



City Research Online

City, University of London Institutional Repository

Citation: Sarkar, S. & Thomas, J. (2016). Sedentary Behavior of White Collar Office Workers-Review. *ECronicon NUTRITION*, 3(6), pp. 726-736.

This is the published version of the paper.

This version of the publication may differ from the final published version.

Permanent repository link: <https://openaccess.city.ac.uk/id/eprint/27650/>

Link to published version:

Copyright: City Research Online aims to make research outputs of City, University of London available to a wider audience. Copyright and Moral Rights remain with the author(s) and/or copyright holders. URLs from City Research Online may be freely distributed and linked to.

Reuse: Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge. 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.

Sedentary Behavior of White Collar Office Workers-Review

Thomas James Hopkin^{1*} and Swrajit Sarkar^{1,2}

¹University of Central Lancashire, Division of Sports Exercise and Nutritional Sciences, United Kingdom

²Leeds Trinity University, Division of Sports, Health and Nutrition, Horsforth, United Kingdom

***Corresponding Author:** Thomas James Hopkin, Division of Sports Exercise and Nutritional Sciences, Preston, Lancashire. PR 12 HE, United Kingdom.

Received: March 31, 2016; **Published:** April 18, 2016.

Abstract

Aim

The aim of this systematic review is to evaluate the physical activity time (PAT) of white collar office workers in order to assess the levels of sedentary activity in an office environment. Analysing the office workers PAT will not only allow an insight into how an office based job could impact a person's overall health and wellness status, but will also allow for the development of future office based interventions aimed at increasing the overall physical activity among white collar office workers.

Methodology

Using the PRISMA 2009 guidelines a literature review was conducted to assess the PAT of office workers and the typical sedentary nature of their work could affect their health. The review consisted of 8 peer reviewed studies, collected through the entry of 9 initial search terms relating to the physical activity, sedentariness and overall health of white collar workers into Discovery, PubMed and Google Scholar search engines.

Results

Results suggesting low physical activity time spent among white collar office workers with the average minutes spent sedentary on a working day mean (\pm SD), (529 \pm 75.3), minutes in light activity, (164.9 \pm 51.1) and vigorous activity time, (28.2 \pm 15.9). Low levels of physical activity were also found during non working days with the average sedentary time being mean (\pm SD), (460.1 \pm 63.2), minutes in light physical activity, (251.2 \pm 102.1), and moderate to vigorous physical activity time (MVPA) time, (17.9 \pm 29.3).

Conclusion

White collar office workers are spending greater amounts of work time in sedentary behavior.

Value

This paper provides a current literature review and analysis of the physical activity levels among office workers and sedentary behavior at work which could effects office workers health and well being.

Keywords: *sedentariness; Physical activity levels; Office workers and white collar workers*

Introduction

The sedentary nature of an office workers job role, through various literature have suggested office workers spend great durations in sedentary activity [1,29]. This accounts for 82% of time in sedentary activity [2, 6, 29]. Furthermore, Physical activity time (PAT) of office workers outside of working hours, finding that the PAT of the most sedentary workers did not increase during non-working hours when compared to workers who had more physically active occupation [6] Greater levels of sedentary activity, classed as any activity below 1.5 Mets, (Metabolic equivalent) [27], is positively correlated with both an increase in risk and the development of NCD's, (non e communi-

cable diseases). This puts white collar workers, office workers in particular, at higher risk of developing diseases. Such as cardio vascular disease, type 2 diabetes and hypertension [12].

The increase of sedentary jobs and decrease in more active job roles over the last 54 years has partly been held responsible for rising over weight and obesity levels due to advancements in technology and transportation [5,28]. In the UK 61.9% of adults are classed as obese [18] and the intangible cost of such is costing the NHS £8.2 billion a year [20]. Obese workers are not as productive, punctual and have a greater number of days out of work when compared to non-obese workers [2,11,26].

