The effects of exercise and social support on mothers reporting depressive symptoms: A pilot randomized controlled trial

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ABSTRACT:
A 12-week randomized controlled trial was conducted (n = 20) investigating the effects of a multi-intervention programme of exercise and social support compared to a control group. Both groups had given birth in the past 12 months and were experiencing depressive symptomatology. Pre-test data of physical fitness and structured questionnaires were compared to post-test data. The results from the study showed that mothers who were in the multi-intervention group improved their fitness levels and depressive symptomatology significantly more than the control group. However, there were no significant changes to either group's social support levels. These results are encouraging and suggest that a pram push walking intervention might be an effective treatment for mothers suffering postnatal distress.

INTRODUCTION

Past research suggests that exercise improves depressive symptomatology, fitness and enhances social interaction established (North et al. 1990; Scully et al. 1998), however, this phenomena has not been studied on women in the postnatal period who are suffering postnatal distress. Postnatal depression (PND) is a serious condition that affects up to 10% of childbearing women postpartum (Boyce et al. 1993). Considering the birth rate in Australia for the 2000 calender year (249 636) (ABS 2000), it is estimated that 24 964 women each year experience PND. This represents a major public health issue for childbearing women in Australia (Stamp & Crowther 1994). Research in the past 10 years has concentrated on causes and consequences, plus prevention of PND (Stamp & Crowther 1994), and little has been done on providing alternative forms of treatment other than traditional medical intervention and counselling. To date, limited research has been conducted on exercise and women in the postnatal period. A few studies exist (Currie & Develin 2000; Koltyn & Schultes 1997; May 1995) which have looked at the effect of some form of exercise on postnatal women, however, no published study has examined the physical, mental and social effects of aerobic exercise on postnatal women. Therefore, one of the most important areas for research is the evaluation of intervention programmes involving exercise.

Physical exercise has been associated with improvement in mood, reductions in depression and anxiety (North et al. 1990) and improvement in self-esteem (Palmer 1995). The literature does vary depending on the type of exercise, programme design

and exercise variables. It has been identified that women suffering from PND may respond to exercise programmes (Choi & Mutrie 1996) since the effects of exercise on mild to moderate depression are well established (e.g. Cramer et al. 1991; North et al., 1990).

However, difficulties arise as to the programme design, obtaining participants and possible adherence to the programme. The area of research is open to the design of innovative exercise programmes, which would be suitable for mothers who are suffering depressive symptoms.

Women themselves have identified that exercise is an important aspect of postnatal well-being (Currie & Develin 2000; Franklin 1988; Lox & Treasure 2000). However, women have reported difficulties continuing with exercise in the postnatal period (Currie & Develin 2000; Lox & Treasure 2000; Palmer 1995) and it was identified that high stress levels or major life disruptions impeded their exercise activities altogether (Lox & Treasure 2000). Not having enough time for physical activity (Eyler et al. 1997) was cited as the most common reason postnatal women do not participate in exercise. The implications of such findings indicate that women in the postnatal period find that large amounts of energy and time are required for formal exercise.

Organized programmes that would accommodate mothers were identified as key issues that would ease the burden, provide motivation to find the time and provide guidance for physical activity (Lox & Treasure 2000). Setting realistic attainable goals for the exercise programme is important so that the individual does not experience failure. The exercise should also be fun, convenient and varied which subsequently is associated with adherence (Franklin 1988). Positive associations have been identified between participation in walking programmes, improvement in physical fitness and improvement in self-esteem (Currie & Develin 2000; Questead & Alquist 1994). A number of factors that could indirectly affect the participant's improvement in self-esteem could be the acquisition of a new skill, increased social contact, attention from the research team and completion of a challenging programme (Questead & Alquist 1994). Changes in body shape and image could also have implications for their feelings of self-worth.

