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Feasibility and acceptability of a home-based physical activity program for postnatal women with depressive symptoms: A pilot study

Key words: Exercise; intervention; postnatal; depression

Abstract:

Background:

Most postnatal women are inactive. Since new mothers, particularly those with heightened depressive symptoms experience several challenges to being active such as lack of time and childcare, home-based programs using hired exercise equipment may help overcome these barriers. This study tested the feasibility and acceptability of a home based treadmill intervention among postpartum women with heightened depressive symptoms.

Methods:

Participants were 11 new mothers (3-9 months postpartum) who at baseline were insufficiently active and experiencing heightened depressive symptoms (based on the Edinburgh Postnatal Depression Scale). Following participation in a 12-week physical activity support program (which included free treadmill hire and access to a purposely designed smartphone web-app), semi-structured interviews were conducted with participants. Depressive symptoms were assessed at weeks 4 and 8 and change in depressive symptoms was analysed using repeated-measures analysis of variance (ANOVA). Thematic analyses were used to identify key themes in qualitative data.

Results:

Quantitative data showed that there was a significant change over time with depressive symptoms decreasing from weeks 0 to 4 (mean difference = -5.9, 95% CI = -8.7, -5.5) and overall from weeks 0 to 8 (mean difference = -7.6, 95% CI = -9.8, -3.1). Postpartum women perceived the program to be convenient, flexible and acceptable. Women suggested that the program was useful in overcoming key barriers to physical activity and perceived that the program increased their physical activity and improved psychological health.

Conclusion:

A home-based physical activity program involving cost-free exercise equipment hire was feasible and well accepted by postpartum women. The effectiveness of this program for increasing physical activity and improving mental health in this population should be further tested.

Background

Postnatal depression affects between 10 and 19% of new mothers worldwide (Woody, Ferrari, Siskind, Whiteford, & Harris, 2017), with a large proportion of women undiagnosed. It is associated with decreased enjoyment in life, social withdrawal, insomnia, self-harm, and in some instances infant-harm (Lee & Chung, 2007). Maternal postnatal depression also impacts on infants' cognitive, behavioural and social development (Murray, 1992) and can have damaging effects on close family members (including impacting their other children and partners' mental health) (Boath, Pryce, & Cox, 1998). Thus, it is important to identify strategies to reduce new mothers' risk of developing this illness. Physical activity, particularly that which is undertaken during leisure-time, has been linked to lower risk of postnatal depressive symptoms (Pritchett, Daley, & Jolly, 2017; Teychenne & York, 2013). Whilst current empirically supported treatments for postnatal depression include psychological therapy (e.g., cognitive behavioural therapy) and anti-depressant medication, such treatments may be limited by several factors. Barriers to psychological therapy can include access (difficulties to getting to therapy with a new baby), expense (particularly while not working), and stigma. Further, possible side effects associated with use of some medications, as well as low acceptability particularly in breastfeeding mothers, may limit anti-depressant medication effectiveness (Berle & Spigset, 2011; Bet, Hugtenburg, Penninx, & Hoogendijk, 2013; Chabrol, Teissedre, Armitage, Danel, & Walburg, 2004). Therefore, physical activity may offer an adjunct or alternate treatment for depressive symptoms in new mothers.

According to the US Department of Health and Human Services (USDDHS), postnatal women (i.e. within 12-months following childbirth) are recommended to undertake at least 150 minutes of moderate-intensity physical activity per week for health benefits (Evenson, Mottola, Owe, Rousham, & Brown, 2014), however most (68%) do not achieve these guidelines (Albright, Maddock, & Nigg, 2006). This may be due to postnatal women facing many challenges to being physically active including barriers to leaving the house, childcare, working around baby feeding and nap

times/routines, and being able to make time for themselves (Evenson, Aytur, & Borodulin, 2009; Saligheh, McNamara, & Rooney, 2016). These barriers to being active are likely to be heightened amongst those experiencing heightened levels of depressive symptoms. Therefore, it is imperative that physical activity programs are targeted and designed to address these challenges.

