al, 1994). Kitch (1994) suggested that one of the causes of developing vocal fatigue was misuse/overuse of the voice; however, this was not statistically

determined. Studies by Avila et al (2010) and Prior et al (2020) reported that singing or rehearsal duration had significant negative correlations with vocal impairment.

Demographic factors were considered by four studies (Achey et al, 2016; Avila et al, 2010; Cohen et al, 2008 and Loiola-Barriero et al, 2016). While the study by Avila et al (2010) reported higher levels of vocal impairment and handicap among younger singers, Cohen et al reported higher levels of vocal handicap among singers who were over 50 years of age. Avila et al (2010) also reported higher levels of vocal disability among female singers. However, Achey et al (2016) and Loiola-Barriero et al (2016) did not find a significant association between vocal symptoms and age or gender. Loiola-Barriero et al (2016) also considered professional experience but did not find significant correlations with any vocal parameters.

Cohen et al (2008) used multiple regression to ascertain that the predictors of vocal handicap were length of the voice problem, neurological voice disorders, benign vocal fold lesions, being an amateur singer and being a singing teacher.

Use of contraceptives and their effect on voice was reported by two studies (Boulet et al, 1996; Ryan et al, 2009). Boulet et al (1996) reported that 37% (n=17) of all the female respondents associated use of the oral contraceptive pill with positive voice changes and 11% (n=5) had experienced such changes themselves while using the pill; however, the significance of this result is unclear as it was not statistically tested. Ryan et al (2009) reported that singers who did not use oral contraceptives reported significantly higher levels of vocal fatigue and hoarseness.

Menstruation/Pre Menstrual Syndrome (PMS) was studied in five studies (Boulet et al, 1996; Davis et al, 1993, Ryan et al, 2009; Sapir et al, 1993 and Lã Filipa, 2007). All studies reported that menstruation and PMS negatively impacted the voice. Lã Filipa (2007) carried out a qualitative study on one classical singer to document the impact of menstrual cycle on the voice and to ascertain if oral contraceptives minimised the impact of vocal changes experienced during menstruation. The singer described her voice as being “less focused” and “less bright”. Some other symptoms described were heaviness in the voice, lack of flexibility, reduced vocal support and control, difficulty singing high notes and singing sustained phrases.

Ryan et al (2009) investigated the perceived impact of the female hormonal cycle on young female singers by recruiting both male and female classical singers and reported that there was a significant difference between males and females on certain vocal parameters such as peak form, weak and sluggish voice and also estimated the cycle effect in females where statistically significant

differences were found for parameters such as vocal fatigue ($p=0.004$) and effort ($p=0.03$) between days 24-4 and 5-23 of the hormonal cycle establishing the impact of PMS on the voice. Davis (1993) reported that age could potentially influence the impact of PMS on voice as respondents in this study around age 35 reported fewer vocal symptoms pertaining to PMS. However, this study involved singers belonging to different genres and therefore the findings do not exclusively apply to classical singers.

Two studies reported the effects of menopause on the voice. Elliott et al (2017) studied voice changes pertaining to menopause in Classical singers and reported that 27% of the participants who reported to have vocal changes experienced them 1-3 years post menopause while 17% reported changes at around 1-3 or 3-6 months. Boulet et al (1996) reported the impact of menopause on the voice and reported that many singers experienced vocal symptoms prior to and during menopause; however, these were also not statistically tested for significance.

Devadas et al (2019) conducted a comprehensive study on Carnatic singers and identified that frequent colds, difficulty in hearing and frequent intake of medication negatively impacted the voice. All relevant details pertaining to factors affecting the voice are presented in Table 2.9.

Table 2.9: Factors associated with voice problems

Study	Statistical analysis	Associated factors	Implications
Achey (2016)	1. Multiple linear regression models to assess if vocal hygiene and vocal health factors predict SVHI-10 score.	1. Regression Coefficients for SVHI-10 Scores in Non-performance (NPCoeff) and Performance Periods (PCoeff)-significant results a. Consideration of singing voice: [NPCoeff=-0.97 (p=0.228)] [PCoeff=-2.55 (p=0.018)] b. Stress reduction: [NPCoeff=1.49 (p=0.010)] [PCoeff=1.43 (p=0.022)] 2. No difference in SVHI scores between gender and age groups.	1. Singers who experience high stress levels are more likely to experience vocal handicap. 2. Awareness of singing voice can reduce vocal handicap 3. SVHI scores are not influenced by age or sex.
Avila (2010)	1. Mann-Whitney to compare the groups based on gender. 2. Spearman correlation to measure the degree of relationship between the scales of IDCC with the other quantitative variables.	Correlations between CSHI and age, gender and total singing duration in groups with and without vocal complaints (VC) 1. Gender-Disability subscale Females-with vocal complaint: 14.2% Males-with vocal complaint: 8.14% p=0.044 2. Age a. Handicap-Without VC: -43.40% (p=0.012) b. Impairment-Without VC: -48.80% (p=0.004) c. Total score-Without VC: -51.30% (p=0.002) 3. Total singing duration a. Total score: -34.50% (p=0.025)	1. Disability subscale scores showed a significant difference between genders with women having greater scores indicating higher levels of disability. 2. A negative correlation was observed in group with no vocal complaints with respect to age (handicap, impairment and total scores) and singing duration (total scores) indicating higher impact of voice problems in younger singers and singers who sing for lesser durations.
Boulet (1996)	Descriptive statistics	1. 37% (17) of all the female respondents associated use of the oral contraceptive pill with voice changes of some kind (details were not asked for) 2. 11% (5) had experienced such changes themselves while using the pill. 3. Menstruation was associated with voice changes by 73% (35) 4. 57% (27) experienced such changes themselves during menstruation.	The problems with voice emission, voice control and attainment of the highest registers seemed to occur more typically in women than in men (not statistically determined)
Cohen (2008)	Univariate using Spearman correlation and multivariate statistics with multiple regression	Univariate analysis 1. Patients aged >50 showed higher levels of handicap 9correlation statistics unavailable) 2. Length of voice problem showed higher levels of handicap (p=0.32; p<0.001) Multivariate analysis	1. Singers older than 50 showed increased levels of vocal handicap. 2. The predictors of vocal handicap were length of the voice problem, neurologic conditions/benign vocal fold lesions and being an amateur singer or singing teacher

Study	Statistical analysis	Associated factors	Implications
		1. Length of voice problem: (b=0.2; p=0.04) 2. Neurologic voice disorder: (b=32.6; p<0.001) 3. Benign vocal fold lesion: (b=8.6; p=0.01) 4. Amateur singer/singing teacher: (b=11.5; p=0.001)	
Davis (1993)	Descriptive statistics	1. At approximately age 35, respondents began to report fewer and less severe symptoms of PMS than younger singers.	Impact of symptoms of PMS on voice reduce as age advances (not statistically determined)
Devadas (2018)	1. Adjusted odds ratio with a 95%confidence interval with multiple logistic regression with forward Wald selection criteria to investigate the association between the presence of VP and the different risk factors.	1. Clenching jaw/teeth while singing a. Unadjusted OR (95%CI) and p value: 4.151(1.787-9.640), p=0.001 b. Adjusted OR (95%CI) and p value: 2.715(1.007-7.315) p=0.048 2. Frequent cold a. Unadjusted OR (95% CI) and p value: 1.927(1.216-3.658), p=0.002 b. Adjusted OR (95%CI) and p value: 2.840(1.135-7.108), p=0.026 3. Difficulty in hearing a. Unadjusted OR (95% CI) and p value: 3.520(1.947-12.210), p=.002 b. Adjusted OR (95%CI) and p value: 4.606(0.993-21.371), p=0.051 4. Stress related to profession a. Unadjusted OR (95% CI) and p value: 2.667(1.409-5.582), p=0.004 b. Adjusted OR (95%CI) and p value: 2.582 (1.121-5.947), p=0.026 5. Frequent intake of medication a. Unadjusted OR (95% CI) and p value: 1.974(1.739-6.254) p=0.026 b. Adjusted OR (95%CI) and p value: 3.483 (1.285-9.440), p=0.014	1. Several health and lifestyle related factors increase the likelihood or risk of developing voice problems in Carnatic singers
Kitch (1994)	Descriptive statistics	All participants reported that the causes of vocal fatigue were overuse or misuse of the voice, use of poor vocal techniques, being "run down" both physically and emotionally, and performance anxiety.	The causes of vocal fatigue were reported (not statistically determined)
Loiola-Barreiro (2016)	1. Spearman correlation 2. Univariate and multiple linear regression analyses	No significant correlation between gender, age and professional experience in singing	CSHI does not correlate with these variables in classical singers

Study	Statistical analysis	Associated factors	Implications
Prior (2020)	1. Spearman's test to correlate subscales with singing related variables	Spearman correlation Impairment and hours of rehearsal: $r_s = -0.335$, $p = 0.040$	Negative correlation indicates that the greater the perception of the impairment, the lesser the rehearsal time.
Ryan (2009)	1. Linear mixed models to measure the independent effects of cycle (days 24–4 compared with days 5–23), gender, and contraceptive pill use on voice quality.	I. Marginal Mean Values for Voice Quality Measurements by Contraceptive Pill Use A. Fatigued-mean: a. Yes: 6.1 (0.3) b. No: 5.3 (NR) c. Difference (CI): -0.8 (-1.6,0.1) d. p value=0.07 B. Hoarse-mean a. Yes: 7.3 (0.3) b. No: 5.9 (0.3) c. Difference (CI): -1.3 (-2.2,-0.5) d. p value=0.003	The negative mean indicates that singers who were not taking a contraceptive pill tended to rate lower on the voice quality scores. The difference in mean values was significant for hoarse voice and marginally significant for fatigued voice.
Sapir (1993)	Descriptive statistics	1. Significant voice problems or changes prior to or during menstruation: n=17 (23%) 2. Severe symptoms of PMS: n=28 (38%)	1. Nearly one-quarter of the students experience problems or changes in their voice prior to or during menstruation (not statistically determined)
Table 2.9: O= Odds Ratio; CI= Confidence Interval; CSHI= Classical Singing Voice Index, NR= Not Reported			

2.4 DISCUSSION

This review investigated self-reported voice problems in classical singers. More specifically the review addressed how self-reported voice problems were assessed; the type, nature, and frequency of self-reported voice problems; and factors associated with self-reported voice problems in classical singers. Thirty-five studies were included in the review, representing 1798 classical singers. Both validated and non-validated methods were employed to identify self-reported voice problems in classical singers. The most commonly employed validated measures were pertaining to vocal handicap, which included CSHI, SVHI and VHI. Classical singers in this review showed elevated levels of vocal handicap; the most common vocal symptoms reported were vocal fatigue, followed by difficulty reaching higher pitches and changes in vocal quality. Factors associated with self-reported voice problems were high stress levels, duration of symptoms, singing level, genre, type of laryngeal pathology, use of contraceptives, lack of hydration, age, gender, singing duration, PMS/menstruation, menopause, frequent colds, clenching jaw/teeth while singing, difficulty in hearing and vocal abuse/misuse.

2.4.1 Study characteristics

Barring one study (Lă Filipa, 2007) which employed a qualitative methodology, a variety of quantitative study designs were employed across the rest of the studies indicating a preference to employ quantitative methodologies for studying voice problems in singers. A range of classical sub genres were included such as Western classical, Carnatic classical, classical choir and opera. Studies have indicated that singing genre can influence voice outcomes (Pestana et al, 2017; Loiola-Barreiro, 2016). However, this review demonstrated that genre is not reported by many studies; 25 authors had to be contacted to determine the genre of their study population.

Awan and Ensslen (2009) studied the Dysphonia Severity Index Scores (DSI) of trained and untrained vocalists and reported that trained singers presented with higher mean DSI scores compared to their untrained counterparts (mean=6.48; SD=2.19 vs mean=4.00; SD=2.04 respectively), indicating that training positively impacts vocal functioning. However, this could not be verified in the present review as the impact of singing training was not studied or reported consistently across studies. Amount of singing was also not reported by all studies, even though it has been shown to be an important parameter concerning vocal health.

2.4.2 Methodological quality

Only 20% of the studies included in this review were of good methodological quality. Among the cross-sectional studies (the most frequently used study design in this review, n=26), the low scores were mainly due to lack of clearly defined inclusion criteria followed by insufficient descriptions of the study setting and the participants. The studies which employed a pre-post study design did not employ a control group which impacted the validity of their findings. It must be noted that studies that were deemed to be of “poor quality” were also included in this data synthesis because all the studies assessed outcomes reliably and lost points for not adequately describing the inclusion criteria or the setting. Better reporting of study and participant characteristics in future studies will enhance the quality of the studies and is therefore recommended.

2.4.3 Self-reported voice problems assessment/measurement

In terms of validated measures, in the Francis et al (2017) systematic review, the VHI and VHI-10 were the most commonly used self-report measures in voice literature. In the present review, similar results were obtained with a majority of studies using self-assessment measures of handicap; however, there was a preference to use measures developed specifically for singing voices, such as CSHI and SVHI. This could be due to the ability of these tools to provide context specific information. Lack of sensitivity of general voice assessment tools in adequately measuring nature of impact of voice problems in singers has been frequently reported (Jacobson et al, 1997; Deary et al, 2003; Hogikyan et al, 1999; Cohen et al, 2007); therefore, it was encouraging to note the preference for using instruments designed for singers. However, the applications of using of generic assessment tools such as VHI are justified and perhaps necessary under certain research conditions, such as comparing voice problems between singers and non-singers or when assessing parameters (e.g., quality of life), where context specific instruments may not be available or developed.

The two singing specific assessments identified in this systematic review were SVHI (and its variants) and EASE. While SVHI provides a good overview of vocal impact across domains (physical, emotional and functional as it is essentially derived from the VHI), the EASE is a tool which specifically examines the impact of vocal load and provides an opportunity for singers to self-rate the current state of their vocal function. SVHI is slightly longer with 36 items (the SVHI-10 could be a good alternative to reduce respondent burden with only 10 items) whereas the EASE is relatively shorter to administer with only

22 items. The EASE was primarily developed to assess the vocal function of clinically normal singers whereas SVHI is a “disease specific” measure. Both tools have a place in the voice clinic and in research- the appropriateness of their use will depend on the clinical requirements or research objectives respectively.

Non validated questionnaires used in this review across studies displayed considerable heterogeneity. This was expected since each questionnaire was developed to suit the objectives of the study. For example, a study to identify voice problems during menopause will focus on matters surrounding the menstrual cycle as opposed to a study focused on identifying voice problems in elderly singers. Additionally, contextual differences (e.g., geographic, cultural etc.) would also explain this heterogeneity and may also lead to different connotations for the same term. However, heterogeneities surrounding reporting of findings and terminologies must be acknowledged along with the limitations they pose to data synthesis. A need for a consensus on how vocal qualities should be described is desirable and indicated in this review. However, this will prove to be a difficult task given the variability and preference to use certain descriptive terms across researchers. Therefore, an appropriate medium can be struck where researchers make efforts to sufficiently define their terminologies (what they mean by each symptom) making it clearer and unambiguous. The Complete Vocal Technique developed and piloted by McGlashan et al (2023) addresses this by providing a comprehensive approach to describing vocal qualities which future researchers can use as a springboard to develop further.

2.4.4 Results obtained from validated measures

Classical singing is a demanding vocal task that requires complex adjustment of various subsystems of voice production. If these adjustments are poorly executed, then there is a likelihood of disrupting the vocal system (Avila et al, 2009). This was reflected in the present review where higher than normal scores were obtained for all validated tools. In five Brazilian studies using the CSHI, comparing the results between singers with and without voice problems, the impairment subscale had the highest scores. Avila et al (2009) suggested that classical singers are likely to have higher scores in impairment and disability subscales rather than handicap because of the relatively less severe vocal alterations experienced by classical singers in general; higher scores in the handicap subscale are likely to occur for more severe symptoms. However, Phyland et al (1999) studied three groups of professional singers,

namely opera, musical theatre and contemporary singers and reported vocal impairment and disability using a self-developed questionnaire. The results were then compared with non-singers and vocal disability scores were significantly different between singers and non-singers, whereas impairment was not. They attributed this to singers attaching importance to even minor changes in vocal status and that singers and non-singers may experience similar symptoms of vocal impairment. However, the study involved singers from multiple genres; therefore, the findings of CSHI reported in this review pertaining to increased levels of impairment may be specific to classical singers only. Alternatively, it may be indicative of variations between the assessment tool itself.

SVHI was first introduced by Cohen et al in 2007 and has since been extensively used in research. However, inconsistencies were noticed in how SVHI scores were calculated and reported (raw vs scaled scores and mean vs range scores). These irregularities significantly reduced the scope of data synthesis in the present review. These inconsistencies have a significant impact on the quality of singing voice research as SVHI is a commonly used tool in research and highlights the need for a more consistent and reliable reporting in future studies. More specifically, we recommend that the scaled scores are consistently used as intended by the original developers as this is the measure which was used during standardisation of the instrument.

Comparing the SVHI-10 scores computed in this review to the normative score, classical singers experienced significantly elevated levels of vocal handicap. On the contrary, the VHI-10 scores tended to be lower than the normative scores among classical singers. This could indicate a higher sensitivity of context specific tools compared to generic tools. Due to significant heterogeneity in reporting of results, the combined scores of VHI and VoiSS scores could not be calculated. Variations and sparsity (e.g., not providing standard deviation values) in the reporting of results of standardised measures were particularly picked up in this review. Future studies should report sufficient statistical details to allow correct interpretation and comparison between studies.

Another observation made pertaining to the application of validated measures was the lack of normatives or cut-off values provided by the original authors which would aid in meaningful interpretation of the scores. The Francis et al (2017) review reported that only three out of the 32 voice-related patient reported outcome measures described their scaling process accurately, thereby making the interpretation of the results unclear. This is reflected in Table 2.4 where the normative values for

various validated tools were unavailable. More research to fill this gap will benefit future researchers and clinicians alike to effectively interpret these scales.

2.4.5 Results of non-validated assessment measures

Non-validated questionnaires were used in 17 studies, the results of which were synthesised in this review to identify the type, nature and frequency of self-reported voice problems in classical singers. A systematic review and meta-analysis of voice problems in singers was carried out by Kwok and Eslick (2017) where they outlined that higher prevalence was observed for laryngeal pain (58%) followed by hoarseness (54%) and vocal fatigue (53%). Therefore, it can be ascertained that vocal fatigue is a common symptom among singers in general, which was identified as the most commonly occurring symptom among classical singers in this review. Vocal fatigue is a relatively obscure term and has been conceptualised in many ways where it is sometimes described as a symptom of an organic pathology, as a series of compensatory behaviours which causes phonotrauma or even an isolated phenomenon (Welham and MacLagan, 2003). Even though fatigue is described as a condition where physical capabilities are diminished (Bestwick-Stevenson, 2022; Abd-Elfattah, 2015), it is possible that the term may be positively associated with better preparation and training (commonly referred to as “no pain no gain” by athletes and singers alike). It is also a perception of the voice user that instigates change in behaviours. Therefore, the usability of this term, given its obscurity in its intended meaning is questionable. Vocal fatigue is associated with both muscular and tissue level changes which makes it an important symptom to consider and decode (Hunter and Titze, 2009). Kitch and Oates (1994) studied vocal fatigue in a group of actors and singers and concluded that a certain level of vocal fatigue is inevitable and may not cause significant harm in the future. However, it becomes imperative to identify acceptable levels of vocal fatigue and ensure that vocal fatigue is effectively addressed by music schools, singing teachers, music directors and performers with appropriate rest periods.

While vocal fatigue is a symptom commonly observed across professional voice users, particularly teachers (e.g., Laukkanen et al, 2009; Roy et al, 2004; Verdolini and Ramig, 2001; Sapir et al, 1993), symptoms related to pitch may be more associated with the singing population. These can be expected to have a detrimental impact on singing performance. While a reduction of the upper singing range was the second most frequent symptom in this review, a previous systematic review involving all singers reported pitch range impairment as their fourth symptom (Kwok and Eslick, 2017). This could indicate

that classical singers have a higher requirement to access the upper range compared to other genres. This is a significant finding which requires further exploration in future research given its implications for providing advice to maintain vocal health and vocal intervention for classical singers.

2.4.6 Comparison of self-reported voice problems across genres

Whilst studies exploring self-reported voice problems in specific genres of singers are limited, a few noteworthy studies are discussed here. Moreti et al (2016) administered the CSHI and Modern Singing Handicap Index or MSHI (for popular singers) on classical singers and popular singers respectively and reported that the CSHI scores were significantly higher in classical singers with vocal complaints compared to MSHI scores in popular singers with vocal complaints. This could indicate a higher impact of vocal complaints in classical singers compared to popular singers. Guzman et al (2014) assessed the voices of 21 rock singers who frequently used the “growl” voice and reinforced falsetto. They reported that these singers presented with elevated SVHI scores (mean=29.47; SD=16.76). Even though the mean SVHI in the present review is higher than what was established for rock singers and may potentially indicate higher levels of vocal handicap among classical singers, the relatively small sample size and vocal health status of the singers during assessment could cast doubt in this interpretation. Devadas et al (2019) investigated voice problems in Yakshagana (Indian folk art) singers and reported that hoarseness was the most frequently reported symptom among this group, as opposed to vocal fatigue that was the most frequently reported symptom among classical singers in this review. These findings suggest there may be differences in self-reported voice problems among singers belonging to different genres. More research is therefore warranted to conclusively ascertain the role of genre in influencing vocal health.

2.4.7 Duration, onset and nature of voice problems in classical singers

Few studies reported details pertaining to duration, onset and nature of voice problems in this review. Identifying whether a voice problem developed suddenly or gradually is of diagnostic significance. For instance, a possible cause for a singer to develop a sudden change in voice quality is vocal fold haemorrhage which requires immediate medical attention to prevent permanent damage to the voice (Sataloff, 2017). Future research should aim to explore voice problems in singers in a more holistic manner by including pertinent details such as duration, onset and nature.

2.4.8 Factors associated with self-reported voice problems in classical singers

This review indicated that a variety of factors can influence the voice. It was noted that most of the studies considered factors only when the voice was used for singing (e.g., performance hours, singing practice hours etc); however the use of voice to perform non singing activities such as talking, performing other jobs or lifestyle (e.g., impact of air travel) were not considered by studies in this review. As the same vocal apparatus is used for all vocal activities, this is a consideration for future research in the area.

The main factors impacting the voice, as highlighted in the present systematic review are discussed below:

2.4.8.1 Stress

Stress and voice use were the two factors that were reported across studies in this review. Three studies reported that stress was positively linked to vocal handicap. The term “stress” was first used by Selye (1956) as any phenomenon which threatened to impact homeostasis. Yaribeygi et al (2017) defined stress as a stimulus that can originate externally or internally and can evoke a biological reaction. These are then compensated by stress responses. In the context of voice, this would represent changes across the various subsystems of the voice mechanism. However, stress is a generic term, and it becomes essential to clearly define the situational contexts underlying stress and analyse vocal symptoms accordingly. Besser et al (2020) investigated the relationship between change in perceived stress levels and vocal symptoms during the COVID-19 pandemic in teachers. They concluded that even though the participants reported higher levels of stress during the transition to online synchronous teaching, they did not report an increase in vocal symptoms. However, teachers who reported high levels of stress prior to the pandemic continued to report vocal symptoms. Therefore, it becomes essential to identify and describe the stress sources to ascertain their impact on the voice. Interestingly, Larrouy-Maestri and Morsomme (2014) reported that stress could also be perceived to have positive implications on the voice. They studied the impact of exam stress on singing accuracy in a group of singing students and reported that first year students predominately experienced a positive effect on their voices and singing due to examination stress. Even though the current review only reported a negative impact of stress on the voice, it can be argued that stress is a multifaceted phenomenon interacting in complex ways with other factors, and with potentially differential effects on different groups and by whether the

stressors are short-term or long-term. These aspects need to be further examined to fully understand the impact of stress on the classical singing voice.

2.4.8.2 *Performance level and vocal load*

Rosen et al (2000) reported that recreational singers showed greater handicap compared to professional singers. In the present review, only one study (Cohen et al, 2008) explored the association between performance level and vocal health and reported that amateur singers showed greater handicap compared to professional singers. This was attributed to a more pro-active treatment seeking behaviour observed among professional singers where they tend to seek help quicker resulting in lesser vocal handicap during assessment.

Various studies with other professional voice users have indicated that excessive voice use could impact the voice. Vocal load is a term often used to quantify voice use. Phyland et al (2013) studied 79 musical theatre performers and carried out focus group interviews or a written survey to understand the impact of vocal load on the voice. They concluded that singers experienced transient and variable changes in their voices which included symptoms of vocal impairment and vocal fatigue. Additionally, they also reported some positive changes experienced by singers as a consequence of heavy vocal load. It was interesting to note that singing or rehearsal duration was reported to be correlating negatively with vocal impairment in this review, indicating a positive association between singing duration and the voice, as reported by Phyland et al (2013). This could be attributed to the fact that the voice has sufficient time to warm up if the singing duration is long and the negative effects of excessive singing is minimised in classical singers due to vocal training and favourable vocal techniques.

2.4.8.3 *Laryngo-Pharyngeal Reflux (LPR)*

LPR has commonly been associated with voice problems in singers. (Cammarota et al, 2003; Cammarota et al, 2007; Pregun et al, 2009). Lloyd et al (2017) indicated that the common vocal symptoms of LPR include hoarseness, throat clearing, perception of excessive mucous accumulation in the throat, swallowing and breathing difficulties, globus sensation, cough, persistent “tickling” sensation in the throat. They also suggested that since singing requires substantial activation and recruitment of the diaphragm, abdominal and intercostal muscles, there are significant changes in intrathoracic pressures leading to an increased pressure on the laryngo-oesophageal sphincter causing LPR. Additionally, they reported that factors such as performance-related stress, anxiety, irregular eating and sleeping habits

can exacerbate LPR in singers. However, in the present review, LPR did not feature as a significant factor associated with classical singers. This could be linked to the inclusion criteria for the review, as studies that only looked at LPR without using any self-report voice measures were excluded. This may have resulted in underestimating the impact of LPR on the classical voice in this review and this area needs investigating.

2.4.8.4 Hormones

Menopause is a phenomenon that has received a considerable amount of research interest in the context of the performing voice. The impact of hormonal changes on vocal anatomy and physiology has been extensively studied by Abitbol et al (1989) et al who outlined structural and functional changes in the vocal apparatus. Fiuza et al (2021) carried out a systematic review to identify the impact of menopause on singers and reported that changes in vocal range, timbre, endurance, and vocal fold mobility were the most commonly reported symptoms. The present review also found decreased vocal range, changes in voice quality and flexibility, endurance and voice control in menopause. However, it must be noted findings are based on two studies that did not statistically determine the presence of vocal symptoms and did not quantify the impact on the voice using validated measures.

PMS/menstruation was reported to negatively impact the voice in this review. Abitbol et al (1989) provided one of the earliest accounts of voice changes due to hormonal changes throughout the and reported that 58% of their participants reported experiencing a hoarse voice and vocal fatigue due to PMS. Gunjawate et al (2016) carried out a systematic review to ascertain the impact of menstrual cycle on singers' voices. The results of studies that used laryngeal imaging or electroglottography indicated hypotension within the laryngeal musculature which required singers to undertake more effort while singing. They also reported a large amount of variability in terms of amount of singing, age range, tasks used and outcome measures considered. This was also found to be the case in the present review; additionally, only one study statistically determined the impact of menstruation/PMS while others did not quantify the effects in a robust manner, similar to the studies on menopause. It becomes imperative to carry out more robust studies including different methodologies (such as longitudinal or qualitative studies) to fully understand the impact of hormonal changes in classical singers.

2.4.9 Limitations and strengths

Only studies that were published in English were included in the review due to limitations in resources and time which may have led to the exclusion of a few relevant articles published in other languages. Ascertaining the study population was challenging as many studies did not report the genre of the singers within their sample clearly. Twenty-five authors of studies that did not mention classical singers were contacted to check if their study population included classical singers; 15 responded. Therefore, it is possible that a few eligible studies may not have been included in this review.

There was significant heterogeneity in how outcomes were reported across studies. Firstly, few studies reported voice outcomes using validated tools, and reporting inconsistencies amongst these studies further limited data synthesis options. Secondly, ranking of symptoms was the only consistently reported measure; therefore, a meta-analysis was not feasible and there were limitations in how this data could be synthesised. For instance, the severity of the reported symptoms could not be analysed, and data synthesis was limited to identifying and ordering symptoms based on frequency. Also, the findings of all studies, irrespective of sample size were given equal weight while calculating a composite score, which may have biased the estimations.

Despite these limitations, an extensive search was carried out to identify articles for this review. The search was implemented across 10 databases using both EBSCO and Ovid platforms. Additionally, grey literature was also searched, and reference tracking undertaken. These improve the strength of the present review in terms of comprehensiveness of the search results. Moreover, given the exploratory nature of this review, studies using validated and non-validated measures were included to capture the breadth of self-reported voice problems in classical singers.

Despite our inability to perform a meta-analysis, a range of techniques was used to synthesise the data, including ranking and weighted scores to meaningfully represent the richness of the data. Lastly, this review is the first of its kind to examine self-reported voice problems in classical singers and provides a comprehensive analysis of research evidence in the area.

2.4.10 Conclusions and future directions

The present systematic review has provided an overview of self-reported voice problems in classical singers. The review ascertained the most frequently occurring symptoms in classical singers and

collated the results of various standardised tools. Moreover, it identified factors that impact the classical singing voice which has preventive and rehabilitative implications.

Results of the systematic review identified significant gaps in the evidence base, pertaining to reporting of outcomes, methodological quality and genre specific studies. A need for more robust reporting of the genre, as well as studies that explore voice problems in specific genres, is warranted to enable voice researchers and clinicians to develop genre specific assessment tools and treatment programmes.

Use of singer specific validated tools to study self-reported voice problems in classical singers will deepen the understanding of all aspects of voice problems in this group. Also, exploring domains other than handicap, such as limitation of activities and participation or voice-related quality of life will be beneficial in providing a broader perspective of the impact of voice problems on classical singers. Using generic assessments will enable a comparison between singers and non-singers which will also strengthen the evidence base.

The relevance of identifying factors associated with voice problems in classical singers is significant in developing preventive programmes, therapeutic interventions and developing advice pertaining to maintaining vocal health. More studies should therefore be undertaken to fully and definitively understand the impact of age, sex, training, lifestyle and other relevant factors on the voices of classical singers.

3 CHAPTER 3: VOICE-RELATED COPING IN PROFESSIONAL VOICE USERS-A SYSTEMATIC REVIEW

Chapter 2 reported the results and implications of a systematic review performed to identify self-reported voice problems in classical singers. The present chapter will explore how singers cope with their voice problems and directly address aim 1 of the programme of research. Owing to limited research on coping skills in singers, a preliminary literature search was performed to aid in appropriate formulation of the research questions, ensuring that enough literature was generated to be analysed. The preliminary literature search addressed the following aims:

1. To identify if a systematic review has already been performed on the considered topic
2. To ensure adequate availability of literature in the topic to be able to perform a review. If not, then the review questions may need to be broadened.
3. To check if review questions need to be narrowed, if vast amounts of literature is yielded with the current questions

A keyword search was performed on the EBSCO Host using the MEDLINE database and on the OVID platform using the EMBASE database in September 2019. The keyword search yielded only 2 hits in EBSCO Host and 0 hits in Ovid. A quick examination of these articles revealed that they were not relevant for the present review. Therefore, the population was extended to include all professional voice users in the systematic review. The implications of this modification will be discussed at the end of this chapter.

This systematic review was published in the Journal of Voice, which is a peer-reviewed journal. The published paper version³ of the chapter is therefore presented here, with an added paragraph on the relevance and applications of the review findings to the current programme of research.

³ **Statement of contribution:** Aparna Ramachandran (AR), Shashi Hirani (SPH), Katerina Hilari (KH) and Ruth Epstein (RE) developed the search strategy. AR carried out the searches. Abstract and full text screening, data screening and quality assessments were carried out by AR, 25% of which was double coded by Niamh Devane (ND). AR prepared the paper, which was iteratively revised and finalised by SPH, KH, RE and ND.

3.1 ABSTRACT

Objectives: This systematic review explored coping with voice problems in professional voice users. The objectives were to: 1) evaluate how voice-related coping is assessed in professional voice users 2) investigate how they cope with voice problems, and 3) identify factors associated with voice-related coping.

Design: Systematic review

Methods: A systematic literature search of ten electronic databases using both EBSCOhost and OVID online platforms was conducted following the Preferred Reporting Items for Systematic Reviews (PRISMA) guidelines. Only peer-reviewed articles which assessed coping in the context of voice problems in professional voice users were included. Methodological quality was assessed using Johanna-Briggs Institute Critical Appraisal checklists. Data analysis was conducted using narrative synthesis.

Results: Following deduplication, abstract and full-text screening, seven articles were included in the review. All participants (n=2484) were teachers; no other professional voice users were covered. 98% of the cases studied were females. The tools used to assess voice-related coping were Utrecht Coping List (UCL) and Voice Disability Coping Questionnaire (VDCQ). Studies that used UCL reported a passive coping pattern in teachers with high vocal handicap whereas VDCQ showed increased use of social support. Factors associated with coping were not examined by any of the studies.

Conclusion: Seeking social support was highlighted as a frequently used coping strategy across studies and measures. Teachers with high vocal handicap used a passive coping pattern and active coping styles were not significantly used. Current evidence does not sufficiently specify factors affecting coping in professional voice users. More research on voice-related coping involving all professional voice users is warranted to identify associated factors and further ascertain its influence on vocal health.

Keywords: Coping, Dysphonia, Voice Disorders, Patient Reported Outcome Measures

3.2 INTRODUCTION AND OBJECTIVES

Professional voice users are individuals whose ability to earn a living is impacted negatively by loss of vocal quality and endurance (Sataloff, 1997). This includes singers, teachers, actors, lawyers etc. The reported lifetime prevalence of voice problems is estimated to be between 50%-80% in teachers (Cantor Cutiva et al, 2013; Martins et al, 2016) in contrast to 29.9% (Roy et al, 2005) in the general population. Other professional voice groups such as singers (Pestana et al, 2017) and telemarketers (2002) have also shown higher prevalence rates (46.09% and 68% respectively) which makes professional voice users a vocally vulnerable group.

Given higher prevalence rates and increased impact of voice problems, it becomes essential to explore how professional voice users manage these voice problems. This is often referred to as coping, which is defined as an adaptational response to a situation or 'stressor' using cognitive or behavioral processes to manage the stress of illness (Lazarus & Folkman, 1984).

Many classifications of coping have been proposed, of which problem focused vs emotion focused (Lazarus & Folkman, 1984) and active vs passive coping (Billings et al, 1981) are most common. Research indicates that problem-focused and active coping can be positively linked to increased well-being whereas emotion-focused and passive coping is associated with negative health outcomes (Penley et al, 2002). However, such classifications only provide a general description of how an individual copes with an illness and do not take into account the context or the variability across the trajectory of an illness. Recent scales such as the Voice Disability Coping Questionnaire (VDCQ) (Epstein et al, 2009) provide a multi-dimensional and context specific description of coping using subscales.

Studies on coping in the context of voice problems are scarce; however, type of voice disorder and severity have been reported to influence how individuals cope with voice problems. Epstein et al (2009) studied coping in two clinical groups namely Muscle Tension dysphonia (MTD) and Adductor Spasmodic Dysphonia (ASD) and reported that avoidance and passive coping were used by the latter group significantly more than the former. This demonstrates the relevance of coping in differentiating between clinical groups and targeting adaptive coping during intervention. De Freitas Valadares, Occhi-Alexandre and Teixeira (2020) also reported that reliance on emotional coping strategies increased with increased severity of dysphonia.

Coping forms an important mediating link between the way individuals view their illness and how health outcomes are appraised (Rachman, 1980) (Fig 3.1). Therefore, coping is directly related to the physical and functional outcomes of a voice problem (Hagger & Orbell, 2003). Consequently, coping can be associated with onset and development of a voice problem (Van Wijck Warnaar et al,

2010), particularly in professional voice users who require a high level of vocal skills such as teachers and singers.

Fig 3.1: Figure explaining the mediating role of coping



The objective of this paper was to identify and analyze the available research evidence pertaining to voice-related coping in professional voice users. The review will summarize relevant data and provide implications for vocal health and identify gaps that need to be addressed in future research. More specifically, the review aimed to address the following questions:

1. How is voice-related coping assessed in professional voice users?
2. How do professional voice users cope with voice problems?
3. What factors are associated with different coping strategies addressing voice problems in professional voice users?

3.3 METHODS

The methods and reporting of this review complied with the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines (Moher et al, 2009). PROSPERO and Cochrane databases were searched to establish the absence of a current or recent review in the area.

3.3.1 Eligibility Criteria

To be eligible studies had to address coping in the context of voice problems in professional voice users. All study designs were eligible. To be included, studies had to measure coping in a valid and reliable manner, using standardized measurement procedures; i.e. voice and coping outcomes had to be measured with psychometrically sound measures (for studies presenting quantitative data), or established ways of analyzing data (for qualitative studies). Studies that measured multiple outcomes, of which coping was one, were included if coping measures were discussed separately.

Studies were excluded if they explored coping related to performance anxiety, or any other 'non vocal' parameter; as were reviews, editorials or unpublished theses/dissertations or articles published in non-peer reviewed journals or magazines.

3.3.2 Information sources

A systematic search using 10 electronic databases (Medline Complete, Academic Search Complete, CINAHL, EMBASE, Music Periodicals, Communication Source, PsycINFO, SCOPUS, Web of Science and NICE) was carried out in February 2020 and regular search alerts were set up to ensure no recent publications were excluded from the review. Searches were last re-run in March/April 2022. Grey literature was also searched using OpenGrey and BASE databases. Citation and reference tracking were carried out for all the studies which were included at the end of the selection process to check for articles that may not have been picked up during database searching.

3.3.3 Search strategy

A subject librarian was consulted to develop the search strategy. Each database was searched separately using a customized search strategy which included keywords and subject terms using EBSCO Host and Ovid platforms. The basic search strategy is provided in Appendix 3.1.

3.3.4 Selection process

The studies retrieved were first imported into Rayyan (Ouzzani et al, 2016) for duplicate removal and study selection; following which, the selected articles were transferred into EPPI-Reviewer (Thomas et al, 2010), for data extraction and data synthesis. The entire screening process was carried out by AR. The title and abstract of the articles were screened against the eligibility criteria to identify studies to include in the review and reasons for exclusion were clearly documented. The full text of all the articles which fulfilled the eligibility criteria was retrieved and reviewed. 25% of articles were screened at both title and abstract and full text level by a second reviewer (ND) who worked independently and was blinded to decisions made by the first reviewer. Disagreements on study selection were discussed by the reviewers for resolution. For papers where a consensus could not be reached between the reviewers, a senior member of the research team (SPH) was consulted for a final decision.

3.3.5 Data collection process

Data was extracted by AR following which 25% of studies were independently double screened to check for consistency of extracted data (ND). A data extraction table was created to collect information pertaining to study and participant characteristics, assessment methods, coping related outcomes and factors influencing coping. Disagreements in decisions surrounding extracted data

were discussed by the reviewers for resolution. When a consensus could not be reached, a senior member of the research team (SPH) was consulted for advice regarding reconciliation.

3.3.6 Data items

Data extracted included title, authors, year of publication, study design, country, participants, population size and distribution, demographic characteristics, work experience of participants, response rate, objectives (of the study), inclusion/exclusion criteria, measures used to assess coping, coping related outcomes, factors influencing coping and key conclusions. Authors were contacted (n=3) if more information was required to aid in data synthesis. After the initial email, one more reminder was sent to the authors.

3.3.7 Risk of bias assessment

The Joanna-Briggs Institute (JBI) Critical Appraisal checklists were used for assessing methodological quality and risk of bias. Since not all the selected studies had the same design, different JBI critical appraisal tools suitable for specific study designs were adopted. The JBI does not provide clear guidelines on including or excluding articles based on quality; therefore, a review specific scoring system was developed to aid in quantifying the decision-making process. The responses outlined in JBI were assigned values as follows: - All responses marked yes were given a value of 2, responses marked no were given a value of 0 and those marked unclear were assigned a value of 1. For each study, the total percentage score was calculated, and this value was compared across studies. A cut-off paradigm was then developed by the authors and the scores were interpreted as follows:

- Scores > 80%= Good methodological quality
- Scores between 60-80%= Fair methodological quality
- Scores < 60%= Poor methodological quality

If any studies were of poor methodological quality, they were not included in the synthesis of the results.

A second reviewer (N.D) carried out an independent quality appraisal assessment, the results of which were discussed with the first reviewer (A.R). Any discrepancies that arose were discussed by the reviewers. When a consensus could not be reached, a senior member of the research team was consulted for advice regarding reconciliation (S.P.H).

3.3.8 Data synthesis

Heterogeneity assessment was done using the I^2 measure to ascertain if a meta-analysis could be performed with a fixed or random measure and calculate a pooled estimate. As a meta-analysis could not be performed, a narrative synthesis was performed. The first step was familiarizing with the included studies. This was done by systematically and comprehensively reading each study and highlighting important characteristics. Each study was described in detail and all key features were summarized for each study. The studies were then tabulated to identify patterns across the included studies. Between and within study differences were explored and this data was used to highlight assessment methods, describe voice-related coping in professional voice users, identify factors affecting coping and ascertain the relationship between voice problems and coping in the study population.

3.4 RESULTS

3.4.1 Study selection

The searches identified 2474 articles. Following deduplication, title and abstract screening, and full text screening, seven studies were included in the review. Figure 3.2 provides the PRISMA flow diagram and further details regarding the study selection process and reasons for study exclusions. Appendix 3.2 presents the reasons for exclusion for each of the 24 excluded studies.

The percentages of agreement between the raters involved in double coding were 88.2% and 100% for title and abstract and full text screening respectively. All discrepancies were resolved by the reviewers following discussion.

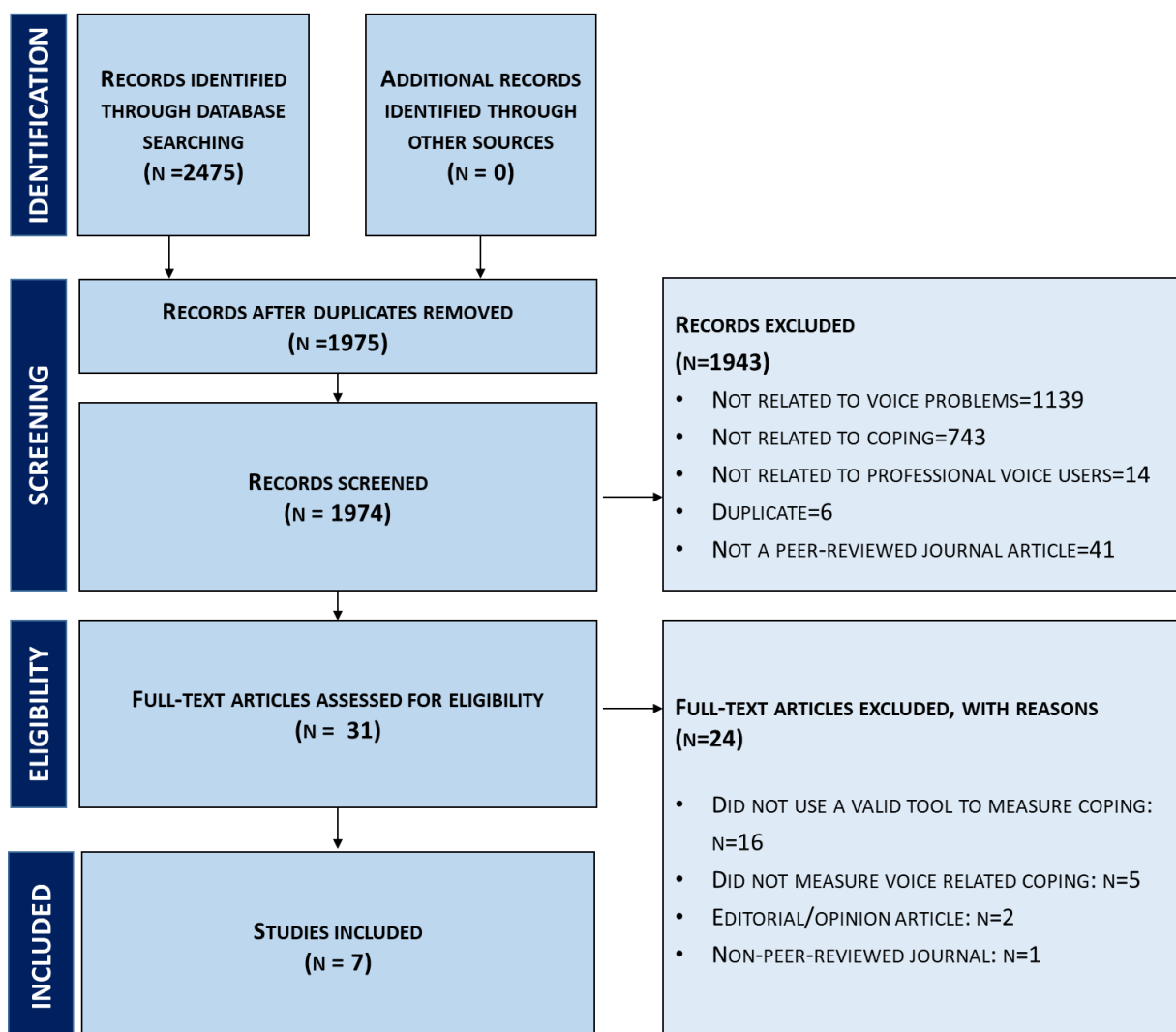
3.4.2 Study Characteristics

Study characteristics are detailed in Table 3.1. The publication dates of the studies ranged from 2003-2017 spanning a period of 15 years. Of the seven included studies, three took place in the Netherlands (De Jong et al, 2003; Meulenbroek et al, 2010a; Meulenbroek et al, 2010b), two in Brazil (Ferracciu et al, 2015; Zambon et al, 2014), one in Sweden (Ahlander et al, 2011) and one in Belgium (Van Wijck-Warnaar et al, 2010). Five studies employed a cross sectional study design with a control group, while the other two used a case control (Ahlander et al, 2011) and a longitudinal (Meulenbroek et al, 2010b) study design.

3.4.3 Participant characteristics

All studies included in the review involved teachers and/or student teachers; no studies involving other professional voice users were identified. The sample sizes ranged from 43 (Meulenbroek et al, 2010b) to 911 (De Jong, 2003). The mean age of participants ranged from 18.6 years (Meulenbroek et al, 2010b) to 48.7 years (Ahlander, 2011) and the age range, in the studies that reported it, was 16-62. Five studies recruited only women and two recruited participants from both genders (Ahlander et al 2011 and De Jong, 2003). There was a total of 1322 female cases, 26 male cases (total n=1348) and 1136 control subjects. Since information regarding sex was not provided in the largest study (De Jong et al, 2003) for the control group, the number of males and females in the control groups across the review could not be generated. The participants ranged from student teachers to primary and secondary school teachers.

Fig 3.2 - PRISMA Flow Diagram illustrating the study selection process



3.4.4 Methodological quality

The cross-sectional studies (n=5), and the case-control study (n=1) were assessed using the JBI tool designed specifically for these study designs. Since a critical appraisal tool specifically designed for longitudinal studies could not be found, the JBI cohort design tool was used for assessing the quality of the longitudinal study (n=1). The initial agreement between the reviewers was 61%. The items with disagreements were discussed between the raters and consensus was reached (100% agreement) for all items. Only one study was rated as of good methodological quality (Ahlander et al, 2012) and the other studies (n=6) were of fair quality. Table 3.2 describes the results of the quality assessment with individual item scores.

Since the studies were of acceptable methodological quality, all seven studies were taken forward for data synthesis.

3.4.5 Assessment of coping

The Utrecht Coping List (UCL) (Scheurs et al, 1988) was used in four studies all of which were undertaken in Europe. UCL is a questionnaire that assesses the general coping style of individuals using 47 questions across seven subscales (Table 3.3). One study used only some sections of the UCL (22 out of 47 questions). The two Brazilian studies used the Voice Disability Coping Questionnaire (VDCQ) (Epstein et al, 2009). VDCQ has 15 items across four subscales which helps to generate a coping profile to evaluate how individuals cope with voice problems. However, they used an earlier version of VDCQ with 27 items, which was culturally adapted and translated to Brazilian Portuguese, where items are classified as 'problem focused' or 'emotion focused' strategies instead of the four subscales described in the original VDCQ. The various coping subscales measured by UCL and VDCQ and their definitions are provided in Table 3.3.

One study (De Jong et al, 2003) used a different approach where coping was conceptualized and assessed based on the principles of the psychological cascade model (Anderson et al, 1995). The psychological cascade model describes three phases from dysfunction to recovery-phase 1, where the patient considers the disorder a threat which is characterized by anxiety, fear and terror of loss, struggle against the loss, searching for help, exhaustion and isolation, and depression; phase 2 (called the pit), characterized by surrendering to the loss without giving up; phase 3 which is characterized by hope and renewal which may lead to recovery. The model also describes some maintaining factors and coping strategies (described in terms of externalization, dependence and awareness) which is believed to influence transition between the phases. According to the model,

a patient proceeds from phase 1 to phase 2 if the maintaining factors are absent and coping strategies are adequate. Alternatively, if coping is inadequate and the maintaining factors are too strong, the patient may be in a deadlocked situation of phase 1 thereby promoting chronicity.

3.4.6 Coping strategies used by professional voice users to manage voice problems

The findings have been organized based on the assessment tool since the constructs used to measure coping are different in the UCL (seven subscales) and VDCQ (problem-focused vs emotion-focused).

Of the four studies that used UCL to assess coping, two studies (Meulenbroek et al, 2010a and Van Wijck-Warnaar et al, 2010) reported the median values of the UCL subscales for teachers with low and high vocal handicap measured using the Voice Handicap index. The combined median scores of the two groups (high and low vocal handicap) across both studies are presented in Figure 3.3.

Fig 3.3: Comparison of UCL scores of teachers with low and high vocal handicap and normative scores

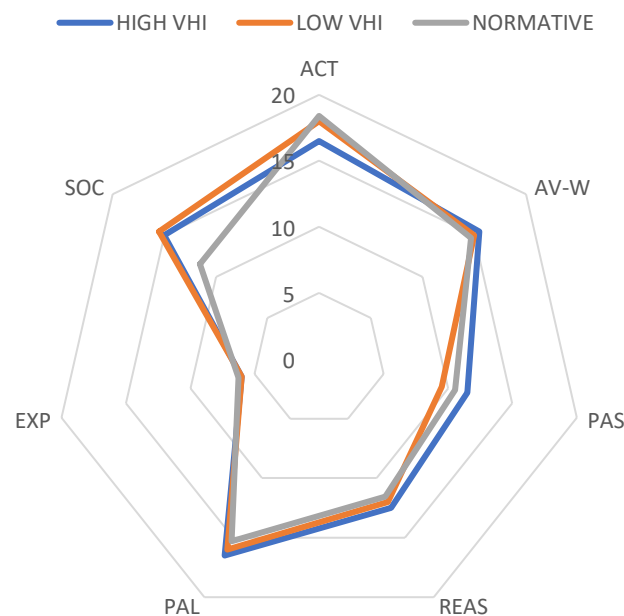


Fig 3.3: VHI=Voice Handicap Index, ACT=Active confrontation or dealing with the problem, Av W=avoidance/waiting, PAS=passive reaction pattern (PAS), REAS=reassuring thoughts, PAL=palliative reactions, EXP=emotional expression, SOC=seeking for social support

A comparison of the UCL scores of the two teacher groups in the two studies with the normative scores of the UCL subscales (Scheurs et al, 1988) revealed the following patterns:

- Teachers with low vocal handicap tended to mirror the normative curve closely, barring the social support subscale, which was higher in both groups of teachers than the controls.
- Teachers with high vocal handicap used more passive coping than teachers with low vocal handicap and the controls, indicated by higher scores in the subscale 'passive reaction pattern'.

- Teachers with high vocal handicap used lesser active coping than teachers with low vocal handicap and the controls, indicated by lower scores in the subscale ‘active confrontation or dealing with the problem’

To summarize, teachers in general used social support more than the control groups (based on the published normative scores), while teachers with high vocal handicap employed more passive coping and less active coping.

A summary of coping patterns based on UCL subscale scores is presented in Table 3.4 for three studies where subscale scores were available (Meulenbroek et al, 2010a; Meulenbroek et al, 2010b & Van Wijck-Warnaar et al, 2010) . In comparison to teachers with low vocal handicap, three studies reported higher scores on the ‘Passive reaction pattern’ subscale, in teachers with higher vocal handicap. Results also showed that teachers with high vocal handicap were less likely to use “active confrontation or dealing with the problem” and “reassuring thoughts” strategies to cope with vocal handicap.

One study did not report the UCL subscale scores; however, they indicated that there was no significant difference in UCL scores between teachers with and without self-reported voice problems (Ahlander et al, 2012). All further details pertaining to results are described in Table 3.5

Table 3.1: Description of study characteristics

STUDY NAME	COUNTRY	PARTICIPANTS	AGE MEAN, (SD), RANGE	SEX		STUDY DESIGN	RESPONSE RATE
				Males	Females		
Ahlander (2012)	Sweden	Total N=62 N=31: Teachers with self-reported voice problems having 15 years of teaching experience (Cases) N=31: Age, gender and school matched teachers without self-reported voice problems having 15 years of teaching experience (Controls)	Mean ages: Cases=48.7 (10.7); Controls=44.6 (9.9)	Group 1=5 (16.12%) Group 2=5 (16.12%)	Group 1=26 (83.87%) Group 2=26 (83.87%)	Case control	47.10%
De Jong (2003)	NL	Total N=911 N=76: Primary and secondary teachers with self-reported voice problems (Cases) N=835: Primary and secondary teachers without self-reported voice problems (Controls/comparison group)	Mean age: cases=45 (NR); Controls: NR Age range: cases=23-59 (NR); Controls: NR	Cases=21 (27.63%)	Cases=55 (72.36%) Controls-No info	Cross-sectional with comparison group	NR
Ferracciu (2015)	Brazil	Total N=110 N=39: Elementary school teachers with voice disorder (based on 100mm VAS: >35mm) (Cases) N=71: Elementary school teachers without voice disorder (based on 100mm VAS: <35mm) (Controls/comparison group)	Mean age=45.81 (7.41) Age range=29-62	-	Females only=110	Cross sectional with comparison group	NR
Meulenbroek (2010a)	NL	Total N=755 N=186: Student teachers with high vocal handicap (75 th percentile of VHI) (Cases) N=167: Student teachers with low vocal handicap (25 th percentile of VHI) (Controls/comparison group) N=402 moderate handicap (not analyzed)	Mean age=18.8 (NR) Age range=16-29	-	Females only=755	Cross sectional with comparison group	100%
Meulenbroek (2010b)	NL	Total N=43 Student teachers having 2 training periods (2 days a week for 25 days)	Mean age=18.6 (NR) Age range=17-23	-	Females only=43	Longitudinal survey	42%
Van Wijck-Warnaar (2010)	Belgium	Total N=470 N=230: Primary school teachers with voice problems of which N=56 have high vocal handicap (75% percentile of VHI scores) and N=54 have low vocal handicap (Cases) N=240: Females from general population (Controls/comparison group)	Mean ages: Teachers=36.3 (NR) Controls=40.4 (NR) Age Range	-	Females only Cases=230 Controls=240	Cross sectional with comparison group	Teachers=51% Controls=60%

STUDY NAME	COUNTRY	PARTICIPANTS	AGE MEAN, (SD), RANGE	SEX		STUDY DESIGN	RESPONSE RATE
				Males	Females		
			Teachers=21-60; controls=21-59				
Zambon (2014)	Brazil	Total N=90 N=30: Primary, middle and high school teachers with self-reported voice problems who sought voice therapy (Cases-Group 1) N=30: Primary, middle and high school teachers with self-reported voice problems who did not seek voice therapy (Cases-Group 2) N=30: Primary, middle and high school teachers without self-reported voice problems (Controls/comparison group-Group 3)	Mean ages: Group 1=26.2 (7.5); Group 2=35.1 (7.9); Group 3=37.2 (9.8) Age range: Group 1=23-49; Group 2=21-51; Group 3=23-66	-	Females only=90	Cross sectional with comparison group	NR

Table 3.1: NL-Netherlands, SD-Standard Deviation, NR-Not Reported, VAS-Visual Analogue Scale, VHI-Voice Handicap Index.

Table 3.2: Quality assessment of the selected articles using the Joanna Briggs Institute Critical Appraisal tools

	Ahlander (2011)	De Jong (2003)	Ferraciu (2015)	Meulenbroek (2010a)	Meulenbroek (2010b)	Van Wijck- Warnaar (2010)	Zambon (2014)
Comparability Of Groups (For Case Control studies)	2	NA	NA	NA	NA	NA	NA
Matching of Cases and Controls (For Case Control Studies)	1	NA	NA	NA	NA	NA	NA
Same Criteria for Identification of Cases and Controls (For Case Control Studies)	2	NA	NA	NA	NA	NA	NA
Clearly Defined Inclusion Criteria	NA	2	1	2	NA	1	2
Description of Sample And Setting	NA	1	1	1	NA	1	1
Valid and Reliable Measurement of Exposure	2	2	1	1	1	2	1
Same Measurement of Exposure for Cases and Controls (For Case Control Studies)/ Free of exposure at start of study (For longitudinal study)	2	NA	NA	NA	1	NA	NA
Measurement of Condition Using Objective Standard Criteria	NA	2	2	1	NA	1	1
Identification Of Confounding Variables	1	1	2	2	2	1	2
Strategies Adopted to Deal with Confounding Variables	1	1	2	2	2	1	1
Valid and Reliable Measurement of Outcomes	2	1	0	1	2	2	0

	Ahlander (2011)	De Jong (2003)	Ferracciu (2015)	Meulenbroek (2010a)	Meulenbroek (2010b)	Van Wijck- Warnaar (2010)	Zambon (2014)
Adequate Duration of Exposure (Only Applicable for Case Control and longitudinal Studies)	1	NA	NA	NA	2	NA	NA
Appropriate Statistical Analysis	2	2	2	2	2	2	2
Completion of follow up (For longitudinal studies)	NA	NA	NA	NA	0	NA	NA
Utilization of strategies to address incomplete follow-up (For longitudinal studies)	NA	NA	NA	NA	0	NA	NA
Total Score	16/20	12/16	11/16	12/16	12/18	11/16	10/16
Total Score (%)	80%	75%	69%	75%	67%	69%	63%
Quality Level	Good	Fair	Fair	Fair	Fair	Fair	Fair
Include/Exclude	Include	Include	Include	Include	Include	Include	Include
<i>Table 3.2: NA=Not applicable</i>							

Table 3.3: Details of coping subscales measured by UCL and VDCQ

Voice Disability Coping Questionnaire		
Subscale	Definition	No: of items in each subscale
Information seeking	“Problem solving coping through seeking information about the condition”	2
Passive coping	“Individuals who do not embrace or reject any proactive coping strategy”	4
Avoidance	“Use of denial, withdrawal, and reorganization of routine activities in the face of dysphonia”	3
Social support	“Range of interpersonal exchanges that provide the individual with information, emotional reassurance, material assistance and self-esteem”	6
Utrecht Coping List		
Subscale	Definition	Number of items in each subscale
Active handling	Active approach to solve a problem where the problem is thought about and approached directly	7
Palliative Reactions	Efforts directed at changing the feelings elicited by a problem.	8
Avoidance/waiting	No effort to change the problem itself, but avoiding the problem or situation	8
Seek social support	Worries are shared with someone	6
Passive reactions	Feelings of helplessness or being pessimistic and overwhelmed by the problem	7
Expression of emotions	Expressing feelings about the problem to others	3
Reassuring thoughts	Engaging in self-encouragement and comforting thoughts	5

Table 3.4: Coping patterns seen in teachers with high vocal handicap based on UCL subscales

Study	Active confrontation or dealing with the problem	Avoidance -Waiting	Passive reaction pattern	Reassuring thoughts	Palliative reactions	Emotional expression	Seeking for social support
Meulenbroek (2010a)		✓	✓		✓	✓	
Meulenbroek (2010b)			✓	X			✓
Van-Wijck Warnaar (2010)	X		✓				✓
Table 3.4: Ticks indicate strategies used more and crosses indicate strategies that are unlikely to be used in teachers with voice problems							

Table 3.6 presents the synthesis of 10 most reported items by groups with voice disorders from the two studies (Ferracciu et al, 2015 and Zambon et al, 2014) that used the VDCQ. Overall, results of 99 patients were analyzed. Five problem-focused and four-emotion focused strategies were reported across the two studies. Additionally, we attempted to classify these items based on the original four subscales of the VDCQ namely information seeking, seeking social support, passive coping and avoidance. This was done by cross-referencing these items with the original published article of the standardization of the VDCQ (Epstein et al, 2009). The frequency of occurrence of each subscale is provided in Table 6. The results of the VDCQ suggested that seeking social support was the most commonly used mode of coping whereas avoidance was used the least.

De Jong (2003) did not use a standardized coping assessment tool since the parameters considered for assessment in the study were directly linked to the psychological cascade model. The results revealed that coping contributed to patients remaining in phase 1 of the psychological cascade model where the patient continues to view the problem as a threat and is anxious, struggling, exhausted and potentially depressed as a result of remaining in phase 1. Of these factors, externalization (whether the patient experienced the causes and solutions of problems as being beyond his control) and unawareness (awareness of whether one was actually in phase 1 of the psychological cascade model) were most correlated with phase 1. Due to differences in methodology, particularly the definition and measurement of coping, the outcomes of this study could not be synthesized with the other studies of this review and are presented separately.

3.4.7 Factors associated with coping in professional voice users

None of the studies aimed to investigate factors affecting coping; however, results from three studies (Meulenbroek et al, 2010a; Meulenbroek et al 2010b; Van Wijck Warmaar, 2010) which used the Voice Handicap Index and the UCL suggested that perception of vocal handicap influenced coping styles, leading to significant differences in UCL subscale scores between groups with high and low vocal impairment. Details about these differences can be found in Table 3.5.

Meulenbroek et al (2010b) reported that student teachers in training showed a more passive style of coping at the end of their training period suggesting that trainee experience could potentially influence coping.

Table 3.5: Synthesis of outcomes reported in the included studies

STUDY NAME	OBJECTIVES	ELIGIBILITY CRITERIA	COPING RELATED OUTCOMES	KEY STUDY CONCLUSIONS
Ahlander (2011)	1. Compare teachers with and without self-reported voice problems and relate the self-assessed voice function to laryngeal findings, voice quality, personality and psychosocial circumstances such as burnout and coping.	Inclusion: 1. Cases and controls belong to the same school 2. Subjectively free from upper airway infections and allergies	No significant differences between teachers with and without self-reported voice problems	1. No significant differences were found within the pairs with respect to coping strategies.
De Jong (2003)	1. Describe the factors that maintain the voice problem and the way in which teachers with chronic voice complaints cope with their voice problem 2. Address the question whether a parallel can be drawn to the psychological cascade model	1. A history of persisting voice problems 2. A previous or present period of absence from work due to voice problems.	Number of patients in: Phase 1: 54 (71%) Phase 2: 12 (16%), Phase 3: 11 (14%) 1. Unawareness: present in 30 patients (39%) 2. Externalization: present in 57 patients (75%). 3. Dependence: present in 51 patients (67%) Significant difference between patients in phase 1 and not in phase 1 with respect to prevalence of: a. unawareness: $p=0.001$ b. externalization: $p\text{ value}=0.001$ c. dependence: $p=0.015$ d. VAS: $p=0.039$ Factors significant to classify patients into phase 1 or not in phase 1 a. unawareness: $p=0.033$ b. Externalization: $p=0.009$	1. Organic lesions may not be responsible for maintaining a voice problem. 2. The positive correlation between the maintaining and coping factors and the severity of voice complaints suggest that these factors play a role in keeping up the voice problem. 3. Patients found in phase 1 are in a deadlocked situation due to the 3 ways of coping-externalization, unawareness and dependency.

STUDY NAME	OBJECTIVES	ELIGIBILITY CRITERIA	COPING RELATED OUTCOMES	KEY STUDY CONCLUSIONS
Ferracciu (2015)	Assess the association between voice disorders with sociodemographic characteristics, vocal aspects, types of coping strategies and vocal impact on daily activities.	Exclusion: Males	VDCQ results-frequency of 5 most reported items for groups with and without (in brackets) voice disorder Item 1: "It helps me to cope with my voice problem if other people are sympathetic"- 94.9%, (87.3%) Item 8:" I find it easier to cope with my voice problem by finding out as much about it as I can" 87.2%, (84.5%) Item 13: "I find it easier to cope with my voice problem if I ask the doctor questions about it"-87.2%, (83.1%) Item 24: "Resting my voice at times, helps me cope with my voice problem" 87.2%, (78.9%) Item15: "I find it easier to cope with my voice problem by wishing that it would go away or somehow be over with"- 84.6% (only group with voice disorder) Item 2: "I try to avoid situations where my voice problem would become evident" (77.5%) (only group without voice disorder)	1. No significant differences in coping reported between the groups 2. Slightly inclined to use more problem focused strategies although not statistically significant
Meulenbroek (2010a)	Investigate coping behavior in relation to the biopsychosocial impact of the voice in female student teachers.	Exclusion: Male students	PAL VHI>75-17 (10-25), VHI<25-16 (8-24); p<0.001 AV-W VHI>75-16 (11-26) VHI<25-15 (8-24); p<0.001 PAS VHI>75-11 (7-21) VHI<25-9 (7-20); p<0.001 EXP VHI>75-6 (3-11) VHI<25-6 (3-11); p<0.003	1. Student teachers with relatively high VHI scores showed higher scores on all subscales related to a passive coping style such as PAS, AV-W and PAL
Meulenbroek (2010b)	Investigate the relation between trainee periods and voice handicap, the general coping style and psychosomatic well-being in starting student teachers	Exclusion: Male students	Difference in VHI total scores in relation to UCL subscale scores PAS Higher VHI- PAS LOW=3 (30) PAS HIGH=7 (70) Lower VHI PAS LOW=22 (66.7) PAS HIGH=11 (33.3); p=0.039 SOC Higher VHI- SOC LOW=5 (50) SOC HIGH=5 (50) Lower VHI SOC LOW=20 (76.9) SOC HIGH=13 (23.1); p=0.551 REAS	1. At the end of training period, 40% students showed more passive coping modes. 2. Students with high VHI at the end of training showed higher scores in PAS and higher risk for higher score in SOC and

STUDY NAME	OBJECTIVES	ELIGIBILITY CRITERIA	COPING RELATED OUTCOMES	KEY STUDY CONCLUSIONS
			Higher VHI- REAS LOW=8 (80) REAS HIGH=2 (20) Lower VHI REAS LOW=21 (63.6) REAS HIGH=12 (36.4); p=0.333	lower risk of higher score in REAS. 3. Overall coping style is more passive than active.
Van Wijck-Warnaar (2010)	Explore the general coping style of female teachers who report a relatively low voice handicap compared with teacher who report a relatively high voice handicap.	Exclusion: Males	Median and (IQR values) and significance value: Teachers: ACT low VHI-19.0 (3.00), high VHI-16.0 (4.25); p =0.001 PAS low VHI-10.0 (3.00), high VHI-12.0 (5.00); p =0.001 General population and teachers irrespective of vocal handicap SOC p =0.001 (mean and IQR values not provided) General population and teachers-high voice handicap SOC Teachers-15.0 (6.00), Controls-13.0 (5.25); p =0.022 AV-W Teachers-15.0 (4.00), Controls-16.0 (3.00); p=0.027	1. Teachers with high VHI cope overall with a passive reaction pattern and less with an active coping style. 2. Teachers in general tend to seek for social support.
Zambon (2014)	1. Understand coping strategies used by teachers with vocal complaint 2. Compare the differences between those who seek and do not seek treatment 3. Check relationship between coping and perceptual analysis, vocal signs and symptoms and VAPP	Exclusion: 1. Use of medications for psychiatric disorders during time of research 2. Being off work/unemployed 3. History of previous voice therapy 4. Males	Strategies which were reported more by group 1-Frequency and significance Item 2:" I try to avoid situations where my voice problem would become evident"- G1-26 (86.7%), G2-17 (56.7%), G3-10 (33.3%), p=0.010 Item 4: "I try to find as much information as possible about my voice problem"-G1-28 (93.3%), G2-20 (66.7%), G3-6 (20%), p=0.010 Item 5: "I find it easier to cope with my voice problem by expressing my feelings outwardly"- G1-26 (86.7%), G2-18 (60%), G3-8 (26.7%), p=0.020 Item 13: "I find it easier to cope with my voice problem if I ask the doctor questions about it"- G1-28 (93.3%), G2-19 (63.3%), G3-4 (13.3%), p=0.005	1. Strategies used by teachers with vocal complaints are more problem focused. 2. No correlation observed between VDCQ scores and treatment seeking behavior

STUDY NAME	OBJECTIVES	ELIGIBILITY CRITERIA	COPING RELATED OUTCOMES	KEY STUDY CONCLUSIONS
			Reported more by G2 Item 22: "I ignore my voice problem by only looking at the good things in life" - G1-9 (30%), G2-18 (60%), G3-5 (16.7%), p=0.020	

Table 3.5: VAS=Visual Analog Scale, VHI=Voice Handicap Index, PAL=Palliative Reactions, AV-W=Avoidance and Waiting, PAS=Passive Reaction, EXP=Expression of emotion, ACT=Active tackling, SOC=Seeking social support, REAS=Reassuring thoughts, VAPP=Voice Activity and Participation Profile

Table 3.6: Combined frequencies of 10 VDCQ items with highest scores reported by Zambon et al (2014) and Ferraciu et al (2015) and classification of items into relevant subscales of the original validated version of the VDCQ (Epstein et al, 2007)

Q no:	Question	n - Yes (%)	Category	Info Seeking	Social Support	Passive Coping	Avoidance
8	I find it easier to cope with my voice problem by finding out as much about it as I can	87%	Problem	✓			
13	I find it easier to cope with my voice problem if I ask the doctor questions about it	82%	Problem		✓		
24*	Resting my voice at times, helps me cope with my voice problem	82%	Problem				
3	I find myself wishing that I never had a voice problem	80%	Emotion			✓	
1	It helps me to cope with my voice problem if other people are sympathetic	79%	Emotion		✓		
4	I try to find as much information as possible about my voice problem	79%	Problem	✓			
15	I find it easier to cope with my voice problem by wishing that it would go away or somehow be over with	77%	Emotion			✓	
2	I try to avoid situations where my voice problem would become evident	75%	Problem				✓
5	I find it easier to cope with my voice problem by expressing my feelings outwardly	75%	Emotion		✓		
7	I find talking with friends and family about my voice problem helpful	72%	Problem		✓		

Table 3.6: *Question 24 is not a part of the original VDCQ items; therefore, the subscale could not be determined.

3.5 DISCUSSION

The purpose of this review was to investigate how professional voice users cope with voice problems. It also aimed to evaluate how coping was assessed and identify factors associated with coping in professional voice users.

Coping with voice problems in professional voice users was explored in this review. Seven studies fulfilled the inclusion criteria and were included in the review. We found that teachers used both active/problem focused and passive/emotion focused coping styles with a slight inclination towards the former. While studies using the UCL reported a more passive coping style and lesser active coping in teachers with higher vocal handicap, studies using the VDCQ reported that social support was used the most in teachers with voice problems and avoidance, the least. Seeking social support was highlighted as a frequently used coping strategy across studies and measures. In terms of factors affecting coping, vocal handicap was an influencing factor; and in student teachers, trainee periods seemed to affect coping.

An issue in this review was that though all professional voice users were included in the search strategy, all studies found were undertaken with teachers. This could be because teachers are a common profession with high voice use and at a higher risk for developing a voice disorder and has therefore received more research attention. Additionally, teachers may also be easier to recruit since considerable numbers of participants can be recruited from a single source (e.g., schools, universities). The evidence base was highly focused on female voice users with five of the seven studies recruiting only females. The justifications provided for recruiting only females were higher incidence of voice problems in women (Meulenbroek et al, 2010b) and that the majority of the teaching population were women (Ferracciu et al, 2015). However, it can be argued that focusing on only one gender does not allow the testing or verification of whether males and females use different coping strategies. It is, therefore, imperative to study both genders to verify if females and males use different coping strategies in future studies.

In terms of the quality of the included studies, limited information was provided regarding the participants and setting in six out of seven studies. This posed difficulties in making comparisons across studies particularly to identify factors that may be associated with coping. Only one study was of good methodological quality (Ahlander et al, 2012). The two Brazilian studies scored the lowest among all

the studies included in the review. This was due to methodological flaws in the use of VDCQ and reporting of results where both studies described the frequency of use of coping strategies using a presence/absence paradigm rather than using the 6-point Likert scale of the VDCQ, thereby reducing specificity and variance of the collected information.

The review summarized the measures used to assess coping in teachers. The tools used for self-assessment of coping were UCL and VDCQ. Though there is overlap between subscales of the two measures (e.g; social support, passive coping), subscales of UCL are constructed on the premise that individuals tend to use fairly similar coping strategies across a wide variety of situations. Therefore, UCL conceptualizes coping as a trait or disposition and essentially measures coping styles and describes the consistent ways in which individuals cope with stress providing validity across different situations (Greenaway et al, 2015). This was reflected in the present review where the measure was used consistently and reliably across all studies (n=4) and yielded similar results. This stability also enables the use of one set of normative data developed by the authors for comparison with different populations across studies. However, measurement of coping as a dispositional style does not account for the inevitable variability in coping behavior induced by the context, thereby oversimplifying the coping process (Greenaway et al, 2015). Moreover, UCL is a generic coping questionnaire that is not disease specific and is therefore not specifically designed to measure voice-related coping. It could be argued that the lack of context-specificity of UCL could potentially overlook the dynamism of a voice problem across situations and across time. Secondly, the full version of UCL is long with 47 questions and could be wearisome and tiring for patients, thereby leading to information loss if not completed in full or properly due to response fatigue.

In comparison to UCL, VDCQ is a disease specific-measure that allows clinicians to evaluate voice-related coping, in a relatively shorter format. The VDCQ measures coping as a state rather than a trait, which means it assumes coping to be a process that is linked to the situation (such as vocal problems, and the specific stage or time within the course of the illness trajectory) rather than a personality characteristic which is relatively stable across situations.

Only two studies in the review used VDCQ to assess coping in teachers and there were issues with scoring. The original 15-item VDCQ compares the individual mean item scores of the four subscales to generate coping profiles. However, both studies in the review used an earlier 27-item version of VDCQ

and adopted a binary subclassification namely problem focused and emotion focused strategies. Additionally, both studies reported results based on the total VDCQ scores which only shows the levels of overall coping rather than identifying patterns across subscales and does not provide a meaningful measure e.g., a higher total VDCQ score does not indicate effective coping. Therefore, these results were not included in the review and only the absolute values of individual items provided by both studies were considered for analysis. This, however, poses an inherent lack of clarity in the interpretation of VDCQ which is supported by the results of a systematic review conducted by Francis et al (2017) on patient-reported outcome measures for voice. They reported that the VDCQ does not describe the proposed scoring approach or algorithm which would assist in interpretation.

