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Association of Restraint and Disinhibition to Gestational Weight Gain Among Pregnant Former Smokers

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Abstract

Gaining excessive weight during pregnancy is associated with immediate maternal and fetal complications as well as longer term obesity. Pre-pregnancy body mass index, age, and smoking cessation have been related to gestational weight gain (GWG); however, less is known about how eating behaviors, that may be amenable to modification and have been related to weight gain outside of pregnancy, affect GWG. The present study evaluated the relationship of dietary restraint and disinhibition to GWG in a sample of women (n=248) who quit smoking before or early in pregnancy. Women self-reported height and pre-pregnancy weight during their third trimester. GWG was calculated by subtracting pre-pregnancy weight from third-trimester weight. The Three-Factor Eating Questionnaire assessed restraint and disinhibition. Average GWG was 14.60 (+7.64) kg and 47% of women had a GWG above the Institute of Medicine recommendations. Linear regression models were used to examine restraint and disinhibition as correlates of GWG, and multinomial logistic regressions were utilized to determine whether eating behaviors were associated with inadequate or excessive GWG. Restraint was positively associated with total GWG but disinhibition was not associated with GWG. Thus, conscious attempts to restrict intake were associated with GWG beyond the influence of covariates. These findings highlight the potential influence of modifiable eating behaviors on GWG and demonstrate the need for additional research to determine how these behaviors relate to GWG over the course of pregnancy.

Keywords

restraint; disinhibition; gestational weight gain

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Introduction

Guidelines for gestational weight gain (GWG), developed by the Institute of Medicine (IOM), were revised in 2009 (IOM, 2009). Excessive GWG, or GWG above that recommended by the IOM based on pre-pregnancy body mass index (BMI), is associated with numerous negative health consequences, including increased chance of cesarean section, (Juhasz et al., 2005), preterm birth, increased risk for preeclampsia and gestational diabetes, and higher infant birth weights (Seiga-Riz et al., 2009). Despite its harmful consequences, rates of excessive GWG are high (Oken, Taveras, Kleinman, Rich-Edwards, & Gillman, 2007) and understanding factors that contribute to GWG can inform interventions to limit excessive weight gain during pregnancy.

Several demographic and behavioral factors have been related to excessive GWG. Younger age and higher pre-pregnancy BMI have been associated with excessive GWG (Abrams, Carmichael, & Selvin, 1995; Chu et al., 2009; Olson & Strawderman, 2003; Stotland et al., 2005). Not surprisingly, increased calorie intake, poor diet quality, and decreased physical activity also affect GWG (Stuebe, Oken & Gilman, 2009). In addition, smoking status has been related to GWG. Women who quit smoking prenatally gain more weight during pregnancy and are more likely to gain excessive GWG than do those who continue to smoke or who have never smoked (Adegboye et al., 2010; Favaretto et al., 2007; Groff, Mullen, Mongoven, & Burau, 1997; Mongoven et al., 1996; Washio, et al., 2011). Although these demographic and behavioral predictors provide insight into factors associated with GWG; the potential influence of other modifiable behaviors that have been related to weight outside of pregnancy is unclear.

In particular, two behaviors that have been associated with weight changes outside of pregnancy are restraint (i.e., conscious attempts to limit, control, or reduce food intake) and disinhibition (i.e., a tendency to overeat in response to emotion/social situations; Hays & Roberts, 2008). For instance, restraint is a stronger predictor of weight variability than body weight (Heatherton, Polivy, & Herman, 1991). Restraint also tends to increase during pregnancy (Fairburn, Stein, & