HHS Public Access

Author manuscript

Midwifery. Author manuscript; available in PMC 2017 December 01.

Published in final edited form as:

Midwifery. 2016 December ; 43: 29–36. doi:10.1016/j.midw.2016.10.010.

Influences of prior miscarriage and weight status on perinatal psychological well-being, exercise motivation and behavior

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Abstract

Objectives—women who have experienced miscarriage may be at increased risk for elevated depressive and anxiety symptoms in subsequent pregnancies. Exercise may be a useful strategy for coping with these symptoms. Little is known about how miscarriage influences prenatal exercise behavior. The study purpose was to examine the influences of miscarriage history and prepregnancy weight status on pregnant women's psychological health, exercise motivation, and behavior using the Theory of Planned Behavior.

Participants/Setting—Pregnant women (N=203; 41 with prior miscarriage; 72 overweight/obese; BMI > 25.0) in the northeast United States.

Design—Women prospectively reported their depressive/anxiety symptoms and exercise motivation/behavior in the 1st, 2nd, and 3rd trimesters via mailed surveys. Group differences in depressive/anxiety symptoms, exercise behavior, and its motivational determinants were examined using Chi Square analyses and Univariate and Multivariate Analyses of Covariance.

Measurements and findings—Women with a history of miscarriage had higher 1st and 2nd trimester depressive/anxiety symptoms and lower 1st trimester attitudes about exercise and 1st and 2nd trimester perceived behavior control than women without a history of miscarriage. Overweight/obese women had higher 1st and 2nd trimester pregnancy depressive/anxiety symptoms, engaged in less prepregnancy exercise, and had lower levels of exercise intention, attitude, and perceived behavior control throughout pregnancy than normal weight women.

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Disclosure statement

The authors report no conflicts of interest. No competing financial interests exist.

Ethics, consent and permissions

This manuscript represents original data on a longitudinal sample of women during pregnancy and postpartum under a currently open and approved Pennsylvania State University IRB protocol #29315.

Key Conclusions—Women with a history of miscarriage and overweight/obese women have poorer psychological health and lower motivation to exercise during pregnancy than women without a history of miscarriage and normal weight women.

Implications for practitioners—Interventions and healthcare provider communications aimed at promoting perinatal exercise behavior and psychological health should take into account pre-pregnancy weight status and pregnancy history to identify strategies to help women, particularly overweight/obese women with a history of miscarriage, to overcome exercise barriers.

Keywords

Miscarriage; Exercise; Physical activity; Psychological well-being; Depression; Anxiety; Pregnancy

Introduction

Miscarriage (i.e., spontaneous perinatal loss < 20 weeks gestation) is the most common complication of early pregnancy and occurs in approximately 24% of pregnancies (American College of Obstetricians and Gynecologists [ACOG], 2013; Jurkovic et al., 2013; Larsen et al., 2013). A miscarriage can be especially traumatic; it is associated with significant psychological distress (i.e., elevated levels of depressive/anxiety symptoms) that may persist during a subsequent pregnancy and postpartum (ACOG, 2013; Jurkovic et al., 2013; Robinson, 2014). This is particularly concerning for overweight and obese (OW/OB) women (i.e., BMI > 25.0) who are at elevated risk for miscarriage and have a higher prevalence of perinatal and postpartum mental disorders than normal weight women, independent of pregnancy history (Lashen et al., 2004; Molyneaux et al., 2014) Engaging in regular exercise behavior may be one non-pharmacological strategy to reduce perinatal symptoms of depression and anxiety (Da Costa et al., 2003).

Exercise has positive mental and physical benefits for pregnant women and their offspring (Symons Downs et al., 2012; U.S. Department of Health and Human Services [USDHHS], 2008). Exercise promotes the viability of a pregnancy, improves fertility rates and perinatal outcomes, and reduces miscarriage rates in obese women with a history of reproductive complications (Clark et al., 1998; Ferreira et al., 2010). Active pregnant women also report lower depressive/anxiety symptoms than sedentary pregnant women (Da Costa et al., 2003). The exercise recommendations suggest that pregnant women participate in 150 minutes of moderate to vigorous exercise weekly (i.e., exertion equal to or greater than a brisk walk for 30 minutes, 5 times a week; USDHHS, 2008) for women without obstetric or medical complications or contraindications (e.g., placenta previa, preterm labor) to exercise (Artal and O'Toole, 2003; USDHHS, 2008). However, only 23% of pregnant women are sufficiently active (Evenson and Wen, 2010). Many factors (e.g., pre-pregnancy inactivity, co-morbid health complications) predispose OW/OB women to be less active than normal weight women (Evenson and Wen, 2010; Zhang and Savitz, 1996).

