

Effect of a single bout of exercise on the mood of pregnant women

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Aim. Few studies have been conducted investigating the psychological benefits of exercise during pregnancy. Additionally, hormonal and cardiovascular responses to water-based and land-based exercise in pregnant women are different. Therefore, this study investigated the influence of a single bout of exercise on the mood of pregnant women participating in an *aqua*- or *studio*-based exercise class compared to a parentcraft and a control group.

Methods. The study consisted of 4 conditions: the 66 participants either took part in an *aqua* class, a gym *studio* class, a parentcraft class or acted as controls. Mood was assessed using the profile of mood states (POMS) just prior to the activity and shortly following the activity.

Results. No initial differences were observed between the four conditions before exercise or activity participation. However, participation in the *aqua* and *studio* conditions resulted in increased overall mood score and showed a significant increase on the vigor subscale. Also, a decrease in the depression subscale of the POMS was found in the *aqua* condition. The parentcraft classes did not alter the women's mood state.

Conclusion. Although the physiological and hormonal reactions are different for *aqua*- and land-based exercise both modes of exercise appear to be equally beneficial for pregnant women to engage in to improve mood. Additionally, exercise, but not parentcraft classes, resulted in enhanced mood in women in their 2nd or 3rd trimester of pregnancy. Although exercise has

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mood benefits that are comparable to other mood management techniques, it also has additional physiological and physical benefits to both the mother and the fetus.

KEY WORDS: Pregnancy - Mood - Aqua and Studio Exercise.

Regular participation in exercise has been associated with primary and secondary prevention of numerous physical health problems.¹⁻³ In addition to the physical health benefits, there is also strong evidence that moderate exercise results in a more positive self-concept, improved mental health, increased sense of well-being, a higher quality of life and improved mood.⁴⁻⁶ With the increased awareness that exercise plays an important role in promoting health and well-being, many women now wish to continue exercising whilst pregnant.^{7,8} Despite several physiological and body composition changes during pregnancy, this period in a women's life is no longer viewed as a phase in which they are expected to be inactive.⁹ Moreover, moderate intensity exercise appears to have no negative consequences for either the pregnant mother or her fetus.^{10,11} If anything, exercise during pregnancy seems to be associated with several physical benefits

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like higher birthweight,¹² increased nutrient delivery to the foetus,¹³ and reduced risk for Cesarean delivery.¹⁴ However, few studies have centered on the psychological benefits of exercise during pregnancy. In particular, the effect of a single bout of exercise on the mood state in pregnant women has been ignored.¹⁵

Mood has been defined as 'the global set of affective states we experience on a day-to-day basis',¹⁶ and can be distinguished from emotions in the way that they are not explicitly related to specific objects or events, so that they may persist even in the absence of particular triggering events.¹⁷ Furthermore, emotions are generally brief (minutes and seconds rather than hours or days) in nature, whereas mood is longer lasting.¹⁸ Numerous studies have shown enhancement in mood in different populations, such as the elderly,¹⁹⁻²¹ college students²² and middle-aged women²³ following exercise participation. In a recent review, it was concluded that acute physical activity improves mood in non-clinical populations and chronic exercise improves mood among clinical populations.²⁴

Taking into consideration the positive psychological and emotional adaptations that occur for many women during pregnancy, this period is also characterized by mood swings, perceived loss of control over bodily changes, anxiety, elevated stress, phobias and low self-esteem.^{25, 26} Moreover, there is evidence that women who exercise during pregnancy report less stress, anxiety, and increased self-esteem in comparison to women who do not exercise regularly.^{27, 28} Given the positive psychological outcomes of moderate intensity exercise, it is surprising that few studies have investigated the relationship between exercise and mood in pregnancy.²⁹