Therefore, this review will analyse the PAT of office workers to assess levels of sedentary activity and if higher levels of activity are being achieved in a fore mentioned population. This will allow for an in-depth evaluation on office workers over all health and how their occupation may be affecting their well being. It is hypothesized that the outcome of this review will determine that the office job role is of a sedentary nature, resulting in a great need for this population PAT to be increased, placing office workers at a greater risk of developing non communicable diseases.

Method

Literature Search

Literature searches were conducted in several search engines including PubMed, Discovery and Google Scholar (1900–2015). The initial search terms used in the previously mentioned search engines included; “PAT of office workers, PAT of white collar workers and sedentary activity of office workers”, these search terms were then developed into more specified search terms relating to the review, for example “sedentary life style and non-communicable diseases”. Both the reference lists of all studies and also any suggested literature by the search engines were examined in order to gain a significant quantity of relevant research. Whilst using the previously mentioned search engines a mix of both general and advanced searches was used with no date boundaries set, only English papers included, although papers that were initially published in another language but are available in English were included in the review, and peer reviewed journals considered in this study. To be included in this review studies had to be free to access through the relevant search engine or a relevant link to a free copy of the study. In this review of literature the PRISMA 2009 check list was followed (PRISMA, 2009).

Eligibility Criteria

For studies to be included in this systematic review the following criteria must have been met; (1) the studies must have been Peer reviewed. (2) The participants involved in the study must have been of working age, >18, <65 (3) the participants of the study must also be employed in a white collar job role, for example an office worker. (4) Studies must have also been researching into the physical activity levels of office workers. These criteria was chosen to allow for a precise review of the literature, the criteria also allows for the relating of research from health and diseases to support and expand upon the finding of the eligible literature.

Screening of the Literature

Literature found through the use of search engines was screened initially through the title and the abstract of the study, deeming if the study was relevant, for example did the study relate to the PAT, sedentariness or overall health of office workers?. If the literature was found to be relevant then the full paper of that study was analysed in greater detail to assess if the study met 14 of the eligibility criteria. Any duplicate papers, Papers that were found multiple times through different searches, were disregarded at this point to avoid incorrect data.

Assessment of Studies Quality

To assess the quality of the studies included in this systematic review of literature guidelines formed by both Penn state college [15], and the journal of European psychology students [31], was used. The use of these guidelines not only allowed forth equality of the research papers to be assessed but also the risk of bias to be reduced, allowing for a higher quality and broader examples of research, any papers that failed to pass the quality assessment were disregarded at this point. For further detail of the quality assessments can be found in appendix 2.

