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Associations Between Mindful Eating Techniques And Gestational Weight Gain

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Abstract

Objective: To investigate the extent to which the use of mindful eating techniques is associated with gestational weight gain among a clinic-based sample of pregnant women.

Methods: Four hundred and forty-eight pregnant women in their second trimester of pregnancy participated in the *Expect With Me* group care study and were selected for this secondary analysis. Sociodemographic and general health data was collected at baseline. Mindfulness practice was measured based on frequency of performing mindful thinking and mindful eating techniques in the third trimester. The main outcome was excessive average weekly gestational weight gain, which was determined using the guidelines published by Institute of Medicine in 2009.

Results: Among control variables, compared to White women, women in other race had 0.29 times the odds (95%CI: 0.14-0.64) to gain excessive weight. Controlling for sociodemographic and behavioral factors, women who entered pregnancy overweight or obese had 3.48 times the odds (95%CI 2.05-1.09) and 2.30 times the odds (95%CI 1.44-3.06) of gaining excessive gestational weight compared to who were normal weight, respectively. Participants paying attention to physical hunger and fullness had 1.66 times the odds (95%CI: 1.09-2.53) of excessive gestational weight gain.

Conclusion: Mindful eating practices were observed more commonly among women who gained weight in excess of gestational weight gain guidelines. Further research is needed to understand the temporality of this association, specifically whether mindful eating practices were, in fact, adopted as a strategy for managing excess weight gain rather than as a preventative measure.

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1. Introduction

Risks of excessive gestational weight gain include and not limited to cesarean deliveries, gestational diabetes mellitus, postpartum weight retention for the mothers, macrosomia, and childhood overweight or obesity for the offspring[1]. To prevent pregnancy complications due to excessive gestational weight gain, Institute of Medicine (IOM) published guidelines on healthy gestational weight gain[2]. The American Congress of Obstetricians and Gynecologists (ACOG) also recommends that providers counsel women on gestational weight gain goals based on their pre-pregnancy BMI during the first prenatal visit and advocate the need to restrict gestational weight gain to achieve optimal pregnancy outcomes[3]. Nonetheless, approximately 50% of pregnant women exceed their healthy weight gain goals in the U.S., with the highest prevalence of excessive gestational weight gain observed in overweight and obese women[4]. Hence, it is of great clinical significance to identify and implement interventions that can restrict gestational weight gain in order to prevent its consequences.

Mindfulness is an emerging topic that has been studied in diverse clinical applications such as treating recurrent major depression[5] and posttraumatic stress disorder[6]. Practicing mindfulness creates awareness of the current moment, as a way of processing information. Conventional dietary-based interventions aim to restrict gestational weight gain by limiting daily calories intake and increasing food quality. However, behavioral change is hard to achieve without systematic training and monitoring. In contrast, mindfulness-based interventions targeting eating behavior provides a training process to develop the critical mindset on paying attention to physical hunger and fullness, food selection and quality, and eating frequency.

Mindfulness-based dietary interventions have shown promise as a weight control method to correct unhealthy dietary behaviors and assist weight loss. Specifically, mindfulness-based interventions may reduce dysregulated eating, including binge eating[7-10], improve glucose control[11], and promote weight loss in obese populations[12]. Practice of mindful eating techniques may likewise be helpful to restrict excessive weight gain during pregnancy. Previous studies on mindfulness-based dietary interventions in pregnancy have primarily assessed their impact on mental health-related outcomes instead of their potential as a weight control technique[13]. The purpose of this study is to investigate the extent to which the use of mindful eating techniques is associated with gestational weight gain among a clinic-based sample of pregnant women. We hypothesized that pregnant women who engaged in mindful thinking and actively practicing mindful eating techniques in the third trimester would have a lower risk of gaining excessive gestational weight gain, compared to those not engaged in mindfulness-based practices.

