



Exercise frequency and maternal mental health: Parallel process modelling across the perinatal period in an Australian pregnancy cohort

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ABSTRACT

Objective: Since the potential mental health benefits of exercise during pregnancy remain unclear, this study examined longitudinally the bidirectional relationship between exercise and maternal mental health symptoms during the perinatal period, and included adjustment for both depression and antidepressant treatment.

Methods: Data were collected across pregnancy (first and third trimesters) and the postpartum (six and 12 months) for 258 women drawn from an Australian pregnancy cohort, the Mercy Pregnancy and Emotional Wellbeing Study (MPEWS). The women were assessed for depression using the EPDS, anxiety using the STAI and a clinical diagnostic interview (SCID-IV), and self-reported use of antidepressants. Exercise was measured using self-reported weekly frequency of 30-min bouts of moderate to vigorous exercise, and data were analyzed using parallel process growth curve modelling.

Results: On average, women's weekly exercise frequency declined during pregnancy, returning to first trimester levels by 12 months postpartum. Women with depression and taking antidepressants reported lower first trimester exercise compared to control women. However, where non-medicated depressed women remained lower and continued to decline to 12 months, women taking antidepressants reported increasing levels of exercise during the perinatal period. Notably, a steeper decline in exercise frequency during the perinatal period was associated with a faster rate of increase in depressive and anxiety symptoms.

Conclusions: This study is the first to examine the longitudinal interaction between exercise and mental health symptoms across the perinatal period. These preliminary findings demonstrate potential benefits for depressive and anxious symptoms when maintaining levels of early-pregnancy exercise throughout pregnancy and the postpartum.

1. Introduction

The need to develop interventions to improve mental health in pregnancy is increasingly being recognized and can only be enhanced by drawing on evidence from well-designed cohort studies. Poor mental health has been associated with increased risk of pregnancy complications resulting in poorer outcomes for both mother and infant [1–3]. For example, outcomes such as pregnancy-induced hypertension (PIH), preterm birth (< 37 weeks), and low infant birth weight (< 2500 g) have all been demonstrated as more prevalent in women with antepartum depression [4,5]. It is likely that such relationships are mediated by mechanisms such as glucose regulation, changes in vasculature and placental function, maternal stress regulation and the inflammatory response [5–7]. In the long-term, offspring exposed to chronic maternal

stress and inflammation during pregnancy may be more likely to develop psychological disorders [8–11]. During pregnancy, there is evidence of the preventative and protective benefits for pregnant women who maintain and even increase physical activity [12,13].

Randomized control trials (RCTs) in adults with mental disorders have demonstrated exercise has some efficacy as an intervention for depressive symptoms, anxiety and quality of life [14]. The mechanisms through which exercise is associated with improved physical and psychological health is most likely the regulation of stress hormones, such as cortisol, via the hypothalamus-pituitary-adrenal (HPA) axis [15] and subsequent anti-inflammatory protection against a chronic low-grade inflammatory response [16]. There is good evidence to support the safety of exercising during pregnancy and the positive effects that exercising yields for maternal and infant outcomes, and fetal development

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[17–23].

The strength of this empirical support has culminated in clinical guidelines from the American College of Obstetricians and Gynecologists [12] and the Royal Australian and New Zealand College of Obstetricians and Gynecologists [13] recommending health care professionals to encourage modified exercise routines during pregnancy following careful assessment of medical and obstetric complications [24]. These guidelines specify the need for appropriate duration, intensities, and activities for pregnant women following the careful assessment of absolute and relative contraindications, such as pregnancy-induced hypertension and fetal growth-restrictions. However, these guidelines only briefly acknowledge the benefits of exercising for general psychological wellbeing for pregnancy women.

Several observational studies to date have examined natural patterns of physical activity during the perinatal period. A recent study plotted trajectories of exercise for pregnant women during only the antepartum period [25]. On average, physical activity increased in the first trimester, plateauing during the third trimester and sharply declining late in the third trimester. Women who self-identified as inactive engaged in less physical activity at the beginning of pregnancy and became more sedentary further into the pregnancy. Another study demonstrated that physical activity rebounds by three months postpartum, returning to levels reported in the first trimester [26]. These studies of general populations did not explore the associations between exercise and mental health during pregnancy.