Few successful strategies for increasing physical activity in postnatal women with depressive symptoms have been identified. Although limited in number, walking interventions show some promise in reducing postnatal depressive symptoms (Armstrong & Edwards, 2003, 2004). However, these interventions often require women to attend on certain days and times for group-based exercise sessions. Given that new mothers (and particularly those with heightened postnatal depressive symptoms) often are challenged to leave the house due to exhaustion and baby routines, feeding and nap times, structured, group-based or other external programs are not always suitable for this population group.

Physical activity interventions using home exercise equipment such as treadmills to reduce depressive symptoms have shown success in promoting physical activity and treating/managing depression in adults (Dimeo, Bauer, Varahram, Proest, & Halter, 2001). However, no such interventions have been tested in postnatal women. Given that providing exercise equipment such as treadmills to postnatal women to use in the home would overcome many of the barriers to physical activity faced by this group (Carter-Edwards, et al., 2009), this represents a simple, potentially feasible and convenient strategy to increase physical activity and potentially treat and/or manage postnatal depressive symptoms. Therefore, the proposed study aimed to investigate the perceived feasibility and acceptability of the “Mums on the Run” program, a multi-component home-based physical activity program, delivered to new mothers with heightened postnatal depressive symptoms.

Methods

This study involved both qualitative and quantitative methods. Ethics approval was obtained from the Deakin University Human Research Ethics Committee (DU-HREC-2016-178).

Participants

During August-September 2016, a flyer with information regarding the study was posted on researchers personal *Facebook* accounts, which was shared (via snowball techniques) by other *Facebook* users including one *Facebook* page related to parenting. Interested participants contacted the researchers and were screened via telephone to ensure they met the following inclusion criteria: 1) Mother 3-9 months postpartum (since 3-months is a substantive amount of time for many postpartum women to safely resume physical activity (including higher-impact activities such as brisk walking and running), and would likely include women who experienced both vaginal and C-section births, as well as difficult births/those with complications (Evenson, et al., 2014); 2) Living in Melbourne, Australia; 3) Currently experiencing heightened postnatal depressive symptoms (i.e. score ≥10 on the Edinburgh postnatal depression scale (EPDS) (Cox, Holden, & Sagovsky, 1987), which has been shown to have high sensitivity and specificity for detecting moderate likelihood of postnatal depression (Figueira, Correa, Malloy-Diniz, & Romano-Silva, 2009; Santos, et al., 2007)); 4) Do not own a treadmill; 5) Do not meet the physical activity recommendations of 150 minutes of moderate-vigorous physical activity per week (using the single question “Do you currently undertake less than 150 minutes a week of physical activity that makes you breathe a little heavier (moderate intensity)?”; 5) Aged over 18 years. A total of 37 women were screened and 19 of those were excluded due to scoring less than 10 on the EPDS. Thus, 18 women were eligible for inclusion, providing contact information to complete the study. Eligible participants were required to obtain medical clearance from their general practitioner and written consent prior to being recruited. Within 6 weeks of recruitment efforts, a total of 14 participants provided both clearance and consent and were recruited to the study. Two participants withdrew from the study (one citing

unrelated medical problems; one citing that they only wanted a brand new treadmill, which was not available) and one participant was unable to be contacted for the follow-up interview. Thus the final sample consisted of 11 women, which was adequate in terms of scope (i.e. data provided comprehensive information and themes), replication (i.e. data from many participants shared common characteristics), and appropriate in terms of proficiency to answer the research question (Morse, 2015; Varpio, Ajjawi, Monrouxe, O'Brien, & Rees, 2017).

Intervention

The 'Mums on the Run' program aimed to increase physical activity and improve mental health (i.e. reduce depressive symptoms) amongst women with postnatal depressive symptoms. The program was a multi-component home-based treadmill intervention, based on theoretically underpinned behaviour change strategies (including goal setting/self-monitoring, education/knowledge, access to equipment), derived from principles of the social cognitive theory (SCT) [which suggests that that personal factors (e.g. self-efficacy, knowledge) and environmental factors (e.g. access to equipment) predict behavior change (Bandura, 1986)]. The intervention also included aspects of the transtheoretical model (processes of change, e.g. providing information regarding consciousness raising for initiation, and reinforcement management for maintenance) (Prochaska & Velicer, 1997). Previous research suggests that women (including mothers) with depressive symptoms believe time management, childcare, knowledge of health benefits of physical activity, access to facilities, and women's-only facilities, are important strategies to increase physical activity/reduce sedentary behaviour (Teychenne, Ball, & Salmon, 2011). Therefore the intervention addressed these factors within the design by: 1) Providing free treadmill hire to each participant for 12 weeks, and 2) Providing access to a purposely designed smartphone web-app which included educational material (e.g. how, why and when to exercise during the postpartum period, overcoming common barriers to physical activity) and motivational material using goal setting and self-monitoring techniques, and

music playlists to enhance psychological health and motivation (Karageorghis & Priest, 2012). Theoretical constructs and corresponding strategies are outlined in Table 1.

