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Maternal Pre-Pregnancy Body Mass Index and Prenatal Sugar Consumption Predict Gestational Weight Gain and/or Postpartum Mental Health in a Health Professional Shortage Area

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Abstract

This study investigated whether the amount of third trimester added sugar consumption interacted with pre-pregnancy BMI (PPBMI) to predict gestational weight gain (GWG) and postpartum mental health in Health Professional Shortage Area (HPSA) for primary care and mental health. Participants included pregnant women aged 18 to 36, with data collected in-person at 33-37 weeks gestation and 6 months postpartum using an anthropometric measurement, Dietary Screener Questionnaire (DSQ), Edinburg Postnatal Depression Scale (EPDS), Prenatal Anxiety Screening Scale (PASS), and the 14-item Perceived Stress Scale (PSS). No moderated mediation models were statistically significant. Results indicated that greater PPBMI predicted decreased GWG and increased 6-month postpartum depression symptoms. There was a significant, positive correlation between prenatal added sugar intake and 6-month postpartum depression, anxiety, and perceived stress symptoms. Support for associations between increasing PPBMI and increasing depression symptoms at 6 months postpartum in this sample of women in an HPSA for primary care and mental health highlights the importance of starting preventative care for women prior to pregnancy. Correlations between greater added sugar intake in the third trimester and increased depression, anxiety, and perceived stress symptoms at 6 months postpartum supports the need for more research directly investigating those relationships, which could inform perinatal prevention/intervention research.

Keywords: Antenatal; diet; underserved area; third trimester; postnatal

Introduction

From 2011-2016, pre-pregnancy body mass index (PPBMI) increased, with 52% of those giving birth having had a PPBMI in the overweight or obese range [1]. Greater rates of maternal gestational diabetes, gestational hypertension, preeclampsia [2-3], preterm or cesarean delivery, stillbirth [2, 4], and antenatal depression and anxiety [5] occur in obese women compared to those with a normal PPBMI. Further, those with pre-pregnancy obesity are more likely exceed Institution of Medicine (IOM) guidelines for weight gain over pregnancy [6], which predicts greater difficulties with antenatal [7] and postpartum mental health [8].

Maternal diet impacts gestational weight gain (GWG) in similar ways as PPBMI, with diets high in sugar predicting depression symptoms [9] and increased GWG for women with pre-pregnancy obesity [10-11]. Given the high incidence and salient mental and physical health effects of pre-pregnancy obesity and excessive weight gain, further studies are needed to understand these complex relations, with preliminary research supporting the importance of concurrently considering sugar consumption.

It is also essential to consider salient contextual factors that predict women's health. In particular, Health Professional Shortage Areas (HPSAs) are defined as those within which there is a shortage of health services for a population, or subset of the population, within an established geographic area [12]. While residents of HPSAs have unique barriers to care, research investigating relations among PPBMI, GWG, and postpartum mental health of women in HPSAs is lacking. The high rates of obesity in US women disproportionately impact those with barriers to healthcare, and it is important to address this gap in the literature to identify modifiable prenatal health factors that increase risk of postpartum distress. Therefore, the current study attempts to bridge these gaps by examining moderated mediation models of relations among maternal PPBMI, GWG, prenatal added sugar intake, and postpartum distress using a sample of women residing in an HPSA for primary care and mental health.

Hypothesis 1-3a (mediation)

GWG up to the third trimester will mediate the positive relation between PPBMI and maternal (1a) depression, (2a) anxiety, and (3a) perceived stress symptoms at 6 months postpartum (see Figure 1).

Hypothesis 1-3b (moderation with added sugar)

The relation between elevated PPBMI and maternal mental health will be moderated by added sugar intake in the third trimester in the mediation model, such that elevated PPBMI will be more robustly related to increased maternal (1b) depression, (2b) anxiety, and (3b) perceived stress symptoms at 6 months postpartum for women with greater added sugar intake in the third trimester (see Figure 1).

