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Social support for exercise from pregnancy to postpartum and the potential impact of a mobile application: A randomized control pilot trial in Southern United States

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ABSTRACT

This study compared perceived social support among women of all body mass index (BMI) categories with an attempt to assess the efficacy of the BumptUp® mobile application to improve social support for exercise during pregnancy and postpartum. Thirty-five pregnant women living in Southern United States were included in the sample. The intervention group received access to the BumptUp® mobile application that was designed to promote physical activity during pregnancy and postpartum. The control group received an evidence-based educational brochure. Perceived social support for exercise was assessed at four-time points using the social support and exercise survey. Outcomes were evaluated at 23–25, 35–37 gestational weeks, and 6 and 12 weeks postpartum. Based on their pre-pregnancy weight and height, BMI was computed to categorize participants into lean, overweight, and obese groups. Social support across BMI categories and between control and intervention groups were compared using linear mixed-effect models. Women grouped in the overweight and obese BMI categories reported receiving significantly lower levels of social support for exercise than women in the lean category throughout pregnancy and postpartum during mid-pregnancy, late pregnancy, and at 12 weeks postpartum ($p < 0.05$). Although the intervention group received higher social support than the control group throughout all four assessment points, the difference was not statistically significant ($p > 0.05$). Women with a pre-pregnancy BMI of overweight and obese received lower social support for exercise during pregnancy and postpartum. The efficacy of BumptUp® to improve perceived social support for exercise in pregnancy and postpartum was not evident in the results.

1. Introduction

Physical activity during and after pregnancy is vital for preventing chronic disease and maintaining optimal health in two generations. Maternal physical activity reduces the risk of pregnancy complications such as pre-eclampsia and gestational diabetes (Davenport et al., 2018a) while also improving fetal and newborn health by reducing the odds of fetal macrosomia (Davenport et al., 2018b) and preterm births. (Magro-Malosso et al., 2017) Maternal physical activity controls gestational weight gain (Ruchat et al., 2018) and prevents the fetal programming of chronic diseases, which reduces the risk of developing such conditions in a newborn's later life. (Heerwagen et al., 2010) After childbirth, physical activity contributes to faster postpartum recovery, (Price et al., 2012) reduces postpartum weight retention, (Ruchat et al., 2018) and attenuates symptoms of postpartum depression. (Kołomańska-Bogucka and Mazur-Bialy, 2019).

To reap the maximum health benefits of physical activity during pregnancy and postpartum, it is recommended to accumulate at least 150 min of moderate physical activity throughout the week. (Bull et al., 2020; Acog, 2020) Despite the recommendations, many pregnant women do not accumulate adequate amounts of physical activity during pregnancy to attain optimum health benefits, (Evenson and Wen, 2010; Hesketh and Evenson, 2015) and this inactive lifestyle often continues during the postpartum period, which increases the future risk of non-communicable diseases. (Pereira et al., 2007; Downs and Hausenblas, 2004) The prevalence of insufficient physical activity is reportedly

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higher among women who have an overweight or obese body mass index (BMI). (Ussery et al., 2020) Social isolation and lack of social support for exercise are major barriers to physical activity among pregnant and postpartum women, (Kieffer et al., 2002; Thornton et al., 2006) and may be more apparent among women who have larger bodies. (Chang et al., 2015; Koleilat et al., 2021).

Social support is critical for changing physical activity behavior during pregnancy and postpartum. A recent systematic review recognized social support as the strongest enabler of physical activity during pregnancy, (Harrison et al., 2018) which is in congruence with the Theory of Planned Behavior (Rhodes et al., 2002) and Social Cognitive Theory. (Bandura, 2004) Family and friends are considered the most common sources of social support for exercise that helps women to overcome barriers and adopt a physically active lifestyle during pregnancy and postpartum. (Kieffer et al., 2002; Thornton et al., 2006) Previous studies have shown that family and friends' support for exercise and pregnant women's perception of the support they receive for exercising is positively associated with physical activity participation in pregnant (Versele et al., 2022; Leppänen et al., 2014) and postpartum women. (Faleschini et al., 2019; Keller et al., 2006) However, very few studies have assessed the social support for exercise during pregnancy and postpartum with specific attention to women who have an overweight or obese BMI. Because women who have larger bodies may be more sensitive to social support during pregnancy, (Thornton et al., 2006; Chang et al., 2015) understanding social support to be active for these women is important.