OW/OB women also have different exercise attitudes, motivation, and perceived barriers compared to normal weight women (Symons Downs et al., 2014a, 2014b). In one of the only located studies to compare exercise motivation of normal weight and OW/OB women,

OW/OB women reported “having no motivation” as their most salient exercise belief whereas normal weight women endorsed a more positive belief that exercise would help to “decrease their discomfort/soreness” (Symons Downs et al., 2014a, 2014b). OW/OB women also report less pleasure from exercise than normal weight women (Ekkekakis and Lind, 2006). This may be due to increased perceived exertion from exercise and may be related to increased oxygen uptake and other physiological changes that occur over the course of pregnancy (Davenport et al., 2009; Mottola, 2013).

To successfully promote perinatal exercise behavior, it is essential to understand the underlying motivational determinants of women’s exercise. A theoretical framework can provide insight for how to influence the behavior and develop interventions targeting modifiable factors to promote exercise (Symons Downs et al., 2012). One theory previously used to explain perinatal exercise behavior and motivation is the Theory of Planned Behavior (TPB; Ajzen, 1991; Hausenblas and Symons Downs, 2004; Symons Downs and Hausenblas, 2003, 2007). The TPB posits that a person’s beliefs about a behavior influences her thoughts/cognitions (attitude), perceptions of social pressures to comply with the behavior (subjective norm), and view of whether the behavior will be difficult or easy to adopt (perceived behavioral control; Ajzen, 1991). Her attitude, subjective norm, and perceived behavioral control influence her motivation (intention) to perform the behavior, which in turn, predicts actual participation in the behavior.

To the authors’ knowledge, there have been no studies that have examined how prior miscarriage and prepregnancy weight status impact exercise behavior. Considering the sensitive nature of these issues, there is a need to better understand the influences of prior miscarriage and prepregnancy weight status on exercise behavior so that health care providers can address these topics in clinical care and health promotion professionals can design interventions to effectively promote perinatal exercise behavior. The purposes of this study were to describe the prevalence of prior miscarriage and obesity in a sample of pregnant women and examine differences in exercise motivation and behavior, and psychological well-being by groups (prior miscarriage or no prior miscarriage; normal weight or OW/OB). Based on past research we hypothesized that women with a history of miscarriage and those who were OW/OB before pregnancy would report lower levels of exercise behavior and its motivational determinants (Symons Downs et al., 2014a; Zhang and Savitz, 1996) and higher levels of depressive/anxiety symptoms (Molyneaux et al., 2014; Robinson, 2014) than women without prior miscarriage and those who were normal weight prepregnancy. We also hypothesized that women who had experienced a prior miscarriage would have the highest prevalence of clinically significant depressive/anxiety symptoms and lowest levels of exercise behavior across the sample (Robinson, 2014).

Methods

Participants

Participants were 203 pregnant women (*M* age = 31 years) and the majority were Caucasian (92%), married (94%), college graduates (98%), working full-time (81%), nulliparous (72%), and were in the income range of $40,000–$100,000 per year (53%); see Table 1. The

mean prepregnancy body mass index (BMI) was 24.87 (*SD* = 5.65), within the normal weight range (World Health Organization [WHO], 2006).

Study design and procedures

A prospective study design was used to conduct this research and the study was approved by a University IRB board. Consent was obtained from a local OB/GYN clinic to recruit participants from their office in the Northeast U.S. Pregnant women received an informational flyer explaining the study at their first prenatal visit (8–12 weeks gestation). Interested women provided their contact information which was collected by the research team. Potential participants were mailed a letter study packet (i.e., letter explaining the study, implied consent form, first trimester [TRI 1] questionnaires and a stamped business reply envelope to return their survey) using Ransdell's (1996) strategies to maximize response rate. Multiple contacts were made over a 4–6 week period and if the participant did not return her packet during this time, she was removed from the study. The same procedures were followed for the second (TRI 2) and third (TRI 3) trimesters; 286 packets were distributed and 203 women returned their TRI 3 questionnaire packets.

Measures

The 20-item *Centers for Epidemiological Studies-Depression* (CESD) *Scale* was used to assess depressive symptoms (Radloff, 1977). Example items are "I felt lonely" and "I had crying spells." Participants responded to the CES-D using a 5-point Likert scale ranging from 0 (rarely) to 3 (most days), with an additional option to indicate "does not apply to me." Scores range from 0–60, with higher scores associated with higher depressive symptomology; scores > 15 indicate clinically relevant symptoms symptoms (Orr and Miller, 1995). The CES-D is valid and reliable in pregnant populations (Radloff, 1977; Orr and Miller, 1995; Orr and Miller, 1995; Rauff and Downs, 2011). In the current study, internal consistency reliability alphas were good in TRI 1 (0.84), TRI 2 (0.83), and TRI 3 (0.84).