Participation in moderate intensity exercise during pregnancy could potentially enhance mood. Such benefits are most likely to occur if the exercise mode is non-competitive, enjoyable, consisting of rhythmical and repetitive movements, low to moderate in intention, and 40 to 60 min in duration.^{24, 30, 31} In one of the few studies that examined mood in pregnant women, Lox *et al.*¹⁵ found improvements in feeling states in pregnant women after a single bout of aquatic exercise, as well as over a 6-week *aqua* exercise training program. However, the hormonal and cardiovascular responses to water-based and land-based exercise in pregnant women are different. In particular, differences have been found in levels of cortisol and $\dot{V}O_{2peak}$ during ergometer exercise in water and on land.³² Also, immer-

sion in 30 °C water decreases resting heart rate (HR) and cycle exercise in water also lowers HR compared to land exercise at the same metabolic rate.³³ Finally, it has been suggested that exercise in water may be the preferred mode of exercise due to increased convective heat loss properties resulting in a more blunted rise in core body temperature.³⁴ This latter suggestion, however, would go against the thermogenic hypothesis of the relationship between exercise and improved mood. This hypothesis suggests that it is this elevation in core body temperature, that occurs during exercise, which is responsible for changes in mood.³⁵ *Aqua* exercise, thus, could result in different effects on the pregnant women's mood in comparison to land-based exercise. An important aim of the current study, therefore, was to assess whether the mode of exercise—*aqua versus studio*—had an influence on pregnant women's mood after a single bout of exercise.

Another activity that is specific to pregnant women, and has a clear purpose and therefore the potential to improve mood,³⁶ is represented by parentcraft classes. These classes aim to prepare the women (usually in the 3rd trimester of pregnancy) for labor and include relaxation techniques and breathing exercises. Parentcraft classes could have similar effects on mood as exercise. In particular, because sense of control, rhythmic breathing, social interaction and 'time-out' or distraction from daily problems have been provided as important reasons for improved mood after exercise.³⁷ Of course, these are also characteristics of parentcraft classes. Therefore, the present study examined whether participation in an *aqua* or *studio* exercise class or parentcraft class improved mood. It was expected (based on the current literature) that pregnant women who took part in an exercise class experienced higher enhancements in mood postexercise than the women in the parentcraft classes. Secondly, this study investigated whether *aqua* and *studio* exercise resulted in similar mood benefits after a single bout of exercise.

Materials and methods

Participants

The participants in the study were 66 pregnant women, aged between 22 and 41 years (mean: 31.63 years; SD: 3.77 years) in the 2nd or 3rd trimester of pregnancy. The subjects either participated in an *aqua*-natal or *studio* exercise class, in a parentcraft class,

or were visiting a general practitioner (GP) surgery (control condition). Table I presents the number of participants in each condition and their trimester of pregnancy, as well as the number of pregnancies for the women in each condition. The participants were recruited from local gym/fitness establishments, hospital parental classes, and local GP surgeries. Permission to approach potential participants was granted by the various gym/fitness establishments, hospitals and surgeries in the Leeds area.

Instruments

The participants completed the profile of mood states (POMS).³⁸ The POMS consists of 65 adjectives rated on a 5-point scale designed to assess the following 6 mood states: tension, depression, anger, vigor, fatigue, and confusion. A global mood state was also calculated as a total measure of affective states. The global score was calculated from subtracting the vigor score from the sum of the negative measures of affect adding a constant of 100 to avoid negative values. Reliability, internal consistency (α 0.83 to 0.84), and factorial validity are well established for the POMS.^{39, 40}

Secondly, participants completed a biographic questionnaire in order to assess their age, number of pregnancies, how often they exercised before and during pregnancy and for how long.

Finally, participants in the activity groups rated how hard they scored the class they had participated in on a scale from 1 to 10 rate of perceived exertion (RPE).⁴¹ RPE was selected to measure exercise intensity because it has been shown that HR is a less sensitive measure to indicate exercise intensity during pregnancy whereas RPE is not significantly altered during standard submaximal exercise in pregnancy.^{42, 43}

Procedures

The study gained ethical approval from the ethic committee of the School of Leisure and Sport Studies, Leeds Metropolitan University, and subjects completed an informed consent form before taking part in the study.

The study consisted of 4 conditions. Participants either took part in an *aqua* class or a gym *studio* class in different gym/fitness facilities. These exercise classes were always taught by qualified instructors and took on average 45-50 min. A third group took part in

TABLE I.—Number of participants in each condition, their trimester of pregnancy, the number of pregnancies, exercise history before pregnancy, and exercise participation during pregnancy.