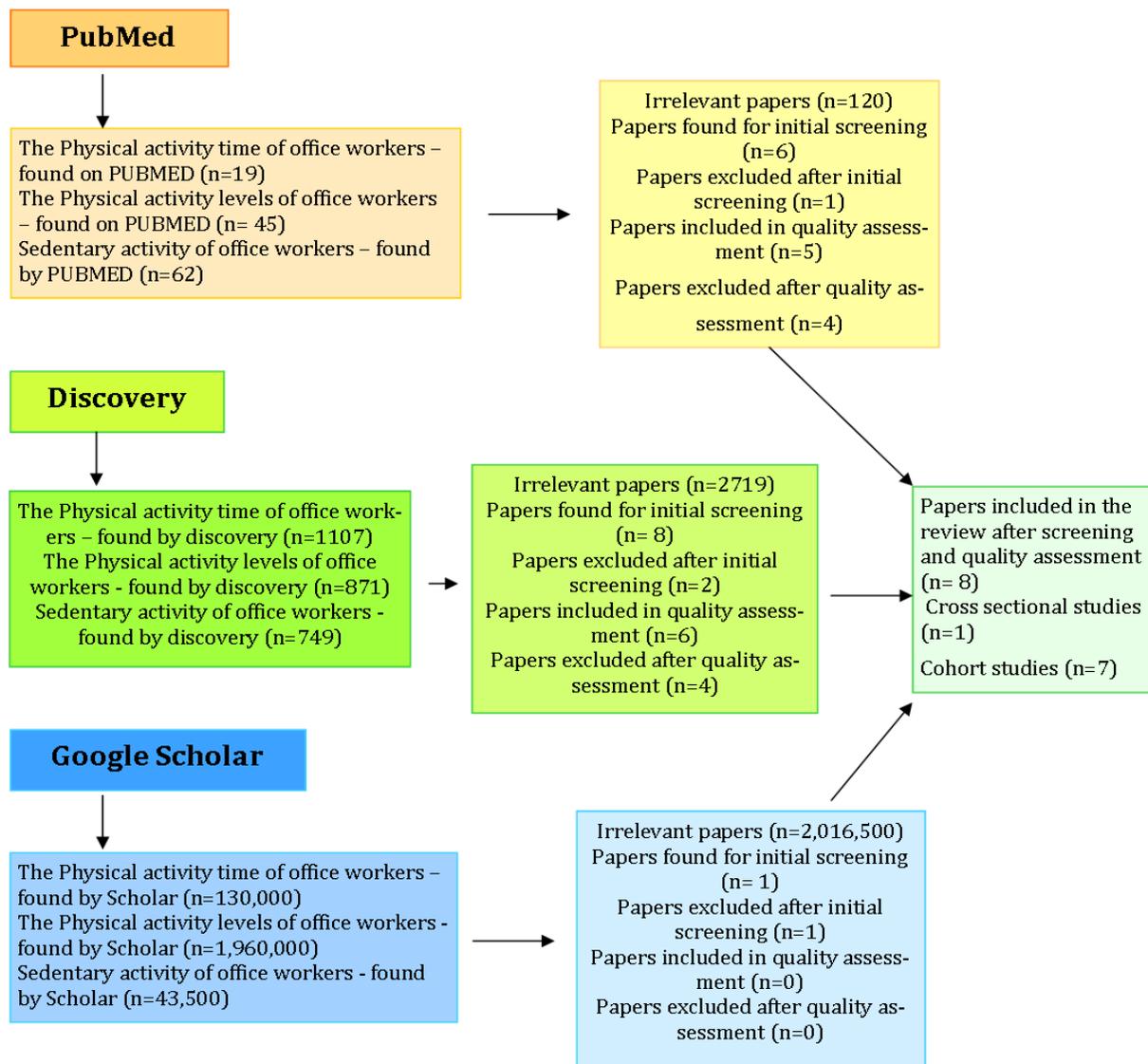


Figure 1: Illustration of the search strategy for the literature involved in this study.

Data Collection Process and Data Items

Data involving the participants PAT was extracted from the studies and categorized into the amount of minutes spent sedentary, in light PA and in Moderate to vigorous physical activity, (MVPA), on both working and non working days with the means and standard deviations also extracted. No assumptions or simplifications were made to the data used in this review, all data used is the data reported from the reviewed studies. Collected data was gathered from respective charts, graphs and tables with mean and standard deviation variables included, the applicable author was contacted regarding any relevant missing data as incomplete data was not included in the analysis.