The 20-item *State-Trait Anxiety Inventory* (STAI) was used to measure state (i.e., "feel right now at this moment") anxiety symptoms (Spielberger and Gorsuch, 1983). The response format consists of a 4-item Likert scale ranging from "not at all" to "very much so" with a higher score indicating greater state anxiety symptoms. The STAI has been widely used as a valid screening tool to identify perinatal anxiety symptoms (Newham et al., 2012; Tendais et al., 2014). In the current study, the internal consistency reliability alphas were excellent in TRI 1 (0.90), TRI 2 (0.89), and TRI 3 (0.90).

The *Leisure-Time Exercise Questionnaire (LTEQ)* was used to examine the frequency of strenuous (e.g., running), moderate (e.g., fast walking), and mild (e.g., yoga) leisure-time exercise performed during a typical week (Godin and Shephard, 1985). Participants were asked to report average weekly bouts of at least 15 min of strenuous, moderate, and mild exercise before pregnancy and during each trimester. Total minutes were determined by summing the strenuous, moderate, and mild scores (i.e., bout×15 min). The LTEQ is a valid and reliable measure of exercise in adults (Godin, 2011; Godin and Shephard, 1985) and has been successfully used in studies examining the TPB and exercise behavior of pregnant

women (Symons Downs and Ulbrecht, 2006; Hausenblas and Symons Downs, 2004; Symons Downs et al., 2014a).

The *Theory of Planned Behavior* (TPB) questionnaire was used to assess attitude, subjective norm, perceived behavioral control, and intention as they relate to perinatal exercise (Symons Downs and Hausenblas, 2003, 2004). Scale correspondence (i.e., equivalence in the measures for the target, action, context, and time) was established in that all TPB items were asked in the middle of each trimester to allow women to have enough time to experience feelings unique to each trimester before reporting their exercise motivation for that trimester (Ajzen, 1991; Courneya, 1994; Symons Downs and Hausenblas, 2007).

Attitude toward exercise was assessed with 7 semantic differential pairs (e.g., useless-useful) that describe how women feel about exercising for 30 minutes on most days in the following week. Participants rated each on a 7-point Likert scale with higher score indicating a more positive exercise attitude. Consistent with other perinatal studies, internal consistency of these items were good (0.85 to 0.89 across the trimesters; Hausenblas & Symons Downs, 2004; Symons Downs and Hausenblas, 2003, 2004).

Subjective Norm was assessed by evaluating participant's perceived support from others to be active. Three items with responses ranging from 1 (strongly disagree/disagree) to 7 (strongly agree/agree) were used to assess how they perceived important others feel about them exercising for 30 minutes on most days in the following week. A higher score reflected higher subjective norm. Similar to other studies, internal consistency of these items were excellent (0.92–0.95 across the trimesters; Hausenblas and Symons Downs, 2004).

Perceived Behavioral Control (PBC) to engage in exercise for 30 minutes on most days of the week was assessed with three items on a 7-point Likert scale ranging from 1 (extremely difficult/very little control/strongly disagree) to 7 (extremely easy/complete control/strongly agree). A higher score reflected stronger perceived control for exercise. The internal consistency of these items was good (alphas ranged from 0.86 to 0.87 across the trimesters and similar to past research (Hausenblas and Symons Downs, 2004; Symons Downs and Hausenblas, 2003, 2007).

Intention to engage in exercise for 30 minutes on most days of the week was assessed with three items measuring women's intention to exercise regularly throughout her pregnancy. Items were rated on a 7-point Likert scale; a higher score reflected greater intention or motivation for exercise. Similar to other studies, internal consistency alphas were excellent (0.95 to 0.97) across the trimesters (Rhodes, Courneya, & Jones, 2005).

The *Pregnancy and Personal History Questionnaire* assessed self-reported number of previous pregnancies, year of last pregnancy, number of miscarriages, years the losses occurred, and perinatal complications (e.g., premature labor, placenta praevia). The questions also inquired about age, height, weight, demographic information, and the baby's due date. Height and weight were used to calculate body mass index (BMI; WHO, 2006). Previous research has shown the correlation between self-reported and measured BMI to be high (r = .95; McAdams et al., 2007).

Findings

Preliminary Analyses

To determine the prevalence of prepregnancy weight status, data were examined across. The total sample (N = 203). Prepregnancy weight status was calculated using the recommendations of the Institute of Medicine (Rasmussen and Yaktine, 2010) to determine prepregnancy body mass index (BMI; Normal weight: 18.5–24.9, Overweight: 25.0–29.9, Obese > 30.0; WHO, 2006): 4% of women were underweight (n = 9), 60% were normal weight (n = 122), 20% were overweight (n = 40), and 16% were obese (n = 32). Due to insufficient data for the underweight group and small sample size in the overweight and obese group, subsequent analyses excluded underweight women and combined the overweight and obese groups. Fifteen women were under exercise restriction due to high risk pregnancy and were excluded from further analyses. OW/OB ($n = 66$) women had a significantly higher mean age than normal weight women ($n = 115$). Women with a history of miscarriage ($n = 41$) had a significantly higher prepregnancy BMI compared to those without a history ($n = 162$). Due to the group differences in mean BMI and age, these factors were entered as covariates in additional analyses. To determine if postpregnancy loss weight retention was associated with increased BMI, pearson correlations were run between years since pregnancy loss, number of previous pregnancy losses, and BMI. There were no significant associations between time since miscarriage, number of miscarriages (range: 1–6), and BMI. A one-way ANOVA was conducted to determine if there were mean differences in outcome variables between women for which this was their subsequent pregnancy directly following a miscarriage ($n = 28$) or if they had a full term birth since the miscarriage ($n = 13$). There were no significant differences in any outcome variables, age, or BMI, for women who did and did not have a full term birth since the miscarriage ($p > 0.05$). No significant group differences were observed for marital status, race/ethnicity, education, family income, or pregnancy history (p's > .05; see Table 1).

Prevalence Rates

Chi-square analyses were used to determine miscarriage group and prepregnancy weight status differences in prevalence rates of reporting clinical levels of symptoms during each trimester (i.e., score > 15 on CES-D; > 40 on STAI; Orr and Miller, 1995; Teixeira, Martin, Prendiville, & Glover 2005) and meeting exercise guidelines (i.e., 150 minutes or more of exercise per week as "meeting guidelines"; less than as "below guidelines"; USDHHS, 2008) before and during pregnancy and (see Table 3). Approximately 20% of participants had experienced a prior miscarriage and 36% of women were OW/OB. There were no significant group differences in the proportion of women meeting exercise guidelines before or during pregnancy ($p > 0.05$; see Table 3). A significantly greater proportion of women with a history of miscarriage reported clinically significant levels of depressive symptoms in TRI 1 and TRI 2 and clinically significant anxiety symptoms during TRI 1, TRI 2, and TRI 3 (see Table 3). There were no prepregnancy weight status differences for clinical rates within the miscarriage groups ($p > 0.05$).

Group Differences

Two multivariate analysis of covariance (MANCOVA) were conducted with prepregnancy weight status (independent fixed factor) and miscarriage and age (covariates). Depressive/anxiety symptoms, and the TPB motivational determinants were the dependent variables for each trimester (see Table 4). Following the MANCOVA, tests of between-subjects effects were conducted to examine group differences in each individual variable (see Table 2). A significant overall multivariate effect and univariate effects for miscarriage was observed; women with a history of miscarriage had significantly higher TRI 1 and TRI 2 depressive/anxiety symptoms than those with no history of miscarriage. A significant univariate effect of prepregnancy weight status was also observed; OW/OB women had significantly higher TRI 1 and TRI 2 anxiety/depressive symptoms compared to normal weight women. There were no significant effects of age in any model.

There was a significant multivariate effect of miscarriage on the TPB motivational determinants at TRI 1; women with a history of miscarriage had lower early-pregnancy intention, attitude, PBC, and subjective norm than women without prior miscarriage. Univariate effects of miscarriage emerged in TRI 1 on attitude and PBC and in TRI 2 on PBC. A significant multivariate effect of the prepregnancy weight status group on the TPB motivational determinants emerged in all three trimesters; OW/OB women had significantly lower intention, attitude, PBC, and subjective norm than normal weight women. In all three trimesters there were also significant univariate effects of prepregnancy weight status on intention, attitude, and PBC such that OW/OB women had significantly lower intention, attitude, and PBC than normal weight women. There were no significant effects of age for any model.

A one-way analysis of covariance (ANCOVA) with prepregnancy weight status (independent fixed factor) and miscarriage group and age (covariates) was conducted to determine group differences in exercise at prepregnancy and during each trimester (see Table 2). There was a significant univariate effect for prepregnancy weight status on prepregnancy exercise; OW/OB women engaged in less prepregnancy exercise than normal weight women (see Table 2). There were no other univariate effects of prepregnancy weight status or history of miscarriage on TRI 1, TRI 2, or TRI 3 exercise.

Discussion

The objective of this study was to examine the influence of history of miscarriage and prepregnancy weight status on symptoms of depression/anxiety, perinatal exercise behavior, and its motivational determinants. To our knowledge, this is one of the first studies to collectively examine these factors. We reported three major findings to inform healthcare provider communications and interventions aimed at promoting exercise behavior in women who have experienced and/or at elevated risk for miscarriage and prepregnancy overweight/obesity. First, women with a history of miscarriage are more likely to experience clinical levels of anxiety throughout their pregnancies and women with a history of miscarriage and OW/OB women display elevated levels of depressive/anxiety during early-to-mid pregnancy. Second, women with a history of miscarriage have lower attitude and perceived control for engaging in exercise during early and mid-pregnancy. Third, OW/OB women have low

motivation to engage in exercise throughout pregnancy. These findings are discussed in more detail below.