Although social support is vital in maternal physical activity interventions, few interventions to date in pregnant and postpartum women included social support as a means to improve their physical activity. (Flannery et al., 2019) Further, no studies, to our knowledge, have investigated social support for physical activity as part of a mobile application, which is considered the most convenient method of reaching women during pregnancy and postpartum. (Tinius et al., 2021) Thus, this study compared perceptions of social support for exercise during pregnancy among women grouped by their BMI as lean, overweight, and obese and assessed the efficacy of the BumptUp® mobile application for increasing perceived social support for exercising during pregnancy and postpartum.

2. Methods

This study is a secondary data analysis of a pilot study that assessed the efficacy of the BumptUp® mobile application in increasing physical activity among pregnant and postpartum women living in a rural city in Kentucky, USA. (Tinius et al., 2022) The participants were recruited from November 2020 to August 2021. The study protocol was approved by the Institutional Review Board of Western Kentucky University (#20–257), and the protocol was registered with clinicaltrials.gov (NCT04480931). The investigators reached 69 pregnant women who planned to deliver at The Medical Center in Bowling Green, Kentucky through the help of healthcare providers, advertising on social media, and word of mouth. The sample included singleton pregnant women between the age of 18 to 44 years who could communicate in English. Possession of a smart phone was also required for inclusion as the intervention was delivered through a mobile application. Pregnant women with any contraindication for exercise participation were excluded from the study. Following an initial screening for eligibility, physician clearance and informed written consent were obtained. Thirty-eight pregnant women were eligible and consented to participate in the study.

2.1. Intervention

Nineteen pregnant women were randomly allocated to the intervention group and received free access to the BumptUp® mobile application. BumptUp® enabled participants to track their physical activity, caloric intake, and gestational weight gain, with visual feedback provided on their progress. The app also included a social support forum, educational articles, and vi. deos containing recommended exercises for pregnant and postpartum women. The social support forum allows pregnant women to communicate with other participants in the study by sharing specific information about their exercise routines with the goal of encouraging and supporting one another. It is also plausible that the weekly educational articles within the app may encourage discussion about physical activity with their family and friends. Additionally, the app includes pregnancy symptom tracking with a flagging system that notifies the users to consult a healthcare provider. The attentional control group also included nineteen pregnant women who received evidence-based educational brochures on maternal physical activity instead of BumptUp®. (Alvis et al., 2019).

2.2. Data collection

Physical activity, social support for exercise, and other information related to outcomes of interests were collected at baseline during 23–25 weeks of gestation, 35–37 weeks of gestation, 6 and 12 weeks postpartum. Socio-demographic data were collected only at the baseline assessment (23–25 weeks of gestation) before randomizing the participant into intervention and control arms. All the surveys were conducted online through the REDCap data collection platform. Pre-pregnancy weight and height were used to calculate the BMI and classified participants into lean, overweight, and obese categories. The social support and exercise survey, a survey specifically designed to assess social support for exercise was used to collect information about the perceived family and friends' support for exercising during the last three months. (Sallis et al., 1987) Participants rated their perception of support for exercise from family and friends on a six-point scale: none, rarely, a few times, often, very often, and does not apply. Scores for social support from family and friends were calculated by totaling responses for 10 items, excluding the rewards and punishment optional scale. (Sallis et al., 1987) "Does not apply" responses were recoded to 1 before calculating the total score. In the final analysis, social support from family and friends was combined to calculate the overall social support score.