2. Methods

2.1 Procedure

This study was a secondary analysis of data from a randomized controlled trial of *Expect With Me*, a group prenatal care intervention aimed reducing adverse perinatal outcomes. *Expect With Me* was conducted in Nashville TN and Detroit MI between 2014 and 2018. It was designed using a human-centered design approach and provided complete prenatal care in a group setting. It offered a comprehensive curriculum, provider training, and state-of-the-art web interface that provided health status tracking, social networking, educational content, and peer and provider support in between prenatal care visits[14]. The eligible mothers were less than 24 weeks of gestation at the time of enrollment. They were able to speak either Spanish or English to ensure a full

understanding of study component. Moreover, they had a willingness to participate in all study procedures.

The original clinical trial recruited a 2:1 matched cohort for women receiving group care versus standard individual care at the same clinical site. Mindfulness-based intervention methods were only accessible to women receiving group care, who received education about mindfulness and engaged in mindfulness practice as part of their group care visits. Therefore, only participants receiving prenatal group care were eligible for the current analysis. For mothers participating in prenatal group care, credentialed prenatal providers (e.g., obstetrician, midwife) conducted one-on-one assessments with each patient for 30 min, and then assisted group discussions on the topics of pregnancy, using adult learning principles for one to one and half hours. Mothers exchanged peer support and gained knowledge and skills related to pregnancy, childbirth, and parenting during these facilitated discussions. They were encouraged to access *Expect With Me* website during prenatal visits to track their own health metrics (e.g. vital signs) and health behaviors.

Five surveys were distributed and collected on the same IT platform over the course of study. Participants completed a baseline survey in their second trimester of pregnancy (14-24 weeks' gestation; prior to randomization) and follow-up surveys in the third trimester (32-42 weeks' gestation), and approximately 6 and 12 months postpartum (5-8 months and 11-14 months, respectively). The baseline survey collected information with respect to sociodemographic characteristics and general health history. Information on a variety of mindful thinking and other psychological factors were collected at all time points. Since the mindfulness-based intervention

targeting dietary habits was completed after randomization, behaviors related to mindful eating techniques were only accessed in the third trimester and postpartum.

Complementary to *Expect With Me* survey data, participants' de-identified electronic medical records of prenatal clinic visits were accessed to collect information on last available prenatal weight measurement and its corresponding gestational age for calculating average weekly gestational weight gain.

2.2 Sample

Figure 1 displays the procedures to achieve the final analysis sample for this analysis. Initially, 946 survey responses were collected from *Expect With Me* prenatal group care, and 456 responses were immediately excluded for skipping questions related to mindfulness in the survey at third trimester. Thereafter, 846 observations were read from electronic medical record to access gestational age and weight at last prenatal clinic visit prior to labor. After integrating two data sets, 452 observations with both survey and electronic medical record information were included for further assessment. By conducting a careful assessment of variables and outcomes of interests, three observations were excluded for erroneous coding of a mindfulness related variable, and an additional one was excluded for missing gestational weight related information. Ultimately, data on 448 pregnant women were included for statistical analyses in the current study. Compared to women included in this study, those excluded were more likely to be Hispanic, smokers and have lower levels of education ($P< 0.05$ for all), while there was no other significant difference in factors related to mindfulness or gestational weight gain.

2.3 Measures

Primary Outcome: Excessive Gestational Weight Gain

Excessive gestational weight gain was determined using the revised guidelines published by Institute of Medicine (IOM) in 2009. For women with healthy pre-pregnancy weight (BMI 18.5-24.9 kg/m^2), the recommended rate of weight gain in second and third trimesters is 0.8 to 1 pound per week, whereas for women who are underweight (BMI <18.5 kg/m^2), overweight (BMI 25–29.9 kg/m^2), and obese (BMI ≥30 kg/m^2), ranges are 1 to 1.3, 0.5 to 0.7, and 0.4 to 0.6 pounds per week, respectively[2]. Pre-pregnancy BMI and pre-pregnancy weight were self-reported in the baseline survey. Weight was recorded at each prenatal visit, and abstracted systematically from the electronic medical records. Average weekly weight gain was calculated by subtracting pre-pregnancy weight from the final third trimester weight prior to labor, divided by the gestational age (weeks) at last prenatal clinic visit. Gestational age was determined by ultrasound, also abstracted from the electronic medical records. Average weekly weight gain was compared with IOM's guidelines to identity participants who exceeded weight gain goals. Calculating average weekly weight gain instead of total gestational weight gain resolved the variation of gestational age at last prenatal visit.