Authors, years and country	Participants	Type of Study	Time at work assessment method	Sedentary (Working days) mins (Mean ± SD)	Light PA (Working days) Mins (Mean ± SD)	Moderate to vigorous PA (Working days) Mins (Mean ± SD)	Sedentary (non working days) Mins (Mean ± SD)	Light PA (non working days) Mins (Mean ± SD)	Moderate to vigorous PA (non working days) Mins (Mean ±SD)	Main Findings
Gleeson S., <i>et al.</i> (2014). Country: UK	210 office workers (170 provided valid data).	Cohort	Using an Acti Graph GT1M Accelerometer the participant's physical activity levels are categorized into sedentary, light and moderate to vigorous, over a 7 day recording period.	580±101	246 ± 90	32 ± 26	460 ± 105	278 ± 126	28±33	Those who spent the greatest time in sedentary behaviour during working hours didn't increase their levels of physical activity or reduce sedentary behaviour outside of the work place.
Biernat E., <i>et al.</i> (2010). Country: Poland	293 office workers. From local (LA) and civil (CA) administration authorities and banks.	Cohort	The participant's physical activity levels were measured using an interview technique with the aid of a short IPAQ.	Nostatistical significance between groups, 582 ± 102	Reported as walking: Bankers 16 ± 3.1, CA 31 ± 4.7, LA 4 ± 2.3	Moderate 8.1 ± 2.2 Bank officials, LA 12.2 ± 2.0, CA 19.8 ± 3.1 Vigorous Bank 5.3 ± 1.6, LA 10.8 ± 1.9	Not reported	Not reported	Not reported	Up to 70% of the office worker had low levels of physical activity and on average 9.7 hours a day was spent sitting or in active.
Toomingas A., <i>et al.</i> (2012). Country: Sweden	140 call centre employees.	Cohort	Using dichotomous in clinometers the participant posture was recorded throughout working hours. Using variables describing the participant's frequency of posture positions and changes in posture the data was analysed	262 ± 76.8	Not reported	Not reported	Not reported	Not reported	Not reported	It is essential that the posture of office workers is changed more frequently in order to present an increase in physical demand, due to the prolonged sitting times and sedentary nature of the job.
Parry's And Straker L. (2013) Country: Australia.	50 office workers.	Cohort	Participant's physical activity was measured using an Accelerometer worn during waking hours over an even day period; participants also recorded a physical activity diary.	676±58.7	176.9±52.6	39.5±18.7	570.5 ± 88.0	224.4 ± 78.3	25.7 ± 25.7	The inactive nature of an office worker job role is a significant cause to these sedentary life style found in most office workers.

Ryan C., <i>et al.</i> (2011). Country: UK	83 office workers.	cohort	Over a 1 week period the participants physical activity levels were measured using active Accelerometers, and were compared to current sitting time recommendations	318 ± 60	Not reported	Not reported	Not reported	Not reported	Not reported	The participants in this study spent significantly long periods of time in sitting positions and sedentary behaviour, for much greater periods than there commended sitting times.
Parry S., <i>et al.</i> (2013) Country: Australia.	62 office workers	Randomized controlled trial	Participants were split into 3 groups each completing office based interventions. 1 week before and after under taking these interventions the participants were a Acti Graph GT3X Accelerometer to measure sedentary time, sustained sedentary time, breaks in sedentary time, light intensity activity and MVPA on work days and during work hours were measured before and following a 12 week intervention period.	721.75 ± 77.5	219.8 ± 58.7	30.3 ± 16.8	Not reported	Not reported	Not reported	Work place interventions can increase PAL of white collar office workers, reduces sedentary time and increase the frequency of breaks.
Keadle SK, <i>et al.</i> (2012) Country: USA.	20 workers employed in sedentary jobs.	Cohort	Acti graph and Acti PAL Accelerometers were initially worn for a 7 day base line period. The participants then completed a 7 day intervention aimed at reducing sedentary time. Their PAL was then measured using 2 questionnaires.	587.12 ± 93.9	Not reported	Not reported	472.9 ± 120.1	Not reported	Not reported	The Acti PAL monitor is sensitive to change, and the Acti graph monitor and self-report questionnaires are less sensitive.
Clemes SA, <i>et al.</i> (2014) Country: UK	72 Office-workers (Low work sitters LWS/medium work-sitters MWS/High work-sitters HWS)24 in each group.		Through the use of pedometers the amount of time spent sitting was measured and the participants split into 3 groups according to the amount of sitting they completed.	LWS-352 ±107 MWS-504 ±69 HWS-661 ±98	Not reported	Not reported	LWS-288±124 MWS-341±142 HWS-382±133	Not reported	Not reported	Office workers who sit for long durations of their working day also spend long durations of non-working day sitting and do not compensate for their sedentary behaviour during working hours.