2.3. Data analysis

Descriptive statistics were calculated for socio-demographic data. Due to right-skewness, overall social support scores were log-transformed prior to analysis. Differences in the overall social support received over time across the three pre-pregnancy BMI categories (lean, overweight, obese) were analyzed using a linear mixed effects model, with an interaction effect included between time and BMI. Next, differences in overall social support scores over time between the intervention and control groups were compared using a linear mixed effects model, this time adjusting for pre-pregnancy BMI and self-reported physical activity levels, with an interaction effect included between time and group. Likelihood ratio testing and Akaike Information Criterion (AIC) were used to select appropriate covariance structures for each mixed model. A Kenward-Roger adjustment was used to correct for negative bias in the standard errors and degrees of freedom calculations induced by the small samples. In all cases, model assumptions were assessed using a combination of visual plots and formal testing. When interaction effects were significant, relevant pairwise comparisons were performed using Fisher's LSD. Estimated group differences from these comparisons were exponentiated as multiplicative effect ratios for purposes of interpretability, returning to the original scale of the score data. Throughout the study, a p-value of less than 0.05 was considered statistically significant. All analyses were completed in SAS 9.4 (SAS Institute Inc.; Cary, NC, USA).

3. Results

At the end of the intervention period, only seventeen participants remained in the intervention arm, while eighteen were in the control arm. One participant in the control arm discontinued the study participation due to spontaneous abortion, and two in the intervention arm were lost to follow-up. The socio-demographic characteristics of participants included in the secondary data analysis are summarized in Table 1.

3.1. Comparing social support for exercise across BMI categories

Before the intervention, at 23 weeks of gestation, the lean group had an estimated 35.8 % larger mean social support score than the group with obesity ($p = 0.044$), where the score was 49.5 % higher than the overweight BMI group ($p = 0.007$). The social support received by women who had an overweight and obese BMI was significantly lower compared to the lean group during and after the pregnancy, except between lean and obese groups in the 6 weeks postpartum assessment point (Table 2).

The intervention group experienced an estimated 14.0 % larger mean social support score at 23 weeks of gestation than the control group, after adjusting for BMI category and self-reported early pregnancy moderate physical activity levels. This difference gradually diminished as the pregnancy progressed (8.6 % larger in the intervention group at 35 weeks) and just after the delivery (6.9 % larger in the intervention group at 6 weeks postpartum) (Table 3). However, 12 weeks after childbirth, the adjusted mean social support score in the intervention group was 26.9 % higher than in the control group ($p = 0.08$).

4. Discussion

The results of this study revealed that women who had an overweight or obese pre-pregnancy BMI received less social support for exercise compared to women who had a lean BMI during pregnancy and postpartum. The efficacy of BumptUp® to improve perceived social support for exercise in pregnancy and postpartum was not evident in the results because the sample of this pilot trial was not sufficiently powered to detect clinically significant differences in support between the intervention and control groups. (Lancaster et al., 2004) Thus, in addition to direct changes in the behavior, future trials should focus on perceived social support for exercise, especially targeting women who have an elevated BMI. A higher perception of social support is advantageous, especially after childbirth, in an effort to restore diminished exercise habits during pregnancy. (Devine et al., 2000) Also, future mobile apps targeting physical activity promotion during pregnancy and postpartum should include improved social support features that not only provide an opportunity to communicate with other users and developers of the app but also with their immediate family, friends, and healthcare providers, which is critical in building a strong system for social support. (Albright et al., 2019) The mobile app provides an additional opportunity for pregnant and postpartum women to feel supported in their decisions to pursue physical activity.

Previous clinical trials advocated for the positive effects of social support on increasing physical activity among postpartum women (Albright et al., 2019; Keller et al., 2014; Fjeldsoe et al., 2020) and some authors recognized social support as the most influential factor for elevating physical activity after childbirth. (Albright et al., 2019) A randomized control trial conducted among postpartum women demonstrated increased social support for exercise in the intervention group, who had access to a tailored eHealth package. (Albright et al., 2019) Similar to our findings, the improvement in social support was not significant in the eHealth group after the intervention period. Another mobile application intervention on a group of women with children under five years showed significant improvements in social support for exercise after the intervention. (Fjeldsoe et al., 2020) The larger sample size of this study may yield this significant result, which also advocates the possibility of observing significant improvements in social support for exercise among BumptUp® users in future full-scale randomized control trials. Another study assessed the efficacy of a social support intervention on postpartum women and observed that the intervention effects were limited only to the intervention period, where the social support declined after the intervention. (Keller et al., 2014) Conversely, although not significant, BumptUp® showed a positive trend of restoring perceived social support after childbirth. This seems logical as postpartum is known to be a very isolating time point; (Humenick, 2003) women are home with the new baby, often off work and not participating in their normal social activities. A suggestion from perinatal educators is to help new mothers link up with each other, which is precisely what the BumptUp® app allows both pregnant and postpartum women to do.