Hypothesis 1-3c (moderated mediation with added sugar)

Elevated PPBMI will be more robustly related to greater GWG in women with greater added sugar intake, which will predict increased maternal (1c) depressive, (2c) anxiety, and (3c) perceived stress symptoms at 6 months postpartum (see Figure 1).

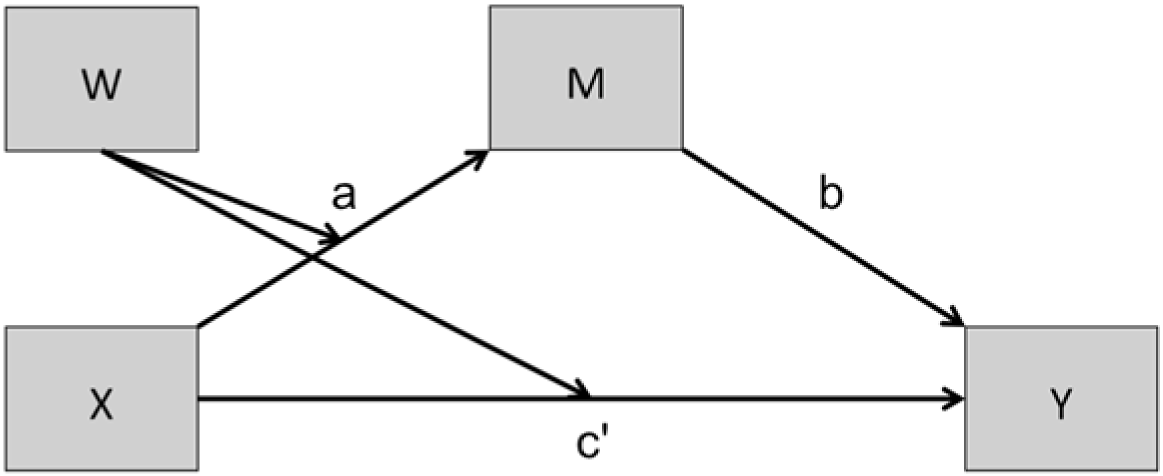

Figure 1. In this model, pre-pregnancy BMI is X, depressive symptoms, symptoms of anxiety, or perceived stress at 6 months postpartum is Y, and added sugar intake is W. The relationship between X and Y is the direct path, M is the mediator, and W is the moderator in this model.

Materials and Methods

Procedures

Current study data were collected as part of the longitudinal Infant Development and Healthy Outcomes in Mothers (IDAHO Mom) Study at Idaho State University. The Idaho State University Human Subjects Committee approved the study, which was conducted in accordance with American Psy-chological Association ethical principles. The IDAHO Mom Study was completed from April 2015 to June 2018. Study details have been published for two projects. One project used some overlapping data with the current project (i.e., perinatal stress and anxiety), but investigated these factors in relation to different variables (i.e., infant perceptions and breastfeeding) [13]. The other project used distinct variables (i.e., maternal prenatal cortisol, breastfeeding, and infant growth) [14]. Study eligibility included adult women with singleton pregnancies, fluent in English, and between 33-37 weeks gestation. Exclusion criteria included multiparous pregnancy, major physical or mental health diagnosis that may impact infant outcomes, Federal Drug Administration Category D or X medication use, or excessive consumption of recreational substances or alcohol during pregnancy.

Participants were recruited from regional service providers and social media advertisements. Prospective participants were screened for eligibility and to provide study information. Those interested in participation who did not meet exclusion criteria were invited to attend the prenatal session. Participants met with a trained research assistant (RA) in the lab during their third trimester, where they completed written informed consent. Participants (n=125) completed interviews or self-report measures of current and past pregnancy-related information, health history, sociodemographic characteristics, and diet (Dietary Screener Questionnaire; DSQ). Weight and height were taken by RAs, and participants were reimbursed \$30. Participants who endorsed critical items or reported distress during the visit, were provided a list of resources reviewed by the RA.