Results of UCL and VDCQ revealed that teachers in general have an inclination to seek support from their peers, friends and family. Evidence (Tamres et al, 2002) suggests that women are more likely to seek social support to deal with problems which may explain this finding since most of the participants in the present review were women. Van-Wijck Warneer (2010) suggests that a passive coping response indicates a defensive approach, where teachers demonstrate an inclination to use situation oriented or emotion focused strategies. They indicated that the combination of social support and passive coping strategies is maladaptive and can be detrimental to effective problem solving and lead to reduced self-esteem and self-confidence. Passive coping is also linked to the development of psychological and physical symptoms and active-problem solving coping to increased well-being and overall health outcomes (Penley et al, 2002). To illustrate this point further, let us consider a singer who has developed hoarseness of voice. They may take control and seek medical help to know more about the problem which is likely to culminate in a positive outcome. Alternatively, they may undertake a passive approach and continue performing, hoping that the voice problem would resolve on its own, thereby creating a situation where a more serious and permanent vocal damage is possible. Even though the pattern of results from research suggests that passive coping correlate with better outcomes, Austenfield and Stanton (2004) refuted this view after performing a systematic review that examined this relationship. They concluded that it was unfeasible to collectively report findings on the association between active and passive coping styles and physical and psychological symptoms due to the vast differences in coping strategies included in the assessment tools and how these strategies were operationally defined. Therefore, implications regarding coping purely based on the active/passive paradigm should be interpreted with caution and clinicians should provide guidance on adaptive coping based on a

multifaceted approach, considering specific coping styles or strategies and context requirements, including the stage of illness. Epstein et al (2009) suggested that individuals with 'chronic' conditions, which require coping with the voice problem over a lengthy period of time, such as Spasmodic Dysphonia, are likely to use avoidance and passive coping because they feel there is little they can do about their voice problem. While this may be beneficial for the individual in the short term, especially in the early stages of the illness, long term use of these mechanisms could impact their quality of life. Therefore, the frequency of use of such strategies should be closely monitored throughout the illness, to avoid maladaptive behavior.

De Jong (2003) explored coping strategies in teachers with persisting voice problems by drawing parallels with the psychological cascade model described by Anderson (cited in De Jong et al, 2003). The study suggested that the majority of the teachers were stuck in phase 1 of the psychological cascade model due to a combination of externalization and unawareness, along with the severity of the voice problem. These factors hindered progressing to phase 2 and 3 which is characterized by acceptance of the disorder and hope finally leading to recovery. Therefore, this study highlights the temporal nature of the process of coping and its evolving trajectory across situations and reiterates the need to take context of the condition into account while taking clinical decisions.

Rong et al (2017) explored the factors affecting adoption of coping strategies while dealing with illness and reported that ethnicity, religion, disease duration, symptom management and various sociodemographic factors influenced coping. Current research in professional voice users does not sufficiently specify these parameters to allow comparisons and synthesis.

3.5.1 Limitations and strength of evidence

A vast amount of heterogeneity was noticed in the results and methodologies adopted to measure outcomes related to coping. The primary reason is the diversity of definitions used to describe coping and lack of a consistent conceptual framework to study coping. More specifically, coping in the context of voice disorders has not received much attention, particularly pertaining to professional voice users.

As indicated above, only studies involving teachers were identified and included in the review. This limits the generalizability of the findings to other professional voice users. Moreover, the quality of included studies was fair.

Despite these limitations, an extensive search was carried out to identify articles for this review. The search was implemented across 10 databases using both EBSCO and Ovid platforms. Additionally, grey literature was also searched, and reference tracing undertaken. These improve the strength of the present review in terms of comprehensiveness of the search results. This review is the first of its kind to examine voice-related coping in professional voice users and provides a comprehensive analysis of research evidence in the area.

3.6 CONCLUSION AND FUTURE DIRECTIONS

Results of the systematic review identified significant gaps in the evidence base, pertaining to methodological strength and population groups. Firstly, only one study was found to be of good methodological quality which recognizes the need for well-developed studies with clear and reliable reporting of results. Secondly, this review identified that only teachers have been studied in the context of coping. More research is warranted involving other professional voice users such as singers to determine if similar mechanisms and resolutions apply. Similarly, a greater balance in examination of genders to identify if they use different strategies is recommended.

Models and frameworks that research coping (transactional model etc.) can account for context and changes over time. Using models, frameworks and qualitative methodologies will provide in-depth understanding of coping processes. Current research does not sufficiently specify factors affecting coping to allow comparisons and synthesis. Examining the influence of constructs such as impact of voice problems, measured using standardized tools such as the Voice Handicap Index (Rosen & Murry, 2000), Voice Activity Participation Profile (Ma & Yiu, 2001) etc. on coping would widen the understanding of factors affecting coping and is a potential area for further research.

[End of published peer-reviewed paper in Journal of Voice]

3.6.1 Implications for the present programme of research

The review was originally focused on singers; however, the current review explored evidence on voice-related coping in professional voice users. All studies included in the review recruited teachers as participants. Even though teachers and singers use their voices for their livelihood and have commonalities pertaining to voice use, vocal impairment, handicap and impact of voice problems on quality of life, there are also important differences between the groups. The classification of voice users by Koufman and Isaacson (1991) places singers in the highest level called elite vocal performers and

teachers in the second level called professional voice users. This implies that singers have a more specialised use of voice which could possibly affect the impact of voice disorders as well as coping. Therefore, results of this review, albeit useful to plan the methodology of the present programme of research, will be interpreted with caution.

Results of the systematic review confirm the need to examine voice-related coping since significant gaps have been identified in the evidence base. The present programme of research will therefore aim to provide much needed information on how singers cope with voice problems and verify its impact on vocal health/handicap. Additionally, the lack of qualitative studies to assess voice-related coping will also be addressed by exploring voice-related coping in singers using a well-established qualitative methodology (Chapter 4).

The results of the present review will be useful in developing the interview guide for the qualitative study (Chapter 4) by providing relevant themes to be explored within the context of coping (e.g., do singers also engage in seeking social support or undertake passive coping strategies similar to teachers) particularly to fill the gaps identified by the review (e.g., what are the factors which impact coping). The present review will also aid in developing the questionnaire for the survey (Chapters 5, 6 and 7). The review has highlighted the usefulness of self-report measures to assess coping in professional voice users and reiterated that VDCQ is a disease specific measure that can provide information pertaining to voice-related coping with more specificity compared to a generic tool like UCL. VDCQ will therefore be the measure of choice to study voice related coping in the quantitative arm of the present thesis (survey) However, VDCQ has not been used in singers (as no relevant studies were found in the review); therefore, the necessity of adding additional items which may be relevant to this population will be considered. The results of the qualitative study (which will be discussed in the next chapter) will identify any missing themes within VDCQ related to assessing voice-related coping in singers and necessary amendments/additions will be made to VDCQ before it is used in the survey (Chapters 5, 6, and 7). Therefore, the results of the present review will also aid in potentially developing a version of VDCQ to be used specifically with the singing population which will then be subsequently included in the survey instrument (this will be discussed further in section 5.3.4.6). Finally, the results of the present review will provide an opportunity to compare the results of the survey and thereby determine if singers present with similar or different coping strategies compared to the population explored in the systematic review.

4 CHAPTER 4: QUALITATIVE STUDY TO EXPLORE PERCEPTIONS OF WESTERN CLASSICAL AND CARNATIC SINGERS, SINGING TEACHERS AND SPEECH AND LANGUAGE THERAPISTS REGARDING SELF-REPORTED VOICE PROBLEMS AND VOICE-RELATED COPING IN SINGERS

The previous chapters (chapters 2 and 3) systematically reviewed the literature pertaining to self-reported voice problems and coping strategies in classical singers and professional voice users respectively. The present chapter will describe the methodology, results and implications of a qualitative study that was undertaken as part of the current programme of research. This study will explore self-reported voice problems, coping strategies, factors influencing vocal health and strategies used by singers to maintain vocal health.

4.1 INTRODUCTION AND NEED FOR THE STUDY

Voice problems in singers are generally identified and managed by a multi-disciplinary team comprised of ENT specialists, speech and language therapists (SLT), and occasionally singing teachers. While the ENT specialists focus on the diagnosis and medico-surgical treatment (when warranted), speech and language therapists and singing teachers are actively involved in providing therapeutic intervention and singing vocal training respectively, to improve all aspects of voice (ease of phonation, breathing, posture etc.) in a more holistic manner. Collaborative efforts (which involves consistent and non-conflicting recommendations) by all professionals can provide the best possible care for a singer and enable them to use their voice in an optimal and efficient manner. The assessment methods and tools used for clinical diagnosis vary greatly across clinics and practitioners. A small number of scales and questionnaires have been developed to specifically assess self-reported voice problems in singers which have been discussed in the introduction chapter (Table 1.2)

SLTs specialised in care of the professional voice are actively involved in identification and management of a variety of voice problems in singers. They will be able to provide reliable accounts of singer self-reported voice problems and the efficacy of assessment tools used to measure them. Information thus gathered could prove useful in improving the sensitivity of voice assessment methods to cater to the needs of a singer. This information is very relevant, given the dearth of research evidence in assessment of voice problems in singers (Kwok & Eslick, 2019; Phylant et al, 2013), which was also highlighted through the systematic review carried out in the present study (Chapter 2).

While SLTs manage the clinical aspects of voice production, singing teachers work on enhancing singing performance by manipulating the artistic elements of singing such as vocal technique (Stemple, Roy &

Klaben, 2014). Research suggests that flawed singing methods and practices can lead to the development of voice disorders (Hogikyan et al, 1999). Also, singers, particularly young singing students in vocal distress frequently approach a vocal coach for advice before consulting a medical professional (Petty, 2012). This would suggest that singing teachers are often the first resort or gate keepers for many singers for seeking professional help and therefore recommendations made by the vocal coach could potentially influence the prognosis of the problem. Further, singing teachers are often capable of detecting perceptually subtle changes or limitations in a singer's voice and refer singers with potential voice disorders to medical professionals (Stemple, Roy & Klaben, 2014). Hence, views and perceptions of singing teachers on self-reported voice problems in singers would enhance the understanding of the complex singing voice; and provide a different perspective to that of an SLT. Collecting information from different professionals could result in a more nuanced perception of the various aspects of voice problems in singers (Stemple, Roy and Klaben, 2014).

Examining the views of SLTs and singing teachers involved in singing voice rehabilitation is useful; however, exploring experiences of singers on self-reported voice problems is essential to get a full picture of the problems they have. Studying self-perception of voice will capture the singer's interpretation of what they think about their voices and their analysis of what impact they create in listeners (Aquino & Teles, 2013). The self-experienced reduction of functional and artistic capacity created by a voice disturbance while singing can only be accurately described by a singer. This information is essential to understand the activity and participation limitations induced by voice problems and their impact on the singer's performance and subsequently, quality of life.

As part of dealing with voice problems, singers may adopt various coping processes to manage their voice problems; however, coping has not been studied in singers (Chapter 3). Since coping can be influenced by cultural and contextual factors (Lazarus & Folkman, 1987) such as singing styles, the mechanisms of coping may be expected to be different in Western classical singers and Carnatic singers even though this has not been previously explored. For example, Carnatic singers have been known to resort to various self-help measures called *paatti vaidyam* (literally translated as Grandmother's medicine) such as consuming turmeric, pepper etc. which could indicate a coping strategy unique to Indian culture (Boominathan, personal communication).

To obtain a holistic and well-balanced perspective of self-reported voice problems and related coping strategies in singers, it is important to gather rich descriptive data from singers and the professionals involved in helping them identify and manage these issues. A cross cultural examination will also highlight the differences in perception of voice problems and coping styles in Western and Carnatic singers and provide an opportunity to compare assessment protocols used by speech and language therapists managing these specific singing groups. Last but not least, the information gathered through this study will aid in developing the assessment protocol for the quantitative survey study (chapter 5).

4.2 AIMS

Qualitative data obtained from Western Classical and Carnatic singers, singing teachers and speech and language therapists was used to answer the following research questions:

1. How do singers, SLTs and vocal coaches describe a normal and pathological voice?
2. What are the vocal problems commonly seen in singers and what are the potential risk factors/causes?
3. How do voice problems impact singers?
4. How do singers cope with voice problems?
5. What are the assessment methods of SLTs working with Western Classical or Carnatic singers to evaluate the voice and coping in singers?
6. What are the beliefs and practices of singers on maintaining vocal health?
7. Are there differences in perceptions of normal and pathological aspects of voice and coping strategies between groups and/or between genres?

The research questions listed below were developed to address the third aim of the present thesis which was “explore perceptions of singers, vocal coaches and speech and language therapists regarding self-reported voice problems in singers and voice-related coping by carrying out detailed semi-structured interviews”. Additionally, some of the research questions also hoped to address the following aims even though they will be primarily addressed by the quantitative arm of the present thesis. These were:

Aim 4: Describe and compare the frequency, severity and nature of self-reported voice problems and coping styles between Western Classical and Carnatic singers and within groups to ascertain the impact of culture, demographic and singing related variables on vocal health.

Aim 5: Examine if there is an association between coping, illness perceptions, demographic, singing medical and lifestyle factors, and self-reported voice problems.

Finally, the qualitative study hoped to inform the development of the survey instrument; therefore, the research questions were developed to provide sufficient data for the same. Table 4.1 describes how the research questions of the present chapter contributed towards addressing the aims and developing the survey instrument.

Table 4.1: Contribution of each research question towards the overall aims of the thesis

RESEARCH QUESTIONS OF THE QUALITATIVE STUDY	RELEVANCE IN ADDRESSING AIMS OF THE PRESENT THESIS
RQ 1: How do singers, SLTs and vocal coaches describe a normal and pathological voice?	It was important to identify the nature and extent of deviation in the voice to be deemed “normal” and “pathological”. This set the foundation to identify self-reported voice problems in singers which is outlined in the first half of aim 3.
RQ 2: What are the vocal problems commonly seen in singers and what are the potential risk factors/causes?	This research question directly addressed the first half of aim 3 related to understanding self-reported voice problems of singers. Factors impacting the voice is outlined in aim 5 of the present thesis were explored through this research question which subsequently aided in the development of the survey instrument.
RQ 3: How do voice problems impact singers?	This research question furthers the understanding of self-reported voice problems by focussing on its impact on the singer. Moreover, this information is crucial as impact is outlined as the main outcomes in the theoretical model.
RQ 4: How do singers cope with voice problems?	This research question directly addresses the second half of aim 3 of the thesis which related to understanding how singers cope with voice problems.
RQ 5: What are the assessment methods of SLTs working with Western Classical or Carnatic singers to evaluate the voice and coping in singers?	Understanding of self-reported voice problems and coping strategies is complete only when information related to how they were assessed is explored. This research question therefore aimed to contribute towards furthering the understanding of self-reported voice problems and coping. Additionally, this information was also crucial to develop the survey instrument by

	providing perspectives on assessment methods employed by SLTs.
RQ 6: What are the beliefs and practices of singers on maintaining vocal health?	Understanding beliefs and practices of singers regarding vocal health maintenance is crucial to identify their efficacy by comparing them with current research evidence and guide in developing the survey instrument. More specifically, this research question provided information to address aim 5 of the present thesis.
RQ 7: Are there differences in perceptions of normal and pathological aspects of voice and coping strategies between groups and/or between genres?	Comparison of self-reported voice problems and coping strategies between genres was one of the main aims of the thesis (as described in aim 4 of the present thesis); even though this aim will be primarily addressed by the quantitative arm of the thesis, the qualitative study hoped to provide some trends which can then be used to compare with the results of the survey and provide a collated impression.

4.3 METHODS

4.3.1 Design

A qualitative analytic methodology was adopted owing to the complexity, diversity and nuanced nature (Holloway and Todres, 2003) of the proposed aims of the study, as it enables a deep exploration of perceptions of the participants regarding voice problems and coping. Qualitative research can undertake a multifaceted approach that is well-suited to studying culture, society and behaviour by analysing and synthesising people's words and actions (Hogan, Dolan and Donnelley, 2009). Qualitative research is concerned with aspects of reality that cannot be quantified (Almeida, Faria & Queirós, 2017) and pays attention to the quality of experiences of subject groups which typically goes unidentified in quantitative research. Therefore, a qualitative approach can potentially capture in-depth information on voice problems and associated voice-related coping in singers from a multi-dimensional perspective.

The study adhered to Consolidated criteria for reporting qualitative research (COREQ) reporting guidelines. Ethical approval was obtained from the Language and Communication Science proportionate review committee of the School of Health Sciences Research Ethics Committee of City,

University of London on 25th February 2020. (Reference number: ETH1920-0100). The ethics application and the approval letter can be found in Appendix 4.1.

Semi-structured qualitative interviews were carried out by the researcher who is a female speech and language therapist specialised in dealing with voice disorders and is currently carrying out research in singing voices. The researcher is also a trained Carnatic singer. A bracketing journal, which is a reflexive journal was maintained to avoid bias that may arise from her background as an SLT and a Carnatic singer. This enabled identification of preconceptions throughout the research process (Ahern, 1999); therefore, this was an ongoing exercise where prejudices were regularly documented. (Tufford & Newman, 2010). The (potential) biases were often discussed with a qualitative expert who was involved in various stages of the research (development, administration and analysis) and provided her insights on addressing them if required. The bracketing journal documented various aspects such as theoretical (e.g., avoiding leading questions which may arise from the research evidence obtained by the researcher) and methodological notes (e.g., maintaining neutrality during interviewing even when the response of the participant may be different from the researcher's point of view), observational comments made during interviews which provided opportunities for the researcher to reflect at a later time and also acknowledge instances where there was a potential role conflict with participants, particularly with those, who were known to the researcher. Elicited data were analysed using Framework analysis (Ritchie and Spencer, 1994). Further details regarding the rationale for selection of Framework analysis and steps involved are detailed under data analysis.

4.3.2 Participants

4.3.2.1 Sampling

The target was to recruit 18 participants representing the singing and the professional communities for the study (Table 4.1). Given the low prevalence of two of the target groups (Western classical and Carnatic singers) professional networks and snowballing were used to find participants. Flick et al (2008) suggested that sample size in qualitative research would depend on the number of comparison points in the study with each comparison parameter requiring at least 2 participants. In the present study the comparison points were identified as genre and profession; this generated six different categories of participants. The categories were:

1. Speech and language therapists specialised in treating voice disorders in Western Classical singers (referred to as Western classical SLTs in this chapter)
2. Speech and language therapists specialised in treating voice disorders in Carnatic singers (referred to as Carnatic SLTs in this chapter)
3. Western Classical singing teachers
4. Carnatic singing teachers
5. Western Classical singers
6. Carnatic singers

Flick et al (2008) also indicated that the nature of the research question(s), feasibility aspects (number of interviewees, timelines etc.) should also be taken into account while determining an appropriate sample size. Based on these guidelines, we aimed to recruit three participants per lab group (18 in total). The groups and the number of participants per group are presented in Table 4.2.

Table 4.2: Distribution of study participants in the qualitative study

	Western Classical	Carnatic	Total
Singers	3	3	6
Voice Coaches	3	3	6
SLTs	3	3	6
Total	9	9	18

4.3.3 Inclusion/Exclusion criteria

To ensure they were specialists in working with singers, Speech and language therapists and singing teachers had to have a minimum of three years of experience working with singers to participate in the study.

Full time or part-time Western Classical and Carnatic singers with relevant professional singing experience were recruited for the study. Since work is seasonal for singers, the amount of professional singing (including vocal practice) done each week/month would be highly variable. Therefore, no minimum criteria were placed for the amount of professional singing done; however, only singers who

were paid for their services were chosen for the study. Singers also had to have a minimum of three years of singing experience.

All participants were over 18 years of age; no gender or cultural limitations were placed. To improve representativeness of the sample, singers, particularly belonging to the Carnatic tradition who did not speak English, but were fluent in regional languages such as Tamil, Malayalam, Hindi and Kannada were also considered for the study, since the researcher is fluent in these languages.

4.3.4 Recruitment

4.3.4.1 Speech and Language Therapists

Professional contacts of the research team (including a Highly Specialist Voice Speech and Language Therapist and Service Manager) working with Western Classical singers were approached via email and asked to share recruiting information with their contacts as well. The alma mater of the researcher was contacted to recruit Speech and Language Therapists working with Carnatic singers.

4.3.4.2 Singing teachers and singers

Classical singers based in the UK were recruited using professional connections of the researcher. Further participants were recruited using snowballing sampling methods.

The researcher also made use of contacts in India through her music tutor(s) to recruit Carnatic singers and singing teachers. Recruitment was continued until the required number (in each characteristic) was reached.

Across participant groups, the researcher had previously established relationships with some of the participants (n=4). Other participants were not known to the researcher prior to contacting them to request participation for the study.

4.3.5 Development of interview guide

The overall structure of the interview guide was based on the theoretical framework provided in Chapter 1. Broadly, the theoretical framework indicated that the primary areas of enquiry were factors impacting the voice, vocal symptoms, illness perceptions-coping and impact of voice problems on the singer. The inclusion of specific areas to be included in the interview guide were informed by the two systematic reviews which were carried out as part of the current thesis. The first systematic review

(Chapter 2) provided information relevant to research objectives 1, 2 ,3, 4 and 6 while the second systematic review (Chapter 3) assisted in developing the interview guide pertaining to research question 4. The information obtained from both reviews were grouped in relation to the research objectives of the qualitative study (resembling a rudimentary matrix). This was then modified into questions and probes further details of which is presented later in this section.

The systematic reviews indicated that there is limited information regarding the impact of genre on self-reported voice problems and coping; therefore, research objective 7 was incorporated into the interview guide on hypothetical grounds backed by the clinical judgments of the supervisory team.

Three separate interview guides, comprising open-ended questions to reflect the difference in perspective and focus of information elicited from each group, were prepared by the researcher, in consultation with the supervisory team, which comprised two highly specialist speech and language therapists and a health psychologist. A set of probes accompanied the open-ended questions to elicit relevant responses. These probes were either mapping (e.g., asking how singers may cope with their voice problems) or mining questions (e.g., asking why singers may use a specific coping strategy such as social support) depending on whether there was a requirement for more breadth or depth.

In summary, they explored perceptions related to normal and pathological aspects of the singing voice, causal and symptomatic characteristics of voice problems, impact of voice problems in singers and how singers manage their voice problems. The questions were appropriately framed and worded for each participant group. For instance, singers were asked questions in a manner enabling self-reflection whereas questions for speech and language therapists and singing teachers drew from their professional experience in dealing with singers. Additionally, the interview guide prepared for speech and language therapists included clinically relevant questions on how they assessed and managed voice problems in singers, whereas emphasis was placed on training-related details for singing teachers. The interview guides used for each participant group are provided in Appendix 4.2.

The guides were then discussed with a researcher specialised in qualitative research to verify the appropriateness of the topic guides and the probes to achieve the intended outcomes. Additionally, the guides were piloted with a singer and a former singing teacher to ascertain the clarity of the questions, linguistic appropriateness and develop a non-invasive interview style. Relevant topics which arose

during interviews, which were not a part of the original interview guide were incorporated into subsequent interviews if deemed appropriate.

4.3.6 Interview process

A participant information sheet was provided to all participants illustrating the purpose, data collection process and the nature of the data to be extracted. Potential participants were also informed that they had the option to withdraw participation from the study at any time, without providing an explanation for their decision. Invitees were given at least 24 hours to consider before taking part. This was done by sending the information booklet in advance via email or post. Scanned copies or photos (with reasonable clarity) of the signed consent forms were requested prior to commencement of the interview. Additionally, consent was verbally affirmed at the start of the interview for all participants.

Participants were interviewed via telephone/video calls. The interviews were both audio and video - recorded and contemporary notes were taken by the researcher if required. The recordings were done using the in-built recording feature of the video conferencing apps and also using an audio recorder. Consent was always sought from the participants prior to recording.

Each participant had a semi-structured interview with the researcher which lasted approximately 45 minutes to one hour. Demographic and singing related details such as experience, genre, training was elicited prior to the main interview questions. Interview schedules ensured unbiased interviewing across participants and sufficient exploration of the topic; however, the questioning process was still kept relatively flexible and depending on the participants' responses, appropriate follow up questions were asked, even if they did not feature in the interview schedule.

Speech and language therapists and singing teachers were interviewed first. This meant that the researcher had the opportunity to make necessary inclusions to the interview guide developed for singers, should any relevant themes emerge from interviewing SLTs and singing teachers which was not originally included in the interview guide (e.g., asking singers if their self-perception of their voices were different from how others perceived their voices, enquiring if singers liked their own voices etc which were originally not included in the interview guide prepared for singers but added later as they emerged as dominant themes after interviewing SLTs and singing teachers).

4.3.7 Data protection

All hard copies of data are stored in a locked drawer in City, University of London. Research data were de-identified and stored separately from identifiable data. Identifiable data (with the exception of consent forms) will be destroyed soon after study closure; consent forms and research data will be transferred to the archives within the University and stored for 10 years, as per university guidelines, after which period they will be securely destroyed.

Soft copies are stored in password-protected computers accessible only by the researcher or supervisors; and will be destroyed within the same timeframe as hard copy data.

Data transfer was done via encrypted keys or encrypted before emailing (via 7zip or VeraCrypt software), followed by passwords on a different platform.

Recordings were immediately transferred to an encrypted device at the end of the interview to ensure data protection. If any participant revealed any personally identifiable information, they were de-identified during transcription.

4.3.8 Data Analysis

All data collected via the audio and video recordings were transcribed by the researcher. All data were anonymised, and initials were assigned to each participant prior to analysis. Pseudonyms were used while reporting the data. All data was organised and managed using the NVivo software package.

To suit the qualitative nature of the study, Framework analysis was adopted. The characteristic feature of Framework analysis is the presentation of data in the form of a matrix, where the rows represent the 'cases' (i.e., an individual interviewee) and the columns represent the 'codes' (conceptual labels assigned to excerpts of raw data), which enables analysis of the data in terms of code or case (Gale et al, 2013). Therefore, this framework can compare and contrast data across cases and within each case (Gale et al, 2013).

4.3.8.1 Rationale for using Framework analysis

Framework analysis illustrates clear steps and systematically analyses, organises and categorises highly unwieldy qualitative data, thereby producing highly structured outputs of summarised data (Gale et al, 2013). Cross sectional descriptive data obtained from different population groups can be effectively

analysed using Framework analysis (Ritchie and Lewis, 2003) as within subject, within group and between group comparisons can be effectively made. This method has also been extensively used to analyse data collected using semi-structured interviews as this type of data analysis ensures homogeneity in topics and key issues covered and enables categorisation (Gale et al, 2013). Additionally, Framework analysis can account for differing views of participants in certain topics (Gale et al, 2013). It also provides transparency in how the perceptions of the participants are interpreted by the researcher (Ritchie and Lewis, 2003) and avoids selection of only desired evidence since the methodology stipulates coding of all gathered data.

4.3.8.2 Steps involved in Framework analysis

Five stages have been described for analysing data using the framework method (Iliffe et al, 2015). A description of the steps and its application in the current study is provided in Table 4.3.

4.3.9 Monitoring, supervision, and quality control

After anonymising the data, at least one participant's transcript per group (n=3) was verified by the methodology expert for comprehensiveness and unbiased interviewing and feedback was provided. Twenty percent of the data was verified by one of the supervisors and disagreements were resolved by the second supervisor not involved in the original verification process.

4.3.9.1 Respondent validation

Member checks allow the researcher to determine if the words of the participant were interpreted correctly and that the summary generated by the researcher is a true representation of the participant's intent. It also provides the participant an opportunity to add more information and reconfirm their view. Member checking was carried out at the end of the transcription phase where each participant's interview transcript was prepared in lay format and provided to the participant to be verified for accuracy. None of the participants highlighted any inaccuracies in the transcripts.

4.3.9.2 Development and verification of the coding framework

The coding framework was developed by the researcher and consequently verified by the methodological expert and the supervisors for accuracy in representing the data and in line with the research objectives.

4.3.9.3 Data triangulation

Three data sets were analysed (SLTs, singing teachers and singers) thereby providing a detailed, complex and balanced viewpoint and enhancing the validity and credibility of the findings.

Table 4.3: Description of various stages of Framework analysis in the context of the current study (Iliffe et al, 2015)

Number	Stage	Description
1	Familiarisation	Researcher familiarised with the recordings and the transcribed data to sensitise to early themes and individual differences. Early impressions or preliminary thoughts pertaining to the transcript were jotted down.
2	Identifying a thematic framework	Key themes present in the transcript were identified. A suitable term or 'code' which best represents the theme was assigned. Initial overarching themes were generated using the interview guide and available literature. Additionally, new themes emerging from the data were noted. Therefore, a combination of inductive and deductive analysis was used, and a thematic index was developed.
3	Indexing	The overarching and subthemes were identified in the thematic framework and applied to all transcribed data
4	Charting	The data was summarised by category from each transcript. A matrix was generated, and the summarised data was 'charted' into the matrix which was generated using NVivo. Relevant quotational references were added
5	Mapping and interpretation	Descriptive and explanatory accounts were created by analysing the charted data. The relationship between the themes were explored and reported.

4.4 RESULTS

4.4.1 Participant characteristics

Nineteen participants (7 male and 12 female) were recruited across the three groups. The participant characteristics are outlined in Table 4.4. Both the SLT and singers' groups had six participants each. However, the singing teachers' group had seven participants. This was because, two of the Western classical singing teachers were practicing as Vocal Rehabilitation Coaches (VRC) and therefore had

significant experience dealing with injured voices. To increase representativeness of this group, one more singing teacher with no formal background in vocal rehabilitation was also recruited. Of all the individuals approached to participate, one singing teacher refused to participate citing personal reasons. The mean age of the participants was 53.7 and the average years of work experience was 26.72 years.

The interviews of the Carnatic singing teachers and singers were carried out in regional Indian languages (Malayalam n=5, Tamil n=1). These were translated verbatim into English by the researcher during transcription. Carnatic SLTs were interviewed in English but occasionally used phrases in Tamil or Kannada which were also translated during transcription. Some phrases were retained in the original language since a direct translation was not possible. However, the intended meaning was indicated in brackets.

Table 4.4 Participant characteristics in the qualitative study (n=19)

PARTICIPANTS	GENRE	AGE	SEX	WORK EXPERIENCE (YEARS)
SLT				
Polly	Western classical	58	Female	34
George	Western classical	49	Male	26
Maddie	Western classical	48	Female	18
Pankaj	Carnatic	43	Male	20
Uma	Carnatic	46	Female	20
Sachin	Carnatic	41	Male	20
SINGING TEACHERS				
Laura	Western classical	75	Female	23
Jessie	Western classical	60	Female	35
Sarah	Western classical	63	Female	28
Robert	Western classical	60	Male	30
Arya	Carnatic	59	Female	37
Giri	Carnatic	61	Male	41
Gauri	Carnatic	65	Female	10
SINGERS				
Anna	Western classical	70	Female	40

SINGERS				
Emily	Western classical	52	Female	42
Richard	Western classical	47	Male	16
Bala	Carnatic	48	Female	32
Venu	Carnatic	35	Male	15
Sai	Carnatic	49	Male	35

4.4.2 Themes and subthemes of the study

Framework analysis revealed nine themes. The themes and subthemes are presented in Figure 4.1. The themes are presented by organising them based on research objectives, with the exception of the final objective “Are there differences in perception of normal and pathological aspects of voice and coping strategies between groups and between genres?” which was relevant across themes and other objectives and was addressed as appropriate within each theme.

4.4.2.1 *Research Objective 1: How do singers, SLTs and singing teachers describe a normal and pathological voice?*

4.4.2.1.1 *Theme 1: Description of normal voice*

4.4.2.1.1.1 Subtheme 1: Vocal attributes of “normal” (good) voice

Generally, SLTs had a clinical perspective on a good voice. They used terminologies of the GRBAS (Grade, Roughness, Breathiness, Asthenia and Strain) to describe a good voice such as appropriate volume, pitch range, no notable hoarseness, breathiness, asthenia (weak voice) and strain. Reliance on patient reports, rather than the perception of the clinician to ascertain if a voice was normal or not, was emphasised. The terms good and “normal” were interchangeably used. Since there is a lot of variation within the singing voice different or distinctive voices may not be “abnormal” if there is sufficient resilience to cope with it and does not cause any detrimental effects on the vocal apparatus. The difference in definition of a normal voice between singers and non-singers was also highlighted with the former having greater pitch, loudness and quality requirements. Pankaj believed that a normal was synonymous with “healthy” and if a singer feels happy and satisfied at the end of a performance, then their voice can be considered normal.

Pankaj: "If a person is feeling healthy, then it [voice] is normal and what is health? Health is happiness, I would think. (smiles)"

Terminologies used by singing teachers to describe a "good" classical voice were modulated/nuanced, flexible, good control of pitch and loudness, free, clear, sturdy/solid, expressive and well supported. The most recurrent descriptor mentioned in this group was the ability of the voice to express emotions.

Emily: "A voice which functions without blockages and a voice which has a unique expression-so a mechanical production for me is not a normal voice. It has to be connected to some other emotional pathway. So, singing without emotion, for me is not a normal voice."

Robert stated that a good voice should "give goosebumps" to the listener. Descriptors associated with Carnatic singing teachers were singing in an open throated manner, low pitched and "heaviness" in voice. **A striking theme among Carnatic singing teachers was the insignificance assigned to voice quality. Various examples were provided to illustrate that many Carnatic singers did not possess a pleasant vocal tone but achieved success and were respected within the Carnatic fraternity.**

Giri: "you don't have to give it [voice quality] first place. Now XX and XX their voice qualities XX, XX. they [did not become popular] because of their voice quality. it was because of their singing skills, and they have earned more respect than those with better voice quality. So isn't this the biggest proof that the greatness is in the skill and not the voice?"

Conversely, Western classical singing teachers reported that voices characterised by smooth and clear vocal tone with minimal breathiness is essential for classical singers and unusual or "quirky" voice qualities may not be acceptable.

Fig 4.1: Themes and subthemes of the qualitative study

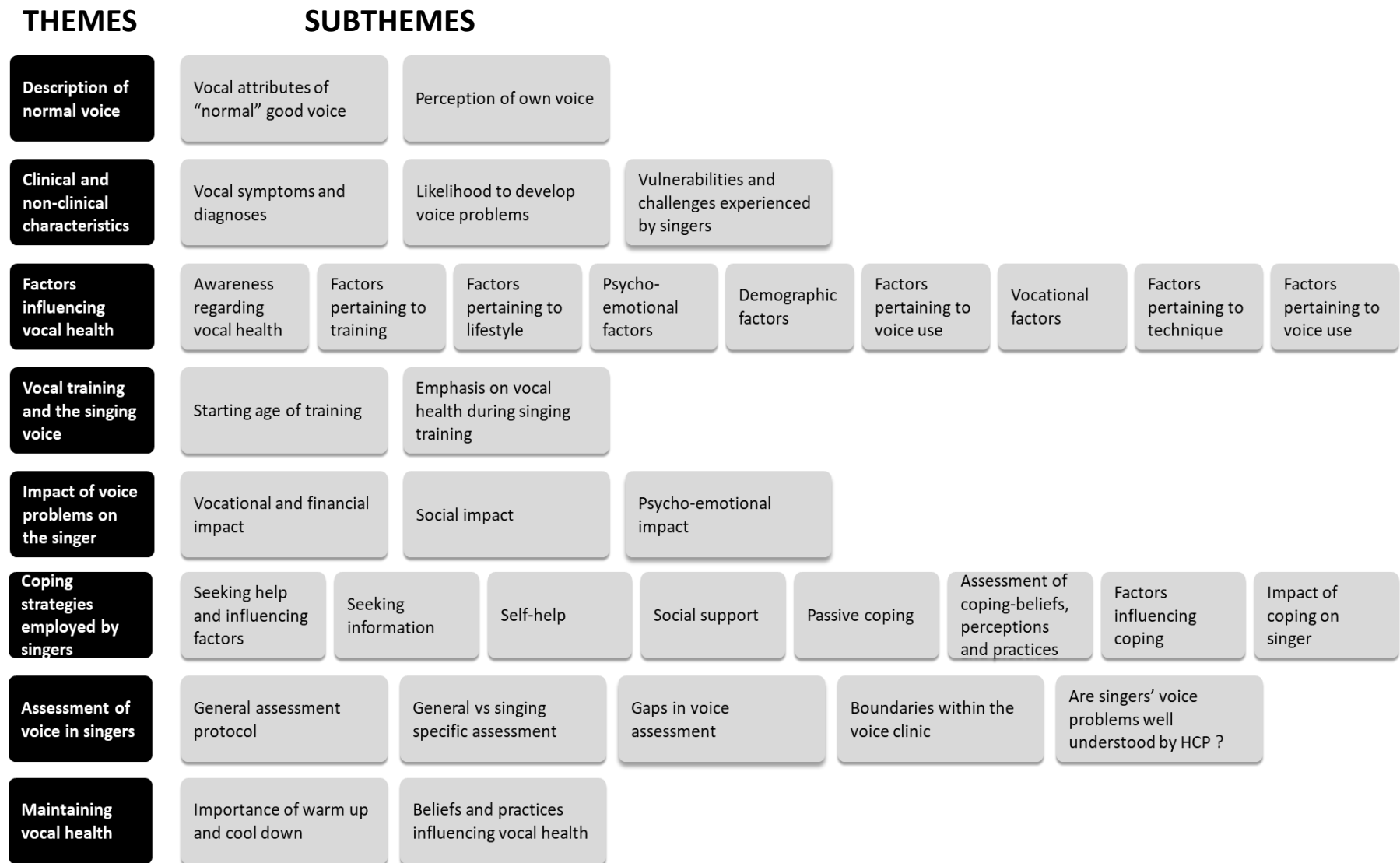


Figure 4.1 The black and grey boxes represent the themes and subthemes respectively

The most dominant descriptor of a good voice among singers was effortlessness or naturalness in singing. Some singers referred to effortlessness as “freedom”. Some other descriptors used were expressive, loud, open singing, clear, well supported, technically sound, good stamina, flexible and grip in voice.

Emily: “For me, its about a freedom and a naturalness of production and that you can hear a directness of expression of thought through the voice.”

Carnatic singers suggested that an adequate pitch range is a prerequisite for a good classical voice.

4.4.2.1.1.2 Subtheme 2: Perception of own voice

Since this theme was relevant only for singers, the results are presented only for this participant group.

A range of descriptors were used by singers to describe their own voices such as big, operatic, silvery, warm with gold sheen, bright, flexible, deep, powerful, natural, emotive, sensitive and so on. Singers also mentioned their weaknesses in their voices such as restrictions in certain regions of pitch. When asked whether they liked their own voices or not, most of the singers who responded negatively to the question had reported a history of voice problems and belonged to the Western classical tradition.

Some singers suggested that their own perception of voice was different from feedback received from listeners.

Anna: “I had a low [pitched] voice, and when I was young, women with low voices were very very unusual. my teachers encouraged me to use that. But I always felt the need to sing higher. And I think that’s probably why I didn’t like it very much, because I just didn’t see this as if it was doing what I ultimately wanted it to do.”

4.4.2.2 Research objective 2: What are the vocal problems commonly seen in singers and what are the potential risk factors/causes?

4.4.2.2.1 Theme 2: Clinical and non-clinical characteristics

4.4.2.2.1.1 Subtheme 1: Vocal symptoms and diagnoses

There was considerable overlap in the vocal symptoms described by all three groups. These were vocal fatigue, lack/loss of stamina or endurance, reduced pitch range including difficulty reaching higher

notes, pain or discomfort in throat including pain, lack of power and change in voice quality/husky or breathy quality. Muscle tension was highlighted by SLTs and singers as a vocal symptom.

Additionally, SLTs reported symptoms such as muscle tension, unable to sustain notes, unable to vary pitch and shortness of breath after singing. One SLT suggested that Western classical singers generally presented with vocal injury and reflux more than Muscle Tension Dysphonia which was more common in singers performing musical theatre. Regarding diagnoses, singers generally presented with structural lesions such as vocal nodules, polyps, haemorrhages, cysts, oedema of vocal folds and pre nodular changes as a result of phonotrauma along with reflux and Muscle Tension Dysphonia. In some singers, the speaking voice may be normal, but the singing voice may not. Additionally, SLTs dealing with Carnatic singers reported that Carnatic singers generally presented with clinically normal voice quality.

Sachin: "Most singers when they come to us, if you do acoustic analysis on them, they will have normal voice quality. Perceptually they will have normal voice quality. But their only difficulty is.. they are not able to sing, their voice is breaking after one hour, singing vocal fatigue is there, and they are not able to reach those higher notes or voice breaks during those higher notes, that's the common difference between a non-singer's complaint and a classical singer."

Singing teachers suggested that most singers will encounter a voice problem at some point in their careers.

Sachin: "Most common problems are related to fatigue and stamina. Voice getting tired, voice taking longer to warm up. That will be the first sign of problems[...]"

The symptom profile reported by Carnatic singing teachers was different and included lack of sturdy voice, wobbly voice (towards the end of a sustained note), difficulty enunciating vowels and having jagged transitions between phrases. The impact of menopause on the voice causing hoarseness, muscle tightness, inability to maintain pitch (*shruthi*) and vocal fatigue was highlighted in this group. Giri believed that performing "good music" with divinity and devotion will enable voice problems to go unnoticed by both the singer and the listener.

Giri: "Somebody who sings good music, even if his voice has a problem, nobody will notice it because of the glory of their singing, even they themselves won't be aware of it.. Because when you do something with bhakthi (devotion).."

Symptoms reported only by singers group were maladjustment between breath pressure and tension of the diaphragm, wobble in voice, reflux, tired voice when not rested or during a cold, excessive vocal strain, throat dryness, loss of tonal quality, loss of base notes after long singing hours, weak voice towards the end of the concert, throat clearing and loss of voice following voice abuse.

Venu: "Long hours of singing affects my voice.. I lose my base register.. My voice kind of becomes a bit feeble, when I compare that with my voice that I started with, started that concert with... Tonal quality is not the same, so I don't have a consistent tonal quality."

4.4.2.2.1.2 Subtheme 2: Likelihood to develop voice problems

SLTs suggested that other singing genres had a greater likelihood of developing voice problems compared to classical singers. While Western classical SLTs indicated that musical theatre singers were most commonly seen in the voice clinic along with pop and rock singers, Indian light music singers were more frequently seen by Carnatic SLTs. They attributed it to better vocal training in classical singers, and in the other groups, number of performances, unpredictability in singing and producing sound in more challenging situations.

Pankaj: "Indian film singing.. So there's so much always, in a search of.. a different voice and differences in the voice. Within the 3 minutes or 4 minutes of song, there has to be a lot of changes in the voice, which is not necessarily there in Carnatic singing. It is a very tempered way of singing and that is the expectation"

A mixed set of opinions were recorded by singing teachers. Only Western classical singing teachers contributed towards this theme. One singing teacher believed that voice problems in classical singers were infrequent, while two singing teachers (who are also vocal rehabilitation coaches) believed that singers of all genres were vulnerable to develop voice problems.

Laura: A lot of classical singers feel that its only pop and Jazz and rock people who get problems. (laughs) [...] But this pressure on them [classical singers]..to do it, so that

very often I think the problems will come around through that sort of pressure.. that everything has got to be lined up beautiful.. So, its hard to say because anybody is vulnerable to voice problems and its not a physical thing.”

4.4.2.2.1.3 Subtheme 3: Fears, vulnerabilities and challenges experienced by singers

This subtheme was raised only by singing teachers and singers. Fear of getting future work and competition were highlighted by both groups.

Only one singing teacher reported on this subtheme and suggested that singers have fears surrounding the performance of their voices along with pressures surrounding living in a big city, inhaling polluted air, having allergies, constant self-doubts and competition.

Western classical singers expressed a variety of vocational fears and vulnerabilities such as fear of getting future work, being liked by employees, singing without amplification (often over a loud orchestra), unrealistic expectations from employees and pressure to accept all offered work.

Carnatic singers raised a different set of vulnerabilities. Carnatic singing encompassed a relatively small circle with a few influential parties-therefore, singers are often under a lot of stress to “please” these decision makers, particularly during performance seasons. Sai mentioned that the Carnatic fraternity was orthodox in its beliefs and not open to embracing changes such as improving the acoustics or microphones for concerts which caused difficulties while singing. This conservative mentality extended to how they perceived voice problems; for example, believing that singers develop voice problems because of lack of belief in God.

Sai: “if you developed a voice problem, they would say.. the other day he spoke against all this [spoke against certain beliefs], so God punished him for that!

4.4.2.2.2 Theme 3: Factors influencing vocal health

4.4.2.2.2.1 Subtheme 1: Awareness regarding vocal health

Lack of awareness regarding vocal hygiene and safe singing practices and its role in causing voice problems among singers was highlighted by all three groups. SLTs and singers indicated lack of knowledge about whom to approach while encountering a voice problem, among singers.

Uma highlighted limited awareness regarding vocal health among Carnatic singing teachers.

Uma: She [patient] was 47 years [...] He [singing teacher] was insisting her, you have to sing in that particular note, you have to go as much high [pitch] as possible. she developed nodules [...] they were not much aware of these age related changes.. They have that kind of, one, what to say, tradition. They are not adjusting as per the need of a student."

Reluctance of singers to take advice from SLTs because they were not singers and did not understand or appreciate the knowledge and skill set of SLTs was also raised.

Mostly, singing teachers believed that singers "sought information" only during a "vocal crisis". Also, a lot of misinformation regarding voice production and vocal health was often shared by singing teachers. Jessie mentioned that this could be because singing is heavily based on self-perception and therefore some advice will not be applicable across singers.

Jessie: "Even really experienced, highly intelligent professional singers will share misinformation [...] Because we base our perception of what we do on what it feels like, to us. And then we try and tell somebody else, that is what they should be doing in order to sound in a particular way and it's.. flawed."

Arya suggested that most Carnatic singing teachers are unaware of using their own voices in a healthy manner which is a significant factor impacting the voices of their students. Most singing teachers do not understand the rationale behind the traditional vocal exercises of Carnatic singing which causes them to be used inappropriately or inefficiently.

Arya: "Unawareness is the main reason [...] The teachers in my generation did not know why they were doing certain things.. Without knowing the cause-effect or the reason, they transferred what they learnt to the students."

Singers indicated that there are better tools and support available today and there is more awareness; however, there was still lack of clarity on whom to approach when a singer develops a voice problem. Stigma surrounding voice problems was also highlighted.

Emily: "I think there is still far too much stigma placed on any kind of vocal difficulties or problems and not enough solutions, not enough this is where you go when you are having this problem. these are the people that will help you. There's too much witch

doctory quackery [...] we are quite backward in making it available and in making that a shame free experience.”

4.4.2.2.2 Subtheme 2: Training factors

Generally, all groups acknowledged that training had a positive influence on singers where they develop good technique and help in “developing a solid and sturdy voice”. SLTs and singing teachers dealing with Carnatic singers indicated that singing lessons were mostly conducted in groups and therefore the tonic frequency chosen for the lesson may not be appropriate for all students which poses difficulties with technique and voice use for both the singer and the teacher. Another factor was pertaining to male teachers teaching female students and vice versa which also posed difficulties with mastering the right technique and issues with tonic frequency. This was indicated to be an issue for both the student as well as the singing teacher as differences in the tonic frequency was believed to negatively impact the voice. All Carnatic sub-groups acknowledged that in the past, singing was taught at the teacher’s home where the students stayed (called the *gurukula sampradaya*) for many years thereby giving them an opportunity to observe and imbibe all the good practices surrounding vocal health and lifestyle. With the *gurukula* setup now obsolete, there was no scope for singing students to naturally learn these aspects anymore. Carnatic singers and SLTs also suggested that training was heavily focused on content with little emphasis on mechanics of voice production such as posture, breath support etc. The reliance on imitation to teach singing, particularly when the student is encouraged to imitate the vocal qualities of the teacher, was highlighted as a potential factor that may negatively impact vocal health in singers by all groups, except SLTs handling Western classical singers. This difficulty was further exacerbated if the singing teacher belonged to the opposite sex.

Bala: “All teachers think, my student should sing just like me, my student is my successor [...] Just because I am nasal, why should the student be nasal too?.. I consider this as a big curse of Carnatic music, and this will affect a student quite a bit, because.. she is imitating another person’s voice quality. So she lose[s] some plus in her own voice and she gain some negative from her guru.”

Some SLTs pointed out that singing teachers were unaccredited and did not require any specific qualifications, so not all training may be consistent or appropriate.

George: "I get a lot of patients who have been told from singing teachers to do more adduction stuff, to get the closure [...] adduct and try to get them the high note, creating more tension. So, often get kind of wrongly guided and umm not teaching them how to support their voice better."

Another observation was that Carnatic students tend to have multiple gurus within a short span of time and young singers are often not given the time to acclimatise to new tutelage and style imposing stress. Pankaj indicated that poor training can have long term consequences on the vocal health of singers as singing is a motor behaviour and undergoes significant "autocorrection" when it is taxed. If singing teachers emphasised vocal health from the beginning, it would equip singers to understand how the body could adapt itself and produce a healthy voice. Lack of aptitude in singers and inability of singing teachers to individualise training were also flagged as factors negatively impacting vocal health.

Singing teachers suggested that not enough emphasis was placed on explaining the mechanics of voice production and maintaining vocal health in music colleges and conservatoires and that there should be a healthy balance between the art and the understanding of the physiology behind it.

They also opined that classical singers work with feedback from others such as singing teachers but are not taught to rely on their own self perception of how a certain vocal manoeuvre feels. Additionally, singers often approach a singing teacher with wrong techniques which they learnt from elsewhere which is hard to correct or change.

Richard suggested that pain, strain or hoarseness following a singing lesson are red flags that indicate that the training is unsuitable for that singer.

Richard: "If you are having lessons with somebody, and you start feeling anything, any strain, pain, tiredness, hoarseness after having a lesson. (gestures with hands and head to indicate no), something is wrong. You are forcing, or the person is asking you to do something that doesn't work for you."

He also believed that the amount of singing training provided by conservatoires is minimal (1 lesson/week) which forces young and inexperienced singers to work on their voices themselves and potentially develop wrong techniques making their voices vulnerable. Further, he suggested that

singing teachers often identify the voice type incorrectly, thereby subjecting a singer to wrong training methods which can be detrimental to the voice.

Sai believed that there were erroneous concepts in Carnatic singing and training. For instance, many students learn from tapes that were recorded many years ago and therefore try to imitate the distorted voice quality of the tape leading to vocal problems. Another opinion was that some singing teachers progressed through the basic singing exercises too quickly and therefore do not give the young student the vocal foundations upon which to build a sustainable voice.

4.4.2.2.3 Subtheme 3: Factors pertaining to lifestyle

Travel and food choices were flagged as important factors impacting voice across groups. Singers are often expected to perform with no time to recover or acclimatise to the effects of altitude changes or environment in the plane (such as air circulation) following travel which can cause significant stress to the voice mechanism.

SLTs indicated that eating patterns can significantly impact the voice by causing reflux. Other factors mentioned were exposure to allergens due to frequent travel and passive smoking.

A singing teacher highlighted the “corporate aspect” surrounding young singers (reflective of a professional identity they are in the process of developing, to portray themselves as a “cool singer” or to simply “fit in”), where singers socialise at pubs and indulge in consuming alcohol or untimely meals which in the long run could cause reflux. Below is an excerpt of a singing teacher;

Sarah: “Its quite interesting how tenacious they are to their corporate identity. They’d much rather have acid reflux and sing to 60% or 40% than they would give up going to the pub with their mates.”

Carnatic singing teachers highlighted different aspects compared to the issues pointed out by Western classical teachers. Acidic foods and cold food items (including cold water) were frequently reported to be associated with voice problems. One singing teacher opined that singers belonging to older generations followed a healthier lifestyle by eating simple and minimal meals which positively influenced their voice. One singing teacher believed that waking up early in the morning (referred to as *brahmamuhoortham* in Sanskrit) and practicing singing had significant benefits for maintaining a

healthy voice. Some other factors believed to be negatively impacting the voice were pollution and lack of exercise.

Inadequate sleep, smoking, alcohol consumption, certain foods (e.g., chocolate, cheese) were some of the factors highlighted by singers which negatively impacted their voice. Singers indicated that some foods generated too much (and sticky) mucous which affected the voice.

Richard: "So if I have a performance the next day, I go to bed at 10'o clock and sleep for a minimum of 8 hours! That's the main lifestyle you have to have. If you have to sing, you have to go to bed early. Because it will help you and your body will be full of energy, your cord will be relaxed, that's the main thing."

Another Western classical singer believed that even though smoking and alcohol adversely affect the voice, most classical singers are responsible and take care of their voices. One Carnatic singer indicated that wind blowing into the ear can affect the voice.

4.4.2.2.2.4 Subtheme 4: Psychological factors

SLTs suggested that singers were generally emotionally vulnerable and often unaccepting of their ageing voice subsequently developing faulty techniques to cope with the physiologic changes causing vocal difficulties.

Western classical singing teachers indicated that most singers who develop vocal pathologies report experiencing psychosomatic distress. Some of these experiences may be during childhood but continue to have an effect on the voice. Singers also have to deal with common life stresses such as a sick child etc. which can tip them into failing with a "highly strung" and "stretched work life" along with the "knocks, bumps and negativity" surrounding a singing career.

Sarah: "And I was just reminded of a tenor that I taught[...]He was having a really excellent career[...]He was married to a very highly academic girl. they had 2 lovely children. she couldn't tolerate this lifestyle because he was never there for the children. And she wanted to end the marriage, so they ended the marriage and I would say within a couple of weeks, he started to experience vocal problems."

Giri believed that one of the main reasons to develop voice problems was mental tension and anxiety which makes your voice “close up”. Other factors mentioned were psychological barriers (e.g. a student unable to sing in higher pitches because they think they are incapable) and anger.

All Western classical singers who had reported voice problems felt that psychological factors contributed both to the problem (e.g., bereavement, disputes) and to recovery.

Anna: “I think that initially the problem was physical. But I think after a while, I mean I thought about this a lot.. I think the reason I didn’t get it back was psychological because I was just.. scared of being in pain, I was scared of doing more damage, that was the most thing that worried me.”

This was not a dominant theme among Carnatic singers.

4.4.2.2.5 Subtheme 5: Socio-cultural factors

Performing concerts during menstruation, especially in religious venues such as Hindu temples (where menstruation is still considered to be a taboo) was highlighted by a Carnatic SLT and singer as a cause for significant stress among female singers as there is a “constant tussle between what is morally right” and what is “doable”.

Pankaj suggested that in South India, there are familial expectations from female Carnatic singers where they have to conform to certain requirements of the family. For instance, a singer with a significant aptitude to sing may be forced to settle for something less challenging such as teaching rather than performing which can cause immense stress to the individual.

Pankaj: “I also feel sociocultural reasons as a reason for women being more vulnerable for voice problems, by nature. Though it’s all evolving and changing to a different stand now, but in a country like India, and in south India, I would still feel there are certain levels of expectations at home and family restrictions could be there where they don’t want to be shining as a star, a singing star. So these are some of the vulnerabilities, it all adds on to the mind of the person.”

Only Carnatic singing teachers contributed to this theme. A few factors mentioned were *paaramparyam* (lineage) which enabled development of singing skills from a young age and blessings of your gurus and God which will prevent development of voice problems.

Carnatic singers indicated that Indian women, in general, used their voices excessively.

Bala: "The first time I experienced voice strain like that was when XX (her son) was 1.5 or 2 years old. I had to speak to him so much. For example, if you have to give food, you have to strain with your voice for so long. say "open your mouth, aaa" and these tonal modulations are all so strenuous. Then speaking with your in-laws, even when you can't speak, you have to talk, to solve the situation, to not be disrespectful. So women have more [voice] use I think."

4.4.2.2.2.6 Subtheme 6: Demographic factors

All groups indicated that women were more vulnerable to develop voice problems. the most common reasons attributed to this were hormonal variations primarily caused due to menstruation, pregnancy and menopause and physiological disadvantages (such as more cyclical vibrations per second in females). An increased vulnerability in young singers was reported by SLTs and singers due to the "still developing" vocal mechanism being taxed with performance demands (e.g., advanced repertoire, excessive practice etc.).

SLTs reported that younger singers pushed themselves too much, ignored minor vocal difficulties during their teens, attended courses that they are unable to cope with, had an unhealthy lifestyle that included drinking, smoking etc., endured stiff competition and had to juggle studies and singing careers causing significant stress and increasing chances of a vocal breakdown. A few SLTs reported that older singers were also vulnerable to develop voice problems due to age related anatomical changes in the laryngeal system.

Additional reasons attributed to females being more vulnerable were pregnancy, conditions such as Poly Cystic Ovarian Disorder and infertility treatments. The general perception was that hormonal factors lowered the pitch, thereby making their regular repertoire challenging to perform.

Maddie: "We do sometimes see women, post menopausal, who had been trained and are a light lyric soprano, whose voice has changed and umm maybe become lower in pitch and they still want to be able to sing the same repertoire that they have always sung. They are someone who are hanging on to their chorus position and still need to

be up in that high register and actually they should just be a second soprano or moving to an alto.”

Reasons for vulnerability in women to develop voice problems suggested by Western classical singing teachers were nurturing qualities and “thinking about others’ feelings” (which makes them take on more stress) and ageing vocal cords which were more problematic in women. Robert did not feel that women were more vulnerable and believed that women were better learners as they were more adaptive and willing to make changes which positively influenced their singing.

Carnatic singing teachers reported that menopause could cause muscle tightness and make the voice sound husky, hoarse, low pitched and unable to maintain pitch. Arya recognised that young students often have weak voices prior to classical training and that this was most prevalent in singers who also sang “light music” genre.

Singers indicated that vulnerability in women could be attributed to reasons such as breastfeeding and more pronounced and ongoing biological changes in women. It was reported that PMS was associated with heaviness in voice and menstrual cycle with a weak voice. Bala reported that pregnancy increased strain (due to compression of lungs) and often caused significant voice abuse during labour. Vocal strain in young mothers while dealing with their children as also highlighted. A male Western classical singer had a different perspective where he believed that there are male singers who attempt to sound more masculine to satisfy societal expectations and develop voice problems. Pre-pubescent voice changes were reported by male singers. Another point highlighted was that some young singers attempt repertoire even before their vocal mechanism is adequately prepared, leading to vocal problems.

4.4.2.2.7 Subtheme 7: Vocational factors

Both SLTs and singers reported that singers who were already established were in a better position to make decisions such as number of performances and so on compared to emerging artists who push themselves, or are often pushed by tour managers, to accept every opportunity and even perform while they are unwell to avoid reputational and financial loss. Part-time singers were considered to be more vulnerable across participant groups as it was stressful to maintain and develop parallel vocational streams and also find sufficient time to carry out vocal practice. Unrealistic expectations from singers were highlighted by singing teachers and singers (e.g. singing without vibrato, lying on your back and

singing etc.). Cross-over singing or singing across genres was reported by all groups causing restrictions in range and increased laryngeal tension since every genre requires different techniques and skill sets.

One SLT suggested that most Carnatic singers were not full-time singers and had other day jobs. Therefore, they work very hard for long periods of time to develop parallel vocational streams which can cause stress to the mind and body.

Singing teachers reported that lesser opportunities (number of singers trained at conservatoires and colleges are greater than the opportunities) and high and occasionally unrealistic expectations of classical singers (e.g., singing without vibrato) from conductors or music directors puts significant amounts of pressure on singers.

Jessie: "Because the conductor may have an inner sort of idea of the sound for that particular repertoire that is sometimes based on a different model like, one perhaps that has children singing the top line. And so asking women to sound like children is going to cause problems."

Singers mentioned that variability in the amount of work available, singing in choral groups (which singers often undertook due to financial reasons), performing in air-conditioned halls, poor acoustics (forcing singers to strain their voices), singing emotionally intense and challenging pieces for rehearsals and performances caused significant stress and impacted the voice negatively.

4.4.2.2.2.8 Subtheme 8: Factors pertaining to technique

Only singing teachers reported on this theme.

The main technical problems experienced by Western classical singers which can be detrimental to the voice was inadequate or inappropriate use of the diaphragm, where they are "pushing too hard" to sing.

Arya suggested that Carnatic singing often sounded "harsh" on the vocal folds while performing certain vocal ornaments.

Arya: "So, the voice has lots of jerks in ours (Carnatic), and while giving gamakams (demonstrates singing gamakams), unnecessary, what to say impression on vocal

cords. There is too much stress. It cannot be called soft, there is no beauty or aesthetics in it. There is no softness at all."

4.4.2.2.2.9 Subtheme 9: Factors pertaining to voice use

Participants across groups identified that excessive singing (which included over practicing and too many performances), singing unsuitable repertoire and extreme voice use negatively impacted the voice.

Within the context of vocal load, Pankaj indicated that work was "seasonal" for Carnatic singers. For example, the December season is considered auspicious among Carnatic singers where they accept as many offers as possible and perform very complex and difficult to execute pieces. This requires long practice hours thereby causing distress to the vocal system and increasing chances of breakdown. Other factors which were perceived as significant by SLTs were lack of voice rest, singing teaching along with performing and practicing sessions, singing while unwell, performing inappropriate repertoires (e.g., singing songs which may be too high pitched for them) and poor speaking behaviours and techniques (as their focus is primarily on singing).

Lack of knowledge about when to stop singing, only resting the singing voice and not the speaking voice, not singing or practicing enough (e.g., during the pandemic), long recitals (e.g., 3-hour long operas with 10 days of practice) performed over many days, were some of the factors reported Western classical singing teachers.

Robert: "Today's conductors [...] they want they want you to sing the opera in the rehearsal. So, when you are on the first performance, then you already (indicates loss of voice with hands over neck) down".

Carnatic singing teachers highlighted excessive talking and lack of practice were the primary reasons impacting vocal function.

Gauri: "It's like a sport where you.. train the body. If everyday you don't run, how will you run a marathon? [...] You have to sit down, take your shruthi box and sing every god damn day. Otherwise, how will your voice obey you?"

Singers indicated that performing extreme singing patterns (staccato in high pitches, extremely loud singing to produce a "big" voice, extremely high pitches), speaking in inappropriate pitches, excessive

and loud speaking, laughing, crying, singing intense vocal ornaments (gamakams) and imitation of improper vocal techniques negatively impacted the voice.

Anna: "I was trying to sing staccato at a very high pitch, which I knew I shouldn't be doing it. But I just kept on forcing it. And I got a very sharp pain across the right hand side of my neck. And my voice just cut out.."

4.4.2.3 Research Objective 3: How do voice problems impact singers?

4.4.2.3.1 Theme 4: Impact of voice problems on the singer

4.4.2.3.1.1 Subtheme 1: Vocational impact

Financial constraints arising from cancelling concerts and inability to find future work was reported by participants across groups. Loss of reputation was indicated by SLTs and singers.

Emily: "Because I couldn't identify what was going on [pertaining to vocal difficulty], I couldn't easily identify what was going on myself, it felt very much like.. is this the end?? Has it just packed up? Have I got to look for another job?"

Sachin suggested that even a slight change or impairment of voice can have a significant impact on the singing performance and subsequently on the singer.

Additional points highlighted by singing teachers were tendency for singers access private healthcare (which is expensive) and developing fear of causing harm to their voice following a history of developing voice problems which can hinder performing at their full potential.

Singers reported fear and anxiety of employers finding out about the voice problem and not want to pursue their singing careers anymore (because of stress surrounding vocal function during performance). As a result of this, many end up pursuing coaching, teaching or vocations unrelated to singing after experiencing voice problems.

4.4.2.3.1.2 Subtheme 2: Social impact

Only singing teachers and singers contributed towards this theme. Both groups indicated that non singers often may react impassively and demonstrate a lack of understanding towards singers who may be dealing with a voice problem.

Anna: "And I also was telling a friend of mine about, my other friend who lost her voice during surgery and I said what an awful thing it was. And her response was.. well Julie Andrews coped with it, and that was the end of it! Other people, I think, don't actually understand."

Singing teachers indicated that voice problems can affect relationships as a result of emotional consequences of dealing with the voice problem.

The social circle of singers will mostly comprise of singers or other performers and therefore a singer with a voice problem may lose out on their social life since they may not be comfortable engaging within these networks.

4.4.2.3.1.3 Subtheme 3: Psychological Impact

SLTs indicated that voice problems can impact self-esteem in singers and cause anxiety regarding their voice problem, causes, prognosis, treatments involved, particularly surgery. One SLT opined that sometimes emotional consequences may hinder treatment progress.

Singing teachers indicated that voice problems can be devastating for a singer and can lead to feelings of identity loss and cause significant emotional distress because of the enormity of the loss. Some other emotional consequences identified were feelings of shame and guilt and a sense of failure

Jessie: "If you are an injured singer, are you not a complete singer, are you not a proper singer? Are you a singer who has done something wrong? So there's the whole guilt, blame thing [...] So that's all just to do with identity."

One singing teacher indicated that singers cannot take criticism on their voices because then often cannot separate themselves from their voices; therefore, they experience high levels of emotional stress which impacts their quality of life after developing a voice problem. Arya indicated that voice problems will cause immense distress in Carnatic singers until they know what the problem is and when it might resolve.

Singers also reported feeling devastated, anxious, frightened, depressed and loss of identity while encountering voice problems.

Anna: "Well it was just devastating, really, because it.. I mean, it, I mean I know that this is going to sound very melodramatic but it felt like my whole, my whole personality had been stripped away from me."

They also reported feeling less worthy, guilt, demotivated and a sense of bereavement as they "lost the most important part of their lives". One singer described having a voice problem as horrific. Another singer mentioned feeling "stupid and silly" because they felt responsible for developing a voice problem and wanted to blame herself.

4.4.2.4 Research objective 4: What are the voice-related coping strategies identified by singers, singing teachers and speech and language therapists? Are there any cultural themes emerging between the groups?

4.4.2.4.1 Theme 5: Beliefs and perceptions surrounding coping strategies employed by singers

4.4.2.4.1.1 Subtheme 1: Seeking help and influencing factors

SLTs reported that even though singers were most astute in self-identifying a voice problem, this did not reflect positively in seeking treatment. Some factors thought to be responsible for delaying treatment seeking behaviour were lack of awareness regarding vocal health and treatment options (including whom to contact), apprehensions surrounding treatment, lack of time/work commitments, perceiving development of voice problems as a failure and sense of guilt. It was reported that professional singers sought help quicker because they habitually analysed their voices a lot and were therefore more concerned about potentially worsening the problem. Additionally, singers only sought medical help when they feared the presence of what they perceived as "organic pathology", especially cancer and did not consult for symptoms such as vocal fatigue.

With Carnatic singers, it was reported that consultations were sought more during peak "singing seasons".

Pankaj: "So Chennai music season, its around December, November-December.. So September onwards, I would have suddenly an increase in the number of singers calling and asking for appointments. And post the season, again in the month of February-March, I will again have a lot of calls."

The trend of “doctor shopping” was also reported among Carnatic singers where they undertook multiple consultations to confirm a diagnosis thereby delaying treatment further. Also, Carnatic singers often consulted with singing teachers for advice pertaining to their voice.

A “culture of silence” among both groups of singers was reported by singing teachers where they were reluctant to discuss or acknowledge their voice problems openly, due to fear of losing opportunities. Alternatively, some singing teachers opined that singers overreact while encountering a minor voice problem which could be overcome using simple remedies like voice rest and unnecessarily consult medical professionals because it was “fashionable”.

Sarah: “I think its quite sad that singers don’t have enough ammunition of their own to try to look inside first.”

Giri opined that the body has a natural ability to heal which is effective if the individual has sufficient self-belief, courage and resilience and a healthcare professional should only be consulted for serious illnesses such as nodules. It was reported that singers may consult their singing teacher depending on their relationship, but not always.

All singers in this study, who reported voice problems consulted a health care professional (ENTs, SLTs) or a chiropractor/masseur. The timeline was not clear across participants and seeking help was generally triggered by a breakdown or negative experience during a performance or extreme discomfort.

Bala: “I may have had this [voice problem] for around 1 or 1 and a half years and I was performing with this I would have (demonstrates voice break). So I took complete voice rest for 4 days and then sang at the academy concert. Despite that, it was a very strenuous concert. I couldn’t sing comfortably. Then I decided to see a doctor and that’s when they identified a polyp.”

Reluctance surrounding vocal surgery was also highlighted.

Sai: “if a [surgical] knife is placed on your throat, then you are a doomed! Then your fate is pretty much decided [indicates a negative connotation]!”

A few participants also reported hesitancy and a feeling of shame among singers to admit having a voice problem and subsequently seek help. None of the participants consulted their singing teacher in the event of a vocal breakdown.

4.4.2.4.1.2 Subtheme 2: Seeking information

Only SLTs and singers reported on this theme.

Pankaj reported that singers expressed an increased inclination to seek more information about vocal health over the last decade which was reflected by various invitations from music schools to give lectures and seminars for the same.

Singers reported trying to find out as much as possible about their voice problems and how voice works to understand and cope with their voice problems. Some sources of information reported were singing teachers with an expertise in vocal physiology, books, other singers and the internet. Sai used a voice simulation software to understand vocal physiology after being diagnosed with a voice problem.

4.4.2.4.1.3 Subtheme 3: Self-help

None of the SLTs dealing with Western classical singers reported the use of self-help as a potential coping strategy by singers. The SLTs handling Carnatic singers reported the employment of self-help in the form of home remedies (commonly called *paattivaidyam* in Tamil which translates to “grandmother’s medicine”) lifestyle choices (e.g., avoiding cold/spicy foods) and using religion or religious practices (praying to deities or providing offerings to gods) to cope with voice problems. Some examples of home remedies were ingesting turmeric, pepper, lemon, ginger, liquorice and ayurvedic concoctions (commonly known as kashayas/kashayams in India) and topical applications of herbs. It was also suggested that most often, self-help strategies were recommended by other singers or significant others and their relevance and effectiveness were often unquestioned by singers following these practices.

Pankaj: “So they hearsay some practices so they would follow that. So that is their first, sort of remedy. And sometimes it works, sometimes it doesn’t work. And if they do not work, they don’t still want to clarify why it is not working, they will still follow something else.”

Almost all singing teachers believed that all singers will resort to self-help strategies to “mend” their voices; however the participants were divided on their beliefs regarding their efficacy. Some of the home remedies mentioned by Western classical participants were echinacea, throat sprays, giving up dairy and practising mindfulness while saltwater gargling, and over the counter ayurvedic medications, pepper, steam inhalation and applying Vicks VapoRub were indicated by Carnatic singing teachers.

In general, Western classical singing teachers did not believe that religion influenced vocal health in any significant way. On the contrary, all participants representing the Carnatic tradition strongly suggested that religion and faith in God reflected positively towards vocal health and dealing with voice problems. it in a calm and relaxed manner.

Gauri: “So MS Amma (renowned Carnatic singer) was there for this important UN concert. And her voice was not cooperating, she was having problems on the day of the concert. I believe, she just shut herself up, looked at paramacharya’s photo, prayed to him with tears in her eyes. She says, I went to the concert and my voice just opened up and I was able to sing!! so how do you explain that?”

Among singers, voice rest was reported by Western classical and Carnatic singers while avoiding cold foods, conservative voice use, gargling with salt and turmeric and use of religion were identified as strategies used to cope with voice problems by Carnatic singers only.

Bala: “Sure (responds when being asked if god helps her cope with her voice problems) [...] Definitely.. I have a lot of belief [in god]. Generally I am an optimist. It [god] is a power, whatever happens, I will get support, you could call it a support system. God is a support system.”

4.4.2.4.1.4 Subtheme 4: Social support

Social support was highlighted as a coping strategy only by SLTs managing Carnatic singers. It was reported that singers often consulted with their peers and significant others and were sometimes given positive advice which positively influenced treatment seeking. Many singers were also a part of organisations or social groups where vocal health was discussed and recommendations to seek help were actively made.

Pankaj: "They [singers] usually consult somebody else with a similar problem or their teacher. they start guiding them, go take a professional opinion, go meet an ENT, go meet a speech pathologist, go meet somebody a general physician. That's when they probably go and see a doctor. Otherwise, they don't go. Doesn't happen so easily, in India at least!"

Singing teachers belonging to Western Classical tradition expressed that singers are "gossipers" and have "gregarious" personalities. Therefore, they often shared their vocal problems with their colleagues and friends, especially with the advent of social media; however, there may be reservations with some singers to share in public. Further, it was suggested that singers were often gullible and therefore are not adept at identifying advice that is useful to them and seek the right help. Sarah acknowledged the potential lack of ineffectiveness of using social support among singing students as they often moaned or complained about the voice problem rather than ask for /seek solutions which embedded undue negativity and worry rather than finding solutions. However, they were reluctant to acknowledge it with their singing teacher. Carnatic singing teachers did not highlight social support as a potential coping strategy used by Carnatic singers.

Contrary to what was mentioned by the other two groups, singers as a group did not actively indulge in seeking social support to deal with their voice problems in this study. Some singers discussed their voice problems with their immediate family members (husband, mother) or with "another singer who had a good pair of ears". Some singers believed that sharing about your voice problem with peers might lead to gaining sympathy, but no real help or support.

Sai: "Not only that, if something like this [developing a voice problem] happened to you, there will be a few sympathisers, other than that do not expect any support from anywhere."

4.4.2.4.1.5 Sub theme 5: Passive coping

Only singing teachers and singers reported on this theme.

Some Western Classical singing teachers suggested that singers tend to put off dealing with their voice problem because they may be frightened, in denial, lack enough knowledge to realise that they may have a voice problem or simply hope that it will go away or resolve on its own. Other passive coping

strategies mentioned were discontinuing singing (citing personal reasons such as bereavement) or indulging in activities unrelated to singing (e.g., switching to playing a musical instrument)

Anna mentioned waiting for their voice to come back but having realised that it was never going to be like before, decided to give up singing and indulge in activities unrelated to music.

4.4.2.4.1.6 Subtheme 6: Assessment of coping beliefs, perceptions and practices - SLT only

A significant degree of commonality was noticed in this theme across SLTs. All participants reported that they did not use a standardised tool or objective assessment of coping during voice evaluation. Participants informally assessed coping as part of obtaining a case history and agreed that assessing coping will help in understanding the belief systems of patients which will aid in planning intervention and influence treatment efficacy. Pankaj indicated that answering a questionnaire on coping would also benefit singers by giving them opportunities to reflect and gain a different perspective.

Pankaj: "Coping, I think if there is culture specific information, it will definitely add to understanding. And many times, these inventories are helpful for the clinician, it is equally helpful for the singer or the patient who is attempting to, you know, who is attempting to solve those inventories. Because it gives them leading ideas. It gives them a thought to think in a direction which is geared towards vocal health."

The majority of the participants agreed that a formal and objective assessment of coping would be beneficial in reframing better coping in patients and measure treatment effectiveness. Some of the barriers reported were time constraints, possibility of questions being repeated from case history thereby increasing patient burden, inability to probe for further information and lack of culture and population specific tools.

4.4.2.4.1.7 Sub theme 7: Factors influencing coping

Only singing teachers and singers reported on this theme.

Singing teachers suggested that how a singer copes with a voice problem depends on the individual and the circumstances. Some individual attributes which may influence coping were patience, self-esteem, self-worth, caring responsibilities, success level of singers (higher stakes for more successful singers which encourages treatment seeking), external locus of control and hiding vulnerabilities. Gauri suggested that desire to overcome their voice problem and passion towards the art of singing would

help singers to deal with their voice problems positively and illustrated the point with the following example.

Gauri: “If they [singers with voice problems] still desire passionately they want to sing, they will somehow surmount those problems and come forward.

Many attributes were mentioned by singers that they believed impacted their coping choices. These were will power, determination, persistence, lack of awareness and education, lack of clarity on whom to approach, personality (e.g., likes to solve own problems) and optimism.

4.4.2.4.1.8 Sub theme 8: Impact of coping on singer - Singers only

Most singers mentioned feeling anxious after returning to performing following vocal treatment and they all reported feeling confident and satisfied at the end of the performance. Anna, who had given up singing following the development of the voice problem, reported that she coped well until the “voice came back” many years later and found that it was “more devastating than losing it” as she was unable to use her voice the same way as before.

4.4.2.5 Research objective 5: What are the assessment methods of Speech and Language Therapists working with Western Classical and Carnatic singers to evaluate the voice and coping and manage vocal problems in singers?

4.4.2.5.1 Theme 6: Assessment of voice in singers

4.4.2.5.1.1 Subtheme 1: General assessment protocol - SLTs only

A detailed case history was reported across participants as an important tool to gain a good understanding of all aspects of the voice problem. The information gathered from case history covered demographics; history and onset of present problem; singing related details (frequency and duration of singing including rehearsal times); social history (family make up, excessive and loud speaking etc.); training related details (amount and frequency of training, details of the singing teacher); vocal hygiene; exercise regime (weight training which may exacerbate muscle tension); playing sports which could alter posture, neck position or breathing pattern; general health; medications (e.g.; aspirin, inhalers); home remedies or exercises or advice from other singers pertaining to what/what not to do. Many SLTs reported assessing the speaking voice along with the singing voice.

Pankaj: I always believe only when a person can walk, can they run. So if the person's speaking voice is assessed, that is important. So I would start with assessing the speaking voice.

Another common practice reported were visual examination of the larynx either using Stroboscopy or Videolaryngoscopy and perceptual assessment using GRBAS and CAPE V. The sensitivity of using GRBAS was questioned by George as it was “too basic” and may underestimate severity of voice problems in singers. The self-assessment tool routinely used for voice assessment by Western Classical SLTs was VHI.

All Carnatic SLTs reported using singing tasks (e.g., singing a *krithi*-a Carnatic musical piece) to analyse the voice. Most Carnatic SLTs opined that self-assessment of the voice is very important especially with singers since it is challenging to identify subtle voice problems using clinician centred assessments. Also, tools such as EASE should be routinely used by singers even outside the voice clinic to have good awareness of their own voices.

All Carnatic SLTs reported using acoustic analysis (e.g., MDVP, phonetograms) for assessing voice while this was reported as an addition (not mandatory) by Western Classical SLTs.

4.4.2.5.1.2 Subtheme 2: Need for singing specific assessment - SLTs only

The general opinion among Western classical SLTs was that the primary role of an SLT was to restore function of the speaking voice. Therefore, a detailed evaluation of the singing voice is not done routinely. Some aspects such as vocal range may be explored in greater detail along with certain aspects of case history (details pertaining to vocal load, demands and aspects such as vocal warm up and cool down) given its relevance to singers. They also reflected that most of the assessment tools and processes are fairly similar for both singing and non-singing patient groups and singer specific tools such as SVHI are not used routinely, although a need for administering singing specific tools was acknowledged. The main barriers against using singing specific assessment tools were heavy caseload and lack of time. When asked about the need for a separate set of normative data for singers, they added it may not be practical as there may need to be different normative data for each genre.

George: “Well again but its normal, so why would you have a separate set of normative[...] If you break down classical, you've got classical west, you've got various

*modalities there. they vary. are you then saying.. we need normatives for that style?
Is that our job?"*

Most Carnatic SLTs stressed that singers should be considered as a separate vocal group as they are elite performers. They also reported that singing specific self-assessment tools were a useful addition in the assessment protocol. However, these tools are still not used routinely in voice clinics. They attributed this to the linguistic diversity across India where multiple languages are spoken within a small geographical boundary; most of the assessment tools such as SVHI and EASE are not available in many Indian languages. All Carnatic SLTs also recognised the need for a separate set of normative data for the assessment tools and methods (both subjective and objective) used for voice assessment, taking into account their enhanced vocal capacities. They reflected that though attempts are being made in this regard (there are separate normative scores for Voice Fatigue Index and Voice Range Profile for Carnatic singers), more data is required across assessments. Pankaj recommended refining the speaking voice assessment to include elements of the singing voice rather than have a separate protocol for singers as assessment of speaking voice was most important for SLTs, reiterating the views of Western Classical SLTs.

4.4.2.5.1.3 Subtheme 3: Gaps in voice assessment- SLTs only

A few gaps were pointed out by some of the SLTs. Pankaj suggested that the current assessment protocol followed in voice clinics was “bare minimum” and advancements need to happen across all assessment technologies (e.g., better technology for visualisation of larynx), especially for researching singing voices. Another opinion was that the singer’s perspective should take precedence over all other assessments and therefore better tools would be beneficial. Sachin suggested that most SLTs lack knowledge pertaining to musicality. If that knowledge gap on understanding the singing aspects (e.g., *raagams*) was filled, it would greatly benefit clinicians and improve communication with the singing patient group. Aspects like changing the base pitch (*shruthi*), impact of moving from one raga to the other, ambience and acoustics of concert halls and impact of accompanying instruments and assessing the voices of singers during performance were not currently explored. Lack of knowledge and training of newly qualified SLTs to assess singing voices was also highlighted.

George suggested that the perceptual assessment using GRBAS is insufficient for assessing singing voices and recommended that clinicians should be trained to use VPA (Voice Profile Analysis) given its detailed approach and its ability to identify subtle variations in both laryngeal and resonance aspects.

4.4.2.5.1.4 Subtheme 4: Boundaries within the voice clinic - SLTs and Singing Teachers only

Both Western classical SLTs and singing teachers suggested the importance of awareness of professional boundaries between all the members of the Multi-Disciplinary Team (MDT).

SLTs highlighted that they should be wary of crossing over to offer help pertaining to singing and related skills; the appropriate referral to a singing teacher needs to be made by the SLT once the speaking voice is restored to function optimally and all the necessary tools for producing a good voice is provided to the patient. Time constraints of SLTs were also highlighted.

Maddie: "Know where the boundary is in terms of what we deal with, because we are not singing teachers [...] spending weeks, working on the singing voice is not great when we have got an 8 month waiting list for other patients"

SLTs also emphasised that the SLT and the singing teacher should work together for the patient to get the best possible care.

George: "We deal with it when it goes wrong, we build the engine, we build the suspension and go, right, now, you need someone to teach you how to drive around your circuit, whatever it may be. Safely."

Since two singing teachers were also VRCs who are a part of the MDT in voice clinics, responses were recorded for this theme from this group. They indicated that while SLTs were trained to respect the boundaries pertaining to other professionals and make appropriate referrals (e.g., psychologists), they may not be aware of the importance of doing the same with respect to singing teachers.

Jessie: "SLTs will have learnt very clearly the boundaries with, for example psychological help [...] An SLT will know the implications of meddling in that. But they won't necessarily know the implications of meddling in the singing voice or know when, not just when to hand over to a specialist, but how to locate a specialist."

4.4.2.5.1.5 Subtheme 5: How well are voice problems of singers understood by healthcare professionals (HCPs)?

Generally, singing teachers and singers reported that voice problems in singers were not fully understood by HCPs and they may not offer (or have knowledge to offer) the right help, especially GPs or ENTs not specialised in singing voices.

Carnatic SLTs highlighted a communication gap between the service provider (the medical professional) and the service user (the singer). The gap was on both sides where the service provider is mostly unaware of the terminologies used by the singers to describe their problems and the singers are often uncomfortable when they don't receive the answer they were expecting from the HCP. Importance of speaking the language of the singers and using singing terminologies to describe their problems was highlighted by all Carnatic SLTs.

One singing teacher indicated that they would mostly receive a generic diagnosis of reflux and be treated accordingly from a GP. Arya believed that voice specialists (referred to as vocologists) should be involved in dealing with Carnatic singers' voices since they have a good understanding of how the voice works and therefore can identify the actual problem.

Anna mentioned that she did not receive a referral to consult an SLT when she encountered a voice problem a few years ago which may have negatively influenced her recovery. Emily pointed out that singers were often seen as hypochondriacs and hysterical which they are not. Also, a lot of HCPs were "out of their depths" and could not grasp the nature of a singer's voice problems.

Emily: "When I had my shoulder surgery, the physiotherapist who had treated me had no concept of the interrelation of that (points to shoulder) and that (points to neck). None! Absolutely zero understanding of the musculature of anything other than the bit that they are dealing with."

4.4.2.6 Research objective 6: What are the beliefs and practices of singers on maintaining vocal health?

4.4.2.6.1 Theme 8: Perceptions of singing teachers and singers regarding maintaining vocal health - singing teachers and singers

4.4.2.6.1.1 Subtheme 1: Importance of warm up and cool down

The general belief across singing teachers and singers was that vocal warm up and cool down was important for vocal health. Cool down was not reported to be routinely practiced and most participants within the Carnatic group were unfamiliar with it.

Most of the singing teachers reported that there was a lot of education in relation to warm up/cool down. However, the classical singers may be less embracing of these habits compared to commercial singers because they are too bound to tradition and there is a reluctance to change methods, practices and beliefs. They also indicated that most of the singers do not warm up, even though they know that it is good for the voice. Sarah added that singers may not be aware of the specifics of warm up and cool down, impacting their effectiveness.

Jessie: “Everybody knows that they should warm up, but they don’t all know how, or how long for, or what order they should do things in, why they are doing these things. Fewer people know that they should cool down. It’s very hit and miss, this knowledge.”

The introductory exercises of Carnatic training in various *raagams* (scales) along with *akaara saadhakam* (traditional exercise using the vowel ah) were recommended by Carnatic singing teachers to warm up the voice.

Singers pointed out that long travel times, lack of facilities in rehearsal venues and lack of knowledge regarding warm up and its benefits were barriers to practicing warm ups. Gauri provided a varying perspective and believed that warm up was not beneficial.

Anna: “I actually found that it was better if I didn’t warm up. Because it was more natural[...].”

All Carnatic singers mentioned some form of vocal warm up using tools such as *varnams* and *akaara saadhakam*. One singer mentioned that *akaara saadhakam* was like a “battery” which had the capacity to power up the voice. Venu was unclear about the duration required to warm up the voice and believed that very short or long warm ups were counterproductive.

4.4.2.6.1.2 Subtheme 2: Beliefs and practices influencing vocal health

Generally, singing teachers emphasised the importance of having sufficient vocal health education, so that singers can help themselves when they encounter a voice problem, and highlighted the benefits of voice rest in maintaining vocal health.

Some of the factors highlighted by Carnatic singing teachers that positively impacted vocal health were: regular practice, breathing exercises (e.g., *praanaayaamam*, a set of traditional Indian breathing exercises), meditation, following good habits and values, having a positive attitude towards your voice, devotion to god/spirituality, good posture (without bending the spine, sitting cross-legged), yoga, blessings of gurus, voice rest, speaking conservatively, physical exercise and drinking hot water, salt water gargling.

Gauri: “The voice is a vehicle. don’t exert, don’t unnecessarily tire it out. These things have to be told to the students. So take your physical exercise, do go for walks, take your hot water, do your salt water gargling, so these things should become part of your daily routine. That will help your voice.”

Among singers, it was reported that stress and anxiety would negatively impact the singing voice. The positive factors mentioned were family support, religiousness/spirituality and embracing the uniqueness of one’s voice.

4.5 DISCUSSION

This study explored self-reported voice problems and coping strategies among Western classical and Carnatic singers by analysing beliefs and perceptions of three participant groups: singers, speech and language therapists and singing teachers. The similarities and differences between the three groups of participants and between genres were highlighted. This section specifically discusses the key findings regarding perception of a good voice, vocal problems encountered by the two groups of singers, impact of voice problems, coping strategies used by singers, assessment methods employed by SLTs to evaluate voice (and coping) and beliefs and practices surrounding vocal health. The strengths and limitations of the study will also be presented.

4.5.1 How do singers, SLTs and vocal coaches describe a normal and pathological voice?

The differences in describing a good voice are noteworthy. The SLTs mostly confined their auditory perceptual descriptions to the GRBAS scale with a few additions pertaining to pitch and volume. GRBAS is one of the most commonly used scaling methods to perceptually analyse the voice in a clinical setting (Dejonckere et al, 2001) and is therefore a familiar framework for SLTs to describe (mainly spoken) voices. Descriptions of singing teachers and singers encompassed a variety of terms covering expression, creativity and effort along with the traditional descriptors used by SLTs. The reductionist perspective of SLTs pertaining to a good voice may lead to lack of acknowledgement of certain voice problems reported by singers, which may fall outside the confines of the GRBAS scale. In line with this, the present study also indicated that singers often present with normal vocal parameters on assessment even though they raise specific complaints regarding their voices. Physiologically, speaking and singing involve balancing the adductive force of the vocal folds, and the subglottic air pressure, which is similar for speech, singing, and other vocal utterances. However, singing involves more prolonged and sustained voice production compared to speaking which is a series of transient sounds which leads to several perceptible acoustic differences. Aso et al (2010) reported that three major differences can be acoustically determined between speaking and singing which are phoneme duration (the duration of each phoneme is relatively similar whereas it is altered in accordance to the musical score in singing), pitch contour (more steady in singing) and power/loudness (variations in power are synchronised with pitch in singing unlike speaking where the changes are unpredictable). The above-mentioned differences are important considerations as they directly reflect on the vocal output. Therefore, an assessment philosophy, purely based on the speaking voice dynamics may not sufficiently consider the needs and requirements of the singing voice as the subtle differences can be of significance. Phyland et al (2013) reported that subtle and transient vocal changes which may be a precursor to developing permanent vocal impairment often go unnoticed. This calls for a need to enhance sensitivity of voice assessment and further affirms the importance of a multidisciplinary approach to handle singing voices. The difference in the importance assigned to voice quality between the genres could reflect differences in performance demands between the genres. Western classical singers typically require a clear vocal quality to effectively perform their pieces, whilst Carnatic singers rely less on vocal quality during a performance. It could also indicate increased expectations of listeners

for Western classical singers to have a “conventionally” sounding voice in order for that singer to be deemed exceptional.

4.5.2 What are the vocal problems commonly seen in singers and what are the potential risk factors/causes?

4.5.2.1 *Opinion about own voice*

Results indicated that singers who reported they did not like their voices also reported voice problems. Nusseck et al (2020) recruited 536 German school teachers and studied the self-perception of their voices. They found that those who reported not liking their voices were more in teachers with voice problems compared to teachers without voice problems. Given the qualitative nature of this study, it cannot be ascertained if voice problems preceded negative self-perception or vice versa. A plausible scenario would be that singers perhaps manipulate their voices to sound a certain way which is more in line with what they perceive to be an ideal voice and develop voice problems due to unhealthy physiological practices. Our data from Carnatic singers suggest that they try (or are sometimes encouraged) to emulate their singing teachers’ voices and may therefore have an image of an “ideal voice” they are trying to live up to; this may eventually lead to disappointment or unhappiness regarding their vocal output, when this pursuit proves to be a futile experience or worse, leads to poorer voice outcomes than earlier.

4.5.2.2 *Vocal symptoms*

A variety of vocal symptoms were reported by the participants. Vocal fatigue, lack/loss of stamina and limitations in pitch were recurrent themes across groups. Similar results were reported in a systematic review (Chapter 3) done as part of this programme of research, which indicated that vocal fatigue and pitch limitations were two of the most frequently reported symptoms among classical singers. The implications of these findings have already been discussed in detail in Chapter 3. Solomon et al (2008) provided a detailed account of vocal fatigue and hypothesised that prolonged experience of vocal fatigue can cause Muscle Tension Dysphonia (MTD) characterised by increase in phonatory effort and strained voice quality. Prolonged MTD can result in tissue changes in the vocal folds; therefore, vocal fatigue is a symptom of serious concern. The influence of genre on perception of symptoms is also of interest. For instance, vibrato was reported as a desirable attribute in Western classical singing but unacceptable among Carnatic singers. Whilst it is not reasonable to expect SLTs to be familiar with the

nuances pertaining to each genre, it is important that SLTs understand the expectations of a singing patient (e.g., asking the singer regarding their vocal expectations) so that they can address their needs to reach the desired vocal outcome.

4.5.3 What are the factors impacting the voice?

A variety of vocational fears and vulnerabilities were reported in this study. These are currently underexplored and further research in this area would allow relevant parties, such as concert organisers, employers and music colleges/conservatoires to take necessary steps to alleviate singer stress (e.g., identifying the stress source and offering guidance to make appropriate modifications) and prepare students to deal positively with stress (e.g., mindfulness training, meditation, handling competition etc.). Stress was identified as one of the most frequently reported factors impacting the voice in the systematic review carried out on classical singers. A detailed account of stress and its impact on the voice is provided in Chapter 2 section 2.4.8.1.

4.5.3.1 Impact of lack of awareness on voice

Factors affecting the voice have been previously studied and reported in the literature (Devadas et al, 2018; Avila et al, 2010) and were also explored in detail in the systematic review (Chapter 2 sections 2.3.8 and 2.4.8). In the current study, lack of awareness was a dominant theme and reported across participant groups for both genres. Lack of awareness involved inadequate information pertaining to healthy singing, maintaining vocal health and seeking support from relevant professionals. Petty (2012) analysed health information seeking behaviours of 151 self-identified classical singers and 49 non singer controls and reported that singers were 10 times more likely to have not known where to find information regarding vocal problems compared to controls; frequently encountering incorrect or incomplete information about voice-related concerns. Similar results were reported by Gilman et al (2009) where Contemporary Commercial Music (CCM) singers expressed a lack of awareness of the availability of voice care professionals to seek help from, in the event of a voice problem. Singers would benefit from having enough knowledge to identify serious vocal changes and seek help to ensure timely intervention and prevent long-term impairment. The barriers to acquiring awareness should be investigated by the knowledge providers i.e., music colleges/conservatoires, healthcare professionals and singing teachers and more information should be made available to singers who may seek it. Lack of awareness of non-specialised healthcare professionals, such as GPs, who were generally reported to

be the first point of contact while experiencing voice problems, was also indicated in this study. Singers often felt that they did not receive timely and relevant advice from GPs and other healthcare professionals (e.g., referring to a specialised voice clinic), and also felt that they did not possess sufficient knowledge on singers' voice problems. Whilst it must be acknowledged that voice problems of singers encompass a relatively niche field, singers may benefit if healthcare professionals, especially GPs are provided with more resources, particularly pertaining to referral pathways so singers can access specialised voice clinics in a timely manner.

4.5.3.2 *Impact of training on voice*

Training was generally viewed positively in this study by all three groups of both genres. Siupsinskiene and Lycke (2010) studied the effect of training on vocal capabilities in 161 trained choir singers and 188 non singers and confirmed that singing capabilities of the voice increased with vocal training. More specifically, pitch range, maximum frequency, maximum intensity, intensity range were some of the areas improved with voice training. Watts (2016) also reported that singing training was negatively associated with a voice disorder. Sharma (2015) suggested that classical singing training enhances the ability to produce a loud voice and develop a good vocal tone. On the other hand, rigorous training has been reported to increase the likelihood of developing voice problems (Benninger, Benninger and Jacobson, 1994; Davies and Jahn, 2004). In the present study, participants across groups and genres also highlighted that inappropriate training methods such as imitation, using the wrong tonic frequency etc. can negatively impact vocal health. These faulty methods may lead to a mismatch between singers' voice (or vocal characteristics) and the one they are trying to emulate (e.g., singing teacher). It is therefore imperative for singing students and prospective singers to evaluate if the training they receive is bringing positive changes in their voices and be mindful of any discomfort in their voices or singing as this may indicate faulty training. This also reinforces the need for individualisation of training where the singing teacher identifies the characteristics of the student's voice and provides training to achieve the ideal standards pertaining to that individual voice.

4.5.3.3 *Impact of lifestyle factors on voice*

Factors related to lifestyle such as travel and improper eating habits were dominant themes in this study. Davies and Jahn (2004) suggested that travel can significantly impact the voice primarily due to the Lombard effect as singers tend to increase their volume in order to be heard over background noise

(a detailed account is provided in chapter 1, section 1.7.4). Whilst there is not much research available outlining the impact of improper eating habits on the singing voice, it has been reported in many studies that singers experience Laryngo-Pharyngeal reflux (LPR) frequently (Loor et al, 2020); for which, poor eating habits could be a cause or contributor (Weber et al, 2014; Lechien et al 2019, Lloyd et al, 2017). The common symptoms of LPR include hoarseness, frequent throat clearing, swallowing difficulties, cough, tickling sensation in the throat, to name a few (Camarota et al, 2003; Pregun et al, 2009). Therefore, LPR is a cause of serious concern and requires much attention to maintain vocal health of singers. Effects of vocal load on the singing voice have been reported in the literature where it is known to be associated with development of voice problems (Phylant et al, 2013). Vocal load was a dominant theme in this study; further research is required to explore how it can be accurately measured both across performance and practice. Further exploration is also warranted to understand the impact of regular speech on vocal load in singers and ascertain if any thresholds can be generated which will inform advice regarding vocal hygiene.

4.5.3.4 Impact of demographic factors on voice

Demographic factors such as gender and age were reported to have an impact on the voice. Female singers were reported to be more vulnerable to develop voice problems across participant groups for both genres. Similar results have been reported by others. Roy et al (2005) reported that women were twice as likely to report a history of voice problems. Miller and Verdolini (1995) reported similar findings supporting an increased vulnerability for female singing teachers to develop voice problems. Watson et al (1998) reported that 76% of voice clinician referrals were female. The fewer referrals of men could alternatively indicate that men are less likely to seek help from professionals and may therefore not get a referral. This poses interesting questions on alternate intervention approaches which may need to be undertaken to help men with voice problems. Ascertaining if predisposed increase in vulnerability in women or poorer treatment seeking among men is therefore crucial and requires more research.

The ageing voice is a highly researched area and various anatomical and physiological changes have been reported as age advances. Goy et al (2013) reported that older females had a lower fundamental frequency and older males had increased Shimmer values compared to their younger counterparts. Mazzetto de Menezes et al (2014) reported increased asthenia and instability in voice in older

participants. Contradicting evidence has been found in the literature pertaining to singers where younger singers are more likely to develop vocal complaints. Mathmann et al (2021) reported that older female singers reported fewer complaints than younger singers. Similar findings were reported by Avila et al (2010) where younger singers reported greater handicap. These differences could be due to the older singers' increased experience and knowledge about the voice. Nevertheless, this area needs further research; the survey study will investigate the impact of age on the singing voice.

4.5.3.5 Factors impacting voice-comparison between genres

A few differences were noted between the genres pertaining to factors impacting the voice. Firstly, the impact of psychological factors on the voice was reported predominantly by Western classical singers. Whilst it is challenging to provide an explanation backed by research evidence for this difference, it may be postulated that Carnatic singers might feel better equipped to deal with the psychological stresses experienced in life. This could be because they have different expectations and models of illness as evidenced by their religious lean in some of the findings. The biopsychosocial model developed by George Engel (1977) systematically considers the biological, social and psychological factors and their intricate interactions to conceptualise health and illness. More recently, in this predominantly "western" model the impact of stress has been at the forefront of causal mechanisms of illness (Borrell-Carrio, Suchman & Epstein, 2004). It would therefore be interesting to explore any deviations in these models due to differences in cultural dimensions in Carnatic singers to better understand their coping philosophies.

On the other hand, Carnatic singers seemed to be more impacted by socio-cultural factors such as singing during menstruation in Hindu temples (a common concert venue for Carnatic concerts). Garg and Anand (2015) reported that in India, menstruation is still a taboo and the exclusion of women from various socio-cultural aspects during menstruation can impact women's emotional state, mentality, lifestyle and health. While it can be argued that taboos surrounding menstruation may be prevalent across cultures (e.g., the recent discussions surrounding acceptance of non-white shorts at Wimbledon), the religious connotation assigned to menstruation in India is very specific to that culture which unfortunately impacts Carnatic singers given the relationship between religion and the art form itself.

Carnatic singers also suggested consuming cold foods to be associated with developing voice problems which was not indicated by their Western classical counterparts. Anecdotally, consumption of cold foods have been negatively linked with vocal health by increasing one's vulnerability to develop a sore throat. However, there is no evidence in the literature which has empirically studied this association, possibly because of the regional specificity of this belief. Sandage et al (2014) studied the vocal function following exposure to cold/dry air and found no difference in phonation threshold pressure or perceived phonatory effort, indicating that the upper airway is tightly regulated to thermal differences. It must be acknowledged that consuming cold foods cannot be likened to being exposed to cold air; however, given the similarities in context, it is an interesting comparison. The survey in the present thesis will study this relationship which will shed more light on the topic.

4.5.4 How do voice problems impact singers?

The impact of voice problems in singers were predominantly financial, social or emotional in this study. Pestana et al (2020) studied the impact of voice problems in Fado singers and reported that nearly half of the singers had to cancel shows due to voice disorders causing financial and reputation loss. In studies on the impact of voice problems in singers, the most frequently used tool is the Singing Voice Handicap Index. Whilst the SVHI is a measure tailor made for singers where all items are highly relevant for singers, it does not provide any further details pertaining to the nature of impact the singer may be facing due to the lack of subscales and specificity in generated scores. Therefore, there is limited research on the social, vocational, financial and emotional impact of voice problems in singers. There are no other relevant outcome measures specifically for singers; some generic measures would be the Voice Activity Participation Profile (Ma & You, 2001) and Voice-Related Quality of Life (Hogikyan & Sethuraman, 1999). However, the relevance and sensitivity of generic measures to the unique circumstances and subsequent impact of voice problems in singers is questionable. An attempt will be made in the current programme of research to develop subscales for SVHI while analysing the data of the survey (Chapter 6) to provide a more nuanced account of how voice problems impact singers.

4.5.5 How do the two groups of singers cope with voice problems?

The present study explored coping with voice problems among Western classical and Carnatic singers. A variety of coping strategies were reported by all groups; however, a few differences were noted between the groups and / or genres. Treatment seeking was reported to be delayed among Carnatic

singers but was not a dominant theme among Western classical SLTs. Gilman et al (2009) assessed treatment seeking behaviours among 78 Contemporary Commercial Music (CCM) singers and concluded that CCM artists were less likely to seek medical care for voice problems compared to general medical problems. They attributed this trend to high costs surrounding treatment and lack of awareness. The Western classical participants recruited for this study were from the UK, where the National Health Service provides all consultations for free, which is not the case in India where all healthcare facilities are normally paid for, which may explain this finding. Examining views of other geographic locations where the cost of health care is out of pocket is required to investigate the impact on health seeking behaviour. Furthermore, the lack of awareness among Carnatic singers regarding specialised facilities for voice assessment and management may also be a contributing factor. Another reason may be due to a preference among Carnatic singers to resort to home remedies while experiencing a voice problem which was also a dominant theme among Carnatic participants. Nair et al (2021) explored the knowledge, attitude and healthcare practices among Carnatic singers and reported that 73% of singers preferred home remedies over seeking medical attention, a trend observed in the current study.

Another striking difference between the genres was how religiousness was viewed as a coping mechanism. All three participant groups indicated the reliance of Carnatic singers in religion to cope with voice problems. Carver, Scheier and Weintraub (1989) defined religious coping as a means to seek comfort, support or guidance from a “divine being” which can be within the confines of an organised religion or by following one’s own informal path of spirituality. Studies have shown that religious coping enables individuals to cope with various stressors of which illness is one (Spilka et al, 1985). Pargament (1995) suggested that individuals often tend to rely on religion as a coping mechanism when they are unable to control the outcome. Singers who are struggling to manage their vocal difficulties (with or without clinical intervention) may resort to “divine intervention” to gain some control over the situation. Carnatic music is heavily influenced by Hinduism and its roots have been traced back to *Saama veda* which is an ancient Hindu scripture (https://en.wikipedia.org/wiki/Carnatic_music; <http://carnatica.in/sangeet/traditional2.htm>). This intricate relationship of the artform with religion may provide an explanation to why Carnatic singers may rely on religion to cope with their voice problems.

In comparison, social support was viewed as a positive and commonly employed coping strategy by both SLTs and singing teachers but not by singers themselves. Some singers indicated that it was difficult for non-singers to be in their shoes perspective wise and fully relate to the impact they are experiencing as a result of the voice problem. Social support may also not be valued since there may be inter singer variations-what may work for one singer may not work for others. The implications of social support and how it influences health outcomes has been discussed in detail in Chapter 3. Generally speaking, social support can be viewed as a positive or negative coping mechanism. Lee et al (2019) suggest that social support does not always lead to positive experiences irrespective of the intention of the support giver. They explained that when support is unwanted, not in line with the needs of the recipient, causes discomfort or could unintentionally cause stress, then social support, as a coping strategy is viewed as negative. While it has been indicated by a few participants in the current study that social support is ineffective, it is difficult to ascertain why this might be the case.

4.5.6 Assessing the singing voice-challenges and future directions

Assessment of the singing voice was explored in detail with SLTs and with singing teachers who also worked as Vocal Rehabilitation Coaches (VRC). A need for culture specific tools was raised by SLTs, particularly to assess coping. As illustrated in Chapter 1 and 3, culture can influence coping philosophies of individuals. Therefore, a mere translation of existing tools may not be sufficient; rather, cultural relevance is a requirement to develop standardised tools. Various translations of the VDCQ have been attempted (Morawska et al, 2019; Faham et al, 2019; Oliveira et al, 2016); however, none of these tools have been adapted to suit the cultural fabric of the population they are supposed to test, barring a few linguistic variations applied to the tools. In relation to developing context specific tools and assessment protocols for singers, SLTs were divided in their opinion, as the need for this was mainly recognised by Carnatic SLTs. The reason for this could be linked to the fact that SLTs in the UK primarily view their responsibilities to lie within the domain of the speaking voice rather than the singing voice. However, recognising singers as a separate diagnostic group and the need for context specific tools have been indicated in the literature (Phyland et al, 2013) and the need for a comprehensive voice assessment protocol to assess various vocal functions which traverses across disciplines is also indicated (Arunachalam et al, 2013). Vocal use of singers cannot be likened to the general population and therefore, developing and applying a separate assessment protocol (which includes an effective

qualitative interrogation to increase the depth and specificity of the assessment) for singers is an interesting prospect for the future of voice assessment and rehabilitation.

4.5.7 What strategies do the two groups of singers use to maintain vocal health?

All groups of participants reflected on warm up/cool down and a variety of strategies were indicated. Elliott, Sundberg and Gramming (1995) provided a detailed account of how vocal warm up physiologically impacts the voice by examining the phonation threshold pressure (PTP) in a group of male and female singers. They identified and reported positive changes in PTP post warm up. Similarly, Lierde et al (2009) reported similar results with female students training to be SLTs where a significant increase in vocal performance was reported post warm up. Most of the Western classical singers in this study reported using a variety of Semi-Occluded Vocal Tract Exercises (SOVTEs) as part of their warm-up routine. While there is limited research on how SOVTEs improve vocal function while used for warm-up, the evidence on the effectiveness of SOVTEs as a treatment approach to rehabilitate injured voices is substantial (Kaneko et al, 2020; Kapsner-Smith et al, 2015; Guzman et al, 2013). It is therefore, encouraging to note that this is a common practice among singers. Carnatic singers reported various practices such as practising singing early in the morning or incorporating foundation exercises in their warm up routine. Given the cultural specificity of these practices and limited generalisability, it is not surprising that there is not much research evidence to validate the effectiveness of these practices to maintain vocal health. Nevertheless, these are noteworthy and interesting lines for future researchers to explore.

4.6 STRENGTHS AND LIMITATIONS OF EVIDENCE

To the best of our knowledge, the present study is the first of its kind to qualitatively explore self-reported voice problems and coping strategies in the two singing groups. The sample size was large for a qualitative study and diverse; data triangulation was achieved by recruiting participants from three groups which significantly enhanced the scope of interpreting the findings and strengthening the research design (Denzin, 1970). Involving a second researcher ensured that there was a reasonable level of monitoring and quality control across all stages of research. Framework analysis, a well-established method of data analysis was adopted. The background of the researcher (being a singer and an SLT) proved beneficial while formulating themes and deriving postulations from the rich dataset;

additionally, the relatability to most participants may have been an added advantage. Finally, respondent validation by means of member checking ensured accuracy in data interpretation.

A few limitations must be noted. Firstly, most of the participants recruited to represent the Western classical genre (barring one singer and one singing teacher) were from the UK. Moreover, all SLTs working with Western classical singers recruited for this study worked at the same establishment. Even though care was taken to avoid researcher bias (e.g., maintaining a bracketing journal), it cannot be ruled out. However, member checks would ensure that bias is limited to a minimum and would therefore ensure validity of the results.

4.7 REFLEXIVITY AND POSITIONING

It is often acknowledged that in qualitative research, the research findings do not naturally emerge from data. They are developed by the researcher based on the choices they have made throughout the research process (Davis, 2020). Therefore, it becomes essential to describe the journey undertaken by the researcher to derive the research conclusions as transparently and rigorously as possible. Reflexivity, therefore, refers to the parameters which may have influenced the choices and decisions made during the research process (from developing the methodology to contextualising the gathered evidence) (Davis, 2020). The researcher acknowledged that “epistemological realism” is unrealistic to expect but made efforts to present all stages of the research with openness and transparency. A few aspects were considered frequently to aid in philosophising reflexivity. These are discussed below:

4.7.1 How does my background influence my relationship with my participants? (Personal reflexivity)

The similarities in identities between the researcher and the participants was a significant factor as the researcher was a Carnatic singer and SLT. As much as possible, the researcher tried to present herself as an accepted yet marginal member of the singing and SLT community (Arber, 2005) so that meaningful social engagement was possible, whenever necessary, but an over-association could be avoided at the same time. This was difficult particularly with the Carnatic singers as most of the participants were known to the researcher prior to participating in the present research. The researcher, therefore spent some time informally interacting with these participants and prepared them to undertake a more formal approach during the interview process. The researcher also explicitly warned these participants to refrain from modifying their responses to suit the narrative of the researcher (which they may or

may not have been aware of). For example, most Carnatic singers knew that the researcher was an SLT; but they were encouraged to share their beliefs about treatment seeking without taking into account, the background of the researcher (most Carnatic singers reported that they sought to resort to home remedies instead of consulting an SLT, which reflects lack of bias).

A few other points are noteworthy. Many participants (particularly Carnatic singers and singing teachers) sought “consultations” during the interview for various voice problems they were encountering. These requests had to be dealt in a sensitive manner as refusal to help at that instance could be misconstrued as a rude gesture, especially in India. To handle such instances, the researcher made another appointment with the concerned participants to talk about managing their voice problems. It is hoped that this approach did not influence the responses of the participants which may have been the case had the researcher presented her opinions/advice during the interview process.

Another issue was related to the cultural expectations of the participants from the researcher. For example, while interviewing Carnatic participants, the researcher was not expected to address the singers or singing teachers who were older than her, using their names. Appropriate means of addressing (either using sir/madam or brother/sister etc.) were therefore used which made the interactions with participants more personal and culturally sensitive. Similar modifications were also made in attire (the researcher mostly wore Indian clothing while interviewing Indian participants) which also created a comfortable atmosphere during interview. The researcher also tried as much as possible to speak in the local language which was most familiar to the participants-while this may have positively influenced the comfort levels experienced by the participants, it posed the added challenge of translating the interviews. Similarly, most Indian participants expected a response of validation from the researcher for every point they made. For instance, the researcher was often asked “isn’t it?” or “right?” and participants only continued when they received a response. The most common response offered by the researcher was “mmhmm”, “yes” or “I see” which the participant may have misunderstood as an expression of agreement by the researcher. However, this was another cultural idiosyncrasy that had to be dealt with and is therefore acknowledged here.

As much as possible, the researcher tried to use her “privileged” position as a singer and SLT (and an Indian who is aware of various cultural, societal and ethnic norms) to her advantage. This was particularly useful with the Carnatic cohort as most of the participants, especially the singers and

singing teachers were not accustomed to participating or even familiar with voice research. It is the researcher's belief that this "relatedness" may have helped "break the ice" on a few occasions.

4.7.2 How does my background (personal and professional) influence my judgments while making methodological decisions? (Functional reflexivity)

The development of the interview guide was primarily informed by the systematic review carried out as part of the current programme of research. However, the interview guide also included a few items that were reflectively added by the researcher, which were informed by her professional and personal beliefs. An example would be the inclusion of items related to religion that were not reported in any relevant literature. This was a significant addition as most Carnatic participants identified their religion as a coping strategy.

Another instance was where a decision was made to recruit an additional participant within the Western classical singing teachers' cohort. After recruiting the required number of Western classical singing teachers (n=3), it was identified that two of the participants were also Vocal Rehabilitation Coaches (VRC). Since the researcher was familiar with the role of VRCs within the voice clinic domain and their likelihood to have greater knowledge about vocal physiology and rehabilitation, it was deemed necessary to recruit a singing teacher who didn't have a VRC background; this decision was made by the researcher after consulting with the supervisory team.

The researcher also had to make a conscious effort to refrain from reacting to opinions of participants even when they completely deviated from the beliefs of the researcher. For example, a Carnatic singing teacher indicated that he would never recommend seeking professional help to his students for voice problems as he believed it was seldom necessary. During this instance, the researcher continued with the interview, but provided information regarding the role of SLTs and ENTs and how they can potentially help singers with voice problems after the termination of the interview.

4.7.3 How do my personal beliefs influence data analysis (e.g., do they make me predisposed to align my data to reach a particular conclusion? (Epistemological reflexivity)

As much as possible, the researcher refrained from understanding the phenomena of interest by reflecting upon the assumptions which were gained over the course of the current research and from personal experiences. However, this is not a quantifiable or measurable attribute and therefore, it is

difficult to ascertain if any unforeseen bias may have influenced the results. It would be misleading to report that the researcher did not have assumptions prior to undertaking the study as this was simply not true. A few examples of anticipated results that were subsequently reported to be true in this chapter are 1) influence of religion among Carnatic singers; 2) differences in lifestyle factors reported by the two groups; 3) Reduced likelihood of SLTs to objectively assess voice-related coping etc. With the pre-assumed results (which were mentioned in the bracketing journal), more caution was exercised while interpreting the results (e.g., discussing them with the qualitative expert or supervisors).

Another conscious effort was pertaining to representing the views of all participants and groups without showing any predilection or preference to a particular participant or group. An attempt was made to try and include quotes from different participants to ensure that the reporting and in turn the participants' voices were not diluted, biased or "muffled".

A particular instance is worth mentioning here. After an interview, the researcher was asked by one of the participants if this research project will "find a cure" for singers like themselves who are suffering from voice problems. This was an intense sentiment for the researcher to subsume as it was not a likely outcome that was likely to cause disappointment in the participant; additionally, it also acted as an emotional trigger as the researcher herself had suffered from voice problems in the past. Therefore, the researcher had to be conscious to not dwell on it and in turn compromise the objectivity of the process.

4.8 CONCLUSION

Studying voice problems of singers is complex and nuanced. Perspectives of SLTs, singing teachers and singers were explored through this study to provide a comprehensive overview regarding various aspects of self-reported voice problems and coping strategies. The similarities between the results reported in the systematic review (chapter 2) and the self-reported voice problems experienced by singers and factors which may influence vocal health reported in this study validate the findings. Several differences have been reported between genres and participant groups which help us understand better the specifics surrounding voice problems in singers. Similarities in perceptions between the genres (e.g., negative effects of overuse and abuse of voice, positive influence of training, importance of using vocal warm ups etc.) were also noted. Coping with voice problems is an under researched topic; therefore, the findings of the present study provide a foundation for future studies. For example, the

effectiveness of strategies such as self-help and social support should be studied and explored further, taking into account the cultural context. The findings of the study also contribute towards bridging the gap between singers and professionals who support them and encourage a multidimensional approach to rehabilitate singing voices. Finally, many of the strategies to maintain vocal health in this study are interesting avenues for further research that may involve intervention development.

5 CHAPTER 5- A SURVEY TO EXPLORE SELF-REPORTED VOICE PROBLEMS AND COPING STRATEGIES IN WESTERN CLASSICAL AND CARNATIC SINGERS: INTRODUCTION AND METHODS

Chapter 4 explored in depth the perceptions regarding self-reported voice problems, coping strategies, factors impacting the voice and strategies to maintain vocal health among Western classical and Carnatic singers, singing teachers and SLTs associated with the two genres. The present chapter will outline the objectives and methods of a survey that was undertaken to study voice problems and coping in large cohorts of the two groups of singers.

5.1 INTRODUCTION

The systematic review described in Chapter 2 has indicated that classical singers experience self-reported voice problems. Some of the frequently reported symptoms were vocal fatigue, difficulty reaching higher notes and changes in voice quality. Additionally, it indicated two major gaps in research evidence- 1) need for good quality studies which are carried out and reported in a robust manner and 2) lack of studies that compared voice problems between genres. The qualitative study was therefore undertaken to narrow this gap by comparing the self-reported voice problems between Carnatic and Western classical singers using Framework analysis which is a well-documented and established methodology. The qualitative study provided a variety of findings pertaining to self-reported voice problems - while some of these can be generalised to both Western classical singers and Carnatic singers (e.g., vocal fatigue being the most frequently reported symptom), a few differences were also noted. For instance, the importance assigned to (impairment in) voice quality was far greater among the Western classical cohort compared to Carnatic participants. A quantitative exploration of the key findings from the systematic reviews and the qualitative study in a larger cohort of Western classical and Carnatic singers will aid in further exploration and validation of these results.

The systematic review described in chapter 3 reported lack of studies related to voice-related coping in singers. The review did not identify any studies that explored voice-related coping in singers, indicating a need for studies that explore voice-related coping in this group. While the qualitative study investigated voice-related coping in Western classical and Carnatic singers, and has laid a foundation, exploring coping in a larger representative sample, using quantitative methodologies, will increase the generalisability of the findings. Moreover, it will provide an opportunity to assess coping in a more structured format using standardised instruments like the VDCQ.

A survey also allows for associations between different variables to be explored in a systematic way. A variety of factors such as gender, clenching of jaw/teeth while singing, frequent colds etc. were indicated to negatively influence voice outcomes in the systematic review described in Chapter 2 (section 2.3.8). The qualitative study also reported similar findings where a multitude of factors such as excessive/extreme singing, lack of practice, lack of awareness about vocal health among singers, lack of vocal warm up, to name a few were highlighted to be associated with developing voice problems (refer to section 4.4.2.2.2). Ascertaining which of these factors are associated with voice outcomes will help in expanding knowledge pertaining to maintaining vocal health and prevention of voice problems and is therefore warranted.

Surveys are arguably one of the most commonly used quantitative methodologies used in health research. Simply put, survey research gathers information from a representative group of individuals (sample) by collecting responses (fixed-choice and open-ended) to questions (Check and Schutt, 2012). Surveys use a rigorous approach to determine all aspects of research such as defining the sample, preparation and distribution of survey material and data collection methods (Ponto, 2015). Quantitative research also encompasses a variety of well-structured and empirically tested analysis approaches that will aid in verifying the findings reported in the earlier chapters, particularly factors that correlate with vocal health. A wider population can be studied using surveys compared to qualitative methods; therefore, there is better representativeness and generalisability of the results along with amenability to statistics to find reliable patterns in data.

Carrying out a quantitative exploration of self-reported voice problems, voice-related coping and factors impacting the voice is therefore indicated to:

1. Tackle the gaps in the evidence base as indicated by the systematic reviews, to better understand the vocal symptoms, factors impacting the voice, vocal impact and coping in the two singing groups
2. Validate the results of the qualitative study by recruiting a larger sample and establish representativeness and generalisability.
3. Profile and compare the vocal symptoms, factors impacting the voice, responses on coping and voice impact between Western classical and Carnatic singers using a bigger sample.

5.2 SURVEY OBJECTIVES

1. Identify the self-reported voice problems, coping strategies, illness perceptions and factors which are likely to influence the voice in Western classical and Carnatic singers (Descriptive).
2. Compare the self-reported voice problems, coping strategies, illness perceptions and factors which are likely to influence the voice between Western Classical and Carnatic singers to ascertain the impact of genre on the voice (Comparative).
3. Explore strategies employed by the two singing groups to maintain vocal health (Descriptive and qualitative).
4. Examine if there is an association between coping, demographic, singing, medical and lifestyle factors, illness perceptions and impact of voice problems (vocal impact) by carrying out correlation analysis (Bivariate analysis)
5. Identify the predictors of vocal impact by carrying out regression analysis (Multivariate analysis)

The results of objectives 1-3 will be discussed in Chapter 6 and objectives 4 and 5 in Chapter 7.

5.3 METHODS

5.3.1 Design and setting

An exploratory cross-sectional design using a self-reported survey of vocal problems and coping strategies was completed by singers belonging to Western classical and Carnatic traditions. The study adhered to the Checklist for Reporting of Survey Studies (CROSS) reporting guidelines (Appendix 5.1). The study was granted ethical approval by City SPHS HRSM research ethics committee (ETH2122-0107) on 18.08.2021 (the ethics application and approval letter is provided in Appendix 5.2). The survey was distributed online thus there were no geographical restrictions to take part.

5.3.2 Inclusion criteria

Singers who:

- Self-identified as being associated with Western classical or Carnatic traditions primarily (singers could be involved with other genres, however their main performing genre should be classical)
- Had undergone singing training (of respective genres) or currently undergoing training (singing students) for a minimum of 1 year

- Were able to read English to a level sufficient to complete the questionnaire
- Were above 18 years of age

5.3.3 Recruitment and data collection

Participant recruitment was carried out between November 2021 to February 2022 using convenience sampling methods and multiple strategies to maximise recruitment. Singers were first recruited using existing professional network connections of the researcher and supervisory team who were classical singers based in the UK and India. Further participants were recruited using snowball sampling methods.

Additionally, the British Voice Association, which has an extensive database of Classical singers in the UK was approached to assist in recruitment. A blanket email was sent to all members of the BVA by the administrator, providing information about the study for those interested to take part.

Social media avenues such as Facebook, Twitter and LinkedIn were also utilised for recruitment. Facebook pages such as Rasikas.org, Carnatic music group, the Opera singer network, Western Classical music and voice geek which have a significant number of Classical singers and singing teachers across ages and experience levels were used to advertise the study and request participation.

5.3.4 Survey instrument

5.3.4.1 Development of the survey instrument

The survey was developed in English and was informed by:

- The systematic review which focused on identifying self-reported voice problems and factors affecting the voice in Classical singers (Chapter 2).
- The systematic review on voice-related coping in professional voice users (Chapter 3).
- The results of the qualitative study on perceptions of singers, singing teachers and SLTs regarding various aspects of self-reported voice problems, voice-related coping and factors affecting the voice in Carnatic and Western Classical singers (Chapter 4).

The framework which was developed for the current programme of research (discussed in the introduction chapter - Fig 1.3) provided the foundation to outline which constructs need to be included in the survey instrument. The decisions pertaining to inclusion of items and measures that best

encapsulate the constructs were informed by the systematic reviews and the qualitative study. The framework (and the systematic reviews, qualitative study) indicated the inclusion of the following constructs, which were included in the survey instrument:

Demographics; self-perception of voice; vocal symptoms; illness perception; coping; factors influencing voice; vocal impact and vocal health maintenance.

The constructs were measured using study specific items and existing standardised measures. A decision was taken to measure core constructs in detail (i.e. using questionnaires with sufficient number of items for constructs such as vocal symptoms, vocal impact and coping); shorter (brief) measures were used for more peripheral constructs such as illness perceptions. This was deemed to be a pragmatic solution to survey completion burden, that allowed participants to answer core questions within a larger framework. The measures developed or used for each construct are outlined below:

5.3.4.2 Demographics

Demographic characteristics were included to adequately describe the participants. Decisions regarding the inclusion of relevant demographic characteristics were made by looking across the studies included in the systematic reviews - characteristics that were frequently reported (or infrequently reported but relevant to the present survey) were included in the questionnaire in this section. The sections included under this section were core demographics (age, sex, education, marital status etc.), singing and training history. Demographic characteristics were also relevant during analyses to identify if there were any notable correlations between these characteristics and the primary outcome measure. The items included in this section are outlined in Table 5.1

5.3.4.3 Self-perception of voice

The qualitative study indicated that how singers perceive their voices may impact vocal health (e.g., singers may want to change their natural vocal attributes to suit their mental image of a good voice, which may not match with their natural voice characteristics, thereby causing voice abuse/misuse) as reported in section 4.4.2.1.1. Therefore, this aspect was explored in the present survey. A variety of descriptors were highlighted by the participants in the qualitative study (e.g., warm, silvery, expressive etc.) which were included in the survey to explore if they had any relevant associations with the outcome measure. The self-description section also enabled to identify the most common attributes

used by Western classical and Carnatic singers to describe their own voices and compare them between groups.

5.3.4.4 *Vocal symptoms*

The systematic review on self-reported voice problems and the qualitative study indicated a variety of voice problems that are likely to be reported by either or both singing groups. Since a standardised measure was unavailable to comprehensively explore vocal symptoms in singers, a measure was developed by compiling the vocal symptoms reported in the systematic review and the qualitative study and added to the survey instrument. The 27 symptoms were presented in such a way that responses pertaining to (i) frequency and (ii) severity of each symptom could be recorded by the participant. Similar to the SVHI, a Likert scale response(s) was chosen for these items.

5.3.4.5 *Illness perceptions*

The concept of illness perception and its role in the common-sense model that is the basis for developing the framework of the current programme of research has been discussed in detail in Chapter 1 section 1.11.1.2. Illness perception refers to the manner in which individuals understand and experience living with a condition and its potential consequences (Broadbent, 2015; Weinman and Petrie, 1997). The Brief Illness Perception Questionnaire (B-IPQ) developed by Broadbent et al (2006) was used to assess illness perceptions in this survey. The authors stipulated that the specificity of the questions can be increased by replacing the term “illness” with a specific condition. Therefore, “illness” was replaced by “voice problem” in this survey. The B-IPQ is a short and quick measure that is comprised of nine single-item subscales. A short description of the items are provided below:

1. Item 1: Consequences- Impact of the voice problem on the participant
2. Item 2: Timeline- Duration of the voice problem
3. Item 3: Personal control- Amount of control perceived by the participant pertaining to their voice problem
4. Item 4: Treatment control- Impact of treatment on the voice problem
5. Item 5: Symptoms- Level of vocal symptoms experienced by the participant
6. Item 6: Concern- Level of concern experienced by the participant pertaining to their voice problem.
7. Item 7: Illness comprehension- Level of understanding of the voice problem experienced by the participant

8. Item 8: Emotion: Emotional impact of voice problem on the participant
9. Item 9: Factors causing voice problem- with the participant indicating their three most important causal factors of voice problems.

Items 1-8 were measured using a 10-point continuous linear scale (ranging from least to most across the scale) while item 9 used open text to record responses. For each item, scores range from 0-10 which are then compared to obtain patterns of illness perceptions.

5.3.4.6 Coping

The VDCQ is the only disease-specific measure available to assess voice-related coping. Moreover, it has repeatedly been tested and found to have good validity and reliability. Therefore, this was the chosen measure to assess coping in singers in the survey. VDCQ has been described previously in Chapter 3 (Table 3.3 in the published paper). While the version published by the authors (Epstein et al, 2009) contains 15 items (following a factor analysis performed by the authors), an earlier and more detailed version of VDCQ with 27 items (representing an increased number of coping constructs) was used in the survey to obtain a broader understanding of coping strategies used by singers. Additionally, three more items were added that were developed based on the results of the qualitative study, which indicated that singers may potentially use them as coping strategies to deal with their voice problems. These were: 1) I find it easier to cope with my voice problem by involving myself in activities unrelated to singing; 2) I tend to resort to home remedies when I have a voice problem; 3) I find it easier to cope with my voice problem if I make myself think that I do not have a voice problem. A mean score is calculated for each subscale (to bring them into the same scale score range), which are then compared to identify the coping patterns. A higher score for a coping strategy indicates more frequent use of that strategy.

5.3.4.7 Factors affecting voice

Similar to vocal symptoms, a variety of factors (e.g., hormonal factors, frequent colds and allergies, frequent intake of medication etc.) affecting the voice were reported in the systematic review. A varied list of factors (e.g., consuming cold/refrigerated items, physical exercise, excessive speaking, positive attitude towards your voice, stress etc.) were also highlighted as factors impacting the voice in the qualitative study. A list compiling the factors identified through both of these sources was developed- for ease of presentation and analysis, these were then further categorised into vocal behaviours,

lifestyle factors, hormonal factors, singing related factors and medical factors. These were then subsequently included in the survey instrument. The response scales ranged from Likert type scales to simple tick boxes for presence / absence of a factor. Further details regarding response scales are outlined in Table 5.1.

5.3.4.8 *Vocal health maintenance*

The various methods and strategies used by singers to maintain vocal health were explored. This information was collected in the form of free text since maintenance of vocal health is a subjective and individualised process. Warm up and cool down were already indicated as positive habits geared towards vocal health, in the qualitative study. Frequency Likert scales were used to ascertain how frequently singers practised warm up/cool down. A few warm up strategies commonly used by Western classical and Carnatic singers (e.g., sirens, akaara saadhakam etc.) were also highlighted in the qualitative study. These were compiled as a list and presented to the participants to indicate the ones they utilised (check all that apply) and a text box was also available to add any additional comments in free text.

5.3.4.9 *Primary outcome measure for objectives 4 and 5 - Impact of voice problems (referred to as vocal impact in the survey)*

Based on the framework, the construct which was chosen to measure outcomes was vocal impact. This is because, impact encapsulates the physical, emotional, psychosocial and vocational consequences of voice problems in singers. The measure chosen to measure impact was the Singing Voice Handicap Index (SVHI). Even though EASE (explained in chapter 1 section) was briefly considered to be used, it was deemed unsuitable as it was developed to assess singing related difficulties mostly pertaining to vocal fatigue or voice overuse which was reductionistic considering the broader aims of the current survey.

A description of SVHI has already been provided in Chapter 2 (Table 2.6). SVHI is a singer specific measure that assesses the overall impact of voice problems in singers. A systematic review carried out as part of the current programme of research (Chapter 2) indicated that the SVHI (and its variants such as CSHI) was the most commonly used measure in this area of research. Given the suitability of SVHI to achieve the survey objectives (as it provides a comprehensive estimation of physical, emotional and psychosocial aspects of self-reported voice problems in singers) and its well-established research base,

SVHI was a good fit for the survey and therefore chosen as the primary outcome measure for objectives 4 and 5. Total scores range from 0-144; a higher score in SVHI indicates greater vocal impact.

Table 5.1 describes the standardised and non-standardised items used in the survey instrument.

5.3.5 Procedure

The online platform, Qualtrics was used to format and administer the survey. A participant information sheet was first displayed to all participants which outlined the aims of the survey, a brief description of the content of the survey and details pertaining to maintaining anonymity and confidentiality of their responses. Participation was only through agreed consent which was displayed to all participants prior to undertaking the survey.

The survey took roughly 30 minutes to complete. A variety of tools available on Qualtrics such as skip logic, display logic etc. were employed to reduce participant burden and make the responses more relevant to each participant. For example, questions on menstruation, PMS, menopause and oral contraception were only displayed to female participants. Forced responses were not used (except for consent) as this may lead to a large number of drop-outs, given the demanding nature of the survey. To prevent multiple submissions by the same participant, the “prevent multiple submissions” option in Qualtrics was kept “on”. The survey was anonymous, and IP addresses of the participants were not collected during participation. Participants were invited to take part in a prize draw (gift card worth £25) and/or receive the results of the survey, the details of which were collected using a separate supplementary survey (the link to access this survey, also hosted on Qualtrics, was provided at the end of the main survey). The responses of both surveys were independent of each other; therefore, it was not possible to link the contact details to the responses of the main survey, thereby maintaining anonymity. The survey results (raw data) could be accessed only by the members of the research team.

Table 5.1: Description of items in the survey instrument

Construct	Sections	Description and number of items	Type of measure	Measurement
Demographics	Demographic information	1. Age 2. Sex, nationality, ethnicity, marital status, caring responsibilities, education level (7 items)	Non-standardised	1. Open text 2. Multiple choice (choose one from a list of options) and
	Singing history	1. Full-time/part-time 2. Genre, performance level and type, voice type 3. Singing experience, singing duration (both practice and performance) (10 items)	Non-standardised	1. Dichotomous (yes/no) 2. Multiple choice (choose one from a list of options) 3. open text
	Singing training history	1. Type of vocal training 2. Duration (2 items)	Non-standardised	1. Multiple choice 2. Open text
Self-perception of voice	Self-perception of voice	1. Attributes describing own voice (choose all that apply from 14 attributes)	Non-standardised	Multiple choice (choose more than one from a list of options) and open text to indicate any attributes other than the available options
Vocal symptoms	Vocal symptoms	1. Presence of current and past vocal problems interfering with singing, diagnosis received for voice problem 2. Onset and nature of the voice problem 3. Progression of the voice problem 4. Duration of voice problem 5. Frequency and severity of symptoms (34 items)	Non-standardised	1. Dichotomous (yes/no) 2. Dichotomous (gradually/suddenly) 3. 4 point Likert scale indicating progression (remained the same-can't say) 4. Open text 5. 5-point frequency Likert scale ranging from never to always

Construct	Sections	Description and number of items	Type of measure	Measurement
Illness perception	Illness perception	Illness Perception Questionnaire (IPQ) (9 items)	Standardised	Continuous linear scale and open text
Coping	Coping with voice problems	Voice Disability Coping Questionnaire, with 3 additional items as indicated by the qualitative study (30 items)	Standardised (with 3 added items)	6-point frequency Likert scale (Almost never to almost always)
Factors affecting voice	Vocal Behaviours	Excessive speaking/singing, extreme speaking/singing, frequent throat clearing, singing while unwell, clenching jaw/teeth while singing, using amplification while singing (6 items).	Non-standardised	4-point frequency Likert scale (Never to often)
	Lifestyle factors affecting voice	1. Amount of sleep 2. Consumption of items such as alcohol, caffeine, tobacco, spicy foods, oily foods, refrigerated items, dairy (7 items), amount of physical exercise (if any) (1 item), body weight (1 item), quantity and frequency of water consumption (2 items), travel history (frequency and modes of travel-2 items), work related stress (1 item) 3. Reasons for work related stress (choose all that apply from 11 options), beliefs regarding factors impacting voice (choose all that apply from 28 options)	Non-standardised	1. Open text 2. A variety of ordinal responses to suit the nature of the questions 3. Multiple choice (choose more than one from a list of options)
	Hormonal factors	PMS, menopause, menstruation, use of oral contraceptives (6 items)	Non-standardised	Dichotomous (yes/no) to record presence or absence of hormonal factors and Likert scales to identify level of impact

Construct	Sections	Description and number of items	Type of measure	Measurement
	Singing related factors	1. Performance anxiety, Attitude towards voice and singing 2. Opinion about own voice (3 items)	Non-standardised	1. Likert scales to suit the nature of the questions 2. Dichotomous (yes/no)
	Medical history	Medical condition which may impact voice, relevant surgeries or medications, impact of COVID 19 on voice, frequent colds/allergies (5 items)	Non-standardised	Multiple choice (choose one from a list of options) and open text to indicate specifics
Vocal impact	Vocal impact	Singing Voice Handicap Index (SVHI) (36 items)	Standardised	5-point Likert scale ranging from never to always
Vocal health maintenance	Strategies to maintain vocal health	1. Warm up/cool down frequency 2. Warm up/cool down strategies used (2 items) 3. Open ended question to explore practices followed to maintain vocal health	Non-standardised	1. 4-point frequency Likert scale (never to often) 2. Multiple choice (choose all that apply) 3. Open text
<i>Table 5.1: The serial numbers of the column description and numbr of items correspond to the numbers in column named measurement indicating the specific response scale used for the corresponding variable</i>				

Following the development of the survey instrument, it was thoroughly reviewed by a leading voice SLT, a highly specialist SLT and a psychologist for coherence and completeness. Further, the survey was piloted with two singers with over 10 years of singing experience, who fulfilled the other eligibility criteria (one female Carnatic singer aged 61 and one male Western classical singer aged 47), to check the content and how clear it was, identify ambiguities or lack of relevance of items, and get an estimate of burden and completion time. Participants also provided feedback on the user friendliness of the online survey. The final version of the survey can be found in Appendix 5.3.

5.3.5.1 Development of multidimensional subscales

Mclver and Carmines (1981) suggested that use of subscales to assess an underlying theme enhances the specificity of the construct intended to be measured. Within the survey instrument, it was identified that the measures used for exploring three core constructs, namely vocal symptoms, vocal impact and coping, required development of subscales to improve interpretation and increase the specificity of the findings.

As the construct “vocal symptoms” was assessed using a list of 27 symptoms (see section 5.3.4.4), it would be unfeasible to analyse them at an individual item level (particularly in multivariate analyses with other constructs within the framework). Further, vocal impact, which was measured using the SVHI does not provide subscales but assesses impact by calculating a sum of the 36 items in the measure. This would significantly restrict the scope of analysis and interpretation, as various divergent features of vocal impact are collapsed when considered as a single scale. This would then limit the means to separately address the different aspects of vocal impact. Finally, coping, measured using the VDCQ in this survey has previously determined subscales; however, these are available only for the 15-item version and therefore cannot be applied to the 30-item full version employed in this study. Due to these reasons, it was deemed necessary to create subscales for these three measures so that scope and specificity of description of the vocal symptoms, impact of voice problems and coping could be enhanced.

To develop subscales for the measures listed above (and also ascertain if the constructs measured were multi-dimensional), Exploratory Factor Analysis (EFA) was carried out through Principal Components Analysis (PCA) and oblique (Direct Oblimin) rotation. In each PCA, to evaluate eligibility of items for PCA, the measure of sampling adequacy (MSA) was assessed using Bartlett’s test of Sphericity (BTS) and the

Kaiser-Meyer-Olkin (KMO) index. Additionally, individual item KMO values were examined to check their contribution to the factor solution, by generating an anti-image correlation matrix to generate a MSA for each item. Any items with an $MSA < 0.60$ were iteratively eliminated from analysis until the MSA of all items was > 0.60 . All other items were included in the PCA. Eigen values (set at 1 or above) and scree plots were used to determine the number of components to extract. Oblique rotation was utilised to allow the constructs to be related to each other (as is common in health research variables).

Following PCA, reliability analysis to measure internal consistency of the generated subscales was carried out using Cronbach's alpha. Ursachi et al (2015) reported that acceptable reliability levels are achieved with alpha values of 0.6 or 0.7 with the reliability being very good with alpha values of 0.8 or higher. However, alpha scores of 0.95 or greater are not ideal as this indicates redundancy (Hulin, Netemeyer, and Cudeck, 2001). These guidelines were taken into account to ascertain if the generated subscales had sufficient internal consistency. If the subscales did not show sufficient reliability, then items were removed until a suitable alpha level was reached.

Should factor analysis not generate a theoretically logical set of subscales with good reliability, then a mapping activity was to be undertaken. For the frequency and severity of symptoms, this would be done by referring to previously established tools (which includes both perceptual and self-report measures as self-report measures specifically assessing vocal symptoms are limited) such as CAPE V (CAPE-V, ASLHA, 2002), GRBAS (Hirano, 1981), Buffalo III Voice Profile (Wilson, 1987), Vocal Tract Discomfort scale (Matheison, 1993) and the Perceptual Voice Profile (Oates and Russell, 1998) and categorising the symptoms accordingly (these measures have been discussed in section 1.8.1.1.3 and Table 1.2). For SVHI, the VHI would be used as a reference point as the SVHI was essentially developed from the VHI. SVHI items would be categorised into Functional, Emotional and Physical subscales (which are the subscales available in VHI). Since the development of VDCQ was based on the WAYS questionnaire developed by Lazarus and Folkman (1980), WAYS was deemed to be an appropriate tool to map the VDCQ items. Another widely recognised coping tool is the COPE inventory developed by Carver et al., (1989). To give more options in finding the appropriate subscales to fit the items of the VDCQ (including the additional 3 items), it was decided that both WAYS and COPE would be used to map the VDCQ items into suitable categories.

Once suitable subscales were determined, means were calculated for all subscales developed for the measures. Since SVHI conventionally calculates a sum of all items, this was computed to enable comparison with the extant literature; but mean scores were used to make comparisons within the survey.

5.3.6 Statistical strategy

All data analyses were performed using IBM SPSS 28.

5.3.6.1 Missing values

A dataset is deemed to have missing values when there are no responses recorded for some cells, thereby making it incomplete. Given the demanding nature of the survey instrument, it was anticipated that missing data might occur and therefore, a plan was developed to deal with them in an efficient manner to ensure that there is no significant data loss or inflation of scores.

Missing values are known to occur at three levels:

- a) At item level where individual items (which may occur within a subscale) are missing
- b) At scale level where the entire scale's constituent items have not been answered or where insufficient items are answered to produce the scale score
- c) At the questionnaire level where all/most of the responses are missing across the questionnaire.

Since the effect of these levels on the output of results vary, they were dealt with in different ways as described below.

a) At item level

To efficiently deal with items missing at item level, a mean substitution methodology was adopted for items of scales with Likert type responses. The scores for missing items were essentially calculated based on the scores present of other items within that subscale for each participant and then averaged. To calculate an adjusted score enabling comparison of scaled scores, the averaged scores were multiplied by the total number of items of the scale. This was only implemented for those participants who had filled in at least 50% of the items within the scale. Responses of participants who filled less than 50% of the items in a scale were not considered for analysis – i.e. the scale was considered missing. For instance, this methodology was adopted for SVHI where there were values missing for each question. For participants who filled in at least 18 questions (total number of items of SVHI are 36), a

mean substitution was carried out to calculate a mean score. This was then pro-rated by multiplying the average value by 36 providing a comparable adjusted score. This was considered to be a suitable imputation strategy as the scores of the participant were used to impute missing values rather than an average of scores across participants (which is a biased approach).

For items with yes/no type responses (e.g., Do you currently have any vocal problems which may interfere with your singing?; Are you taking contraceptives? etc.) and for items where participants were instructed to select options that apply to them from a list (e.g., which of the following variables do you believe impacts the voice?), the missing responses were assumed to be indicative of absence of the phenomenon of interest and therefore coded as “no”.

- b) At variable or scale level where the entire variable has not been answered or the scale scores have > 50% missing values

To deal with missing data at this level, single imputation was adopted to “fill in” the missing data. This was done to avoid limiting the sample size which would occur with the more traditional methods such as list-wise or pair-wise deletion. As a first step, checks were made to ensure that the variables to be imputed were missing completely at random using Little’s MCAR test. Once this was established, the imputation process was commenced. Hot deck imputation was used to impute missing values. Hot deck imputation is a matching method where values are imputed to match the scores of a similar respondent (Roth, 1994). This was done using Predictive Mean Matching (PMM) where a small set of respondents are chosen from complete cases who have the closest values to the predicted missing, following which, one of these candidates are randomly chosen and the missing values are replaced with the observed values of the chosen respondent. Following PMM, 10 datasets were generated, of which a random dataset (generated using an online random generator) was chosen for analysis.

- c) At the questionnaire level where all/most of the responses are missing across the questionnaire. If a participant essentially submitted an empty questionnaire, or did not fill beyond the demographics section, they were excluded from analysis and not counted in the sample size.

Missing value analyses was carried out for the entire questionnaire and the percentage of variables, cases and values missing were analysed. Additionally, the missing value patterns were also investigated to check if the missing values exhibited any significant patterns, where a combination of questions were not consistently answered.

5.3.6.2 Comparisons between groups

This section describes the methods employed to address objective 2.

The two participant groups in this survey, namely the Western classical group and the Carnatic group were compared to establish any group differences. To compare frequency data (e.g., sex, maintaining vocal health), the χ^2 test was used. To compare Likert-type responses and single scale items (such as IPQ), Mann Whitney u test was used. T-tests were used to compare means of variables. Shapiro-Wilk was used to establish normality of the data. It has been reported that T-tests are robust for moderately skewed data (Cessie, Goeman & Dekkers, 2020; Lumley et al, 2002); therefore, for variables which had a significant result on the Shapiro Wilk test ($p < 0.001$), they were followed up with non-parametric tests such Mann Whitney. However, if the results were similar to t-test, then the latter was reported, else, the Mann Whitney results were reported. Hedge's g was used to describe effect size. The level of significance was fixed at 0.05.

Sections 5.3.5.3 and 5.3.5.4 describe the methods employed to address objectives 4 and 5 respectively.

5.3.6.3 Correlations

Pearson's r correlation was used to determine relationships between continuous variables and subscales. For binary variables correlated with a continuous variable, a point-biserial correlation was used. Assumptions of linearity and normality were checked. If they were not met, the Spearman's correlation coefficient was reported. The cut-offs for coefficients were as follows (Cohen, 1988):

- 0.10-0.29= (explaining 1-8% of the variance) = Weak correlation
- 0.3-0.49 (explaining 9-24% of the variance) =Moderate correlation
- 0.5-1 (explaining 25-100% of the variance) =Strong correlation

The level of significance was fixed at $p < 0.05$.

Variables that indicated a correlation coefficient greater than or equal to 0.3 were carried forward for regression analysis.

5.3.6.4 Regression analysis

Regression analysis was carried out to identify the variables which may predict an outcome and estimate the amount of change in the outcome variable as a result of changes in the predictor variables. The outcome or the dependent variable was SVHI (which measured the construct vocal impact) as indicated in section 5.3.3.1.8 and the independent or predictor variable *categories* were demographics, singing related details, frequency of symptoms, VDCQ, IPQ, vocal behaviours, lifestyle factors, medical factors and singing related factors. Of these categories, variables that indicated a correlation coefficient greater than or equal to 0.3 during correlation analysis were entered into the regression equation. All categorical variables were dummy coded to make them eligible for multiple regression. If there were a large number of potential predictors following correlation analysis and the case to variable ratio was not met, stepwise regression analysis was first carried out as a screening step to limit/reduce the number of predictor variables to those that uniquely contribute to the outcome. This was done per category of predictors. The variables which provided a significant contribution to predict the outcome ($p < 0.05$) in this step were identified.

Following this, the “significant” variables were theoretically grouped and entered into a hierarchical regression model (Tabachnick & Fidell, 2001) to identify how well a set of variables were able to predict the outcome. The variables were entered in blocks in a specified order, based on theoretical grounds (Pallant, 2020). The contribution of each independent variable to predict the outcome was assessed after controlling for the effects of the previously entered variables. The adjusted R^2 values were used to determine the amount of variance which may be accounted for by each model to predict the outcome and examine the cumulative effects on the variance after adding each block. At each block the R^2 change was reported to identify how much variance can be explained by the respective block after the earlier variables are statistically adjusted for (i.e. controlled for). At the final step (when all variables are in the equation), the independent variables within each model, which made a *unique* significant contribution to predict the outcome, were identified by checking which of these variables provided statistically significant results within the model, via their beta coefficients (and also identify those that contributed most to the outcome after controlling for the others).

The pre-requisites (assumptions) for carrying out multiple regression, such as adequate sample size, multicollinearity, outliers, normality, linearity, homoscedasticity and independence of errors were checked; violations (if any) were accounted for or acknowledged during interpretation. Table 5.2 describes the pre-requisite assumptions and the methods used to determine them.

5.3.7 Sample size

G*Power (Faul et al, 2009) was used to determine sample size. For a 2-group comparison (using ANOVA) with alpha at 0.05, power at 90%, medium effect size ($f=0.15$), it was estimated that there will need to be 172 total participants. This was also evaluated to be sufficient to conduct multiple regression (alpha = 0.05, power = 90%, medium effect size $f^2=0.15$) with 15 predictors (required $n=171$). It was also possible to carry out a Principal Components Analysis of VDCQ, SVHI and frequency of symptoms with an item to participant ratio of 6, if all items were included and ratio of approximately nine if 20 items were retained (this ratio was calculated based on VDCQ which was the longest scale with highest number of items).

Table 5.2: Description of regression assumptions, methods used to assess them and implications for the study (Pallant, 2020)

Assumption	Description	Method to assess (including criteria)	Action taken if violated
Normality	The residuals (differences between the predicted and obtained DV scores) should be normally distributed (with a characteristic bell curve shape)	Normal probability plots and scatterplots (of standardised residuals, ZRED and standardised predictions ZPRED) were used to check assumptions. For normality, the residuals should lie in a reasonably straight diagonal line on the normality plots to ascertain normality.	Mild deviations will be acknowledged as a limitation. Cases causing severe deviation will be excluded from analysis
Linearity	The residuals (differences between the predicted and obtained DV scores) should be linear (the relationship should be a straight line)	The scatterplot should indicate a fairly straight line which is approximately horizontal at zero	Mild deviations will be acknowledged as a limitation.

Assumption	Description	Method to assess (including criteria)	Action taken if violated
			Cases causing severe deviation will be excluded from analysis
Homoscedasticity	The residuals should have the same variance for all predicted scores around the predicted DV scores.	Scatterplots should indicate that the residuals are roughly rectangular in shape (not curvilinear or higher on one side) with maximum concentration of scores along the zero point.	Mild deviations will be acknowledged as a limitation. Cases causing severe deviation will be excluded from analysis
Adequate sample size	Sufficient case to predictor variables ratio is required to carry out multiple regression analysis	G* power was used to calculate adequate sample size (details in section 5.3.5.1). Univariate analyses were carried out to further limit the number of independent variables entered into the regression model	If the case to predictor ratio is low, it will be acknowledged as a limitation
Multicollinearity	The independent variables should not correlate strongly (<0.80 ; Field, 2000) with one another.	Correlation matrices were inspected for all independent variables	In case of predictor variables which correlate “strongly” with each other, the one which is more supported by theory will be carried forward and the other variable will be deleted from the regression model- OR a composite score calculated (if appropriate)
Outliers	Outliers occur when a participant has unusually low or high values for a predictor variable.	Univariate outliers are indicated in scatterplots if the residuals are >3.3 or <-3.3 . For multivariate outliers, Mahalanobis distances were assessed by determining the critical chi-square value using the number of predictor variables as the degrees of freedom. The alpha level	Cases identified as significant outliers will be deleted from analysis

Assumption	Description	Method to assess (including criteria)	Action taken if violated
		used was 0.001 (Tabachnick & Fidell, 2001).	
Independence of errors	The residuals are independent of one another	Durbin-Watson test was used to ascertain that residuals were uncorrelated. Field (2009) suggests that values under 1 or more than 3 are a definite cause for concern (value closer to 2 is ideal);	Variables causing severe deviation will be excluded from analysis

6 CHAPTER 6- A SURVEY TO EXPLORE SELF-REPORTED VOICE PROBLEMS AND COPING STRATEGIES IN WESTERN CLASSICAL AND CARNATIC SINGERS - RESULTS PART 1

Chapter 5 outlined the background and need for the survey, the objectives and the methods employed in carrying out the survey. This chapter will cover the results of the following objectives:

1. Identify the self-reported voice problems, coping strategies, illness perceptions and variables which are likely to influence vocal health in Western classical and Carnatic singers (Descriptive).
2. Compare the self-reported voice problems, coping strategies, illness perceptions and variables which are likely to influence vocal health between Western Classical and Carnatic singers to ascertain the impact of genre on vocal health (Comparative).
3. Explore strategies employed by both singing groups to maintain vocal health (Descriptive and qualitative).