Table 1. Components of the 12-week home-based treadmill intervention underpinned by theoretical constructs

Theoretical construct	Mediator/influence	Intervention strategies
Increasing knowledge	• Benefits of being active • Physical activity recommendations	**Web-app:** Included treadmill program tailored to current activity/fitness levels (e.g. inactive, moderately active walker, high active runner), suggesting either walking and/or running at various speeds (e.g. 5.5 kph = steady walk, 7.0 kph = brisk walk, 9.5 kph = jog) and durations. Warm up and cool down routines were also recommended. Provision of physical activity information (e.g. recommendations and health benefits of physical activity for new mothers)
Overcoming barriers	• Time management • Access to facilities • Women's only • Childcare • Motivation	**Provision of free treadmill hire.** Treadmill hire cost was $180 AUD for 3 months (covered by research project funds). Treadmill models included the Bodyworks JX325, the JGpi 16km and the J Olympic Treadmills, which incorporated changeable inclines, speeds, and programs **Provision of music workout mixes on Spotify:** Developed for the study **Web-app:** Motivational material that included tips on how to overcome common barriers to physical activity as a new mother. e.g. enlisting social support from partner, family, friends, was suggested to help overcome lack of social support and social isolation. Details of key mental health support organisations were also provided to participants.
Self-monitoring and goal setting	• Self-efficacy/confidence	**Treadmill logbook and goal planner**: Available on the web-app and as a hard-copy. Users would log each treadmill session and develop weekly goals. **Web-app:** Included information on setting achievable physical activity goals, allowed for tracking of goals and provided feedback regarding goal achievement. Note – Although the app explained that 150 minutes of moderate-intensity physical activity (such as brisk walking) is recommended for general health benefits, participants were encouraged to set small, achievable goals to begin with and gradually build on this as their program progresses.

Measures

Postnatal depressive symptoms

For the purposes of initial screening and monitoring for ethical purposes throughout the program, depressive symptoms were assessed via telephone in weeks 0, 4, and 8, using the EPDS (Cox, et al., 1987), a valid and reliable 10-item self-report tool (Cox, et al., 1987; Kernot, Olds, Lewis, & Maher,

2015). Participants were asked to report how often they had experienced various feelings or behaviours (related to postnatal depressive symptoms) in the past week, rating their responses on a 4-point Likert scale (e.g. 0 = no, not at all; 4 = Yes, Quite a lot). Scores for each of the 10 items were then summed, with a total score of ≥10 indicating presence of heightened depressive symptoms. Following ethical protocol, if women scored 10 or more on the EPDS, or they score 1,2 or 3 on item 10 of the EPDS (which refers to feelings of self-harm) at any assessment period, then the researcher would immediately provide referral to mental health support services as well as recommending women to seek support from their doctor. This included all 11 participants at the initial screening.

Feasibility and acceptability

Following participation in the 12-week program, women were invited to take part in a one-on-one semi-structured interview (either face-to-face or by telephone based on participants personal preference) with a researcher to assess perceptions on feasibility and acceptability of the program overall as well as specific components of the program. In the context of this study, 'feasibility' referred to whether it was practical and convenient to include the treadmill exercise program into women's daily lives and 'acceptability' referred to whether walking/running on the treadmill was an activity women would adopt and contentedly to engage in. Participants were asked questions, such as, *"Did you feel confident that you could take part in program/use the treadmill? Why?/Why not?"; "Do you think the "Mums on the run program" would be effective in increasing physical activity amongst other new mums like yourself? Why/why not? Which aspects in particular?"; "What did you like most about the "Mums on the run" program? Why?"; "What did you like least about the "Mums on the run" program? Why?"; "Did you find any aspects of the program in particular useful for overcoming barriers to being active? If yes, what barriers prevented you and which aspects of the program helped?"* Interviews were audio recorded and later transcribed. Additionally, other (%) indicators of feasibility and acceptability were also used, and included: Retention rate (feasibility and

acceptability); Reported problems with treadmills (feasibility); Recruitment (feasibility and acceptability).