RAs contacted participants approximately 1 month after the participant's due date to schedule their 6-month postnatal session. Participants (n=96) were weighed, measured, and completed the Edinburgh Postnatal Depression Scale (EPDS), Perceived Stress Scale (PSS-14), and Prenatal Anxiety Screening Scale (PASS), among other measures for the larger study. Participants were reimbursed \$30.

Participants

Due to underrepresentation, participants with a PPBMI in the underweight category (BMI<18.5; n=4) were excluded from the current study, leaving 92 participants. Researchers determined a sample size of 71 gives sufficient power for testing moderated mediation [15]. A G*Power *a-priori* power analysis was used with a medium effect size (f^2=0.15), low Type I error probability (α=0.05), and power of 0.80, which resulted ina required sample size of 77 [16]. Thus, the sample of 92 was considered adequate.

Measures

Maternal PPBMI was determined using participants' self-reported pre-pregnancy weight and measured height using an adult stadiometer (Shorr Productions, Olney MD; accuracy to 0.1 cm) at the prenatal session.

GWG was determined by calculating the difference between measured weight at the prenatal session using a battery powered, calibrated scale (Seca 876; accuracy to 0.1 kg), and self-reported pre-pregnancy weight.

The DSQ is a 26-item self-report dietary intake screener developed by the National Cancer Institute [17]. The DSQ records the frequency of consumption of 19 specific food items over the previous month to infer specific food group and nutrient intake, including added sugars [17]. Reported frequencies of consumption were converted to estimates of daily intake using scoring algorithms developed for NHANES 2009-2010 [17-18], and generated using SAS software. The regression coefficient from DSQ added sugar intake in relation to 24-hour recall estimates was 0.77 among women [18].

The 10-item EPDS evaluates experiences and feelings over the previous 7 dayson a 4-point Likert scale, with high scores indicating elevated distress [19]. Postpartum, the EPDS has high concurrent validity with the General Health Questionnaire (GHQ-12) [20]. The EPDS demonstrated good reliability (Cronbach's α=0.81) in the present sample.

The PASS was developed to screen for problematic anxiety symptoms in perinatal samples [21]. The PASS evaluates symptoms over the past month on a 4-point Likert scale with higher scores indicating increased anxiety. The PASS demonstrates high convergent validity with the DASS-21 Anxiety scale and the State-Trait Anxiety Inventory (STAI) subscales, and adequate test-retest reliability between the third trimester and 2-6 months postpartum [21]. The PASS demonstrated high reliability (Cronbach's α=0.93) in the present sample.

The PSS-14 [22] evaluates thoughts, feelings, and coping behaviors in relation to life issues over the past month on a 5-point Likert scale from 0=never to 4=very often. After considering four reversed scored items, greater total scores indicate higher perceived stress [22]. The PSS-10 was validated for pregnant and postpartum women in Canada, in the second and third trimesters, and at 4 and 12 months postpartum, demonstrating high reliability for all time periods, moderate test-retest reliability between the second and third trimesters, and significant correlations with the STAI State Anxiety subscale [23]. Participants in the current study demonstrated good reliability (Cronbach's α=0.78) on the PSS-14.

Statistical Analyses

All analyses were conducted using IBM SPSS Statistics for Macintosh, Version 25.0. Descriptive statistics for all variables also included potential covariates. Regression assumptions of normality, linearity, and homoscedasticity were tested to determine data transformation needs. EPDS and PASS scores were transformed via square root transformations, PPBMI via log transformation, and added sugar intake via inverse transformation [24]. No other violations of regression assumptions were found. All models were tested using Hayes (2013) PROCESS macro v2.16. A mediation model was tested for Hypotheses 1a-3a. The indirect effect was assessed using a bias-corrected bootstrap confidence interval with 5,000 iterations. A conditional process model was utilized to estimate conditional direct effects for Hypotheses 1b-3b and conditional indirect effects for Hypotheses 1c-3c [25].