6.1 PARTICIPANT CHARACTERISTICS

Qualtrics recorded 309 accesses to the survey, of which 93 participants did not fulfil the eligibility criteria and were therefore not allowed to undertake the survey. 51 were empty responses or not filled beyond the demographics section and were not taken further. Of the remaining 165 responses, 30 were full responses. Even though the proportion of partial responders was large, the actual level of missing data was low (refer to section 6.2 and Fig 6.1 for further details). The partial responses were either subjected to mean substitution or multiple imputation using the methods described in chapter 5 (depending on which method was applicable). Therefore, the number of participants considered in this survey was 165, of whom 102 (61.8%) identified as Carnatic singers and 63 (38.2%) as Western classical singers. The mean ages and standard deviations of the Carnatic and Western classical cohorts were 39.62 (SD=12.15) and 43.72 (12.89) respectively. There was a higher number of females in both groups; n=40 (63.5%) and n=80 (78.4%) in Western classical and Carnatic groups respectively. The majority of Western classical participants were British (n=38, 61.3%) whereas the majority of Carnatic singers were Indian (n=85, 85.9%). Compared to the Carnatic group, the Western classical group had more part time singers in relation to the sample (43 vs 58; 68.3% versus 56.9%). The part-time jobs indicated by the two cohorts are listed in Table 6.1.

Pertaining to singing level, the largest category in both groups was professional singers ($n=36$, 57.1% for Western classical group and $n=39$, 38.2% for the Carnatic group) and mostly performed solo ($n=59$, 93.7% for Western classical group and $n=97$, 95.1% for Carnatic group). The mean (SD) years of training was 16.90 (12.19) and 16.41 (8.94) years for Western classical and Carnatic singers respectively. Mean singing experience was computed to be 26.75 (14.80) years for the Western classical group and 23.62 (12.09) for the Carnatic group. The number of hours of singing practice and performance per week were comparable between the groups and are presented in Table 6.1. Singers also reported other genres they may be associated with, which indicated that a majority of Western classical singers were associated with musical theatre ($n=35$, 55.6%) and Carnatic singers with Indian film/light music ($n=76$, 74.5%). Among the Western classical singers, 27 women (43.5%) were sopranos, and 11 males (17.7%) were tenors.

Pertaining to education levels, the largest category in both groups was of post-graduates [Western classical $n=31$ (64.6%); Carnatic $n=40$ (65.6%]. Thirty-two (68.1%) of Western Classical and 46 (75.4%) Carnatic singers indicated that they were either married or in a relationship.

Chi square tests were used to compare characteristics that were relevant (e.g., ethnicity would show statistically significant differences between groups, but this was expected and therefore not statistically compared) and if it was viable to do so (i.e. categorical data and expected counts > 5 in $>80\%$ of cells). Of the variables tested, there was a statistically significant difference on the number of professional singers [$\chi^2(1,165)=4.382$; $p=0.036$] and gender [$\chi^2(1,165)=5.616$; $p=0.018$], with Western classical singers having a higher number of professional singers and a higher number of male participants. Continuous data was compared using independent t tests. While the number of singing teachers was not statistically different between the groups, the number of hours of singing teaching was significantly greater among Western classical singers [$t(61)=3.13$; $p=0.003$]. Similarly, though the number of part-time and full time singers was not significantly different between the groups, the duration of working as a singer among part-time singers was significantly higher among Western classical singers [$t(78)=3.81$; $p<0.001$]. The starting age of singing training was also significantly different between the groups with Carnatic singers starting their training younger than Western classical singers [$t(160)=7.74$; $p<0.001$].

All relevant details pertaining to participant characteristics including inferential statistics are reported in Table 6.1.

6.2 MISSING VALUE ANALYSES

Figure 6.1 presents the number of items and cases with missing values. The analysis indicated that 30 cases (18%) had no missing values. The total number of variables applicable to all participants (e.g., questions on menstruation were not applicable for male participants) was 298, resulting in 49,170 values (individual pieces of information). Of these, 17.5% (n=8608) of the values were missing. Analysing the items with most missing values indicated that questions pertaining to severity of voice problems experienced by the participants (28 items) had the highest values (ranging between 54% to 36%). This could be because frequency and severity were assessed for each symptom using a dual column format and therefore participants may have responded to only the frequency scale rather than both. Given the high percentage of missing values for every item pertaining to severity, this category was excluded from all further analyses. Following deletion of severity items, the missing values reduced to 14.5 % (6543 items) and the number of complete responses increased to 45. Missing value patterns were analysed which indicated that the most frequently occurring pattern was where no responses were missing. When missing value analysis was carried out separately for the two groups, it was indicated that Western classical singers had more complete responses (n=27; 43%) compared to Carnatic singers (n=18; 18%). A table outlining the percentage of missing values for all variables is provided in Appendix 6.1 (this includes missing values at item level and scale level).

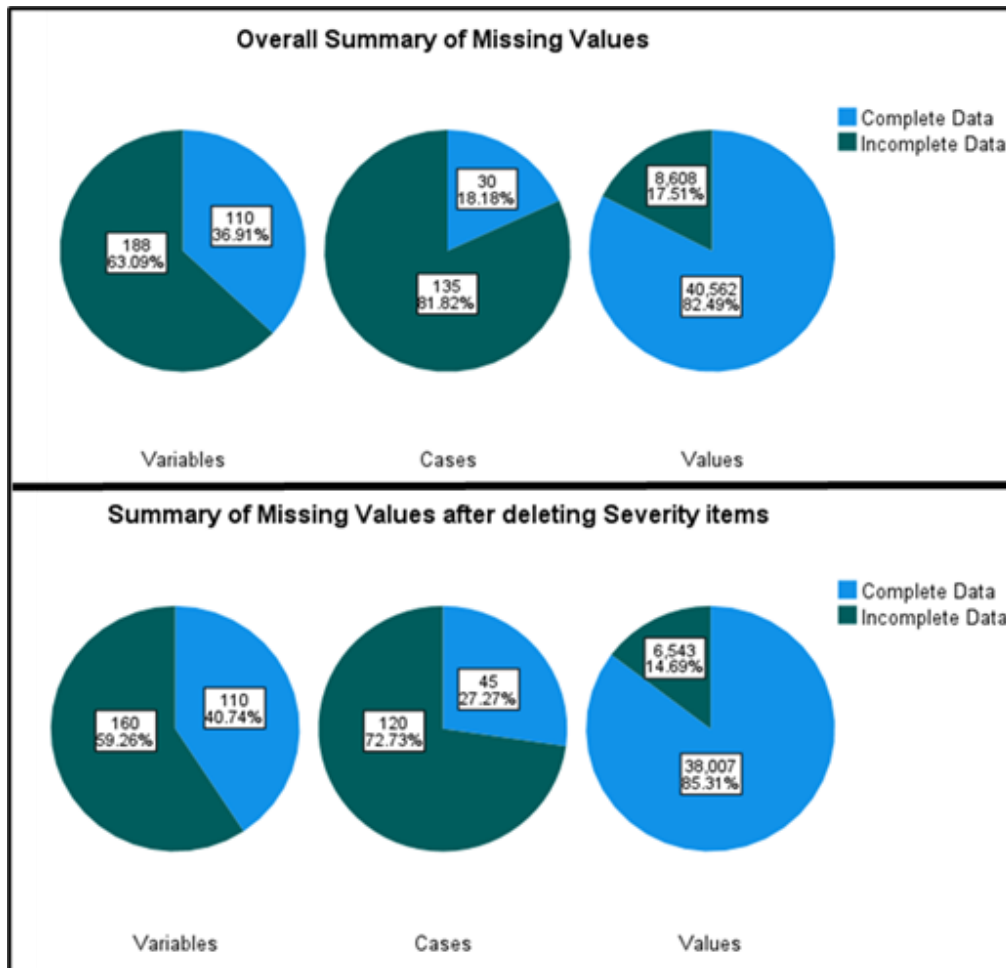
Table 6.1 Demographic characteristics of the participants for total sample and per singing group.

CONSTRUCT	CHARACTERISTIC	TOTAL SAMPLE	WESTERN CLASSICAL	CARNATIC	INFERENTIAL STATISTICS		
	PRIMARY SINGING GENRE	165 (100%)	63 (38.2%)	102 (61.8%)			
DEMOGRAPHIC CHARACTERISTICS	AGE, RANGE AND SD	N=162	N=62	N=100	t	df	p
	MEAN, RANGE (SD)	41.35, 18-75 (12.58)	43.72, 20-75 (12.89)	39.62, 18-68 (12.15)	1.97	160	0.05
	SEX AT BIRTH	N=165	N=63	N=102	χ^2	df	p
	FEMALE N (%)	120 (72.7%)	40 (63.5%)	80 (78.4%)	4.38	1	0.36
	MALE N (%)	45 (27.3%)	23 (36.5%)	22 (21.6%)			
	NATIONALITY	N=161	N=62	N=99			
	USA/CANADA	15 (9.3%)	12 (19.4%)	3 (3.1%)	NP	NP	NP
	AUSTRALIAN	3 (1.9%)	3 (4.8%)	0 (0%)	NP	NP	NP
	BRITISH	48 (29.8%)	38 (61.3%)	10 (10.1%)	NP	NP	NP
	EUROPEAN	5 (3.1%)	5 (8.1%)	0 (0%)	NP	NP	NP
	INDIAN	88 (54.7%)	3 (4.8%)	85 (85.9%)	NP	NP	NP
	OTHER	2 (1.2%)	1 (1.6%)	1 (1%)	NP	NP	NP
	ETHNICITY	N=164	N=62	N=102			
	WHITE	51 (31.1%)	49 (79%)	2 (2%)	NP	NP	NP
	ASIAN	97 (59.1%)	7 (11.3%)	90 (88.2%)	NP	NP	NP
	BLACK	1 (0.6%)	1 (1.6%)	0 (0%)	NP	NP	NP
	OTHER	15 (9.1%)	5 (8.1%)	10 (9.8%)	NP	NP	NP
	EDUCATION LEVEL	N=109	N=48	N=61	χ^2	df	p
	COLLEGE/PRE-UNIVERSITY OR EQUIVALENT	9 (8.3%)	4 (8.3%)	5 (8.2%)	0.12	2	0.994
	UNIVERSITY	29 (26.6%)	13 (27.1%)	16 (26.2%)			
	POST GRADUATE OR HIGHER	71 (65.1%)	31 (64.6%)	40 (65.6%)			
	MARITAL STATUS	N=108	N=47	N=61	χ^2	df	p
	MARRIED/IN A RELATIONSHIP	78 (72.2%)	32 (68.1%)	46 (75.4%)	2.06	4	0.72
	SINGLE/WIDOWED/DIVORCED	26 (24.07%)	13 (27.6%)	13 (21.3%)			
SINGING HISTORY	PART TIME/FULL TIME	N=165	N=63	N=102	χ^2	df	p
	FULL TIME	64 (38.8%)	20 (31.7%)	44 (43.1%)	2.12	1	0.15
	PART TIME	101 (61.2%)	43 (68.3%)	58 (56.9%)			

CONSTRUCT	CHARACTERISTIC	TOTAL SAMPLE	WESTERN CLASSICAL	CARNATIC	INFERENTIAL STATISTICS		
	PART-TIME JOBS UNDERTAKEN	N=82	N=40	N=42			
	HEALTHCARE	8 (9.7%)	5 (12.5%)	3 (7.1%)	NV NV NP		
	IT/SOFTWARE	11 (13.4%)	3 (7.5%)	8 (19%)			
	FINANCE/BANKING	3 (3.7%)	0	3 (7.1%)			
	TEACHER	24 (29.3%)	19 (47.5%)	5 (11.9%)			
	OTHER	36 (43.9%)	13 (32.5%)	23 (54.7%)			
	DURATION WORKING AS A PART-TIME SINGER	N=80	N=34	N=46	t	df	p
	MEAN (SD)	22.48 (20.60)	31.92 (25.14)	15.5 (12.82)	3.81	78	<0.001
	SINGING RELATED DETAILS				t	df	p
	SINGING EXPERIENCE (YEARS) (N=160)	24.81 (13.23)	26.75 (14.80) N=61	23.62 (12.09) N=99	1.45	158	0.15
	NUMBER OF HOURS OF SINGING PRACTICE PER WEEK (N=161)	8.58 (7.44)	9.25 (8.48) N=62	8.16 (6.73) N=99	0.89	159	0.37
	PERFORMANCE-HOURS PER MONTH (N=148)	11.08 (18.08)	11.62 (16.98) N=61	10.71 (18.91) N=87	0.29	146	0.76
	NUMBER OF HOURS OF TEACHING SINGING	16.02 (11.66)	21 (12.86), N=27	12.29 (9.20) N=36	3.13	61	0.003
	SECONDARY GENRES						
	JAZZ	17 (10.3%)	14 (22.2%)	3 (2.9%)	NP	NP	NP
	MUSICAL THEATRE	40 (24.2%)	35 (55.6%)	5 (4.9%)	NP	NP	NP
	INDIAN FILM/LIGHT MUSIC	79 (47.8%)	3 (4.8%)	76 (74.5%)	NP	NP	NP
	CONTEMPORARY CHOIR	12 (7.27%)	9 (14.3%)	3 (2.9%)	NP	NP	NP
	OTHER	34 (20.6%)	17 (27%)	17 (16.7%)	NP	NP	NP
	SINGING LEVEL				χ ²	df	p
	AMATEUR	35 (21.2%)	11 (17.5%)	24 (23.5%)	0.86	1	0.35
	SEMI-PROFESSIONAL	48 (29.1%)	14 (22.2%)	34 (33.3%)	2.33	1	0.12
	PROFESSIONAL	75 (45.5%)	36 (57.1%)	39 (38.2%)	5.61	1	0.18
	SINGING TEACHER	65 (39.4%)	27 (42.9%)	38 (37.3%)	0.51	1	0.47

CONSTRUCT	CHARACTERISTIC	TOTAL SAMPLE	WESTERN CLASSICAL	CARNATIC	INFERENTIAL STATISTICS		
	PERFORMANCE TYPE				χ^2	df	p
	SOLO SINGERS N (%)	156 (94.5%)	59 (93.7%)	97 (95.1%)	0.16	1	0.69
	GROUP SINGERS N (%)	97 (58.8%)	44 (69.8%)	53 (52%)	5.14	1	0.23
	DUET SINGERS N (%)	80 (48.5%)	33 (52.4%)	47 (46.1%)	0.62	1	0.43
	VOCAL CLASSIFICATION (WC ONLY) N (%)		N=62				
	CONTRALTO		2 (3.2%)	NA	NP	NP	NP
	ALTO		2 (3.2 %)	NA	NP	NP	NP
	SOPRANO		27 (43.5%)	NA	NP	NP	NP
	MEZZO-SOPRANO		9 (14.5%)	NA	NP	NP	NP
	BARITONE		7 (11.3%)	NA	NP	NP	NP
	BASS		3 (4.8%)	NA	NP	NP	NP
	TENOR/COUNTER-TENOR		12 (19.3%)	NA	NP	NP	NP
SINGING TRAINING	TRAINING RELATED DETAILS				t	df	p
	MEAN (SD) STARTING AGE FOR TRAINING	11.76 (7.08)	16.50 (5.64) N=61	8.90 (6.29) N=101	7.74	160	<0.001
	MEAN YEARS OF TRAINING (SD)	16.60 (10.28)	16.90 (12.17) N=59	16.41 (8.94) N=93	0.28	150	0.77
Table 6.1: SD=Standard Deviation, df=degree of freedom, NP=Not Performed as the comparison is not relevant; NA: Not Applicable							

Fig 6.1: Summary of missing values, per item (values), variables and participants (cases)



As described in the methods, mean substitution was employed during analysis. At scale/variable level, the number of complete responses was 70 (42.42%); 37.5% of variables and 9.7% of the total number of items had missing values. Further analysis at scale/variable level utilised a single imputed dataset (dataset number 6 which was randomly chosen from the 10 datasets generated following PMM). The variables which were imputed are presented in Table 6.2. For the set of variables that were imputed, Little's test indicated that the variable was missing completely at random ($\chi^2=1316.01$, $DF=1304$, $Sig.=.402$).

Table 6.2: List of imputed variables for the survey

Section	Imputed variables	No. of datapoints imputed
Demographic information	Age, sex, nationality, ethnicity, marital status, caring responsibilities, education level	9
Singing history	Full-time/part-time, primary singing genre, performance level and type, singing experience, singing duration (both practice and performance)	10
Singing training history	Type and duration of vocal training	4
Self-perception of voice	Attributes describing own voice	14
Vocal problems	Current vocal problems interfering with singing, voice problems in the past interfering with singing; frequency and severity of symptoms subscales (4 subscales), SVHI subscales (6 subscales)	12
Coping with voice problems	VDCQ subscales	7
Illness perception	IPQ items	8
Vocal Behaviours	Excessive speaking/singing, extreme speaking/singing, frequent throat clearing, singing while unwell, clenching jaw/teeth while singing, using amplification while singing	6
Lifestyle variables affecting voice	Amount of sleep, consumption of items such as alcohol, caffeine, tobacco, spicy foods, oily foods, refrigerated items, dairy, amount of physical exercise, body weight, quantity and frequency of water consumption, work related, reasons for work related stress (11 items), travel, beliefs regarding variables impacting voice (28 variables)	39
Singing related variables	Performance anxiety, Attitude towards voice and singing, opinion about own voice	3
Medical history	Medical condition which may impact voice, relevant surgeries or medications, impact of COVID 19 on voice, frequent colds/allergies	5
Maintaining vocal health	Warm up/cool down and strategies used	9

Once imputed the final sample size was n=165; across 101 variables and 17 subscales.

6.3 Objective 1: Identify the self-reported voice problems, illness perceptions, coping strategies and variables which are likely to influence vocal health in Western classical and Carnatic singers

6.3.1 Description of self-reported voice problems

6.3.1.1 Perception of own voice

All participants were asked to identify attributes which best describe their voices. The attribute most commonly used by singers belonging to both groups was “expressive” [Western classical n=44 (69.9%); Carnatic n=62 (60.7%)]. Attributes most commonly used by Western classical singers were “warm” (n=38, 60.3%), “big/loud” (n=37, 58.7%), “melodious” (n=34, 53.9%) and “wide-ranged” (n=33, 52.3%). “Melodious” (n=62, 60.7%), “open throated” (n=55, 53.9%), “sweet” (n=42, 41.1%) and “warm” (n=36, 35.2%) were most commonly used by Carnatic singers to describe their voices. Table 6.3 shows the frequency distribution of the various attributes reported by the participants.

Participants were also asked if they liked their voices to which 83 (81%) of the Carnatic singers and 53 (84%) of Western classical singers responded positively.

Table 6.3: Frequencies of the attributes used by both groups to describe their own voices

Attribute	WC (N=63)	Carnatic (N=102)
Expressive	44 (69.9%)	62 (60.7%)
Warm	38 (60.3%)	36 (35.2%)
Big/Loud	37 (58.7%)	28 (27.4%)
Melodious	34 (53.9%)	62 (60.7%)
Wide-Ranged	33 (52.3%)	28 (27.4%)
Open throated	24 (38.1%)	55 (53.9%)
Solid	24 (38.1%)	23 (22.5%)
Steady	20 (31.7%)	27 (26.4%)
Sweet	18 (28.5%)	42 (41.1%)
Silvery	15 (23.8%)	8 (7.8%)
Gold	11 (17.4%)	8 (7.8%)
Husky	7 (11.1%)	18 (17.6%)
Nasal	5 (7.9%)	18 (17.6%)
Do you like your own voice?	WC (N=63)	Carnatic (N=102)
Yes	53 (84%)	83 (81%)
No	10 (16%)	19 (19%)

Table 6.3: Darker colour indicates higher frequency

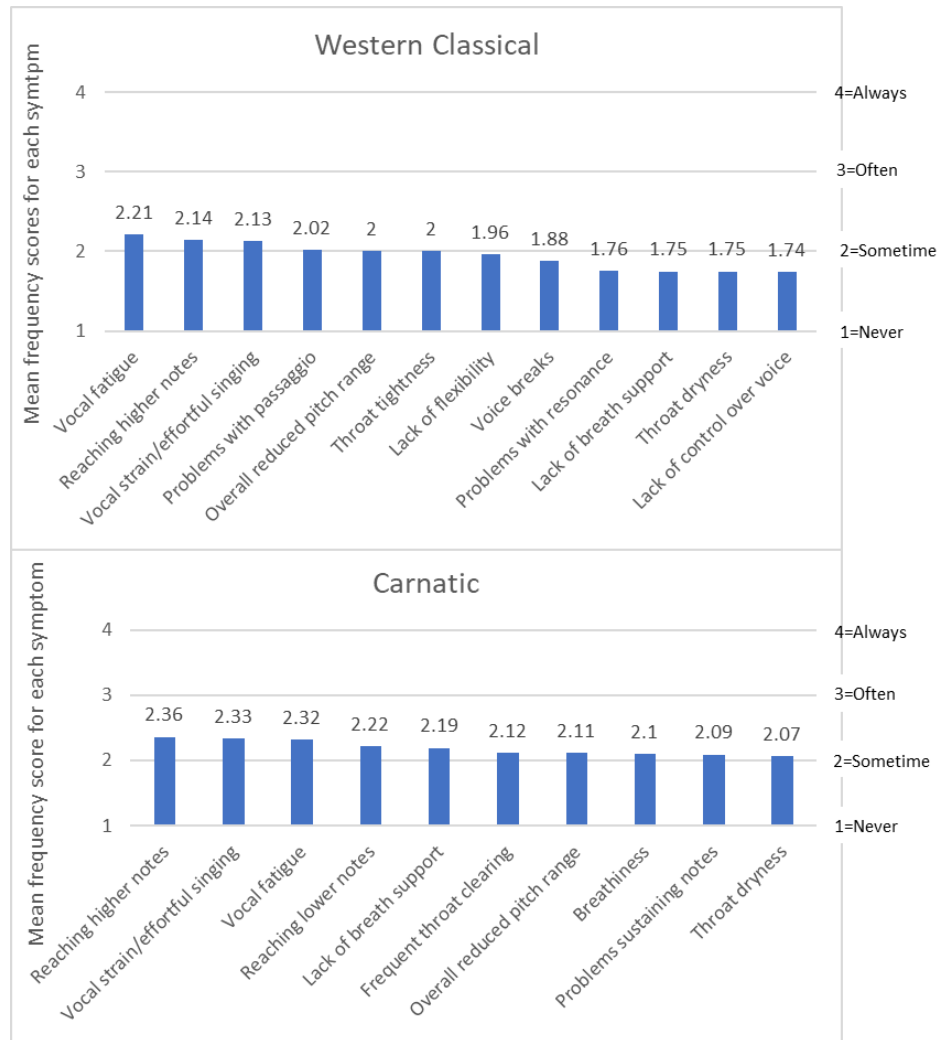
6.3.1.2 Prevalence of voice problems

When asked if they are currently experiencing voice problems which may interfere with their singing, 17 (27%) Western Classical singers and 42 (41.2%) Carnatic singers responded “yes”. Thirty-six Western classical singers (57.1%) and 48 (47.1%) Carnatic singers reported that they had experienced voice problems limiting their singing abilities in the past. There were no significant differences in current or past voice problems between the groups (Table 6.3).

6.3.1.3 Frequency of symptoms

Since there were a large number of symptoms, only the top 10 symptoms are discussed here. Figure 6.2 represents the ten most frequently reported symptoms by group. Based on the mean frequency scores, the top three symptoms reported by the two groups were the same; vocal fatigue [Western classical mean (SD)=2.21 (0.81); Carnatic mean (SD)=2.32 (0.91)], reaching high notes [Western classical mean (SD)=2.14 (0.86); Carnatic mean (SD)=2.36 (0.87)] and vocal strain/effortful singing [Western classical mean (SD)=2.13 (0.70); Carnatic mean (SD)=2.33 (0.91)]. Vocal fatigue was the most frequently reported symptom among Western classical singers and reaching high notes among Carnatic singers. While most of the reported symptoms were similar between the groups, a few differences were noted. Reaching lower notes (mean; SD=2.22; 0.99), frequent throat clearing (mean; SD=2.12; 0.88), breathiness (mean; SD=2.10; 0.79) and problems sustaining notes (mean; SD=2.09; 0.94) were among the top ten symptoms reported by Carnatic singers, whereas problems with passaggio (mean; SD=2.02; 0.76), voice breaks (mean; SD=1.88; 0.67), problems with resonance (mean; SD=1.76; 0.72) and lack of control over voice (mean; SD=1.74; 0.78) were reported more by Western classical singers. The mean (SD) of all the individual items is provided in Appendix 6.2.

Fig 6.2: Mean scores of the ten most frequently reported symptoms by group



6.3.1.3.1 Subscales to group the frequency of symptoms

In order to group the symptoms into categories, a factor analysis was attempted. However, the factor loadings failed to provide a conclusive result as the manner in which the items loaded onto factors did not have a logical commonality. However, the factor analysis (eigen values and scree plots) indicated that the construct was multidimensional (refer to Appendix 6.3 for further details). Therefore, mapping was undertaken as explained in section 5.3.5.1 following which subscales generated were labelled (1) *Acoustic inadequacies*, (2) *Throat discomfort symptoms*, (3) *Auditory perceptual inadequacies* and (4) *Vocal performance problems* (Appendix 6.3 outlines the mapping process). A description of the subscales and the items included in each subscale is provided in Table 6.4.

Table 6.4: Description of the frequency of symptoms' subscales and Cronbach's alpha values

	Acoustic inadequacies	Throat discomfort symptoms	Auditory perceptual inadequacies	Vocal performance problems
Description	Items related to deficits in psychoacoustic attributes such as pitch, loudness and resonance	items describing symptoms that can be physically perceived	Items mainly pertaining (but not restricted) to voice quality that can be perceived by others	Items indicative of issues specific to the singing voice or singing manoeuvres
Symptoms included in the subscale	Problems reaching higher notes	Vocal fatigue	Harshness	Lack of voice control
	Problems reaching lower notes	Throat pain	Hoarseness	Lack of flexibility
	Overall reduced pitch range	Throat tightness	Breathiness	Loss of form
	Difficulty singing softly	Throat dryness	Huskiness	Difficulty with vocal ornaments
	Difficulty singing loudly	Throat itchiness	Voice breaks	Problems sustaining notes
	Lack of vocal power	Vocal strain/effortful singing	Loss of voice	Lack of breath support
	Resonance problems	Frequent coughing		Difficulties with Passaggio
		Frequent throat clearing		
Cronbach's alpha	$\alpha=0.712$	$\alpha=0.832$	$\alpha=0.716$	$\alpha=0.817$

All subscales had respectable Cronbach's alpha scores demonstrating internal consistency. Removal of items from subscales did not increase the alpha values.

The mean scores of the subscales are outlined in Table 6.5. The subscales with highest mean scores among Western classical singers and Carnatic singers were *Throat discomfort symptoms* (Mean; SD=1.86; 0.52-between "Never" and "Sometimes" on the Likert scale) and *Acoustic inadequacies* (Mean; SD=2.02; 0.55- closer to "Sometimes" on the Likert scale) respectively. Both groups had the lowest scores for *the Auditory perceptual inadequacies* subscale [Western classical mean (SD)=1.65 (0.41; Carnatic mean (SD)=1.76 (0.51)-between "Never" and "Sometimes" on the Likert scale].

Table 6.5: Descriptive mean scores of the frequency of symptoms' subscales for each group

Subscale	No of items	Western Classical (n=63)				Carnatic (n=102)			
		Mean	SD	S-W	p	Mean	SD	S-W	p
Throat discomfort symptoms	8	1.86	0.52	0.97	0.16	1.96	0.59	0.97	0.01
Auditory perceptual inadequacies	6	1.65	0.41	0.96	0.06	1.76	0.51	0.97	0.01
Vocal performance problems	7	1.78	0.51	0.92	<.001	1.90	0.62	0.96	0.01
Acoustic inadequacies	7	1.81	0.59	0.93	0.00	2.02	0.55	0.98	0.07
<i>Table 6.5: SD: Standard Deviation; S-W: Shapiro-Wilk used to assess normality</i>									

6.3.1.4 Vocal impact - The Singing Voice Handicap Index (SVHI).

The raw score (sum) for the 36 item SVHI for Carnatic group was 41.78 (SD=23.54) and 32.24 (SD=22.33) for the Western classical group. The scaled (percent) scores (SD) were 22.39 (15.51) and 29.02 (16.35) for Western classical and Carnatic singers respectively and 26.48 (SD=16.31) for the overall study sample. The percentage scores were compared to the normative score of 20.35 (Sobol et al, 2019); a statistically significant difference (greater scores) was observed for Carnatic [$t(101)=5.35$; $p<0.001$] but not for Western classical singers [$t(62)=1.04$; $p=0.30$]. The overall sample scores also showed a statistically significant difference (greater scores) when compared to the normative score [$t(164)=4.82$; $p<0.001$]. Comparison between genres will be discussed under objective 2 (Section 6.4).

6.3.1.4.1 Generating subscales for SVHI

Similar to the frequency of symptoms items, the factor analysis results did not provide a logical solution. One reason for this was that too many items loaded onto a single factor and secondary PCA of that factor did not yield any theoretically logical scales. As with the frequency of symptoms, factor analysis (eigen values and scree plots; refer to Appendix 6.4) demonstrated that the construct was multidimensional. Therefore, item mapping was utilised to generate subscales. This was done by mapping all the SVHI items against the subscales of the Voice Handicap Index (Physical, Functional and Emotional). The mapping process is presented in Appendix 6.4.

First, three congruous subscales were generated for SVHI. However, it was noted that the Physical subscale had too many items compared to the other two subscales. Therefore, this was split into two

subscales which were named *Physical - Auditory Perceptual* and *Physical - Consistency and Effort* (Physical-Consistency for short). Additionally, another subscale was generated from the *Emotional* and *Functional* subscales, to represent difficulties pertaining to performance, given the professional implications of voice problems in singers. This subscale was named *Vocational*. Internal consistency analysis revealed that all five scales had sufficient reliability. Table 6.6 provides a description of the subscales and the Cronbach's alpha values.

To summarise, following mapping, five subscales were generated. The mean scores⁴ of each subscale were calculated. For Western classical singers, the subscales with highest and lowest scores were *SVHI-Physical-Consistency* (Mean=1.17; SD=0.80- between "Almost never" and "Sometimes" on the Likert scale) and *SVHI-Functional* (Mean=0.69; SD=0.62- between "Never" and "Almost never" on the Likert scale) respectively. Among Carnatic singers, the *SVHI-Physical-Auditory perceptual subscale* had the highest scores (Mean=1.36, SD=0.69- between "Never and "Almost never" on the Likert scale) whereas the *SVHI-Vocational* subscale (Mean=0.92, SD=0.83 – closer to "Almost never" on the Likert scale) scored the least. The mean scores are presented in Table 6.7. Comparison of scores (both SVHI total and the subscale scores) between the groups will be reported under the results of objective 2 (section 6.4.1).

6.3.2 Description of Illness perceptions

Since the brief IPQ uses a single item scale approach, each item was analysed separately. In both groups, the results showed that the highest scores were obtained for *Illness coherence*-IPQ 7 [Western classical mean (SD)=7.54 (2.57); Carnatic mean (SD)=6.56 (2.55)], *Treatment control*-IPQ 4 [Western classical mean (SD)=6.79 (2.43); Carnatic mean (SD)=6.22 (2.48)] and *Personal control*-IPQ 3 [Western classical mean (SD)=6.54 (2.71); Carnatic mean (SD)=6.31 (2.34)] indicating that singers perceived a good understanding of their voice problem, believed that treatment was helpful to deal with their voice problem and felt that they were in control with respect to their voice problem. Table 6.8 reports the mean scores of all IPQ subscales.

⁴ The mean scores generated for all measures was calculated by estimating the subscale scores for each participant and then calculating the group mean.

Table 6.6: Description of the SVHI subscales and Cronbach's alpha values

	Functional	Vocational	Emotional	Consistency and effort	Auditory Perceptual
Description	Items which reflect difficulties in vocal function that can impact daily life	Items pertaining to impact of voice problems on the singing profession	S11. I get nervous before I sing because of my singing problems.	Items reflecting inconsistencies in voice production and increased vocal effort	Items related to changes in voice that can be auditorily perceived by the self and the listener.
SVHI items included in the subscale	S4. People ask "What is wrong with your voice?" when I sing.	S34. I am worried my singing problems will cause me to lose money.	S7. My singing voice upsets me.	S27. My voice quality is inconsistent.	S26. My speaking voice is hoarse after I sing.
	S16. My singing voice is never normal.	S35. I feel left out of the music scene because of my voice.	S29. My singing makes me feel handicapped.	S6. My voice "gives out" on me while I am singing.	S19. I have trouble controlling the breathiness in my voice.
	"S28. My singing voice makes it difficult for the audience to hear me."	"S36. I have to cancel performances, singing engagements, rehearsals, or practices because of my singing."	S9. I am embarrassed by my singing	S5. My ability to sing varies day to day.	S21. I have trouble singing loudly.
	S12. My speaking voice is not normal.	S33. I feel something is missing in my life because of my inability to sing.	S24. My singing makes me feel incompetent	S25. My singing sounds forced.	S20. I have trouble controlling the raspiness in my voice.
	S17. I have trouble making my voice do what I want it to.	S14. I've had to eliminate certain songs from my singing/performances.	S15. I have no confidence in my singing voice.	S18. I have to "push it" to produce my voice when singing.	S13. My throat is dry when I sing.
	S8. My singing problems make me not want to sing/perform.		S23. I feel anxious about my singing.	S30. My singing voice tires easily.	S2. My voice cracks and breaks.
			S32. I am unsure of what will come out when I sing.	S1. It takes a lot of effort to sing.	S31. I feel pain, tickling, or choking when I sing.

	Functional	Vocational	Emotional	Consistency and effort	Auditory Perceptual
			S3. I am frustrated by my singing		S10. I am unable to use my "high voice."
					S22. I have difficulty staying on pitch when I sing.
Cronbach's alpha	0.809	0.853	0.933	0.899	0.873

Table 6.7: Descriptive mean scores of the SVHI subscales for each group

SVHI subscales	No: of items	Western Classical (n=63)				Carnatic (n=102)			
		Mean	SD	S-W	p	Mean	SD	S-W	p
Functional	6	0.69	0.62	0.95	0.01	0.98	0.76	0.98	0.06
Physical-Auditory Perceptual	9	0.76	0.53	0.90	<.001	1.36	0.69	0.94	<.001
Vocational	5	0.83	0.92	0.84	<.001	0.92	0.83	0.91	<.001
Emotional	9	0.92	0.90	0.85	<.001	1.10	0.87	0.93	<.001
Physical-Consistency	7	1.17	0.80	0.95	0.01	1.34	0.84	0.97	0.01
SVHI-Sum	36	32.24	22.33	0.94	0.01	41.78	23.55	0.98	0.07
<i>Table 6.7: SD= Standard Deviation; S-W= Shapiro-Wilk used to assess normality</i>									

Table 6.8: Descriptive mean scores of the IPQ subscales for each group

IPQ single item subscales	Western Classical (n=63)		Carnatic (n=102)	
	Mean	SD	Mean	SD
IPQ 1-Consequences	2.69	0.93	3.41	2.35
IPQ 2-Timeline	3.11	0.93	4.06	2.78
IPQ 3-Control	2.71	0.93	6.31	2.34
IPQ 4-Treatment	2.43	0.9	6.22	2.48
IPQ 5-Symptoms	2.05	0.95	3.34	2.04
IPQ 6-Concern	2.94	0.92	4.84	2.63
IPQ 7-Coherence	2.57	0.86	6.56	2.55
IPQ 8-Emotion	3.16	0.93	4.98	2.72
<i>Table 6.8: SD=Standard Deviation</i>				

For the last item of IPQ, participants were asked to rank the top three causes of their vocal symptoms. Results indicated that among Western classical singers, high vocal load/voice overuse (n=10; 22.22%), stress (n=9; 20%) and voice misuse (n=7; 15.5%) were frequently reported. Among Carnatic singers, frequently reported factors were lack of vocal practice (n=9; 14.51%), lack of rest/tiredness (n=8; 12.9%) and high vocal load/voice overuse (n=8; 12.9%). The frequencies of all causal factors mentioned by the participants for both groups are provided in Appendix 6.5.

6.3.3 Coping with voice problems

An extended 30 item version of VDCQ was used. Firstly, an analysis at item level was performed to identify the coping trends within and between groups. Comparison of the top five (most frequently) used coping strategies between groups revealed that two items appeared in both the groups which

were pertaining to resting of voice (item S-27), [Western classical mean (SD)=4.02 (1.38); Carnatic mean (SD)=4.15 (1.49)] and resorting to home remedies (item A2) [Western classical mean (SD)=3.60 (1.64); Carnatic mean (SD)=3.95 (1.58)]. Western classical singers had two items pertaining to seeking information in their top 5 items (items S-19 and S-18) whereas the same items appeared much further down in comparison for Carnatic singers. Analysing the top ten coping strategies employed by groups revealed that a variety of coping strategies were employed by the two groups as displayed in Figure 6.3 with mean (SD) scores ranging from 4.25 (1.83) (item S-19) to 3.06 (1.37) (item S-23) (“Very often” to “Sometimes” in relation to the Likert scale) in Western classical singers and 4.15 (1.49) (Item S-27) to 2.98 (1.67) (item S-26) in Carnatic singers (“Very often” to “Almost never” in relation to the Likert scale). Appendix 6.6 provides the mean frequency scores of both groups for all VDCQ items.

6.3.3.1 Creating subscales for VDCQ

Even though VDCQ has previously determined subscales, this is available only for the 15-item version. As a 30-item version (including the additional items added for the present survey) was employed in this study, a factor analysis was performed to extract subscales. However, as with the frequency of symptoms and SVHI, despite multiple attempts at operating all processes involved in factor analysis (e.g., specifying a range of factors and carrying out secondary PCAs), a theoretically sound set of subscales could not be produced; however, multidimensionality was indicated as in previous variables and mapping was again used to determine subscales.

Seven subscales were generated which were (1) *Seeking social support*, (2) *Keeping to self*, (3) *Positive reappraisal/positive reinterpretation and growth*, (4) *Escape-avoidance*, (5) *Distancing/detachment*, (6) *Information seeking* and (7) *Tension reduction/mental disengagement*. Two items (“I find religion and praying to god help cope with my voice problem” and “I tend to resort to home remedies when I have a voice problem”) did not theoretically fit under any subscale and were therefore analysed as separate items. Following the development of the subscales, internal consistency measured using Cronbach’s alpha revealed that all scales had sufficient reliability. Table 6.9 provides an account / definition of the subscales, their descriptions and Cronbach’s alpha values. Removal of items did not result in better alpha scores. The PCA results and the mapping process for VDCQ is presented in Appendix 6.7. Mean scores per individual and then per group were calculated for all the subscales and are presented in Table 6.10. The scores indicated that for both groups, the subscale with highest

Fig 6.3: Mean scores of the ten most frequently reported coping strategies by each singing group

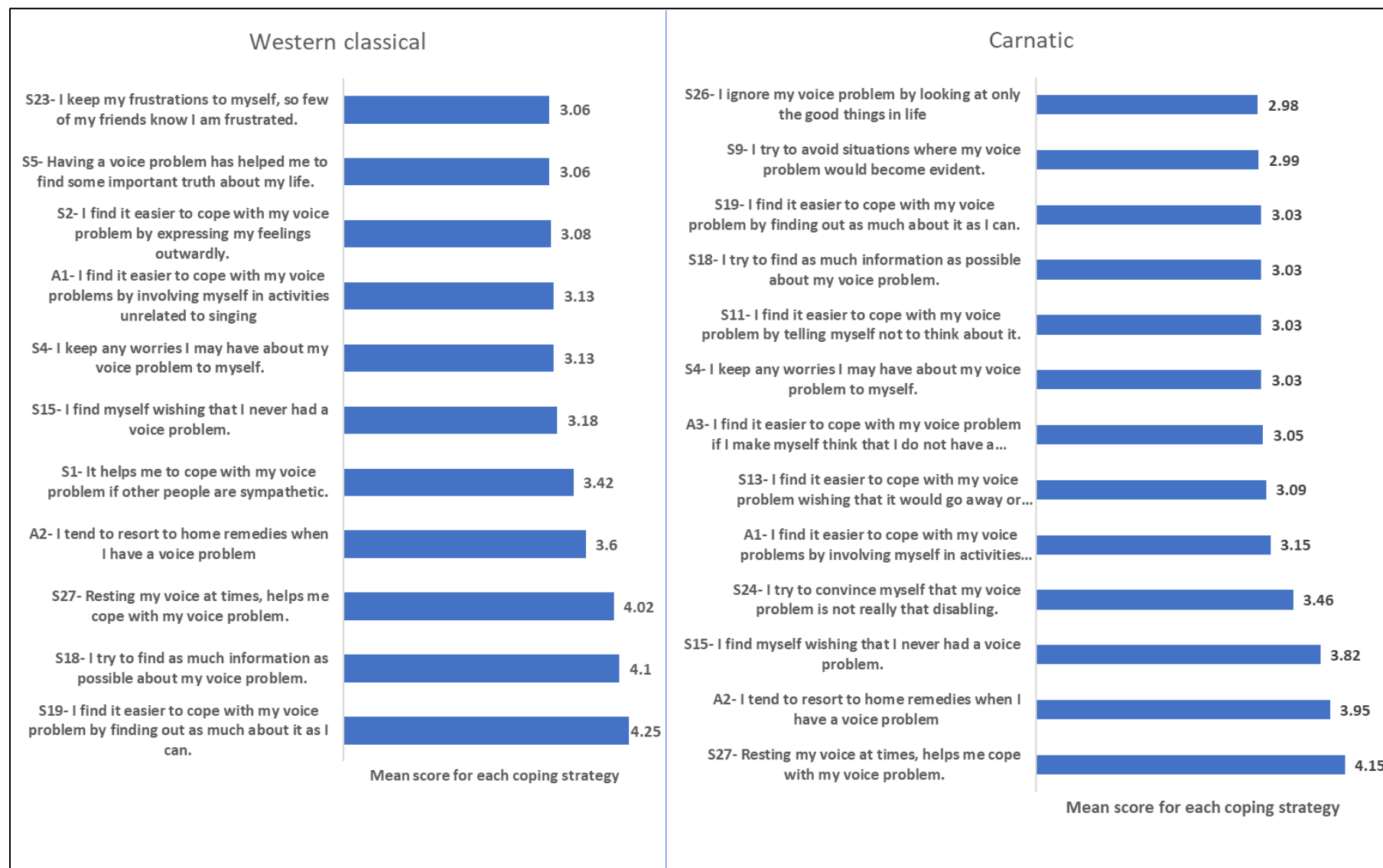


Fig 6.3: More than 10 symptoms are presented here as some of the symptoms had the same mean scores

Table 6.9: VDCQ subscales, descriptions and Cronbach's alpha values

	Seeking social support	Keeping to self	Positive reappraisal/ reinterpretation and growth	Escape-Avoidance	Distancing/detachment	Info seeking	Tension reduction/mental disengagement
Description	Seeking assistance, information, advice or emotional support from others	Efforts to regulate feelings and or actions	Growing from a situation or viewing it in a positive light	thoughts or efforts undertaken to avoid or escape the problem	efforts undertaken to detach and minimise the situation	Seeking information to specifically address the problem	Disengaging or withdrawing from the problem
Items	1. It helps me to cope with my voice problem if other people are sympathetic.	4. I keep any worries I may have about my voice problem to myself.	5. Having a voice problem has helped me to find some important truth about my life.	7. When my voice gets bad, I find myself taking it out others around me.	11. I find it easier to cope with my voice problem by telling myself not to think about it.	18. I try to find as much information as possible about my voice problem.	17. I try to become involved in as many physical activities as possible to take my mind off my voice problem.
	2. I find it easier to cope with my voice problem by expressing my feelings outwardly.	23. I keep my frustrations to myself, so few of my friends know I am frustrated.	25. Having a voice problem has helped me develop into a better person.	9. I try to avoid situations where my voice problem would become evident.	20. I find it easy to cope with my voice problem when I compare myself to other people who have worse health problems.	19. I find it easier to cope with my voice problem by finding out as much as I can	27. Resting my voice at times, helps me cope with my voice problem.
	3. I find talking with friends and family about my voice problem helpful.		24. I try to convince myself that my voice problem is not really that disabling.	10. I find it easier to cope with my voice problem by avoiding being with people in general.	21. I find it easier to cope with my voice problem by joking about it.		28. I find it easier to cope with my voice problems by involving myself in activities unrelated to singing (eg: playing a musical instrument)

	Seeking social support	Keeping to self	Positive reappraisal/ reinterpretation and growth	Escape-Avoidance	Distancing/detachment	Info seeking	Tension reduction/mental disengagement
	6. I find it easier to cope with my voice problem if I ask the doctor questions about it.		26. I ignore my voice problem by looking at only the good things in life	13. I find it easier to cope with my voice problem wishing that it would go away or somehow be over with."	30. I find it easier to cope with my voice problem if I make myself think that I do not have a problem		
	14. I ask people to help me with those things I cannot manage because of my voice problem.			15. I find myself wishing that I never had a voice problem.	12. I take the view that there is little I can do about my voice problem.		
				16. I find it easier to live with my voice problem, if I do not use my voice.	22. I cope better with my voice problems by trying to accept it, since nothing can be done.		
Cronbach's alpha	$\alpha=0.747$	$\alpha=0.640$	$\alpha=0.716$	$\alpha=0.776$	$\alpha=0.767$	$\alpha=0.903$	$\alpha=0.696$

scores was *Information seeking* [Western classical mean (SD)=3.07 (1.69) (closer to “sometimes” on the Likert scale); Carnatic mean (SD)=2.45 (1.45) (between “Almost never and “Sometimes” on the Likert scale)]. For Western classical group, *Escape-avoidance* (mean=1.38; SD=1.00; between “Never and “Almost never” on the Likert scale) was the subscale with the lowest mean scores whereas for Carnatic singers, it was *Seeking social support* (mean=1.51; SD=0.97; between “Never and “Almost never” on the Likert scale).

The comparisons of all measures (frequency of symptoms, SVHI, B-IPQ and VDCQ) between the groups will be discussed in section 6.4 under the second objective.

Table 6.10: Descriptive mean scores of VDCQ subscales for both groups

VDCQ subscales	No: of items	Western Classical (n=63)				Carnatic (n=102)			
		Mean	SD	S-W	p	Mean	SD	S-W	p
Social Support	5	1.83	1.02	0.97	0.19	1.51	0.97	0.96	0.01
Keeping to self	2	2.06	1.19	0.97	0.12	1.82	1.37	0.94	<.001
Positive reappraisal	4	1.68	1.00	0.97	0.14	2.03	1.27	0.96	0.00
Escape-Avoidance	6	1.38	1.00	0.94	0.01	1.66	1.07	0.97	0.01
Distancing	6	1.01	0.75	0.95	0.01	1.59	1.00	0.96	0.00
Information seeking	2	3.07	1.69	0.89	<.001	2.45	1.45	0.96	0.01
Tension reduction	3	1.90	1.01	0.98	0.52	2.15	1.16	0.98	0.11

Table 6.10: SD= Standard Deviation; S-W=Shapiro-Wilk used to assess normality

6.3.4 Variables which are likely to influence the voice

Twenty-seven variables across five categories were investigated in this survey and frequency, level of agreement, likelihood or severity was calculated for each variable.

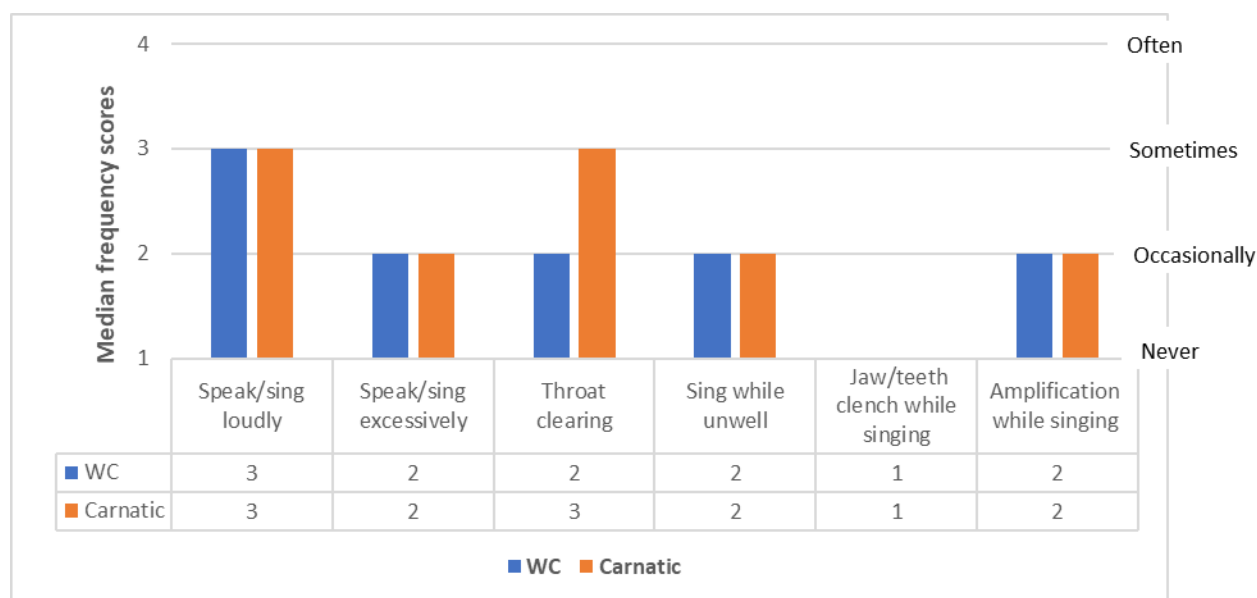
6.3.4.1 Vocal behaviours

Six vocal behaviours were studied and both groups indicated that vocal behaviour used “often” was loud speaking/singing [Western classical n=22 (34.9%); Carnatic n=18 (17.6%)]. The vocal behaviour which was reported to be used the least (never on the Likert scale) was clenching teeth/jaw while singing for Western classical (n=34, 54%) and singing while unwell for Carnatic singers (n=36, 35.2%).

The frequencies of each vocal behaviour are provided in Table 6.11. Median frequency scores⁵ were also calculated to ascertain the frequency of the vocal behaviours among the groups. Speaking/singing loudly was the most frequently reported vocal behaviour within both groups, the median (IQR) scores being 3 (2) and 3 (1) in Western classical and Carnatic singers respectively. Carnatic singers also reported similar results for frequent throat clearing.

Figure 6.4 presents the mean frequency scores of the six vocal behaviours for both cohorts.

Fig 6.4: Median frequency scores of vocal behaviours for both groups



6.3.4.2 Lifestyle variables

Variables included under this category were sleep, consumption of various items (which are likely to negatively impact the voice), physical exercise, body weight, water consumption, stress and travel (total number of variables=12).

Singers were asked about regular consumption of items such as alcohol, caffeine, tobacco, spicy or oily foods, dairy and cold/refrigerated foods. Similar to vocal behaviours, median frequency scores (across singing groups) were calculated for consumption of each item to identify patterns in frequency.

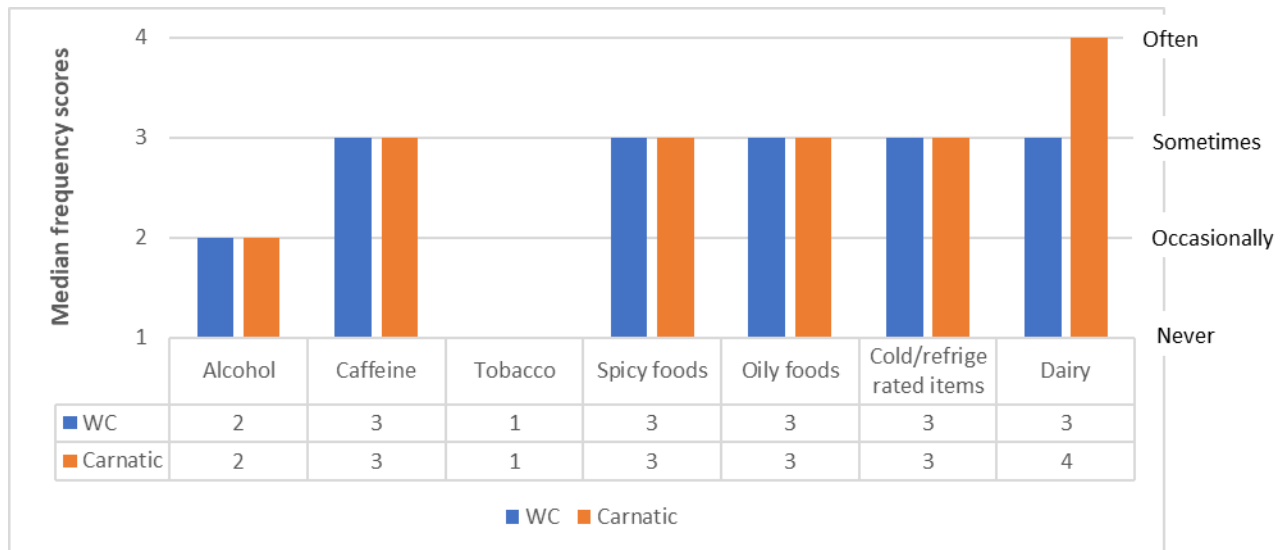
⁵ The mean frequency scores calculated for some of the variable clusters in this section are not interpreted as absolute values-they were calculated only to identify the items which were reported more frequently in relation to the other items within that cluster.

Table 6.11: Frequency of vocal behaviours which are likely to negatively impact the voice reported by the two groups

Behaviour	WC n (%)						Carnatic n (%)					
	Never	Occasionally	Sometimes	Often	Median	IQR	Never	Occasionally	Sometimes	Often	Median	IQR
Speak/sing loud	5 (7.9%)	21 (33.3%)	15 (23.8%)	22 (34.9%)	3	2	6 (5.9%)	36 (35.3%)	42 (41.2%)	18 (17.6%)	3	1
Speak/sing excessively	9 (14.3%)	24 (38.1%)	23 (36.5%)	7 (11.1%)	2	1	20 (19.6%)	44 (43.1%)	23 (22.5%)	15 (14.7%)	2	1
Frequent throat clearing	5 (7.9%)	32 (50.8%)	19 (30.2%)	7 (11.1%)	2	1	11 (10.8%)	35 (34.3%)	34 (33.3%)	22 (21.6%)	3	1
Singing while unwell	10 (15.9%)	29 (46.0%)	14 (22.2%)	10 (15.9%)	2	1	36 (35.3%)	29 (28.4%)	30 (29.4%)	7 (6.9%)	2	2
jaw/teeth clenching while singing	34 (54.0%)	21 (33.3%)	6 (9.5%)	2 (3.2%)	1	1	62 (60.8%)	33 (32.4%)	7 (6.9%)	0 (0.0%)	1	1
Amplification while singing?	28 (44.4%)	24 (38.1%)	6 (9.5%)	5 (7.9%)	2	1	29 (28.4%)	36 (35.3%)	27 (26.5%)	10 (9.8%)	2	2
Table 6.11: WC=Western Classical; IQR=Inter Quartile Range												

Consumption of dairy was the most frequently reported variable by Carnatic singers (median=4; IQR=1). Among Western classical singers, consumption of caffeine (median=3; IQR=2), spicy foods (median=3; IQR=2), oily foods (median=3; IQR=1), cold/refrigerated items (median=3; IQR=2) and dairy (median=3; IQR=2) were frequently reported. The frequencies are reported in Table 6.12 and the mean scores are presented in Figure 6.5.

Fig 6.5: Median frequency scores of consumptions of various items which are likely to negatively impact the voice



The mean number of hours of sleep was calculated to be higher among Western classical singers (mean=6.88 hours; SD=1) compared to Carnatic singers (6.52 hours; SD=1.06).

Singers were asked if they took physical exercise and responses were indicated using a frequency Likert scale (Everyday, 4-6 times a week, 2-4 times a week and infrequently). 17% (n=11) of Western classical singers and 14% (n=14) of Carnatic singers indicated that they took exercise everyday whereas 21% (n=13) of Western classical singers and 28% (n=29) of Carnatic singers reported that they exercised infrequently.

When asked to indicate if they had a healthy body weight, 33 (52%) Western classical singers and 45 (44%) Carnatic singers responded 'yes'. Regarding hydration, about 42% of the participants in both groups indicated that they had between 4-8 glasses of water. Twenty-five (40%) Western classical singers and 29 (28%) Carnatic singers also indicated that they sipped water on a regular basis particularly during performance (Table 6.13).

Table 6.12: Consumption of items which are likely to negatively impact the voice reported by the two groups

Item	WC n (%)						Carnatic n (%)					
	Never	Rarely	Occasionally	Frequently	Median	IQR	Never	Rarely	Occasionally	Frequently	Median	IQR
Alcohol	25 (39.7%)	13 (20.6%)	18 (28.6%)	7 (11.1%)	2	2	40 (39.2%)	29 (28.4%)	22 (21.6%)	11 (10.8%)	2	2
Caffeine	13 (20.6%)	12 (19.0%)	21 (33.3%)	17 (27.0%)	3	2	14 (13.7%)	17 (16.7%)	29 (28.4%)	42 (41.2%)	3	2
Tobacco	54 (85.7%)	8 (12.7%)	0 (0.0%)	1 (1.6%)	1	0	85 (83.3%)	10 (9.8%)	5 (4.9%)	2 (2.0%)	1	0
Spicy foods	6 (9.5%)	19 (30.2%)	21 (33.3%)	17 (27.0%)	3	2	7 (6.9%)	30 (29.4%)	44 (43.1%)	21 (20.6%)	3	1
Oily foods	1 (1.6%)	22 (34.9%)	34 (54.0%)	6 (9.5%)	3	1	6 (5.9%)	26 (25.5%)	53 (52.0%)	17 (16.7%)	3	1
Cold/refrigerated items	11 (17.5%)	11 (17.5%)	20 (31.7%)	21 (33.3%)	3	2	14 (13.7%)	26 (25.5%)	37 (36.3%)	25 (24.5%)	3	1.25
Dairy	2 (3.2%)	14 (22.2%)	18 (28.6%)	29 (46.0%)	3	2	7 (6.9%)	9 (8.8%)	32 (31.4%)	54 (52.9%)	4	1
Table 6.12: WC=Western Classical; IQR=Inter Quartile Range												

Table 6.13: Lifestyle variables which are likely to impact voice problems in singers

Lifestyle factors	WC				Carnatic			
Sleep (Hrs/day)	Mean	SD			Mean	SD		
	6.99	1			6.58	1.06		
Physical exercise n (%)	Everyday	4-6 times/wk	2-4 times/wk	Infrequently	Everyday	4-6 times/wk	2-4 times/wk	Infrequently
	11 (17.5%)	13 (20.6%)	26 (41.3%)	13 (20.6%)	14 (13.7%)	26 (25.5%)	33 (32.4%)	29 (28.4%)
Healthy body weight n (%)	Yes	No	Not sure	Prefer not to say	Yes	No	Not sure	Prefer not to say
	33 (52.4%)	24 (38.1%)	6 (9.5%)	0 (0.0%)	45 (44.1%)	33 (32.4%)	21 (20.6%)	3 (2.9%)
Hydration n (%)								
Quantity	<2 glasses	Between 2-4 glasses	Between 4-8 glasses	>8 glasses	<2 glasses	Between 2-4 glasses	Between 4-8 glasses	>8 glasses
	1 (1.6%)	14 (22.2%)	26 (41.3%)	22 (34.9%)	4 (3.9%)	29 (28.4%)	44 (43.1%)	25 (24.5%)
Sip water regularly	Never	Occasionally	Sometimes	Often	Never	Occasionally	Sometimes	Often
	3 (4.8%)	17 (27.0%)	18 (28.6%)	25 (39.7%)	9 (8.8%)	30 (29.4%)	34 (33.3%)	29 (28.4%)
Travel n (%)	Yes	No			Yes	No		
Travel for performances	42 (66.7%)	21 (33.3%)			49 (48.0%)	53 (52.0%)		
	< 5 times	5-10 times	10-20 times	>20 times	< 5 times	5-10 times	10-20 times	>20 times
Duration	8 (12.7%)	8 (12.7%)	7 (11.1%)	10 (15.9%)	10 (9.8%)	5 (4.9%)	4 (3.9%)	7 (6.9%)
Stress n (%)	None at all	A little	A moderate amount	A lot	None at all	A little	A moderate amount	A lot
	12 (19.0%)	21 (33.3%)	23 (36.5%)	7 (11.1%)	39 (38.2%)	39 (38.2%)	19 (18.6%)	5 (4.9%)

Table 6.13: WC=Western Classical; SD=Standard Deviation

Forty-two (66%) Western classical singers indicated that they travel to give performances whereas among Carnatic singers, it was 49 (48%). 10 (15.8%) Western classical singers indicated that they travelled more than 20 times a month whereas the most frequently indicated duration was lesser (n=10; 9.8%) among Carnatic singers (<5 times a month) (refer to Table 6.13).

Only 12 (19%) Western classical singers indicated that they experienced no work-related stress whereas among Carnatic singers, an analogous response was indicated by 39 (38%) singers. Seven (11%) Western classical singers and five (4.9%) Carnatic singers indicated that they experienced work related stress a lot. (Table 6.13). When asked to indicate the reasons contributing to work related stress (Table 6.14) both groups indicated “personal commitments” to be the most frequently reported factor [26 (41%) vs 17 (16.6%) among Western classical and Carnatic singers respectively] Fears surrounding procuring future work (n=24; 38%) and expectations from employers (n=23; 36.5%) were other frequently reported variables among Western Classical singers whereas Carnatic singers reported lack of fairness (n=15; 14.7%), difficulties in refusing work n=15; 14.7%), poor acoustics (n=15; 14.7%) and lack of rest (n=15; 14.7%).

Table 6.14: Frequencies of reasons contributing to work related stress among both groups of singers

Reasons for work related stress	WC n (%)	Carnatic n (%)
Competition	16 (25.30%)	10 (9.80%)
Lack of fairness	16 (25.30%)	15 (14.70%)
Personal commitments	26 (41.20%)	17 (16.60%)
Refuse work	10 (15.80%)	15 (14.70%)
Poor acoustics	7 (11.10%)	15 (14.70%)
Expectation of others	16 (25.30%)	14 (13.70%)
Lack of rest	13 (20.60%)	15 (14.70%)
Presence of vocal problems	14 (22.20%)	11 (10.78%)
Fears regarding future work	24 (38.09%)	7 (6.80%)
Financial factors	16 (25.30%)	11 (10.78%)
Expectation from employers	23 (36.50%)	11 (10.78%)

6.3.4.3 Hormonal variables

Of female participants (Western classical n=40; Carnatic n=80), 22 (80%) Western classical singers and 26 (55%) of Carnatic singers indicated that they experienced PMS across a frequency range (sometimes to always). Almost all Western classical singers (21/22; 95%) and most of the Carnatic singers (17/26; 65%) who reported experiencing PMS also experienced a negative impact on their singing. Eleven (33.3%) Western classical singers and 14 (29%) of Carnatic singers reported to be experiencing (or experienced) menopause of which nine (81%) Western classical and four (28%) Carnatic singers reported that menopause negatively impacted their voices. Only five (15%) Western Classical singers and one (2%) Carnatic singer reported using oral contraceptives. Table 6.15 reports the frequencies of the hormonal variables.

Table 6.15: Frequencies of hormonal variables of both groups

Hormonal Variables	Western Classical n (%)				Carnatic n (%)			
	Never	Sometimes	Most of the time	Always	Never	Sometimes	Most of the time	Always
PMS	10 (25%)	12 (30.0%)	4 (10.0%)	6 (15.0%)	21 (26.3%)	16 (20.0%)	7 (8.8%)	3 (3.8%)
Oral contraceptives	Yes	No			Yes	No		
	5 (12.5%)	27 (67.5%)			1 (1.3%)	46 (57.5%)		
	11 (27.5%)	21 (52.5%)			14 (17.5%)	34 (42.5%)		
Menopause								
Impact on singing	Not at all	A little	A moderate amount	A lot	Not at all	A little	A moderate amount	A lot
PMS	10 (25.0%)	11 (27.5%)	7 (17.5%)	3 (7.5%)	29 (36.3%)	8 (10.0%)	6 (7.5%)	3 (3.8%)
Menstruation	12 (30.0%)	11 (27.5%)	5 (12.5%)	4 (10.0%)	29 (36.3%)	11 (13.8%)	3 (3.8%)	4 (5.0%)
Menopause	2 (5.0%)	2 (5.0%)	0 (0.0%)	7 (17.5%)	10 (12.5%)	2 (2.5%)	1 (1.3%)	1 (1.3%)

6.3.4.4 Medical variables

When asked if they suffered from any medical conditions that could affect their voices, 18 (28%) Western classical singers and 27 (26%) Carnatic singers responded “yes”. The most frequently reported medical condition by both groups was reflux. Some other conditions highlighted (using open text) were Asthma, thyroid issues, Tonsillitis, Fibromyalgia, sluggish liver/kidney, pneumonia and anxiety. Few

singers [8 (12.6%) Western classical and 11 (10.7%) Carnatic] indicated that they had surgeries that may impact the voice. Nine (14.2%) Western classical and seven (6.8%) Carnatic singers also reported having medications regularly which could potentially affect the voice. The medicines mentioned (via open text) by the participants were Claritin, anticoagulants, thyroid medication, Lisinopril, Metoprolol, Atorvastatin, Sertraline and Steroid inhaler. Singers were also asked if Covid-19 had impacted their voices to which nine (14.2%) Western classical singers and three (2.9%) Carnatic singers responded 'yes'. A 'maybe' response was provided by 12 (19%) Western classical singers and 29 (28.4%) Carnatic singers. Problems following Covid 19 were breathing issues, frequent throat clearing, coughing, reduced performances/opportunities, lack of energy and an impact on overall health (indicated using open text). Six (9.5%) Western classical singers and 17 (16.6%) Carnatic singers indicated that they encounter colds/allergies 'often'. The frequencies of all responses pertaining to medical variables are provided in Table 6.16.

Table 6.16: Frequency of medical variables likely to impact the voice reported by participants

Medical variables	Western Classical n (%)			Carnatic n (%)				
	Yes	No			Yes	No		
Medical conditions	18 (28.6%)	45 (71.4%)			27 (26.5%)	75 (73.5%)		
Surgery	8 (12.7%)	55 (87.3%)			11 (10.8%)	91 (89.2%)		
Medications	9 (14.3%)	54 (85.7%)			7 (6.9%)	95 (93.1%)		
	Yes	No	Maybe		Yes	No	Maybe	
COVID-19	9 (14.3%)	42 (66.7%)	12 (19%)		3 (2.9%)	70 (68.6%)	29 (28.4%)	
	Rarely	Occasionally	Sometimes	Often	Rarely	Occasionally	Sometimes	Often
Colds/allergies	19 (30.2%)	23 (36.5%)	15 (23.8%)	6 (9.5%)	15 (14.7%)	25 (24.5%)	11 (10.8%)	10 (9.8%)

6.3.4.5 Singing related variables

Performance anxiety was also investigated among both groups. None of the Western classical singers indicated that they experienced performance anxiety 'a lot' whereas 15 (14.7%) Carnatic singers indicated so. Most of the singers indicated that they experienced 'a little' performance anxiety (Western classical n=35 55.5%; Carnatic n=44, 43.1%). Singers were also asked if they had a positive attitude towards their voices to which 24 (38.1) Western classical singers and 42 (66.6%) Carnatic

singers answered “definitely yes”. None of the Western classical singers and four (3.9%) Carnatic singers answered “definitely not” to the same question. Table 6.17 shows the singing related variables reported by the participants.

Table 6.17: Frequencies of singing related variables of both groups

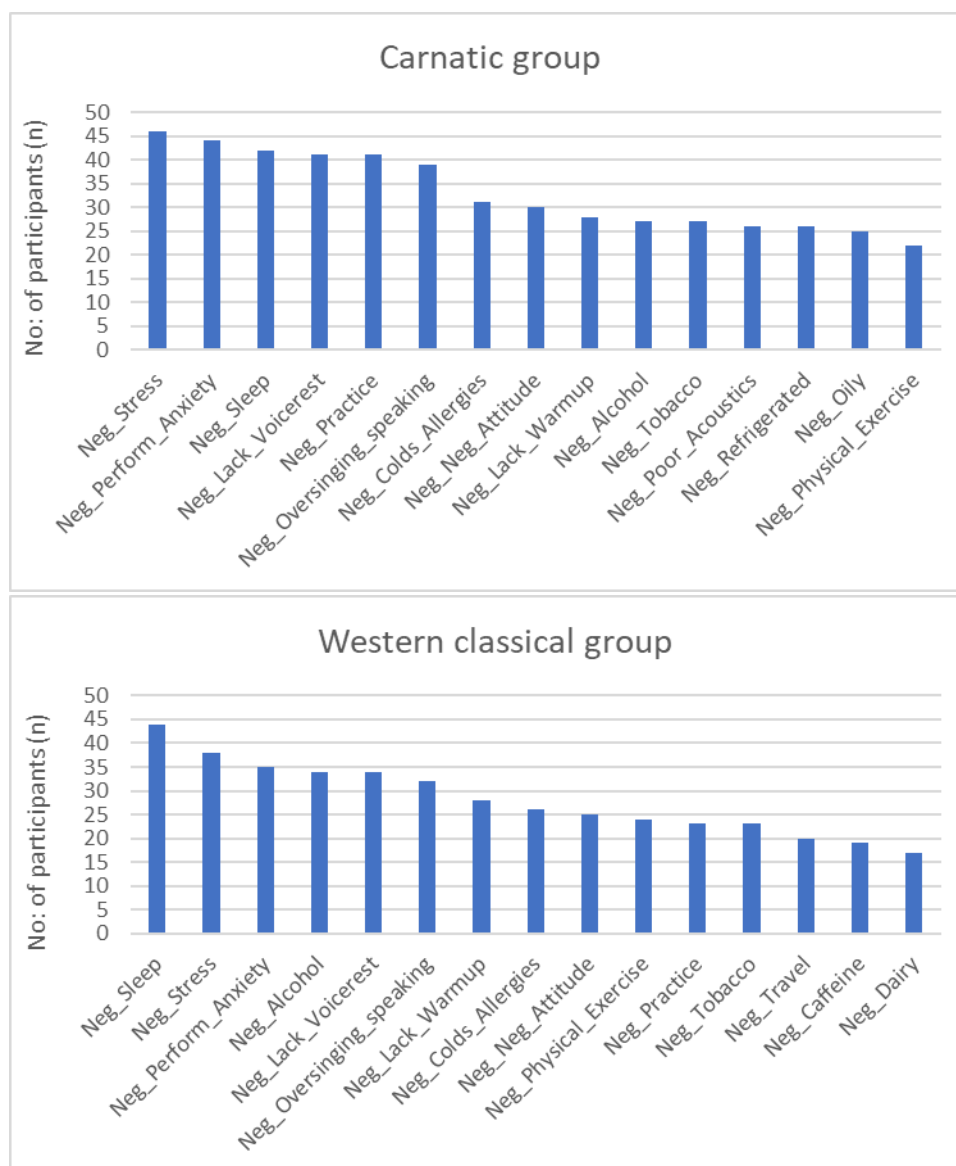
Singing related	Western Classical n (%)					Carnatic n (%)				
	Not at all	Little	Moderate amount	A lot		Not at all	A little	Moderate amount	A lot	
Performance anxiety	14 (22.2%)	35 (55.6%)	14 (22.2%)	0 (0.0%)		17 (16.7%)	44 (43.1%)	26 (25.5%)	15 (14.7%)	
	Def not	Probably not	Might or might not	Probably yes	Def yes	Def not	Probably not	Might or might not	Probably yes	Def yes
Positive attitude towards singing	0 (0.0%)	4 (6.3%)	10 (15.9%)	25 (39.7%)	24 (38.1%)	4 (3.9%)	6 (5.9%)	16 (15.7%)	34 (33.3%)	42 (41.2%)

Table 6.17: Def=Definitely

6.3.4.6 Beliefs of participants pertaining to variables negatively impacting the voice

For both groups, the three most frequently reported variables that they believed to negatively impact the voice were stress [Western classical n=38 (60.31%), Carnatic n=46 (45.09%)] lack of sleep [Western classical n=44 (69.8%), Carnatic n=42 (41.1%)] and performance anxiety [Western classical n=35 (55.5%), Carnatic n=44 (69.8%)]. The most frequently reported factor was lack of sleep (n=44, 69.8%) among the Western classical singers and stress (n=46, 45.09%) among the Carnatic singers. Analysing the top 15 variables for both groups indicated that most of the variables reported by the two groups were similar. However, different food items were highlighted by the two groups, where majority of Carnatic singers indicated consumption of oily (n=25, 24.5%) and refrigerated foods (n=26, 25.4%) and majority of Western classical singers highlighted consumption of caffeine (n=19, 30.1%) and dairy (n=17, 26.9%) as having a negative influence on their voices. Another factor reported as one of the top 15 variables by Western classical singers was travel (n=20, 31.7%). Appendix 6.8 provides the frequencies for all the variables included in this section and Figure 6.6 illustrates the top 15 variables.