A quasi-experimental study assessed the efficacy of a mobile application for improving social support for exercise among pregnant women and reported that the mobile application used in the intervention showed significant effects in the sample. (Kiani and Pirzadeh, 2021) We suspect our findings could be similar with a larger sample size in the future and if family and friends were connected to the social discussion forum.

Our findings underscore the idea that social support for physical activity is often lacking for women who have larger bodies. A neglected and often overlooked barrier to physical activity among pregnant women who have larger bodies may be experiences of weight stigma preconception and throughout gestation. (Incollingo Rodriguez et al., 2021) It has been well documented that adults who have obesity are subjected to weight stigma in several social settings, including in physical activity contexts. (Puhl and Suh, 2015) Weight stigma is defined as negative misconceptions and stereotypes associated with body weight, and often projects individuals with larger bodies with poor judgmental labels such as being lazy or disinterested in being active. (Puhl et al., 2020) These assumptions can carry forward in pregnancy

Table 1
Socio-demographic characteristics of pregnant women in the sample recruited from a rural city in the Southern United States, 2020–2021.

Variable	Frequency (%)
Marital status	
Single	1 (2.9)
Married	34 (97.1)
BMI category	
Lean	10 (28.6)
Overweight	13 (37.1)
Obese	11 (31.4)
Not recorded	1 (2.9)
Annual income (USD)	
20,001–40,000	2 (5.7)
40,001–60,000	6 (17.1)
60,001–80,000	8 (22.9)
80,000 <	19 (54.3)
Race	
Caucasian	35 (100)
Education level	
Highschool/GED	1 (2.9)
Associates	1 (2.9)
Bachelors	18 (51.4)
Masters	9 (25.7)
PhD	4 (11.4)
Technical/Trade	2 (5.7)

Table 2
Perceived social support for exercise among US pregnant and postpartum women in different BMI categories, 2020–2021.

Time point	Lean Median (IQR)	Overweight Median (IQR)	Obese Median (IQR)	BMI Group 1	BMI Group 2	Estimated Effect Ratio	95 % CI for Effect Ratio	p-value
23 weeks' gestation	51 (41 to 56)	32 (27 to 38)	30 (27 to 43)	Lean	Obese	1.36	(1.01, 1.83)	0.044
				Lean	Overweight	1.50	(1.12, 1.99)	0.007
				Obese	Overweight	1.10	(0.83, 1.46)	0.494
35 weeks' gestation	48.5 (37 to 50)	32 (27 to 35)	25 (22 to 33.5)	Lean	Obese	1.52	(1.13, 2.05)	0.007
				Lean	Overweight	1.44	(1.08, 1.92)	0.015
				Obese	Overweight	0.95	(0.71, 1.26)	0.693
6 weeks postpartum	40 (35 to 51)	23.5 (22 to 33)	34.5 (26 to 43.5)	Lean	Obese	1.26	(0.93, 1.71)	0.132
				Lean	Overweight	1.60	(1.18, 2.16)	0.003
				Obese	Overweight	1.26	(0.95, 1.69)	0.109
12 weeks postpartum	49.5 (40 to 59)	32 (22 to 35.5)	33.5 (29 to 45)	Lean	Obese	1.50	(1.10, 2.03)	0.011
				Lean	Overweight	1.73	(1.28, 2.32)	0.001
				Obese	Overweight	1.15	(0.87, 1.53)	0.320

Table 3
Perceived social support for exercise among US pregnant women in the intervention and control groups from pregnancy to postpartum after adjusting for BMI and physical activity.