Similar to prior research (Gong et al., 2013; Gaudet et al., 2010; McCarthy et al., 2015), women with a history of miscarriage reported higher levels of depressive/anxiety symptoms in TRI 1 and TRI 2 than those without prior loss. Also, a greater proportion of women with a miscarriage history experienced clinical levels of depression through TRI 2 and anxiety through TRI 3. The high prevalence of these symptoms among pregnant women is concerning given the association between prenatal mood disturbances and preterm delivery, low birth weight, physiological effects on the neonate, and postpartum depression. (Sutter-Dallay et al., 2005). These findings suggest management of prenatal anxiety and depressive symptoms, particularly among overweight and obese pregnant women, may provide for better maternal and fetal outcomes during pregnancy and postpartum. Recent evidence suggests complementary approaches that cultivate mindfulness (i.e., paying attention on purpose, in the present moment) encourages emotional regulation and may reduce depressive symptoms (Berking and Wupperman, 2012; Desrosiers et al., 2013). The benefits of mindfulness may extend in to the postpartum period improving mental health distress and may even have an indirect positive effect on child development (Perez-Blasco et al., 2013). Prescribing anxiety reducing behavioral strategies (e.g., mindfulness training, yoga, and progressive muscle relaxation) may be particularly useful at this time. A study by Leiferman et al. (2014) suggests that pregnant patients want information about how to manage perinatal stress. More specifically, in a recent survey 84% (228/247) depressed pregnant women reported they would use an alternative approach for stress management during pregnancy (Matthews et al., 2016). Healthcare providers are not generally trained to provide stress management counseling or education to their patients unless the patient requests this information. In cases where healthcare providers do provide this information, there is often little-to- no follow-up as the pregnancy progresses. There is clearly a need for additional research to understand how to best screen for depression to determine individuals that need information and referrals for support, how to train health care providers about managing anxiety and depressive symptoms during pregnancy (e.g., online, in person training), which health care providers should receive training (e.g., MD, nurse practitioner), and whether healthcare professionals actually use the training they received (Leiferman et al., 2010).

Women with a history of miscarriage also had lower TRI 1 exercise attitude and TRI 1 and TRI 2 PBC than those without a history. The differences in women's attitude about exercise between miscarriage groups may be due to elevated levels of anxiety in early pregnancy related to the fear of having another miscarriage and the common misconception that perinatal exercise behavior can lead to miscarriage (Clarke and Gross, 2004; Evenson et al., 2009; Hanghøj, 2013). However, there is limited evidence to support this claim; the majority of studies examining miscarriage and perinatal exercise have found that the risk is no higher for active pregnant women than for inactive pregnant women (Clapp, 1989; Maconochie et al., 2007; Magann et al., 2002; Schlüssel et al., 2008). Given the elevated depressive/anxiety symptoms among women with a history of miscarriage, promoting exercise as a way to improve perinatal mental health may help to improve the exercise attitudes of pregnant women (Da Costa et al., 2003).

Findings from this study also suggest that OW/OB women may be at higher risk for experiencing depressive/anxiety symptoms during TRI 1 and TRI 2 than normal weight women. Healthcare providers may want to monitor the psychological well-being of OW/OB women with a history miscarriage over the course of pregnancy and provide similar recommendations for anxiety/depression reducing strategies even if the symptoms are at sub-clinical levels. Future research is warranted to determine the effect of healthcare provider's referral for stress management on the patients' psychological well-being and health-related outcomes, especially among OW/OB pregnant women.

To our knowledge, this is one of the first studies to identify prepregnancy weight status group differences in exercise behavior and its motivational determinants. OW/OB women had lower levels of exercise attitude, PBC, and intention throughout their pregnancies. These findings are consistent with recent research that found OW/OB women were less likely to endorse positive exercise beliefs (Symons Downs et al., 2014a). While there were no prepregnancy weight status differences in perinatal exercise behavior, OW/OB women were significantly less active before pregnancy than normal weight women. Given that prepregnancy activity level is a strong predictor of perinatal exercise and motivational determinants (Ning et al., 2003; Weir et al., 2010), and that pregnant women who are inactive, especially OW/OB women, are at a higher risk for excessive gestational weight gain and associated pregnancy complications (e.g., gestational diabetes; Symons Downs et al., 2014b) promotion of preconception exercise in OW/OB women may be most beneficial for their mental and physical health throughout pregnancy. Furthermore, OW/OB women in our study also reported higher levels of TRI 1 and TRI 2 depressive and anxiety symptoms. There is a need for future research to understand the benefits of healthcare providers monitoring the psychological wellbeing of OW/OB women with a history miscarriage.