Demographic and behavioural characteristics

A brief questionnaire was completed by participants during week 12 which assessed demographic characteristics (age, height/weight, level of education, hours worked per week, marital status, postcode), pregnancy status, and anti-depressant medication use (Yes/No). Physical activity was assessed using an adapted version of the Active Australia Survey (Australian Institute of Health and Welfare, 2003), a reliable and valid tool (Brown, Bauman, Timperio, Salmon, & Trost, 2002). Participants estimated the frequency and total duration of time spent undertaking moderate and vigorous physical activity for leisure and transport purposes in a typical week.

Data Analysis

Using SPSS (version 21) software, quantitative data was analysed using descriptive statistics to obtain means and standard deviations. Further, change in depressive symptoms (weeks 0, 4, 8) was analysed using a repeated measures analysis of variance (ANOVA). Qualitative data were analysed using thematic data analysis, outlined by Braun & Clarke (Braun & Clarke, 2006). Firstly, transcripts were repeatedly read and hand-coded (Phase 1). Secondly, the qualitative data analysis program NVivo (version 11) was used to organise this data and code participant quotes into sub-categories (Phase 2). Thirdly, major categories (e.g. neighbourhood factors) were formed through grouping similar codes/sub-categories (e.g. neighbourhood environment; safety) together (Phase 3). Sub-themes (e.g. overcoming barriers), based on the major categories, were identified and reviewed (Phase 4). Finally, broad themes (e.g. barriers) were defined and named (Phase 5). The 'keyness' of themes was defined as either the most commonly cited categories, or those that provided the most

significant/novel information to expand knowledge to answer the research question, which is consistent with the approach outlined by Braun & Clarke (Braun & Clarke, 2006). In order to ensure reliability of data analysis and interpretation, researcher triangulation was implemented (Golafshani, 2003), whereby all transcripts were coded by one author (MT), and then a random subset (n=4) were coded by a second author (PvdP). Both authors met to discuss coding and preliminary themes and sub-themes. No discrepancies were observed. To illustrate key themes, participants' quotes are presented. These have been anonymised by giving a random number to each participant (Phase 6).

Results

The final sample consisted of 11 women, ranging from 26 to 37 years of age. Almost three quarters (73%) of the sample had a University degree. All women were married or living in a de-facto relationship. 10 women lived in a house and one lived in a flat/townhouse. Baseline EPDS scores ranged from 10 to 18 and mean scores and standard deviation for weeks 0, 4 and 8 are presented in Table 2. Three women reported a baseline EPDS score of 10, four women reported a score of 11, one reported a score of 13, one reported a score of 15, and two women reported a score of 18. No women scored greater than 0 on question 10 (regarding feelings of self-harm) of the EPDS. No participants were taking anti-depressants at the week 12 assessment.

Table 2. Depressive symptoms and physical activity characteristics (Mean and standard deviation) of women (n = 11)

Outcome	**Week 0**	**Week 4**	**Week 8**	**Week 12**
Depressive symptoms (EPDS), *Mean (SD)*	12.91 (2.91)	7.0 (3.95)	5.27 (2.41)	N/A
MVPA (Active Australia Survey) (hrs/wk), *Mean (SD)*	N/A	N/A	N/A	3.4 (2.21)

MVPA, Moderate-vigorous physical activity; EPDS, Edinburgh postnatal depression scale; N/A, Not assessed

Quantitative study

Quantitative data showed that there was a significant change over time for depressive symptoms ($F_{2, 20}$ = 29.928, *P* = 0.000) across the three assessment periods; depressive symptoms decreased from weeks 0 to 4 (mean difference = -5.9, 95% CI = -8.7, -5.5) and overall from weeks 0 to 8 (mean difference = -7.6, 95% CI = -9.8, -3.1). All 11 women had a reduction in depressive symptoms from baseline to 8 weeks, ranging from a drop of 4 to 13 EPDS points (median = 8).