The aim of this study was to compare the well-being of women who were experiencing feelings of postnatal distress and who were allocated to a multi-intervention programme of exercise and support to the well-being of similar women in a non-intervention control group. It was hypothesized that, compared to a control group, participants in the intervention programme would improve their mental well-being and feelings of depression; their physical fitness; and levels of social support. All factors were assessed by applying the methodological framework of a programme evaluation study which compared pre-test results to the post-test effects.

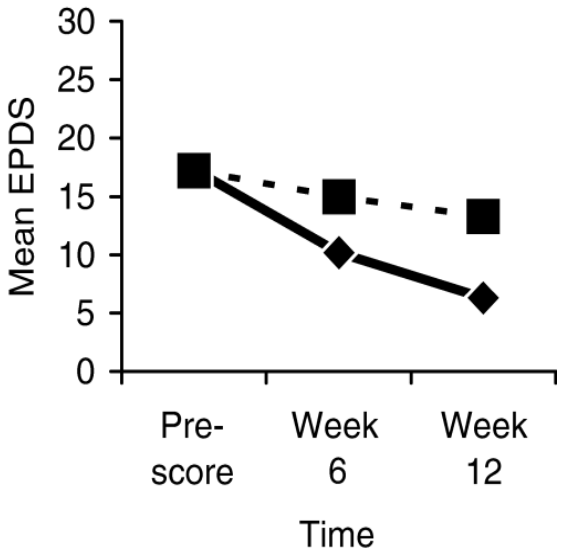

FIG. 1: Edinburgh Postnatal Depression Scale mean scores over time.

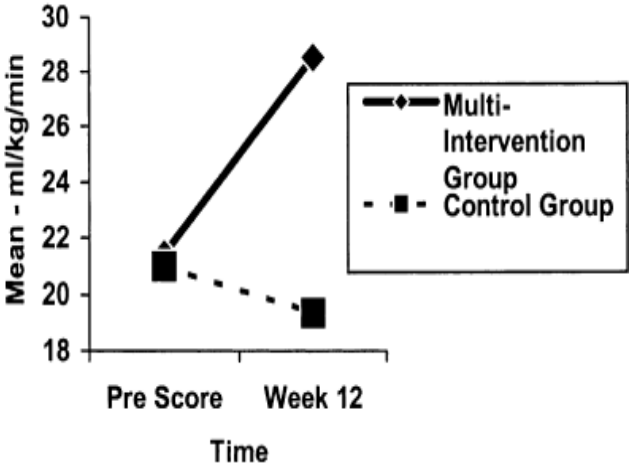

FIG. 2: Maximum volume of oxygen mean scores over time.

Group	EPDS	DASS	GHQ	SSI
***n* = 10 for each group**				
Score range	0–30	0–4	0–12	0–135
Pre-test				
Intervention	17.40 (4.65)	1.80 (1.69)	5.44 (3.88)	97.00 (23.44)
Control	18.40 (4.77)	2.25 (1.48)	8.00 (3.80)	89.90 (15.86)
Week 6				
Intervention	7.20 (4.32)	0.08 (0.92)	2.44 (1.81)	101.60 (20.71)
Control	13.50 (4.53)	1.80 (1.69)	5.70 (4.00)	84.10 (19.65)
Week 12				

Group	EPDS	DASS	GHQ	SSI
***n* = 10 for each group**				
Intervention	4.60 (3.34)	0.00 (0.00)	1.11 (1.17)	101.60 (19.31)
Control	14.70 (7.66)	1.70 (1.57)	5.10 (4.09)	89.00 (17.36)

TABLE 1: Edinburgh Postnatal Depression Score (EPDS), Depression Anxiety Stress Scale (depression; DASS), 12-item General Health Questionnaire (GHQ-12) and Social Support Interview (SSI) means and standard deviations

METHOD

Design

The study was a randomized controlled led trial where participants were randomly allocated at the completion of fitness testing to either a multi-intervention group or a non-intervention group. Participants in the multi-intervention group were encouraged to attend three pram push exercise sessions and one social support session per week for 12 weeks. All participants completed a fitness test both prior to the start of the programme and at the completion of the intervention period. All women answered pre- and post-test questionnaires which assessed their general well-being, depressive symptomatology, anxiety and their available social support.