Timepoint	Control Median (IQR)	Intervention Median (IQR)	Intervention: Control		
			Estimated Effect Ratio	95 % CI for Effect Ratio	p-value
23 weeks' gestation	33.5 (29 to 44.5)	38.5 (29.5 to 52)	1.14	(0.87, 1.49)	0.324
35 weeks' gestation	32 (25 to 49)	34 (27 to 45)	1.09	(0.83, 1.42)	0.540
6 weeks postpartum	29 (23 to 44)	35.5 (25 to 43)	1.07	(0.81, 1.41)	0.624
12 weeks postpartum	32 (23 to 47)	35.5 (32 to 44.5)	1.27	(0.97, 1.67)	0.084

resulting in judging pregnant women with larger bodies as likely inactive or disinterested in improving their health. (Nagpal et al., 2022b) In fact, a scoping review noted that even when pregnant women are seeking advice on health behaviors like nutrition and exercise from their healthcare provider, it may be delivered with a connotation that the person likely will not adhere to recommendations. (Nagpal et al., 2020) In non-pregnant studies, experiencing weight stigma has been associated with reduced physical activity. (Pearl et al., 2021) Importantly though, social support in pregnancy is suggested to be 'protective' against experiences of weight stigma. (Nagpal et al., 2022a) Taken together with our findings, it may be plausible that increased social support for exercise for pregnant women who have overweight, and obesity is an integral factor to overcome weight stigma as a barrier to being active.

Maternal morbidity and mortality in the United States is a public health crisis. The United States is the most dangerous developed nation to give birth in, (Slomski, 2019) despite the fact that resources and medical care in the United States are advanced. While the issue is certainly multifaceted, one factor contributing to this is that more and more women are entering pregnancy with an obese and overweight BMI, which is often associated with increased risk of complications and other co-morbidities. (Say et al., 2014) Interestingly, social factors have been determined to be a major culprit of unhealthy behaviors and racial gaps in outcomes. While efforts need to be made in many areas of health care, accessible mHealth applications that can help women lead healthier lifestyles, make integral social connections, and manage weight may be helpful. Further, mHealth apps that can provide a missing sense of social support can go a long way towards improving health outcomes by facilitating increased adherence and encouragement to engage in healthy behaviors like physical activity.

Our sample size is relatively small (as to be expected with a pilot study), and the sample only included Caucasian women, which limits the generalizability of the findings. Another limitation is the self-reported nature of the social support data. It is likely that feelings of social support change from day to day throughout pregnancy and postpartum, and this is difficult to account for with surveys; however, we did assess social support at four different time points in an attempt to gain a true understanding of each participant's levels of support. The social support survey was not specifically tailored to assess direct support provided by the mobile application; instead, it quantified the changes in perception of the support that pregnant women usually receive from their family and friends to be active in pregnancy and continue throughout postpartum. Also, this study assumed BumptUp® provides ample resources and empowers participants to talk about exercising during pregnancy and postpartum with their family, friends, and healthcare providers, which impacts their perceptions and the actual social support they receive. Despite these limitations, this study was one of the first to assess the efficacy of a mobile application for improving perceived social support for exercise among pregnant women, which also highlighted the discrepancy of perceptions by women who have an elevated BMI. Future mobile apps targeting physical activity promotion during pregnancy and postpartum should include features that facilitate discussions with family and friends about exercise. Such mobile apps with advanced social support features should be introduced to other regions and countries where more social support is needed to exercise, especially during pregnancy and postpartum.

5. Conclusion

Social support received by women who had an overweight or obese BMI during their pregnancy and postpartum is lower than that by women who had a lean BMI. The efficacy of the BumptUp® mobile application to improve social support for exercise during pregnancy and postpartum is vague, and the social support aspect of the app should continue to support women have a higher BMI who may be subjected to additional psychosocial barriers to physical activity like weight stigma.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2023.102485.

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