Parry S., et al. (2013) Country: Australia.	62 office workers	Randomized control trial	Participants were split into 3 groups each completing office based interventions. 1 week before and after undertaking these interventions the participants were a Acti Graph GT3X Accelerometer to measure sedentary time, sustained sedentary time, breaks in sedentary time, light intensity activity and MVPA on work days and during work hours were measured before and following a 12 week intervention period.	721.75 ± 77.5	219.8 ± 58.7	30.3 ± 16.8	Not reported	Not reported	Not reported	Work place interventions can increase PAL of white collar office workers, reduces sedentary time and increase the frequency of breaks.
Keadle SK., et al. (2012) Country: USA.	20 work-ers employed in sedentary jobs.	Cohort	Acti graph and Acti PAL Accelerometers were initially worn for a 7 day base line period. The participants then completed a 7 day intervention aimed at reducing sedentary time. Their PAL was then measured using 2 questionnaires.	587.12 ± 93.9	Not reported	Not reported	Not reported	472.9 ± 120.1	Not reported	The Acti PAL monitors sensitive to change, and the Acti graph monitor and self-report questionnaires are less sensitive.
Clemes SA., et al. (2014) Country: UK	72 Office-workers (Low work sitters LWS/ medium work sitters MWS/ High work sitters HWS)24 in each group.		Through the use of pedometers the amount of time spent sitting was measured and the participants split into 3 groups according to the amount of sitting they completed.	LWS-352±107 MWS-504±69 HWS-661±98	Not reported	Not reported	Not reported	LWS-288 ± 124 MWS-341 ± 142 HWS-382 ± 133	Not reported	Office workers who sit for long durations of their working days also spend long durations of non-working days sitting and do not compensate for their sedentary behaviour during working hours.

Results

7 Cohort studies and 1 cross sectional study, with data pooled together, were reviewed in order to assess the PAT of white collar office workers. Through the analysis of 210 office workers [6], reported that on working days office workers spent 580 ± 101 minutes in sedentary activity, compared to no working days when office workers were only found to spend 460 ± 105 minutes in sedentary activity. MVPA was also found to decrease on non-working days when compared to working days with 28 ± 33 minutes and 32 ± 26 minutes being reported respectively. Analyzing the PAT of 293 office workers, [3], also reported high levels of sedentary activity with 582 ± 102 minutes of sedentary activity being reported on working days. Low levels of both light PA and MVPA was also reported in this study with the 3 groups of office workers completing on average 12.7 minutes of light PA and 56.2 minutes of MVPA a day.

Similar results was found, [29], with 262 ± 76.8 minutes of sedentary activity being reported in 140 call centre employees. In a similar cohort study [25], also only analyzing the sedentary time of office workers during working days, reported 318 ± 60 minutes of sedentary time was reported in 83 office workers.

The only randomized control trial included in this review [23], also reported that the 50 office workers spent long durations of time sedentary on both working and non-working days, 676 ± 58.7 minutes and 570.5 ± 88.0 minutes respectively. This study also reported low levels of light PA, 176.9 ± 52.6 minutes, and MVPA, 39.5 ± 18.7 , on working days. Low levels of light PA, 224.4 ± 78.3 minutes, and MVPA, 25.7 ± 25.7 , were also reported in the office workers during non-working days.

Similar study [22], found similar results to those found in the other papers included in this review with high levels of sedentary activity, 721.75 ± 77.5 minutes, and low levels of MVPA 30.3 ± 16.8 minutes, reported on working days. However light PA was found to be higher than that found in the other reviewed studies, 219.8 ± 58.7 minutes.

High levels of sedentary activity during both working and non working days were reported [17], 587.12 ± 93.9 minutes and 472.9 ± 120.1 minutes respectively. Similar findings were reported [6], with high levels of sedentary activity being reported on both working days; Low work sitters 352 ± 107 minutes, medium work sitters 504 ± 69 minutes, high work sitters 661 ± 98 minutes, and non-working days; Low work sitters 288 ± 124 minutes, Medium work sitters 341 ± 142 minutes, high work sitters 382 ± 133 minutes, by the 3 groups of office workers.