Sample

Participants were drawn from the Gold Coast region of Queensland. To be included in the study the participant had to have a child between the ages of 6 weeks and 12 months and have an Edinburgh Postnatal Depression Score (EPDS) (Cox et al. 1987) of 12 at the screening phase. The EPDS is a scale commonly used by health professionals to determine the postnatal well-being of mothers. It is recognized that a score of 12 is an indicator a women is suffering PND (Boyce et al. 1993; Cox et al. 1987; North et al. 1990). Participants were also required to complete the Physical Activity Readiness-Questionnaire (PAR-Q) (1994) for clearance to be available for the study and were excluded if they had a medical condition that would prevent regular aerobic exercise.

To determine the appropriate sample size, data from previously conducted validation studies were used (Boyce et al. 1993; Cox et al. 1987; North et al. 1990). To date, no published research has been conducted on a group of postnatal women who have exercised and used the EPDS as a tool to determine variations in depressive symptomatology. Therefore, general PND validation studies were used to determine the expected variations in mean scores before and after walking and the power for determining the expected sample size. Statistical information from Boyce et al.'s (1993) validation study of an Australian sample was used to calculate the standard deviation for depressed and non-depressed participants as determined by the EPDS. These figures were depressed mean = 17.8 (SD = 3); non-depressed mean = 5.2 (SD = 3.7) ($t = 9.83$, d.f. = 101, $P < 0.01$).

In calculating sample size, it was assumed that the standard deviation would not change for depressed and non-depressed mothers, and therefore would remain at 3. We estimated the mean used for depressed mothers, was 18 (similar to Boyce et al.'s study and also middle of the valid responses of 1224). According to Cox et al. (1987) in their validation of the EPDS, women who were depressed at the first interview but not depressed 11 weeks later after a counselling intervention, had a score reduction of 6 (EPDS-1 mean score = 15.8, EPDS-2 = 9.8, t = 3.72, P = 0.002). The EPDS-2 score fell below the threshold of 12/13. The mean drop of 6 from Cox et al. (1987) study was therefore used for this study. It was calculated that a mean drop of 6 from the mean would show decreased depression.

A two-tailed test with a 5% significance and 80% power was used to calculate total sample size required. Using the University of Iowa website (www.stat.uiowa.edu/~rlenth/ Power/Index.html) and selecting a two sample t-test, the result was n = 17. To allow for 20% loss, the sample required was 20. The percentage drop out rate of 20% was used on the basis of other studies involving exercise interventions for depressed participants (e.g. Cramer et al. 1991 (25%); Moses et al. 1989 (20%); McCann & Holmes 1984 (10%)).

Recruitment

Participants were recruited using two methods.

Method one

Women were recruited by recommendations from various health professionals (e.g. community child health nurse, social worker, counselor, psychologist, GP, psychiatrist). The participant gave the researchers permission (consent form) to access their EPDS for use in the study.

Method two

Women were recruited by self-recommendation. Advertising was done via a flyer, print media, radio, email, and community notice-boards. Feature articles promoting the study were also done in the two local newspapers. Flyers were also posted at child care centres, play groups and preschools.

Participants who presented with self-recommendation were screened to establish if they met the initial inclusion criteria. Once they satisfied the inclusion criteria and were screened for their physical health, read the information package and signed the consent, they were admitted to the study.

Measures

Data were collected at pre-test/week 1, week 6 and week 12. Three self-report measures were used to collect data concerning depressive symptomatology. The first instrument, the EPDS (Cox et al. 1987), was administered in a structured format as a pre-test questionnaire for inclusion in the study. The 12-item General Health Questionnaire (GHQ 12) (Goldberg & Williams 1988) and the Depression Anxiety Stress Scale (DASS) (Lovibond & Lovibond 1993) were also administered in a structured format. All three measures have been well validated (EPDS by Boyce et al. 1993; Cox et al. 1987; Murray & Carothers 1990; North et al. 1990; GHQ 12 by

Boyce et al. 1993; and DASS by Antony et al. 1998; Lovibond & Lovibond 1995) and considered appropriate measures of postnatal distress.

One measure was used to collect data concerning levels of social support. The Social Support Interview (SSI) (O'Hara 1995) was administered in a structured questionnaire format. The SSI was chosen for the study as it is the most contemporary reliable measure which assesses the level of social support available to women in the postnatal period. The questionnaire has not been validated against other standard measures which is a limitation. However, for the purpose of the current research, the data were compared with O'Hara's (1995) findings.

The Physical Activity Research Questionnaire (PAR-Q) (Canadian Fitness and Lifestyle Research Institute 1994) is a seven-item questionnaire that identifies individuals who physically may not meet the demands that an exercise programme might offer. Participants answered the questionnaire prior to taking part in the study. If a participant answered 'yes' to one or more questions, they were required to have a physical examination with their doctor. A letter of approval was then required from their GP granting them approval to take part in an exercise programme.

A fitness test required the participant to perform a circular walking test at the commencement and completion of the study. The participant walked only to 80% of their maximum age predicted heart rate (American College of Sports Medicine 2001). The test is less invasive than a maximal test to exhaustion and more suitable for women who have given birth in the past 12 months. The participant's heart rate was recorded every 3 min as the intensity level increased. The predicted maximum volume of oxygen (VO2 max) consumption was extrapolated (McConnell 2001) and used to compare both groups pre- and post-test data.

For participants in the multi-intervention group, the Borg's perceived level of exertion scale (original 1970, updated 1998) was used as a point of reference to assess their own intensity of exercise. Participants were also required on a weekly basis to complete their own personal exercise profile according to the results of their exercise session. Their target heart rate, frequency, type of exercise, duration, intensity, and heart rate directly after completion of the exercise session were recorded.

Demographic data were also obtained and both groups completed an evaluation questionnaire at the completion of the intervention. This enabled participants to reflect on how the key issues of exercise, social support and depression had affected their lives.

PROCEDURE

Ethical approval was obtained from the university (Queensland University of Technology Ethics 2000) in which the research was undertaken, the local Gold Coast District Health Services (1997) and two centres in the catchment area. A designated medical doctor was allocated to the study. This doctor was available for either the research team (with participant consent) or the participants to contact. The objective was to protect any participant from either group who communicated or expressed feelings or thoughts of self-harm to themselves or the baby, or suicidal thoughts or tendencies.

After the recruitment period was complete and participants had returned the consent form, EPDS questionnaire and PAR-Q, they were invited to attend an information evening where the procedures were explained. Questions and discussion was encouraged and the evening also gave women the opportunity to meet the chief investigator and other participants.

Fitness testing

The week following the information evening the women were given the choice to attend one of the five mornings available between 06:00 and 07:15 hours for fitness testing. The same procedure occurred at the completion of the 12-week intervention period. Two volunteer carers were available to look after the children should a participant need to bring their child/children with them. It was predicted that the test, depending on the individual's fitness level, could take anywhere between 10 minutes and 40 minutes. Two volunteer exercise physiologists helped in administering the test.

The fitness test was a field adapted version of a graded treadmill test. The 'Cornish Wheel' concept which was used and originally developed by Dr Geoffrey Cornish (Cornish 1983; currently modified) could test multiple participants at once. The test involved the participant beginning at the 22 metre colour-coded marker and walking around in a circular motion keeping up with a beep sound which was set at 10-second intervals. Continuity and pace with the beep was crucial and an instructor was with the participant to ensure they followed the correct procedure. After 3 minutes the participant's heart rate was recorded and they moved out another 2 metres. As the participant moved out on each 2-metre stage the pace, distance and intensity increased. The process of 3-minute intervals of exercise followed heart rate monitoring and moving further out on the wheel. This continued until the participant reached 80% of their maximum heart rate or they felt fatigued, uncomfortable or exhausted and unable to continue. The test is a predictive test used to predict maximal aerobic capacity. A predicted VO2 value was obtained by extrapolating the relationship between heart rate and VO2, to age predicted maximal heart rate (HR max.) (Noonan & Dean 2000).

Randomization

At the completion of the fitness test, participants were randomly allocated to either the multi-intervention group or the control group. The procedure of randomization required the participant to choose a sealed envelope. Envelopes contained a sheet of paper with either an A or B on it. The participant, prior to choosing the envelope, was informed that A corresponded to the exercise group and B corresponded to the control group. It was stressed that the process was random and that the chief investigator had no control over who was selected into which group. Participants chose their envelope and their allocation was recorded.

Multi-intervention group

The participants allocated to the multi-intervention group began the 12-week program the following week. The exercise component of the intervention involved the participant walking three times per week with the group for 3040 minutes at a

moderated intensity (6075% of age predicted heart rate) to improve both cardiovascular endurance (American College of Sports Medicine 2001) and depressive levels (North et al. 1990; Scully et al. 1998). For the first 3 weeks a few participants walked for only 30 minutes in order to make the exercise achievable and to help with compliance.

Participants were encouraged to attend all three pram walking sessions on a Monday, Wednesday and Friday at 9.30 am at a point that was central to the catchment area and had flat walking paths suitable to push a pram. If for unforeseen circumstances a participant was unable to make a session, they were encouraged to make up the session independently and record it in their exercise diary. After the sessions on Mondays an informal gathering (morning tea provided) for a chat and play with the children was encouraged. This was conducted at the nearby local primary school hall. The chief investigator was present at the walking and support sessions. The participant was required to perform muscle stretches before and after the walk and the chief investigator educated them on appropriate stretches.

Participants were required to complete their own personal exercise profile diary according to the results of their exercise sessions and their heart rate (carotid and radial pulse) was taken directly after completion of the exercise sessions. A log of who attended both the exercise sessions and informal social support sessions was kept.

Non-intervention control group

The participants assigned to the non-intervention group were required to perform the circular walking test at the beginning and end of the programme as well as completing the assigned questionnaires. They were not involved in the multi-intervention programme. The non-intervention group at the completion of the study were given the opportunity to be involved in the alternative programme of two sessions of exercise over a 6-week period. To minimize effects of the control group receiving no specific intervention, phone support was provided to participants at week 6 and participants were encouraged to contact the researchers if they had any concerns. In addition, the control group were advised to maintain their usual regime and social activities.

Data analysis

To test for the effect of the intervention over time, a two-way analysis of variance (ANOVA) was conducted on the major outcome variables. Group (intervention vs control) was the between subject factor and time (pre-test, week 6, week 12) was the within subject factor or repeated measures factor. Due to the small sample size, further tests were conducted to check the assumptions of the statistical test to be used. The results showed that using Mauchly's Test, the Sphericity assumptions of repeated measures for ANOVA were met. Furthermore, tests of homogeneity of variance assumptions also confirmed that this assumption was met. Data analysis was conducted using the software package SPSS for Windows Release 10.0. (Norusis 2000).

RESULTS

Demographics

The demographic profile of the two groups was similar with the majority of the sample aged between 21 and 30 years. All were in a married/de facto relationship and had either one or two children and the majority of mothers were the homemaker with an annual family income of A$30 000 and A$40 000. Just over half of the mothers were taking medication for PND and only a limited number were receiving counselling. Most women were exercising 12 days per week both pre- and post-birth, prior to taking part in the study. Seventy per cent of participants from the multi-intervention group and 60% of participants from the control group were recommended to the study by health professionals, and the remaining participants self-recommended.