Qualitative study

From qualitative data, a total of three 'broad' themes [1) Barriers; 2) Benefits; 3) Feasibility and Future Development], including seven 'sub-themes' [1.1) Barriers during the program; 1.2) Overcoming barriers; 2.1) Behavioural benefits; 2.2) Psychological and physical health benefits; 3.1) Program usage; 3.2) Program value; 3.3) Future recommendations] were constructed. These are illustrated in Figure 1.

[INSERT FIGURE 1 HERE]

FIGURE CAPTION: Figure 1. Broad themes and sub-themes constructed from qualitative data

ABBREVIATIONS USED IN FIGURE: PA, physical activity

Theme 1: Barriers to engaging in physical activity

Women provided insight into how the program helped them overcome barriers to being physically active, as well as which barriers they still faced in being physically active during the program.

1.1 Factors helping women overcoming barriers

Women identified a wide variety of ways that the *Mums on the Run* program helped them overcome barriers to physical activity. This included overcoming a lack of motivation, being housebound (due to demanding sleep routines, lack of childcare), and poor weather.

Motivation

All but one woman described how the program motivated them to be more physically active. Specifically, women suggested that having access to the treadmill helped them to establish exercise routines, overcome perceived barriers (e.g. headache, stress), "fuel" motivation, and initiate ongoing change.

"I thought it was great! Helping, giving someone a treadmill for 12 weeks just to get some motivation together, because it's a lot easier to get motivated when it's your own home and you don't need to find a babysitter or leave the house, that's great" (ID 2)

Housebound

Nearly all the women suggested that the program was particularly useful in overcoming the barrier of being housebound with a new baby. Women described how they previously had difficulties leaving the house with a newborn, particularly if their baby was unsettled, and had previously felt "stuck" at home". The treadmill component of the program provided these women with an "easy", "convenient", "flexible" and "safe" option to exercise at home.

"… I didn't leave the house with her because she cried all the time, I literally did not go anywhere. So I didn't go walking…oh, we'd go for a quick walk around the block until she'd start crying. So at home it would have been alright because I'd put her in..this…rocker thing" (ID 22)

A number of women suggested that being able to exercise at home overcame their need for childcare, which had previously been a key barrier to their physical activity due to the additional organisation and cost that was involved.

"I just found it really hard to find things where I could take the baby along or get someone to look after him. So it seemed like a nice solution" (ID 20)

About half the participants described valuing how the treadmill allowed them to utilise their baby's nap times to be physically active. This was viewed as a real benefit of the program, given that women often felt constrained by the rigorous sleeping schedules of their child.

"I've been working it around nap time. Just time of the day where it can be, can be quite stuck at home just waiting while they're napping so it's giving me a bit more purpose to my day" (ID 8)

Nearly all women suggested that poor weather was a barrier to them being active previously by reducing their motivation to exercise as well as increasing the difficulty of pushing a pram in such conditions. Women felt that the treadmill component of the program allowed them to overcome this and exercise regardless of the weather.

1.2 Barriers to using the treadmill

Children

Most women suggested that having children was a key barrier to using the treadmill. Specifically, women discussed the challenge of having more than one child, and whilst they wanted to exercise while their newborn was asleep, their older children demanded attention and thus they felt guilty that they were not spending that time with their older children. For this reason, it was suggested that the treadmill component of the program may be better suited to first-time mothers. Further, a few women also indicated that they were unable to leave their babies to go for a walk on the treadmill, since their babies were either too clingy or they didn't nap for long enough.

"having… a Velcro baby, and I couldn't really leave her while I'm walking on the treadmill, because that was a bit hard. She wouldn't be put down more than five minutes at a time, and she's still like that…I was able to get on there twice a week, but it was twice a week with a screaming baby" (ID 36)

Lack of time

Just over half the mothers suggested that time was a barrier to being active and using the treadmill, citing balancing motherhood duties as well as going back to work as the key reasons for lacking time.

Physical problems

A few women described having to reduce the intensity or frequency of their exercise due to adverse effects, including sore knees and fatigue from over exerting themselves, whilst a couple of women suggested that postpartum-specific factors including issues with their pelvic floor muscles and breastfeeding supply issues prevented them from being able to be as active as they had planned.

Theme 2: Benefits

Women discussed the benefits of the program encompassing behavioural, mental, physical and knowledge/motivational domains.