Strengths and limitations

There are several strengths of this study. To the authors' knowledge, no prior studies have prospectively examined the influence of prior miscarriage and prepregnancy weight status on exercise behavior in pregnant women. The prospective study design was a strength as this allowed for the examination of several time points over the course of pregnancy. This study focuses on a special population and the study findings may offer insight to researchers and clinicians working with this group of women. There are also some study limitations. First, the study sample was homogenous and representative of a population residing near a large university in rural Pennsylvania. Our study sample may also represent a more motivated sample of pregnant women than those who did not elect to participate in the study. Thus, the generalizability of the findings to other populations may be limited. Second, the study used validated measures, however, there are inherent limitations with self-reported data. Also, due to insufficient data, we were not able to examine group comparisons by underweight, normal weight, overweight, and obese categories. Future studies may want to further examine these subgroups of women as well as exploring potential influences of miscarriage within each weight status group. Lastly, we did not include a measure of perceived fear as this may be related to exercise behavior (or lack thereof) in a pregnancy following a miscarriage.

Implications for practice

In summary, these findings suggest that a woman's history of miscarriage and prepregnancy weight status may impact her exercise motivation and psychological health in a subsequent pregnancy. Women who have experienced a miscarriage and OW/OB women experience unique barriers to exercise during pregnancy, along with poorer psychological health, which may influence the postpartum health of the woman and her child (Sutter-Dallay et al., 2004; Van den Bergh et al., 2005). Future research is needed to best determine how to adapt research interventions aiming to promote perinatal exercise behavior among this population in a clinical setting, through education of both healthcare providers and pregnant women about the safety and benefits of perinatal exercise. Pilot studies should aim to find strategies able to be utilized by practitioners and healthcare providers in clinical settings to target the unique needs of women based on their miscarriage history and prepregnancy weight status, particularly among OW/OB women who have experienced a prior miscarriage, and may be at highest risk for psychological distress and inactivity during a subsequent pregnancy.

Acknowledgments

Funding

Support for this work has been provided by the National Heart, Lung, and Blood Institute (NHLBI) of the National Institutes of Health through grant R01 HL119245-01.

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Table 1

Demographic Characteristics of the Study Sample (Percentages) and Group Differences in Categorical Variables.

	Total Sample % (*N* = 203)*	***Normal Weight***		***Overweight/Obese***		***PPWS Group Differences***			**PL Group Differences**		
		No Miscarriage % (*N* = 96)	**Miscarriage % (*N* = 20)**	**No Miscarriage % (*N* = 49)**	**Miscarriage % (*N* = 17)**	**χ^2**	**df**	***p***	**χ^2**	**df**	***p***
Prepregnancy Weight Status											
Underweight	4%										
Normal Weight	60%										
Overweight	40%										
Obese	16%										
Pregnancy History											
Previous Miscarriage	20%										
No Previous Miscarriage	80%										
Marital Status						6.18	4	0.19	2.74	4	0.59
Married	95.5	98.0	100.0	94.3	84.2						
Single	2.9	1.0	0.0	3.8	10.5						
Divorced	0.5%	0.0	0.0	1.9	0.0						
Other	1.0%	1.0	0.0	0.0	5.3						
Race/Ethnicity						7.14	3	0.07	5.07	3	0.17
Caucasian	92.6	92.2	85.7	98.1	94.7						
Asian	4.4	4.9	9.5	0.0	0.0						
Hispanic	1.5	0.0	4.8	1.9	5.3						
Other	1.5	2.9	0.0	0.0	0.0						
Education						4.92	3	0.18	2.13	3	0.55
Graduate	46.8	50.0	45.0	43.4	31.6						
College	49.3	47.1	55.0	49.1	63.2						
High School	2.5	1.0	0.0	5.7	5.3						
Other	1.5	2.0	0.0	1.9	0.0						
Family Income						6.74	5	0.24	4.93	5	0.43
> $100,000	24	29.6	20.0	13.2	15.8						

	Total Sample % (*N* = 203)*	*Normal Weight*		*Overweight/Obese*		*PPWS Group Differences*			PL Group Differences		
		No Miscarriage % (*N* = 96)	Miscarriage % (*N* = 20)	No Miscarriage % (*N* = 49)	Miscarriage % (*N* = 17)	χ^2	df	*p*	χ^2	df	*p*
$40,000 – 100,000	55.6	51	70.0	58.8	73.7						
$20,000 – 39,999	14.8	15.3	10.0	20.8	5.3						
$10,000 – 19,999	3.6	3.1	0.0	3.9	5.3						
< $10,000	1.5	1	0.0	1.9	0.0						
Pregnancy History						0.10	1	0.92	0.76	1	0.78
No Full Term Births	36.3	37.9	31.8	34.0	47.4						
1+ Full term Births	63.7	62.1	68.2	66.0	52.6						

*Note. Study sample includes all participants including underweight (*n* = 7) and exercise-restricted women (*n* = 15); PPWS = Prepregnancy Weight Status; PL = Perinatal Loss.