Psychological well-being

The results from the study showed that the mothers who were randomly assigned to the multi-intervention group improved their depressive symptomatology significantly compared to the control group. Analysis revealed that there was a significant main effect for time ($F_{2,17} = 54.6$, $P < 0.01$), group ($F_{1,18} = 8.1$, $P < 0.01$), and the interaction of time and group ($F_{2,17} = 9.5$, $P < 0.01$). Post-hoc analyses for the EPDS revealed that the groups did not differ prior to the programme ($t(1) = 0.02$, $P > 0.05$), and that the intervention group reported significantly less depressive symptomatology than the control group at week 6 ($t(21) = 0.08$, $P < 0.01$) and week 12 ($t(3) = 8.96$, $P < 0.01$) (Fig. 1). Both the DASS (depression) and the GHQ-12 analysis revealed that there was a significant main effect for time (DASS, $F_{2,17} = 6.37$, $P < 0.01$; GHQ-12, $F_{2,16} = 8.90$, $P < 0.01$) and group (DASS, $F_{1,18} = 4.23$, $P < 0.05$; GHQ-12, $F_{1,17} = 5.887$, $P < 0.05$), but the interaction of time and group was not significant (DASS, $F_{2,17} = 1.93$, $P > 0.05$; GHQ-12, $F_{2,16} = 0.48$, $P > 0.05$) (Table 1). This indicates that regardless of which group participants were in, they all improved over time. Despite this general improvement over time, the reported depression and psychological disturbance for control group participants was still in the moderate to severe range.

Results also revealed that the intervention group had better general health scores than the control group and the participants in the intervention group reported less depression (EPDS and DASS-depression) overall. Both groups, according to the GHQ-12 range (012) were experiencing high to severe psychological disturbance. At week 6, the multi-intervention group were in the mild to moderate range with a mean score of 2.44 and the control group remained at 5.70, which still indicated high to severe psychological disturbance. The multi-intervention group at week 12 scored at the range, which indicates no disturbance (Goldberg & Williams 1988). In contrast, the control group still reported scores indicating high to severe psychological disturbance.

Social support

For social support levels, there was no significant main effect for time ($F_{2,17} = 1.26$, $P > 0.05$), group ($F_{1,18} = 2.17$, $P > 0.05$), or the interaction of time and group ($F_{2,17} = 3.20$, $P > 0.05$). These results indicate that neither group had any significant changes to their social support across the 12 weeks (Table 1). According to O'Hara (1995) the level of satisfaction for both groups reflects a high level of perceived social support

from their spouse, parent and confidant. This high level of support may suggest a ceiling effect, making improvement on their already high levels of social support difficult.

Fitness

The total number of sessions offered to participants from the multi-intervention group was 36. The mean number of sessions attended by participants was 23.70 sessions. The Borg Scale (1998) average exertion range was 13, which indicated that participants found the exercise sessions to be 'somewhat hard', but still able to continue. The recommended moderate intensity of exercise (King et al. 1992) of between 60 and 75% as recommended by the American College of Sports Medicine (2001) to improve cardiovascular endurance and depressive levels was between 113 and 142 beats per minute. The mean heart rate was 129 beats per minute, which indicates that the women on average were exercising at 68% intensity of their age predicted heart rate.