Figure 6.6: Beliefs of participants pertaining to variables negatively impacting the voice-Top 15 variables



6.3.4.7 Summary of variables which are likely to impact voice

Vocal behaviours, consumption of various items, other lifestyle variables, hormonal variables, medical variables and some singing related variables were explored among both groups and described. A general observation was that many frequency trends were similar between the groups. The most frequently reported vocal behaviour by both groups was speaking/singing loudly. Similarly, both groups reported consumption of dairy most frequently. Regarding exercise, most of the singers in both groups indicated exercising 2-4 times a week and having a healthy body weight. Water consumption trends were also similar between groups with most participants indicating that they drink between 4-8 glasses of water a day. Regarding stress, both groups indicated personal commitments to be the main causal

factor contributing to work related stress. The majority of female singers of both groups indicated that PMS negatively impacted their voice; however, pertaining to menopause, most of menopausal Carnatic singers indicated no impact on the singing voice while most of menopausal Western classical singers indicated a negative impact on their voices. Most singers of both groups did not indicate any medical variables which may impact the voice. A positive attitude towards their singing voices was frequently reported among both groups. Pertaining to beliefs of singers regarding variables which may influence the voice, for both groups, the three most frequently reported variables were stress, lack of sleep and performance anxiety.

Inferential statistics comparing the results of Western classical and Carnatic singers for variables discussed in this section is presented under Objective 2 in section 6.4.

6.4 Objective 2: Compare the self-reported voice problems, coping strategies, illness perceptions and variables which are likely to influence vocal health between Western Classical and Carnatic singers to ascertain the impact of genre on vocal health (Comparative).

The subscale scores for frequency of symptoms, SVHI, B-IPQ and VDCQ were compared between the singing groups using Independent t tests and the results are presented below (all details are also presented in Table 6.18).

6.4.1 Self-reported voice problems⁶

6.4.1.1 Frequency of symptoms subscales

The mean scores of the subscales were compared between the groups and a statistically significant difference was observed for the subscale *Acoustic inadequacies* [$t(163)=-2.29$; $p=0.02$]. Figure 6.7 provides a comparative illustration of the subscale scores of the two groups. Carnatic singers showed higher scores on all the subscales.

⁶ Mann Whitney U tests produced similar results as independent t test for variables with a significant Shapiro Wilk test; therefore, only the t test results are presented here. Mann Whitney U test results are available in Appendix 6.9.

Fig 6.7 Comparison of mean scores of frequency of symptoms' subscales between the two groups

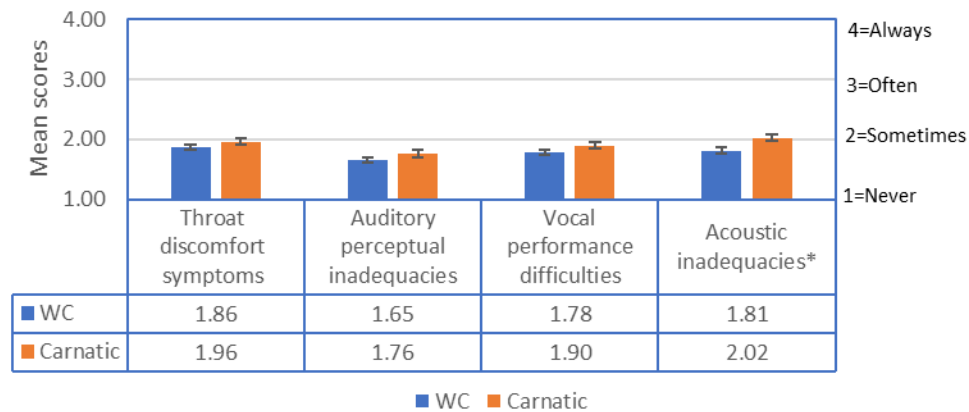


*Fig 6.7: * indicates a significant difference between the two groups. Error bars indicate 95% Confidence intervals of the mean*

Table 6.18: Comparison of mean scores of the survey measures (subscales) between the two groups

Freq of symptoms	t	df	p	Hedge's g	Lower CI	Upper CI
Throat discomfort symptoms	-1.11	163.00	0.27	-0.18	-0.28	0.08
Auditory perceptual inadequacies	-1.54	152.14	0.13	-0.23	-0.25	0.03
Vocal performance problems	-1.31	150.01	0.19	-0.20	-0.29	0.06
Acoustic inadequacies	-2.29	163.00	0.02	-0.37	-0.39	-0.03
SVHI	t	df	p	Hedge's g	Lower CI	Upper CI
Physical-Auditory Perceptual	-6.22	154.18	<0.001	-0.94	-0.78	-0.41
Functional	-2.58	163.00	0.01	-0.41	-0.52	-0.07
Vocational	-0.67	163.00	0.50	-0.11	-0.37	0.18
Emotional	-1.30	163.00	0.20	-0.21	-0.46	0.10
Physical-Consistency	-1.31	163.00	0.19	-0.21	-0.43	0.09
SVHI-Overall Mean	-2.56	163.00	0.011	-0.41	-0.47	-0.06
SVHI-Sum	-2.58	163.00	0.011	-0.41	-0.47	-0.06
VDCQ	t	df	p	Hedge's g	Lower CI	Upper CI
Social Support	2.03	163.00	0.04	0.32	0.01	0.64
Keeping to self	1.17	163.00	0.24	0.19	-0.17	0.66
Positive reappraisal	-1.85	163.00	0.07	-0.29	-0.72	0.02
Escape-Avoidance	-1.65	163.00	0.10	-0.26	-0.61	0.05
Distancing	-4.19	156.22	<0.001	-0.63	-0.84	-0.30
Information seeking	2.50	163.00	0.01	0.40	0.13	1.11
Tension reduction	-1.38	163.00	0.17	-0.22	-0.59	0.11
Religion (single item)	-4.20	117.29	<0.001	-0.736	-1.71	-0.62

Home remedies (single item)	-1.13	105	0.26	-.219	-.97	.26
IPQ	U	p				
IPQ 1-Impact	1407.0	0.19				
IPQ 2-Timeline	1391.0	0.41				
IPQ 3-Control	1413.0	0.38				
IPQ 4-Treatment control	1317.5	0.31				
IPQ 5-Symptoms	1424.5	0.37				
IPQ 6-Concern	1272.0	0.07				
IPQ 7-Coherence	1182.0	0.05				
IPQ 8-Emotion	1345.5	0.31				
<i>Table 6.18: T test was used for frequency of symptoms' scales, SVHI, and VDCQ. Mann Whitney u test was used for IPQ; CI=95% Confidence intervals</i>						

6.4.1.2 SVHI

The raw scores of SVHI sum (presented in Table 6.18) was compared between the groups which suggested a statistically significant difference in the scores, indicating overall higher levels of vocal impact among Carnatic singers [$t(163)=-2.578$, $p=0.011$; Western classical mean (SD)=32.24 (22.33); Carnatic mean (SD)=41.78 (23.55)]. The scaled scores (calculated as percentage) also showed a statistically significant score between the groups (same t statistics as the raw scores, because they were based on transformation of the dependent variable); [Western classical mean (SD)=22.39 (15.50); Carnatic mean (SD)=29.02 (16.35)]

A comparison of the subscale scores between the groups suggested that there was a statistically significant difference for the *SVHI-Functional* [$t(163)=-2.58$, $p=0.01$; Western classical mean (SD)=0.76 (0.53); Carnatic mean (SD)=1.36 (0.69)] and *SVHI-Physical-Auditory Perceptual* [$t(154.1)=-6.22$, $p<0.001$; Western classical mean (SD)=0.69 (0.62); Carnatic mean (SD)=0.98 (0.76)] subscales. Similar trends were observed with the percentage scores (provided in Appendix 6.10). Figure 6.8 provides a comparison of SVHI subscale scores between the groups showing higher scores among Carnatic singers on all subscales.

Fig 6.8: Comparison of mean scores of SVHI subscales between the two groups

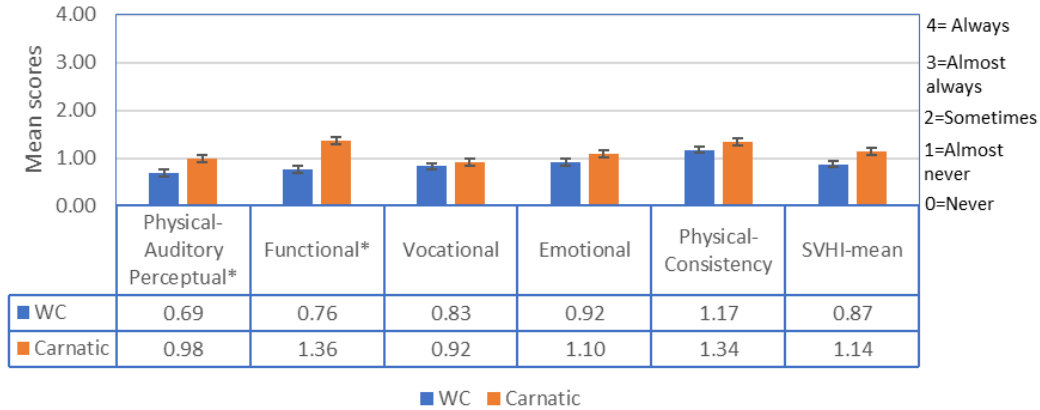


*Fig 6.8: * indicates a significant difference between the groups. Error bars indicate 95% Confidence intervals of the mean*

6.4.2 Illness perceptions

Since the IPQ included single item scales, Mann-Whitney U test was used to compare the subscales; however Mean (SD) were calculated rather than median (IQR) as IPQ traditionally calculates the former. Results (Table 6.18) revealed that only *IPQ 7-Coherence* [$U = 1182.0$, $p = 0.05$; Western classical mean (SD)=7.54 (2.57); Carnatic mean (SD)=6.56 (2.55)] showed statistically significant difference between the groups with Western classical singers indicating higher coherence. Figure 6.9 provides a comparison of IPQ items between the groups.

Fig 6.9: Comparison of mean scores of IPQ items between the two groups

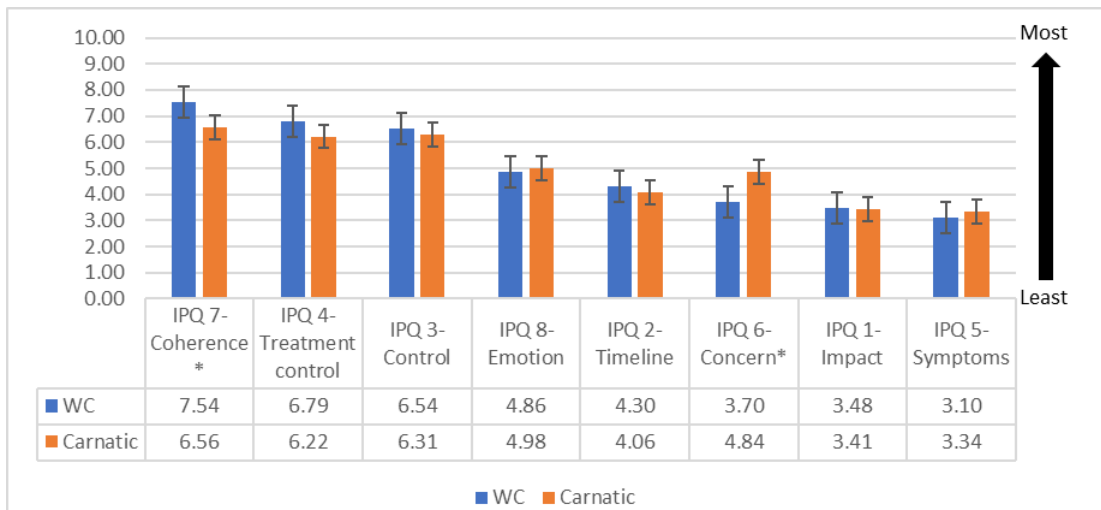
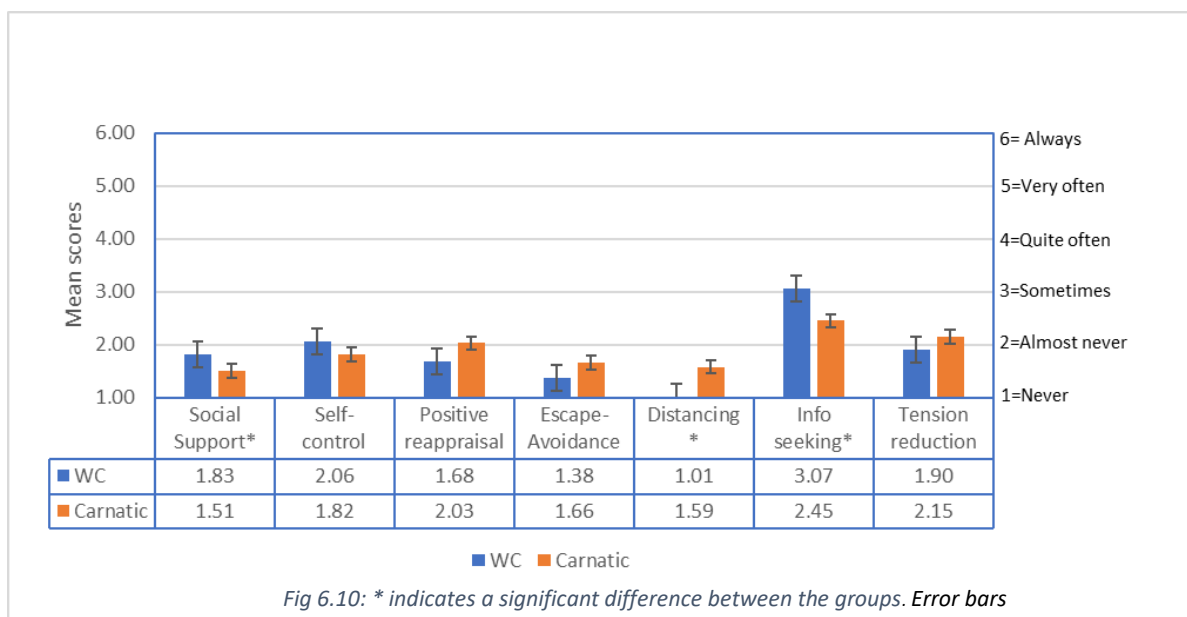


*Fig 6.9: * indicates a significant difference between the groups. Error bars indicate 95% Confidence intervals of the mean*

6.4.3 Coping with voice problems

A comparison of VDCQ subscales between Western classical and Carnatic singers revealed a statistically significant difference between the groups for the subscales *Seeking social support* [$t(163)=2.03$, $p=0.044$; Western classical mean (SD)=1.83 (1.02); Carnatic mean (SD)=1.51 (0.97)], *Distancing* [$t(156.21)=-4.19$, $p<0.001$; Western classical mean (SD)=1.01 (0.75); Carnatic mean (SD)=1.59 (1.00)] and *Information seeking* [$t(163)=2.50$, $p=0.018$; Western classical mean (SD)=3.07 (1.69); Carnatic mean (SD)=2.45 (1.45)] (see Fig 6.10). While Carnatic singers showed higher scores on the *Distancing* subscale, Western classical singers scored higher for *Seeking social support* and *Info seeking* subscales. The two items which did not fit under any subscale were analysed separately and results revealed that there was a statistically significant difference for the item pertaining to *religion* [$t(117.29)=-4.21$, $p<0.001$; Western classical mean (SD)=1.73 (1.25); Carnatic mean (SD)=2.90 (1.78)] with Carnatic singers showing higher mean scores (Table 6.18).

Fig 6.10: Comparison of mean scores of VDCQ subscales between groups



6.4.4 Variables which are likely to impact voice

Section 6.1.4 provided a descriptive account of the variables which are likely to impact voice in Western classical and Carnatic singers. This section will compare the results and determine if any statistically significant differences exist between the groups. Table 6.19 shows the results of inferential statistics for all variables.

6.4.4.1 Vocal behaviours

Significant differences between groups were observed only for the item related to using amplification [U=2490, p=0.011] with Carnatic singers reporting it more frequently.

6.4.4.2 Lifestyle variables

No significant differences were observed between the groups for any items related to consumption of items. There was a statistically significant difference between the groups [t(163)=2.11; p=0.018] for mean hours of sleep with Western classical singers scoring higher. No significant differences were noted for items related to physical exercise, hydration or body weight.

Comparing work related stress, a statistically significant difference [U=2254.5, p<0.001] was observed between the groups with Western classical singers indicating stress more frequently. Among the reasons contributing to work related stress, a statistically significant difference was observed between the groups for the following items (all items were more frequently reported among Western classical singers): Competition [U=2712, p=0.008], personal commitments [U=2422.5, p<0.001], presence of vocal problems [U=2845.5, p=0.047], fears regarding future work [U=2209.5, p<0.001], financial factors [U=2743.5, p=0.014] and expectations from employers [U=2386.5, p<0.001].

A statistically significant difference was observed between the groups pertaining to travel U=2614.5, p=0.020] with Western classical singers reporting more frequent travel.

6.4.4.3 Hormonal factors

Among hormonal factors PMS [U=504.5, p=0.019], menstruation [U=563, p=0.039] and menopause [U=27.5, p=0.003] showed significantly different scores between the groups with Western classical singers reporting a greater impact on their voices for all three variables. The number of female singers using oral contraceptives were also significantly higher among the Western classical group [U=650.5, p=0.027].

6.4.4.4 Singing related variables

A statistically significant difference was observed between the groups for performance anxiety [U=2520, p=0.01] with Carnatic singers indicating higher scores.

No statistically significant differences were reported for medical factors.

6.4.4.5 Beliefs of participants pertaining to variables negatively impacting the voice

Among the top 15 variables, nine variables showed statistically significant differences between the groups; of these the variables more frequently reported by Carnatic singers were consumption of oily foods [U=2782, p=0.035], refrigerated food consumption [U=2649, p=0.005] and those reported more frequently by Western classical singers were inadequate sleep [U=2292, p<0.001], alcohol consumption [U=2329.5, p<0.001], caffeine consumption [U=2685, p=0.011], dairy consumption [U=2692.5, p=0.007], lack of physical exercise [U=2682 p<0.022], travel [U=2665.5, p=0.010] and lack of warm up [U=2667, p=0.025]. (Appendix 6.11 provides the Mann Whitney U results of all the variables which are believed to impact voice.

Table 6.19: Comparison (inferential test results) of variables likely to impact voice between the two groups

Vocal behaviours	Mann-Whitney U	p
Speak/sing loud	2916	0.295
Speak/sing excessively	2930	0.317
Frequent throat clearing	2773.5	0.119
Singing while unwell	2676.5	0.060
Jaw/teeth clenching while singing	2928.5	0.276
Amplification while singing?	2490	0.011
Lifestyle factors		
Consumption of items	Mann-Whitney U	p
Alcohol	3102	0.696
Caffeine	2693.5	0.069
Tobacco	3116	0.607
Spicy foods	3192.5	0.942
Oily foods	2971	0.372
Cold/refrigerated items	3002.5	0.462
Dairy	2919	0.283
Sleep	T (df)	p
Amount of sleep/day	2.11 (163)	0.018
Physical exercise	Mann-Whitney U	p
Regular physical exercise	3034.5	0.533
Body weight	Mann-Whitney U	p
Healthy body weight	2749.5	0.092
Hydration	Mann-Whitney U	p
Quantity	2766	0.111

Sip water regularly	2809	0.156
Travel	Mann-Whitney U	p
Travel for performances	2614.5	0.020
Frequency	374	0.384
Stress	Mann-Whitney U	p
Experiencing work related stress	2254.5	<0.001
Reasons for work related stress	Mann-Whitney U	p
Expectation from employers	2386.5	<0.001
Financial factors	2743.5	0.014
Fears regarding future work	2209.5	<0.001
Presence of vocal problems	2845.5	0.047
Lack of rest	3022.5	0.326
Expectation of others	2838	0.060
Poor acoustics	3097.5	0.511
Refuse work	3175.5	0.840
Personal commitments	2422.5	<0.001
Competition	2712	0.008
Lack of fairness	2869.5	0.089
Hormonal factors		
Impact of PMS on voice	504.5	0.019
Impact of menstruation on voice	563.0	0.039
Impact of menopause on voice	27.5	0.003
Taking oral contraceptives	650.5	0.027
Medical factors	Mann-Whitney U	p
Medical conditions	3145.5	0.769
Surgery	3151.5	0.709
Medications	3037.5	0.473
COVID-19	2974.5	0.119
Frequent colds/allergies	2878.5	0.241
Singing related factors	Mann-Whitney U	p
Performance anxiety	2520	0.013
Positive attitude towards singing	3199	0.960

6.4.5 Summary of Objective 2

Vocal symptoms, vocal impact, illness perceptions, coping and variables which are likely to impact the voice were compared between the two groups. A summary of variables which showed statistically significant differences between the two groups for each construct is provided in Table 6.20.

Table 6.20: Summary of Objective 2-comparison of frequency of symptoms, vocal impact, illness perceptions and coping between the two groups

Construct (measure)	Subscales with significant results	Direction of effect
Vocal symptoms (Frequency of symptoms' scale)	Acoustic inadequacies	Carnatic singers scored higher
Vocal impact (SVHI)	1. SVHI sum and percentage 2. Functional 3. Physical-Auditory perceptual	Carnatic singers scored higher on all subscales
Illness Perception (IPQ)	1. IPQ 7-Coherence	1. WC singers scored higher
Coping (VDCQ)	1. Social support 2. Distancing 3. Info seeking 4. Religious coping	1. WC singers scored higher 2. Carnatic singers scored higher 3. WC singers scored higher 4. Carnatic singers scored higher
Variables which are likely to impact voice	1. Speaking/singing loudly 2. Singing while unwell 3. Using amplification while singing 4. Amount of sleep 5. Frequency of travel 6. Experiencing work related stress 7. Hormonal factors 8. Performance anxiety	1. WC singers scored higher 2. WC singers scored higher 3. Carnatic singers scored higher 5. WC singers scored higher 6. WC singers scored higher 7. WC singers scored higher 8. WC scored higher 9. Carnatic singers scored higher
Variables which are likely to impact voice-Beliefs	1. Consuming oily foods 2. Consuming refrigerated foods 3. Inadequate sleep 4. Alcohol consumption 5. Consuming caffeine 6. Consuming dairy 7. Lack of physical exercise 8. Travel 9. Lack of warm up	1. Carnatic singers scored higher 2. Carnatic singers scored higher 3. WC singers scored higher 4. WC singers scored higher 5. WC singers scored higher 6. WC singers scored higher 7. WC singers scored higher 8. WC singers scored higher 9. WC singers scored higher

6.5 Objective 3: Explore strategies employed by the two singing groups to maintain vocal health (Descriptive and qualitative).

6.5.1 Warm-up

The results (presented in Table 6.21) suggested that more Western classical singers (n=38, 60.3%) reported practising warm up 'often' compared to Carnatic singers (n=28, 27.4%). A statistically

significant result was reported between the groups pertaining to frequency of warm up with Western classical singers reporting warm up practice more frequently [$\chi^2(3)=19.23$; $p<0.001$]. Fifteen (23.8%) Western classical singer indicated that they ‘never or occasionally’ practised warm up whereas 46 (45.09%) Carnatic singers reported so. The three most frequent warm up exercises used by Western classical singers were humming (n=39, 62%), pitch glides (n=38, 60.3%) and lip trills (n=35, 55.5%). Among Carnatic singers, the three most frequent warm up exercises were *Akaara saadhakam* (vocal exercises using the vowel ah) (n=39, 38.2%), humming (n=35, 34.3%) and practising *varisai* (introductory vocal lessons in Carnatic music) (n=32, 31.3%). Further details pertaining to the warm-up strategies used by the two groups is provided in Table 6.22.

Table 6.21: Frequency of warm-up and cool-down among participant groups

Do you regularly warm up and cool down your voice before and after singing?	WC	Carnatic	Pearsons Chi Square		
			χ^2	df	Sig
Never/Occasionally	15 (23.8%)	46 (45.09%)	19.23	3	<.001
Sometimes	10 (15.8%)	28 (27.4%)			
Often	38 (60.3%)	28 (27.4%)			

Table 6.22: Warm up strategies used by the two groups

Strategies	WC - N (%)	Carnatic - N (%)
Pitch glides	38 (60.3%)	19 (18.6%)
Lip Trills	35 (55.6%)	12 (11.8%)
Tongue Trills	31 (49.2%)	9 (8.8%)
Humming	39 (61.9%)	35 (34.3%)
Sirens	33 (52.4%)	5 (4.9%)
Akaara Saadhakam	0 (0.0%)	39 (38.2%)
Varisai	0 (0.0%)	32 (31.4%)

6.5.2 Other practices followed by singers to maintain vocal health

An open-ended question was asked to all participants to report practices followed to maintain vocal health. Among Western classical singers, the most frequently reported practices were getting adequate sleep (n=13, 20.6%), warming up the voice (n=13, 20.6%), staying hydrated (n=13, 20.6%), carrying out regular vocal practice (n=12, 19.04%), taking regular physical exercise (n=8, 12.6%), steam inhalation (n=8, 12.6%) and avoiding/minimising alcohol intake (n=8, 12.6%). Practices frequently reported by

Carnatic singers were daily/regular singing practice (n=17, 16.6%), vocal exercises [e.g., varisai, sthayi exercises (n=11, 10.8%)], Akaara/ukaara/makaara saadhakam (n=9, 8.8%), avoiding consumption of cold/refrigerated foods (n=8, 7.8%), warming up the voice (n=6, 5.8%), and drinking warm-hot water/liquids (n=5, 4.9%). To aid better interpretation of the large number of individual responses of the participants, they were grouped into the following categories- sleep, hydration, diet/limiting consumption of items, warm up, vocal practice, voice use, general health, attitudes, seek-help and other practices. The frequencies of all practices (categorised as mentioned earlier) are provided in Table 6.23.

Table 6.23: Practices reported by Western classical and Carnatic singers to maintain vocal health

Category	Western Classical	N (%)	Carnatic	N (%)
Sleep	Adequate sleep	13 (20.6%)	Adequate sleep	1 (1.0%)
Hydration	Adequate hydration	13 (20.6%)	Adequate hydration	4 (3.9%)
Diet/ consumption of items	Avoid/minimise alcohol	8 (12.7%)	Avoiding cold foods	8 (7.8%)
	Good diet	4 (6.3%)		
	Avoid acidic foods	2 (3.2%)		
	Avoid caffeine	2 (3.2%)		
	Avoid smoking	2 (3.2%)		
	Avoid spicy foods	2 (3.2%)		
Warm up	Warm up regularly	13 (20.6%)	Warm up regularly	6 (5.9%)
Vocal practice	Maintain a weekly routine /regular practice/vocal exercises	12 (19.0%)	Daily/regular singing practice	17 (16.7%)
	Work with vocal coaches regularly	4 (6.3%)	Akaara Sadhakam (ukaaram/makaaram)	9 (8.8%)
	SOVTE/LAX VOX	3 (4.8%)	Varisai and sthayi exercises	6 (5.9%)
	Technical exercises	2 (3.2%)	Breathing exercises	5 (4.9%)
	Developing a good technique	2 (3.2%)	Vocal exercises	5 (4.9%)
	Regularly work on repertoire	2 (3.2%)	Practice upper octaves	2 (2.0%)
Voice use	Voice rest	3 (4.8%)	Voice rest	2 (2.0%)
			Proper use/awareness of speaking voice	2 (2.0%)
			Reduced talking	2 (2.0%)
General health	Regular exercise/physical warmups/stretching	8 (12.7%)	Rest	3 (2.9%)
	Rest	6 (9.5%)		
	Meditation	3 (4.8%)	Yoga	3 (2.9%)
	Yoga	3 (4.8%)		
	Management of gastrointestinal issues	3 (4.8%)		

Category	Western Classical	N (%)	Carnatic	N (%)
	Pilates	2 (3.2%)		
Attitudes	Being relaxed/avoid stress	5 (7.9%)	Calming the mind prior to performance	3 (2.9%)
	Positive attitude/avoid negative thoughts	3 (4.8%)	Positive mindset/being happy	2 (2.0%)
Seek help	Physio/vocal health specialist consultations for therapy/massages etc.	2 (3.2%)		
Other practices	Steam inhalation	8 (12.7%)	Gargling	2 (2.0%)
			Pranayama	2 (2.0%)

6.6 DISCUSSION

This chapter reported the results pertaining to self-reported voice problems and coping strategies in Western classical and Carnatic singers from the survey. It also explored how singers perceive their illness and finally described the strategies used by these two groups of singers to maintain their vocal health. In brief, we found vocal fatigue, reaching higher notes and vocal strain was reported to be the three most frequently occurring vocal symptoms by both groups. Carnatic singers scored higher on all measures of vocal symptoms (frequency of symptoms' scale) and vocal impact (SVHI) compared to Western classical singers. Significant differences were also noted for some of the subscales of both frequency of symptoms' scale and SVHI between the groups. Pertaining to coping, the subscale with highest scores in both groups was information seeking; however significant differences were observed between the groups for the subscales *Seeking social support* (higher among Western classical singers), *Information seeking* and *Distancing*, with the former two strategies more commonly employed among Western classical singers and *Distancing* among Carnatic singers. *Religious coping* was also significantly higher among Carnatic singers. A variety of warm up strategies such as pitch glides, humming and Akaara saadhakam were indicated to be frequently used in this sample. Other strategies to maintain vocal health such as getting adequate sleep and hydration, carrying out regular vocal practice etc. were also reported. A more detailed discussion of the results is below.

6.6.1 Sample characteristics-representativeness and generalisability

One hundred and sixty-five singers were recruited, of which 63 were Western classical singers and 102 were Carnatic singers. There was a greater number of females compared to males in both groups, with the male to female ratio being lower among Carnatic singers. This is not uncommon in voice research

involving classical singers as similar inequalities in gender have been reported in the literature (Devadas et al, 2018; Loiola-Barreiro et al, 2015, Karulkar et al, 2020) where more female participants are recruited. Current evidence indicates a greater vulnerability among women, particularly professional voice users, to develop voice problems due to physiological, hormonal and behavioural characteristics (Hunter, Smith and Tanner, 2011). This could explain the increased willingness or motivation amongst women to partake in research. The systematic review reported in Chapter 2 indicated that there are inconsistencies in reporting of participant characteristics in studies pertaining to singing voice research. A systematic review performed by Pestana, Vaz-Feitas and Manso (2017) to report the prevalence of voice problems among singers made similar conclusions regarding reporting inconsistencies and therefore were unable to report important characteristics such as mean age. Therefore, it is difficult to make assertions regarding representativeness in relation to age, singing experience, training etc. as they are not consistently reported in the literature. Moreover, population-based statistics on the proportion of male and female in the singing fraternity is unavailable to evaluate representativeness.

Between the two groups in the current survey, there were significantly more professional singers among the Western classical group compared to the Carnatic group. The systematic review outlined in Chapter 2 indicated that performance level (professional vs amateur) could impact vocal health as amateur singers showed higher SVHI scores compared to professional singers (Cohen et al, 2008). The authors attributed this to swifter treatment seeking among professional singers. Since the Carnatic group had a significantly higher number of amateur singers and consistently scored higher on all the voice outcomes, this will need to be accounted for in interpretations, e.g. it is possible that Cohen's study results were replicated in the present study. However, performance level did not affect voice outcomes significantly in a study done by Loiola- Barreiro et al (2015) where the VHI was administered in 58 classical singers. This could also indicate higher sensitivity of SVHI to performance level in this population, as there are more singing related items in the SVHI. An analysis of genre by performance level with SVHI outcomes between the two groups will ascertain if performance level impacts vocal impact; whilst this is beyond the scope of analysis for the current research, it is an interesting pathway to explore in the future.

The discussion of the main results will be presented in four sections:

1. Section 1: item level analyses of self-reported voice problems (frequency of symptoms and vocal impact), illness perceptions and coping.
2. Section 2: subscale level analyses of self-reported voice problems (frequency of symptoms and vocal impact) and coping
3. Section 3: Variables which are likely to impact the voice.
4. Section 4: Maintaining vocal health among the two groups.

6.6.2 Section 1: Identify the self-reported voice problems, illness perceptions and coping strategies in Western classical and Carnatic professional singers

Results presented here are based on analysis at item level.

6.6.2.1 *How did singers perceive their own voices?*

A variety of descriptors were used by singers with “expressive” being used most commonly by both groups. The impact of these perceptions (descriptors) on the voice are not straightforward to ascertain as there is limited evidence in the literature. Interestingly, “expressive” was also a frequently used descriptor by singing teachers and singers while describing a “good” voice. This could indicate that voice quality and range are desirable qualities among classical singers in general. It is not far-fetched to assume that singers would naturally work towards acquiring these qualities; therefore, it is hoped that this information would benefit singing teachers, SLTs and other members who are likely to influence vocal health among singers to provide the right guidance geared towards advising singers on safe vocal practices to achieve these qualities. While most of the attributes were unambiguously positive, there were some which may be perceived as positive or negative (e.g., husky, nasal). Cluster analysis of the various attributes would clarify how they were viewed by singers.

6.6.2.2 *What was the prevalence of voice problems in the study sample?*

Within the study sample, the prevalence of current voice problems was higher in Carnatic singers (41%) compared to Western classical (27%), albeit insignificant. Devadas et al (2018) calculated the prevalence of current voice problems among 190 Carnatic singers and reported it to be 23% which is much lower than the results of the present study. Additionally, Devadas et al (2018) used purposive sampling and distributed paper surveys to potential participants (singers who were between 18-60 years of age and were involved in singing for more than 2 hours/week over a period of 12 months) whereas convenience sampling was used in the present survey using an online questionnaire. The

sampling method used in the present study may have encouraged singers with voice problems to take part in the survey. The number of singers who had experienced voice problems in the past (across their singing careers) were also slightly higher (47%) in the present study compared to those reported by Devadas et al (2018) which was about 35%. While the prevalence of current voice problems was comparatively lower among Western classical singers in the current study (27%) compared to Carnatic singers (41%), prevalence of singers who have experienced voice problems in the past was 57.1% which was higher than the Carnatic group (47%). Phyland et al (1999) also reported a high prevalence of voice problems in their study involving opera singers where 67% of singers reported experiencing a voice problem over the past 12 months. The authors indicated that there are issues related to operational definitions and differences in sampling methods across studies which makes it challenging to compare prevalence rates of voice problems across studies.

6.6.2.3 Symptoms reported by the singers (Item level analysis)

The most commonly reported symptoms in both groups, namely vocal fatigue, difficulty reaching higher pitches and vocal strain are in line with previous research on classical singers. A similar symptom cluster was reported in the systematic review (refer to Chapter 2, section 2.3.7.2.1) where classical singers reported vocal fatigue and reduction of upper range most frequently. Vocal fatigue and its implications on the singing voice has already been discussed in Chapter 2 (section 2.4.5). Kitch and Oates (1994) reported that the most frequent voice-related changes associated with vocal fatigue were reduced pitch and dynamic range and increased tension and discomfort in the throat, neck and jaw regions. Therefore, it would be interesting to explore if these symptoms are inter-related and occur synchronously where one phenomenon feeds into the other. Simply put, does vocal fatigue lead to the development of the other symptoms indicated by the singers such as reduced range and throat discomfort? Similar propositions have also been made by Devadas et al (2018). Correlation analysis between vocal fatigue and other symptoms, which will be carried out in the next chapter will throw more light on this proposition.

6.6.2.4 Impact on the singing voice

SVHI was used to determine levels of vocal impact which first calculates a raw (sum) score which is then transformed into scaled (percent) score. Due to reporting inconsistencies in the literature, which was identified through the systematic review on self-reported voice problems in classical singers carried out

as part of the current programme of research and reported in chapter 2, both raw and scaled scores were reported in the present survey. The scaled score (SD) reported for the study sample in the present survey was 26.48 (16.31) which was significantly higher than the normative score of 20.35 indicating higher than normal levels of vocal impact. In the systematic review reported in Chapter 2, only one study (Cohen et al, 2008) had reported the scaled scores (SD) of SVHI which was reported to be 39.2 (19.2) within their study population. Nacci et al (2020) measured SVHI scores in 42 singing students and reported the scaled SVHI score to be 32.3 (SD=20.9). In comparison, the SVHI scores reported in the current survey was lower. The study by Cohen et al (2008) recruited singers who presented to a voice clinic with voice problems which likely explain the higher SVHI scores compared to the present survey. Also, Nacci et al (2020) reported that their study population was young and therefore may not possess good vocal techniques or vocal habits which may be responsible for the higher SVHI scores.

Castelblanco et al (2016) recruited 47 healthy singers and reported SVHI scores using a total sum which was 22.4 (16.33); this was much lower than the raw scores reported in the present survey (mean=38.4; SD=23.48). This could be attributed to the study population itself as the present survey recruited singers with and without vocal symptoms. Studies similar to the present survey where singers with and without voice problems were recruited are limited; therefore, an exact comparison of the results obtained in the present survey to prior research was challenging.

Similar to results obtained for prevalence of voice problems in the present survey, the raw and scaled SVHI scores were significantly higher among Carnatic singers. Moreover, the scaled scores of Carnatic singers were also significantly higher than the normative scores. This is indicative of higher levels of vocal impact among this group of singers. A translation and validation study of SVHI into Kannada by Gunjawate et al (2017) reported that the SVHI scores (SD) for Indian singers with and without voice problems were 61.05 (20.57) and 19.81 (10.74) respectively. The results of the present survey reported for Carnatic singers (29.01; SD=16.35) would therefore fall within the range reported by Gunjawate et al (2017). Western classical singers showed only slightly elevated scores compared to the mean (22.39; SD=15.50). The implications of the differences in vocal impact reported by both groups will be discussed in later sections of this chapter and Chapter 8.

6.6.2.5 What were the trends observed in Illness perceptions?

Illness perception is a very under researched topic within the context of voice problems. Therefore, this survey was one of the first of its kind to report how singers perceive their voice problems. Illness representations are proposed to influence how an individual reacts or responds to an illness; differences in how illness is viewed can evoke different responses (e.g. coping) in individuals experiencing the same condition (Shiloh, 2006). Illness representations develop from information gathered from social sources (other professionals, family friends etc.), direct experience of a condition and treatment, cultural beliefs (Shiloh, 2006) and so on which makes its inclusion relevant for the present study. The results indicated that illness perceptions were fairly similar between the groups. The three items with highest scores were *Illness coherence* (IPQ 7), *Treatment control* (IPQ4) and *Personal control* (IPQ 3).

High scores for the construct *Illness coherence* indicated that the singers in this study felt that they had enough knowledge pertaining to the causes, symptoms and progression of their voice problem and more importantly, what needs to be done about it. The benefits of knowledge about health and ill-health have been documented in the literature (Stormacq et al, 2020; Amann et al, 2015) and have been positively linked to overall health outcomes. It was also encouraging to note that singers perceived treatment to be beneficial pertaining to their voice problems as this is likely to suggest that singers are more likely to seek treatment while encountering voice problems. *Personal control* was also indicated to be a strong belief among the singers and is often associated with improved quality of life (Wang et al, 2021) and better health outcomes (Hong et al, 2021). A combination of good understanding about the voice problem, positive outlook regarding treatment outcomes and high levels of perceived control indicates an encouraging and optimistic trend of illness perceptions among the singers in the present study.

Both groups scored the lowest scores for *IPQ 5-Symptoms* with Western classical singers scoring slightly lower than Carnatic singers. This was also an expected result as the singers in this survey only presented with slightly elevated SVHI scores; moreover, the average scores on the frequency of symptoms' scale ranged between Never-Sometimes on the Likert scale. This indicates that the population of singers in the present survey did not perceive their symptoms to be considerably frequent or severe.

6.6.2.6 Coping trends among singers in the present study (Item level)

Analysis at item level indicated that the coping strategies most frequently adopted by Carnatic singers were home remedies (Item A2) and voice rest (Item S27). A variety of home remedies used by Carnatic singers was highlighted in the results of the qualitative study (Chapter 4, section 4.4.2.4.1.3). There are no studies that have looked at the effects of home remedies on vocal health and therefore, it is difficult to ascertain if it is an adaptive (or effective) coping strategy. Resting the voice, more commonly known as vocal naps, on the other hand is advised by SLTs and ENTs across voice clinics as an effective strategy to maintain vocal health and was therefore an encouraging trend observed among the singers in this group as a potential voice-related coping strategy. Sataloff (1997) recommends observing 20 minutes of silence, two to three times a day as a positive modification in vocal behaviour to combat excessive voice use. Yiu and Chan (2003) compared the vocal performance of 20 karaoke singers by subjecting half of them to regular voice rest and hydration while the other half sang continuously with neither. Results indicated that singers with hydration and voice rest performed for longer and singers who took neither had reduced upper range and abnormal jitter levels implying the techniques effectiveness to maintain vocal function. Despite the popularity of vocal naps as a fundamental recommendation for maintaining vocal health, it was surprising that there were no studies that exclusively looked at the effect of vocal naps on the voice, except in estimating its effect on post-surgical voice rehabilitation.

Among Western classical singers, items pertaining to seeking help (Item S19) and seeking information (S18) were most frequently employed. Anker et al (2011) defined information seeking as a purposeful problem-solving strategy which is goal orientated and adopted by individuals who may encounter a stressful situation such as illness. Lambert and Loiselle (2007) reported that information seeking is a key coping strategy that leads to health promotive activities and aids in adjusting to the illness. A general point of view is that information seeking is an adaptive coping strategy and leads to positive health outcomes. However, it is crucial to ensure that singers seek information from reliable/ credible sources. A study by Van Riel (2017) which looked at the impact of “Googling” your illness reported increased worry levels in younger participants. It, therefore, becomes essential that singers have easy access to accurate information pertaining to voice problems. Singers should be urged to contact organisations such as British Association of Performing Arts Medicine (BAPAM) or the British Voice Association (BVA) who possess scientifically valid resources and important links with healthcare professionals who can provide appropriate help and accurate information to singers.

6.6.3 Section 2: Compare the self-reported voice problems and coping styles between Western Classical and Carnatic singers to ascertain the impact of genre on vocal health.

6.6.3.1 *Creation of subscales and their interpretations*

The inability to use factor analysis results to create subscales in this survey is noteworthy. A variety of manipulations in factor structure were attempted; however, a theoretically plausible factor loading could not be achieved. One explanation for this could be the inherent differences between Western classical and Carnatic singers which might make it unsuitable to combine them during factor analysis. Unfortunately, due to limited sample size per group, a factor analysis could not be attempted for each group separately. Therefore, mapping was undertaken as outlined in chapter 5 (section 5.3.4.3) using previously established scales and measures as reference points to generate subscales. The next step would be to carry out Confirmatory Factor Analysis to enable the verification of a suggested factor structure. However, this is beyond the scope of the current programme of research but will be attempted in future.

6.6.3.2 *Frequency of symptoms subscales*

The 27 items to identify the frequency of vocal symptoms was developed for the purpose of this survey which were chosen based on the results of the systematic review and the qualitative study. Since most, if not all of the symptoms are “perceptual” by nature, the most commonly used and valid perceptual tools such as GRBAS, CAPE-V and Buffalo Voice Profile guided the development of the subscales.

The frequency of symptoms subscales showed that Western classical singers had highest scores for *Throat discomfort subscale* and Carnatic singers for *Acoustic inadequacies subscale*. This is unsurprising as four of the top 10 symptoms (vocal fatigue, vocal strain, throat tightness and throat dryness) reported by Western classical singers belonged to the throat discomfort scale; similarly, three of the top 10 symptoms (difficulty reaching higher notes, difficulty reaching lower notes and overall reduced pitch range) reported by Carnatic singers, two of which appeared in the top five list of reported symptoms belonged to the *Acoustic inadequacies* subscale.

It was also interesting to note that both groups scored the lowest scores for the *Auditory perceptual inadequacies* scale which included items mainly pertaining to voice quality. A systematic review by Kwok and Eslick (2017) indicated that hoarseness, which is one of the most characteristic symptoms of

vocal quality was the second most prevalent symptom among singers (54%) which was placed even above vocal fatigue (53%). Since the systematic review included singers of all genres, it is possible that low prevalence of voice quality symptoms is characteristic of classical singers which is interesting to note. Only one scale namely *Acoustic inadequacies* showed statistically significant differences between the groups. This subscale included symptoms related pitch, loudness and resonance. A profile of the top 10 vocal symptoms Carnatic singers had indicated that they reported difficulties in reaching higher pitches, lower pitches and an overall reduced pitch range. Reaching lower pitches was reported by Western classical singers very infrequently. This could be because 43.5% of Western classical singers who took part in the survey were sopranos who primarily relied on their upper frequency ranges. Since low pitched singing is one of the characteristic features of Carnatic singing (Arunachalam et al, 2013), this was picked up frequently as a major symptom by this group which reflected in high scores in the *Acoustic inadequacies* subscale. In other words, the different vocal requirements of the genres influences their perceptions of problems, some of which will not be evident in Western classical singers as it is not expected to be used and therefore affected or even noticed if there is a problem or inadequacy. Therefore, it is suggestive that expectations of vocal performance can be important to influence perceptions of voice problems among singers.

6.6.3.3 SVHI subscales

The original authors of the SVHI (Cohen et al, 2007) attempted to perform factor analysis of the measure during its development; however, they reported that following PCA, the items loaded on a single factor which explained about 52% of the variance. Therefore, SVHI has traditionally been scored as a single scale. Interestingly, PCA results of the present study indicated multidimensionality (see Appendix 6.4). Since the SVHI's interpretative value is limited to only calculating a total score and PCA indicated the presence of multiple factors, the creation of subscales for a validated measure such as SVHI was believed to be justified. As indicated in section 6.3.1, since a good solution was not possible through PCA, the multidimensional indications were taken from the results of PCA and mapping was carried out.

The SVHI subscale most frequently reported in Western classical singers was *SVHI-Consistency* which correlated well with the frequency of symptoms results as they both included vocal fatigue indicative items. Similarly, among Carnatic singers, the most frequently reported subscale was *SVHI-Physical-*

Auditory perceptual, which included items pertaining to pitch, which is in line with the frequency of symptoms scores. It must be emphasised that the consistency and effort subscale was a close second problem area among Carnatic singers; therefore, this subscale was also rather frequent among this group. This indicates that the impact of voice problems among both groups is primarily in the physical domain. Similar results were reported by Rosen and Murry (2000) where they administered the VHI among 106 singers (of which 38 singers were classical) and reported the highest mean scores for the physical subscale.

The higher levels of vocal impact among Carnatic singers, compared to Western classical singers across voice outcomes must be acknowledged. As indicated in paragraph one of this chapter, Carnatic singers scored higher on all voice outcomes indicative of a greater vulnerability. Given the fact that the two groups were quite similar demographically (except in terms of professional level and gender inequality which is unlikely to produce such a significant difference in scores), it is possible that the higher prevalence is due to other differences. Firstly, Carnatic singing, as a genre could be more vocally demanding. Unlike Western classical singing which groups singers based on their voice type (e.g., soprano, alto etc.), such categorisations are unavailable in Carnatic singing. This would mean that all singers are essentially expected to sing across the three octaves irrespective of their natural predispositions. This is likely to cause problems with the voice due to extreme singing and wider vocal performance demands.

Another reason could be cultural, which may influence how vocal health is viewed. For example, the two most commonly employed coping strategies by Carnatic singers were resting their voices and resorting to home remedies, which could be construed as a reluctance to seek professional help. Cohen et al (2017) indicated that delayed ENT consultations can adversely affect vocal outcomes. Also, India has a rich heritage of traditional medicine and therefore, the use of medicinal herbs and home remedies is a common cultural theme (Gaunt, 2015). There is limited evidence regarding the effectiveness of these methods on voice rehabilitation or vocal health; therefore, their actual impact is difficult to ascertain. However, reliance on home remedies is likely to delay seeking help from an ENT professional/SLT which may have adverse consequences. Moreover, healthcare could be expensive in India as most individuals tend to seek private consultations, which may influence treatment seeking. Petty (2012) highlighted that classical singers often sought help from their singing teachers in case of a vocal problem. The guru-shishya Parampara literally translated to teacher-student tradition is an ethos

that is set deeply within the cultural fabric of India (Prickett, 2007) that significantly influences the pedagogy of Carnatic singing. Therefore, Petty's findings pertaining to seeking help from singing teachers are likely to be more prevalent among Carnatic singers, who may not be able to provide a medically informed perspective may be a factor influencing judgments pertaining to maintaining vocal health; however, these claims need empirical validation with further research.

Finally, the increased prevalence of impact among Carnatic singers could be due to differences in lifestyle or other factors which need to be assessed in greater depth with a larger sample. Some of these variables were analysed in the present study and a few differences were observed. The implications of these differences and their possible impact on the overall results regarding self-reported voice problems will be discussed in the next chapter (Chapter 7, section 7.1).

6.6.3.4 VDCQ subscales

It was surprising to note that both singing groups reported *Information seeking* as the most frequently reported behaviour, even though the two items pertaining to info seeking were not among the 10 most frequently reported VDCQ items. An explanation for this could be that most of the frequently reported items were spread across five scales and therefore did not uniquely represent a specific scale. Also, the second most frequent item related to home remedies did not belong to any scale. Moreover, the mean scores of the individual items were very similar with only minute differences in value (most of the subscale scores ranged between Never-Almost never) and may therefore not be indicative of sufficient clinical relevance. The implications of *Information seeking* and its impact on vocal health has already been discussed in section 6.6.2.6 and is generally associated with positive outcomes that alleviate stress (Endler and Parker, 1990). The subscales used the least by both groups is also of significance and must be discussed. *Escape avoidance* is largely viewed as an emotion focused coping strategy where the individual copes with stress by avoiding or ignoring the stressor and is viewed to be a predictor of reduced well-being (Mausbach et al, 2005). While avoidant coping may benefit singers short term as it may help to deal with the immediate stress caused by the onset of the voice problem, it is unlikely to positively influence vocal health long-term. Similar views regarding *Escape avoidance* have been proposed by Epstein et al (2008) related to adopting this coping strategy on a long-term basis. Therefore, reduced use of *Escape avoidance* may be indicative of better vocal health outcomes in Western classical singers.

Among Carnatic singers, the coping strategy least used was *Seeking social support*. The effectiveness of *Social support* as a coping strategy has been discussed in Chapter 3 section 3.5 as this was the most commonly employed coping strategy among teachers. Epstein et al (2008) viewed *Social support* as an adaptive strategy as it equipped individuals with tools and resources to deal with the physical and emotional consequences of a voice problem.

A statistically significant difference was observed between the groups for the item representing *Religious coping*. This was also highlighted in the qualitative study and the influence of religion in Carnatic singing was explained in detail (see section 4.5.5). Pargament et al (2005) provided a detailed account on religious coping where he described it as multimodal (involving behaviours, emotions, cognitions etc.), dynamic (changes with time, context or circumstance) and multivalent (as it can lead to negative or positive outcomes). Ross (1990) reported that religious affiliation was positively linked to quality of life. A meta-analysis performed by Ano and Vasconcelles (2005) indicated that religious coping is significantly associated with psychological adjustment to stress. This would indicate that religious coping can be effective in dealing with the emotional consequences of a voice problem. However, given the complexity of this coping strategy, its effectiveness in dealing with (practical) voice problems is difficult to ascertain as its success (or failure) to be adaptive depends on multiple factors as mentioned above.

The adaptive/maladaptive nature of the coping strategies described in this chapter will be discussed further within the context of correlation and regression results presented in chapter 7.

6.6.4 Section 3: Variables which are likely to impact the voice

A variety of variables such as vocal behaviours, consumption of items which are likely to impact the voice, lifestyle variables, hormonal variables, medical variables and singing related variables were explored and the frequencies were reported. Many trends such as levels of hydration, amount of exercise, body weight, positive attitude towards voice and consumption of items were similar between the groups.

The average levels of water consumption were reported to be between 4-8 glasses of water. The effect of hydration on the voice has been researched extensively and positive results have been reported on voice quality (Alves et al, 2019; Franca and Simpson, 2009) and vocal physiology (Sivasankar and Leydon, 2010). Sataloff (1997) indicated that singers require about 64 fl.oz of water to maintain

sufficient levels of hydration. The current study did not report the results using metric units such as litres or ounces (as this was expected to make it challenging for participants to respond to) and used “number of glasses” to report results. A typical glass would be 8 ounces; therefore, the singers in the present survey are likely to be sufficiently hydrated. The association between hydration and vocal impact will be ascertained in Chapter 7 which will provide more conclusive evidence.

The adverse effects of alcohol on the voice are well documented, the most commonly reported effects being dehydration causing changes in the laryngeal mucosa, decrease in muscle activity and lack of control of the vocal system (Benninger et al, 1994, Boone et al, 2005). It was therefore encouraging to note that majority of the singers in both groups indicated that alcohol or tobacco was not consumed on a regular basis. This is in line with previous research where singers reported to indulge in smoking or consuming alcohol lesser than the general population (Mathmann et al, 2021).

Both groups reported indulging in physical exercise 2-4 times a week. Research has mainly focused on studying the impact of vocal exercises on the voice; however, there is limited evidence on the impact of general physical exercise on vocal health. A study by McHenry and Evans (2016) studied the applicability of aerobic exercises as a warm-up for singing and indicated favorable aerodynamic changes (an increase in mean Sound Pressure Level and mean airflow during voicing) during singing after aerobic exercise. A few studies have indicated an improvement in lung and respiratory health with physical exercise (Sheff, 2016). This could benefit singers as the respiratory system is the power source for voice production. The qualitative study indicated that singers perceived physical exercise to be beneficial in maintaining a healthy voice; therefore, further research to specifically study the short term and long-term impact of physical exercise and the voice is warranted as this can be beneficial in formulating appropriate advice to singers.

Consumption of dairy was frequently reported by both groups. Historically, consumption of dairy has been associated with development of mucous among singers. This association was repeatedly indicated during the qualitative interviews undertaken as part of the current programme of research, particularly among the Western classical cohort. Surprisingly, there is no research accepting or refuting this claim within the evidence base. Sessions (2020) published an opinion piece in which it is claimed that one of the proteins available in milk called Casein releases a chemical called Beta-casomorphine-7 (BCM-7) which is known to cause an excess release of mucous, albeit in the digestive tract, which cannot produce

any noticeable changes to the vocal tract. However, a postulation has been proposed where a complex chemical reaction could possibly cause mucous secretion within the airway in some individuals. However, these are not empirical claims or backed up with research evidence. Moreover, the timeline of the impact of dairy consumption may also be of significance as this can have implications on how it can be managed (e.g., if the impact of dairy consumption is immediate, then singers can be advised to avoid consuming dairy prior to performance). The results of the present study would hopefully encourage more research to ascertain the true impact of dairy consumption of the voice.

The qualitative study indicated that participants negatively linked sleep deprivation with the voice. While there was a statistically significant difference between the groups on average sleep duration which was calculated to be higher among Western classical singers (6.88 hours vs 6.52 hours), the difference may not be practically or clinically relevant. Sleep has been associated with quality of life and overall health outcomes (Gallicchio and Kalesan, 2009). Cho et al (2017) studied the association between dysphonia and sleep duration and concluded that a sleep duration <5 hours (OR = 1.454; 95% CI, 1.153–1.832) or >9 hours (OR = 1.365; 95% CI, 1.017–1.832) was significantly associated with dysphonia when compared to a sleep duration of 7 hours. They also indicated that a sleep duration <5 hours increased the odds of developing long term dysphonia (>3 weeks in duration) by 1.6 fold (OR = 1.574; 95% CI, 1.203–2.247). Bagnall, Dorrian and Fletcher (2011) studied the impact of sleep deprivation on the voice and reported that after 24 hours of sleep deprivation, the voice was reported by the listener judges to be tired, rough and less brilliant. Acoustic analysis also indicated a reduction in fundamental frequency which indicated that inadequate sleep negatively impacted the voice. It is challenging to ascertain the amount of sleep an individual requires to maintain adequate functioning (which includes vocal functioning), the ideal sleep duration is estimated to be between 6-8 hours a day (Cho et al, 2017); therefore, it can be assumed that singers in the present study indicated adequate sleep durations. Similar to hydration, Chapter 7 will examine any associations between sleep and vocal impact in Chapter 7 which will provide substantial evidence.

A few significant differences were observed between the groups. Speaking and singing loudly, singing while unwell, work-related stress and travel were more frequently indicated by Western classical singers whereas using amplification while singing was indicated more by Carnatic singers. A study by Kim et al (2022) suggested that speaking in loud intensities for long durations can increase the risk of developing dysphonia and cause a variety of vocal symptoms such as hoarseness, vocal strain,

breathiness, asthenia etc. Even though there is limited research evidence regarding the impact of singing while unwell, it is logical to assume that it may have a negative impact on the voice. The negative implications of stress on the voice have been discussed in detail in Chapter 2 section 2.4.8.1. The adverse impact of frequent travel has also been outlined in Chapter 4 section 4.5.3.3. Finally, use of amplification has been positively associated with voice use as it leads to reduced intensities and lower pitches which is in line with a more natural pattern of voice production. To summarise, these patterns indicated that Western classical singers could potentially experience a negative impact on their voices due to the differences in the above-mentioned variables. However, as reported in earlier sections, Western classical singers showed significantly lesser levels of vocal impact and less frequent symptoms as reflected in the SVHI and frequency of symptoms' scales. This could indicate that the variables discussed here may not be that critical to affecting vocal impact. Alternatively, these variables may be more relevant when they occur in conjunction with another or a group of variables (e.g., lack of hydration along with loud speaking may be detrimental compared to the impact of each of these variables individually). Further research involving clusters/combinations or interactions of variables could be useful in establishing their collective impact on the voice. Additionally, the correlation and regression analyses discussed in the following chapter will be useful in determining if these variables statistically predict vocal impact and thereby help in ascertaining their impact on vocal health.

6.6.5 Section 4: what are the strategies employed by singers to maintain vocal health?

6.6.5.1 Warm up and cool-down

One of the most recommended strategies to maintain vocal health is warm up/cool down. The present study indicated that significantly more number of Western classical singers regularly practiced vocal warm-up and cool-down compared to Carnatic singers. Ragan (2015) evaluated if there were discernible differences in perceptions as a result of employing cool down exercises. The results revealed that 68% of singers showed improvement in the SVHI scores. However, the amount of improvement was not statistically significant. Similar findings were reported by Elliot, Sundberg and Gramming (1995) where all singers who undertook vocal warm up indicated a subjective improvement in their voices and experienced better timbre, increased ease of singing, particularly at high pitches and more control. This could potentially explain the increased levels of vocal impact experienced by Carnatic singers; however, it is pertinent to examine if there is an association between warm up and cool down and vocal impact which will be discussed in the following chapter (Chapter 7).

A variety of strategies were indicated by the participants to maintain vocal health, of these the most frequently reported were adequate sleep, hydration and regular singing practice. The possible ill-effects of sleep deprivation on the voice have already been discussed in the earlier section; therefore, it was heartening to observe that singers in the current study prioritised the need for adequate sleep to maintain vocal health. Similarly, the importance of hydration on the voice has been discussed in the earlier section Sivasankar and Leydon (2010) performed a systematic review to ascertain the role of systemic (fluid within the body and vocal fold tissue) and superficial (fluid lining in the surface of the vocal folds) hydration on the voice and concluded that inclusion of both systemic and superficial hydration improved the overall health and efficiency of the vocal folds. Steam inhalation, which is one of the most effective methods of achieving superficial hydration (Sivasankar and Leydon, 2010) was also indicated as a frequently used vocal health strategy by a few participants. Mahalingam and Boominathan (2016) studied the effects of steam inhalation on 45 vocally healthy females and reported improvements in acoustic measures such as jitter, shimmer and Harmonic to Noise ratio (HNR). There are no studies examining the effects of regular vocal practice on the voice; however, the anecdotal evidence from the qualitative study is strong and therefore warrants an empirical exploration. Moreover, the correlation and regression analyses undertaken in the current study (described in Chapter 7) will provide important details regarding the impact of vocal warm up and some strategies mentioned in this section on vocal impact.

6.7 CONCLUDING REMARKS

The current chapter described the self-reported voice problems, illness perceptions, coping strategies and variables that are likely to impact the voice. Relevant comparisons were also made between the groups. The next chapter will explore factors that are associated with vocal impact and determine its predictors using correlation and regression analysis. References will be drawn from the current chapter while discussing the correlation and regression results to further explain some of the results of the present chapter (e.g., association of coping strategies such as *Escape avoidance* and *Religious coping* to vocal impact, impact of warm up and cool down on vocal impact etc). Chapter 7 will also include the limitations and strengths of the survey and provide an overall conclusion of the survey.

7 CHAPTER 7- A SURVEY TO EXPLORE SELF-REPORTED VOICE PROBLEMS AND COPING STRATEGIES IN WESTERN CLASSICAL AND CARNATIC SINGERS - RESULTS PART 2

Chapter 6 described the results pertaining to description and comparison of self-reported voice problems, illness perceptions, coping strategies and factors which are likely to impact the voice in Western classical and Carnatic singers. The chapter also outlined the various strategies used by both groups to maintain vocal health.

This chapter will discuss the association/relationship of vocal impact (dependent variable) with other constructs (e.g., vocal symptoms, coping, illness perceptions, demographics etc.). More specifically, the results of survey objectives 4 and 5 will be presented here which are:

4. Examine if there is an association between coping, illness perceptions, demographic, singing medical and lifestyle factors, and vocal impact by carrying out correlation analysis (bivariate analysis)
5. Identify the predictors of vocal impact by carrying out regression analysis (multivariate analysis)

The methods for these objectives have already been discussed in Chapter 5 sections 5.3.5.3 and 5.3.5.4

7.1 Objective 4: Examine if there is an association between illness perceptions, coping, demographic, singing, medical and lifestyle factors and self-reported voice problems by carrying out correlation analysis (Bivariate analysis)

Correlation matrices were generated and examined to establish the relationships between the variables. The results are presented as grey coloured gradients with a darker colour representing stronger positive correlations between variables. Negative correlations are represented as a pink gradient. To indicate the level of significance of correlations, the following key was used:

$P < 0.05$ -denoted as *; $P < 0.01$ -denoted as **; $P < 0.001$ -denoted as ***

The matrices are presented below.

7.1.1 Correlation between SVHI subscales

A moderate to high positive correlation was observed between the subscales (r range=0.46-0.66) and a high correlation was observed between all the SVHI subscales and the SVHI-Overall mean. Among the subscales, the strongest correlations were observed between the *SVHI-Functional* scale and the other

SVHI subscales. The weakest correlation was observed between *SVHI-Vocational* and *SVHI-Physical-Auditory perceptual* subscales. Table 7.1 shows the correlation matrix between the SVHI subscales.

Table 7.1: Correlations between the SVHI subscales (including SVHI-Overall mean)

	SVHI – Overall Mean	SVHI-Physical-Aud Per	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical-Consistency
SVHI-Mean		0.783	0.858	0.802	0.849	0.85
SVHI-Physical Auditory Perceptual	0.783		0.653	0.459	0.614	0.587
SVHI-Functional	0.858	0.653		0.609	0.656	0.672
SVHI-Vocational	0.802	0.459	0.609		0.586	0.62
SVHI-Emotional	0.849	0.614	0.656	0.586		0.627
SVHI-Physical-Consistency	0.85	0.587	0.672	0.62	0.627	
<i>Aud Per=SVHI-Physical Auditory perceptual scale; P<0.05-denoted as *; P<0.01-denoted as **; P<0.001-denoted as ***</i>						

7.1.2 Vocal impact and demographic factors

Among the demographic factors, for categorical variables, each category was operationalised as presence vs non presence of attribute (i.e. white vs non-white ethnicity) to make a binary variable that could be correlated with VHI sub-scales via point-biserial correlations. Within these associations, only ethnicity and nationality showed moderate correlations with the outcomes. A negative correlation was observed between white ethnicity and all subscales of SVHI, with a significant correlation between *SVHI-Physical-Auditory perceptual* and white ethnicity ($r=-0.35$; $p<0.001$). A similar trend was noticed for British nationality and all SVHI subscales with a significant result for *SVHI-Physical-Auditory perceptual* subscale ($r=-0.256$; $p<0.001$). A moderate positive correlation was observed for Asian ethnicity ($r=-0.41$; $p<0.001$) and Indian nationality ($r=-0.31$; $p<0.001$) with *SVHI-Physical-Auditory perceptual subscale*. Table 7.2 depicts the correlation matrix between SVHI and demographics.

Table 7.2: Correlations between vocal impact (SVHI) and demographic factors

	SVHI – Overall mean	SVHI-Physical - Aud Per	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical-Consistency
Age/sex						
Age	-0.072	-0.157*	-0.126	-0.072	-0.006	-0.127
Gender at birth	0.115	0.135	0.080	0.104	0.161*	0.091
Nationality						
USA/Canada	-0.12	-0.142	-0.130	-0.030	-0.089	-0.195
British	-0.047	-0.256***	-0.046	0.023	0.030	0.037
Indian	0.101	0.306***	0.133	0.007	0.015	0.037
Other	0.035	0.034	-0.020	-0.019	0.027	0.107
Ethnicity						
White	-0.132	-0.354***	-0.121	-0.052	-0.060	-0.072
Asian	0.212*	0.405***	0.169*	0.111	0.145	0.102
Other	-0.145	-0.118	-0.091	-0.104	-0.148	-0.057
Relationship Status						
Married	-0.053	-0.093	-0.016	-0.058	0.008	0.028
Widowed/Divorced	0.072	0.140	-0.001	0.057	-0.025	-0.033
Single	0.03	0.012	0.046	0.044	0.045	0.039
Can't say	-0.095	-0.112	-0.053	-0.071	-0.060	-0.087
Education						
College	-0.022	-0.100	-0.013	-0.022	0.032	-0.001
University	-0.017	-0.010	0.016	-0.055	-0.063	0.013
Postgraduate	0.028	0.062	-0.008	0.064	0.043	-0.012
<i>Aud Per=SVHI-Physical Auditory perceptual scale; P<0.05-denoted as *; P<0.01-denoted as **; P<0.001-denoted as ***</i>						

7.1.3 Vocal impact and singing related characteristics

A variety of singing related characteristics were explored of which genre and training showed some noteworthy trends. A moderate positive correlation was observed between genre and *SVHI-Physical-Auditory perceptual scale* ($r=0.42$; $p<0.001$), but not with any other SVHI subscale. A moderate correlation (negative for WC training and positive for Carnatic training) was also observed with the SVHI auditory perception subscale (WC $r=-0.40$; $p<0.001$ and Carnatic $r=0.46$; $p<0.001$). Indian light music genre (one of the secondary genres indicated by Carnatic singers) also showed a moderate positive

correlation ($r=0.330$; $p<0.001$). Table 7.3 reports the correlation matrix between SVHI and singing related characteristics.

Table 7.3: Correlations between vocal impact (SVHI) and singing related characteristics

	SVHI- Overall mean	SVHI- Physical - Aud Per	SVHI- Functional	SVHI- Vocational	SVHI- Emotional	SVHI- Physical- Consistency
Singing genre						
Primary	0.198*	0.418***	0.198*	0.052	0.101	0.102
Jazz	-0.100	-0.149	-0.091	-0.019	-0.100	-0.095
Musical theatre	-0.041	-0.247**	-0.024	0.055	0.028	-0.037
Indian light music	0.214*	0.330***	0.215**	0.160*	0.092	0.146
Contemporary choir	0.011	-0.083	0.026	-0.013	0.016	0.053
Singing level						
Amateur	0.157*	0.185*	0.155*	0.158*	0.154*	0.087
Semi professional	0.068	0.034	0.072	0.088	0.012	0.134
Professional	-0.196*	-0.214**	-0.204**	-0.184*	-0.137	-0.170*
Singing teacher	-0.038	-0.033	0.048	-0.086	-0.015	-0.082
Singing Experience						
Singing Years	-0.116	-0.169	-0.132	-0.137	-0.060	-0.144
Performance Type						
Solo	-0.106	-0.063	-0.011	-0.085	-0.082	-0.115
Group	0.018	-0.048	0.028	-0.014	0.105	-0.016
Duet	-0.130	-0.158*	-0.161*	-0.003	-0.104	-0.108
Training						
WC	-0.215**	-0.402***	-0.231**	-0.114	-0.078	-0.140
Carnatic	0.248**	0.455***	0.255***	0.089	0.161*	0.145
Duration	-0.095	-0.086	-0.021	-0.137	-0.090	-0.067
Singing duration						
Practice-Hours per week	-0.033	0.000	0.030	-0.085	-0.050	-0.026
Performance-Hours per month	-0.166*	-0.172*	-0.033	-0.147	-0.169*	-0.172*
Full/part time	0.031	0.038	-0.001	0.006	0.067	0.079
Part-Time job						
Healthcare	-0.059	-0.104	-0.049	0.053	-0.044	-0.080

	SVHI-Overall mean	SVHI-Physical - Aud Per	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical-Consistency
IT/Software	0.173	0.286**	0.287**	0.084	0.103	0.195
Finance/Banking	0.112	0.156	0.040	0.056	0.094	0.091
Teacher	-0.123	-0.260*	-0.174	-0.098	-0.114	-0.180
Other	-0.013	0.045	-0.023	-0.021	0.024	0.044
<i>Aud Per=SVHI-Physical Auditory perceptual scale; P<0.05-denoted as *; P<0.01-denoted as **; P<0.001-denoted as ***</i>						

7.1.4 Vocal impact and medical factors

Current and past voice problems, diagnosis, onset, duration and progression of voice problems were included under medical conditions. Among the medical factors, current voice problems moderately correlated with all the subscales of SVHI (r range=-0.32 to -0.38; p<0.001) (except SVHI vocational). These correlations were negative because presence of voice problem was coded 0 and absence coded 1. No other notable correlations were observed. Table 7.4 depicts the correlation matrix between SVHI and medical factors.

Table 7.4: Correlations between vocal impact (SVHI) and medical factors

	SVHI-Overall mean	SVHI-Physical - Aud Per	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical-Consistency
Medical condition impacting voice	0.164*	0.191*	0.106	0.200*	0.090	0.147
Surgery impacting voice	-0.028	-0.082	-0.053	-0.081	-0.032	-0.103
COVID-19-impact on voice	0.059	0.023	0.033	0.103	0.013	0.082
Medications impacting voice	0.004	0.033	0.026	0.069	0.013	-0.060
Current VP	-0.364*	-0.336***	-0.376***	-0.262***	-0.363***	-0.319***
Past VP	-0.144	-0.115	-0.205**	-0.121	-0.162*	-0.100
Year of onset of VP	-0.055	0.069	0.014	0.034	-0.128	-0.190
Duration in months	0.216	0.072	0.185	0.156	0.224	0.172
Onset of VP	-0.074	-0.011	-0.016	-0.072	-0.085	-0.119
Diagnosis of VP	0.006	0.115	0.035	0.046	-0.072	0.074
Progression of VP	0.029	0.002	-0.147	0.079	0.063	0.064
<i>Aud Per=SVHI-Physical Auditory perceptual scale; VP=voice problems; P<0.05-denoted as *; P<0.01-denoted as **; P<0.001-denoted as ***</i>						

7.1.5 Vocal impact and vocal symptoms

A positive correlation was expected between vocal impact and vocal symptoms which was observed across the matrix. Generally, there were moderate positive correlations between the SVHI subscales and frequency of symptoms subscales (r range=0.30-0.62) except between *SVHI Vocational* scale and *Auditory perceptual inadequacies* symptom scale ($r=0.27$; $p<0.001$) and *SVHI Emotional* scale and *Acoustic inadequacies* symptom scale ($r=0.28$; $p<0.001$) which only showed weak correlations.

All the frequency of symptoms subscales showed moderate to strong correlations with the mean SVHI (r range=0.45-0.62). The weakest correlation was between the *SVHI Vocational subscale* and the symptom subscales (r range=0.27-0.31). Among the symptoms subscales the *Vocal performance problems* subscale showed the strongest correlation with all the SVHI subscales (r range=0.37-0.62). The strongest correlation was between the *Vocal performance problems* subscale and *SVHI-Overall mean* ($r=0.62$; $p<0.001$) and weakest between *Auditory perceptual inadequacies* symptom scale and *SVHI Vocational* subscale ($r=0.27$; $p<0.001$). Table 7.5 shows the correlation matrix between SVHI and frequency of symptoms.

Table 7.5: Correlations between vocal impact (SVHI) and vocal symptoms (Frequency of symptoms scale)

	SVHI- Overall mean	SVHI- Physical-Aud Per	SVHI- Functional	SVHI- Vocational	SVHI- Emotional	SVHI- Physical- Consistency
Vocal discomfort	0.460***	0.464***	0.333***	0.300***	0.415***	0.373***
Auditory perceptual inadequacies	0.483***	0.476***	0.386***	0.267***	0.388***	0.470***
Vocal performance problems	0.620***	0.497***	0.443***	0.370***	0.539***	0.563***
Acoustic inadequacies	0.448***	0.453***	0.328***	0.315***	0.284***	0.432***
<i>Aud Per=SVHI-Physical Auditory perceptual scale; P<0.05-denoted as *; P<0.01-denoted as **; P<0.001-denoted as ***</i>						

7.1.6 Vocal impact and illness perceptions

Positive correlations were expected between impact, timeline, symptoms, and concern and emotion (IPQ items 1, 2, 5, 6, 8) and vocal impact. Similarly, negative correlations were anticipated between control over the voice problem, treatment control and coherence (IPQ items 3, 4 and 7).

As expected, control experienced by participants over their voice problem (IPQ item 3) showed a moderate negative correlation with all the subscales of SVHI and *SVHI-Overall mean*. Moderate correlations were also observed between most of the SVHI subscales (and *SVHI-Overall mean*) and impact of voice problem, experiencing symptoms and concern over voice problem (IPQ variables 1, 5 and 6). Strongest correlations were observed between the IPQ variables and SVHI mean. Perceptions pertaining to treatment benefit (IPQ item 4) showed weakest correlations with all SVHI subscales. Table 7.6 depicts the correlation matrix between SVHI and IPQ.