2.1 Behavioural benefits

Nearly every woman suggested that the program increased their physical activity levels. Specifically women described how the program helped them re-establish or initiate physical activity routines due to not only the treadmill, but also the information and goal setting/self-monitoring tools provided in the web-app. A handful of women suggested that the program provided them with "structure" for being active, as well as provided them with motivation to maintain physical activity even after the program was finished.

"…feel like I'm back into a regular routine. It's not the intensity I would have done previously but at least it's regular. So now I feel like I've got that base and I can build up from there" (ID 20)

Women described how after the program finished they now felt motivated to continue to exercise, due to establishing a good "base" level of fitness. A few women suggested that they were now looking at joining gyms and fitness classes with a couple of women thinking about hiring or

purchasing a treadmill for their home.

"very beneficial, absolutely loved it, I loved it, and now I'm thinking ok how can I incorporate a treadmill…in my house as well" (ID 1)

A couple of women also described that the program had additionally motivated them to exercise with others outside of the house, such as women from their 'mothers group'.

"We had one day catch up a week and then I was like oh, you know, I might see if one of them want to go for a walk..." (ID 22)

2.2. Psychological and physical health benefits

Most women described how they felt the program positively impacted on their mental health. These women suggested the program noticeably improved their mood, reduced stress, increased their energy, instilled a sense of patience within them, provided them with a sense of achievement, increased motivation including being more "driven" for the day ahead, and increased their self-confidence.

"Whenever I was using [the treadmill], I was always much more energetic, much happier the next day or the next few days afterwards. Then, when I found I wasn't using it, I didn't feel as good" (ID 27)

More than half of the women described valuing how the program gave them an opportunity to take some time out and do something for themselves, providing them with a new sense of identity. Many women felt overwhelmed with being a mother at times, and that they were "*just a mum, I just feed and change nappies"* (ID 1). But when they started exercising during the program they gained a little more perspective on life.

"You just feel is this what my life is now? This is how all mums feel, and it's not until you actually start doing something for yourself again, that you think, oh yeah, my life doesn't have to be

all about the baby all the time. I can have these little times to myself where I can do something for me again" (ID 33)

Additionally, a few women also perceived that participating in the program had increased their fitness, noticing improvements in their cardio-respiratory fitness as well as reduction in body weight.

"I'm much fitter than I would have been if I hadn't have been in the program and just been waiting for summer" (ID 2)

Theme 3: Feasibility and future development

Women provided insights into which components of the program they engaged with (usage), what they valued about the program (program value), as well as made suggestions for the future development of the program (future recommendations)

3.1 Program usage

Treadmill

All women used the treadmill, with all but one woman suggesting they enjoyed the treadmill component of the program. On average, women reported exercising on the treadmill 3 to 4 times per week and generally for about 30 minutes per session, with a couple of women suggesting they used it every day. In regards to unintentional effects, about half the women reported that their husband or older children also used the treadmill at times.

Web-app

Most women reported using the web-app information initially, and although the information was perceived to be highly useful, most women did not use the app after the first week or two. Most women used the goal setting planner and log book (particularly for initiation) and perceived these to be a particularly useful aspects of the program, helping them set and achieve goals, monitor their

activity, enhance motivation and accountability to be active, as well as serving as a reminder/prompt.

"I liked that I had to commit myself. I'm accountable to what I'm writing down saying that I'm going to do for the week. I'm made accountable with that. Just gives me a bit of extra motivation to get on the treadmill to do that" (ID 8)

Music playlists

About half the participants noted that they enjoyed and used the music playlists provided in the program. The other half of women used their own music, with a couple of women suggesting this was because they had difficulties downloading Spotify.

3.2 Program value

Acceptability

Nearly every woman indicated that they valued the program, would use the program again if they were given the opportunity and would recommend the program to new mothers. Women agreed that the program should be offered by general practitioners (GP's), maternal health centres, and/or local councils.

"Absolutely. Definitely. I think women would jump at the chance. It does get very lonely, you know. I think and it's hard to fit everything in, do something for yourself. At least if women have a little bit of exercise, I don't know, it gets very depressing being really overweight and being stuck inside, so I think it's a really great idea" (ID 2)

Although most women suggested the program was comprehensive and perceived that it increased their physical activity, one woman indicated she would not be interested in participating in the program again. The reason for this was due to her dislike of the treadmill activity, with her preference to be outside of the home when exercising.