Analysis revealed that there was no significant main effect for time ($F1,17 = 1.94$, $P > 0.05$), or group ($F1,17 = 3.40$, $P > 0.05$), however, there was a significant interaction of time and group ($F1,17 = 10.52$, $P < 0.01$). Post-hoc analysis revealed that the groups did not differ in their fitness test prior to the programme ($F1,18 = 0.808$, $P > 0.05$), however, the post-fitness test result showed that the intervention group reported significantly improved fitness levels ($F1,17 = 0.013$, $P < 0.01$) (Fig. 2). Both groups were very similar at the pre-test phase (control group mean = 20.9760 mL/kg per min; intervention group mean = 21.3790 mL/kg per min). According to Howley and Franks (1992), both groups mean scores for the pre-test phase were in the lowest category of needing extra fitness work. After the 12-week programme the control group were still in the lowest category but the intervention group were at the top end of the next category of borderline (needs extra cardiorespiratory fitness work (< 25 mL/kg per min), borderline (2529 mL/kg per min), adequate (3034 mL/kg per min), and good (> 34 mL/kg per min)). This indicates that the fitness levels of both groups were very similar prior to the intervention period, however, at week 12 the multi-intervention group's fitness improved (mean VO2 max, 28.5320 mL/kg per min). In contrast the control group's mean score decreased to 19.3510 mL/kg per min (Fig. 2).

DISCUSSION

The findings support two of the three hypothesis tested in the study. The hypotheses that, compared to a control group, participants in the intervention programme would improve their mental well-being and feelings of depression and improve their physical fitness were supported by the findings. The third hypothesis which stated that, compared to a control group, participants in the multi-intervention programme would enhance their social network, was not supported.

The study has shown that improvement in physical fitness occurred simultaneously with improvements in depressive symptomatology. The three self-reports measures of depression (EPDS, DASS and GHQ-12) improved for the women involved in the exercise and support sessions. The underlying causes and mechanisms as to why exercise improves psychological well-being is still unclear. Various theories exist (e.g. distraction from stress, alteration in brain monoamines, endorphin release) (e.g.

Dishman 1997), however, the current evidence regarding these theories is inconclusive and only a limited number of studies exist that test the hypothesis (Gauvin & Spence 1996). It is well established that mild to moderate depression improves with exercise interventions (North et al. 1990; Scully et al. 1998). The findings from the study have shown that postnatal women involved in regular exercise and informal support sessions improved their depressive levels and overall well-being. However, recruitment was difficult with the mothers reluctant to come forward due to the stigma associated with PND (e.g. Currie & Develin 2000).

An important key factor in offering such programmes is to make the programme achievable and setting realistic goals so that the women are able to achieve success. Brown et al. (1995) recognizes this to be an integral component of an exercise programme so that the individual does not experience failure. Of greatest challenge for postnatal women, particularly women suffering postnatal distress, is time and tiredness (Currie & Develin 2000). According to Eyler et al. (1997) lack of time is the most common reason women do not participate in exercise. By offering women structured programmes, it gives them the opportunity to be involved in an activity where they are receiving attention by an instructor and positive encouragement. This alone provided motivation to attend sessions.

The average attendance at exercise sessions was 66% and considering the women also had their children to consider their adherence levels were good. The combined reasons for not attending were sick child/children (62%); sickness (14%); commitment to other engagement (8%); work (7%); holiday (5%); other (4%). The women were always enthusiastic and made every effort to make it to the sessions.

The findings from the study are consistent with the literature, which identified that improvements in fitness were associated with improvements in self-image and a general overall feeling of physical and emotional general well-being. Further benefits highlighted by the women were improvement in coping with daily activities, improvement in sleep patterns due to being tired from the exercise and more energy for the children.

Social contact through exercise has been highlighted in the literature to have beneficial effects (Scully et al. 1998). Creating an environment where women are free to discuss their feelings with other women who are having similar experiences creates emotional and social support. Currie and Develin (2000) identified that 94% of participants from their pram push programme felt that social aspects were the reason for taking part in the exercise. Exercise sessions offer women an informal platform to discuss issues pertaining to childbirth, raising children and other lifestyle issues. The study revealed that the continuity of the sessions meant that the women could return to their conversations and offer support and advice to each other. Key factors that were integral to the social support received included being with other women who were having similar experiences; not focusing and discussing PND all of the time; continuity and being out in the fresh air with the children.