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Table 2

Means, Standard Deviations, and Group Differences Between the Study Variables.

Variable	Total Sample (*N* = 203)[a]		Normal Weight				Overweight/Obese				PPWS Group Differences [b]		PL Loss Group Differences	
			No PL (*N* = 96)		PL (*N* = 19)		No PL (*N* = 53)		PL (*N* = 17)					
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*df*	*F*	*df*	*F*
Age	31.1	4.0	30.3	4.1	32.0	2.8	31.9	4.3	32.6	4.0	1, 195	5.53 *	1, 202	3.42
Body Mass Index Prepregnancy	24.6	5.7	21.6	1.6	21.7	1.9	29.7	4.9	32.0	6.8	–	–	1, 202	4.20 *
CES-D														
TRI 1	9.9	7.1	8.6	6.2	13.4	7.3	10.2	7.3	11.5	6.9	3, 177	3.51 *	1, 177	5.81 *
TRI 2	7.8	6.1	6.6	5.0	10.6	9.2	8.4	6.5	9.9	5.3	3, 177	3.88 **	1, 177	5.92 *
TRI 3	9.6	6.8	8.5	5.7	11.2	7.2	10.8	8.7	10.8	6.9	3, 177	1.73	1, 177	1.14
STAI														
TRI 1	32.3	7.9	31.2	7.7	35.8	7.4	32.1	8.2	34.2	7.8	3, 177	2.63 *	1, 177	4.99 *
TRI 2	30.9	7.3	29.5	6.0	35.4	10.8	31.4	7.6	31.2	6.5	3, 177	3.44 *	1, 177	5.60 *
TRI 3	31.5	7.6	30.4	6.6	33.6	10.0	32.8	8.2	32.2	7.6	3, 177	1.87	1, 177	0.82
Average Weekly LTEQ EXB Min														
Prepregnancy	136.5	92.2	153.8	95.8	123.9	86.6	103.5	79.1	125.3	80.1	3, 177	2.90 *	1, 177	0.23
TRI 1	108.6	88.8	121.9	96.8	82.5	75.0	98.3	88.6	96.6	64.0	3, 177	1.18	1, 177	1.91
TRI 2	108.7	85.9	109.8	76.9	92.0	74.0	94.5	83.3	102.4	84.9	3, 177	0.31	1, 177	0.21
TRI 3	105.8	82.2	112.7	85.4	92.4	83.2	104.5	89.1	122.6	55.9	3, 177	0.13	1, 177	0.02
Intention														
TRI 1	16.2	4.8	17.2	4.3	14.7	6.8	14.7	4.5	15.1	4.7	3, 177	3.10 *	1, 177	1.85
TRI 2	16.5	4.6	17.4	4.3	15.9	5.3	15.4	4.4	13.9	6.0	3, 177	4.18 **	1, 177	3.33
TRI 3	14.3	5.9	15.8	5.7	13.7	7.1	13.1	5.12	13.2	6.2	3, 177	2.96 *	1, 177	1.23
Attitude														
TRI 1	41.7	6.6	43.8	5.5	38.6	8.6	39.5	6.6	38.8	5.8	3, 177	7.90 ***	1, 177	8.32 **
TRI 2	42.5	5.8	44.0	5.0	42.6	4.8	40.5	6.3	39.8	7.0	3, 177	6.53 ***	1, 177	1.40

Variable	Total Sample (*N* = 203)[a]		Normal Weight				Overweight/Obese				PPWS Group Differences [b]		PL Loss Group Differences	
			No PL (*N* = 96)		PL (*N* = 19)		No PL (*N* = 53)		PL (*N* = 17)					
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***df***	***F***	***df***	***F***
TRI 3	38.9	8.1	41.7	7.2	38.1	9.0	36.2	7.0	37.3	6.9	3, 177	6.44***	1, 177	1.53
PBC														
TRI 1	14.7	4.5	15.6	4.7	13.4	4.7	14.0	4.3	13.2	3.7	3, 177	2.78*	1, 177	3.63*
TRI 2	15.3	4.1	16.1	4.3	13.7	4.6	15.0	3.7	13.3	3.8	3, 177	4.00**	1, 177	6.36*
TRI 3	13.8	4.7	15.1	4.5	13.2	5.9	12.9	4.0	13.0	3.8	3, 177	2.95*	1, 177	1.54
Subjective Norm														
TRI 1	17.2	3.7	17.6	3.4	15.9	3.8	17.2	4.1	16.7	3.9	3, 177	1.01	1, 177	2.84
TRI 2	17.6	3.6	18.1	3.3	16.7	4.3	17.2	3.6	16.9	4.4	3, 177	1.22	1, 177	1.98
TRI 3	16.1	4.9	16.9	4.3	15.3	5.4	15.9	4.2	15.5	4.7	3, 177	1.39	1, 177	1.99