Results

Descriptive statistics indicated a mean participant age of 27.29 (*SD*=3.85) years. The majority of participants identified as White/ Cauc-asian (88%), with 14% identifying as Hispanic or Latina. The majority of participants earned an annual income of $50,000-74,999 (28%), had earned a college or university degree (39%), were exp-ecting their first child (40%), and were living in an HPSA for primary care (80%) and mental health (100%).

Potential covariates included maternal age at prenatal session, ethnicity, educational attainment, household income, and parity. Bivariate Pearson correlations (see Table 1) indicated expected significant correlations among scores on the EPDS, PASS, and PSS-14. Prenatal added sugar intake was significantly correlated with postpartum EPDS, PASS, and PSS-14 scores. Maternal age was significantly negatively correlated with added sugar intake, PASS, and PSS-14 scores, and was included as a covariate in models including added sugar intake with PASS and PSS-14 outcomes.

		1	2	3	4	5	6	7	8	9	10	11
1.	Age	1										
2.	Income	.446**	1									
3.	Grade	.341**	.457**	1								
4.	Parity	.533**	0.186	-0.163	1							
5.	Ethnicity	-0.161	-.235*	-0.010	-0.114	1						
6.	Hispanic/ Latina	-0.015	-0.084	-0.178	0.164	.267*	1					
7.	Sugar Intake†	-.226*	-0.071	-0.163	0.061	-0.094	.270**	1				
8.	PPBMI†	0.065	-0.037	-0.079	-0.103	0.080	0.065	-0.146	1			
9.	GWG	0.154	0.168	0.170	0.102	0.025	0.003	0.024	-.250*	1		
10.	EPDS†	-0.184	-0.140	-0.151	-0.148	0.117	0.076	.234*	.220*	0.017	1	
11.	PASS†	-.207*	-0.142	-0.088	-.210*	-0.013	-0.042	.250*	0.159	-0.031	.626**	1
12.	PSS-14	-.256*	-0.144	-0.156	-0.118	0.007	-0.051	.299**	0.165	-0.052	.653**	.607**

This table contains bivariate or point-biserial correlations between primary study variables and potential covariates. PPBMI=Pre-pregnancy body mass index; GWG=Gestational weight gain; Sugar=Added sugar intake in the third trimester; EPDS=Edinburgh Postnatal Depression Scale; PASS=Perinatal Anxiety Screening Scale; PSS-14=14-item Perceived Stress Scale. †denotes a transformed variable, *p<0.05, **p<0.01

Table 1.Correlations among Primary Study Variables

None of the mediation models were significant (p=.085-.317). Indirect effect 95% confidence intervals around the relationship between GWG and postpartum mood allincluded 0. Greater PPBMI predicted lower GWG (b=-21.974, t-(90)=-2.450, SE=8.968, p=0.016), indicating a significant a-path for all mediation models. Further, PPBMI significantly predicted maternal depression symptoms at 6 months postpartum (b=1.919, t(89)=2.246, SE=0.854, p=0.027), but not anxious (b=2.109, t(89)=0.090, SE=0.016, p=0.929) or perceived stress symptoms (b=10.335, t(89)=1.500, SE=6.891, p=0.137).

Within the moderated mediation models, the interaction between PPBMI and added sugar intake in the third trimester did not significantly predict maternal distress at 6 months postpartum, and a significant amount of explained variance in symptom scores was notadded by the interaction term above and beyond other predictors in the models (p=.274-.905). The relationship between PPBMI and GWG was not moderated by added sugar intake in the third trimester in any of the moderated mediation models, and there was not a significant amount of explained variance in GWG added by the interaction term above and beyond the other predictors in the models (p=.789-.963). The conditional indirect effect of PPBMI on maternal distressat 6 months postpartum via GWG was not statistically significant as evidenced by 95% confidence intervals surrounding the index of moderated mediation all including 0.