Table 7.6: Correlations between vocal impact (SVHI) and Illness Perception (IPQ items)

	SVHI-Overall mean	SVHI-Physical-Aud Per	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical-Consistency
IPQ 1-Impact	0.481***	0.285***	0.346***	0.449***	0.461***	0.376***
IPQ 2-Timeline	0.428***	0.313***	0.368***	0.345***	0.340***	0.333***
IPQ 3-Control	-0.387***	-0.347***	-0.325***	-0.303***	-0.331***	-0.365***
IPQ 4-Treatment Control	-0.080	-0.080	-0.029	-0.027	-0.062	-0.143
IPQ 5-Symptoms	0.440***	0.344***	0.342***	0.342***	0.355***	0.423***
IPQ 6-Concern	0.448***	0.345***	0.414***	0.367***	0.341***	0.374***
IPQ 7-Coherence	-0.136	-0.145	-0.087	-0.122	-0.122	-0.091
IPQ 8-Emotion	0.372***	0.252**	0.255**	0.350***	0.350***	0.295***
<i>Aud Per=SVHI-Physical Auditory perceptual scale; P<0.05-denoted as *; P<0.01-denoted as **; P<0.001-denoted as ***</i>						

7.1.7 Vocal impact and coping

Among the VDCQ subscales, *Escape Avoidance* correlated the most with all SVHI subscales (r range=0.37-0.53) and information seeking correlated the least (r range=0.00-0.16). Highest correlations were observed between the VDCQ subscales and SVHI mean (r range=0.11-0.53) and the SVHI vocational subscales (r range=0.17-0.51). The subscales which correlated the most were VDCQ *Escape Avoidance* and SVHI mean ($r=0.53$; $p<0.001$) whereas *SVHI-Physical-Auditory perceptual* and VDCQ *information seeking* ($r=0.00$; $p=0.99$) showed no correlation. Table 7.7 depicts the correlation matrix between SVHI and VDCQ

Table 7.7: Correlations between vocal impact (SVHI) and coping (VDCQ)

	SVHI-Overall mean	SVHI-Physical - Aud Per	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical-Consistency
Social support	0.185*	0.163*	0.111	0.170*	0.144	0.220**
Keep to self	0.367***	0.193*	0.241**	0.377***	0.347***	0.253**
Positive reappraisal	0.330***	0.290***	0.339***	0.311***	0.230**	0.314***
Escape Avoidance	0.529***	0.405***	0.370***	0.513***	0.409***	0.374***
Distancing	0.388***	0.412*	0.332***	0.238**	0.352***	0.294***
Info seeking	0.106	0.000	0.107	0.166*	0.111	0.061
Tension reduction	0.239***	0.255***	0.146***	0.288***	0.217**	0.181*
VDCQ S8-Religion	0.224*	.393***	.262**	.115	.135	.146
<i>Aud Per=SVHI-Physical Auditory perceptual scale; P<0.05-denoted as *; P<0.01-denoted as **; P<0.001-denoted as ***</i>						

7.1.8 Vocal impact and lifestyle factors

None of the lifestyle factors showed moderate or strong correlations with vocal impact. Clenching of teeth/jaw while singing showed the largest correlations (r range=0.14 to 0.28) with the SVHI subscales. Table 7.8 depicts the correlation matrix between SVHI and lifestyle factors.

Table 7.8: Correlations between vocal impact (SVHI) and lifestyle factors

	SVHI-Overall mean	SVHI-Physical - Aud Per	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical-Consistency
Speak/sing loudly	0.064	0.070	-0.019	0.025	0.067	0.019
Sing or speak excessively	0.008	-0.008	-0.011	0.104	-0.041	0.023
Throat clearing	0.180*	0.186*	0.125	0.114	0.105	0.074
Singing when unwell	0.102	0.119	0.095	0.100	0.087	0.124
Jaw/teeth clenching while singing	0.249*	0.154**	0.247***	0.279***	0.280**	0.138
Use amplification while singing	0.050	0.161*	0.091	0.021	-0.003	0.037
Travel	-0.205	-0.219	-0.153	-0.102	-0.207	-0.176
Consume alcohol	0.062	0.029	0.103	0.015	0.055	0.094
Consume caffeine	0.005	0.017	0.050	-0.068	-0.039	0.026

	SVHI- Overall mean	SVHI- Physical - Aud Per	SVHI- Functional	SVHI- Vocational	SVHI- Emotional	SVHI- Physical- Consistency
Consume tobacco	0.079	0.100	0.061	0.058	0.018	0.018
Consume spicy foods	-0.052	0.028	-0.054	-0.130	-0.046	0.005
Consume oily foods	-0.074	-0.067	-0.053	-0.070	-0.046	-0.114
Consume cold or refrigerated foods	-0.103	-0.080	-0.104	-0.105	-0.102	-0.070
Consume dairy	0.113	0.101	0.056	0.049	0.035	0.173*
Physical exercise	0.082	0.016	0.119	0.101	0.042	0.077
Healthy body weight	0.003	0.092	-0.026	-0.001	-0.023	-0.048
Water consumption	-0.075	-0.149	-0.037	0.058	-0.052	-0.030
Sip water regularly	0.128	0.108	0.040	0.055	0.121	0.115
Work related stress	0.029	-0.022	0.004	0.063	0.092	0.047
Expectation from employers	-0.132	-0.201*	-0.129	-0.086	-0.061	-0.067
Financial factors	0.079	-0.037	0.012	0.158*	0.123	0.066
Fears regarding future work	-0.073	-0.210*	-0.092	0.012	0.005	-0.012
Presence of vocal problems	0.272*	0.112	0.179*	0.252*	0.293*	0.259*
Lack of rest	0.058	0.022	0.000	0.068	0.066	0.074
Expectation of others	0.139	0.067	0.079	0.100	0.147	0.160*
Poor Acoustics	0.067	0.049	0.043	0.048	0.059	0.072
Refuse Work	0.135	0.021	0.030	0.153*	0.165*	0.167*
Personal Commitments	0.052	-0.070	-0.026	0.100	0.098	0.101
Competition	0.115	-0.005	0.087	0.105	0.126	0.157*
Lack of Fairness	-0.017	-0.089	0.005	0.048	0.013	-0.024
<i>Aud Per=SVHI-Physical Auditory perceptual scale; P<0.05-denoted as *; P<0.01-denoted as **; P<0.001-denoted as ***</i>						

7.1.9 Vocal impact and singing related factors

Among the three singing related factors, performance anxiety and positive attitude towards singing voice moderately correlated with the SVHI mean and SVHI emotional subscales. As expected, performance anxiety correlated positively (r range=0.21 to 0.38) whereas positive attitude correlated negatively (r range=-0.23 to -0.46) with SVHI. The highest correlation was observed between positive

attitude and SVHI Emotional ($r=-0.46$; $p<0.001$). Table 7.9 depicts the correlation matrix between SVHI and singing related factors.

Table 7.9: Correlations between vocal impact (SVHI) and singing related factors

	SVHI- Overall mean	SVHI- Physical - Aud Per	SVHI- Functional	SVHI- Vocational	SVHI- Emotional	SVHI- Physical- Consistency
Performance anxiety	0.356***	0.280***	0.284***	0.211**	0.384***	0.253**
Positive attitude towards voice/singing	-0.386***	-0.233**	-0.376***	-0.276***	-0.463***	-0.339***
Opinion about own voice	-0.246*	-0.178*	-0.268***	-0.227**	-0.281***	-0.27***
Regular warm up and cool-down	-0.137	-0.130	-0.041	0.017	-0.059	-0.166*
<i>Aud Per=SVHI-Physical Auditory perceptual scale; $P<0.05$-denoted as *; $P<0.01$-denoted as **; $P<0.001$-denoted as ***</i>						

7.1.10 Vocal impact and other variables

The relationship between self-attributes used by singers to describe their voices and beliefs and perceptions pertaining to factors influencing voice problems were also analysed with SVHI subscales. No notable correlations were found. The correlation matrices are provided in Appendix 7.1

7.1.11 Summary of variables which correlated with vocal impact

Table 7.10 indicates the variables (arranged by construct) which moderately (and significantly) correlated with the SVHI outcomes. The variables in the green and blue boxes positively and negatively correlated with vocal impact respectively. All the variables that moderately or strongly correlated with the outcomes were carried forward for inclusion in regression analyses.

Table 7.10: List of variables which moderately/strongly correlated with SVHI outcomes

Constructs	SVHI-Overall mean	SVHI-Physical- Aud perceptual	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical- Consistency
Demographics		Nationality- Indian ↑				
		Ethnicity- White ↑				
		Ethnicity- Asian ↑				
Singing related characteristics		Primary singing genre ↑				
		Other genres- Indian light music ↑				
		Training-WC ↑				
		Training- Carnatic ↑				
Medical factors	Current voice problems ↑	Current voice problems ↑	Current voice problems ↑			Current voice problems ↑
Freq of symptoms	Throat discomfort ↑	Throat discomfort ↑	Throat discomfort ↑	Throat discomfort ↑		Throat discomfort ↑
	Auditory perceptual inadequacies ↑	Auditory perceptual inadequacies ↑	Auditory perceptual inadequacies ↑	Vocal performance problems ↑		Auditory perceptual inadequacies ↑
	Vocal performance problems ↑	Vocal performance problems ↑	Vocal performance problems ↑	Acoustic inadequacies symptoms ↑		Vocal performance problems ↑
	Acoustic inadequacies symptoms	Acoustic inadequacies symptoms ↑	Acoustic inadequacies symptoms ↑			Acoustic inadequacies symptoms ↑

Constructs	SVHI-Overall mean	SVHI-Physical-Aud perceptual	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical-Consistency
IPQ	IPQ 1-Impact ↑		IPQ 1-Impact ↑	IPQ 1-Impact ↑	IPQ 1-Impact ↑	IPQ 1-Impact ↑
	IPQ 2-Timeline ↑	IPQ 2-Timeline ↑	IPQ 2-Timeline ↑	IPQ 2-Timeline ↑	IPQ 2-Timeline ↑	IPQ 2-Timeline ↑
	IPQ 3-Control ↓	IPQ 3-Control ↓	IPQ 3-Control ↓	IPQ 3-Control ↓	IPQ 3-Control ↓	IPQ 3-Control ↓
	IPQ 5-Symptoms ↑	IPQ 5-Symptoms ↑	IPQ 5-Symptoms ↑	IPQ 5-Symptoms ↑	IPQ 5-Symptoms ↑	IPQ 5-Symptoms ↑
	IPQ 6-Concern ↑	IPQ 6-Concern ↑	IPQ 6-Concern ↑	IPQ 6-Concern ↑	IPQ 6-Concern ↑	IPQ 6-Concern ↑
	IPQ 8-Emotion ↑			IPQ 8-Emotion ↑	IPQ 8-Emotion ↑	
Coping	Keep to self ↑	Escape Avoidance ↑	Positive reappraisal ↑	Keep to self ↑	Keep to self ↑	Positive reappraisal ↑
	Positive reappraisal ↑	Distancing ↑	Escape Avoidance ↑	Positive reappraisal ↑	Escape Avoidance ↑	Escape Avoidance ↑
	Escape Avoidance ↑	VDCQ S8-Religion ↑	Distancing ↑	Escape Avoidance ↑	Distancing ↑	
	Distancing ↑					
Singing related factors	Performance anxiety ↑				Performance anxiety ↑	
	Positive attitude towards voice and singing ↓		Positive attitude towards voice and singing ↓		Positive attitude towards voice and singing ↓	Positive attitude towards voice and singing ↓
Total predictors	17	18	14	12	15	13
Aud Per=SVHI-Physical Auditory perceptual scale; Variables in green boxes showed strong correlations with vocal impact subscales and variables in blue boxes showed moderate correlations. Direction of relationship is indicated using ↑ and ↓ arrows denoting a positive and negative correlation respectively						

7.2 Objective 5: Identify the predictors of vocal impact by carrying out regression analysis (multivariate analysis)

7.2.1 Stepwise regression for outcomes which did not meet the required case to variable ratio

A recalculation of the required case to variable ratio was carried out as the initial calculation provided in Chapter 5 section 5.3.5.1 was based on a total sample size of 171 which was not achieved (total n for the survey was 165). Following recalculation using G*Power (Faul et al, 2009), it was estimated that for a sample size of 165, multiple regression ($\alpha = 0.05$, power = 90%, medium effect size $f^2=0.15$) can be carried out with 14 predictors. Of the six outcome variables three (*SVHI-Overall mean*, *SVHI Physical-Auditory Perceptual* and *SVHI-Emotional*) did not meet the required case to variable ratio. Therefore, stepwise regression analysis was carried out to further reduce the number of predictor variables for these outcomes and selecting the 'best' predictors from each category (the regressions were carried out separately for each category). The basic assumptions of multicollinearity, normality, linearity, homoscedasticity and independence of residuals were met. There were no significant outliers; therefore, no transformations were made to any of the variables. Three variables (ethnicity, nationality and other singing genres) were dummy coded to create unique categories; no collapsing of groups was carried out during this process.

The stepwise regression analysis results are outlined in Table 7.11. After performing stepwise regression, the number of predictors for the three outcome variables were in line with the required case to variable ratio (number of predictors; *SVHI-Overall mean*=12, *SVHI-Physical-Auditory Perceptual*=10, *SVHI-Emotional*=10).

Table 7.11: Results of the stepwise regression highlighting the significant predictors for the three outcome measures

	SVHI-Overall mean				SVHI-Emotional				SVHI-Physical-Auditory Perceptual			
	Unstd. B	Std. Err	t	Sig.	Unstd. B	Std. Err	t	Sig.	Unstd. B	Std. Err	t	Sig.
SINGING RELATED DETAILS												
(Constant)									0.76	.075	10.07	<0.001
Training-Carnatic									0.64	0.10	6.52	<.001
FREQUENCY OF SYMPTOMS												
Constant	-27.14	6.13	-4.43	<0.001	-0.92	0.24	-3.77	<.001	-0.69	0.19	-3.54	<0.001
Auditory perceptual problems	11.03	3.29	3.35	<.001	0.34	0.14	2.47	0.02	0.40	0.11	3.79	<.001
Vocal performance problems	17.83	2.82	6.33	<.001	0.69	0.11	6.26	<.001	0.32	0.09	3.53	<.001
Acoustic inadequacies	6.85	2.72	2.52	0.01					0.29	0.09	3.29	<.001
COPING-VDCQ												
Constant	.29	.09	3.01	0.003	0.13	0.14	0.95	0.34	0.27	0.10	2.65	0.009
Keep to self	.230	.045	5.10	<.001	0.16	0.05	3.21	<.001				
Escape-Avoidance	.147	.049	3.03	.003	0.22	0.06	3.51	<.001	0.23	.05	4.16	<.001
Distancing	.101	.034	2.93	.004	0.19	0.07	2.80	0.01	0.19	.06	3.25	.002
VDCQ S8 (Religion)									0.07	.03	2.44	.016
ILLNESS PERCEPTIONS (IPQ)												
Constant	1.09	.14	7.56	<.001	.465	.105	4.44	<0.001	1.254	.168	7.447	<0.001

	SVHI-Overall mean				SVHI-Emotional				SVHI-Physical-Auditory Perceptual			
	Unstd. B	Std. Err	t	Sig.	Unstd. B	Std. Err	t	Sig.	Unstd. B	Std. Err	t	Sig.
IPQ 1-Impact	.079	.020	3.84	<.001	0.15	0.02	6.31	<.001				
IPQ 3-Control	-.088	.017	-5.18	<.001	- 0.10	0.02	- 4.05	<.001	- 0.08	0.02	- 4.25	<.001
IPQ 5-Symptoms									0.07	0.03	2.19	0.03
IPQ 6-Concern	.053	.018	2.94	0.004					0.04	0.02	1.99	0.05
MEDICAL FACTORS												
Current Voice problems	- 15.95	3.64	- 4.38	<.001	- 0.59	0.14	- 4.30	<.001	- 0.43	0.11	- 3.94	<.001
SINGING RELATED FACTORS												
Constant	50.96	9.29	5.49	<0.001	1.71	0.36	4.73	<0.001				
Performance anxiety	7.29	1.98	3.68	<.001	0.28	0.07	3.98	<.001				
Positive attitude towards voice	- 7.20	1.69	- 4.26	<.001	- 0.30	0.06	- 4.71	<.001				
Total number of predictors	12				10				10			
Table 7.11: Unstd B=Unstandardised B, Std.Err=Standard error, Sig=significance												

7.2.2 Hierarchical regression analysis

At the end of correlation analysis and stepwise regression (for the three variables as described in the earlier section), the variables as outlined in Table 7.12 were entered into a hierarchical regression model.

Table 7.12: List of variables entered in the hierarchical regression model for each SVHI outcome

Constructs	SVHI-mean	SVHI-Physical-Aud perceptual	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical-Consistency
Freq of symptoms	Auditory perceptual inadequacies	Auditory perceptual inadequacies	Throat discomfort symptoms	Throat discomfort symptoms	Auditory perceptual inadequacies	Throat discomfort symptoms
	Vocal performance problems	Vocal performance problems	Auditory perceptual inadequacies	Vocal performance problems	Vocal performance problems	Auditory perceptual inadequacies
	Acoustic inadequacies symptoms	Acoustic inadequacies symptoms	Vocal performance problems	Acoustic inadequacies symptoms		Vocal performance problems
			Acoustic inadequacies symptoms			Acoustic inadequacies symptoms
Coping	Keep to self	Escape Avoidance	Positive reappraisal	Keep to self	Keep to self	Positive reappraisal
	Escape Avoidance	Distancing	Escape Avoidance	Positive reappraisal	Escape Avoidance	Escape Avoidance
	Distancing	VDCQ S8-Religion	Distancing	Escape Avoidance	Distancing	
IPQ	IPQ 1-Impact	IPQ 3-Control	IPQ 1-Impact	IPQ 1-Impact	IPQ 1-Impact	IPQ 1-Impact
	IPQ 3-Control	IPQ 5-Symptoms	IPQ 2-Timeline	IPQ 2-Timeline	IPQ 3-Control	IPQ 2-Timeline
	IPQ 6-Concern	IPQ 6-Concern	IPQ 3-Control	IPQ 3-Control		IPQ 3-Control
			IPQ 5-Symptoms	IPQ 5-Symptoms		IPQ 5-Symptoms
			IPQ 6-Concern	IPQ 6-Concern		IPQ 6-Concern
				IPQ 8-Emotion		
Singing related characteristics		Training-Carnatic				

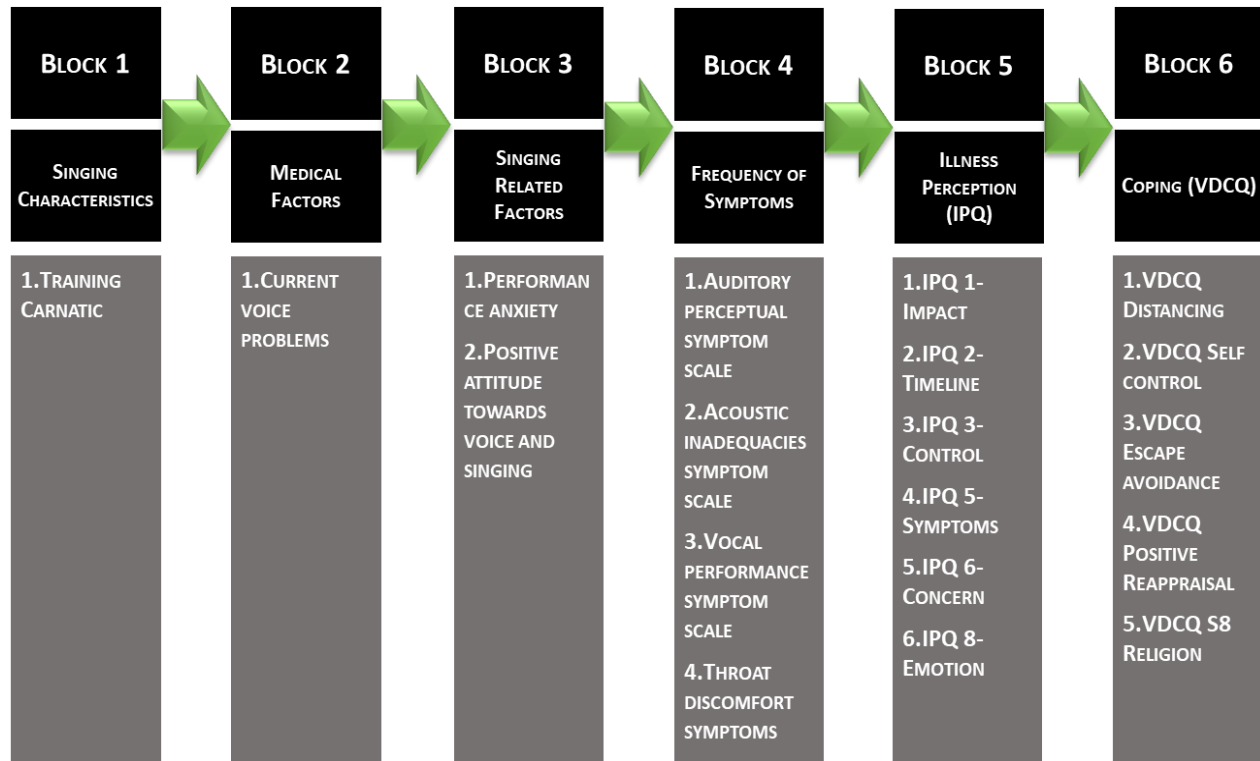
Constructs	SVHI-mean	SVHI-Physical-Aud perceptual	SVHI-Functional	SVHI-Vocational	SVHI-Emotional	SVHI-Physical-Consistency
Medical factors	Current voice problems	Current voice problems	Current voice problems		Current voice problems	Current voice problems
Singing related factors	Performance anxiety				Performance anxiety	
	Positive attitude towards voice and singing		Positive attitude towards voice and singing		Positive attitude towards voice and singing	Positive attitude towards voice and singing
Total predictors	12	11	14	12	10	13

The predictor variables were entered into 6 hierarchical regression models to identify which of these variables predicted the SVHI subscales/outcomes. The model was run separately for each of the six SVHI outcomes (different number of predictors as above). Assumptions for hierarchical regression were met and the case to variable ratio was acceptable for all outcomes (<14 variables). Associated figures are presented in Appendix 7.2.

The order of entry of variable was driven by theory and the framework adopted for the current programme of research which was the Common-Sense Model (CSM) (refer to section 1.12.1 Fig 1.3). Accordingly, demographics and singing characteristics were added first. Following this, the factors (identified through systematic reviews and the qualitative study) that are likely to impact the voice were added. The CSM proposes that symptoms cause illness perceptions which leads to coping choices; the variables were therefore entered in the same order. A summary of the order in which the blocks were entered is indicated below and presented in Figure 7.1 (also includes details of specific variables per block):

1. Singing characteristics; 2. Medical factors; 3. Singing related factors; 4. Frequency of symptoms;
5. Illness perceptions (IPQ); 6. Coping (VDCQ).

Fig 7.1 Order of blocks entered in the regression model – with details of specific variables per block



7.2.2.1 Results for outcome variable 1: SVHI- Overall mean

For *SVHI-Overall mean* variable, five blocks with a total of 12 predictor variables were entered. Table 7.13 provides a summary of the regression model. The first block included medical factors with one predictor (current voice problems) having a statistically significant R^2 change of 15.8% ($p < 0.001$).

Next, singing related factors were added which included two predictors (positive attitude towards voice); a significant R^2 change of 14.3% ($p < 0.001$) was reported. The frequency of symptoms' subscales were added next (Block 3) which included *Acoustic inadequacies symptoms subscale*, *Auditory perceptual inadequacies subscale* and *Vocal performance problems symptoms subscale*. Results indicated that the R^2 change was 24.1% which was also statistically significant ($p < 0.001$). Block 4 (IPQ) which included 3 predictors, namely *IPQ 1-Impact*, *IPQ 3-Control* and *IPQ 6-Concern* also revealed a statistically significant R^2 change of 10% ($p < 0.001$). The final block was coping which included three predictors (*Distancing*, *Keep to self* and *Escape Avoidance*); however, the R^2 change was not significant for this block.

Table 7.13: Regression model summary of SVHI-Overall Mean

Model	Adj R ²	R ² Change	F Change	df1	df2	Sig. F Change	D-W
Medical	0.153	0.158	30.602	1	163	<0.001	1.991
Singing related	0.288	0.143	16.406	2	161	<0.001	
Symptoms	0.524	0.241	27.623	3	158	<0.001	
Illness Perceptions	0.620	0.100	14.319	3	155	<0.001	
Coping	0.630	0.016	2.366	3	152	0.073	
Table 7.13: Adj R ² =Adjusted R ² ; df=Degrees of freedom; D-W=Durbin-Watson							

Analysis of regression coefficients table (Table 7.14) indicated that six variables uniquely and significantly contributed to the variance of *SVHI-Overall mean*. These (arranged from largest to smallest β values) were *Vocal performance problems* subscale ($\beta=0.23$; $p<0.001$), *IPQ 3-Control* ($\beta=-0.19$; $p<0.001$), *Auditory perceptual inadequacies* subscale ($\beta=0.18$; $p<0.001$), positive attitude towards voice ($\beta=-0.15$; $p=0.007$), *IPQ 1-Impact* ($\beta=0.13$; $p=0.048$) and current voice problems ($\beta=-0.11$; $p=0.045$). *IPQ 3-Control* and positive attitude towards voice reduced the *SVHI- Overall mean* scores whereas the other variables increased the *SVHI- Overall Mean* scores.

Table 7.14: Regression coefficients of the predictor variables of SVHI- Overall Mean

Model	Predictors	B	SE	Beta	t	Sig.	CI lower	CI upper
	(Constant)	0.30	0.28		1.09	0.278	-0.25	0.86
Medical	Current voice problems	-0.15	0.07	-0.109	-2.02	0.045	-0.30	0.00
Singing related	Performance anxiety	0.05	0.04	0.064	1.22	0.226	-0.03	0.13
	Positive attitude towards voice	-0.09	0.03	-0.145	-2.73	0.007	-0.16	-0.03
Symptoms	Acoustic inadequacies symptoms subscale	0.12	0.07	0.104	1.82	0.070	-0.01	0.25
	Auditory perceptual inadequacies subscale	0.25	0.08	0.176	3.08	0.002	0.09	0.40
	Vocal performance symptom subscale	0.26	0.07	0.230	3.70	< 0.001	0.12	0.40
Illness Perception	IPQ 1- Impact	0.04	0.02	0.132	1.99	0.048	0.00	0.07
	IPQ 3- Control	-0.05	0.01	-0.186	-3.67	< 0.001	-0.08	-0.02
	IPQ 6-Concern	0.02	0.01	0.079	1.27	0.205	-0.01	0.05
Coping	VDCQ Distancing	0.05	0.04	0.072	1.33	0.186	-0.02	0.13
	VDCQ Keep to self	0.04	0.03	0.080	1.54	0.125	-0.01	0.09
	VDCQ Escape avoidance	0.05	0.04	0.083	1.27	0.206	-0.03	0.14
SE=Standard error; CI=95% confidence interval								

7.2.2.2 Results for outcome variable 2: SVHI-Physical-Auditory perceptual

Five blocks with a total of 11 predictor variables were entered for *SVHI-Physical-Auditory perceptual* subscale. Table 7.15 provides a summary of the regression model. The first block was singing related characteristics with one predictor (Training-Carnatic) entered into the model. A significant R^2 change of 24.1% ($p<0.001$) was indicated. Next, medical factors with one predictor (current voice problems) was entered which revealed a significant R^2 change of 8.1% ($p<0.001$). The frequency of symptoms' subscales were added next (Block 3) which included *Acoustic inadequacies* symptoms subscale, *Auditory perceptual inadequacies* symptoms subscale and *Vocal performance problems* symptoms subscale. Results indicated that the R^2 change was 31.3% which was statistically significant ($p<0.001$). Block 4 (IPQ) which included 3 predictors, namely *IPQ 3-Control*, *IPQ 5-Symptoms* and *IPQ 6-Concern* also revealed a statistically significant R^2 change of 5.5% ($p<0.001$). The final block was coping which included three predictors (*Distancing*, *Escape Avoidance* and religion); the R^2 change which was 6.3% was statistically significant ($p<0.001$) for this model.

Table 7.15: Regression model summary of SVHI-Physical-Auditory perceptual

Model	Adj R ²	R ² Change	F Change	df1	df2	Sig. F Change	D-W
Singing related	0.234	0.241	37.382	1	118	<0.001	1.840
Medical	0.310	0.081	13.984	1	117	<0.001	
Symptoms	0.619	0.313	32.584	3	114	<0.001	
Illness Perception	0.667	0.055	6.558	3	111	<0.001	
Coping	0.727	0.063	9.086	2	108	<0.001	
Table 7.15: Adj R ² =Adjusted R ² ; df=Degrees of freedom; D-W=Durbin-Watson							

Analysis of regression coefficients table (Table 7.16) indicated that eight variables uniquely and significantly contributed to the variance of *SVHI-Physical-Auditory perceptual*. These (arranged from largest to smallest β values) were *Vocal performance problems* subscale ($\beta=0.27$; $p=0.011$), training-Carnatic ($\beta=0.19$; $p<0.001$), VDCQ 8 Religious coping ($\beta=0.18$; $p=0.001$), *IPQ 3-Control* ($\beta=-0.18$; $p=0.001$), *Auditory perceptual inadequacies* subscale ($\beta=0.17$; $p=0.006$), *Acoustic inadequacies* symptoms scale ($\beta=0.16$; $p=0.008$), *IPQ 5-Symptoms* ($\beta=0.15$; $p=0.004$) and VDCQ *Distancing* ($\beta=0.15$; $p=0.018$). Except *IPQ 3-Control*, all other variables increased *SVHI-Physical-Auditory perceptual* scores.

Table 7.16: Regression coefficients of the predictor variables of SVHI-Physical-Auditory Perceptual

Model	Predictors	B	SE	Beta	t	sig	CI (Lower)	CI (Upper)
	(Constant)	-0.70	0.25		-2.82	0.006	-1.19	-0.21
Singing related	Training-Carnatic	0.25	0.07	0.19	3.41	<0.001	0.11	0.40
Medical	Current voice problems	-0.03	0.08	-0.02	-0.34	0.735	-0.18	0.13
Symptoms	Vocal performance symptom subscale	0.34	0.08	0.27	4.18	<0.001	0.18	0.50
	Auditory perceptual inadequacies subscale	0.26	0.10	0.17	2.78	0.006	0.08	0.45
	Acoustic inadequacies symptoms subscale	0.21	0.08	0.16	2.72	0.008	0.06	0.36
Illness perception	IPQ 3- Control	-0.04	0.01	-0.18	-3.42	0.001	-0.07	-0.02
	IPQ 5- Symptoms	0.05	0.02	0.15	2.05	0.043	0.00	0.09
	IPQ 6- Concern	-0.01	0.02	-0.03	-0.34	0.737	-0.04	0.03
Coping	VDCQ Escape avoidance	0.02	0.05	0.03	0.42	0.672	-0.08	0.12
	VDCQ Distancing	0.10	0.04	0.15	2.40	0.018	0.02	0.19
	VDCQ 8 Religion (single item)	0.08	0.02	0.18	3.37	0.001	0.03	0.12
SE=Standard error; CI=95% confidence interval								

7.2.2.3 Results for outcome variable 3: SVHI-Functional

Five blocks with a total of 14 predictor variables were entered for *SVHI-Functional*. Table 7.17 provides a summary of the regression model. The first block included medical factors with one predictor (current voice problems) which revealed a statistically significant R^2 change of 14.1% ($p<0.001$). Next, singing related factors were added which included one predictor (positive attitude towards voice); a significant R^2 change of 8.7% ($p<0.001$) was reported. The frequency of symptoms' subscales were added next (Block 3) which included *Throat discomfort* symptoms scale, *Acoustic inadequacies* symptoms subscale, *Auditory perceptual inadequacies* symptoms subscale and *Vocal performance problems* symptoms subscale. Results indicated that the R^2 change was 14.4% which was also statistically significant ($p<0.001$). Block 4 (IPQ) which included five predictors, namely *IPQ 1-Impact*, *IPQ 2-Timeline*, *IPQ 3-Control*, *IPQ 5-Symptoms* and *IPQ 6-Concern* also revealed a statistically significant R^2 change of 6.5%

($p < 0.001$). The final block was coping which included three predictors (*Distancing*, positive reappraisal and *Escape Avoidance*) where the R^2 change was significant (R^2 change=3.5%; $p = 0.022$).

Table 7.17: Regression model summary of SVHI-Functional

Model	Adj R ²	R ² Change	F Change	df1	df2	Sig. F Change	D-W
Medical	0.136	0.141	26.856	1	163	<0.001	2.029
Singing related	0.219	0.087	18.317	1	162	<0.001	
Symptoms	0.349	0.144	9.045	4	158	<0.001	
Illness perception	0.397	0.065	3.548	5	153	0.005	
Coping	0.423	0.035	3.292	3	150	0.022	
Table 7.17: Adj R ² =Adjusted R ² ; df=Degrees of freedom; D-W=Durbin-Watson							

Analysis of regression coefficients table (Table 7.18) indicated that six variables uniquely and significantly contributed to the variance of *SVHI-Functional*. These (arranged from largest to smallest β values) were VDCQ-positive reappraisal ($\beta = 0.20$; $p = 0.005$), positive attitude towards voice ($\beta = -0.19$; $p = 0.005$), *Vocal performance problems* symptoms subscale ($\beta = 0.18$; $p = 0.035$), *Auditory perceptual inadequacies* symptoms subscale ($\beta = 0.16$; $p = 0.033$), *IPQ 3-Control* ($\beta = -0.15$; $p = 0.021$) and current voice problems ($\beta = -0.15$; $p = 0.035$). Except *IPQ 3-Control* and positive attitude towards voice, all other variables increased the *SVHI-Functional* scores.

Table 7.18: Regression coefficients of the predictor variables of SVHI-Functional

Model	Predictors	B	SE	Beta	t	Sig.	CI lower	CI upper
	(Constant)	0.669	0.37		1.803	0.073	-0.064	1.401
Medical	Current voice problems	-0.218	0.10	-0.145	-2.133	0.035	-0.421	-0.016
Singing related	Positive attitude towards voice	-0.134	0.05	-0.187	-2.849	0.005	-0.227	-0.041
Symptoms	Auditory perceptual inadequacies subscale	0.249	0.12	0.163	2.150	0.033	0.02	0.478
	Vocal performance symptom subscale	0.217	0.10	0.175	2.127	0.035	0.015	0.419
	Throat discomfort symptoms subscale	-0.031	0.10	-0.024	-0.306	0.760	-0.233	0.171
	Acoustic inadequacies symptoms subscale	0.087	0.09	0.069	0.964	0.336	-0.091	0.266
Illness perception	IPQ 6-Concern	0.039	0.02	0.151	1.788	0.076	-0.004	0.082
	IPQ 3- Control	-0.045	0.02	-0.153	-2.336	0.021	-0.082	-0.007

Model	Predictors	B	SE	Beta	t	Sig.	CI lower	CI upper
	IPQ 2- Timeline	-0.001	0.02	-0.006	-0.075	0.940	-0.038	0.035
	IPQ 1- Impact	0.004	0.03	0.015	0.172	0.864	-0.045	0.054
	IPQ 5- Symptoms	0.009	0.03	0.025	0.286	0.775	-0.052	0.069
Coping	VDCQ Positive reappraisal	0.119	0.04	0.195	2.818	0.005	0.036	0.203
	VDCQ Escape avoidance	-0.017	0.06	-0.025	-0.300	0.765	-0.132	0.097
	VDCQ Distancing	0.027	0.05	0.036	0.514	0.608	-0.077	0.131
SE=Standard error; CI=95% confidence interval								

7.2.2.4 Results for outcome variable 4: SVHI-Vocational

Three blocks with a total of 12 predictor variables were entered for *SVHI-Vocational*. Table 7.19 provides a summary of the regression model. Block 1 (frequency of symptoms' subscales) were added first which included *Acoustic inadequacies* symptoms subscale, *Throat discomfort* symptoms subscale and *Vocal performance problems* symptoms subscale. Results indicated that the R^2 change was 15.1% which was statistically significant ($p<0.001$). Block 2 (IPQ) which included six predictors namely *IPQ 1-Impact*, *IPQ 2-Timeline*, *IPQ 3-Control*, *IPQ 5-Symptoms*, *IPQ 6-Concern* and *IPQ 8-Emotional* also revealed a statistically significant R^2 change of 18.8% ($p<0.001$). The final block was coping which included three predictors (*Distancing*, *Keep to self* and positive reappraisal) where the R^2 change of 7.3% was statistically significant ($p<0.001$).

Table 7.19: Regression model summary of SVHI-Vocational

Model	Adj R ²	R ² Change	F Change	df1	df2	Sig. F Change	D-W
Symptoms	0.141	0.151	14.409	2	162	<0.001	1.977
Illness Perception	0.305	0.188	7.407	6	156	<0.001	
Coping	0.370	0.073	6.306	3	153	<0.001	
Table 7.19: Adj R ² =Adjusted R ² ; df=Degrees of freedom; D-W=Durbin-Watson							

Analysis of regression coefficients table (Table 7.20) indicated that only three variables uniquely and significantly contributed to the variance of *SVHI-Vocational*. These (arranged from largest to smallest β values) were VDCQ-Escape Avoidance ($\beta=0.24$; $p=0.007$), *IPQ 3-Control* ($\beta=-0.18$; $p=0.010$) and VDCQ-Keep to self ($\beta=0.17$; $p=0.017$). Of these, the VDCQ items increased the *SVHI-Vocational* scores, whereas *IPQ 3-Control* decreased the scores.

Table 7.20: Regression coefficients of the predictor variables of SVHI-Vocational

Model	Predictors	B	SE	Beta	t	sig	CI lower	CI upper
	(Constant)	-0.166	0.29		-0.573	0.568	-0.737	0.406
Symptoms	Vocal performance symptom subscale	0.135	0.12	0.091	1.122	0.264	-0.103	0.372
	Throat discomfort symptoms subscale	0.160	0.12	0.105	1.357	0.177	-0.073	0.394
Illness perception	IPQ 3- Control	-0.062	0.02	-0.177	-2.605	0.010	-0.108	-0.015
	IPQ 1- Impact	0.043	0.03	0.122	1.327	0.187	-0.021	0.106
	IPQ 2- Timeline	0.004	0.02	0.012	0.161	0.872	-0.042	0.049
	IPQ 5- Symptoms	0.005	0.04	0.012	0.131	0.896	-0.07	0.08
	IPQ 6-Concern	0.002	0.03	0.005	0.059	0.953	-0.053	0.057
	IPQ 8-Emotion	0.018	0.03	0.061	0.716	0.475	-0.032	0.069
Coping	VDCQ-Escape Avoidance	0.196	0.07	0.238	2.748	0.007	0.055	0.337
	VDCQ Keep to self	0.111	0.05	0.168	2.423	0.017	0.021	0.202
	VDCQ-Positive reappraisal	0.051	0.05	0.070	0.994	0.322	-0.051	0.153
SE=Standard error; CI=95% confidence interval								

7.2.2.5 Results for outcome variable 5: SVHI-Emotional

Five blocks with a total of 10 predictor variables were entered for *SVHI-Emotional*. Table 7.21 provides a summary of the regression model. The first block included medical factors with one predictor (current voice problems) which revealed a statistically significant R^2 change of 13.2% ($p < 0.001$). Next, singing related factors were added which included two predictors (Performance anxiety and attitude towards voice); a significant R^2 change of 20.1% ($p < 0.001$) was reported. The frequency of symptoms' subscales were added next (Block 3) which included *Acoustic inadequacies* symptoms subscale and *Vocal performance problems* symptoms subscale. Results indicated that the R^2 change was 15.3% which was also statistically significant ($p < 0.001$). Block 4 (IPQ) which included two predictors, namely *IPQ 1-Impact* and *IPQ 3-Control* also revealed a statistically significant R^2 change of 7.4% ($p < 0.001$). The final block was coping which included three predictors (*Distancing*, *Keep to self* and *Escape Avoidance*); however, the R^2 change was not significant.

Table 7.21: Regression model summary of SVHI-Emotional

Model	Adj R ²	R ² Change	F Change	df1	df2	Sig. F Change	D-W
Medical	0.127	0.132	24.815	1	163	<0.001	1.893
Singing related	0.321	0.201	24.329	2	161	<0.001	
Symptoms	0.470	0.153	23.657	2	159	<0.001	
Illness perception	0.541	0.074	13.215	2	157	<0.001	
Coping	0.548	0.015	1.870	3	154	0.137	
Table 7.21: Adj R ² =Adjusted R ² ; df=Degrees of freedom; D-W=Durbin-Watson							

Analysis of regression coefficients table (Table 7.22) indicated that five variables uniquely and significantly contributed to the variance of *SVHI-Emotional*. These (arranged from largest to smallest β values) were *Vocal performance problems* subscale ($\beta=0.29$; $p<0.001$), *IPQ 1-Impact* ($\beta=0.24$; $p<0.001$), positive attitude towards voice ($\beta=-0.23$; $p<0.001$), performance anxiety ($\beta=0.12$; $p=0.040$) and *IPQ 3-Control* ($\beta=-0.11$; $p=0.048$).). Except *IPQ 3-Control* and positive attitude towards voice, all other variables increased the *SVHI-Emotional* scores.

Table 7.22: Regression coefficients of the predictor variables of SVHI-Emotional

Model		B	SE	Beta	t	sig	CI lower	CI upper
	(Constant)	0.42	0.41		1.042	0.299	-0.38	1.23
Medical	Current voice problems	-0.18	0.11	-0.099	-1.706	0.090	-0.39	0.03
Singing related	Performance anxiety	0.12	0.06	0.120	2.075	0.040	0.01	0.24
	Positive attitude towards voice	-0.20	0.05	-0.226	-3.880	<0.001	-0.30	-0.10
Symptoms	Acoustic inadequacies symptoms subscale	0.19	0.11	0.101	1.660	0.099	-0.04	0.41
	Vocal performance symptom subscale	0.43	0.10	0.285	4.350	<0.001	0.24	0.63
Illness perception	IPQ 3- Control	-0.04	0.02	-0.112	-1.992	0.048	-0.08	0.00
	IPQ 1- Impact	0.09	0.02	0.243	3.593	<0.001	0.04	0.13
Coping	VDCQ Distancing	0.08	0.05	0.083	1.405	0.162	-0.03	0.19
	VDCQ Escape avoidance	-0.03	0.06	-0.041	-0.584	0.560	-0.15	0.08
	VDCQ Keep to self	0.07	0.04	0.103	1.801	0.074	-0.01	0.15
SE=Standard error; CI=95% confidence interval								

7.2.2.6 Results for outcome variable 6: SVHI Physical-Consistency

For SVHI Physical-Consistency five blocks with a total of 13 predictor variables were entered. Table 7.23 provides a summary of the regression model. The first block included medical factors with one predictor (current voice problems) which revealed a statistically significant R^2 change of 10.2% ($p<0.001$). Next, singing related factors were added which included one predictor (positive attitude towards voice); a significant R^2 change of 7.4% ($p<0.001$) was reported. The frequency of symptoms' subscales were added next (Block 3) which included *Throat discomfort* symptoms subscale, *Acoustic inadequacies* symptoms subscale, *Auditory perceptual inadequacies* symptoms subscale and *Vocal performance problems* symptoms subscale. Results indicated that the R^2 change was 28.7% which was also statistically significant ($p<0.001$). Block 4 (IPQ) which included five predictors, namely *IPQ 1-Impact*, *IPQ 2-Timeline*, *IPQ 3-Control*, *IPQ 5-Symptoms* and *IPQ 6-Concern* also revealed a statistically significant R^2 change of 9.1% ($p<0.001$). The final block was coping which included two predictors (positive reappraisal and *Escape Avoidance*); a statistically significant R^2 change was indicated (R^2 change=3.3%; $p=0.003$).

Table 7.23: Regression model summary of SVHI Physical-Consistency

Model	Adj R ²	R Square Change	F Change	df1	df2	Sig. Change	D-W
Medical	0.096	0.102	18.424	1	163	<0.001	2.004
Singing related	0.165	0.074	14.437	1	162	<0.001	
Symptoms	0.441	0.287	21.028	4	158	<0.001	
Illness perception	0.520	0.091	6.192	5	153	<0.001	
Coping	0.550	0.033	6.021	2	151	0.003	
Table 7.23: Adj R ² =Adjusted R ² ; df=Degrees of freedom; D-W=Durbin-Watson							

Analysis of regression coefficients table (Table 7.24) indicated that seven variables uniquely and significantly contributed to the variance of SVHI-Physical-Consistency. These (arranged from largest to smallest β values) were *Vocal performance problems* symptoms subscale ($\beta=0.33$; $p<0.001$), *IPQ 5-Symptoms* ($\beta=0.24$; $p=0.002$), *IPQ 3-Control* ($\beta=-0.22$; $p=0.021$), VDCQ-positive reappraisal ($\beta=0.20$; $p=0.001$) *Auditory perceptual inadequacies* symptoms subscale ($\beta=0.20$; $p=0.003$), *Acoustic inadequacies* symptoms scale ($\beta=0.17$; $p=0.007$) and positive attitude towards voice ($\beta=-0.15$; $p=0.012$).

Except *IPQ 3-Control* and positive attitude towards voice, all other variables increased the *SVHI-Physical-Consistency* scores.

Table 7.24: Regression coefficients of the predictor variables of SVHI Physical-Consistency

Model	Predictors	Unstd B	SE	Beta	t	sig.	CI lower	CI upper
	(Constant)	0.306	0.372		0.823	0.412	-0.429	1.042
Medical	Current voice problems	-0.096	0.103	-0.056	-0.931	0.353	-0.299	0.107
Singing related	Positive attitude towards voice	-0.121	0.048	-0.148	-2.546	0.012	-0.215	-0.027
Symptoms	Vocal performance symptom subscale	0.463	0.103	0.325	4.482	<0.001	0.259	0.667
	Auditory perceptual inadequacies subscale	0.353	0.117	0.202	3.004	0.003	0.121	0.585
	Acoustic inadequacies symptoms subscale	0.248	0.091	0.172	2.714	0.007	0.068	0.429
	Throat discomfort symptoms subscale	-0.154	0.103	-0.105	-1.493	0.138	-0.358	0.05
Illness perception	IPQ 3- Control	-0.073	0.019	-0.219	-3.797	<0.001	-0.111	-0.035
	IPQ 5- Symptoms	0.097	0.031	0.239	3.145	0.002	0.036	0.158
	IPQ 1- Impact	0.028	0.025	0.082	1.087	0.279	-0.023	0.078
	IPQ 2- Timeline	-0.034	0.019	-0.118	-1.788	0.076	-0.071	0.004
	IPQ 6-Concern	-0.001	0.022	-0.003	-0.039	0.969	-0.044	0.043
Coping	VDCQ Positive reappraisal	0.143	0.041	0.204	3.456	0.001	0.061	0.225
	VDCQ Escape avoidance	-0.066	0.058	-0.083	-1.138	0.257	-0.18	0.049
SE=Standard error; CI=95% confidence interval								

7.2.2.7 Summary of regression analysis

The predictors of the six outcomes (SVHI overall mean and subscales) were identified using hierarchical regression analysis. Overall, 14 unique predictors were identified. Table 7.25 provides an outline of the variables that significantly and uniquely predicted each outcome. The table also indicates the direction of effect of each variable in predicting the outcomes using arrows (↑ indicates increase in outcomes and ↓ indicates reduction in outcomes). The total number of significant and unique predictors for each outcome is also depicted in Table 7.25 which indicates that *SVHI-Physical-Auditory perceptual* had the

largest number of unique predictors (eight predictors) followed by *SVHI-Physical-Consistency* with seven predictors, *SVHI-Functional* and *SVHI-Overall mean* with six predictors each, and finally *SVHI-Emotional* with five predictors. The outcome with the least number of predictors was *SVHI-Vocational* with only three unique and significant predictors.

The block that accounted for the largest R^2 change in four SVHI outcomes (*SVHI-Overall mean*, *SVHI-Physical-Auditory perceptual*, *SVHI-Functional* and *SVHI-Physical-Consistency*) was (frequency of) symptoms. Illness perception and Singing characteristics showed the largest R^2 change in one outcome each (*SVHI-Vocational* and *SVHI-Emotional* respectively). The variable that accounted for the greatest amount of variance in four SVHI outcomes (*SVHI-Overall mean*, *SVHI-Physical-Auditory perceptual*, *SVHI-Emotional* and *SVHI-Physical-Consistency*) was *Vocal performance problems* symptoms' scale. *VDCQ-Escape Avoidance* and *VDCQ-Positive Reappraisal* accounted for the greatest amount of variance in one outcome each (*SVHI-Vocational* and *SVHI-Functional* respectively).

A few trends can be noted by analysing the results across outcomes which is summarised here based on the hierarchy of blocks (blocks 1-6). *SVHI-Physical-Auditory perceptual* was the only outcome which was significantly predicted by a singing related demographic/block 1 (Training-Carnatic). Among medical factors (block 2) current voice problems predicted higher vocal impact of two outcomes (*SVHI-Overall mean* and *SVHI-Functional*). Among singing related factors (block 3), positive attitude towards voice predicted lower vocal impact of four outcomes (*SVHI- Overall mean*, *SVHI-Functional*, *SVHI-Emotional* and *SVHI-Physical-Consistency*) and performance anxiety predicted higher vocal impact of only one outcome (*SVHI-Emotional*). Among the frequency of symptoms' subscales (block 4), *Vocal performance problems* symptoms scale predicted five outcomes (all except *SVHI-Vocational*), *Auditory perceptual inadequacies* symptoms scale predicted four outcomes (*SVHI- Overall mean*, *SVHI-Physical Auditory perceptual*, *SVHI Functional* and *SVHI Consistency*) and *Acoustic inadequacies* symptoms scale significantly predicted higher vocal impact in two outcomes (*SVHI-Physical Auditory perceptual* and *SVHI Consistency*). Of the six IPQ variables (block 5) included in the regression equations, *IPQ 3-Control* predicted lower vocal impact in all the outcomes whereas *IPQ 1-Impact* and *IPQ-Symptoms* predicted higher vocal impact of two outcomes each; (*SVHI- Overall mean* and *SVHI Emotional*) and (*SVHI-Physical-Auditory perceptual* and *SVHI-Physical-Consistency*) respectively. Three VDCQ scales and one single item (religious coping) were included in the coping "block"/block 6 across the regression

equations and all four predicted higher vocal impact; Positive reappraisal for two outcomes (*SVHI-Functional* and *SVHI-Physical-Consistency*), *Distancing*, *Keep to self* and religious coping for one outcome each (*SVHI-Physical-Auditory perceptual*, *SVHI-Vocational* and *SVHI-Physical-Auditory perceptual* respectively). Of all the variables that predicted SVHI outcomes, *IPQ 3-Control* and positive attitude towards voice reduced the SVHI subscale scores; all other variables increased the SVHI subscale scores.

Table 7.25: Variables that significantly predicted the SVHI outcomes and direction of effect.

Block	SVHI-mean		SVHI-Physical- Auditory-Perceptual		SVHI-Functional		SVHI-Vocational	SVHI-emotional	SVHI-Physical- Consistency		
Singing characteristics			Training-Carnatic	↑							
Medical factors	Current voice problems	↑			Current voice problems	↑					
Singing related factors	Positive attitude towards voice	↓			Positive attitude towards voice	↓		Positive attitude towards voice	↓	Positive attitude towards voice	↓
								Performance anxiety	↑		
Frequency of symptoms	Auditory-perceptual subscale	↑	Auditory-perceptual subscale	↑	Auditory-perceptual subscale	↑				Auditory-perceptual subscale	↑
	Vocal performance symptom scale	↑	Vocal performance symptom scale	↑	Vocal performance symptom scale	↑		Vocal performance symptom scale	↑	Vocal performance symptom scale	↑
			Acoustic inadequacies	↑						Acoustic inadequacies	↑
Illness perception	IPQ 1- Impact	↑	IPQ 5- Symptoms	↑				IPQ 1- Impact	↑	IPQ 5- symptoms	↑
	IPQ 3- Control	↓	IPQ 3- Control	↓	IPQ 3- Control	↓	IPQ 3- Control	↓	IPQ 3- Control	↓	IPQ 3- Control
Coping			VDCQ Distancing	↑	VDCQ positive reappraisal	↑	VDCQ Keep to self	↑		VDCQ positive reappraisal	↑
			VDCQ Religious coping	↑			VDCQ escape-avoidance	↑			
Total no of predictors	6		8		6		3	5	7		
Direction of relationship is indicated using ↑ (and red boxes) and ↓ (green boxes) arrows denoting an increase and decrease in outcomes respectively											

7.3 DISCUSSION

A thorough exploration of factors associated with and predicting vocal impact was carried out in this study. Fourteen significant and unique predictors were identified which predicted vocal impact (SVHI subscales). The validity of the methodology employed for regression analysis and the implications of the study results (impact of predictors on vocal impact) will be discussed in this section. Following this, the strengths and limitations of the evidence presented in this survey (Chapters 6 and 7) will be examined. Finally, a few concluding remarks and future directions related to the survey will be presented.

7.3.1 Examination of methodological considerations for regression analysis

The robustness of multiple regression methods to identify the association between a number of predictors and an outcome variable is well documented (Tabachnick and Fidell, 2001); therefore, its use in this study is validated. Correlation was first carried out as a screening step to identify the potential factors to be included in the regression analysis. An additional screening step using stepwise regression was carried out for outcomes that did not meet the required case to variable ratio. This multi-level screening ensured the case to variable ratio in final multivariate regressions. Given the fact that all the pre-requisite assumptions of multiple regression were met (multicollinearity, homoscedasticity, case to variable ratio, linearity etc.) the results of the regression analyses carried out and presented in this chapter can be deemed acceptable.

Hierarchical regression was chosen because of its ability to evaluate the contributions of the predictors above and beyond the predictors entered previously (Pallant, 2020). Therefore, the effect of a predictor variable, after controlling for the effects of the other variables can be calculated by analysing the adjusted R^2 (Lewis, 2007), which was the method used for the present study. In simple terms, the unique proportion of variance of each predictor block could be calculated which gave a clear estimate of the “predictive value” of each block. The coefficients then provided details pertaining to the specific predictor variables within each block. Richardson et al (2015) reported that hierarchical regression provides estimates with better precision when there are multiple outcomes which was the case in the present study. Therefore, the choice hierarchical regression for the purpose of this study is justified.

It must be reiterated that the order in which the blocks were entered into the hierarchical equation was informed by the theoretical framework which was developed based on a valid and highly

researched model, namely the common-sense model (Leventhal et al, 1980). One issue with using this framework for hierarchical regression was that the construct “symptoms” appears twice in the CSM- once at the beginning of the symptom-illness perception-coping chain and also at the end of the chain (by way of appraisal) forming a loop. Therefore, a decision had to be made to decide where symptoms must be fitted in. Since the present study was cross-sectional, it was placed at the beginning of the chain, before illness perceptions. Leventhal’s Common-Sense model is a widely used theoretical framework (Leventhal et al, 2016) which fits in all the components of the present study; therefore, use of this model to guide the order of entry of the variables into the regression model can be validated.

The following sections will first provide a brief discussion of the bivariate analyses followed by the interpretation of multivariate analyses (as applicable).

7.3.2 Demographic variables and vocal impact

None of the demographic factors correlated with vocal impact following bivariate analysis and were therefore not entered in the regression equation. This indicates that age, sex, education and other factors did not have a significant association with vocal impact within the sample of this study. The systematic review results reported in Chapter 3 reported that only one study (Avila et al, 2010) reported a higher impact score among women and younger singers while three studies (Achey et al, 2016; Devadas et al, 2018 and Loiola-Barreiro et al, 2016) reported no significant differences pertaining to demographics. The current results are therefore in agreement with the balance of the past literature.

7.3.3 Singing related characteristics and vocal impact

Of the singing related characteristics, following bivariate analysis, four variables (primary singing genre, training-Western classical, training-Carnatic and other genres-Indian light music) showed moderate/strong correlations with only one outcome which was *SVHI-Physical-Auditory perceptual* scale. However, at the end of multivariate analysis, only Carnatic training significantly predicted the outcome. This is not a straightforward result to interpret as this may not essentially indicate that Carnatic training increases *SVHI-Physical-Auditory perceptual* scores; the duration of training was not a predictor of vocal impact (this would also be an expected result if training impacted *SVHI-Physical-Auditory perceptual*). It could simply indicate the increased vulnerability of Carnatic singers to experience vocal impact pertaining to *SVHI-Physical-Auditory perceptual* scale which was already established with the significantly increased SVHI and symptoms scores. In other words, training could

be a “proxy” result with the primary genre being responsible for influencing vocal impact. This argument is further strengthened by a very strong correlation ($r=0.916$, $p<0.001$) between Carnatic training and primary singing genre. Higher scores were also reported for all SVHI outcomes among Carnatic singers compared to Western classical singers as outlined in Chapter 6, which further strengthens the implication of this result to indicate higher vulnerability among Carnatic singers. The results in Chapter 6 section 6.4.1.2 also indicated that the subscale which showed the most significant difference between the groups (in terms of t scores and p values) was also *SVHI-Physical-Auditory perceptual*. A reason for this subscale to be most impacted by genre could be related to the items included in it which are mainly physical vocal symptoms. Carnatic singers have scored higher in all the subscales of the frequency of symptoms’ measure. This could indicate that higher perception of physical symptoms is evident among Carnatic singers which possibly explains the isolated impact of genre on only the *SVHI-Physical-Auditory Perceptual* scale.

There is conflicting evidence related to the impact of genre on vocal health. Phyland et al (1999) studied the self-reported voice problems in terms of impairment, disability and impact in three groups of singers-classical, musical theatre and contemporary singers and concluded that there were no significant differences between the three singing styles for all domains. However, Moreti et al (2012) compared vocal impact between classical singers and popular singers and concluded that classical singers showed greater levels of vocal impact. The present study may be indicative of a possible association between genre and voice quality symptoms (as the *SVHI-Physical Auditory perceptual* subscale predominantly includes items related to voice quality) and lays a foundation to better understand the nature of this association with further research. The possibility of Carnatic training impacting vocal impact should however not be completely ruled out as this has serious implications regarding vocal health of singers performing in this genre. This is because training is an inevitable entity of Carnatic singing as it is challenging to perform in this genre without formal training. The current study did not explore training related aspects in depth; therefore, further research is required to identify any vocal practices or cultural factors which may not be conducive to vocal health. In other words, it needs to be ascertained if certain aspects of Carnatic singing training leads to higher vocal impact or if this form of singing leads to developing a voice that may be susceptible to vocal impact.

7.3.4 Medical factors and vocal impact

Among the medical factors, only presence of current voice problems correlated with all SVHI outcomes except SVHI vocational following bivariate analysis. At the end of multivariate analysis, this variable also predicted SVH-mean and *SVHI-Functional*. This is an expected result as SVHI is a measure which was specifically designed to measure vocal dysfunction from a functional, psychological and physiological perspective (Phyland et al, 2012). This also validates the appropriateness of using SVHI as the outcome measure for the current study as it is an indirect estimate of construct validity. Importantly, it also indicates that the subscales of SVHI developed in the current study measure different constructs as current voice problems did not predict all the subscales. Morsomme (2007) also reported similar results using the VHI in a study involving 192 classical singers. Specifically, they reported a statistically significant result between singers and non-singers on the functional ($p=0.013$) and the SVHI total score ($p=0.006$). While the current study used SVHI, the results can be comparable as the subscales were generated by mapping the items and the subscales of the VHI.

7.3.5 Lifestyle factors and vocal impact

Among lifestyle factors none of the variables showed moderate correlations with vocal impact after bivariate analysis; therefore, they were not included in the regression analysis. The lifestyle factors included in the current study and the trends observed among the groups have already been discussed in Chapter 6. Evidence pertaining to lifestyle factors among classical singers indicate that this group of singers report reasonably healthy lifestyles compared to other singing groups (Dassie-Leite et al, 2011) and the general population (Mathmann et al, 2021). This could be because classical singers have a more disciplined approach and are heavily dependent on their voices professionally. This may discourage them from indulging in poor vocal habits or practices such as smoking, consuming large amounts of alcohol etc. When asked about strategies used by the singers to maintain vocal health (objective 3 of the survey, section 6.3.4.6 and qualitative study-section 4.4.2.6.1.2), many singers indicated practicing good lifestyle behaviours such as getting adequate sleep, hydration etc. Therefore, classical singers, as a cohort (Western classical and Carnatic singers) may not frequently exhibit unhealthy lifestyle practices which may explain the finding pertaining to this block.

7.3.6 Singing related factors and vocal impact

Among the singing related factors, bivariate analysis showed moderate correlations with two variables which were positive attitude towards voice and performance anxiety-both variables uniquely and significantly predicted SVHI outcomes at the end of multivariate analysis. Positive attitude towards voice and singing significantly predicted all SVHI outcomes except *SVHI-Physical-Auditory perceptual* and *SVHI-Vocational*. This is a unique finding as attitude towards the voice has not been frequently studied and reported in voice research. Kato et al (2015) reported that attitude is a bi-product of affect; positive affect has been demonstrated to have long term health benefits. It is unclear if lack of voice problems influence the development of a positive attitude towards one's own voice or vice versa. A positive attitude is likely to reflect in the attitude that singers might undertake towards voice use and ultimately vocal health as they would embrace their voice/vocal qualities as it is (with its advantages and shortcomings). When a singer encounters a voice problem, if the voice, particularly the singing voice is viewed positively, it is likely that they would undertake a more favourable approach to both embrace and alleviate the problem (e.g., a singer may have a reduced pitch range due to age related changes, but a positive outlook towards their current vocal abilities is likely to encourage the singer to select repertoire which suits her current vocal abilities rather than stretching them to suit her earlier repertoire). Further investigation is warranted to determine how rehabilitation and maintenance of vocal health can be influenced by instilling a positive attitude among singers.

The other variable in this block was performance anxiety which predicted the *SVHI-Emotional* subscale. Performance anxiety or Music Performance Anxiety (MPA) is defined as anxiety or apprehension experienced by a performer related to musical performance and is characterised by affective, cognitive, somatic and behavioural symptoms (Kenny, 2010). MPA can manifest before or during a performance (van Kemenade et al, 1995) and is characterised by physical symptoms such as tachycardia, sweaty palms, cardiac irregularities, tremors, hypertension, dry mouth etc. (Brantigan et al, 1982), emotional symptoms such as panic and stress and cognitive symptoms such as self-doubt or expectation of failure which may lead to avoidance behaviours (Fernholz, 2019). Given the psychological overlay in the manifestation of performance anxiety and its impact on emotion, the result obtained in this study is arguably justified. Beta-blockers or Cognitive Behavioural Therapy (CBT) are normally prescribed to singers who suffer from high levels of performance anxiety (Fernholz, 2019). Brantigan et al (1982) reported that beta blockers successfully eliminated the physical symptoms associated with

performance anxiety such as dry mouth. A systematic review by Fernholz et al (2019) which looked at the effectiveness of performance anxiety management reported that CBT provided beneficial results; however, they recommended more studies to be undertaken with adequate control groups and better methodological rigour. Another significant point is that the specificity of this result to the *SVHI-Emotional* subscale further supports the use of subscales while administering SVHI and emphasises the need to consider the different components of impact separately, rather than analysing them as a single construct (by calculating the SVHI total score).

While regular warm-ups are recommended by health care professionals and singing teachers alike, this study did not find a significant association between regular warm-ups and vocal health. Only a weak negative correlation was observed with all the SVHI subscales during bivariate analysis. De Fatta and Sataloff (2012) provided some interesting insights on warmup and cool-down strategies and how it may influence vocal health. They indicated that the current evidence base does not clearly define the value of these exercises. Also, while most of the studies indicate favourable results pertaining to self-perception, it is seldom backed by objective evidence. For instance, Motel et al studied the effect of warm ups on sopranos and concluded that the phonation threshold pressure actually increased following vocal warm up, making singing more effortful. However, De Fatta and Sataloff (2012) also indicated that none of the studies showed measurable adverse effects as a result of warm ups or cool downs and concluded that until scientific studies prove otherwise, singers should continue to warm up and cool down, based on anecdotal observations of experienced vocal pedagogues.

7.3.7 Vocal symptoms and vocal impact

All four subscales of the frequency of symptoms' scale showed moderate/strong correlations with vocal impact during bivariate analysis; of these, only the *Throat discomfort* subscale did not predict vocal impact. This could mean that despite the physical discomfort experienced by singers, it does not influence the physical emotional, vocational or functional consequences of a voice problem. Another possibility is that the discomfort symptoms are perhaps too mild or transient to impact the SVHI scores compared to problems in voice quality or *Vocal performance problems* which are more obvious deficits and therefore making a significant impact on the SVHI outcomes. Phyland et al (2012) indicated that tools like the SVHI and VHI may not be sensitive to detect the small and transient physical changes often reported by singers. Moreover, these symptoms may occur along a temporal continuum where the

discomfort symptoms occur early on and then lead on to problems in voice quality or developing performance related symptoms (this may not always be the case as there may be a variety of causes of voice problems in singers that progress differently (e.g., vocal haemorrhage with a sudden onset), but this may be a frequent pattern). This should not be misconstrued to imply that discomfort symptoms do not influence vocal health. In fact, one of the most common symptoms indicated by the singers in this study was vocal fatigue, which is included under the discomfort scale. This could further strengthen the temporal angle described earlier whereby vocal fatigue could be a “cause” for other symptoms along the continuum, such as problems in voice quality etc. Therefore, these symptoms should still be considered with seriousness during assessment and management irrespective of the fact that they did not predict the SVHI outcomes. Future research could focus on exploring the temporal aspect by selecting participants based on the duration of onset of voice problems and controlling or measuring the impact of the trajectory of development of the voice problem.

It was surprising to note that none of the frequency of symptom subscales significantly predicted the vocational subscale. This indicates that frequency of symptoms, in general, do not have a major influence on vocational aspects among singers. The only voice-related outcome measure which has a vocational subscale is the Voice Activity and Participation profile (VAPP) developed by Ma and Yiu (2001). While there are no studies conducted on singers which used the VAPP, a few studies have been done on teachers. A study by Yu et al (2019) indicated that teachers with voice problems scored significantly higher scores in the vocational subscale indicating that vocal symptoms had a vocational impact among teachers. It is possible that the vocational subscale is more impacted by severity of the voice problem rather than frequency; low level concerns occurring frequently can be ‘lived with’ whereas severe vocal problems even if infrequent need to be dealt with due to their increased impact on vocation. Along similar lines, it is also likely that singers are more astute to perceive very mild deviations in their voices (Phylard et al, 2014) which may not be currently severe enough to disrupt their vocation. Due to high percentages of missing values in items pertaining to severity, they were not considered in the present survey. More studies exploring the relationship of severity with all the subscales will be a beneficial addition to the evidence base.

In the previous chapter, a possible relationship between vocal fatigue and other symptoms such as reduced pitch range, increased laryngeal tension and discomfort was proposed (section 6.6.2.3). To verify this within the dataset of the current survey, a correlation analysis was carried out between vocal

fatigue and the rest of the symptoms (these results are presented here and not under the main results section as description of vocal fatigue is not one of the aims of the present study). Results indicated strong correlations between vocal fatigue and throat discomfort symptoms such as pain, throat tightness and also with the Frequency of symptoms' subscale *Throat discomfort* symptoms ($r=0.625$; $p<0.001$). A moderate correlation was observed between vocal fatigue and difficulty reaching higher pitches ($r=0.45$; $p<0.001$). However, it must be mentioned that vocal fatigue showed moderate and strong correlations with 21/27 symptoms and was the symptom that showed the largest number of strong correlations among the symptoms (6/27). This could indicate a possible association of vocal fatigue with a variety of symptoms and warrants further investigation to fully understand the nature of relationship and direction of effect (does vocal fatigue lead to development of these symptoms or vice versa?).

7.3.8 Illness perceptions and vocal impact

Among the illness perception variables, six variables showed moderate/strong correlations after bivariate analysis. Of which three variables were indicated to be predictors of vocal impact after multivariate analysis; the predictors were *IPQ 3-Control*, *IQ 1-Impact* and *IPQ 5-Symptoms*. Among the predictors, *IPQ 3-Control* predicted all the outcomes. It was interesting to note that control indicated an inverse relationship with the outcome variables, indicating that the more control the individuals felt they possessed over their voice problem, the less impact they reported. Similar results were reported by Misono et al (2015) where they established an inverse relationship ($r = -0.30$; $P < 0.0001$) between vocal impact (measured using VHI-10) and perceived control (measured using Perceived Control over Stressful events Scale developed by Frazier et al, 2011) in 533 patients with voice disorders. Control is a generic term that indicates how much ability one perceives to have to influence their outcomes and is generally associated with better health outcomes (Lachman et al, 2011). Robinson and Lachman (2017) indicated that control is a construct that can be modified through interventions. Therefore, SLTs can tailor their sessions to provide a sense of autonomy and independence to singers visiting a voice clinic (e.g., provide adequate knowledge about a vocal condition, suggest appropriate methods to self-assess their voices, equip them with a variety of tools and provide indications on when to use them etc.) which increases personal control and subsequently vocal health. Another construct closely related to control is self-efficacy which relates to belief in one's own ability to organize and execute actions to result in desired outcomes (Bandura, 1997) and therefore is an important predictor of illness. Research

has pointed towards a close relationship between the two constructs (Tavousi et al, 2009). More research on how control (and self-efficacy) would influence voice treatment outcomes would provide useful insights to voice clinicians and is therefore recommended.

IPQ 1-Impact refers to the level of impact experienced by singers due to their voice problem. Results suggested that higher levels of impact experienced by singers predicted higher levels of overall vocal impact (total SVHI) and the emotional subscale. This result is logical since SVHI predominantly measures the impact of voice problems in singers using a handicap construct.

IPQ 5-Symptoms positively predicted *SVHI-Physical-Consistency*. This indicates that singers who experienced more symptoms reported higher vocal impact within the *SVHI-Physical-Consistency* domain. This is also to be expected as SVHI consistency includes physical vocal symptoms; therefore, the association is highly plausible and explainable.

Use of IPQ is uncommon in voice and there is limited research evidence. As discussed in this section, regression analysis indicated that illness perception significantly predicted vocal impact. This makes it an important tool to consider while carrying out voice assessments in the clinic. Moreover, assessing illness perceptions along with coping provides a full picture of how adaptive or maladaptive a singer's coping assessment might be. It also re-emphasises the breadth of assessments required to comprehensively assess the singing voice and not confine its scope to only physical impairments or impact. More research is indicated to investigate direction of effect more thoroughly using qualitative methodologies or longitudinal studies which can investigate both directional and temporal aspects that influence the impact of illness perception as a construct.

7.3.9 Coping and vocal impact

The final block included coping items and bivariate analysis indicated that *Keep to self*, Positive reappraisal, *Escape Avoidance* and *Distancing* showed moderate correlations with SVHI outcomes. Multivariate analysis determined that *Escape Avoidance*, *Keep to self*, positive reappraisal and religion were predictors of vocal impact. The impact of *Escape Avoidance* on health outcomes and specifically the voice has already been discussed in section 6.6.3.4 of Chapter 6. This strategy was a predictor of *SVHI-Vocational* and *SVHI-SVHI-Physical-Auditory perceptual*. This is also a logical association as singers who use *Escape Avoidance* (e.g., cancelling singing performances, restricting the repertoire due to restricted range, avoiding social situations where voice problems may be apparent

etc.) are likely to experience increased levels of vocational impact. With respect to *SVHI-Physical Auditory perceptual* subscale which mainly includes physical symptoms, singers perhaps resort to *Escape Avoidance* as it completely eliminates exposure (Sege, 2018) to the unpleasant experience they are having during voicing; however, given the negative implications of utilising this strategy (e.g., avoiding being with others due to vocal concerns causing further emotional distress due to isolation and not offering any help to alleviate the problem), over-reliance on this strategy is a cause for concern while considering well-being in singers.

Keep to self was reported to predict overall vocal impact (SVHI total) and the *SVHI-Vocational* subscale. Through *Keep to self* an individual hopes to regulate emotions felt as a consequence of a stressor, in this case, a voice problem. Studies examining the impact of *Keep to self* on health are rare; therefore, it is challenging to imply the “modus operandi” of this coping strategy on vocal health. Without further investigation, we can only speculate that singers engaging in *Keep to self* experience heightened levels vocational impact as this coping strategy essentially encourages an individual to “hide” their worries and frustrations leading to similar consequences of *Escape Avoidance* (cancelling concerts, modifying repertoire, reduced social interaction with other singers etc.). However, it is fair to conclude that this coping strategy is likely to negatively impact vocal health, particularly with long term voice conditions as it does not offer any favourable solutions to deal with the voice problem. However, it might be an adaptive strategy for transient vocal difficulties (e.g., voice problems due to laryngitis) as it may be the right approach to avoid further injury and promote self-healing of the voice thereby prolonging careers. A longitudinal exploration of *Keep to self* in singers with short term and long-term vocal difficulties would be beneficial in fully understanding the adaptive/maladaptive nature of this coping strategy.

Similar postulations can be made regarding the influence of positive reappraisal on the voice as interpreting a voice problem as an opportunity for “personal growth” may not translate to reflect better vocal health outcomes as no direct efforts are taken to alleviate the “vocal stressor” or make any significant changes. These hypotheses are supported by a study carried out by Penley, Tomaka and Wiebe (2002) which indicated that coping strategies such as *Keep to self* and avoidance correlated negatively to health outcomes whereas positive reappraisal did not have a conclusive impact on health outcomes. Similar to self-efficacy, they may have a place in different points of an illness timeline. More specifically, they can be considered adaptive early on within the timeline; however, long term use or later in an illness may be maladaptive.

A coping strategy which predicted only the *SVHI-Physical-Auditory perceptual* scale was reliance on religion (VDCQ item S8). It must be reiterated that this was a single item predictor and therefore may not have the validity of a multiple item subscale. Nevertheless, this is an interesting finding as religion has been consistently discussed in the qualitative study and while reflecting on the differences between the groups; however, it has not been discussed within the context of being a predictor of vocal impact. It is safe to interpret that this result is more reflective of Carnatic singers as Western classical singers did not frequently engage in religious coping. In fact, there was a statistically significant difference between the two groups for this item. This finding is maybe indicative of the maladaptive nature of this coping strategy and as mentioned earlier, reflects on the maladaptive coping trend of Carnatic singers. Research evidence regarding the impact of religious coping is mixed, as outlined in section 6.6.3.5 of Chapter 6. In the present survey, it has been ascertained that religious coping leads to increased vocal impact within the physical domain (more specifically, the auditory perceptual symptoms) and could potentially be a contributing factor to the increased SVHI scores demonstrated by Carnatic singers. The qualitative study highlighted the reliance of some Carnatic singers on religious practices to alleviate their voice problems (refer to Chapter 4 section 4.4.2.4.1.3). Increased awareness among Carnatic singers highlighting the services which can be accessed during a vocal crisis and strategies to maintain vocal health (vocal hygiene maintenance practices) will be a step in the right direction to encourage a more adaptive coping approach to deal with voice problems. More research is also warranted to ascertain if religious coping can be used in an adaptive manner (e.g., to increase self-belief) among religiously inclined singers as religiosity may be a significant part of their identities/culture and therefore needs to be sufficiently acknowledged.

Social support is a topic of interest in the present survey as this was the coping strategy which was used the least by Carnatic singers; also, a statistically significant difference was observed between the groups for this strategy (where Western classical singers employed social support more than Carnatic singers). Only a weak correlation was observed between SVHI and social support (Table 7.7) supporting the notion that social support could be a potentially adaptive strategy. Similar views have been proposed by Epstein et al (2008). Therefore, it is possible that reduced use of this coping strategy is not necessarily beneficial to Carnatic singers to deal with voice problems. However, these correlations must be interpreted with caution as they are not predictive of an association or indicate directionality of the effects (identifying the cause and the effect).