Reports from the women would suggest that they benefited from the social aspects of the programme. The positive support provided by each other raises the question about the minimal changes in support levels across the study. Pre-test and post-test scores did not alter over the period of the intervention for either group. The week 1 scores

for both the intervention and control groups were high on the SSI (O'Hara 1995). It would suggest that participants had a high level of social support at the commencement of the programme. Overall, this high level of support may suggest a ceiling effect, making improvement on their already high levels of social support difficult. Alternatively, it could be possible that the SSI may not be sensitive enough in detecting changes in support levels for this cohort of women.

In summary, the results support the literature, which indicate that programmes that aim to improve psychological well-being, cardiovascular endurance and are at least 9 weeks in duration have shown to improve depressive symptomatology (e.g. American College of Sports Medicine 2001; Blumenthal et al. 1999; Moses et al. 1989). Providing women with organized pram-push exercise programmes gives women the opportunity to improve their physical fitness, provides motivation, helps foster social contact, is inexpensive and the mothers' progress can be monitored easily.

Limitations

A limitation of the study was that the Cornish Walking Wheel (CWW) fitness test had not been validated against a lab-based treadmill test. It has been identified that the literature regarding the adequacy of establishing validity, reliability and sensitivity of submaximal testing is limited (Noonan & Dean 2000). The need to further test submaximal performance is required. The basic aim of the testing would be to compare the relationship between the two fitness tests to determine whether the participant's heart rate response and VO2 during progressive exercise could predict VO2 max. Therefore, by using the estimated maximal heart rate, the estimated VO2 max could be extrapolated by plotting the submaximal exercise intensities. The test, therefore, could validate the use of the assumed oxygen cost of walking in the CWW test with the actual oxygen cost of walking using a treadmill test and expired gas analysis for each stage and speed. In both cases the assumptions associated with extrapolation to maximum are not validated, but the literature does support the use of treadmill submaximal tests and their correlation to maximum tests. The benefit of submaximal testing allows a predicted VO2 max to be identified, to make diagnosis, assess functional limitations and to further assess the outcome of intervention programmes (American College of Sports Medicine 2001; Palmer 1995) designed for exercise prescription for various populations.

It is not known whether the exercise, social support alone or in combination was effective in reducing depressive symptomatology. It would be recommended that follow-up research involve three groups (exercise, social support and control) to enable the researcher to distinguish whether exercise alone can improve PND. The results from the study further support the need for a separate social support group to determine the effect of the social interaction as an independent factor. This would be achieved by adding a social support group, which would control for the social aspects of the intervention programme of exercise, which by its group nature, encompasses elements of social support.

A limitation of the study was that the women were not able to attend all of the sessions offered. It would be recommended for any follow-up research that the participants be required to attend two exercise sessions and make up the third session independently. It would also be recommended that the ratio of assistants walking with

the mothers were limited to 1 : 10, Therefore, the programme would offer personal treatment and education as to the benefits of exercise so as to establish appropriate exercise habits and lifestyle changes.

Future directions

Collaboration and consensus of methods and techniques used to assess exercise programmes, plus communication among key personnel would help contribute to a more global understanding of how best to intervene in PND. Standard forms of treatment are not always effective and the need for alternative choices used as an adjunct to traditional strategies are needed. Psychological variables offer promise for greater participation, however, no individual model can best explain exercise behaviour. The need to further test alternative treatments and programmes suitable for mothers and their babies is required. Exercise programmes, once developed and established, could provide alternative or complimentary therapies in the form of primary and secondary prevention options.

In conclusion, the study conducted was successful in providing improvement in depressive symptomatology and fitness levels for mothers suffering from postnatal distress. However, it is the first study of its kind and much more can be learnt from similar studies. The study provides a base for future research and has the potential application for programmes to be implemented in the mental health field. Mental health care workers would be well placed to refer mothers to such programmes and to work with instructors with experience in exercise prescription to conduct the programmes.

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