Discussion

Current study strengths and weaknesses should be considered when interpreting results. Strengths of the current study included the longitudinal nature of the study and the limited attrition rate, established and well-validated variable measures, and the novelty of the sample (HPSA) and findings. Limitations included sociodemographic homogeneity, a limited number of underweight women and those with clinically significant psychopathology, lack of differentiation regarding the source and timing of added sugar intake, and utilizing continuous GWG and PPBMI data rather than categorical.

Increased PPBMI predicted increased postpartum depression symptoms, which replicates previous findings. Compared to women in the normal weight category prior to pregnancy, women classified as obese (i.e., BMI ≥ 30 kg/m^2) are at greater risk of depression up to 1 year postpartum [5]. These significant relations in a sample with few participants reaching threshold for elevated depression symptoms suggests that considering subclinical levels is important. Further, this finding has been extended to women in HPSAs.

PPBMI did not predict symptoms of anxiety or perceived stress at 6 months postpartum, failing to replicate prior literature indicating a relation between pre-pregnancy obesityand prenatal anxiety and perceived stress [26]. This may have been due to the fact that the 2009 study examined prenatal distress and PPBMI was coded on a categorial rather than continuous scale. Additionally, while depression, anxiety, and perceived stress symptoms are significantly correlated, constructs are distinct. The pattern of findings may indicate that PPBMI is predictive of postpartum symptoms unique to depression, but not those unique to anxiety or perceived stress.

GWG for this sample was not predictive of 6-month postpartum distress. While one research team demonstrated a relation between GWG and 1-month postpartum depression risk, another found no association between GWG and elevated 6-month postpartum depression [8, 27]. Additionally, a unique study found third-trimester GWG predicted depression symptoms at 45-60 days postpartum, butnosuch relation when using total GWG [28]. This may support the importance of distinguishing trimester-specific weight gain when investigating postpartum mental health risk.

Increased added sugar intake did not significantly interact with increased PPBMI to predict distress at 6 months postpartum. However, added sugar intake in the third trimester had significant, positive correlations with EPDS, PASS, and PSS-14 scores at 6 months postpartum. These findings replicate prior findings of a significant, positive association between added sugar intake at 14-18 weeks gestation and increased EPDS scores at 6-8 weeks postpartum, with current study findings supporting a long-lasting effect of sugar intake over pregnancy on a broader range of postpartum distress variables [9].

Moderated mediation hypotheses were not supported. This may be because our study did not specifically investigate sugar from sugar-sweetened beverages, nor did it investigate PPBMI as a categorical variable. Therefore, future research may wish to investigate distinct sources of added sugar intake as well as coding PPBMI on different measurement scales to determine whether/how it may influence associations.

Conclusions: The current study further extended existing literature by replicating established relations between PPBMI and GWG in a novel US sample in an HPSA for primary care and mental health. This study is the first known to find significant associations between increased prenatal sugar intake in the third trimester and increased depressive, anxious, and perceived stress symptoms at 6 months postpartum. The implications of this study involve prevention efforts for postpartum depression, including identifying women prior to pregnancy who could benefit from weight management strategies to reduce risk of long-term postpartum depression, and maintaining efforts to reduce added sugar consumption during pregnancy given their role in predicting multiple indices of postpartum distress. Future directions for research include examining the direct relation between added sugar intake during pregnancy and postpartum mood, timing effects, and potential moderators in more diverse samples.

Competing Interests

The authors declare that they have no competing interests.