Another interesting point to note was that none of the coping strategies correlated negatively with any of the SVHI outcomes; this indicates that none of the coping strategies increased vocal health (information seeking showed the weakest correlations but still did not predict vocal health). This could be interpreted in a few ways. Firstly, it is possible that coping, as a construct is mainly focused on ill-health rather than health. Therefore, the focus is on minimising the effects of an illness rather than promoting health. Secondly, it is possible that the full version of the VDCQ primarily focused on identifying maladaptive strategies which may be reflected in the associations identified with the SVHI outcomes. A further explanation is that having to actively cope to manage a vocal condition (irrespective of the valence of that coping strategy) means that there is cognitive load – the frequency of this as measured via the VDCQ type scales may lead to negative outcomes overall. Further work potentially of qualitative nature (as it allows in depth investigation) of coping in vocal areas is required to investigate these complex relationships which potentially are contradictory unless considered in conjunction with specific contexts.

7.4 STRENGTHS AND LIMITATIONS OF THE SURVEY

Even though steps were taken to deal with missing responses in an effective manner (using mean substitution and single imputation), the low number of full responses must be acknowledged. The number of empty responses were far greater than anticipated; given the novel nature of the current study, curiosity surrounding the contents of the survey may have prompted participants to skim through the items; or there may have been a lack of understanding on the nature of the items. Also, the survey was demanding due to the large number of items which may have impacted the completion rate. However, this survey was exploratory and therefore, the risk of not obtaining higher numbers of full responses was expected and plans were made to deal with partial responses even prior to dissemination of the survey. The timing of the survey launch also posed some difficulties as it was a busy time for Carnatic singers (owing to the December music season being imminent); similarly, Western classical singers were also in preparation for various concerts booked in conjunction with the festive period in December. To mitigate this, the survey was closed in February to allow greater time for completion, but timing may still have impacted participation.

Given the differences between the two groups compared in this study, analysing the risk factors separately for the two groups would have been beneficial. However, due to limited sample size this was not feasible in great depth. The limitations of using a single imputation dataset must also be

acknowledged, the most significant of which are underestimation of standard errors leading to overestimation of the test statistic (Soley-Bori, 2013). However, a more robust imputation method such as multiple imputation was not feasible within the time frame of this thesis but will be considered for future publications.

The severity component of symptoms could not be included in the analysis and this is a limitation, that needs to be acknowledged, as identifying the severity of a symptom along with its frequency provides a full picture about the significance and impact it may have on singers. Due to the large number of missing values (as indicated in section 6.2), a pragmatic decision had to be made to exclude this aspect as using strategies to deal with this missing data may have impacted the integrity of the results. It is possible that the format in which the items pertaining to symptoms were presented to the participants was the issue; for each symptom, the participants were instructed to indicate the frequency and severity which appeared in side-by-side response columns. This may have prompted the participants to only answer the frequency element of the question and ignore/miss the severity one (especially if completed on mobile phones within the Qualtrics software).

This survey is the first of its kind to compare Western classical and Carnatic genres. Despite the cultural differences which include differences in terminologies used between the two genres, the survey instrument ensured that the test items were relevant for both groups by using appropriate tools (e.g., skip logic in Qualtrics or providing more explanation to some terms which may not sound familiar to a particular group) and being as inclusive as possible. The development of the entire survey instrument was informed by the results of the qualitative study performed earlier (chapter 4) and the systematic reviews (chapters 2 and 3) which provides methodological credibility to the appropriateness of the instrument to study the aims in a valid and reliable manner. The breadth of exploration of all aspects related to self-reported voice problems is considerable and provides many avenues to be empirically explored in further research. Coping and illness perception are particularly under researched areas in the field of voice, therefore the present study contributes significantly to the evidence base. Lack of sufficient detail pertaining to sample characteristics, particularly singing related details in singing voice research was reported in Chapter 2 as a limitation. This has been mitigated in the present survey by describing all the relevant sample characteristics in this survey which will validate the findings of this study. Creation of the frequency of symptoms measure is a step in the right direction towards filling an evident gap in research as similar tools which measure frequency of symptoms in singers are currently

unavailable. Similarly, creation of subscales to interpret SVHI and VDCQ (27 item) measures provided more depth and specificity while analysing the results of the survey. One complication of this is that there are many more relationships and effects to investigate, interpret and report and this brings added complexity; but it was a challenge undertaken in the current research.

7.5 CONCLUSION

The present study has indicated that self-reported voice problems are prevalent among Western classical and Carnatic singers and provided a detailed profile of the symptoms that they are likely to experience. While similarities can be drawn on the symptomatology reported by the two groups (e.g., presence of vocal fatigue), there are important differences as well. This strengthens the notion that genre can influence the development and manifestation of self-reported voice problems among singers. This may, potentially impact the treatment / interventions for each group when vocal problems occur. The predominantly used coping strategy among both groups was information seeking; however, a collective analysis of illness perceptions and coping strategies employed by both groups are indicative of a more adaptive approach among western classical singers. Further studies that employ a longitudinal study design can ascertain the effectiveness of these coping strategies in different contexts, along the different points of the temporal journey of vocal illnesses, and thus help further understand the dynamic undertones of coping processes. Findings pertaining to self-reported voice problems and coping strategies have important implications in assessment and management of voice problems which is useful for all members of the voice care team. The various predictors identified through this survey convey the collective idea that voice can be impacted by a multitude of factors, which extends much beyond the physical domain to include other areas (e.g., positive attitude towards the voice, performance anxiety feeling of control over voice problems etc.) some of which may be overlooked by healthcare professionals or educators involved in helping singers develop and maintain their voices. Therefore, it is hoped that the results of this survey will be useful to develop appropriate advice for singers to help prevent voice problems and subsequently equip singers with necessary information and tools to maintain vocal health as well as provide appropriate treatment during a vocal crisis. Singers also indicated a variety of approaches employed by them to maintain vocal health some of which have been established as vocally healthy strategies, while others require empirical testing to ascertain their impact in positively influencing vocal health (again at the correct point of an illness by adopting approaches outlined in the Transtheoretical model proposed by Prochaska et al, 1994); therefore, more

research in these areas will provide much needed evidence for these thus far “anecdotally useful” practices.

This survey is first of its kind for multiple reasons. Firstly, studies comparing culturally and technically different singing genres are rare; therefore, this study has been able to ascertain how culture and genre may have an impact on the voice. Secondly, there is limited research examining voice-related coping among singers as demonstrated in the systematic review undertaken as part of the current programme of research (Chapter3). Finally, the explorative nature of the current survey, where a variety of aspects were studied provides a good overall picture of self-reported voice problems, coping strategies and predictors of vocal impact (and their complex natures), thereby providing many avenues for further research.

8 CHAPTER 8 - DISCUSSION

The primary objective of the current programme of research was to explore self-reported voice problems and coping strategies in Western classical and Carnatic singers. Additionally, the various components of this research aimed to identify the predictors of self-reported voice problems, examine the influence of genre (and culture) on self-reported voice problems, and coping and strategies employed by the two groups of singers to maintain vocal health. A variety of methodologies (systematic review, qualitative methods and survey) were utilised to answer the primary and secondary research questions which have been presented as separate chapters in this thesis. Each chapter included a discussion where the results were interpreted and explained in relation to existing research evidence. Also, alternate explanations for results that deviated from the current evidence base have been provided and suggestions have been made for results that require further research evidence to make firmer conclusions. The strengths and limitations for each individual component of the thesis have also been discussed. Therefore, this chapter is an overall examination of evidence gathered throughout the course of this programme of research. This provides an opportunity to cumulate the findings, explain any methodological issues, highlight the clinical implications of the integrated findings and revisit the theoretical framework which provided the foundation to design and carry out this programme of research. Directions pertaining to future research are also discussed.

8.1 INTERGRATED FINDINGS - SELF-REPORTED VOICE PROBLEMS

Through the various methods employed in this thesis, the self-reported voice problems experienced by Carnatic and Western classical singers were explored in detail. The systematic review provided an account of the self-reported voice problems seen in classical singers that was useful during the development of the interview guide of the qualitative study and the survey instrument. It also gathered useful evidence which was beneficial to compare the results of the empirical components (qualitative study and survey) of the current programme of research with the results of the systematic review and identify if Western classical and Carnatic singers reported similar or unique symptoms compared to classical singers as a single cohort. There were some noteworthy similarities between the systematic review and the other two components. For example, the systematic review indicated that vocal fatigue and restricted upper ranges were frequently reported among classical singers which was subsequently confirmed through the results of the qualitative (interview) and quantitative (survey) studies. This consistency in findings, strengthens the reliability of the reported findings and offers some useful

implications. These results are instrumental in providing appropriate advice to and raising awareness regarding the symptoms that classical singers are likely to experience. Additionally, the results will provide guidance to singers to “optimise” their singing, wherein they are able to effectively utilise their voices by minimising vocal effort (and fatigue) and maximising vocal output, thereby ensuring a healthy and efficient voice production. While this is an iterative and subjective process, if singers (and singing teachers) have sufficient information regarding what is likely to “go wrong”, they can take appropriate steps to ensure that singing is carried out in a manner that does not compromise vocal health. For example, introducing vocal naps into daily routines of singers could be one of the most practical ways of preventing the onset of vocal fatigue (Sataloff, 2012). Gotaas and Staar (1993) also emphasised the role of voice rest in tackling vocal fatigue. Even though voice rest was frequently indicated as a method for maintaining vocal health by singing teachers and singers, vocal naps were not frequently mentioned. This could be because singers (and singing teachers) may be unaware of the significant benefits offered by vocal naps and may consider this strategy to be too short and insufficient to have a positive impact on the voice. This was also reflected in some of the responses obtained during the qualitative interviews where singers often indicated that they rested their voice for “days” prior to a performance rather than taking shorter and more frequent breaks in voice use. Generating more awareness on the vocal benefits of vocal naps which is a more practical means of resting the voice will therefore increase its use and the frequency with which it is recommended by singing teachers.

A few aspects that were not explicitly reported in the earlier chapters (particularly, the survey) are addressed next. These aspects emerged once the evidence across the two experimental studies was collated and considered together - they were minor themes in the qualitative study and not statistically significant findings in the survey, but reported in both studies, thereby making them relevant. The first point is related to the relationship between how singers viewed their own voices and its influence on vocal health. In the qualitative study, it was observed that all singers who reported having voice problems did not like their own voices (i.e., had negative perceptions of their voices). Since this was not frequently encountered in previous research, a relevant question was added to the survey instrument (Q.28-Do you like your own voice?) to check if there were any notable relationships between “liking” or “disliking” your voice and SVHI outcomes. Albeit weak, a significant negative correlation was observed with dislike of voice associated with greater impact. While the survey evidence in itself is insufficient to make any definitive conclusions, integrating the results of the qualitative study and the

survey could indicate a plausible relationship between the two. Perhaps a Likert scale type of response to the question in the survey may have enabled a more nuanced response or it could be that opinion about a singer's voice requires a more step-by step exploration and cannot be explored with one question only. It can be argued that "vocal image" (how one views their own voice) can be likened to "body image" (how one views their own body) or self-image (how one conceptualises the self). It may be that singers may resort to vocally unhealthy strategies to match their voices to their expectations similar to how a person with an insecure body image may resort to unhealthy eating habits (Kapoor et al 2022). There is also anecdotal evidence that singers may resort to smoking to develop their lower register when this vocal attribute is desired (this was also mentioned by a Carnatic singer during his interview for the qualitative study). Further research will inform SLTs and singing teachers on the importance of developing a positive vocal image among singers during rehabilitation and singing training respectively to avoid maladaptive or harmful behaviours to manipulate voice quality.

The second point was related to singing or performing multiple genres and its impact on self-reported voice problems. In the qualitative study, participants indicated that singing in other genres could potentially influence vocal health; however, the impact was viewed positively by some and negatively by others across the two groups. A similar result was obtained when a correlation analysis was run between "other genres" performed by participants of the survey and SVHI outcomes, where singers indicating that they also performed musical theatre indicated a weak but significant negative correlation with SVHI-Auditory perceptual, whereas singers performing Indian film music along with classical singing indicated a moderate significant positive correlation with three SVHI subscales. This could indirectly reflect one of the main results obtained from the survey where Western classical singers in general scored less than Carnatic singers on SVHI outcomes, as musical theatre and Indian light music are genres mostly associated with Western classical and Carnatic singing respectively. A similar result was also observed pertaining to the impact of Carnatic singing training, which was identified as a predictor of increased vocal impact and a similar interpretation was made, where it was seen as a "proxy" to the impact of genre rather than training itself. Overall, these trends emerging from the qualitative study and the survey are indicative of the need for more research to understand the full impact of singing in multiple genres on various aspects of voice.

8.1.1 The survey instrument - points to consider

The SVHI is a singer specific tool designed with the premise to reliably assess voice problems and their impact on a singer and was therefore included in the survey instrument. However, one limitation was that SVHI lacked specificity by providing only a total score. To fully utilise the scope offered by SVHI in terms of the breadth of constructs it covers, subscales were generated. A correlation analysis between SVHI and current voice problems in the survey revealed moderate correlations with four subscales and the SVHI-mean (r range=-0.32 to -0.38 and a substantial shared variance ranging from 6.7% to 14%). This further validates the need for subscales while using SVHI rather than restricting its scope to a single score. The added specificity of the Vocational scale which is not available with the VHI takes into consideration aspects that are relevant to professional voice users and singers in specific.

Another consideration is the use of an additional frequency of symptoms scale when the SVHI already has items covering physical symptoms. Even though the SVHI does indeed have a few items related to vocal symptoms, they did not comprehensively cover all the symptoms that singers are likely to experience (as indicated by the systematic review on self-reported voice problems and the qualitative study). Since identifying self-reported voice problems was a primary objective of the current programme of research, it was imperative that this aspect was investigated in a thorough manner and a broad exploration of vocal symptoms was attempted. Moreover, the theoretical framework used in the current study specifies that the symptoms should be assessed as a separate entity to study the impact of their frequency and severity on outcome (in this case, the SVHI); this further justifies the development and use of the frequency of symptoms measure. Correlation analysis of the frequency of symptoms subscales and SVHI did not indicate a consistent strong correlation between the subscales (except for the vocal performance symptom subscale and SVHI-emotional and SVHI-consistency); therefore, they do not capture the same constructs, justifying the simultaneous use of these two measures in the same survey. It is worth noting that a similar symptom measure specific to the singing voice is currently unavailable for research or clinical use. Therefore, a more robust validation and standardisation of this measure will be a useful addition for clinicians and researchers dealing with singers and needs to be addressed in future research. Similarly, the subscales generated for SVHI will also enhance the interpretative value of SVHI and provide clinicians with more specificity to identify areas of vocal handicap.

It is unlikely that similar results would have been generated had the SVHI-10 be used instead of the full version. Firstly, it would have been impossible to generate subscales for SVHI as there will not be sufficient items (SVHI-10 only has 10 items). Generating subscales for SVHI was one of the most significant outcomes of the present thesis. Moreover, some of the items particularly in the SVHI Functional and SVHI Auditory perceptual subscales are not included in SVHI-10; this may not have provided another crucial result of the thesis which was establishing a difference in vocal impact between the two groups (there was a statistically significant result was obtained between the two genres for these subscales). This justifies the use of the full version of SVHI rather than SVHI-10.

A revisitation of the available tools to study singing voices will be helpful to justify the choices of the measures used in the present thesis. Table 1.2 in the introduction chapter indicated the tools available to assess self-reported voice problems. Since the thesis dealt with singers, singer specific tools were preferred so that the assessments will be relevant to the study population. Need for using singing specific tools has been highlighted in the literature; for e.g., the primary motive for developing SVHI was because a lack of specificity was noticed with the VHI items (authors). This meant that generic measures such as VHI or Vocal Tract discomfort Scale were not considered. Only two measures were available which were developed for singers-SVHI and EASE. Given the breadth of areas covered by SVHI rather than only vocal fatigue which is the case with EASE, the most appropriate tool was chosen for the present thesis.

The development of subscales for SVHI will increase the clinical usability of the tool as specific areas where vocal impact is experienced by a singer can be identified. Even though the subscales were developed with Carnatic and Western classical singers, SVHI as a tool is not genre specific. Therefore, it is not unreasonable to assume that the subscales will also be relevant for all genres. Factor analysis of SVHI subscales using data from singers belonging to other genres will confirm the usability of the subscales across genres.

8.2 INTEGRATED FINDINGS - ILLNESS PERCEPTIONS AND COPING WITH VOICE PROBLEMS

Oloff, Brosschot and Godaert (1992) suggested that an individual's ability to cope with a stressor can have adverse consequences on health. The impact of a voice problem on various aspects of a singer's life is substantial and therefore the strategies used by them to manage the physical, social, vocational and emotional consequences are of significance. Coping is also included in many models of health

behaviours and linked to important outcomes (as outlines in the Self-regulation model by Leventhal et al, 1980). In the present thesis, Coping strategies used by professional voice users (which included only teachers) was explored through a systematic review. Strategies specifically used by Western classical and Carnatic singers were investigated using semi-structured interviews in the qualitative study and the VDCQ in the survey.

Social support was the most commonly reported coping strategy in the systematic review; however, this was not frequently reported among singers in either the qualitative study or the survey, particularly among Carnatic singers. This could be because, the stigma associated with developing a voice problem may be far greater among singers compared to teachers, possibly because a singer's identity / self-image is more tied into their voice. The vocational impact of a voice problem may also be different for these two groups. Singers may most typically be hired *because* of their vocal abilities which is not the case with teachers; for the latter, a voice that allows them to exercise their professions is sufficient. In that sense, there is a higher reliance on vocal performance among singers, which could contribute to the lack of will to seek social support for fear of being "judged" or losing face. Moreover, a statistically significant difference between Western classical and Carnatic singers for the social support subscale indicated a much higher reluctance to rely on it among Carnatic singers. Some possible reasons could be cultural perspectives (e.g., vocal illness is viewed as a weakness or personal failure), higher levels of competition, more judgmental society, to name a few; however more research is required to make conclusive remarks.

The most commonly employed coping strategy by both groups in the survey was information seeking and its implications have been discussed in detail in the survey chapter (Chapter 6, section 6.6.2.6). A finding that was consistent across the qualitative study and the survey was the reliance of singers, especially Carnatic singers on home remedies. Nair, Joshi and Gunjawate (2021) studied the practices of Carnatic singers related to vocal health care and reported that 73% of Carnatic singers resorted to home remedies instead of seeking medical attention. Interestingly, several studies have indicated the use of home remedies (e.g., consuming pepper, turmeric, liquorice etc.) for voice care within the Indian context (Boominathan et al, 2008; Devadas et al, 2019; Arunachalam et al, 2014); however, no studies have been undertaken to measure their impact on relevant voice outcomes/parameters. Given this consistent finding in the literature, more research measuring their effectiveness is warranted; this will

further help ascertain the adaptive/maladaptive nature of this coping strategy and inform its vocal health implications, especially for professionals reliant on their voice.

Religious coping was an interesting finding reported in this thesis. Religious coping was exclusively observed in Carnatic singers only. The survey did not include any questions regarding the religious beliefs or religiousness of the participants; however, the (supposed) inherent religiosity among Carnatic singers is a plausible explanation for the employment of religious coping among this group. Even though religious coping was seen only in Carnatic singers in this study, it is important to study this coping strategy in other cultures including Western classical singers. Religious coping is discussed further in section 6.5.

A few dichotomies were discussed in section 1.6.3 pertaining to measurement of coping, which could impact the conceptualisation of coping within a particular research (or clinical) framework. In the survey, the VDCQ was used which measures coping as state rather than trait. Therefore, the questionnaire is formulated to measure coping as current processes or strategies i.e. thoughts and actions in response to specific stressful situations such as vocal problems rather than a personality characteristic that is relatively stable. While state measures take into account the evolutionary nature of coping, they lack replicability as they are not as stable as trait measures given their susceptibility to situational factors. Secondly, rather than using a binary classification such as problem-focused/emotion-focused, a multi dimension categorisation of coping strategies was reflected in the survey. This was because, the interpretative value of identifying if a particular coping strategy is problem or emotion focused is limited, as neither category assertively determines if a particular strategy was useful or not (refer to sections 1.10.3.2 and 3.5 for a detailed account of adaptive and maladaptive coping). Also, the two-dimensional conceptualisation of coping strategies is restrictive in ascertaining the specific tendencies of individuals in coping with voice problems. The frequency of use of the seven coping subscales (identified following mapping) in the survey aided in describing the coping philosophies of Western classical and Carnatic singers with specificity offered by multidimensionality. Finally, VDCQ is a disease specific scale and therefore was clinically relevant and appropriate to assess coping in this survey (based on state rather than trait as the intention was to look for reactive measures to an illness state). These dichotomies and their impact on interpreting the results of the survey are important to consider while drawing conclusions.

The Common-Sense Model (CSM) proposed by Leventhal et al theorises that when an individual encounters an illness, they make attempts to conceptualise or assign meaning to their illness, following which coping strategies will be adopted to manage the illness. Therefore, the CSM proposes a strong relationship between illness perceptions and coping. While this is a slight digress from the research objectives of the current programme of research, a quick analysis of the relationship between illness perceptions and coping strategies based on the results of the survey will further the understanding of how coping operates in the study groups. A correlation analysis (Appendix 8.1) indicated that escape avoidance showed a moderate to strong correlation with nearly all items of the IPQ (except timeline and coherence). A negative correlation was observed between IPQ-3 control and escape-avoidance. Overall, this meant that poor perceptions of the illness (higher impact, more symptoms, greater emotional consequences, greater concern) was associated with escape avoidance. Another interesting finding was pertaining to IPQ 3-Control where a negative correlation with five coping scales (social support, self-control, positive reappraisal, escape avoidance and distancing) and a positive correlation with two scales (information seeking and tension reduction) was observed. Since higher control (Lachman et al, 2011) and information seeking (Endler and Parker, 1990) are associated with better health outcomes, this could be an example of an adaptive illness perception-coping chain. A more detailed exploration of these relationships will provide valuable information regarding adaptive coping and the role of illness perceptions in facilitating these decisions; additionally, it will allow a test of the model which was beyond the scope of this thesis.

8.3 INTEGRATED FINDINGS - PREDICTORS OF VOICE PROBLEMS IN SINGERS

Factors affecting the voice were also explored in detail. The systematic review established the various factors which have been indicated to impact vocal health that laid the groundwork for the body of work (qualitative study and survey) to follow. The qualitative study led to some interesting observations pertaining to factors that may negatively impact the voice, which have not been frequently reported in the evidence base. Some of these were imitation (of the singing teacher's voice rather than style), poor acoustics in performance environment, lack of awareness among singers regarding vocal health, lack of faith in God, to name a few (see Chapter 4 section 4.4.1.1.3). In the current evidence base, demographic, environmental and lifestyle related factors have been reported to influence the singing voice (Davies and Jahn, 2004; Devadas et al, 2018); therefore, the factors outlined in the qualitative study and the subsequent predictors established through the survey provide some fresh perspectives.

A few notable findings from the survey were the impact of positive attitude towards voice and sense of control over the voice problem, which positively influenced the voice. Moreover, factors such as performance anxiety and coping strategies (e.g., escape avoidant coping, self-control) were also important and have not been identified as predictors of vocal health in the evidence base. This thesis highlighted the variety in predictors of vocal health that encompassed various aspects, some of which may be applicable only to the singing population (e.g., performance anxiety), whilst others may be more generic (e.g., frequency of symptoms, sense of control over voice problem etc.) and perhaps applicable to all professional voice users. These results suggest that future research should include more comprehensive assessment of factors that may affect the voice; and clinicians should use more thorough and broader assessments that can be useful in providing customised intervention to singers on an individual needs basis. Importantly, identifying predictors is essential to provide appropriate advice to singers on preventing the development of voice problems and also influence treatment outcomes; therefore, the predictors identified in this study will hopefully benefit researchers and clinicians in both fronts.

Lack of awareness was a major theme in the qualitative study that was believed to negatively influence vocal health by all three groups (SLTs, singing teachers and singers) representing both genres. Awareness regarding vocal health was not explored in the survey as it is a major research question and therefore needs to be explored separately. Ragan et al (2022) assessed the knowledge levels regarding vocal hygiene among 406 professional voice users (of which, about 70% of participants were singers/singing teachers) They reported that participants indicated lack of awareness especially regarding implementation of vocal hygiene strategies on a regular basis was low among participants with about 40% of participants reporting that they did not pay any attention to vocal hygiene. Seeking timely help is imperative with vocal symptoms which can also be positively influenced by increased awareness among singers and other significant “gatekeepers” to treatment-seeking, such as singing teachers (Petty, 2012). Petty (2012) studied health information seeking behaviours among 151 self-identified classically trained singers and reported that 74 singers did not know where to find information about their voice problem and 68 singers felt the information was incorrect/incomplete. The findings of this study highlight the importance of increasing awareness among singers, through workshops, written materials backed by the evidence base, materials made available to singers through various outlets such as music colleges, conservatoires, organisations, such as the British voice

Association (BVA) and The British Association of Performing Arts Medicine (BAPAM) etc. Future research could measure effectiveness of various awareness programmes, if they lead to positive, adaptive vocal health behaviours and their impact on vocal health.

8.4 INTEGRATED FINDINGS - MAINTAINING VOCAL HEALTH

The results of the survey showed a negative correlation, albeit weak between warm up and SVHI scores. The evidence from the qualitative study, however, was strongly indicative of the positive influence of warm up and cool down on maintaining vocal health. The long-term effects of warm up on vocal health have not been studied and current evidence is only indicative of the short-term benefits of vocal warm up (e.g., using straw phonation, trills etc.) on the voice (Costa et al, 2011; Ragan, 2016). It must also be mentioned Still, these studies did not explicitly study the effects of “warm up”/ “cool down” strategies, but rather reported changes in voice outcomes following their use. Further research is required to establish a causal link.

Singers reported utilising a variety of strategies they believed would positively influence vocal health in the qualitative study and the survey (e.g., regular singing practice, consuming herbal teas/concoctions, steam inhalation, Akaara saadhakam, hydration, adequate sleep, pranayamam etc.). Similar results were reported by Nair et al (2021) where Carnatic singers commonly consumed items such as pepper, turmeric etc. and relied on regular singing practice to maintain their voices. While a few aspects such as hydration, sleep and steam inhalation have research evidence to support their effectiveness to maintain vocal health, the benefits of other strategies are anecdotal and therefore provide avenues for further research.

8.5 A RETROSPECTIVE ANALYSIS OF THE IMPACT OF GENRE ON VOCAL HEALTH

The qualitative study and the survey have arguably established that the two genres included in this study have many differences. The socio-cultural aspects such as views regarding menstruation, familial responsibilities/expectations of women, reliance on self-help (*paattivaidyam*) etc. depicted in the qualitative study are essentially a reflection of the differences between the “east and west”. These are aspects that require serious consideration during assessment and management as seeing singers as a single cohort does not promote exploring these unique and important aspects of their culture that influence their practice.

Carnatic singers indicated higher scores in all vocal outcomes in the survey. The implications of higher prevalence of vocal symptoms and impact among the singers belonging to this genre has been discussed in detail in chapter 6 sections 6.6.3.2 and 6.6.3.3. The most relevant demographic difference between the groups was the number of professional (vs amateur) singers. It has been indicated in the evidence base (Cohen et al, 2008) and the qualitative study (refer to chapter 4 and 4.4.2.1.3-Vocational factors) that amateur singers are more likely to develop and report voice problems, due to vocational vulnerabilities (e.g., amateur singers may not be able to decline work even while unwell) or financial issues (access to health care may be an expensive affair for amateur singers). Therefore, the increased scores among Carnatic singers can be indicative of either a significant impact of singing level on the voice or a higher prevalence among Carnatic singers. Both explanations have important implications; therefore, more research is warranted to ascertain the impact of singing level on vocal health.

The difference in symptom profile where Western classical singers scored highest for throat discomfort compared to Carnatic singers who scored highest for the acoustic inadequacies is perhaps one of the most important findings of this study, illustrating the impact of genre on the singing voice. The physical impact of singing manoeuvres caused by the two genres is reflected in the symptoms reported by the singers; therefore, the influence of genre in symptom manifestations was clearly indicated through this body of research.

Genre was also related to how singers may cope with their voice problems. Religious coping and resorting to home remedies were indicated as dominant themes among the Carnatic participants in the qualitative study. These results were replicated in the survey and a statistically significant difference was also observed between the groups for religious coping. Carnatic singing and its relationship with Hinduism has been discussed in section 1.3.1. A few Carnatic singers and singing teachers who took part in the qualitative study indicated that most of the repertoire of Carnatic singing is in relation to a Hindu deity and that religiousness is an inevitable aspect of the tradition. While there isn't sufficient evidence to ascertain the fact that religious coping may be a contributing factor for Carnatic singers to experience more voice problems, it is a possibility. This claim is further strengthened by the regression analysis results where religious coping uniquely and significantly predicted vocal impact (more specifically, SVHI-Auditory perceptual subscale). Given the implications of this coping strategy on Carnatic singers as a cohort, further research with a larger sample size to establish the impact of religious coping on vocal health will be beneficial.

It is worth mentioning that many organisations were approached during recruitment for the survey. While a positive response was obtained from the BVA and BAPAM who assisted in advertising the recruitment, there was no response obtained from the Carnatic organisations. This could reflect lack of familiarity with research or lack of awareness regarding the importance of vocal health (and related research). However, it should be clarified that these organisations are mainly comprised of artists (or music enthusiasts) and therefore cannot be likened to BAPAM or BVA which have been primarily set up to improve or maintain performers' health and well-being. The need for an organisation such as the BVA or BAPAM is indicated and would be hugely beneficial to singers in India. Even though it will be a huge task to set up a similar organisation due to the geographical and cultural diversity in India and the significantly large number of singers, it will be a valuable undertaking and a right step geared towards maintaining vocal health.

The evidence base so far has been inconclusive (Phyland et al, 1999; Avila et al, 2010) to ascertain the impact of genre on the singing voice. Therefore, one of the most important results of the present study was the observable differences between genres across various aspects pertaining to vocal impact. This research is the first of its kind to study the differences between two culturally diverse genres, which prompted the adoption of a more exploratory approach, encompassing a range of aspects related to self-reported voice problems and coping to explain the complexity underlying such a comparison. Our approach also provides a framework for future researchers who wish to carry out similar studies.

8.6 GENERALISABILITY AND REPLICABILITY OF THE FINDINGS

An important issue to address is the extent to which the results of this research can be considered representative of all Western classical and Carnatic singers. Kurkull and Ganguli (2012) indicated that generalisability is primarily dependent on internal validity. Internal validity simply questions if the study results are actually "true" and is dependent on 1) the appropriateness of the study design, 2) methods employed for data collection and 3) appropriate statistical analyses (Kurkull and Ganguli, 2012). The justifications for decisions pertaining to all three factors listed above have been provided in the respective chapters and the most appropriate methodological options (within the constraints of the study) were used to carry out the qualitative and quantitative arms of the thesis. With qualitative studies, generalisability is often a topic of conflict and there are no clear guidelines on how it can be achieved. For instance, Carminati (2018) reported that generalisability can only be truly achieved in qualitative studies if two conditions exist: 1) Generalisability is the main objective of the study; 2)

precautions are undertaken concerning the philosophy and the terminologies used in the study (making sure that philosophical traditions underpinning the research are clearly specified and no new methodological terminologies are introduced). Since the first condition is not the case in the present body of research, assessing generalisability will be challenging. Nevertheless, the qualitative study used a well-established data analysis method, namely framework analysis, achieved data triangulation, was sufficiently double coded and had an adequate sample size, which enhanced internal validity.

Setia (2016) indicated that a cross-sectional study design was suitable to carry out population-based surveys which justifies the suitability of this design for the survey undertaken in this research. The various statistical analyses (regression, comparison of means and frequencies) were carried out using methodologically appropriate techniques. Convenience sampling was undertaken for the survey which may not produce as generalisable results as other sampling methods such as random sampling (Jager et al, 2017). However, convenience sampling was the most feasible method to use with a population as poorly defined as Western Classical and Carnatic singers. The advantages of convenience sampling outweighed its cons to deal with the impact of COVID 19 and its general advantage of ensuring a higher participation rate.

The research area investigated by this thesis is relatively unexplored; therefore, comparative results are limited in past literature. Wherever possible, parallels were drawn with already published evidence and the findings of the studies in this research (e.g., prevalence of voice problems, SVHI sum scores, factors affecting the voice etc.) were in agreement with previous research. However, research on voice-related coping, especially within the context of the singing voice is almost non-existent; therefore, making claims on the replicability of the results of the present programme of research is problematic. However, owing to the specific nature of these groups and the eligibility criteria employed, along with a rigorous methodology, the experimental studies employed in this programme of research undeniably provide an exploratory account of self-reported voice problems and coping strategies in Western classical and Carnatic singers. Most importantly, it provides future researchers sufficient methodological rigour and detail, and useful tangents to confirm the affirmations outlined in this body of work which will also shed light on whether the current results are generalisable and replicable.

8.7 REVISITING THE THEORETICAL FRAMEWORK

Chapter 1 (section 1.12.1) had outlined the theoretical framework (Fig 1.3) underpinning the research objectives. The development of the framework was informed by the Common-Sense Model (CSM) and a structural framework proposed by Shaw (1999) to study coping, illness behaviour and health outcomes (refer to section 1.11 for details).

A few additions and modifications were made to the framework with the progression of each stage of the study. The modified framework is provided in Figure 8.1. The green boxes outline the additions made to the model following completion of different aspects of this research which are discussed here. A variety of predisposing factors were added to the model following the qualitative study. For example, the qualitative study indicated that having a positive attitude towards your voice and singing can positively influence vocal health, which was subsequently explored through the survey and verified to predict SVHI outcomes. The original framework only mentioned four coping subscales (as outlined in the original VDCQ-15) which was expanded to seven subscales following mapping (with additional items on religious coping and home remedies). Finally, the outcomes, which are measured across three domains, namely physical, vocational and psychosocial were originally intended to be measured using three separate validated measures. However, during the development of the survey instrument, it became apparent that the inclusion of three validated measures would significantly increase participant burden. Moreover, the SVHI is a comprehensive tool with items that cover all the three domains (physical, functional and emotional) of outcomes. Therefore, a decision was made to use only the SVHI to measure all domains, which was possible after the development of the subscales, as presented in Figure 8.1.

A few sections of the proposed framework were not explored and are marked in red in Figure 8.1. According to Shaw's model, coping mediates the effect of predisposing factors, symptom presentation and the situational and individual constructs on the final outcome measures. Mediation analysis was beyond the scope of this thesis and was therefore not undertaken. Also, the feedback loop as postulated by the CSM which occurs from outcomes back to symptom presentation could not be verified in the present research as a longitudinal study design would be required to verify this pathway. However, assessing the ongoing nature of the coping process would be a valuable addition to the evidence base and is therefore recommended.

A few hypotheses were made based on the theoretical framework prior to commencement of the survey. Relationships were hypothesised between predisposing factors, symptom presentations, illness perceptions and coping on voice outcomes (hypotheses 1-3). Correlation analysis reported in Chapter 7 ascertained that some of these variables did show a significant relationship to the outcome measures thereby supporting these assumptions. It was also hypothesised that coping would predict voice outcomes which was also established through the regression analyses. Moreover, many more predictors were identified indicating that the predisposing factors, symptom presentations and illness representations also predicted voice impact / SVHI outcomes.

It must be clarified that the present thesis does not claim to make a theoretical contribution as the framework used for the development of the study has not been empirically tested and can therefore not be considered as a reliable model to replicate in future research. Further testing is warranted to develop a well-tested framework for which the results of the present thesis can be used. This is an area for future work.

Fig 8.1: Modifications made to the original theoretical framework

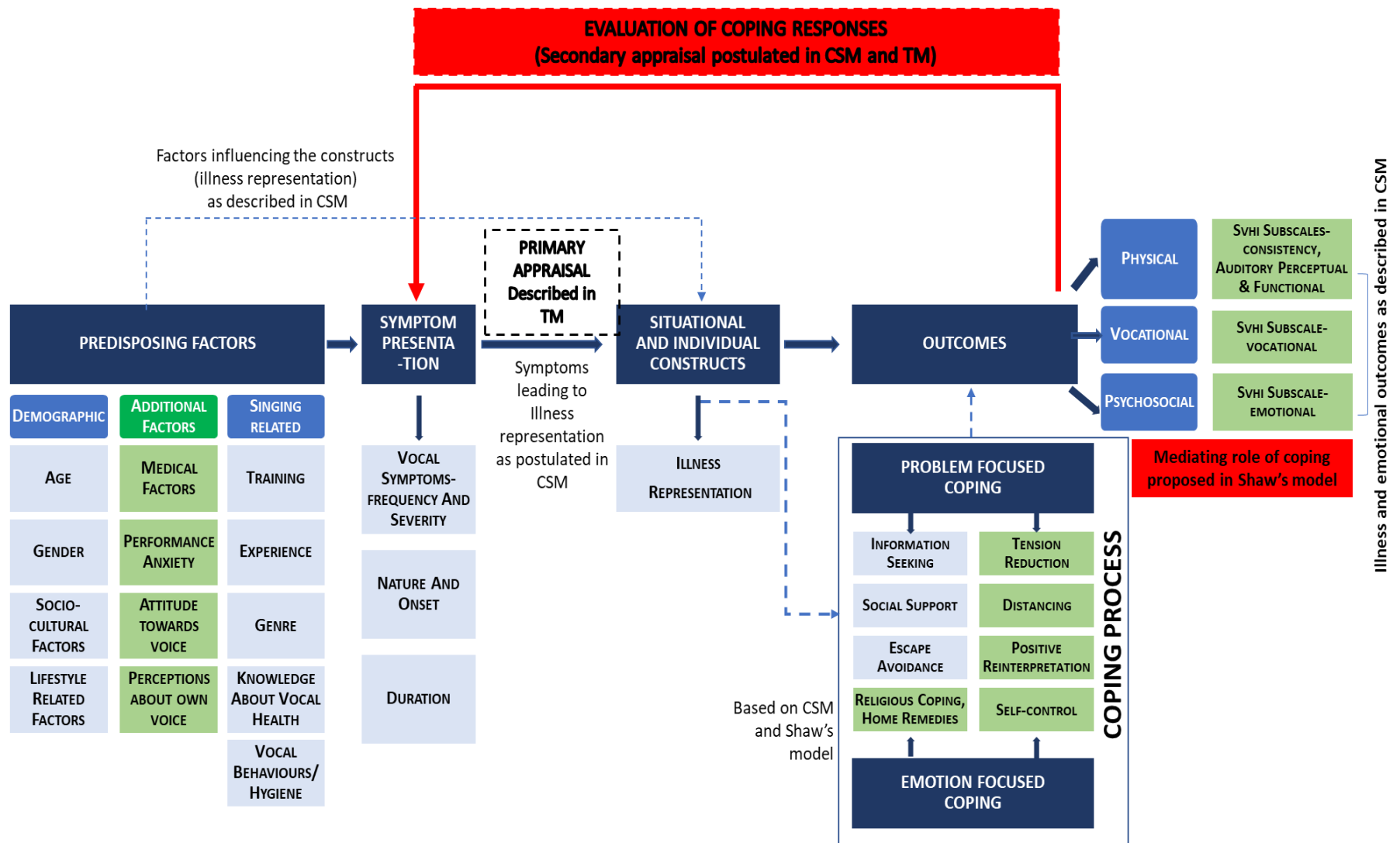


Figure 8.1: CSM=Common Sense Model, TM=Transactional Model of Stress and Coping

8.8 IMPACT OF COVID-19 ON THE THESIS

As a major portion of the current research was carried out amidst the outbreak of Covid-19, a discussion pertaining to its impact on the research is warranted. Covid-19 was declared as a pandemic in March 2020 and subsequently, the UK announced its first lockdown. The ethics application for the qualitative study was being prepared during that time. Whilst the original idea was to have a hybrid approach for data collection where some of the interviews were to be carried out face to face and some online, this was reconsidered, and all interviews were carried out virtually using any of the available video conferencing options (depending on the preference of the participant). This is not acknowledged as a major limitation as the interviews took place in 2021 by which time, virtual meetings were more common than earlier; therefore, participants did not indicate any issues with engagement during the interview. It was also easier logistically to find a suitable time for interviews as participants mostly took part from their homes. Additionally, due to the extended impact of Covid-19 on the entertainment sector, singers who participated in the qualitative study reported to have more “free time” and were therefore willing to take part in the study. It is also possible that singers may have used their voice less during this period which may have impacted their perceptions of their singing voice and impact of regular voice use on it (singers were actively asked to reflect on their pre-Covid voices and routines to mitigate this bias as much as possible).

By the time the survey was launched, singers had resumed their normal work routines; it is possible that many singers were undertaking more work than usual to make up for lost opportunities during lockdown. Therefore, recruitment for the survey was challenging as many singers who were approached indicated that they did not have the time to take part in the survey. This may have negatively impacted recruitment of participants for the survey.

8.9 METHODOLOGICAL CONSIDERATIONS - STRENGTHS AND LIMITATIONS

The course and progression of this research is a strength of the thesis. We commenced with two systematic reviews identifying self-reported voice problems and coping styles and continued with the qualitative study exploring perceptions of singers, singing teachers and SLTs which then culminated in the survey. This sequence ensured that all the experimental arms of the project (the qualitative study and the survey) had been informed by a strong theoretical foundation, thereby increasing their validity. The placement of the qualitative study was a point of discussion as it can methodologically be fitted either before or after the survey (sequential mixed methods), depending on its purpose. Given the dearth of evidence in the area, especially pertaining to coping, inclusion of the qualitative study early ensured a deep exploration of aspects that input to the survey. It also provided an opportunity to explore experiential tangents which may not have been feasible within the constraints of a quantitative methodology. The qualitative study preceding the survey informed its development, provided much needed theoretical input to the survey, and enabled the identification of areas that required examination on a larger sample.

A few limitations must be acknowledged. The first is the difficulty generalising the results of the systematic review on voice-related coping in professional voice users to singers. All studies included in the review recruited teachers as participants. Even though teachers and singers use their voices for their livelihood and have commonalities pertaining to voice use, vocal impairment and impact of voice problems on quality of life, there are also important differences between the groups. The classification of voice users by Koufman and Isaacson (1991) places singers at the highest level, referring to them as elite vocal performers and teachers in the second level, referring to them as professional voice users. This implies that singers have a more specialised use of voice possibly affecting both the impact of voice problems and coping. Therefore, results of this review were mainly used for developing the methodologies of the experimental studies of this research rather than gaining an understanding on how singers may specifically cope with their voice problems.

The background of the researcher (being an SLT and a trained Carnatic singer) brought unique insights and personal experiences that were hugely beneficial in the development and implementation of the study as well as understanding participant responses, particularly in the qualitative study. However, this could also have led to researcher bias. This was reasonably avoided by employing reflexivity principles by way of bracketing (Gearing, 2004). This also enabled a deeper reflection during all stages

of the study from designing the study to interpreting the data (Tufford and Neuman, 2010). Additionally, it prompted the researcher to understand and embrace influences that were formed through years of being an SLT and a singer and enable approaching the participants' viewpoints (Starks and Trinidad, 2007).

Attempting factor analysis, correlations and regression analysis separately for each genre may have produced different results and provided opportunities for some useful comparisons between genres. However, this was not feasible due to low sample size for each genre to be considered separately.

The exploratory nature of the entire programme of research can be viewed positively or negatively as it has compromised on depth to obtain breadth. This was a conscious decision given the dearth of evidence in the areas explored by the thesis. It is hoped that the current body of work will generate more research interest, thereby leading to a deeper investigation of selected aspects explored here and providing more conclusive and generalisable evidence.

The survey instrument was developed only in English and the linguistic proficiencies of all the participants in the language is unverifiable. It must be acknowledged that Carnatic singers, in particular, may not have had sufficient proficiency in English. To mitigate for this, efforts were made to simplify the survey instrument items in terms of linguistic complexity; and the survey instrument was piloted on Carnatic singers who did not use English on a daily basis for communication and their input was used to clarify/modify any items that were unclear. Moreover, Carnatic music is prevalent in the southern half of the country where the literacy rates are generally higher with one of the states being the most literate state of India. This may indicate a higher prevalence of English literacy among Carnatic singers. Nevertheless, it is still possible that some of the items may have been interpreted differently. Avisati, Le Donné and Paccagnella (2019) reported that cultural norms may mediate the response process of participants when presented with Likert items. Chen et al (1995) also made similar assertions on response styles across nationalities where Japanese and Chinese participants were more likely to use the midpoint of the scales compared to American participants who frequently used the extreme points while responding. Even though there are no similar studies carried out in an Indian population, the study by Chen et al (1995) would mean that the "yardstick" used to indicate the frequency, severity or impact of an item may be influenced by culture; the impact of this difference in the current survey is however difficult to ascertain but important to consider. Translation of the survey instrument was not

attempted in the present survey as there are four languages spoken in South India (Carnatic singing is a South Indian art form) and a translated version in each language was not feasible within the constraints of the current research.

8.10 CLINICAL IMPLICATIONS

The implication of the findings on assessment and management as well as prevention of voice problems in these groups of singers are significant and have been highlighted throughout this thesis. In summary, the current study has reinstated that singers are a special group of voice users; this was reflected in their varied symptom profiles, unique factors that impacted their voices, and a heightened impact of voice problems. Singers may present with normal speaking voices and altered singing voices as depicted in the qualitative study. With the majority of the assessment being “speaking voice” based (also indicated by SLTs in the qualitative study), the probability of undermining or diluting the voice problems experienced by singers while visiting a voice clinic is reasonably high. The findings of this thesis highlight the need for a more thorough and sensitive assessment approach, specifically developed for singers, to be undertaken by all members of a multi-disciplinary voice team. This would include consistently using singing based assessment tools such as SVHI, employing appropriate acoustic and aerodynamic assessments to increase the sensitivity of the assessment process, obtaining a detailed case history outlining all the possible causes (including factors that may only be relevant to singers such as performance anxiety, genres performed by the singing patient, presence of cross-over singing etc.), to provide a deeper and broader evaluation of the singing voice. Also, efforts need to be made for the development of a unified assessment protocol (akin to a minimal data set) to ensure consistency in the way singing voices are assessed across voice clinics.

Such efforts will also significantly improve the quality and quantity of data available for future research involving singing voices. The present study has provided a step forward and established that even within singers, there may be subcategories on the basis of genre as measurable differences have been ascertained between Western classical and Carnatic singers. The present study hopes to inform voice SLTs and related health care professionals (which includes all members of a clinical voice team) regarding the influence of genre and in turn demonstrate the complexities of the singing voice, which may be trivialised or simplified (e.g., by using non singer specific tools or normative data which may not reflect the superior vocal function required for singers) in a clinical or research setting. The

development and use of a separate set of normative data for singers is an important step to accurately assess the above-average vocal requirements of this group.

Voice-related coping is yet to find its place in voice research and within the voice clinic. Clinically, coping is rarely considered both during assessment and therapy (as indicated in the qualitative study). However, the present thesis has indicated that certain coping strategies (*Escape-avoidance*, *Keep to self* etc.) can be predictive of poorer voice outcomes. Identifying the coping philosophies of singers who visit a voice clinic and examining if they are likely to be adaptive or maladaptive (in the current stage of illness) is crucial and is a significant “take home message” from the current body of work. SLTs dealing with injured singing voices would benefit from looking beyond the physical impairments and subsequent disabilities and handicaps and take into account aspects such as coping, which have been linked with voice outcomes in this study. More research pertaining to changes in coping pre and post therapy and their subsequent impacts on voice outcomes will inform SLTs dealing with singing voices regarding the impact of coping and how it may be incorporated in routine clinical activities.

A variety of predictors vocal outcomes/vocal impact were identified through the systematic review and the qualitative study and were then statistically verified in the survey through regression analysis. It is hoped that this information will inform SLTs, singing teachers (and significant others) and subsequently singers to gain a better understanding of how voice problems can be prevented, and which aspects may contribute to vocal impact. This also provides implications to singing teachers to tailor their training methods through taking these predictors into account and thereby ensuring safe singing practices during training.

Singers present with specific sets of needs (as shown in the results) and SLTs must take these into consideration when establishing treatment goals to return the voice to optimal use. This may include a referral to the singing voice specialist who is part of the comprehensive multidisciplinary voice team who could specifically work on transferring the voice techniques to improve singing vocal function and performance.

8.11 FUTURE DIRECTIONS

Although healthcare research encompasses a variety of study designs, methods and subject areas, all are primarily carried out to improve patient care. This can be manifested in the form of better assessment methods (increased sensitivity, reliability and validity, easier methods of administration

etc.); developing, improving or comparing existing treatment options; and creating suitable prevention programmes to ensure maintenance of health. More research to generate normative data which takes into account, the higher vocal requirements of singers is indicated. A more holistic assessment approach needs to be undertaken for singers where the physical, emotional, vocational and psychosocial aspects of voice problems are assessed. Therefore, adapting and validating existing instruments such as VAPP and VoiSS for singers would bring a multidimensional perspective to singing voice assessments. Cultural adaptations of these tools to suit “non-Western populations” rather than simple translations would also be a step in the right direction as most of the current assessment tools such as the Singing Voice Handicap Index are standardised using Western Classical and contemporary singers.

The results of the present study have indicated that coping can predict voice outcomes. This indicates that voice-related coping is an important factor that can have serious implications on treatment of voice problems and maintenance of vocal health. Ascertaining the exact role of coping in further research where coping is considered an “outcome measure” would be useful. It would enable us to identify and understand the factors that influence a singer’s ability to cope with voice problems. Use of both state and trait measures would also ascertain the constant and dynamic aspects of coping that require more clarity.

Studies specifically investigating the impact of genre on vocal health are fairly uncommon in voice research. Such studies provide specificity and pick out issues which may or may not be generalisable to other genres. More research on identifying the genre specific predictors of voice problems would be beneficial in identifying the risk factors and providing tailor-made advice to singers regarding prevention of voice problems and thereby maintaining vocal health. Cross cultural evaluations between Western classical and Carnatic singers, with respect to frequency and clinical presentation of vocal symptoms, vocal practices and coping strategies (influenced by both tutelage and culture) can enable a highly beneficial ‘mutual’ learning platform, wherein the positive attributes from each genre can be imbibed by the other to reduce the risk of developing voice problems and maintain vocal health.

A variety of secondary analyses (e.g., correlations between self-reported attributes and development of voice problems, differences in coping strategies between singers with and without voice problems

etc.) are feasible with the dataset obtained through the survey. These analyses would add further depth to the results and will be undertaken in future.

The present study was restrictive in terms of the assessment methods utilised as it completely relied on self-report. More studies including objective assessment methods such as acoustic analysis of the voice, imaging techniques such as video-laryngoscopy etc. along with self-report measures will provide a more holistic understanding of voice problems in singers. This would also give an opportunity for researchers to assess the alignment of the results produced by the various assessment methods and how they may relate to coping assessments (e.g., do singers with vocal nodules cope differently compared to those with Muscle Tension Dysphonia?).

Since longitudinal studies have the ability to measure changes over time, they would be needed to accurately measure the long-term effects of the predictors identified in this research. Also, such studies can observe the dynamic changes and adaptations occurring in the coping process with the progression (or improvement) of a voice problem. This would provide invaluable data regarding the prognosis and adaptive behaviours and subsequently influence better treatment outcomes. More qualitative studies are also recommended to explore specific aspects of self-reported voice problems and coping to achieve deep and rich content high in specificity.

Given the exhaustive nature of the present thesis, a summary of the intended plans for publishing this body of work will be useful. Table below indicates the publications which have been planned on a chapter by chapter basis.

Table 8.1: Outline of planned publications with corresponding aims and findings

CHAPTER NUMBER	CHAPTER TITLE	PLANNED PUBLICATIONS		
		PAPERS TO BE PUBLISHED	AIMS	FINDINGS
Chapter 2	Self-reported voice problems in classical singers	Entire chapter to be published as a paper	1. How are self reported voice problems assessed? 2. What are the commonly reported self-reported voice problems? 3. What are the factors impacting the voice?	1. Report validated tools used across studies and details of non validated tools 2. Present results separately for validated and non validated tools. Present the symptoms reported across studies (validated and non-validated) and compare validated measure scores with normative (where possible) 3. Report factors impacting voice (mention factors which have been statistically verified to impact voice)
Chapter 3	Voice related coping in professional voice users	Entire chapter published as a paper	PUBLISHED	PUBLISHED
Chapter 4	Qualitative study	Exploring views of SLTs, singing teachers and singers regarding self reported voice problems in singers	1. How do singers, SLTs and vocal coaches describe a normal and pathological voice? 2. What are the vocal problems commonly seen in singers and what are the potential risk factors/causes? 3. How do voice problems impact singers? 4. What are the assessment methods of SLTs working	Present and discuss themes relevant to these research questions which are: Description of normal voice; clinical and non clinical characteristics; factors influencing vocal health; vocal training and its impact on the singing voice; impact of voice problems on the singer; assessment of voice in singers

CHAPTER NUMBER	CHAPTER TITLE	PLANNED PUBLICATIONS		
		PAPERS TO BE PUBLISHED	AIMS	FINDINGS
			with Western Classical or Carnatic singers to evaluate self-reported voice problems?	
Chapter 4	Qualitative study	Exploring views of SLTs, singing teachers and singers regarding voice related coping in singers	1. How do singers cope with voice problems? 2. What are the assessment methods of SLTs working with Western Classical or Carnatic singers to evaluate voice related coping in singers?	1. Present and discuss themes and subthemes relevant to these research questions which are: 2. Coping strategies employed by singers-seeking help and influencing factors, seeking information, self-help, social support, passive coping; assessment of coping-beliefs and practices; factors influencing coping and impact of coping on the singer
Chapters 5, 6 and 7	Survey	Self-reported voice problems in Western classical and Carnatic singers	1. Identify the frequency of self-reported voice problems in Western classical and Carnatic singers 2. Compare the self-reported voice problems between Western classical and Carnatic singers	1. (a) Present the results of the frequency of symptoms scale for each group using descriptive statistics (b) present the results of SVHI for each group using descriptive statistics 2. Compare the results of the frequency of symptoms scale and SVHI between the groups to identify any differences using comparative statistics
		Illness perceptions and voice related coping in Western classical and Carnatic singers	1. Identify the illness perceptions of Western classical and Carnatic singers 2. Identify the coping strategies employed by	1. Present the results of the IPQ for each group using descriptive statistics 2. Present the results of VDCQ for each group using descriptive statistics 3. Compare the IPQ and VDCQ scores between the groups to identify any

CHAPTER NUMBER	CHAPTER TITLE	PLANNED PUBLICATIONS		
		PAPERS TO BE PUBLISHED	AIMS	FINDINGS
			Western classical and Carnatic singers	differences using comparative statistics
		Factors impacting the voice in Western classical and Carnatic singers	1. Identify the predictors of vocal handicap in Western classical and Carnatic singers	1. Present the bivariate results identifying relevant associations between vocal impact (SVHI subscales) and a variety of factors 2. Present the multivariate results to identify the predictors of vocal impact (SVHI subscales)
		Development of a tool to assess vocal symptoms in singers	1. Describe the methods employed to develop the tool 2. Describe the items and subscales (including scoring)	1. Present the method of development (factor analysis to mapping) 2. Present the tool with items and subscales and scoring
		Development of subscales for the Singing Voice Handicap Index	1. Describe the methods employed to develop the tool 2. Describe the items and subscales (including scoring)	1. Present the method of development (factor analysis to mapping) 2. Present the tool with items and subscales and scoring
		Development of VDCQ for singers	1. Describe the methods employed to develop the tool 2. Describe the items and subscales (including scoring)	1. Present the method of development (factor analysis to mapping) 2. Present the tool with items and subscales and scoring

8.12 SUMMARY AND CONCLUSION

Singing voice has always intrigued voice researchers; however, many pivotal aspects related to vocal health and impact are still relatively unexplored. This novel doctoral thesis explored some of these under researched areas, attempting to fill some of the crucial gaps in the literature. Primarily, this research identified the self-reported voice problems, coping strategies and predictors of vocal impact in Western classical and Carnatic singers. Additionally, it also reported on how these two groups of singers maintained their vocal health. An increased vulnerability among Carnatic singers, reporting more frequent vocal symptoms and higher levels of vocal impact is indicative of genre (and possibly culture) impacting vocal health. Similar influences of genre and culture were also evident in the choice of coping strategies between the groups. The similarities and differences in all the outcomes have also been explored and reported.

The symptom profiles, predictive factors and coping strategies reported in this thesis will help relevant service providers (SLTs, singing teachers, VRC etc.) to develop interventions, to best prevent and manage vocal problems and maintain vocal health in singers and to enable singers to deal effectively with vocal difficulties. It is hoped that the exploratory approach undertaken and the strong methodological approach used in the thesis, which incorporated both qualitative and quantitative frameworks, will act as a springboard for future research comparing self-reported voice problems, coping strategies and predictor factors between different singing genres and achieving a deeper understanding of the unique aspects surrounding the enigmatic singing voice.

9 REFERENCES

- Abd-Elfattah, H.M., Abdelazeim, F.H. and Elshennawy, S. (2015) 'Physical and cognitive consequences of fatigue: A Review', *Journal of Advanced Research*, 6(3), pp. 351–358. doi:10.1016/j.jare.2015.01.011.
- Abou-Elsaad, T., Baz, H., Afsah, O. and Abo-Elsoud, H., 2017. Validation and Adaptation of the Singing Voice Handicap Index for Egyptian Singing Voice. *Journal of Voice*, 31(1), pp.130.e1-130.e6.
- Abitbol, J., Brux, J.D., Millot, G., Masson, M.-F., Mimoun, O.L., Pau, H., Abitbol, B., 1989. Does a hormonal vocal cord cycle exist in women? Study of vocal premenstrual syndrome in voice performers by videostroboscopy-glottography and cytology on 38 women. *Journal of Voice* 3, 157–162. [https://doi.org/10.1016/S0892-1997\(89\)80142-0](https://doi.org/10.1016/S0892-1997(89)80142-0)
- Achey, M., He, M. and Akst, L., 2016. Vocal Hygiene Habits and Vocal Handicap Among Conservatory Students of Classical Singing. *Journal of Voice*, 30(2), pp.192-197.
- Ahern, K.J., 1999. Ten Tips for Reflexive Bracketing. *Qual Health Res* 9, 407–411. <https://doi.org/10.1177/104973239900900309>
- Åhlander, V.L., Rydell, R., Löfqvist, A., 2012. How Do Teachers With Self-Reported Voice Problems Differ From Their Peers With Self-Reported Voice Health? *Journal of Voice* 26, e149–e161. <https://doi.org/10.1016/j.jvoice.2011.06.005>
- Åhlander, V., Rydell, R., Fredlund, P., Magnusson, C., Wilén, S., 2019. Prevalence of Voice Disorders in the General Population, Based on the Stockholm Public Health Cohort. *Journal of Voice* 33, 900–905. <https://doi.org/10.1016/j.jvoice.2018.07.007>
- Ahmadi, N., Abbott, K.V., Rajati, F., Khoddami, S.M., Torabinezhad, F., Ebrahimi Takamjani, I., Vasaghi-Gharamaleki, B., 2022. Effects of Laryngeal Manual Therapy on Primary Muscle Tension Dysphonia (MTD-1): Implications for MTD-1 Type. *Journal of Voice* S0892199722001060. <https://doi.org/10.1016/j.jvoice.2022.04.002>
- Akgöl, J., Özkut, B., Denizoglu, İ.İ., Orhon, E.Ş., Aycan, K., Güven, A., 2022. Determining Knowledge Level, Attitude, Behaviors Regarding Vocal Hygiene and Use of Medical Drugs and Herbal Medicinal Products for Vocal Health in Second Level Professional Voice Users. *Journal of Voice* S0892199722002880. <https://doi.org/10.1016/j.jvoice.2022.09.015>
- Almeida, F., Faria, D. and Queirós, A., 2017. Strengths and Limitations of Qualitative and Quantitative Research Methods. *European Journal of Education Studies*, 3(9).
- Alves, M., Krüger, E., Pillay, B., van Lierde, K., van der Linde, J., 2019. The Effect of Hydration on Voice Quality in Adults: A Systematic Review. *Journal of Voice* 33, 125.e13-125.e28. <https://doi.org/10.1016/j.jvoice.2017.10.001>
- Amann, J., Rubinelli, S., Kreps, G.L., 2015. Revisiting the concept of health literacy. The patient as information seeker and provider. *The European Health Psychologist* 17, 286–290.
- Anker, A.E., Reinhart, A.M., Feeley, T.H., 2011. Health information seeking: A review of measures and methods. *Patient Education and Counseling* 82, 346–354. <https://doi.org/10.1016/j.pec.2010.12.008>
- Ano, G.G., Vasconcelles, E.B., 2005. Religious coping and psychological adjustment to stress: A meta-analysis. *J. Clin. Psychol.* 61, 461–480. <https://doi.org/10.1002/jclp.20049>

- Aquino, F. and Teles, L., 2013. Autopercepção vocal de coristas profissionais. *Revista CEFAC*, 15(4), pp.986-993.
- Arber, A., 2006. Reflexivity: A challenge for the researcher as practitioner? *Journal of Research in Nursing* 11, 147–157. <https://doi.org/10.1177/1744987106056956>
- Aronson, A. and Bless, D., 2009. *Clinical Voice Disorders*. N.Y.: Thieme.
- Arunachalam, R., Boominathan, P. and Mahalingam, S., 2014. Clinical Voice Analysis of Carnatic Singers. *Journal of Voice*, 28(1), pp.128.e1-128.e9.
- ASHA, 2020. Voice Disorders: Overview. [online] Asha.org. Available at: <<https://www.asha.org/practice-portal/clinical-topics/voice-disorders/>> [Accessed 7 October 2020].
- Aso, S., Saitou, T., Goto, M., Itoyama, K., Takahashi, T., Komatani, K., Ogata, T., & Okuno, H.G., 2010. SpeakBySinging: Converting singing voices to speaking voices while retaining voice timbre.
- Austenfeld, J.L., Stanton, A.L., 2004. Coping Through Emotional Approach: A New Look at Emotion, Coping, and Health-Related Outcomes. *J Personality* 72, 1335–1364. <https://doi.org/10.1111/j.1467-6494.2004.00299.x>
- Ávila, M.E.B.D., Oliveira, G., Behlau, M., 2010. Índice de desvantagem vocal no canto clássico (IDCC) em cantores eruditos. *Pró-Fono R. Atual. Cient.* 22, 221–226. <https://doi.org/10.1590/S0104-56872010000300011>
- Awan, S. and Ensslen, A., 2010. A Comparison of Trained and Untrained Vocalists on the Dysphonia Severity Index. *Journal of Voice*, 24(6), pp.661-666.
- Awan, S., Novalski, C. and Yingling, J., 2013. Test-Retest Reliability for Aerodynamic Measures of Voice. *Journal of Voice*, 27(6), pp.674-684.
- Avvisati, F., Le Donné, N., Paccagnella, M., 2019. A meeting report: cross-cultural comparability of questionnaire measures in large-scale international surveys. *Meas Instrum Soc Sci* 1, 8. <https://doi.org/10.1186/s42409-019-0010-z>
- Bagnall, A.D., Dorrian, J., Fletcher, A., 2011. Some Vocal Consequences of Sleep Deprivation and the Possibility of “Fatigue Proofing” the Voice With Voicecraft® Voice Training. *Journal of Voice* 25, 447–461. <https://doi.org/10.1016/j.jvoice.2010.10.020>
- Bainbridge, K.E., Roy, N., Losonczy, K.G., Hoffman, H.J., Cohen, S.M., 2017. Voice disorders and associated risk markers among young adults in the United States: Voice Disorders in Young Adults. *The Laryngoscope* 127, 2093–2099. <https://doi.org/10.1002/lary.26465>
- Balasubramaniam, R., Shastry, A., Singh, M. and Bhat, J., 2015. Cepstral Characteristics of Voice in Indian Female Classical Carnatic Singers. *Journal of Voice*, 29(6), pp.693-695.
- Bandura, A., 1997. *Self-efficacy: The exercise of control*. W H Freeman/Times Books/ Henry Holt & Co.
- Baracca, G., Cantarella, G., Forti, S., Pignataro, L. and Fussi, F., 2013. Validation of the Italian version of the Singing Voice Handicap Index. *European Archives of Oto-Rhino-Laryngology*, 271(4), pp.817-823.
- Bartholomew, W., 1934. A Physical Definition of “Good Voice-Quality” in the Male Voice. *The Journal of the Acoustical Society of America*, 5(3), pp.224-224.
- Beck, E., 1993. *The Anatomical Chart Series*. Chicago, Ill.: Anatomical Chart Co., p.22.
- Becker, M., 1974. *The Health Belief Model And Personal Health Behavior*. Thorofare, N.J.: Slack.

- Behrman, A., 2005. Common Practices of Voice Therapists in the Evaluation of Patients. *Journal of Voice*, 19(3), pp.454-469.
- Benninger, M., Jacobson, B. and Johnson, A., 1994. *Vocal Arts Medicine: The Care And Prevention Of Professional Voice Disorders*. New York: Thieme Medical Publishers.
- Benyamini, Y. and Karademas, E., 2019. Introduction to the special issue on the common sense model of self-regulation. *Health Psychology Review*, 13(4), pp.373-377.
- Berghs, G., Creylman, N., Avaux, M., Decoster, W., De Jong, F., 2013. A lifetime of professional singing: Voice parameters and age in the Netherlands Radio Choir. *Logopedics Phoniatrics Vocology* 38, 59–63. <https://doi.org/10.3109/14015439.2012.731082>
- Besser, A., Lotem, S., Zeigler-Hill, V., 2022. Psychological Stress and Vocal Symptoms Among University Professors in Israel: Implications of the Shift to Online Synchronous Teaching During the COVID-19 Pandemic. *Journal of Voice* 36, 291.e9-291.e16. <https://doi.org/10.1016/j.jvoice.2020.05.028>
- Bestwick-Stevenson, T. et al. (2022) 'Assessment of fatigue and recovery in sport: Narrative review', *International Journal of Sports Medicine*, 43(14), pp. 1151–1162. doi:10.1055/a-1834-7177.
- Biasutti, M. and Concina, E. 2014. The role of coping strategy and experience in predicting music performance anxiety. *Musicae Scientiae*, 18(2), pp.189-202.
- Billings, A.G., Moos, R.H., 1981. The role of coping responses and social resources in attenuating the stress of life events. *J Behav Med* 4, 139–157. <https://doi.org/10.1007/BF00844267>
- Boersma, P., 2001. Praat, a system for doing phonetics by computer. *Glott International* 5:9/10, 341-345.
- Boominathan, P., 2004. Do Carnatic singer's have singer's formant? – An exploratory study. *Proceedings of The Frontiers of Research in Speech and Music conference*.
- Boominathan, P., 2012. *Acoustic Analysis Of The Singing Voice Of Trained Carnatic Singers Untrained Light Music Singers And Non Singers*, Ph.D. Sri Ramachandra Medical College and Research Institute.
- Boominathan, P., Madhavan, A. and Ravi, S., 2006. Singing frequency range in trained Carnatic singers. *Frontiers of Research in Speech and Music*.
- Boone, D.R., McFarlane, S.C., Von Berg, S.L., 2005. *The voice and voice therapy*, 7th ed. ed. Pearson/Allyn & Bacon, Boston, MA.
- Borge, C.R., Moum, T., Puline Lein, M., Austegard, E.L., Wahl, A.K., 2014. Illness perception in people with chronic obstructive pulmonary disease. *Scand J Psychol* 55, 456–463. <https://doi.org/10.1111/sjop.12150>
- Borrell-Carrio, F., 2004. The Biopsychosocial Model 25 Years Later: Principles, Practice, and Scientific Inquiry. *The Annals of Family Medicine* 2, 576–582. <https://doi.org/10.1370/afm.245>
- Boulet, M.J., Oddens, B.J., 1996. Female voice changes around and after the menopause — an initial investigation. *Maturitas* 23, 15–21. [https://doi.org/10.1016/0378-5122\(95\)00947-7](https://doi.org/10.1016/0378-5122(95)00947-7)
- Brandtstädter, J. 1992. Personal control over development: Some developmental implications of self-efficacy. In R. Schwarzer (Ed.), *Self-efficacy: Thought control of action* (p. 127–145). Hemisphere Publishing Corp.
- Brantigan, C.O., Brantigan, T.A., Joseph, N., 1982. Effect of beta blockade and beta stimulation on stage fright. *The American Journal of Medicine* 72, 88–94. [https://doi.org/10.1016/0002-9343\(82\)90592-7](https://doi.org/10.1016/0002-9343(82)90592-7)

- Broadbent, E., Petrie, K.J., Main, J., Weinman, J., 2006. The Brief Illness Perception Questionnaire. *Journal of Psychosomatic Research* 60, 631–637. <https://doi.org/10.1016/j.ipsychores.2005.10.020>
- Broadbent, E., Wilkes, C., Koschwanetz, H., Weinman, J., Norton, S., Petrie, K.J., 2015. A systematic review and meta-analysis of the Brief Illness Perception Questionnaire. *Psychology & Health* 30, 1361–1385. <https://doi.org/10.1080/08870446.2015.1070851>
- Button, L., 2008. Effect of social support and coping strategies on the relationship between health care-related occupational stress and health. *Journal of Research in Nursing*, 13(6), pp.498-524.
- Caffier, P.P., Salmen, T., Ermakova, T., Forbes, E., Ko, S.-R., Song, W., Gross, M., Nawka, T., 2017. Phonomicrosurgery in Vocal Fold Nodules: Quantification of Outcomes in Professional and Non-Professional Voice Users. *Medical Problems of Performing Artists* 32, 187–194. <https://doi.org/10.21091/mppa.2017.4035>
- Cammarota, G., Masala, G., Cianci, R., Palli, D., Capaccio, P., Schindler, A., Cuoco, L., Galli, J., Ierardi, E., Cannizzaro, O., Caselli, M., Dore, M., Bendinelli, B. and Gasbarrini, G., 2007. Reflux Symptoms in Professional Opera Choristers. *Gastroenterology*, 132(3), pp.890-898.
- Cantor Cutiva, L.C., Vogel, I., Burdorf, A., 2013. Voice disorders in teachers and their associations with work-related factors: A systematic review. *Journal of Communication Disorders* 46, 143–155. <https://doi.org/10.1016/j.jcomdis.2013.01.001>
- Carding, P. and Horsley, I., 1992. An evaluation study of voice therapy in non-organic dysphonia. *International Journal of Language & Communication Disorders*, 27(2), pp.137-158.
- Carminati, L., 2018. Generalizability in Qualitative Research: A Tale of Two Traditions. *Qual Health Res* 28, 2094–2101. <https://doi.org/10.1177/1049732318788379>
- Carver, C.S., Scheier, M.F., Weintraub, J.K., 1989. Assessing coping strategies: A theoretically based approach. *Journal of Personality and Social Psychology* 56, 267–283. <https://doi.org/10.1037/0022-3514.56.2.267>
- Castelblanco, L., Habib, M., Stein, D., de Quadros, A., Cohen, S. and Noordzij, J., 2014. Singing Voice Handicap and Videostrobolaryngoscopy in Healthy Professional Singers. *Journal of Voice*, 28(5), pp.608-613.
- Le Cessie, S., Goeman, J.J., Dekkers, O.M., 2020. Who is afraid of non-normal data? Choosing between parametric and non-parametric tests. *European Journal of Endocrinology* 182, E1–E3. <https://doi.org/10.1530/EJE-19-0922>
- Chandra, A., 2001. Relationship Between Fundamental Frequency Of Voice And ‘A:Dha:Ra Shruthi’ In Carnatic Vocal Music. Masters. University of Mysore.
- Chandramowli, G., 2015. Analysis Of Established Performing Styles And Their Various Aspects Contributing To The Development Of Carnatic Music. Ph.D. Annamalai University.
- Check, J., Schutt, R.K., 2012. *Research Methods in Education*. SAGE Publications, Inc., 1 Oliver’s Yard, 55 City Road London EC1Y 1SP. <https://doi.org/10.4135/9781544307725>
- Chen, G.-M., 1995. Differences in Self-Disclosure Patterns among Americans Versus Chinese: A Comparative Study. *Journal of Cross-Cultural Psychology* 26, 84–91. <https://doi.org/10.1177/0022022195261006>
- Cho, J.-H., Guilminault, C., Joo, Y.-H., Jin, S.-K., Han, K.-D., Park, C.-S., 2017. A possible association between dysphonia and sleep duration: A cross-sectional study based on the Korean National Health and nutrition examination surveys from 2010 to 2012. *PLoS ONE* 12, e0182286. <https://doi.org/10.1371/journal.pone.0182286>

- Christensen, A. and Moran, P., 1998. Psychological Aspects of End-Stage Renal Disease, In: Bellack, A. and Hersen, M., 1998. *Comprehensive Clinical Psychology*. Amsterdam: Pergamon, pp.321-338.
- Clarós, P., Clarós-Pujol, A., Clarós, A., 2018. Arytenoid asymmetry in opera singers. *European Annals of Otorhinolaryngology, Head and Neck Diseases* 135, 389–392. <https://doi.org/10.1016/j.anorl.2018.08.014>
- Clarós, P., Blebea, C., Pujol, M.C., Clarós-Pujol, A., Clarós, A., 2021. Voice After Rhinoplasty. An Important Question for the Opera Singers. *Journal of Voice* 35, 614–617. <https://doi.org/10.1016/j.jvoice.2019.11.024>
- Cohen J., 1988. *Statistical Power Analysis for the Behavioral Sciences*. New York, NY: Routledge Academic
- Cohen, S., Jacobson, B., Garrett, C., Noordzij, J., Stewart, M., Attia, A., Ossoff, R. and Cleveland, T., 2007. Creation and Validation of the Singing Voice Handicap Index. *Annals of Otology, Rhinology & Laryngology*, 116(6), pp.402-406.
- Cohen, S.M., Noordzij, J.P., Garrett, C.G., Ossoff, R.H., 2008. Factors associated with perception of singing voice handicap. *Otolaryngol.--head neck surg.* 138, 430–434. <https://doi.org/10.1016/j.otohns.2007.12.041>
- Cohen, S., Statham, M., Rosen, C. and Zullo, T., 2009. Development and validation of the singing voice handicap-10. *The Laryngoscope*, 119(9), pp.1864-1869.
- Cohen, S.M., Lee, H.-J., Roy, N., Misono, S., 2017. Chronicity of Voice-Related Health Care Utilization in the General Medicine Community. *Otolaryngol Head Neck Surg* 156, 693–701. <https://doi.org/10.1177/0194599816688203>
- Costa, C.B., Costa, L.H.C., Oliveira, G., Behlau, M., 2011. Immediate effects of the phonation into a straw exercise. *Braz. j. otorhinolaryngol. (Impr.)* 77, 461–465. <https://doi.org/10.1590/S1808-86942011000400009>
- Crocco, L., Madill, C. and McCabe, P., 2017. Evidence-based Frameworks for Teaching and Learning in Classical Singing Training: A Systematic Review. *Journal of Voice*, 31(1), pp.130.e7-130.e17.
- Cross, M., March, L., Lapsley, H., Byrne, E. and Brooks, P., 2005. Patient self-efficacy and health locus of control: relationships with health status and arthritis-related expenditure. *Rheumatology*, 45(1), pp.92-96.
- Dassie-Leite, A.P., Duprat, A. de C., Busch, R., 2010. Comparação de hábitos de bem estar vocal entre cantores líricos e populares. *Rev. CEFAC* 13, 123–131. <https://doi.org/10.1590/S1516-18462010005000118>
- Davies., G. and Jahn, A., 2004. *Care Of The Professional Voice : A Guide To Voice Management For Singers, Actors And Professional Voice Users*. 2nd ed. London: A&C Black Publishers Limited.
- Davis, C., Lee Davis, M., 1993. The effects of premenstrual syndrome (PMS) on the female singer. *Journal of Voice* 7, 337–353. [https://doi.org/10.1016/S0892-1997\(05\)80257-7](https://doi.org/10.1016/S0892-1997(05)80257-7)
- Davis, D., 2020. Presenting research reflexivity in your PhD thesis. *Nurse Researcher* 28, 37–43. <https://doi.org/10.7748/nr.2020.e1644>
- Dayme, M., 2009. *Dynamics Of The Singing Voice*. New York: Springer.
- Deary, I.J., Wilson, J.A., Carding, P.N., MacKenzie, K., 2003. VoiSS. *Journal of Psychosomatic Research* 54, 483–489. [https://doi.org/10.1016/S0022-3999\(02\)00469-5](https://doi.org/10.1016/S0022-3999(02)00469-5)
- De Araújo Pernambuco, L., Espelt, A., Balata, P.M.M., De Lima, K.C., 2015. Prevalence of voice disorders in the elderly: a systematic review of population-based studies. *Eur Arch Otorhinolaryngol* 272, 2601–2609. <https://doi.org/10.1007/s00405-014-3252-7>

- de Assis Moura Ghirardi, A., Piccolotto Ferreira, L., Pimentel Pinto Giannini, S. and Dias de Oliveira Latorre, M., 2013. Screening Index for Voice Disorder (SIVD): Development and Validation. *Journal of Voice*, 27(2), pp.195-200.
- Defatta, R., Sataloff, R.T., 2012. The Value of Vocal Warm-up and Cool-down Exercises: Questions and Controversies. *Journal of singing* 69, 173–175.
- de Freitas Valadares, G., Occhi-Alexandre, I.G.P., Teixeira, L.C., 2020. Sense of Coherence and Coping Strategies in Patients With Dysphonia. *Journal of Voice* S0892199720303556.
<https://doi.org/10.1016/j.jvoice.2020.09.012>
- de Jong, F.I.C.R.S., Cornelis, B.E., Wuyts, F.L., Kooijman, P.G.C., Schutte, H.K., Oudes, M.J., Graamans, K., 2003. A Psychological Cascade Model for Persisting Voice Problems in Teachers. *Folia Phoniatr Logop* 55, 91–101.
<https://doi.org/10.1159/000070091>
- Dejonckere, P., Bradley, P., Clemente, P., Cornut, G., Crevier-Buchman, L., Friedrich, G., Van De Heyning, P., Remacle, M. and Woisard, V., 2001. A basic protocol for functional assessment of voice pathology, especially for investigating the efficacy of (phonosurgical) treatments and evaluating new assessment techniques. *European Archives of Oto-Rhino-Laryngology*, 258(2), pp.77-82.
- Denizoglu, İ., 2016. Validation and reliability of Turkish Singing Voice Handicap index. *The Turkish Journal of Ear Nose and Throat*, 26(1), pp.1-6.
- Denzin, N. K. (1970). *The research act: A theoretical introduction to sociological methods*. Chicago, IL: Aldine.
- In: Fusch, P., Fusch, G.E., Ness, L.R., 2018. Denzin's Paradigm Shift: Revisiting Triangulation in Qualitative Research. *JOSC* 10. <https://doi.org/10.5590/JOSC.2018.10.1.02>
- Devadas, U., Kumar, P. and Maruthy, S., 2020. Prevalence of and Risk Factors for Self-Reported Voice Problems Among Carnatic Singers. *Journal of Voice*, 34(2), pp.303.e1-303.e15.
- Devadas, U., Hegde, M., Maruthy, S., 2019. Prevalence and Risk Factors of Self-reported Voice Problems Among Yakshagana Artists. *Journal of Voice* 33, 124.e35-124.e47. <https://doi.org/10.1016/j.jvoice.2017.09.010>
- Devadas, U., Vinod, D. and Maruthy, S., 2019. Cross-Cultural Adaptation and Validation of the Evaluation of the Ability to Sing Easily (EASE) for Kannada-Speaking Carnatic Classical Singers. *Journal of Voice*.
- Edgar, K. and Skinner, T., 2003. Illness Representations and Coping as Predictors of Emotional Well-being in Adolescents with Type 1 Diabetes. *Journal of Pediatric Psychology*, 28(7), pp.485-493.
- Elangovan, N. and Rajendran, R., 2015. Conceptual Model: A Framework for Institutionalizing the Vigor in Business Research. *IBM 2015 Proceedings*.
- Elfström, M., Rydén, A., Kreuter, M., Taft, C. and Sullivan, M., 2005. Relations Between Coping Strategies and Health-Related Quality Of Life In Patients With Spinal Cord Lesion. *Journal of Rehabilitation Medicine*, 37(1), pp.9-16.
- Elliot, N., Sundberg, J., Gramming, P., 1995. What happens during vocal warm-up? *Journal of Voice* 9, 37–44.
[https://doi.org/10.1016/S0892-1997\(05\)80221-8](https://doi.org/10.1016/S0892-1997(05)80221-8)
- Elliott, M., 2017. Singing Through Menopause: Reactions and Responses – Survey Results. *Journal of Singing* 73, 269–278.
- Endler, N.S., Parker, J.D., 1990. Multidimensional assessment of coping: A critical evaluation. *Journal of Personality and Social Psychology* 58, 844–854. <https://doi.org/10.1037/0022-3514.58.5.844>

- Engel, G.L., 1977. The Need for a New Medical Model: A Challenge for Biomedicine. *Science* 196, 129–136. <https://doi.org/10.1126/science.847460>
- Epstein, R., Hirani, S.P., Stygall, J., Newman, S.P., 2009. How Do Individuals Cope With Voice Disorders? Introducing the Voice Disability Coping Questionnaire. *Journal of Voice* 23, 209–217. <https://doi.org/10.1016/j.jvoice.2007.09.001>
- Epstein, R., Stygall, J. and Newman, S., 1997. The short-term impact of Botox injections on speech disability in adductor spasmodic dysphonia. *Disability and Rehabilitation*, 19(1), pp.20-25.
- Faham, M., Ahmadi, A., Hosseinifar, S., Iravani, K. and Azimi, H., 2019. Cross-cultural Adaptation and Validation of the Persian Version of Voice Disability Coping Questionnaire (P-VDCQ): Introducing a New Instrument. *Journal of Voice*, 33(4), pp.435-440.
- Faul, F., Erdfelder, E., Buchner, A., Lang, A.-G., 2009. Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods* 41, 1149–1160. <https://doi.org/10.3758/BRM.41.4.1149>
- Fernholz, I., Mumm, J.L.M., Plag, J., Noeres, K., Rotter, G., Willich, S.N., Ströhle, A., Berghöfer, A., Schmidt, A., 2019. Performance anxiety in professional musicians: a systematic review on prevalence, risk factors and clinical treatment effects. *Psychol. Med.* 49, 2287–2306. <https://doi.org/10.1017/S0033291719001910>
- Ferracciu, C.C.S., Santos, L.V. de A., Teixeira, L.R., Almeida, M.S., 2015. Estratégias de enfrentamento e perfil de participação e atividades vocais em professoras da rede pública de ensino com e sem distúrbios de voz. *Rev. CEFAC* 17, 1184–1194. <https://doi.org/10.1590/1982-0216201517415714>
- Field., 2009. Autocorrelation statistical value of the Durbin-Watson. 220-221.
- Fiuza, M.B., Sevillano, M.L., Lã, F.M.B., 2023. Singing at menopause: A systematic review with pedagogical implications. *Musicae Scientiae* 27, 193–217. <https://doi.org/10.1177/10298649211047884>
- Flick, U., 2007. *Designing Qualitative Research*. SAGE Publications, Ltd, 1 Oliver's Yard, 55 City Road, London England EC1Y 1SP United Kingdom. <https://doi.org/10.4135/9781849208826>
- Folkman, S., 2007. The case for positive emotions in the stress process. *Anxiety, Stress, & Coping*, 21(1), pp.3-14.
- Franca, M.C., Simpson, K.O., 2009. Effects of Hydration on Voice Acoustics. *CICSD* 36, 142–148. https://doi.org/10.1044/cicsd_36_F_142
- Francis, D.O., Daniero, J.J., Hovis, K.L., Sathe, N., Jacobson, B., Penson, D.F., Feurer, I.D., McPheeters, M.L., 2017. Voice-Related Patient-Reported Outcome Measures: A Systematic Review of Instrument Development and Validation. *J Speech Lang Hear Res* 60, 62–88. https://doi.org/10.1044/2016_JSLHR-S-16-0022
- Francis, J., Johnston, M., Robertson, C., Glidewell, L., Entwistle, V., Eccles, M. and Grimshaw, J., 2010. What is an adequate sample size? Operationalising data saturation for theory-based interview studies. *Psychology & Health*, 25(10), pp.1229-1245.
- Frazier, P., Keenan, N., Anders, S., Perera, S., Shallcross, S., Hintz, S., 2011. Perceived past, present, and future control and adjustment to stressful life events. *Journal of Personality and Social Psychology* 100, 749–765. <https://doi.org/10.1037/a0022405>
- Gale, N., Heath, G., Cameron, E., Rashid, S. and Redwood, S., 2013. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology*, 13(1).