Primary Predictor: Mindfulness Thinking and Practices

Mindfulness practice was measured based on frequency of performing mindful thinking and mindful eating techniques. Mindful thinking was measured in the third trimester, where the participants indicated how often during the previous month they felt or behaved in the specified ways. Participants were asked to complete three questions related to mindful thinking. The first question concerned frequency of eating to forget worries, the second, paying attending to physical

hunger and the third, stopping eating sooner when food stopped tasting good. Mindful eating techniques assessed during the third trimester included use of a food diary, "My Plate", Mindful "Check-ins", Progressive Muscle Relaxation (PMR), "Mindful Moments", and meditation, since they were the specific strategies taught by the intervention. The frequency of how often participants ate to forget worries was measured using a scale from 1 (never) to 5 (always). Those answering 1 (never) or 2 (rarely) were considered to be actively engaged in mindful thinking, whereas those responding 3 (sometimes), 4 (often), and 5 (always) were classified as not being engaged. For the other questions on mindful thinking and mindfulness techniques, the measurements were achieved using a scale from 1 (not at all) to 6 (usually more than once per day). Participants practicing mindful thinking or mindful eating techniques at least several times per week were considered to be active practitioners, whereas those answering less or about once per week were classified as not engaged in mindfulness practices. The rationale to choose this cut-off was that mindfulness should be routinely practiced. A composite variable, based on responses to all techniques, was created to indicated whether the participants were actively practicing at least one technique versus none.

2.4 Control Variables

All analyses controlled for sociodemographic factors and health behaviors linked to gestational weight gain or mindfulness in previous research[15-18]. Covariates data were all collected in baseline survey, including maternal age, race or ethnicity (White, Black, and other), relationship status (married or living with partner versus other), insurance coverage (private insurance and Medicaid), education (less than high school, high school graduate, and at least some college), smoking (Yes or No), drinking (Yes or No), and number of previous live birth (none versus at least

one). Participants were also asked whether or not they had experienced food insecurity in the past month, using the USDA 6-item scale for measuring food insecurity[19]. Based on the frequency to experience each item, the responses were considered as affirmative or not for each of the 6 questions. The sum of affirmative responses to the six questions was the household's raw score on the scale. Thereafter, raw score 0 and 1 was categorized as high food security, whereas raw score ranging 2 to 6 was categorized as low food security.

2.5 Data Analyses

All analyses were conducted using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). Means and frequencies for all covariates were calculated to characterize the sample. T-tests and Chi-square tests were conducted to compare women who had healthy versus excessive weight gain. The mindfulness variable that was significantly associated with excessive weight gain was then used to stratify the participants and explore what sociodemographic factors might contribute to mindful eating. A multivariable logistic regression model was built using a backward elimination strategy to determine the reduced model to predict excessive gestational weight gain. First, a full model including all the covariates was built to estimate whether the mother will have excessive gestational weight gain. Thereafter, the covariate with highest p-value was considered as the least significant factor and removed from the model. This procedure was repeated until all the covariates included in the model were significantly associated with excessive gestational weight gain ($p>0.05$). The reduced model demonstrated how the response to each significant variable would alter the total chance in predicting the primary outcome. Hence, the multivariate logistic regression model was used to explore the association between race or ethnicity, pre-pregnancy BMI,

gestational weight gain, and paying attention to physical hunger and fullness in the third trimester. P value less than 0.05 was considered as statistically significant.