The few studies that have documented the associations between exercise and mental health across the perinatal period [27,28] have used small samples of healthy women [29]. Using a sample of 43 women, Goodwin et al. demonstrated that women who self-reported any exercise during pregnancy were less likely to score in the clinical range of the General Health Questionnaire compared to women who self-reported no exercise during pregnancy. Poudevigne and O'Connor compared the changes in associations between physical activity and mood in a group of 12 pregnant women to a matched group of 12 non-pregnant women for seven months. They found that similar to non-pregnant women during the same period, above-average energy expenditure by healthy pregnant women was associated with mood stability during pregnancy. However, while there appears to be some association between exercise and mental health in pregnancy, a meta-analysis examining clinical trials of exercise in pregnancy identified low-to-moderate quality trials and concluded that there is only limited evidence that exercise is an effective treatment of depression during pregnancy [30]. To our knowledge, there are very few RCTs that have investigated whether exercise improves the mental health of pregnant women, and the nature of the longitudinal association between mental health symptoms and changes in exercise frequency throughout the perinatal period has not been previously examined.

In this study, we address this issue by using data from a relatively large cohort study (Mercy Pregnancy and Emotional Wellbeing Study; MPEWS) designed to specifically examine the course of common mental health disorders over the perinatal period, which allows for sophisticated modelling of the longitudinal pattern of symptoms. We use data on weekly exercise frequency over the perinatal period (at first and third trimesters, and six and 12 months postpartum) and investigate bidirectional associations with maternal mental health during the same period. Another advantage of MPEWS is that antidepressant medication use has been thoroughly documented; for the first time, we are able to examine patterns of exercise reported by women whose depression is being treated by an antidepressant.

First, we examine at each time point over pregnancy the differences in exercise frequency over the perinatal period, comparing three groups of women: those taking antidepressants, those with depression but not taking antidepressant medication, and control women. Although we expect that, on average, exercise frequency will reduce during pregnancy and increase again in the postpartum, we hypothesize that control women will report significantly more frequent exercise at each

time-point during the perinatal period.

Second, after controlling for a depression diagnosis and antidepressant use, we will examine bidirectional associations between changes in exercise frequency during the perinatal period and changes in both depressive and anxious symptoms during the same period. In a second hypothesis, for women whose exercise frequency reduces more steeply compared to the average, we hypothesize their depressive and anxious symptoms will increase more steeply compared to the average.

2. Method

2.1. Participants

The sample in this paper is drawn from the Mercy Pregnancy and Emotional Wellbeing Study (MPEWS), based in Melbourne, Australia, and uses data collected at four time-points: first and third trimester, and six and 12 months postpartum. A study protocol can be found in Galbally et al. [31]. Women with only one out of four points of data were not included in this paper leaving a subsample from this cohort of $n = 258$ (92% of the full cohort). The study recruited three groups: women taking antidepressants ($n = 44$), non-medicated women who met diagnostic criteria for Major Depressive Disorder ($n = 28$), and control women who did not meet criteria for diagnosis of depression or taking antidepressant medication ($n = 186$). A diagnosis of Major Depressive Disorder was used to stratify recruitment so that depression, which is a major focus of service delivery and prevention efforts in Australia, could be specifically examined.

2.2. Measures

2.2.1. Mental health

2.2.1.1. Depression. A diagnosis of Depression including Major Depressive Disorder and Dysthymia was established using the mood module of the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (SCID-IV) administered to all participating women upon recruitment to the study (i.e., prior to 20 weeks). In addition to the resulting groups of the recruitment framework, we also used a binary variable to group women with and women without a depression diagnosis. Women meeting DSM-IV criteria for major depressive disorder, regardless of antidepressant use, were coded as 1 (*Currently depressed*; $n = 55$) and all other women coded as 0 (*Not currently depressed*; $n = 203$).

Depressive symptoms were measured using the Edinburgh Postnatal Depression Scale (EPDS) [32] at four time-points: during first and third trimesters, and six and 12 months postpartum. The EPDS comprises ten items measuring depressive symptom severity on a 4-point (0–3) scale, producing a total score ranging between 0 and 30, where higher scores indicate higher levels of depressive symptoms. Although several cut-off scores have been used to screen for postpartum depression [33], the most common being 12 or 13 [34], in this study we treat depression symptoms data as continuous. The EPDS has been shown to be a valid scale for use with Australian women during the perinatal period [35]. In our sample, the EPDS scale at each measurement demonstrated strong internal consistency, with Cronbach's alphas ranging 0.85 to 0.86.

2.2.1.2. Anxiety. Anxiety was measured using the state anxiety subscale from the State-Trait Anxiety Inventory (STAI, Y-form; [36]) at all four time-points during the perinatal period. The inventory measures situational anxiety symptoms using 20 items. Each item is measured using a 1 (*Not at all*) to 4 (*Very much so*) Likert scale. The sum of the items, ranging 20 through 80, indicates the magnitude of situational anxiety reported by the participant at the point in time of completion, with higher scores indicating more state anxiety. Australian norms are available for a general Australian adult population, suggesting a normative mean of approximately 34 ($SD \sim$

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