Accountability

Two thirds of women described how various aspects of the program promoted feeling accountable. Although the fortnightly phone-calls were delivered by program staff to assess the mental health of participants for ethical purposes, women appreciated the phone calls, indicating that they were a good opportunity to self-monitor their own depressive symptoms and physical activity and were also useful as a means of support and a prompt to keep being active.

"Just having someone check on your wellbeing and trying to monitor your fitness and wellbeing and mental state; it was a nice sanity check" (ID 27)

The treadmill as well as the goal setting and self-monitoring tools were also suggested by a few women to enhance accountability to themselves.

Flexibility

Many women valued the flexibility of the program in enabling them to overcome barriers to physical activity (e.g. offering flexibility in the time of day they can be active), the convenience and ease of delivery and set up, as well as the provision of tailored "workouts", suited to their fitness levels.

"I think it would because of the flexibility. Having the flexibility of being able to do it in the comfort and safety of your own home and not having to worry about day or time or whatever, would work really well" (ID 13)

3.3 Future recommendations

Program length

Most women agreed that the program length (12 weeks) was appropriate. Women felt that they were more motivated because they had it for a short amount of time, and liked that the program

was long enough to see change and achieve goals but not so long that it was overwhelming (which would potentially hinder commitment). They also suggested that 12-weeks provided them with a good base level of motivation and fitness to continue their exercise routine after the program was finished.

Delivery

Most women suggested that they preferred the hard copy version of the goal setting and self-monitoring materials (e.g. log book), rather than using the online web-app version of these tools, as they were easier to complete and remember to complete if they were in hard copy near the treadmill and acted as a prompt to exercise.

"I found [the hard copy] a lot easier. Just had it on the bench and then when I got off the treadmill I'd write it down... It also looked at me as well when I walked past because if I hadn't done it for the day I'd think ohhh, it's sitting there blank" (ID 12)

A few women also described the web-app as not being mobile-friendly which they felt hindered their use of it. A native app (i.e. an application developed specifically for an Android or Apple smartphone) was suggested to be a more suitable and user-friendly platform for information delivery. Further, two women suggested that offering other exercise equipment options such as a stationary bike would be useful as there would be less impact on joints than a treadmill and may interest a wider range of women.

Support

A few women indicated that having more social interaction from the program team (via phone, text or skype) and/or use of an online forum (such as a moderated Facebook page) for the program would be useful for ongoing support and motivation.

Discussion

Depressive symptoms decreased over the duration of the 'Mums on the Run' program, which is in line with qualitative data in which women described the program as resulting in several mental health benefits, including improved mood, reduced stress, increased motivation, confidence and energy. Although confirmation of findings through RCT's are needed, these results provide preliminary evidence that the program may be beneficial for mental health amongst postpartum women. These mental health benefits to exercise during the postpartum period have been described in previous qualitative research (Saligheh, et al., 2016) and are further supported by findings of a recent meta-analysis that showed that among the small number of existing treatment trials, there was a moderate effect of exercise on reducing depressive symptoms in postpartum women (McCurdy, Boule, Sivak, & Davenport, 2017).

The 'Mums on the Run' program was found to be feasible to take part in and perceived to be a convenient, flexible and acceptable program to increase physical activity in postpartum women experiencing depressive symptoms. Recruitment into the program was relatively fast (6-weeks using a low-intensive approach i.e. sharing a facebook post) given that the study involved various levels of screening and targeted a hard-to-reach population group (i.e. those experiencing high levels of depressive symptoms). The high retention rate (78%) is a further indication of the programs high level of feasibility and acceptability. Just one participant (of the initial 12) (8%) did not participate in the qualitative interview, which suggested that the program was well-accepted, whilst just one participant reported there to be a mechanical issue with her treadmill (which was then replaced immediately), which suggested that the treadmill aspect of the program was mostly feasible. Women perceived that the program helped them overcome a number of key barriers to physical activity. Specifically, 'lack of motivation' and being 'housebound', key barriers to physical activity reported in previous literature amongst postpartum women (Saligheh, et al., 2016), were able to be