Day	Sedentary (Time) minutes mean (\pm SD)	Light PA (Time) minutes mean (\pm SD)	MVPA (Time) minutes mean (\pm SD)
Working Day	529 ± 75.3	164.9 ± 51.1	28.2 ± 15.9
Non-Working Day	460.1 ± 63.2	251.2 ± 102.1	17.9 ± 29.3

Table2 :Average PAT for both working and non-working days.

Discussion

This review found that office workers spend great durations of both working and non-working days in sedentary activity, this combined with the low levels of light PA and MVPA completed by the office workers analysed in this review places this population at a greater risk of developing non communicable diseases, [12]. When the finding of this review are compared to previous research showing the sedentary behavior of white collar workers it adds to a growing body of evidence showing the low levels of PA undertaken by office workers and the detrimental effects this could have on their health. Through the use of accelerometers it was reported that a sample of $n=210$ UK office workers spent 57% of their working day as sedentary [6]. Similar findings were also reported in a study involving 193 Australian office workers, with accelerometers measuring 77% of the participant's time in work as sedentary, accounting for on average 6.6 hours of the participants time spent at work, [29]. This is significantly lower than the 9.7 hours a day reported by [3]. In the previously mentioned study it was also found that of then = 293 polish office workers who spent the most time being sedentary also had higher BMI values and lower levels of physical activity [3]. This research also supports past research which found that the most sedentary participants during working hours did not compensate for their sedentary behavior with physical activity during non-working hours [6]. This finding fur-

ther support evidence showing the work place as the main setting for sedentary behavior [29]. It is of vital importance that the PAT of this population is increased as studies have repeatedly shown that sedentary behavior can increase the risk of obesity, developing non-communicable diseases, and is associated with all causes of cardiovascular disease mortality, independent of the amount of moderate to vigorous physical activity performed [15,16,30].

Duration of Sedentary Behavior

Past research has not only found that high percentages of an office workers day are sedentary but also that the bouts of sedentary activity are often for long uninterrupted periods of time. 55% of sedentary behavior is spent in durations of 20 or 30 minutes [29], this is further supported by findings showing between 25-67% of sitting time in 83 office workers was greater than 20 and 30 minutes long [25]. These long durations of uninterrupted sedentariness are not beneficial to health with evidence suggesting a regular change in posture may decrease plasma glucose and insulin levels after food consumption [10] and regular changes in posture can also enhance musculoskeletal health and levels of productivity in the workplace [13].

Comparison of Working Days to Non-Working days

This systematic review also compared the duration of time spent sedentary on work days to non-work days, it was found that the white collar office workers analysed In this review spent greater durations of time sedentary on working days when compared to non-working days. This is further supported by an increase in sedentary behavior of between 7.5% and a 9.9% on work days found by recent research, [19, 29]. This supports the growing evidence that shows those who are sedentary in the work place continue their sedentary behavior during non-working hours. 210 office workers PAL were measured during both working and non-working hours using Acti Graph accelerometers over a 7 day period [6]. This study found that sedentary activity during working hours was strongly correlated with sedentary activity on both non working hours on work days and sedentary activity on non working days, it was also found that the participants who spent the greatest duration of working hours in sedentary activity also spent significantly greater durations of non-working days in sedentary behavior when compared to the participants with the lowest amount of time spent in sedentary activity during working hours [6]. This review also found that office workers did increase their levels of light physical activity on non-working days when compared to working days, this finding contradicts past research with many studies finding those who spent long amounts of time in sedentary behavior during working hours would also continue this sedentary behavior during non working hours and also decrease light physical activity during this time [22]. However greater durations of MVPA was not completed by the office workers in this review on non-working days when compared to working days, supporting the growing body of evidence showing that the amount of MVPA undertaken by those who are the most and least sedentary are not significantly different, showing that there is no compensation outside of working hours for these sedentary activity completed during working hours, such as an increase in PAT [6]. This was also found in Dutch office workers who after long periods of uninterrupted sitting throughout the working day didn't compensate during non-working hours [24]. However sitting time during both working hours and non-working hours has been analysed finding that those who worked in predominantly sedentary job roles, such as office workers, were significantly more likely to participate in physical activity during non-working hours when compared to more active job roles [4]. However this is the only study to find these results showing that the main body of evidence supports that those who are inactive during working hours do not increase their PAL outside of work to compensate for previous sedentary behaviour. The recording of office workers meeting a set PAL have produced poor results with only 49% of participants meeting the recommended duration of MVPA set by the ACSM of 150 minutes a week [3], 30-60 minutes of moderate PA or 20-60 minutes or vigorous PA a day [1]. This further shows the sedentary nature of not only the office workers job role but also their low levels of physical activity outside of working hours.