References

1. Deputy, NP., Dub, B., SharmaAJ. (2018). Prevalence and trends in prepregnancynormal weight—48 States, New York City, and District of Columbia, 2011–2015. *MMWR66: 1402*–1407. https://doi.org/10.15585/mmwr.mm665152a1
2. Li, N., Liu, E., Guo, J., Pan, L., Li, B., Wang, P., Liu, J., Wang, Y., Liu, G., Baccarelli, AA., Hou, L., Hu, G. (2013). Maternal prepregnancybody mass index and gestational weight gain on pregnancy outcomes. *PLoS ONE8*:e82310. https://doi.org/10.1371/journal.pone.0082310
3. Zhou, A., Xiong, C., Hu, R., Zhang, Y., Bassig, BA., Triche, E., Yang, S., Qiu, L., Zhang, Y., Yao, C., Xu, S., Wang,Y., Xia, W., Qian, Z., Zheng, T., Zhang, B. (2015). Pre-pregnancy BMI, gestational weight gain, and the risk of hypertensive disorders of pregnancy: A cohort study in Wuhan, China. PLOS ONE 10e0136291. https://doi.org/10.1371/journal.pone.0136291
4. Liu, P., Xu, L., Wang, Y., Zhang, Y., Du, Y., Sun, Y., Wang, Z. (2016). Association between perinatal outcomes and maternal pre-pregnancy body mass index: Perinatal outcomes and maternal BMI. *Obes Rev 17*:1091–1102. https://doi.org/10.1111/obr.12455
5. Molyneaux, E., Poston, L., Ashurst-Williams, S., Howard, LM. (2014). Obesity and mental disorders during pregnancy and postpartum: A systematic review and meta-analysis. *ObstetGynecol 123*:857–867. https://doi.org/10.1097/AOG.0000000000000170
6. Morisset, AS., Dubois, L., Colapinto, CK., Luo, ZC., Fraser, WD. (2017). Prepregnancybody mass index as a significant predictor of total gestational weight gain and birth weight. *Can J Diet Pract Res, 78*:66–73. https://doi.org/10.3148/cjdpr-2016-035
7. Bodnar, LM., Wisner, KL., Moses-Kolko, E., Sit, DKY., Hanusa, BH. (2009). Prepregnancybody mass index, gestational weight gain, and the likelihood of Major Depressive Disorder during pregnancy. *Journal ClinPsy 70*:1290–1296. https://doi.org/10.4088/JCP.08m04651
8. Bolton, JL., Wiley, MG., Ryan, B., Truong, S., Strait, M., Baker, DC., Yang, NY., Ilkayeva, O., O'Connell, TM., Wroth, SW., Sánchez, CL., Swamy, G., Newgard, C., Kuhn, C., Bilbo, SD., Simmons, LA., (2017). Perinatal western-type diet and associated gestational weight gain alter postpartum maternal mood. *Brain Behav7*:e00828. https://doi.org/10.1002/brb3.828
9. Chatzi, L., Melaki, V., Sarri, K., Apostolaki, I., Roumeliotaki, T., Georgiou, V., Vassilaki, M., Koutis, A., Bitsios, P., Kogevinas, M., (2011). Dietary patterns during pregnancy and the risk of postpartum depression: The mother–child 'Rhea' cohort in Crete, Greece. *Pub Health Nutr 14*:1663–1670. https://doi.org/10.1017/S1368980010003629
10. Renault, KM., Carlsen, EM., Nørgaard, K., Nilas, L., Pryds, O., Secher, NJ., Olse,n SF., Halldorsson, TI. (2015). Intake of sweets, snacks and soft drinks predicts weight gain in obese pregnant women: Detailed analysis of the results of a randomisedcontrolled trial. *PLOS ONE 10*:e0133041. https://doi.org/10.1371/journal.pone.0133041
11. Wrottesley, S., Pisa, P., Norris, S., (2017). The influence of maternal dietary patterns on body mass index and gestational weight gain in urban black South African women. *Nutrients 9*:732. https://doi.org/10.3390/nu9070732
12. Health Resources & Services Administration. HRSA Health Workforce Shortage Designation. https://bhw.hrsa.gov/shortage-designation/types. Accessed August 2019