3. Results

3.1 Participant Characteristics

Participant characteristics for the full sample and stratified by healthy versus excessive gestational weight gain are shown in Table 1. At study entry, participants had a mean (SD) age of 25.3 (5.5) years; 39% were covered by private insurance, while 61% relied on Medicaid. Twenty-seven percent of participants self-identified as White, 63% as Black, and 10% as other race. Sixty percent were married or living with partner. Twelve percent had an education level less than high school, 39% were high school graduate, and 49% had at least some college education. Seventy percent of participants were at high food security status. Nine percent were smokers, and 2% drank two or more alcoholic drinks in one sitting prior to entering pregnancy. Approximately one-half (51%) of participants had at least one previous live birth. Four percent of participants entered pregnancy underweight, 39% were healthy weight, 23% were overweight, and 34% were obese. Forty-eight percent of participants had gestational weight gain that exceeded the recommended guidelines. Women with excessive gestational weight gain were significantly more likely to be white (32% vs 23%) (P=0.006) and enter pregnancy overweight (32% vs 15%) or obese (38% vs 30%) (P <0.001), compared to women with appropriate gestational weight gain. There was no difference in age, relationship status, education, food security, smoking, drinking, number of previous live births, or mindful thinking at baseline between women with healthy versus excessive gestational weight gain.

3.2 Association between Mindfulness and Gestational Weight Gain

Mindful thinking in the third trimester was assessed, participants with excessive weight gain were more likely to pay attention to physical hunger and fullness (70% vs 60%), compared to those gained an appropriate amount of weight. Among control variables, compared to White women, women in other race had 0.29 times odds (95%CI: 0.14-0.64) to gain excessive weight. White and Black women had similar odds to gain weight excessively ($p<0.05$).

Controlling for socioeconomic and behavioral factors, women who entered pregnancy overweight or obese had 3.48 times the odds (95%CI 2.05-1.09) and 2.30 times higher odds (95%CI 1.44-3.06) of gaining excessive gestational weight compared to who were normal weight, respectively. In general, there was a higher proportion of participants with excessive gestational weight gain paid attention to physical hunger and fullness in the third trimester (70% vs 30%), compared to those not paying attention. After checking, the interaction between pre-pregnancy BMI category and paying attention to physical hunger and fullness was not significant ($P>0.05$) and not included in the model. Participants paying attention to physical hunger and fullness had 1.66 times the odds (95%CI: 1.09-2.53) of excessive gestational weight gain. Practicing mindful eating techniques was not significantly associated with gaining excessive gestational weight.

3.3 Mindful eating techniques

Table 3 shows the characteristics of the sample stratified by whether or not the participants paid attention to physical hunger and fullness in the third trimester. Compared to women did not pay attention to physical hunger and fullness, those paying attention were more likely to be covered by private insurance (46% vs 25%, $P<0.001$), White (32% vs 17%, $P=0.001$), at least some college

education (56% vs 34%, P<0.001), and without previous live births (60% vs 49%, P=0.024). When it came to mindfulness practices in the third trimester, the participants paying attention were more likely to stop eating when food stopped tasting good (50% vs 18%), practice at least one of the mindful eating techniques (39% vs 10%), and practice each of the specific mindful eating technique (food diary: 10% vs 2%; Mindful "Check-ins": 20% vs 2%; "My Plate": 25% vs 4%; any of Progressive Muscle Relaxation (PMP), "Mindful Moments", or meditations: 21% vs 5%) (P<0.005 for all). There was no significant difference in age, relationship status, food security status, drinking, smoking, pre-pregnancy BMI, or eating to forget worries between those paying attention to physical hunger and fullness in the third trimester versus those not.

Among those practicing at least one mindful eating techniques in the third trimester, a bar plot showing their preferences for which technique to practice was demonstrated in Figure2. Sixty-three percent of participants practicing mindfulness techniques used "My Plate", 24% kept a food diary, 49% practiced Mindful "Check-ins", 54% practiced any of Progressive Muscle Relaxation (PMP), "Mindful Moments", or meditations, and 8% practiced all methods being taught during group prenatal care.