Notes. PL =Perinatal Loss; PPWS = Prepregnancy Weight Status; TRI = Trimester; LTEQ = Leisure Time Exercise Questionnaire; EXB= Exercise Behavior; PBC = Perceived Behavioral Control; CES-D = Centers for Epidemiological Studies Depression Scale; STAI = State Trait Anxiety Inventory;

[a] Study sample includes all participants including underweight ($n = 7$) and exercise-restricted women ($n = 15$);

[b] PPWS group differences adjusted for age and PL;

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Table 3

Group Prevalence of Meeting Exercise Guidelines and reporting Clinical Levels of Depressive and Anxiety Symptoms.

						PL Group Differences			*PPWS Group Differences*		
	Total Sample* % (*N* = 181)	**No Perinatal Loss % (*N* = 145)**	**Perinatal Loss % (*N* = 36)**	**Normal Weight % (*N* = 115)**	**Overweight/Obese % (*N* = 66)**	**χ^2**	**df**	***p***	**χ^2**	**df**	***p***
CES-D Clinical Score†											
TRI 1	19	16	33	17	24	5.64	1	0.02	1.60	1	0.21
TRI 2	10	8	19	7	15	4.53	1	0.03	3.14	1	0.08
TRI 3	18	17	19	16	23	0.44	1	0.83	1.41	1	0.24
STAI Clinical Score§											
TRI 1	17	13	31	15	20	6.35	1	0.01	0.73	1	0.39
TRI 2	10	8	19	10	9	4.53	1	0.03	0.85	1	0.77
TRI 3	14	10	28	10	19	7.36	1	0.007	3.02	1	0.08
Meeting EXB Guidelines¶											
Prepregnancy	95.5	28	34	37	24	0.46	1	0.49	3.30	1	0.07
TRI 1	2.9	28	26	27	26	0.03	1	0.87	0.01	1	0.91
TRI 2	0.5	31	25	27	24	0.49	1	0.48	0.16	1	0.69
TRI 3	1.0	36	24	24	30	2.12	1	0.14	0.76	1	0.38

*Note. Total Sample excludes underweight (n = 7) and exercise-restricted women (n = 15); PPWS = Prepregnancy Weight Status; PL = Perinatal Loss; EXB = Exercise Behavior; CESD = Centers for Epidemiological Studies Depression Scale; STAI = State Trait Anxiety Inventory;

†CES-D clinical levels correspond with a score > 15;

§STAI clinical levels correspond with a score > 40.

¶USDHHS (2008) guidelines of 150 minutes EXB/week;

Table 4

Multivariate and Univariate Analyses of Covariance Among Outcome Variables *

Multivariate Effects (*N* = 181)	*Wilks' lambda*	*F*	*df*	*p*
Psychological Well-Being: Depressive and Anxiety Symptoms				
TRI 1				
Prepregnancy Weight Status	0.99	0.21	2, 176	0.81
Perinatal Loss	0.96	3.13	2, 176	**0.04**
TRI 2				
Prepregnancy Weight Status	0.99	0.91	2, 176	0.41
Perinatal Loss	0.96	3.33	2, 176	**0.03**
TRI 3				
Prepregnancy Weight Status	0.99	1.12	2, 176	0.33
Perinatal Loss	0.99	0.57	2, 176	0.57
TPB Constructs: Intention, Attitude, PBC, & Subjective Norm				
TRI 1				
Prepregnancy Weight Status	0.92	4.03	4, 174	**0.004**
Perinatal Loss	0.95	2.42	4, 174	**0.05**
TRI 2				
Prepregnancy Weight Status	0.89	5.20	4, 174	**0.001**
Perinatal Loss	0.96	1.72	4, 174	0.15
TRI 3				
Prepregnancy Weight Status	0.88	6.21	4, 174	< **0.001**
Perinatal Loss	0.98	0.56	4, 174	0.69

Notes: TRI = Trimester; PBC = Perceived Behavioral Control; Within-trimester analyses of variance by construct grouping (i.e. motivational determinants, psychological wellbeing, TPB) with prepregnancy weight status as fixed factor and PL and age as covariates.

*Age did not emerge as a significant factor in any analysis.