overcome due to the convenient and flexible nature of the program. Despite some other walking intervention strategies (e.g. 'pram walking') promoted physical activity amongst postpartum women with depressive symptoms (Armstrong & Edwards, 2004), many of those interventions have often not addressed these key barriers to exercise. Notwithstanding, women did suggest that they still faced some barriers in using the treadmill during the program, namely 'children' (motherhood responsibilities) and 'lack of time', both of which are common barriers to exercise cited by postpartum women in previous literature (Saligheh, et al., 2016). Although the program provided information (in a web-app) on how to overcome these barriers, as well as home-based equipment in an effort to target those barriers, postpartum women may need additional support to help manage their family, work and personal health responsibilities, such as brief telephone health coaching.

The program was perceived by women to be effective in initiating and maintaining physical activity routines (behavioural benefits). Although a randomised controlled trial (RCT) would be required to determine effectiveness on physical activity, this information is promising. The intervention was based on theoretically underpinned behaviour change strategies, derived from principles of the social cognitive theory (SCT) (Bandura, 1986)], as well as aspects of the transtheoretical model (Prochaska & Velicer, 1997). Thus, it is expected that such a program would result in change in physical activity and hence larger-scale trials are required to test this.

Women perceived the multi-component program to be acceptable, flexible and to increase accountability for physical activity. The provision of exercise equipment, a web-app and music playlists were generally well-received and valued, despite some features (e.g. web-app) only being used more so in the early stages of the program. Multi-component approaches (i.e. using more than one activity/strategy to achieve outcome) are generally more likely to be effective in increasing

physical activity, compared to single component approaches (Kahn, et al., 2002). Together, these pilot findings provide a basis for the need to undertake an effectiveness trial as a next research step.

Finally, the length of the program (12-weeks) appeared to be appropriate to enhance motivation and initiate exercise routines. Studies have shown that physical activity programs between four and 12-weeks can be effective in reducing risk of depression in the general population, and that 12-weeks is the most commonly used trial length for this purpose (Stanton & Reaburn, 2014). However, women did suggest some aspects of the program could be refined such as provision of social support in the form of either telephone calls or forums on social media). This is particularly noteworthy given that social support is a key behaviour change strategy used for physical activity participation, as well as being a strategy used in the treatment/management of depression (Connolly, Feltz, & Pivarnik, 2014).

Study findings should be interpreted with acknowledgment of limitations. Although data saturation did occur, the small sample size may limit the generalisability of findings to other segments of this population group (e.g. socioeconomically disadvantaged or ethnic minority postpartum women). However, given that the program is likely to be suitable for disadvantaged women (due to being provided free treadmill hire and overcoming the barrier of cost of childcare), it would be worth investigating further in such populations. The name “Mums on the run” does suggest that the focus of the program was on running, which may have limited who volunteered for the study. One participant was unable to be contacted for the follow-up interview and it is unknown as to whether this was due to a lack of interest in (or usefulness of) the program, or other factors. Further, the nature of the one-on-one interview may be subject to provision of socially desirable responses. A lack of control group also limits the interpretation of results from the quantitative study as changes in depressive symptoms may have been due to factors external to the program such as mothers adapting to their new lifestyle or improved sleep quality. Furthermore, the study was unable to

assess change in physical activity (due to the different measures used at baseline and follow-up). However, a strength of this study was the mixed methods design. The qualitative study enabled in-depth data to be collected and analysed, allowing for a detailed exploration of the perceived feasibility and acceptability of this program in new mothers with heightened depressive symptoms. Retention rate (78%) was high. Moreover, combining home equipment with low- intensity motivational and social support represents a suite of best-practice, theoretically-derived behaviour change approaches that are highly promising and overcome many of the challenges of this target group.

A multi-component, theoretically underpinned, home-based physical activity program involving free exercise equipment hire was feasible and well accepted by postpartum women. Future research should use these findings to further develop and test the effectiveness of this program for increasing physical activity and improving mental health.

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Competing interests

The authors declare that they have no competing interests

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Availability of data and materials

The datasets analysed during the current study are not publicly available due to ethical restrictions (participants have not consented to the use of their data for purposes other than those for which they originally consented). Should a researcher request the data for a particular purpose, an ethically compliant dataset may be made available via the senior author upon approval by the Deakin University Human Research Ethics Committee.

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