	Aqua	Studio	Parent-craft	Control
<i>Trimester and no. of pregnancies</i>				
2 nd trimester	12	10	--	18
3 rd trimester	13	11	13	--
1 st pregnancy	21	18	12	13
2 nd pregnancy	4	3	1	5
<i>Exercise history before pregnancy</i>				
Never exercised	3	2	3	6
1× a week (45 min)	—	3	3	1
2× a week (45 min)	16	11	4	9
3+ a week (45 min)	6	5	3	2
<i>Exercise during pregnancy</i>				
Less than 1× a week	3	2	13	18
1× a week (45 min)	8	7	0	0
2× a week (45 min)	12	9	0	0
3+ a week (45 min)	2	3	0	0

a parentcraft class, taught by a midwife, in a hospital parentcraft room. These sessions also took about 45-50 min. Note, the participants in this condition did not take part in any exercise whilst pregnant. Parentcraft classes are usually for women in their 3rd trimester of pregnancy. Therefore, a fourth condition was included in the study. This condition consisted of pregnant women in their 2nd trimester of pregnancy, who did not exercise or did not take part in parentcraft classes (control condition). These participants were recruited from local GP surgeries. After explaining the purpose of the study and obtaining informed consent from the participants, questionnaires were administered in the following order: first the POMS was administered to the *aqua*, *studio* and parentcraft groups approximately 10 min before the class was to commence and immediately after the class had finished. The participants were instructed to complete the POMS using the “how do you feel right now” version. The biographic questionnaire was administered after the exercise or parentcraft class. Finally, at the end of the class participants were asked to rate how hard they perceived they had worked (RPE). In the GP surgery condition, the biographic questionnaire was administered first, followed by the POMS, before women went to see the doctor for a routine visit.

The *aqua* and *studio* condition were similar in nature, that is, in both conditions participants performed rhythmic exercises with music. The program consisted mainly of aerobic and muscular endurance exercises. These

TABLE II.—Results (*F* value, significance level [*P*] and effect size) of the two-way analysis of variance (conditions by test sessions) with repeated measures on the last factor.

	Condition		Test session		Interaction	
	F(2.54)	Sign and effect size*	F(1.54)	Sign and effect size*	F(2.54)	Sign and effect size*
Total mood	0.13	0.36	37.9	<0.001	4.23	0.02
Tension	1.2	0.04	32.35	<0.001	0.14	0.14
Depression	0.43	0.31	4.51	<0.001	2.8	0.87
Anger	0.84	0.04	10.54	0.38	1.85	0.01
Fatigue	0.6	0.65	25.65	0.04	1.69	0.07
Vigor	3.84	0.02	24.38	0.08	5.1	0.09
Confusion	0.78	0.43	17.52	0.002	2.39	0.17
		0.03		0.16		0.06
		0.55		<0.001		0.19
		0.02		0.32		0.06
		0.03		<0.001		0.009
		0.13		0.31		0.16
		0.47		<0.001		0.1
		0.03		0.25		0.08

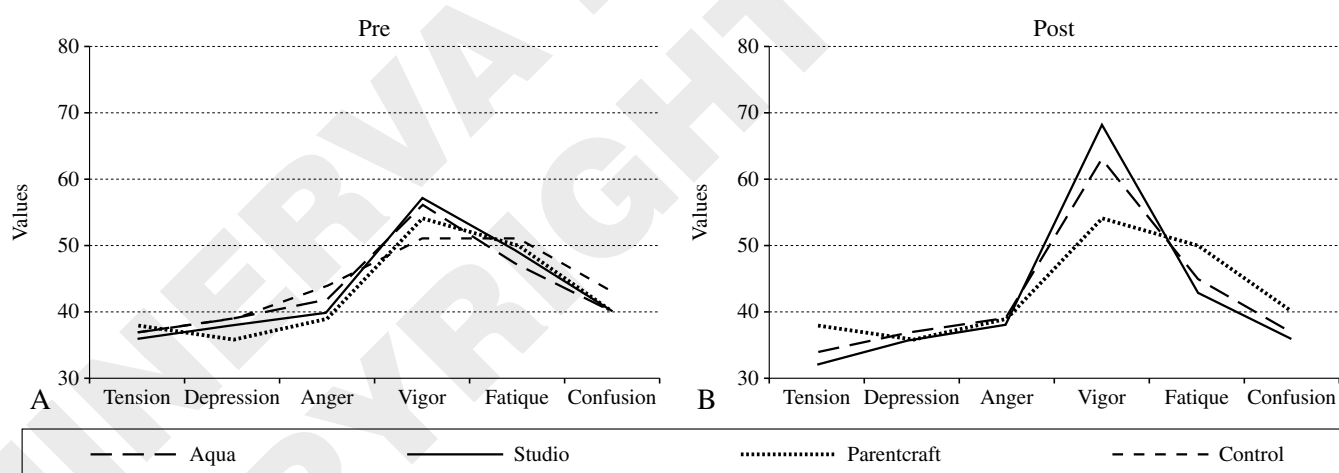
* Effect size is partial η^2 .

Figure 1.—Profile of mood states for the four conditions (aqua, studio, parentcraft, control) at the pretest stage (A) and after participation in exercise (aqua, studio) and/or activity (parentcraft class) (B).

classes were taught by the usual instructors, who were always trained in the area of exercise and pregnancy. All classes had already a predetermined structure; the level of exercise intensity was classified by the fitness instructors as low to moderate. In these classes, there were not only pregnant women, but also women who recently had the baby, and the babies assisted to the class. However, the *aqua* class took place in a swimming pool whereas the *studio* class took place at a gym *studio*. The parentcraft class consisted of a theoretical explanation about breastfeeding and relaxation exercises, and no

music was used. In all conditions the participants were in their own environment, and they were already familiar with the activity, which they regularly attended weekly as well as with the place and instructor or midwives thus improving the ecological validity of the study.⁴⁴

Statistical analysis

One-way analysis of variance was used to see whether there were any significant differences between the participants in terms of age, number of pregnancies,

and dependent variable-mood before the activity. A two-way analyses of variance (3 conditions [*aqua*, *studio* and *parentcraft*] by 2 test sessions [pre and post] with repeated measures on the last factor) was carried out in order to ascertain whether the different activities had different effects on the participants' mood. If a significant omnibus F was obtained, Newman-Keuls test for *a posteriori* comparisons were employed to determine the exact location of the differences.⁴⁵ Because violation of the assumption of sphericity was a concern, Huynh-Feldt correction was applied. The data were analysed using SPSS computer software program (SPSS Inc., Chicago, IL, USA).

Results

Preactivity analysis

One-way analysis of variance for age ($F [3.62] = 1.484$; $P = 0.228$, and number of pregnancies $F [3.62] = 1.647$; $P = 0.188$) did not indicate any significant differences between the four conditions. Table I presents the frequency of exercise participation before pregnancy and the duration of the activity for the participants in the four conditions. The *aqua* and *studio* conditions had significant more participants who exercised two or more times a week ($X^2_3 = 9$; $P = 0.029$) than the *parentcraft* and control conditions. Furthermore, the frequency and duration of exercise participation during pregnancy for the *aqua* and *studio* conditions is also presented. Note, the participants in the *parentcraft* and GP surgery conditions did not participate in formal exercise classes whilst pregnant.

One-way analysis of variance was performed on pre-activity mood state scores in order to test for biases affecting the samples. The four groups did not show statistically significant differences before treatment for any of the individual mood states or total mood (Tension $F [3.71] = 0.71$, $P = 0.55$; Depression $F [3.71] = 0.96$, $P = 0.42$; Anger $F [3.71] = 1.81$, $P = 0.15$; Fatigue $F [3.71] = 0.59$, $P = 0.63$; Vigor $F [3.71] = 1.2$, $P = 0.32$; Confusion $F [3.71] = 1$, $P = 0.40$; Total Mood $F [3.71] = 0.71$, $P = 0.55$).

Postactivity analysis

First, two-way analysis of variance was conducted to establish if trimester had an effect on changes in mood in both exercise conditions: test session (pre and post) by trimester (second and third). No signifi-

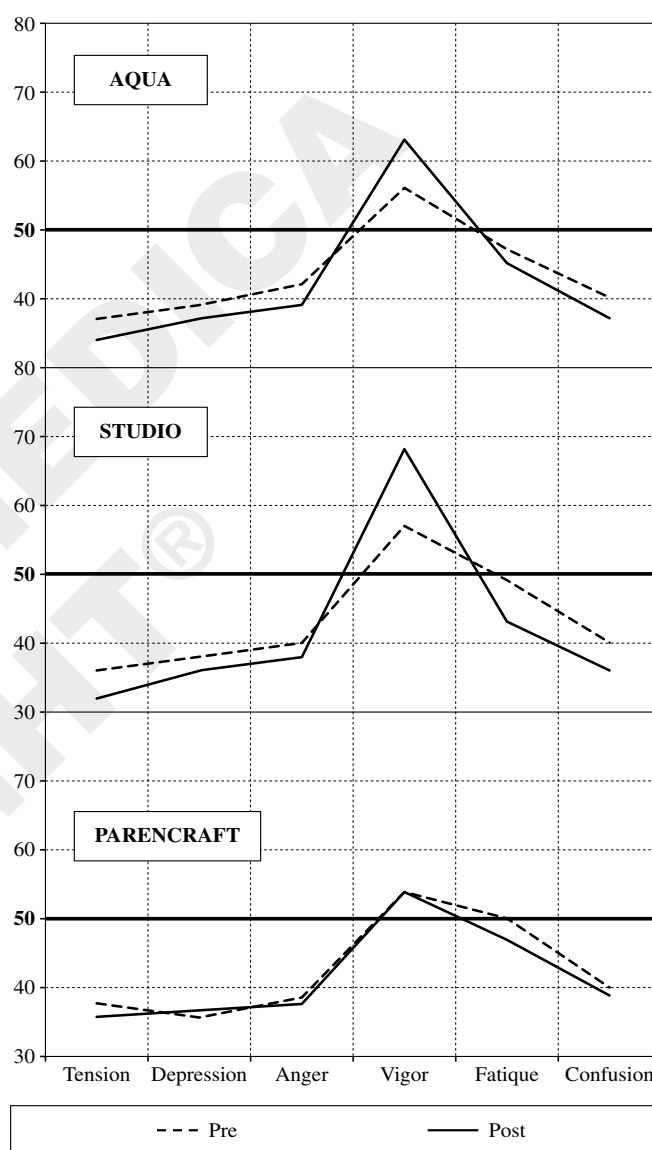


Figure 2.—Profile of mood states for the Aqua (condition 1), studio (condition 2) and parentcraft (condition 3) conditions approximately 10 min before the exercise/activity and after the exercise/activity.

cant differences were found and additional analysis where conducted on the participants sample as a whole (collapsed across trimester). Table II shows the condition and test session main effects as well as the interaction for the two-way analysis of variance (condition by test session) results (Figures 1, 2). Mauchly's test statistic was significant for each mood variable and because the estimation of sphericity was >0.75

the Huynh-Feldt correction was applied. Only a condition main effect was found for vigor. However, test sessions main effects were found for all dependent variables. Moreover, a significant interaction was observed for vigor and total mood whereas a near significant interaction effect was found for depression.

Posthoc comparisons for vigor and total mood scores revealed that there were no initial differences between the three conditions, but both exercise classes increased their vigor levels from pre- to postexercise ($P < 0.01$), whereas the parentcraft condition did not observe any changes. Posthoc comparisons were also conducted for depression. This showed only a significant decrease in depression score for the *aqua* condition ($P < 0.05$). With regard to the test session main effect for tension, anger, fatigue and confusion, it was found that they all decreased in magnitude indicating that participants improved their mood following the activity in all three conditions.

Finally, one-way analysis of variance for RPE was highly significant, $F(3.62) = 35.6$; $P < 0.001$. Posthoc comparisons revealed that both exercise conditions scored significantly higher on RPE in comparison to the parentcraft condition ($P < 0.01$). However, no significant difference was found between the *aqua* and *studio* condition indicating that the work engaged in during both exercise classes was of similar intensity.