Work place Interventions

The work place has been identified as an applicable place to increase the PAT of workers, especially white collar workers due to their high levels of sedentariness [21]. With some recent research suggesting that work place interventions are successful at both increasing the physical activity levels of office workers and also decreasing the time spent sedentary at work [22]. Although the previously mentioned study did increase the PAL of office workers and decrease the time spent in sedentary activity this was only achieved with minimal suc-

cess as light physical activity was increased on average by 7 minutes and sedentary behavior was decreased by 1-2% [22]. Similar success rates have been achieved in which sedentary time was decreased by 5% a working day [17]. These results are further supported by a meta-analysis concluding that the health and physical activity of employees could be improved by some work place interventions [7]. However this is contradicted by another meta-analysis finding that due to the poor design of the interventions PAL of the office workers hasn't been found to significantly increase post intervention, with a small number of studies finding little to no improvements in the PAL and or health of the office workers [9]. These findings show that more research needs to be conducted in order to improve the quality of design used in future interventions due to the varied but mainly poor results of past work place interventions.

Future research

Future research should concentrate on the analysis of office workers diets, analyzing both the macro and micro nutrient content of their diet. Research so far has found office workers to typically consume diets high in fat, due to the availability of convenience foods, this combined with this dietary nature of an office worker job places this population at a greater risk of developing non communicable diseases. Research into both the physical activity levels and the diets of this population not only would allow for a greater insight into their health but would also allow for the development of work interventions.

Conclusions

This systematic review found that white collar workers spend great durations of both working and non-working days in sedentary activity, with little increases in physical activity shown during non-working days. This is in agreement with recent research showing these dietary natures of not only a white collar office workers job role but also lifestyle, with high levels of sedentary activity and low levels of physical activity reported.

Author Contributions

TJH and SS both contributed equally to the search of literature and writing the general review regarding sedentary behavior of white collar office workers.

Conflicts of Interest

The authors declare no conflict of interest.

Bibliography

1. American college of sports medicine. "ACSM | News Releases". (2015).
2. Brown HE., *et al.* "Objectively measured sedentary behavior and physical activity in office employees: relationships with presenteeism". *Journal of Occupational and Environmental Medicine* 55.8 (2013): 945-953.
3. Biernat E., *et al.* "Physical activity of office workers". *Biology of Sport* 27.4 (2010): 289-296.
4. Chau J., *et al.* "Cross-sectional associations between occupational and leisure-time sitting, physical activity and obesity in working adults". *Preventive Medicine* 54.3-4 (2012): 195-200.
5. Church TS., *et al.* "Trends over 5 decades in the U.S. occupation-related physical activity and their associations with obesity". *PLoS One* 6.5 (2011): e19657.
6. Clemes Stacy A., *et al.* "Office Workers' Objectively Measured Sedentary Behavior and Physical Activity During and Outside Working Hours". *American College of Occupational and Environmental Medicine* 56.3 (2014): 298-303.
7. Conn VS., *et al.* "Meta-analysis of work place physical activity interventions". *American Journal of Preventive Medicine* 37.4 (2009): 330-339.
8. Department of Health and Jane Ellison MP. "Reducing obesity and improving diet" (2013).