4. Discussion

The current study included 448 pregnant women receiving *Expect With Me* prenatal group care, and 216 (48.2%) of them were identified to gain excessive gestational weight according to IOM's guidelines on healthy weekly gestational weight gain. Smoking and education level were not statistically correlated with gestational weight gain. Education level was significantly associated with paying attention to physical hunger and fullness in the third trimester (p<0.001),

however, it was not a modifier of the association of excessive gestational weight gain and mindfulness and removed from the full logistic regression model.

The results showed that race/ethnicity, pre-pregnancy BMI and paying attention to physical hunger and fullness in the third trimester varied significantly between women gaining healthy versus excessive gestational weight. To be specific, White women were more vulnerable to gain excessive weight compared to Black women and women in other races including Asian, Native American and multiple races. A previous research working on the risk of excessive gestational weight gain in Hispanic and Black women compared to non-Hispanic women in Colorado also suggested that Hispanic and Black women had increased odds for inadequate gestational weight gain and decreased odds for excessive gestational weight gain[20]. Women in other race category had a mixture of Asian, Native American and multiple races population. It was hard to identify which race primarily led to the observation of reduced odds to gain excessive weight compared to White women. Our findings on the association between pre-pregnancy BMI and excessive gestational weight gain were also consistent with previous literatures[21,22]. In the multivariable model, women who were overweight or obese pre-pregnancy had increased odds of excessive gestational weight gain compared to normal weight women.

Paying attention to physical hunger and fullness in the third trimester was associated with gaining excessive gestational weight but in the opposite direction than we hypothesized. In the multivariate logistic regression model, after controlling for other covariates, women paying attention to their physical hunger or fullness had higher odds of gaining weight excessively compared to those more paying attention. A possible explanation for this finding may be reverse

causality: that gaining weight proceeded mindfulness-based eating habits being established. De facto, health providers are required advocate the need to restrict gestational weight gain to women who are more vulnerable to exceed gestational weight gain goals during prenatal visits[3]. Prenatal providers monitor the gestational weight gain at each visit and might repetitively emphasize weight control to women who have already exceeded or are at higher risk of exceeding weight gain goals. Thus, women gaining excessive weight may have been more aware of their health metrics and might have employed mindful eating strategies to restrict gaining more weight.

Mindfulness requires active involvement of one's cognitive-perception system. By practicing mindfulness, one will be able to pay attend to the present moment, on purpose and nonjudgmentally[23]. Mindful eating emphasizes how to eat rather than what to eat, and may provide positive effects that go beyond healthy dietary changes to promote better mental and physical health[24]. Hence, mindfulness-based eating interventions tend to manage mental health related dietary issues like binge eating in general population[7-10]. Mindfulness-based intervention targeting pregnant women focuses more on managing pregnancy related mental health conditions such as prenatal depression, stress and anxiety, which may consequently affect their eating behaviors[25].

In the current study, mindfulness-based dietary intervention was executed as a weight control strategy, which consisted of two elements: mindful thinking and mindful eating techniques. Practicing mindful eating techniques was associated with paying attention to physical hunger and fullness. Regardless of the type of mindful eating technique, women practicing the skills at least several times a week were more likely to also paying attention to physical hunger and fullness. This matched our hypothesis and was consistent with the previous study that practicing mindful

thinking would facilitate practice of mindful eating, and eventually mindful eaters would be more mindful in their everyday life[25].

Mindful eating in practice is demonstrated by increasing awareness of emotional eating, eating slowly, eating away from distractions, and acknowledging responses to food[26]. This study found that among women practicing at least one mindful eating technique, the most popular strategy was "My Plate", which recommends to make half of the meal vegetables or fruits[27]. We also observed that multiple sociodemographic factors play a role on whether the mother established mindful thinking or not. Women who reported not paying attention to physical hunger and fullness were more likely to be Black race, covered by Medicaid, have lower education level and have previous live births, compared to mothers paying attention to their own physical hunger. Low level of education is correlated with low income households[28], who are more likely to lack a regular source of care before pregnancy. Future mindfulness interventions should consider how such factors may influence women's ability to engage in healthy dietary behaviors.