Discussion

The major aim of the present study was to investigate whether a bout of *aqua*, or *studio* exercises or a parentcraft class resulted in a change in mood in women who were in their 2nd or 3rd trimester of pregnancy. No differences in mood were observed between the four conditions (*aqua* and *studio* exercises, parentcraft, control) before exercise or activity participation. The *aqua* and *studio* conditions resulted in an increase in overall mood and an increase in vigor. Also, a decrease in depression was found in the *aqua* condition. The time main effect suggests that all three (exercise, parent craft) conditions showed a decrease in tension, anger, fatigue and confusion following engagement in the activity (Figures 1, 2). The results of the present study indicate that both *aqua* and *studio* classes are effective in improving pregnant women's mood despite difference in physiological reaction between water- and land-based exercise. Secondly, exercise was more effective in improving mood than

the parentcraft classes. The latter has some implications for the theoretical mechanisms underlying the relationship between exercise and mood alteration.

Preactivity

The participants in the four conditions did not differ in their age, number of pregnancies or their mood. However, the control condition consisted mainly of women who did not have an exercise history. Furthermore, the pregnant women who participated in the exercise classes were most likely to do this once or twice a week, whereas before pregnancy they tended to exercise at least 2 to 3 times a week. The relatively low frequency in exercise participation during pregnancy might be due to a lack of knowledge on the benefits of exercise during pregnancy or the physiological and physical changes (*e.g.* nausea) accompanying pregnancy causing additional demands in performing exercise.^{8, 46, 47} Additionally, it has been suggested that psychological variables, like mood, result in a reduction in physical activity during pregnancy.²⁹

Postactivity

There are many ways in which we can enhance our mood. The results of the present study indicate that exercise, either in the form of *studio* or *aqua* classes, appears to be an effective way for pregnant women to improve their mood.⁸ That is, participation in the *aqua*, and/or *studio* exercise classes, resulted in an increase in overall mood and vigor. The time main effects also indicated a decrease in tension, depression, anger, fatigue and confusion. These results are in agreement with earlier studies, which have found that participation in a single bout of exercise results in mood enhancement.⁴⁸ The results are also similar to that of a study by Lox *et al.*¹⁵ This study showed that an acute bout of *aqua* exercise resulted in an improvement in mood in pregnant women. However, this study used the Subjective Exercise Experience Scale,⁴⁹ rather than the POMS, to assess participant's mood. This makes a straight comparison difficult.

The fact that it was vigor in particular that showed a significant increase could be two-fold. First, the other subscales are negatively scored, and were already extremely favorable at the onset of the testing, and subsequently there was relatively less room for further improvement (ceiling effect). The vigor subscale, on the other hand, is positively scored and allowed

for substantial improvements. Secondly, the levels of the hormone progesterone is increasing continuously as pregnancy advances.³² Progesterone has a wide range of effects in particular feeling fatigued, and may cause an increased need for sleep.⁵⁰ Although not measured in the present study, it might well be that exercise counteract some of the effects of progesterone and makes the pregnant women feel more energetic resulting in a higher score for the vigor subscale, as well as lower scores on the fatigue subscale (Figures 1, 2). This would be an interesting area of further study.

Although only a near significant difference was found for the variable depression, it was felt appropriate to conduct posthoc comparisons. These showed that the participants in the *aqua* condition exhibited a significant decrease in depression. An important reason for their reduction in depression might have been due to the fact that they had more room for improvement. Hence, their pre-exercise score was the highest in comparison with the *studio* and parentcraft conditions. Note, no differences were found between the conditions postexercise. However, this finding is potentially important. There are currently concerns about the use of antidepressants during pregnancy. In particular for pregnant women, the cost of taking antidepressants might outweigh the benefits.²⁶ Results of the present study and that of Lox *et al.*¹⁵ would suggest that exercise could be a non-pharmacological alternative, in particular for pregnant women with mild to moderate depression symptoms. This would be an important area of future research, in particular, in light of recent suggestion in the domain of sport performance. Lane *et al.*,⁵¹ in this respect, outlined how the interacting effects of depression could moderate other mood states as well as performance. Similar effects could also account for positive outcomes in the exercise domain.