9. Dishman RK., *et al.* "Work site physical activity interventions". *American Journal of Preventive Medicine* 15.4 (1998): 344-361.
10. Dunstan D., *et al.* "Breaking Up Prolonged Sitting Reduces Postprandial Glucose and Insulin Responses". *Diabetes Care* 35.5 (2012): 976-983.
11. Finkelstein EA., *et al.* "The costs of obesity in the workplace". *Journal of Occupational and Environmental Medicine* 52 (2010): 971-981.
12. Healy GN., *et al.* "Objectively measured sedentary time, physical activity, and metabolic risk: the Australian diabetes, obesity and life style study (AusDiab)". *Diabetes Care* 31.2 (2008): 369-371.
13. Healy G., *et al.* "Reducing prolonged sitting in the workplace (an evidence review: full report)". *Victoria n health promotion foundation* (2012).
14. Hu FB., *et al.* "Television watching and other sedentary behaviours in relation to risk of obesity and type 2 diabetes mellitus in women". *JAMA* 289.14 (2003): 1781-1791.
15. Joe Schall. "Assessing Source Quality (1999).
16. Katzmarzyk PT., *et al.* "Sitting time and mortality form all causes, cardiovascular disease, and cancer". *Medicine & Science in Sports & Exercise* 41.5 (2009): 998-1005.
17. Kozey-Keadle S., *et al.* "The Feasibility of Reducing and Measuring Sedentary Time among Overweight, Non-Exercising Office Workers". *Journal of Obesity* 2012 (2011).
18. Life styles statistic steam, Health and Social Care Information Centre. "Statistic son Obesity, Physical Activity and Diet". hscic.V1.0 (2014).
19. McCrady S and Levine J. "Sedentariness at Work: How Much Do We Really Sit?" *Obesity* 17.11 (2009): 2103-2105.
20. NICE. National Institute of Health and Care Excellence. "Costing Report: Four Commonly Used Methods to Increase Physical Activity (2006).
21. Owen N., *et al.* "Too much sitting: the population health science of sedentary behaviour". *Exercise and Sport Sciences Reviews* 38.3 (2010): 105-113.
22. Parry S., *et al.* "Participatory Workplace Interventions Can Reduce Sedentary Time for Office Workers-A Randomised Controlled Trial". *PLoS ONE* 8.11 (2013): e78957.
23. Parry S and Straker L. "The contribution of office work to sedentary behaviour associated risk". *BMC Public Health* 13.1 (2013): 296.
24. Proper K., *et al.* "Physical activity among Dutch workers-differences between occupations". *Preventive Medicine* 43.1 (2006): 42-45.
25. Ryan CG., *et al.* "Sitting patterns at work: objective measurement of adherence to current recommendations". *Ergonomics* 54.6 (2011): 531-538.
26. Schulte Paul A., *et al.* "Work, Obesity, and Occupational Safety and Health". *American Journal of Public Health* 97.3 (2007): 428-436.
27. Sedentary behaviour research network. "Standardized use of the terms" sedentary and" sedentary behaviours". *Applied Physiology, Nutrition, and Metabolism* 37.3 (2012): 540-542.
28. Straker L and Mathiassen SE. "Increased physical workloads in modern work a necessity for better health performance?" *Ergonomics* 52.10 (2009): 1215-1225.
29. Thorp AA., *et al.* "Prolonged sedentary time and physical activity in work place and non-work contexts: across-sectional study of office, customer service and call centre employees". *International Journal of Behavioral Nutrition and Physical Activity* 9 (2012):128.

30. Thorp AliciaA., *et al.* "Prolonged sedentary time and physical activity in work place and non-work contexts: across-sectional study of office, customer service and call centre employees". *International Journal of Behavioral Nutrition and Physical Activity* 9 (2012): 128.
31. Toomingas A., *et al.* "Variation between seated and standing/walking postures among male and female call centre operators". *BMC Public Health* 12.1 (2012): 154.
32. Wilmot EG., *et al.* "Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis". *Diabetologia* 55.11 (2012): 2895-2905.
33. Zorana Zupan. "How to critically evaluate the quality of a research article?".

Volume 3 Issue 6 April 2016

© All rights reserved by Thomas James Hopkin and Swrajit Sarkar.