13. Riedstra, J.P., & Aubuchon-Endsley, N. (2019). A moderated mediation model of maternal perinatal stress, anxiety,infant perceptions, and breastfeeding. *Nutrients,* 11:2981. doi: 10.3390/nu11122981
14. Aubuchon-Endsley, N., Swann-Thomsen, H.E., & Douthit, N. (2020). Maternal prenatalcortisol and breastfeeding predict infant growth. *Int. J. Environ. Res. Public Health*, 17:8233. doi:10.3390/ijerph17218233
15. Fritz, M.S., & Mackinnon, D.P., (2007). Required sample size to detect the mediated effect. *Psychol Sci 18*:233-239. doi: 10.1111/j.1467-9280.2007.01882.x.
16. Faul, F., Erdfelder, E., Lang, AG., Buchner, A., (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods, 39*:175–191. https://doi.org/10.3758/BF03193146
17. National Cancer Institute (2018). Dietary Screener Questionnaire in the NHANES 2009-2010: Background. *Epidemiology and Genomics Research Program*. https://epi.grants.cancer.gov/nhanes/dietscreen/
18. Thompson, FE., Midthune D. Kahle L, Dodd, KW. (2017). Development and evaluation of the National Cancer Institute's Dietary Screener Questionnaire scoring algorithms. *J Nutr 147*(6), 1226–1233. https://doi.org/10.3945/jn.116.246058
19. Cox, JL., Henshaw, C., Holden, J., (2014). Perinatal Mental Health: The Edinburgh Postnatal Depression Scale Manual: Vol. 2nd ed. *RCPsych Publications*; nlebk. http://libpublic3.library.isu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=752903&site=eds-live&scope=site
20. Navarro, P., Ascaso, C., Garcia-Esteve, L., Aguado, J., Torres, A., Martín-Santos, R., (2007). Postnatal psychiatric morbidity: A validation study of the GHQ-12 and the EPDS as screening tools. *Gen Hosp Psychiatry 29*:1–7. https://doi.org/10.1016/j.genhosppsych.2006.10.004
21. Somerville, S., Dedman, K., Hagan, R., Oxnam, E., Wettinger, M., Byrne, S., Coo, S., Doherty, D., Page, AC. (2014). The Perinatal Anxiety Screening Scale: Development and preliminary validation. *Arch WomensMent Health 17*:443–454. https://doi.org/10.1007/s00737-014-0425-8
22. Cohen, S., Kamarck, T., Mermelstein, R. (1983). A global measure of perceived stress. *J Health Soc Behav 24*:385–396.
23. Benediktsson, I., McDonald, S., Tough, S. (2017). Examining the psychometric properties of three standardized screening tools in a pregnant and parenting population. *Matern Child Health J 21*:253–259. https://doi.org/10.1007/s10995-016-2128-4
24. Tabachnick, BG., Fidell, LS., (2013). Using multivariate statistics. *Pearson Education*. https://books.google.com/books?id=ucj1ygAACAAJ
25. Hayes, AF. (2013). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach (2013-21121-000). Guilford Press; psyh. http://libpublic3.library.isu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2013-21121-000&site=eds-live&scope=site
26. Laraia, BA., Siega-Riz, AM., Dole, N., London, E. (2009). Pregravidweight is associated with prior dietary restraint and psychosocial factors during rregnancy. Obesity 17:550–558. https://doi.org/10.1038/oby.2008.585
27. Ertel, KA., Silveira, ML., Pekow, PS., Dole, N., Markenson, G., Chasan-Taber, L., (2015). Prepregnancy body mass index, gestational weight gain, and elevated depression symptoms in a Hispanic cohort. *Health Psychol 34*:274–278. https://doi.org/10.1037/hea0000137
28. Dayan, F., Javadifar, N., Tadayon, M., Malehi, AS., Komeili, Sani H. (2018). The relationship between gestational weight gain and postpartum depression in normal and overweight pregnant women. *J Pregnancy 2018*:1–6. https://doi.org/10.1155/2018/9315320