Differences in physiological and hormonal reactions have been found between exercising in the water and on land in pregnant women.³³ No significant differences were found in RPE or mood between the *aqua* and *studio* conditions in the present study. This suggests that both modes of exercise are beneficial in improving mood in pregnant women as long as participants work at a moderate level of exercise intensity. In this respect, it has been found that 5 min of walking can already result in mood enhancements.^{52, 53} Furthermore, it has been shown that women showed beneficial effects on mood after a single bout of exercise that lasted 30 min.⁵⁴ However, 40-60 min of exer-

cise are required to produce additional psychological benefits from exercise.⁵⁵ The approximately 45-50 min of exercise the participants of this study took part in would be inline with this recommendation. However, future research is warranted to establish optimal duration of the exercise sessions. This is particular important for pregnant women due to the associated risk factors whilst exercising.⁹

The present study also investigated the effectiveness of exercise in comparison to parentcraft classes in enhancing mood. The results indicated that exercise resulted in larger improvements in mood than parentcraft classes (Figures 1, 2). Relaxation exercises comprise a large part of parentcraft classes. Berger *et al.*,⁵⁶ in this respect, have shown that relaxation was associated with similar improvements in mood as exercise. The present study, however, did not support the findings of this study.

An additional benefit of exercise participation is that it also provides a variety of health benefits to both the mother and the fetus.¹¹⁻¹³ Many other mood-enhancement techniques, including parentcraft classes, do not provide such extra benefits. During pregnancy, however, the women in the present study exercised less than before they were pregnant. This is a common finding in the literature; that is, during pregnancy or *postpartum* exercise levels dropping-off significantly.^{8, 57} However, it should be noted that there is currently only limited information available regarding general active living during pregnancy and *postpartum*.⁹ Additionally, women's beliefs and perceptions about physical activity during pregnancy might prevent them of maintaining an active lifestyle during this period of their life.⁵⁷ Therefore, there appears to be a need for effective intervention programs which inform and engage pregnant women in more active lifestyles in general and regular exercise in particular.

The causal mechanisms for improved mood after exercise have not been clearly established in the scientific literature. However, the fact that only the exercise conditions showed a significant improvement in mood in the present study suggest that physiological mechanisms, although not explicitly measured in this study, play a more prominent role. Hence, some of the psychological mechanisms suggested to improve mood are not able to explain the non-significant changes in mood in the parentcraft class. For example, the 'time-out',⁵⁸ sense of control, and social interaction

hypothesis suggests changes in mood in all three conditions. Although, it has to be acknowledged that music could have had a mediating effect in the present study. Activity performed with music has been associated with more positive mood states than the same activity performed without music.⁵⁹ Further research is warranted to investigate the physiological and psychological mechanisms, as well as the role of music on the improvement of mood after exercise.

A limitation of the present study is the non-random sampling of the participants. That is, women in these exercise conditions engaged more in some form of exercise preceding their pregnancy in comparison to the participants in the parentcraft and control conditions. These women, therefore, might be predisposed to enjoy the exercise experience.

Conclusions

In conclusion, the findings of the present study suggest that a single bout of *aqua* and/or *studio* exercise, but not parentcraft classes, results in enhanced mood in women in their 2nd or 3rd trimester of pregnancy. Although exercise has mood benefits that are comparable to other mood management techniques, it also has additional physiological and physical benefits to both the mother and the fetus.¹²⁻¹⁴ In addition, although the physiological and hormonal reaction are different for *aqua*- and land-based exercise both modes of exercise appear to be equally beneficial for pregnant women to engage in order to improve mood. Although the benefits of a single bout of exercise only last for 2 to 4 h,^{53, 60} the more positive mood can have significant benefits to the pregnant women overall quality of life. Da Costa *et al.*⁷ recently showed that regular physical activity participation was associated with enhanced psychological well-being, as measured by a variety of psychosocial inventories, during pregnancy. Therefore, in uncomplicated pregnancies, an acute bout as well as regular exercise may be a potential effective and low-cost method of enhancing mood and has also the additional health benefits for both the mother and fetus.

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