- Gallicchio, L., Kalesan, B., 2009. Sleep duration and mortality: a systematic review and meta-analysis. *Journal of Sleep Research* 18, 148–158. <https://doi.org/10.1111/j.1365-2869.2008.00732.x>
- Garg, S., Anand, T., 2015. Menstruation related myths in India: strategies for combating it. *J Family Med Prim Care* 4, 184. <https://doi.org/10.4103/2249-4863.154627>
- Gauffin, J. and Hammarberg, B., 1991. *Vocal Fold Physiology*. San Diego, Calif: Singular Pub. Group.
- Gaunt, R., Herbs., 2015. *Home Medicine, and Self-Reliance: A Study on the Current Status of Traditional Home Medicine in Idukki District, Kerala. Independent Study Project (ISP) Collection*. 2078.
- Gearing, R.E., 2004. Bracketing in Research: A Typology. *Qual Health Res* 14, 1429–1452. <https://doi.org/10.1177/1049732304270394>
- Ghaemi, H., Dehqan, A., Mahmoodi-Bakhtiari, B. and Sobhani-rad, D., 2020. The Singing Voice Handicap Index (SVHI): Validation and Adaptation Into Persian. *Journal of Voice*, 34(1), pp.158.e17-158.e23.
- Gillespie, A. and Abbott, K., 2010. The influence of clinical terminology on self-efficacy for voice. *Logopedics Phoniatrics Vocology*, 36(3), pp.91-99.
- Gilman, M., Merati, A., Klein, A., Hapner, E. and Johns, M., 2009. Performer's Attitudes Toward Seeking Health Care for Voice Issues: Understanding the Barriers. *Journal of Voice*, 23(2), pp.225-228.
- Gliklich, R., Glovsky, R. and Montgomery, W., 1999. Validation of a Voice Outcome Survey for Unilateral Vocal Cord Paralysis. *Otolaryngology–Head and Neck Surgery*, 120(2), pp.153-158.
- Gotaas, C., Starr, C.D., 1993. Vocal Fatigue Among Teachers. *Folia Phoniatri Logop* 45, 120–129. <https://doi.org/10.1159/000266237>
- Gray, G. and Wise, C., 1959. *The Bases Of Speech*. Joanna Cotler Books.
- Greenaway, K.H., Louis, W.R., Parker, S.L., Kalokerinos, E.K., Smith, J.R., Terry, D.J., 2015b. Measures of Coping for Psychological Well-Being, in: *Measures of Personality and Social Psychological Constructs*. Elsevier, pp. 322–351. <https://doi.org/10.1016/B978-0-12-386915-9.00012-7>
- Goy, H., Fernandes, D.N., Pichora-Fuller, M.K., Van Lieshout, P., 2013. Normative Voice Data for Younger and Older Adults. *Journal of Voice* 27, 545–555. <https://doi.org/10.1016/j.jvoice.2013.03.002>
- Greene, M. and Mathieson, L., 2002. *Greene And Mathieson's Voice And Its Disorders*. 6th ed. London ; New Jersey: Whurr Publishers.
- Gunjawate, D., Aithal, V., Guddattu, V., Kishore, A. and Bellur, R., 2016. Exploring Attitudes of Indian Classical Singers Toward Seeking Vocal Health Care. *Journal of Voice*, 30(6), pp.761.e23-761.e26.
- Gunjawate, D.R., Aithal, V.U., Ravi, R., Venkatesh, B.T., 2017. The Effect of Menstrual Cycle on Singing Voice: A Systematic Review. *Journal of Voice* 31, 188–194. <https://doi.org/10.1016/j.jvoice.2016.04.018>
- Gunjawate, D., Ravi, R. and Bellur, R., 2018. Acoustic Analysis of Voice in Singers: A Systematic Review. *Journal of Speech, Language, and Hearing Research*, 61(1), pp.40-51.
- Gunjawate, D.R., Aithal, V.U., Guddattu, V., Bellur, R., 2017. Adaptation and Validation of the Kannada Version of the Singing Voice Handicap Index. *Journal of Voice* 31, 507.e7-507.e11. <https://doi.org/10.1016/j.jvoice.2016.10.012>

- Guzman, M., Barros, M., Espinoza, F., Herrera, A., Parra, D., Muñoz, D., Lloyd, A., 2013. Laryngoscopic, Acoustic, Perceptual, and Functional Assessment of Voice in Rock Singers. *Folia Phoniatr Logop* 65, 248–256. <https://doi.org/10.1159/000357707>
- Haddon, E., 2009. Instrumental and vocal teaching: how do music students learn to teach?. *British Journal of Music Education*, 26(1), pp.57-70.
- Hagger, M., Koch, S., Chatzisarantis, N. and Orbell, S., 2017. Supplemental Material for The Common Sense Model of Self-Regulation: Meta-Analysis and Test of a Process Model. *Psychological Bulletin*,.
- Hagger, M.S., Orbell, S., 2003. A Meta-Analytic Review of the Common-Sense Model of Illness Representations. *Psychology & Health* 18, 141–184. <https://doi.org/10.1080/088704403100081321>
- Haile, L., Gallagher, M., Robertson, R.J., 2015. *Perceived exertion laboratory manual: from standard practice to contemporary application*. Springer, New York.
- Hakes, J., Shipp, T. and Doherty, E., 1987. Acoustic properties of straight tone, vibrato, trill, and trillo. *Journal of Voice*, 1(2), pp.148-156.
- Hale, E., Treharne, G. and Kitas, G., 2007. The Common-Sense Model of self-regulation of health and illness: how can we use it to understand and respond to our patients' needs?. *Rheumatology*, 46(6), pp.904-906.
- Han, P.K.J., Klein, W.M.P., Arora, N.K., 2011. Varieties of Uncertainty in Health Care: A Conceptual Taxonomy. *Med Decis Making* 31, 828–838. <https://doi.org/10.1177/0272989X10393976>
- Heman-Ackah, Y.D., Dean, C.M., Sataloff, R.T., 2002. Stroboscovideolaryngoscopic Findings in Singing Teachers. *Journal of Voice* 16, 81–86. [https://doi.org/10.1016/S0892-1997\(02\)00075-9](https://doi.org/10.1016/S0892-1997(02)00075-9)
- Higgins O, Sixsmith J, Barry MM, Domegan C. A literature review on health information- seeking behaviour on the web: a health consumer and health professional perspective. Stockholm: ECDC; 2011.
- Hill, S., Dziedzic, K., Thomas, E., Baker, S. and Croft, P., 2007. The illness perceptions associated with health and behavioural outcomes in people with musculoskeletal hand problems: findings from the North Staffordshire Osteoarthritis Project (NorStOP). *Rheumatology*, 46(6), pp.944-951.
- Hillenbrand, J., 2011. *Acoustic Analysis of Voice: A Tutorial*. Perspectives on Speech Science and Orofacial Disorders, 21(2), pp.31-43.
- Hirano, M., 1981. *Clinical Examination Of Voice*. Wien: Springer, pp.83-84.
- Hirano, M., 1988. Vocal mechanisms in singing: Laryngological and phoniatic aspects. *Journal of Voice*, [online] 2(1), pp.51-69. Available at: <<https://www.sciencedirect.com/science/article/pii/S0892199788800584>>.
- Hočevár-Boltežar, I., Šereg-Bahar, M., Kravos, A., Mumović, G. and Mitrović, S., 2012. Is an occupation with vocal load a risk factor for laryngopharyngeal reflux: a prospective, multicentre, multivariate comparative study. *Clinical Otolaryngology*, 37(5), pp.362-368.
- Hoch, M., 2018. Historical Landmarks in Singing Voice Pedagogy. *Voice and Speech Review*, [online] 13(1), pp.43-60. Available at: <<https://www.tandfonline.com/doi/abs/10.1080/23268263.2018.1527585>>.
- Hogan, J., Dolan, P. and Donnelley, P., 2009. *Approaches To Qualitative Research: Theory And Its Practical Application (A Guide For Dissertation Students)*. Cork: Oak Tree Press.
- Hogikyan, N.D., Sethuraman, G., 1999. Validation of an instrument to measure voice-related quality of life (V-RQL). *Journal of Voice* 13, 557–569. [https://doi.org/10.1016/S0892-1997\(99\)80010-1](https://doi.org/10.1016/S0892-1997(99)80010-1)

- Holden, G., 1992. The Relationship of Self-Efficacy Appraisals to Subsequent Health Related Outcomes. *Social Work in Health Care*, 16(1), pp.53-93.
- Holloway, I. and Todres, L., 2003. The Status of Method: Flexibility, Consistency and Coherence. *Qualitative Research*, 3(3), pp.345-357.
- Hong, J.H., Lachman, M.E., Charles, S.T., Chen, Y., Wilson, C.L., Nakamura, J.S., VanderWeele, T.J., Kim, E.S., 2021. The positive influence of sense of control on physical, behavioral, and psychosocial health in older adults: An outcome-wide approach. *Preventive Medicine* 149, 106612. <https://doi.org/10.1016/j.ypmed.2021.106612>
- Hugh-Munier, C., Scherer, K., Lehmann, W. and Scherer, U., 1997. Coping strategies, personality, and voice quality in patients with vocal fold nodules and polyps. *Journal of Voice*, 11(4), pp.452-461.
- Hulin, C., Cudeck, R., Netemeyer, R., Dillon, W.R., McDonald, R., Bearden, W., 2001. Can a Reliability Coefficient Be Too High. *Journal of Consumer Psychology* 10, 55–69. https://doi.org/10.1207/S15327663JCP1001&2_05
- Hunter, E.J., Tanner, K., Smith, M.E., 2011. Gender differences affecting vocal health of women in vocally demanding careers. *Logopedics Phoniatrics Vocology* 36, 128–136. <https://doi.org/10.3109/14015439.2011.587447>
- Hunter, E.J., Titze, I.R., 2009. Quantifying Vocal Fatigue Recovery: Dynamic Vocal Recovery Trajectories after a Vocal Loading Exercise. *Ann Otol Rhinol Laryngol* 118, 449–460. <https://doi.org/10.1177/000348940911800608>
- Iglesias-Rey, M., Barreiro-de Acosta, M., Caamaño-Isorna, F., Vázquez-Rodríguez, I., González, A., Lindkvist, B. and Domínguez-Muñoz, E., 2013. How do psychological variables influence coping strategies in inflammatory bowel disease?. *Journal of Crohn's and Colitis*, 7(6), pp.e219-e226.
- Iliffe, s., Wilcock, j. and Drennan, V., 2015. Changing Practice In Dementia Care In The Community: Developing And Testing Evidence-Based Interventions, From Timely Diagnosis To End Of Life (EVIDEM). [ebook] Southampton: NIHR, p.Appendix 65. Available at: <<https://www.ncbi.nlm.nih.gov/books/NBK286110/>> [Accessed 18 July 2020].
- Ilomäki, I., Leppänen, K., Kleemola, L., Tyrmi, J., Laukkanen, A. and Vilkman, E., 2009. Relationships between self-evaluations of voice and working conditions, background factors, and phoniatric findings in female teachers. *Logopedics Phoniatrics Vocology*, 34(1), pp.20-31.
- Jacobson, B.H., Johnson, A., Grywalski, C., Silbergleit, A., Jacobson, G., Benninger, M.S., Newman, C.W., 1997. The Voice Handicap Index (VHI): Development and Validation. *Am J Speech Lang Pathol* 6, 66–70. <https://doi.org/10.1044/1058-0360.0603.66>
- Jager, J., Putnick, D.L., Bornstein, M.H., 2017. II. More than just convenient: the scientific merits of homogeneous convenience samples: developmental methodology. *Monographs Society Res Child* 82, 13–30. <https://doi.org/10.1111/mono.12296>
- Jiang, J. and Maytag, A., 2014. Aerodynamic measures of glottal function. *Current Opinion in Otolaryngology & Head and Neck Surgery*, 22(6), pp.450-454.
- Jithin, K.V., 2014. Role Of Media In The Development Of Carnatic Music. Ph.D. Kannur University.
- Jones, K., Sigmon, J., Hock, L., Nelson, E., Sullivan, M., Ogren, F., 2002. Prevalence and Risk Factors for Voice Problems Among Telemarketers. *Arch Otolaryngol Head Neck Surg* 128, 571. <https://doi.org/10.1001/archotol.128.5.571>

- Kaneko, M., Sugiyama, Y., Mukudai, S., Hirano, S., 2020. Effect of Voice Therapy Using Semioccluded Vocal Tract Exercises in Singers and Nonsingers With Dysphonia. *Journal of Voice* 34, 963.e1-963.e9. <https://doi.org/10.1016/j.jvoice.2019.06.014>
- Kapoor, A., Upadhyay, M.K., Saini, N.K., 2022. Relationship of eating behavior and self-esteem with body image perception and other factors among female college students of University of Delhi. *J Educ Health Promot* 11, 80. https://doi.org/10.4103/iehp.iejhp_855_21
- Karulkar, R.R., Ravi, R., Gunjawate, D.R., 2021. Voice-related complaints and vocal and nonvocal habits of Hindustani classical singers: a questionnaire-based study. *Logopedics Phoniatrics Vocology* 46, 149–154. <https://doi.org/10.1080/14015439.2020.1788158>
- Kapsner-Smith, M.R., Hunter, E.J., Kirkham, K., Cox, K., Titze, I.R., 2015. A Randomized Controlled Trial of Two Semi-Occluded Vocal Tract Voice Therapy Protocols. *J Speech Lang Hear Res* 58, 535–549. https://doi.org/10.1044/2015_JSLHR-S-13-0231
- Kato, K., Zweig, R., Schechter, C.B., Barzilai, N., Atzmon, G., 2016. Positive attitude toward life, emotional expression, self-rated health, and depressive symptoms among centenarians and near-centenarians. *Aging & Mental Health* 20, 930–939. <https://doi.org/10.1080/13607863.2015.1056770>
- Keenan, A. and McBain, G., 1979. Effects of Type A Behaviour, Intolerance of Ambiguity, and Locus of Control on the Relationship Between Role Stress and Work-Related Outcomes. *Journal of Occupational Psychology*, 52(4), pp.277-285.
- Kempster, G., Gerratt, B., Verdolini Abbott, K., Barkmeier-Kraemer, J. and Hillman, R., 2009. Consensus Auditory-Perceptual Evaluation of Voice: Development of a Standardized Clinical Protocol. *American Journal of Speech-Language Pathology*, 18(2), pp.124-132.
- Kenny, D., 2010. The role of negative emotions in performance anxiety. In Juslin P. N. (Ed.), *Handbook of music and emotion: Theory, research, applications*. Oxford, UK: Oxford University Press.
- Kiebles, J., Doerfler, B. and Keefer, L., 2010. Preliminary evidence supporting a framework of psychological adjustment to inflammatory bowel disease†. *Inflammatory Bowel Diseases*, 16(10), pp.1685-1695.
- Kim, J.-S., Kim, Sukil, Moon, T.-H., Park, S., Kim, S.H., Kim, Subin, Lee, D.-H., Kim, B.G., Chang, K.-H., Park, J.-O., 2023. Effect of Occupational Noise Exposure on the Prevalence of Benign Vocal Fold Lesions: A Nationwide Population-Based Study. *Clin Exp Otorhinolaryngol* 16, 87–94. <https://doi.org/10.21053/ceo.2022.01298>
- Kitch, J.A., Oates, J., 1994. The perceptual features of vocal fatigue as self-reported by a group of actors and singers. *Journal of Voice* 8, 207–214. [https://doi.org/10.1016/S0892-1997\(05\)80291-7](https://doi.org/10.1016/S0892-1997(05)80291-7)
- Konnai, R., Jayaram, M. and Scherer, R., 2010. Development and Validation of a Voice Disorder Outcome Profile for an Indian Population. *Journal of Voice*, 24(2), pp.206-220.
- Koopman, J., 2020. A Brief History Of Singing. [online] www2.lawrence.edu. Available at: <<https://www2.lawrence.edu/fast/KOOPMAJO/antiquity.html>> [Accessed 5 October 2020].
- Koufman, J. and Isaacson, G., 1991. The Spectrum of Vocal Dysfunction. *Otolaryngologic Clinics of North America*, 24(5), pp.985-988.
- Kreiman, J., Gerratt, B., Kempster, G., Erman, A. and Berke, G., 1993. Perceptual Evaluation of Voice Quality. *Journal of Speech, Language, and Hearing Research*, 36(1), pp.21-40.

- Kretchy, I., Owusu-Daaku, F. and Danquah, S., 2014. Locus of control and anti-hypertensive medication adherence in Ghana. *Pan African Medical Journal*, 17.
- Krohne, H. W., 1993. Vigilance and cognitive avoidance as concepts in coping research. In: Krohne, H., 1993. *Attention And Avoidance*. Seattle: Hogrefe & Huber Publishers.
- Krom, G., 1993. A Cepstrum-Based Technique for Determining a Harmonics-to-Noise Ratio in Speech Signals. *Journal of Speech, Language, and Hearing Research*, [online] 36(2), pp.254-266. Available at: <<https://pubs.asha.org/doi/10.1044/jshr.3602.254>>.
- Kronenberg, L., Goossens, P., van Busschbach, J., van Achterberg, T. and van den Brink, W., 2015. Coping styles in substance use disorder (SUD) patients with and without co-occurring attention deficit/hyperactivity disorder (ADHD) or autism spectrum disorder (ASD). *BMC Psychiatry*, 15(1).
- Kukull, W.A., Ganguli, M., 2012. Generalizability: The trees, the forest, and the low-hanging fruit. *Neurology* 78, 1886–1891. <https://doi.org/10.1212/WNL.0b013e318258f812>
- Kwok, M. and Eslick, G., 2019. The Impact of Vocal and Laryngeal Pathologies Among Professional Singers: A Meta-analysis. *Journal of Voice*, 33(1), pp.58-65.
- Lã, Filipa., Davidson, J.W., Ledger, W., Howard, D., Jones, G., 2007. A Case-Study on the Effects of the Menstrual Cycle and the Use of a Combined Oral Contraceptive Pill on the Performance of a Western Classical Singer: An Objective and Subjective Overview. *Musicae Scientiae* 11, 85–107. <https://doi.org/10.1177/10298649070110S205>
- Lachman, M.E., Neupert, S.D., Agrigoroaei, S., 2011. The Relevance of Control Beliefs for Health and Aging, in: *Handbook of the Psychology of Aging*. Elsevier, pp. 175–190. <https://doi.org/10.1016/B978-0-12-380882-0.00011-5>
- Lam Tang, J.A., Boliek, C.A., Rieger, J.M., 2008. Laryngeal and Respiratory Behavior During Pitch Change in Professional Singers. *Journal of Voice* 22, 622–633. <https://doi.org/10.1016/j.jvoice.2007.04.002>
- Lambert, S.D., Loiselle, C.G., 2007. Health Information—Seeking Behavior. *Qual Health Res* 17, 1006–1019. <https://doi.org/10.1177/1049732307305199>
- LaPine, P., 2008. The Relationship between the Physical Aspects of Voice Production and Optimal Vocal Health. *Music Educators Journal*, 94(3), pp.24-29.
- Larrouy-Maestri, P., Morsomme, D., 2014. The Effects of Stress on Singing Voice Accuracy. *Journal of Voice* 28, 52–58. <https://doi.org/10.1016/j.jvoice.2013.07.008>
- Laukkanen, A., Leppänen, K. and Ilomäki, I., 2009. Self-Evaluation of Voice as a Treatment Outcome Measure. *Folia Phoniatica et Logopaedica*, 61(1), pp.57-65.
- Lazarus, R. and Folkman, S., 1984. *Stress, Appraisal, And Coping*. New York: Springer.
- Lazarus, R. and Folkman, S., 1988. *Ways of Coping Questionnaire: research edition manual*.
- Lechien, J.R., Schindler, A., Robotti, C., Lejeune, L., Finck, C., 2019. Laryngopharyngeal reflux disease in singers: Pathophysiology, clinical findings and perspectives of a new patient-reported outcome instrument. *European Annals of Otorhinolaryngology, Head and Neck Diseases* 136, S39–S43. <https://doi.org/10.1016/j.anorl.2018.08.008>
- Lee, A.R., Sim, H.S., 2013. The Korean Version of the Singing Voice Handicap Index. *Commun Sci & Dis* 18, 194–202. <https://doi.org/10.12963/csd.13019>

- Lee, H.-Y., Oh, J., Kawachi, I., Heo, J., Kim, S., Lee, J.-K., Kang, D., 2019. Positive and negative social support and depressive symptoms according to economic status among adults in Korea: cross-sectional results from the Health Examinees-Gem Study. *BMJ Open* 9, e023036. <https://doi.org/10.1136/bmjopen-2018-023036>
- Lehto, L., Rantala, L., Vilkman, E., Alku, P. and Bäckström, T., 2003. Experiences of a Short Vocal Training Course for Call-Centre Customer Service Advisors. *Folia Phoniatica et Logopaedica*, 55(4), pp.163-176.
- Leventhal, H., Meyer, D., & Nerenz, D. 1980. The common sense representation of illness danger. In S. Rachman (Ed.), *Medical psychology* (Vol II, pp.7-30), New York: Pergamon Press.
- Lumley, T., Diehr, P., Emerson, S., Chen, L., 2002. The Importance of the Normality Assumption in Large Public Health Data Sets. *Annu. Rev. Public Health* 23, 151–169. <https://doi.org/10.1146/annurev.publhealth.23.100901.140546>
- Lierde, K.M., D’haeseleer, E., Baudonck, N., Claeys, S., De Bodt, M., Behlau, M., 2011. The Impact of Vocal Warm-Up Exercises on the Objective Vocal Quality in Female Students Training to be Speech Language Pathologists. *Journal of Voice* 25, e115–e121. <https://doi.org/10.1016/j.jvoice.2009.11.004>
- Lloyd, A.T., Ruddy, B.H., Silverman, E., Lewis, V.M., Lehman, J.J., 2017. Quantifying Laryngopharyngeal Reflux in Singers: Perceptual and Objective Findings. *BioMed Research International* 2017, 1–10. <https://doi.org/10.1155/2017/3918214>
- Lo Buono, V., Corallo, F., Bramanti, P. and Marino, S., 2016. Coping strategies and health-related quality of life after stroke. *Journal of Health Psychology*, 22(1), pp.16-28.
- Loiola-Barreiro, C.M., Silva, M.A.D.A.E., 2016. Índice de desvantagem vocal em cantores populares e eruditos profissionais. *CoDAS* 28, 602–609. <https://doi.org/10.1590/2317-1782/20162015226>
- Lombard, E., 1911. Le signe de l’élévation de la voix. *Ann. Malad. l’Oreille Larynx*, 37, pp.101-119. In: Brumm, H. and Zollinger, S., 2011. The evolution of the Lombard effect: 100 years of psychoacoustic research. *Behaviour*, 148(11-13), pp.1173-1198.
- Loor, A., Nedelecuț, S., Dumitrașcu, D.L., 2020. High prevalence of gastroesophageal reflux in vocal opera students. A case-control type study. *Medicine and Pharmacy Reports*. <https://doi.org/10.15386/mpr-1370>
- Lorenz, A., Kleber, B., Büttner, M., Fuchs, M., Mürbe, D., Richter, B., Sandel, M. and Nawka, T., 2013. Validierung des Singing Voice Handicap Index in der deutschen Fassung. *HNO*, 61(8), pp.699-706.
- Lundy, D.S., Casiano, R.R., Sullivan, P.A., Roy, S., Xue, J.W., Evans, J., 1999. Incidence of abnormal laryngeal findings in asymptomatic singing students. *Otolaryngol.--head neck surg.* 121, 69–77. [https://doi.org/10.1016/S0194-5998\(99\)70128-2](https://doi.org/10.1016/S0194-5998(99)70128-2)
- Ma, E.P.-M., Yiu, E.M.-L., 2001b. Voice Activity and Participation Profile: Assessing the Impact of Voice Disorders on Daily Activities. *J Speech Lang Hear Res* 44, 511–524. [https://doi.org/10.1044/1092-4388\(2001/040\)](https://doi.org/10.1044/1092-4388(2001/040))
- Maddux, J. and Rogers, R., 1983. Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *Journal of Experimental Social Psychology*, 19(5), pp.469-479.
- Mahalingam, S., Boominathan, P., 2016. Effects of steam inhalation on voice quality-related acoustic measures: Steam Inhalation and Acoustic Voice Measures. *The Laryngoscope* 126, 2305–2309. <https://doi.org/10.1002/lary.25933>

- Martins, R.H.G., do Amaral, H.A., Tavares, E.L.M., Martins, M.G., Gonçalves, T.M., Dias, N.H., 2016. Voice Disorders: Etiology and Diagnosis. *Journal of Voice* 30, 761.e1-761.e9. <https://doi.org/10.1016/j.jvoice.2015.09.017>
- Maruthy, S. and Ravibabu, P., 2015. Comparison of Dysphonia Severity Index Between Younger and Older Carnatic Classical Singers and Nonsingers. *Journal of Voice*, 29(1), pp.65-70.
- Mathieson L. 1993. Vocal tract discomfort in hyperfunctional dysphonia. *Voice*, 2, 40–48.
- Mathmann, P., Konerding, U., Deuster, D., Neumann, K., 2021. The Influence of Age, Gender, Health-Related Behaviors, and Other Factors on Occupationally Relevant Health Complaints of Singers. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2021.08.001>
- Mausbach, B.T., Roepke, S.K., Chattillion, E.A., Harmell, A.L., Moore, R., Romero-Moreno, R., Bowie, C.R., Grant, I., 2012. Multiple mediators of the relations between caregiving stress and depressive symptoms. *Aging Ment Health* 16, 27–38. <https://doi.org/10.1080/13607863.2011.615738>
- Mazzetto De Menezes, K.S., Master, S., Guzman, M., Bortnem, C., Ramos, L.R., 2014. Differences in Acoustic and Perceptual Parameters of the Voice Between Elderly and Young Women at Habitual and High Intensity. *Acta Otorrinolaringologica (English Edition)* 65, 76–84. <https://doi.org/10.1016/j.otoeng.2013.11.012>
- McAuliffe, C., Corcoran, P., Keeley, H.S., Arensman, E., Bille-Brahe, U., De LEO, D., Fekete, S., Hawton, K., Hjelmeland, H., Kelleher, M., Kerkhof, A.J.F.M., Lönnqvist, J., Michel, K., Salander-Renberg, E., Schmidtke, A., Van Heeringen, K., Wasserman, D., 2006. Problem-solving ability and repetition of deliberate self-harm: a multicentre study. *Psychol. Med.* 36, 45–55. <https://doi.org/10.1017/S0033291705005945>
- McElpatrick, S., Carson, J., Annett, J., Cooper, C., Holloway, F. and Kuipers, E., 2000. Assessing coping skills in mental health nurses: is an occupation specific measure better than a generic coping skills scale?. *Personality and Individual Differences*, 28(5), pp.965-976.
- McGlashan, J., Aaen, M., White, A. and Sadolin, C (2023) A mixed-method feasibility study of the use of the Complete Vocal Technique (CVT), a pedagogic method to improve the voice and vocal function in singers and actors, in the treatment of patients with Muscle Tension Dysphonia: A study protocol, Pilot and Feasibility Studies, 9(1). doi:10.1186/s40814-023-01317-y.
- McHenry, M.A., Evans, J., 2017. Aerobic Exercise as a Warm-up for Singing: Acoustic Impacts. *Journal of Voice* 31, 438–441. <https://doi.org/10.1016/j.jvoice.2016.10.023>
- McIver, J.P., Carmines, E.G., 1981. Unidimensional scaling, Sage university papers series. Sage Publications, Beverly Hills.
- Meulenbroek, L.F.P., de Jong, F.I.C.R.S., 2010. Trainee Experience in Relation to Voice Handicap, General Coping and Psychosomatic Well-Being in Female Student Teachers: A Descriptive Study. *Folia Phoniatr Logop* 62, 47–54. <https://doi.org/10.1159/000239063>
- Meulenbroek, L.F.P., Thomas, G., Kooijman, P.G.C., de Jong, F.I.C.R.S., 2010. Biopsychosocial impact of the voice in relation to the psychological features in female student teachers. *Journal of Psychosomatic Research* 68, 379–384. <https://doi.org/10.1016/j.jpsychores.2009.10.002>
- Miller, M. and Verdolini, K., 1995. Frequency and risk factors for voice problems in teachers of singing and control subjects. *Journal of Voice*, 9(4), pp.348-362.

Miller, R., 1997. National Schools Of Singing: English, French, German, And Italian Techniques Of Singing Revisited. Lanham: Scarecrow Press.

Misono, S., Meredith, L., Peterson, C.B., Frazier, P.A., 2016. New Perspective on Psychosocial Distress in Patients With Dysphonia: The Moderating Role of Perceived Control. *Journal of Voice* 30, 172–176. <https://doi.org/10.1016/j.jvoice.2015.02.002>

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., for the PRISMA Group, 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ* 339, b2535–b2535. <https://doi.org/10.1136/bmj.b2535>

Moos, R. and Holahan, C., 2003. Dispositional and contextual perspectives on coping: Toward an integrative framework. *Journal of Clinical Psychology*, 59(12), pp.1387-1403.

Morawska, J., Politanski, P., Sliwinska-Kowalska, M. and Niebudek-Bogusz, E., 2019. Validation of the Polish Version of Voice Disability Coping Questionnaire (PL-VDCQ). *Otolaryngologia*, 18(3), pp.101-109.

Moreti, F., Ávila, M.E.B.D., Rocha, C., Borrego, M.C.D.M., Oliveira, G., Behlau, M., 2012. Influência da queixa e do estilo de canto na desvantagem vocal de cantores. *J. Soc. Bras. Fonoaudiol.* 24, 296–300. <https://doi.org/10.1590/S2179-64912012000300017>

Morsomme, D., Gaspar, M., Jamart, J., Remacle, M., Verduyck, I., 2007. Adaptation du voice handicap index à la voix chantée [Voice handicap index adapted to the singing voice]. *Rev Laryngol Otol Rhinol (Bord)* 128, 305–314.

Nacci, A., Bastiani, L., Barillari, M.R., Martinelli, M., Lechien, J.R., Simoni, F., Berrettini, S., Fattori, B., 2022. Reflux Symptom Index (RSI) and Singing Voice Handicap Index (SVHI) in Singing Students: A Pilot Study. *Journal of Voice* 36, 288.e25-288.e34. <https://doi.org/10.1016/j.jvoice.2020.05.005>

Nair, R.M., Joshi, A., Gunjawate, D.R., 2021. Knowledge, Attitude and Practices Towards Vocal Health Care Amongst Indian Carnatic Singers. *Journal of Voice* S0892199721002381. <https://doi.org/10.1016/j.jvoice.2021.07.004>

Nazer, S., V.K, V., 2016. Pitch Range Comparison between Trained Singers, Amateur Singers and Non-Singers. *Language in India* 16.

Neipp, M., López-Roig, S. and Pastor, M., 2007. Control beliefs in cancer: A literature review. *Anuario de Psicología*, 38(3).

Neto, L., Meyer, D., 2017. A Joyful Noise: The Vocal Health of Worship Leaders and Contemporary Christian Singers. *Journal of Voice* 31, 250.e17-250.e21. <https://doi.org/10.1016/j.jvoice.2016.07.012>

Neumann, F., 1970. Ornament and structure. *The Musical Quarterly*, LVI (2), pp.153-161.

Nunez, F. and Garcia-Lopez, I., 2010. Validation of the Singing Voice Handicap Index Into Spanish. *Otolaryngology–Head and Neck Surgery*, 143(2_suppl), pp.P221-P221.

Nusseck, M., Spahn, C., Echternach, M., Immerz, A., Richter, B., 2020. Vocal Health, Voice Self-concept and Quality of Life in German School Teachers. *Journal of Voice* 34, 488.e29-488.e39. <https://doi.org/10.1016/j.jvoice.2018.11.008>

Oates, J. and Russell, A., 1998. Learning voice analysis using an interactive multi-media package: Development and preliminary evaluation. *Journal of Voice*, 12(4), pp.500-512.

- Oates, J., 2009. Auditory-Perceptual Evaluation of Disordered Voice Quality. *Folia Phoniatrica et Logopaedica*, 61(1), pp.49-56.
- Olf, M., Brosschot, J.F., Godaert, G., 1993. Coping styles and health. *Personality and Individual Differences* 15, 81–90. [https://doi.org/10.1016/0191-8869\(93\)90044-4](https://doi.org/10.1016/0191-8869(93)90044-4)
- Oliveira, G., Hirani, S., Epstein, R., Yazigi, L. and Behlau, M., 2016. Validation of the Brazilian Version of the Voice Disability Coping Questionnaire. *Journal of Voice*, 30(2), pp.247.e13-247.e21.
- Ouzzani, M., Hammady, H., Fedorowicz, Z., Elmagarmid, A., 2016. Rayyan—a web and mobile app for systematic reviews. *Syst Rev* 5, 210. <https://doi.org/10.1186/s13643-016-0384-4>
- Pallant, J., 2020. SPSS survival manual: a step by step guide to data analysis using IBM SPSS, Seventh edition. ed. Routledge, Place of publication not identified.
- Palo Alto California: Consulting Psychologists Press. In: Lundqvist, L. and Ahlström, G., 2006. Psychometric evaluation of the Ways of Coping Questionnaire as applied to clinical and nonclinical groups. *Journal of Psychosomatic Research*, 60(5), pp.485-493.
- Palsule, M., 2015. What Is Western Classical Music? How Is It Different From Indian Classical Music? | Serenade. [online] Serenade. Available at: <<https://serenademagazine.com/series/music-education/what-is-western-classical-music-how-is-it-different-from-indian-classical-music/>> [Accessed 7 October 2020].
- Paoliello, K.B.G., Pereira, L.D., Behlau, M., 2021. Voice Quality and Auditory Processing in Subjects with and Without Musical Experience. *Journal of Voice* 35, 9–17. <https://doi.org/10.1016/j.jvoice.2019.07.006>
- Paolillo, N. and Pantaleo, G., 2015. Development and Validation of the Voice Fatigue Handicap Questionnaire (VFHQ): Clinical, Psychometric, and Psychosocial Facets. *Journal of Voice*, 29(1), pp.91-100.
- Pargament, K.I., Smith, B.W., Koenig, H.G., Perez, L., 1998. Patterns of Positive and Negative Religious Coping with Major Life Stressors. *Journal for the Scientific Study of Religion* 37, 710. <https://doi.org/10.2307/1388152>
- Penley, J.A., Tomaka, J., Wiebe, J.S., 2002. The Association of Coping to Physical and Psychological Health Outcomes: A Meta-Analytic Review. *Journal of Behavioral Medicine* 25, 551–603. <https://doi.org/10.1023/A:1020641400589>
- Pestana, P.M., Vaz-Freitas, S., Manso, M.C., 2017. Prevalence of Voice Disorders in Singers: Systematic Review and Meta-Analysis. *Journal of Voice* 31, 722–727. <https://doi.org/10.1016/j.jvoice.2017.02.010>
- Pestana, P.M., Vaz-Freitas, S., Manso, M.C., 2020. Prevalence, Characterization, and Impact of Voice Disorders in Fado Singers. *Journal of Voice* 34, 380–386. <https://doi.org/10.1016/j.jvoice.2018.10.015>
- Petekkaya, E., Özandaç Polat, S. and Hilmi Yücel, A., 2018. Comparative Analysis of Vocal Intensity and Aerodynamic Parameters between Singers and Non-Singers. *SM Otolaryngology*, 2(1), pp.1-4.
- Petty, B., 2012. Health Information-Seeking Behaviors Among Classically Trained Singers. *Journal of Voice*, 26(3), pp.330-335.
- Phyland, D., Oates, J. and Greenwood, K., 1999. Self-reported voice problems among three groups of professional singers. *Journal of Voice*, 13(4), pp.602-611.
- Phyland, D., Pallant, J., Benninger, M., Thibeault, S., Greenwood, K., Smith, J. and Vallance, N., 2013. Development and Preliminary Validation of the EASE: A Tool to Measure Perceived Singing Voice Function. *Journal of Voice*, 27(4), pp.454-462.

- Phyland, D., Thibeault, S., Benninger, M., Vallance, N., Greenwood, K. and Smith, J., 2013. Perspectives on the Impact on Vocal Function of Heavy Vocal Load Among Working Professional Music Theater Performers. *Journal of Voice*, 27(3), pp.390.e31-390.e39.
- Pinheiro, J., Silverio, K., Siqueira, L., Ramos, J., Brasolotto, A., Zambon, F. and Behlau, M., 2017. Correlation between vocal tract symptoms and modern singing handicap index in church gospel singers. *CoDAS*, 29(4).
- Piowarczyk, T.C., Oliveira, G., Lourenço, L., Behlau, M., 2012. Vocal Symptoms, Voice Activity, and Participation Profile and Professional Performance of Call Center Operators. *Journal of Voice* 26, 194–200. <https://doi.org/10.1016/j.jvoice.2011.02.006>
- Ponto, PhD, Aprn, Agcns-Bc, Aocns®, J., 2015. Understanding and Evaluating Survey Research. *JADPRO* 6. <https://doi.org/10.6004/jadpro.2015.6.2.9>
- Prebil, N., Hočevár Boltežar, I. and Šereg Bahar, M., 2020. Risk Factors for Voice Problems in Professional Actors and Singers. *Slovenian Journal of Public Health*, 59(2), pp.92-98.
- Pregun, I., Bakucz, T., Banai, J., Molnár, L., Pavlik, G., Altorjay, I., Orosz, P., Csernay, L., Tulassay, Z., Herszényi, L., 2009. Gastroesophageal Reflux Disease: Work-Related Disease? *Dig Dis* 27, 38–44. <https://doi.org/10.1159/000210102>
- Prickett, S., 2007. Guru or Teacher? Shishya or Student? Pedagogic Shifts in South Asian Dance Training in India and Britain. *South Asia Research* 27, 25–41. <https://doi.org/10.1177/026272800602700102>
- Prior, B.R., Cursiol, J.A., Almeida Prado, M.Y.D., Aguiar Ricz, L.N., 2023. Effect of COVID-19 Quarantine on Voice Handicap Index in Female Classical Singers. *Journal of Voice* 37, 145.e1-145.e6. <https://doi.org/10.1016/j.jvoice.2020.11.020>
- Prochaska, J.O., Velicer, W.F., Rossi, J.S., Goldstein, M.G., Marcus, B.H., Rakowski, W., Fiore, C., Harlow, L.L., Redding, C.A., Rosenbloom, D., Rossi, S.R., 1994. Stages of change and decisional balance for 12 problem behaviors. *Health Psychology* 13, 39–46. <https://doi.org/10.1037/0278-6133.13.1.39>
- Rachman, S., 1980. *Medical Psychology*. Pergamon press, New York.
- Radnitz C.L., Tiersky L. (2007) Psychodynamic and Cognitive Theories of Coping. In: Martz E., Livneh H. (eds) *Coping with Chronic Illness and Disability*. Springer, Boston, MA
- Ragan, K., 2016. The Impact of Vocal Cool-down Exercises: A Subjective Study of Singers' and Listeners' Perceptions. *Journal of Voice* 30, 764.e1-764.e9. <https://doi.org/10.1016/j.jvoice.2015.10.009>
- Rajan, M., Vijayasanen, D. and Vijayakumar, A., 2019. Predicting \$Gamaka\$ s—The Essential Embellishments in Karnatic Music. *IEEE Access*, [online] 7, pp.175386-175395. Available at: <https://www.researchgate.net/publication/337704438_Predicting_Gamakas_-_The_Essential_Embellishments_in_Karnatic_Music>.
- Rammohan, A., 2002. *The Handbook Of Tamil Culture And Heritage*: International Tamil Language Foundation. National Publishing Co.
- Randolph, G., Sritharan, N., Song, P., Franco, R., Kamani, D., Woodson, G., 2015. Y Thyroidectomy in the Professional Singer-Neural Monitored Surgical Outcomes. *Thyroid : official journal of the American Thyroid Association* 25. <https://doi.org/10.1089/thy.2014.0467>

- Rangarajan, A., Santhanam, D.P., Selvaraj, J.L., 2020. Translation and Validation of Tamil Version of Singing Voice Handicap Index-10 (TSVHI-10). *Journal of Voice* 34, 158.e9-158.e16.
<https://doi.org/10.1016/j.jvoice.2018.08.003>
- Rangarajan, A., Selvaraj, J.L., Santhanam, D.P., 2019. The Voice-Related Quality Of Life: A Study on the Reliability and Validity of the Tamil Version. *Clin Med Insights Ear Nose Throat* 12, 117955061983104.
<https://doi.org/10.1177/1179550619831049>
- Rezende, G., Irineu, R.D.A., Dornelas, R., 2015. Coro universitário: autopercepção de sintomas vocais e desvantagem vocal no canto. *Rev. CEFAC* 17, 1161–1172. <https://doi.org/10.1590/1982-0216201517415114>
- Richardson, D.B., Hamra, G.B., MacLehose, R.F., Cole, S.R., Chu, H., 2015. Hierarchical Regression for Analyses of Multiple Outcomes. *Am. J. Epidemiol.* 182, 459–467. <https://doi.org/10.1093/aje/kwv047>
- Ritchie, J. and Lewis, J., 2003. *Qualitative Research Practice*. London: Sage.
- Ritchie, J. and Spencer, L. 1994. Qualitative data analysis for applied policy research. In: Bryman, A. and Burgess, B., 2002. *Analyzing Qualitative Data*. Hoboken: Taylor and Francis.
- Robertson, I., Cooper, C., Williams, J. and Williams, J., 1990. The validity of the occupational stress indicator. *Work & Stress*, 4(1), pp.29-39.
- Robinson, S.A., Lachman, M.E., 2017. Perceived Control and Aging: A Mini-Review and Directions for Future Research. *Gerontology* 63, 435–442. <https://doi.org/10.1159/000468540>
- Rocha, B., Moreti, F., Amin, E., Madazio, G. and Behlau, M., 2014. Cross-cultural adaptation of the Brazilian version of the protocol Evaluation of the Ability to Sing Easily. *CoDAS*, 26(6), pp.535-539.
- Rodica-Elena, M., Alexandra-Sabina, P., 2017. Evaluación multidimensional de la calidad de voz de los futuros intérpretes vocales de élite. *Rev. ORL* 8. <https://doi.org/10.14201/orl201784.15785>
- Rong, X., Peng, Y., Yu, H., Li, D., 2018. Factors associated with adoption of coping strategies among Chinese patients with heart failure in ethnic minority regions. *J Clin Nurs* 27, 3324–3334.
<https://doi.org/10.1111/jocn.14199>
- Ropero Rendón, M.D.M., Ermakova, T., Freymann, M.-L., Ruschin, A., Nawka, T., Caffier, P.P., 2018. Efficacy of Phonosurgery, Logopedic Voice Treatment and Vocal Pedagogy in Common Voice Problems of Singers. *Adv Ther* 35, 1069–1086. <https://doi.org/10.1007/s12325-018-0725-x>
- Rosen, C. and Murry, T., 2000. Voice Handicap Index in singers. *Journal of Voice*, 14(3), pp.370-377.
- Rosen, C., Lee, A., Osborne, J., Zullo, T. and Murry, T., 2004. Development and Validation of the Voice Handicap Index-10. *The Laryngoscope*, 114(9), pp.1549-1556.
- Roth, P.L., 1994. Missing data: a conceptual review for applied psychologists. *Personnel Psychology* 47, 537–560. <https://doi.org/10.1111/j.1744-6570.1994.tb01736.x>
- Roy, N., Merrill, R., Thibeault, S., Parsa, R., Gray, S. and Smith, E., 2004. Prevalence of Voice Disorders in Teachers and the General Population. *Journal of Speech, Language, and Hearing Research*, 47(2), pp.281-293.
- Roy, N., Merrill, R.M., Gray, S.D., Smith, E.M., 2005. Voice Disorders in the General Population: Prevalence, Risk Factors, and Occupational Impact: The Laryngoscope 115, 1988–1995.
<https://doi.org/10.1097/01.mlg.0000179174.32345.41>

- Rutter, M., 2006. Implications of Resilience Concepts for Scientific Understanding. *Annals of the New York Academy of Sciences*, 1094(1), pp.1-12.
- Ryan, M., Kenny, D.T., 2009. Perceived Effects of the Menstrual Cycle on Young Female Singers in the Western Classical Tradition. *Journal of Voice* 23, 99–108. <https://doi.org/10.1016/j.jvoice.2007.05.004>
- Sala, E., Laine, A., Simberg, S., Pentti, J. and Suonpää, J., 2001. The Prevalence of Voice Disorders Among Day Care Center Teachers Compared with Nurses. *Journal of Voice*, 15(3), pp.413-423.
- Sandage, M. and Emerich, K., 2002. Singing Voice. *The ASHA Leader*, 7(13), pp.6-15.
- Sandage, M.J., Connor, N.P., Pascoe, D.D., 2014. Vocal Function and Upper Airway Thermoregulation in Five Different Environmental Conditions. *J Speech Lang Hear Res* 57, 16–25. [https://doi.org/10.1044/1092-4388\(2013/13-0015](https://doi.org/10.1044/1092-4388(2013/13-0015)
- Sapienza, C. and Hoffman-Ruddy, B., 2016. *Voice Disorders*. 3rd ed. San Diego: Plural Publishing Inc.
- Sapir, S., 1993. Vocal attrition in voice students: Survey findings. *Journal of Voice* 7, 69–74. [https://doi.org/10.1016/S0892-1997\(05\)80113-4](https://doi.org/10.1016/S0892-1997(05)80113-4)
- Sapir, S., Mathers-Schmidt, B. and Larson, G., 1996. Singers' and non-singers' vocal health, vocal behaviours, and attitudes towards voice and singing: indirect findings from a questionnaire. *International Journal of Language & Communication Disorders*, 31(2), pp.193-209.
- Sataloff, R.T., 1997. *Professional voice: the science and art of clinical care*, 2nd ed. ed. Singular Pub. Group, San Diego.
- Sawyer, A.T., Harris, S.L., Koenig, H.G., 2019. Illness perception and high readmission health outcomes. *Health Psychology Open* 6, 205510291984450. <https://doi.org/10.1177/2055102919844504>
- Scherer, K., 1986. Voice, Stress and Emotion. In: Appley, M. and Trumbull, R., 1986. *Dynamics Of Stress: Physiological, Psychological And Social Perspectives*. New York: Plenum Publishing Corporation, pp.157-179.
- Schoenmakers, E., van Tilburg, T. and Fokkema, T., 2015. Problem-focused and emotion-focused coping options and loneliness: how are they related?. *European Journal of Ageing*, 12(2), pp.153-161.
- Schloneger, M.J., 2011. Graduate Student Voice Use and Vocal Efficiency in an Opera Rehearsal Week: A Case Study. *Journal of Voice* 25, e265–e273. <https://doi.org/10.1016/j.jvoice.2010.09.010>
- Schreurs, P. J. G., van de Willige, G., Tellegen, B., & Brosschot, J. F. 1993. Herziene handleiding Utrechtse Coping Lijst (UCL). Lisse: Swets & Zeitlinger B.V. In: Turner, H., Bryant-Waugh, R., Peveler, R. and Bucks, R., 2012. A Psychometric Evaluation of an English Version of the Utrecht Coping List. *European Eating Disorders Review*, 20(4), pp.339-342.
- Schwarzer, R., & Schwarzer, C. 1996. A critical survey of coping instruments. In: M. Zeidner & N. S. Endler (Eds.), *Handbook of coping: Theory, research, applications* (p. 107–132). John Wiley & Sons.
- Seashore, C., 1931. The Natural History of the Vibrato. *Proceedings of the National Academy of Sciences*, 17(12), pp.623-626.
- Sege, C.T., Bradley, M.M., Lang, P.J., 2018. Avoidance and escape: Defensive reactivity and trait anxiety. *Behaviour Research and Therapy* 104, 62–68. <https://doi.org/10.1016/j.brat.2018.03.002>
- Selye, 1956., in: *Government Model Science College*, Sharma, D.K., 2018. *Physiology of Stress and its Management*. MSR 1, 1–5. <https://doi.org/10.24966/MSR-5657/100001>

- Sessions, M., 2020. An Analysis of Dairy and its Effects on Vocal Production. Undergraduate Research Journal: Vol. 24 , Article 10.
- Setia, M., 2016. Methodology series module 3: Cross-sectional studies. Indian J Dermatol 61, 261. <https://doi.org/10.4103/0019-5154.182410>
- Shankar, V., 1999. The Art And Science Of Carnatic Music. Chennai: Parampara. In: Boominathan, P., 2012. Acoustic Analysis Of The Singing Voice Of Trained Carnatic Singers Untrained Light Music Singers And Non Singers,. Ph.D. Sri Ramachandra Medical College and Research Institute.
- Sharma, A., 2015. Voice Cultivation In Hindustani Classical And Western Music A Comparative Study. Ph.D. Panjab University.
- Shaw, C., 1999. A framework for the study of coping, illness behaviour and outcomes. Journal of Advanced Nursing, 29(5), pp.1246-1255.
- Sheff, 2016. Your lungs and exercise. Breathe 12, 97–100. <https://doi.org/10.1183/20734735.ELF121>
- Shiloh, S., 2006. Illness Representations, Self-Regulation, and Genetic Counseling: A Theoretical Review. Journal of Genetic Counseling 15, 325–337. <https://doi.org/10.1007/s10897-006-9044-5>
- Shrivastav, R. and Wingate, J. M., 2015. Perceptual Attributes and Assessment of the Singer's Voice. In: Benninger, M., Murry, T. and Johns, M., 2015. The Performer's Voice. 2nd ed. San Diego: Plural Publishing Inc, pp.179-192.
- Sielska-Badurek, E., Sobol, M., Cioch, A., Osuch-Wójcikiewicz, E., Rzepakowska, A. and Niemczyk, K., 2017. Adaptation and validation of the Singing Voice Handicap Index into Polish. Clinical Otolaryngology, 42(5), pp.994-999.
- Siupsinskiene, N., Lycke, H., 2011. Effects of Vocal Training on Singing and Speaking Voice Characteristics in Vocally Healthy Adults and Children Based on Choral and Nonchoral Data. Journal of Voice 25, e177–e189. <https://doi.org/10.1016/j.jvoice.2010.03.010>
- Sivasankar, M., Leydon, C., 2010. The role of hydration in vocal fold physiology. Current Opinion in Otolaryngology & Head & Neck Surgery 18, 171–175. <https://doi.org/10.1097/MOO.0b013e3283393784>
- Skinner, E., Edge, K., Altman, J. and Sherwood, H., 2003. Searching for the structure of coping: A review and critique of category systems for classifying ways of coping. Psychological Bulletin, 129(2), pp.216-269.
- Smith, E., Verdolini, K., Gray, S., Nichols, S., Lemke, J., Barkmeier, J., Dove, h. and Hoffman, H., 1996. Effect of voice disorders on quality of life. Journal of Medical Speech-Language Pathology, 4(4), pp.223-244.
- Smith, G., 2018. Step away from stepwise. J Big Data 5, 32. <https://doi.org/10.1186/s40537-018-0143-6>
- Smith, J. and Firth, J., 2011. Qualitative data analysis: the framework approach. Nurse Researcher, 18(2), pp.52-62.
- Soley-Bori, M. (2013) 'Dealing with missing data: key assumptions and methods for applied analysis', Boston University school of Public Health technical report.
- Solomon, N., 2008. Vocal fatigue and its relation to vocal hyperfunction. International journal of speech-language pathology 10, 254–66. <https://doi.org/10.1080/14417040701730990>
- Sparks, F. et al. (2023) 'Tracheoesophageal voice therapy in Postlaryngectomy Rehabilitation: A systematic review', Journal of Voice [Preprint]. doi:10.1016/j.jvoice.2023.10.033.

- Speyer, R., Wieneke, G. and Dejonckere, P., 2004. Self-assessment of voice therapy for chronic dysphonia. *Clinical Otolaryngology and Allied Sciences*, 29(1), pp.66-74.
- Spilka, B., Hood, R. W. and Gorsuch, R. L., 1985. *The psychology of religion: An empirical approach*. Englewood Cliffs, NJ: Prentice-Hall. In: Prado, G., Feaster, D.J., Schwartz, S.J., Pratt, I.A., Smith, L., Szapocznik, J., 2004. Religious Involvement, Coping, Social Support, and Psychological Distress in HIV-Seropositive African American Mothers. *AIDS Behav* 8, 221–235. <https://doi.org/10.1023/B:AIBE.0000044071.27130.46>
- Starks, H., Brown Trinidad, S., 2007. Choose Your Method: A Comparison of Phenomenology, Discourse Analysis, and Grounded Theory. *Qual Health Res* 17, 1372–1380. <https://doi.org/10.1177/1049732307307031>
- Stemple, J., Roy, N. and Klaben, B., 2014. *Clinical Voice Pathology*. 5th ed. San Diego: Plural Publishing.
- Stipek, D. and Weisz, J., 1981. Perceived Personal Control and Academic Achievement. *Review of Educational Research*, 51(1), pp.101-137.
- Stormacq, C., Wosinski, J., Boillat, E., Van den Broucke, S., 2020. Effects of health literacy interventions on health-related outcomes in socioeconomically disadvantaged adults living in the community: a systematic review. *JBIE Evidence Synthesis* 18, 1389–1469. <https://doi.org/10.11124/JBISRI-D-18-00023>
- Sujitha, P. S. and Pebbili, G., 2020. Cepstral Analysis of Voice in Young Adults. *Journal of Voice*,.
- Sukanen, O., Sihvo, M., Rorarius, E., Lehtihalmes, M., Autio, V. and Kleemola, L., 2007. Voice Activity and Participation Profile (VAPP) in assessing the effects of voice disorders on patients' quality of life: Validity and reliability of the Finnish version of VAPP. *Logopedics Phoniatrics Vocology*, 32(1), pp.3-8.
- Sumsion, T., 1998. The Delphi Technique: An Adaptive Research Tool. *British Journal of Occupational Therapy*, 61(4), pp.153-156.
- Sundberg, J., 1974. Articulatory interpretation of the "singing formant". *The Journal of the Acoustical Society of America*, 55(4), pp.838-844.
- Sundberg, J., 1990. What's so special about singers?. *Journal of Voice*, [online] 4(2), pp.107-119.
- Sundberg, J., 1994. Acoustic and psychoacoustic aspects of vocal vibrato. *STL-QPSR*, 35(2-3), pp.45-68.
- Supraja, A. and Savithri, S., 2007. Relationship Between Habitual Frequency of Voice and 'A:Dha:Ra Shruthi' In Carnatic Vocal Music. *Proceedings of International Symposium: Frontiers of Research on Speech and Hearing*, All India Institute of Speech and Hearing.
- Tabachnick, B. G., and Fidell, L. S., 2001. *Using multivariate statistics* (4th ed.). Needham Heights, MA: Allyn and Bacon.
- Tamres, L.K., Janicki, D., Helgeson, V.S., 2002. Sex Differences in Coping Behavior: A Meta-Analytic Review and an Examination of Relative Coping. *Pers Soc Psychol Rev* 6, 2–30. https://doi.org/10.1207/S15327957PSPR0601_1
- Tavousi, M., Hidarnia, A., Montazeri, Ali., Hajizadeh, E., Taremian, F., and Ghofranipour, F. 2009. Are Perceived Behavioral Control and Self-Efficacy Distinct Constructs?. *European Journal of Scientific Research*. 30. 146-152.
- Tepe, E., Deutsch, E., Sampson, Q., Lawless, S., Reilly, J. and Sataloff, R. 2002. A Pilot Survey of Vocal Health in Young Singers. *Journal of Voice*, 16(2), pp.244-250.

The Voice Foundation, 2020. Voice Anatomy & Physiology. [online] THE VOICE FOUNDATION. Available at: <<https://voicefoundation.org/health-science/voice-disorders/anatomy-physiology-of-voice-production/>> [Accessed 17 September 2020].

Thomas J, Brunton J, Graziosi S., 2010. EPPI-Reviewer 4.0: software for research synthesis. EPPI-Centre Software. London: Social Science Research Unit, Institute of Education, University of London.

Thomas, G., de Jong, F., Cremers, C. and Kooijman, P., 2006. Prevalence of Voice Complaints, Risk Factors and Impact of Voice Problems in Female Student Teachers. *Folia Phoniatica et Logopaedica*, 58(2), pp.65-84.

Thomas, G., Kooijman, P., Cremers, C. and Jong, F., 2005. A comparative study of voice complaints and risk factors for voice complaints in female student teachers and practicing teachers early in their career. *European Archives of Oto-Rhino-Laryngology*, 263(4), pp.370-380.

Thomas, J., Brunton, J., Graziosi, S., 2010. EPPI-Reviewer 4.0: software for research synthesis. EPPI-Centre Software.

Thompson, B., 1989. Why Won't Stepwise Methods Die? *Measurement and Evaluation in Counseling and Development* 21, 146–148. <https://doi.org/10.1080/07481756.1989.12022899>

Tiemensma, J., Gaab, E., Voorhaar, M., Asijee, G., Kaptein, A., 2016. Illness perceptions and coping determine quality of life in COPD patients. *COPD Volume* 11, 2001–2007. <https://doi.org/10.2147/COPD.S109227>

Tufford, L., Newman, P., 2012. Bracketing in Qualitative Research. *Qualitative Social Work* 11, 80–96. <https://doi.org/10.1177/1473325010368316>

Turner, H., Bryant-Waugh, R., Peveler, R., Bucks, R.S., 2012. A Psychometric Evaluation of an English Version of the Utrecht Coping List: An English Version of the UCL. *Eur. Eat. Disorders Rev.* 20, 339–342. <https://doi.org/10.1002/erv.2173>

Tutya, A., Zambon, F., Oliveira, G. and Behlau, M., 2011. Comparação dos escores dos protocolos QVV, IDV e PPAV em professores. *Revista da Sociedade Brasileira de Fonoaudiologia*, 16(3), pp.273-281.

Urrutikoetxea, A., Ispizua, A., Matellanes, F. and Aurrekoetxea, J., 1995. Prevalence of Vocal Nodules in Female Teachers. Video Presentation at 1st World Voice Congress, Oporto, Portugal

Ursachi, G., Horodnic, I.A., Zait, A., 2015. How Reliable are Measurement Scales? External Factors with Indirect Influence on Reliability Estimators. *Procedia Economics and Finance* 20, 679–686. [https://doi.org/10.1016/S2212-5671\(15\)00123-9](https://doi.org/10.1016/S2212-5671(15)00123-9)

Van Kemenade, J.F.L.M., Van Son, M.J.M., Van Heesch, N.C.A., 1995. Performance Anxiety among Professional Musicians in Symphonic Orchestras: A Self-Report Study. *Psychol Rep* 77, 555–562. <https://doi.org/10.2466/pr0.1995.77.2.555>

van Rhenen, W., Schaufeli, W.B., van Dijk, F.J.H., Blonk, R.W.B., 2008. Coping and sickness absence. *Int Arch Occup Environ Health* 81, 461–472. <https://doi.org/10.1007/s00420-007-0238-4>

Van Riel, N., Auwerx, K., Debbaut, P., Van Hees, S., Schoenmakers, B., 2017. The effect of Dr Google on doctor–patient encounters in primary care: a quantitative, observational, cross-sectional study. *BJGP Open* 1, bjgpopen17X100833. <https://doi.org/10.3399/bjgpopen17X100833>

Van Wijck-Warnaar, A., Van Opstal, M.J.M.C., Exelmans, K., Schaekers, K., Thomas, G., de Jong, F.I.C.R.S., 2010. Biopsychosocial Impact of Voicing and General Coping Style in Teachers. *Folia Phoniatr Logop* 62, 40–46. <https://doi.org/10.1159/000239062>

- Verdolini, K., Ramig, L.O., 2001. Review: occupational risks for voice problems. *Logoped Phoniatr Vocol* 26, 37–46.
- Vermeulen, R., Van Der Linde, J., Abdoola, S., Van Lierde, K., Graham, M.A., 2021. The Effect of Superficial Hydration, With or Without Systemic Hydration, on Voice Quality in Future Female Professional Singers. *Journal of Voice* 35, 728–738. <https://doi.org/10.1016/j.jvoice.2020.01.008>
- Waller, K. and Bates, R., 1992. Health Locus of Control and Self-Efficacy Beliefs in a Healthy Elderly Sample. *American Journal of Health Promotion*, 6(4), pp.302-309.
- Wallston, K., Strudler Wallston, B. and DeVellis, R., 1978. Development of the Multidimensional Health Locus of Control (MHLC) Scales. *Health Education Monographs*, 6(1), pp.160-170.
- Wang, J., Yang, Z., Zheng, Y., Peng, Y., Wang, Q., Xia, H., Wang, Y., Ding, J., Zhu, P., Shang, L., Zheng, Z., 2021. Effects of illness perceptions on health-related quality of life in patients with rheumatoid arthritis in China. *Health Qual Life Outcomes* 19, 126. <https://doi.org/10.1186/s12955-021-01770-4>
- Watson, V.M., David R., 1998. The teaching voice: problems and perceptions. *Logopedics Phoniatrics Vocology* 23, 133–139. <https://doi.org/10.1080/140154398434158>
- Watson, N., Oakeshott, P., Kwame, I. and Rubin, J., 2013. A Comparison of the Voice Handicap Index-10 Scores Between Medical and Musical Theater Students. *Journal of Voice*, 27(1), pp.129.e21-129.e23.
- Watts, C., 2016. The Prevalence of Voice Problems in a Sample of Collegiate a Cappella Singers. *Journal of Speech Pathology & Therapy*, 1(1), pp.1-10.
- Weber, B., Portnoy, J.E., Castellanos, A., Hawkshaw, M.J., Lurie, D., Katz, P.O., Sataloff, R.T., 2014. Efficacy of Anti-Reflux Surgery on Refractory Laryngopharyngeal Reflux Disease in Professional Voice Users: A Pilot Study. *Journal of Voice* 28, 492–500. <https://doi.org/10.1016/j.jvoice.2013.12.009>
- Weinert, C., Cudney, S. and Spring, A., 2008. Evolution of a Conceptual Model for Adaptation to Chronic Illness. *Journal of Nursing Scholarship*, 40(4), pp.364-372.
- Weinman, J., Petrie, K.J., 1997. Illness perceptions: A new paradigm for psychosomatics? *Journal of Psychosomatic Research* 42, 113–116. [https://doi.org/10.1016/S0022-3999\(96\)00294-2](https://doi.org/10.1016/S0022-3999(96)00294-2)
- Welham, N.V., MacLagan, M.A., 2003. Vocal Fatigue: Current Knowledge and Future Directions. *Journal of Voice* 17, 21–30. [https://doi.org/10.1016/S0892-1997\(03\)00033-X](https://doi.org/10.1016/S0892-1997(03)00033-X)
- White, A.H., Schofferman, J.A. (Eds.), 1995. *Spine care*, One ed. ed. Mosby, St. Louis.
- White, K., Issac, M., Kamoun, C., Leygues, J. and Cohn, S., 2018. The THRIVE model: A framework and review of internal and external predictors of coping with chronic illness. *Health Psychology Open*, 5(2), p.205510291879355.
- Wikipedia, 2020. Madras Music Season. [online] En.wikipedia.org. Available at: <https://en.wikipedia.org/wiki/Madras_Music_Season> [Accessed 7 October 2020].
- Williams, N. and Carding, P. 2005. *Occupational voice loss*. Boca Raton: Taylor & Francis.
- Williams, P. and Webb, C., 1994. The Delphi technique: a methodological discussion. *Journal of Advanced Nursing*, 19(1), pp.180-186.
- Williams, S. and Cooper, C., 1998. Measuring occupational stress: Development of the Pressure Management Indicator. *Journal of Occupational Health Psychology*, 3(4), pp.306-321.

Wilson, D.K., 1987. Voice problems of children, 3rd ed. ed. Williams & Wilkins, Baltimore.

Wuyts, F., De Bodt, M. and Van de Heyning, P., 1999. Is the reliability of a visual analog scale higher than an ordinal scale? An experiment with the GRBAS scale for the perceptual evaluation of dysphonia. *Journal of Voice*, 13(4), pp.508-517.

Yiu, E.M.-L., Chan, R.M.M., 2003. Effect of Hydration and Vocal Rest on the Vocal Fatigue in Amateur Karaoke Singers. *Journal of Voice* 17, 216–227. [https://doi.org/10.1016/S0892-1997\(03\)00038-9](https://doi.org/10.1016/S0892-1997(03)00038-9)

Yaribeygi, H., Panahi, Y., Sahraei, H., Johnston, T.P., Sahebkar, A., 2017. The impact of stress on body function: a review. *EXCLI Journal*; 16:Doc1057; ISSN 1611-2156. <https://doi.org/10.17179/EXCLI2017-480>

Yu, L., Lu, D., Yang, H., Zou, J., Wang, H., Zheng, M., Hu, J., 2019. A comparative and correlative study of the Voice-Related Quality of Life (V-RQOL) and the Voice Activity and Participation Profile (VAPP) for voice-related quality of life among teachers with and without voice disorders. *Medicine* 98, e14491. <https://doi.org/10.1097/MD.00000000000014491>

Zambon, F., Moreti, F., Behlau, M., 2014. Coping Strategies in Teachers With Vocal Complaint. *Journal of Voice* 28, 341–348. <https://doi.org/10.1016/j.jvoice.2013.11.008>

Zhang, Z., 2016. Mechanics of human voice production and control. *The Journal of the Acoustical Society of America*, 140(4), pp.2614-2635.