This study had several limitations. First, approximately half of *Expect With Me* study participants did not attend mindful eating training or report all of their mindful eating practices, and were excluded from the analysis. Future mindfulness-based intervention should work on how to increase the compliance of participants. Secondly, pre-pregnancy weight was self-reported and may be subjective to bias. Previous literature suggested self-reported information do not alter BMI category[29], whereas it may affect the calculation of average weekly gestational weight gain in this study. Last but not least, a future randomized clinical trial study can better investigate the causative relationship between mindfulness and gestational weight gain.

5. Conclusion

In this study, mindful eating practices were observed more commonly among women who gained weight in excess of gestational weight gain guidelines. Further research is needed to understand the temporality of this association, specifically whether mindful eating practices were, in fact, adopted as a strategy for managing excess weight gain rather than as a preventative measure.

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Table 1: Description of socioeconomic and general health characteristics, mindful thinking and mindful eating practices in the third trimester, in terms of gestational weight gain[a]

Characteristic	Total (N= 448)[b]	Healthy GWG* (N=232)[b]	Excessive GWG (N=216)[b]	P Value[c]
Age (years)	25.3± 5.5	25.1± 5.3	25.5± 5.7	0.411
Insurance Coverage				0.372
Private Insurance	173(38.7%)	94(40.7%)	79(36.6%)	
Medicaid	274(61.3%)	137(59.3%)	137(63.4%)	
Race/ethnicity				0.006
White	118(26.8%)	52(23.0%)	66(30.7%)	
Black	277(62.8%)	141(62.4%)	136(63.3%)	
Other	46(10.4%)	33(14.6%)	13(6.1%)	
Live with Partner, husband or boyfriend				0.657
No	179(40.0%)	95(41.0%)	84(38.9%)	
Yes	269(60.0%)	137(59.1%)	132(61.1%)	
Education				0.469
Less than High School	54(12.1%)	32(14.0%)	22(10.2%)	
High school graduate	174(39.1%)	87(38.0%)	87(40.3%)	
At least some college	217(48.8%)	110(48.0%)	107(49.5%)	
Food Security Score				0.807
Low(2-6)	136(30.6%)	68(30.1%)	67(31.2%)	
High(0-1)	306(69.4%)	158(69.9%)	148(68.8%)	
Smoking				0.663
No	405(90.8%)	212(91.4%)	193(90.2%)	
Yes	41(9.2%)	20(8.6%)	21(9.8%)	
Drinking				0.629
No	440(98.4%)	229(98.7%)	211(98.1%)	
Yes	7(1.6%)	3(1.3%)	4(1.9%)	
Pre-pregnancy BMI (kg/m^2)				
<18.5	16(3.6%)	14(6.0%)	2(1.0%)	<0.001
18.5≤BMI≤24.9	176(39.3%)	112(48.7%)	63(29.2%)	
25≤BMI≤29.9	103(23.0%)	35(15.1%)	68(31.5%)	
≥30	153(34.2%)	70(30.2%)	83(38.4%)	
N of previous live births				0.846
0	251 (56.0%)	131 (56.5%)	120 (55.6%)	
≥1	197 (44.0%)	101 (43.5%)	96(44.4%)	
Not eat to forget worries or cheer up in bad mood	355(79.2%)	187(80.6%)	168(77.8%)	0.419
Pay attention to physical hunger and fullness to eat right amount	291(65.0%)	139(59.9%)	152(70.4%)	0.021
Stop eating sooner when food started tasting no good	174(38.8%)	88(37.9%)	86(39.8%)	0.683

[a] Table values are mean ± SD for continuous variables and n (column %) for categorical variables.
[b] Numbers may not sum to total due to missing data, and percentages may not sum to 100% due to rounding.
[c] P-value is for t-test (continuous variables) or χ^2 test (categorical variables).
*GWG refers to gestational weight gain.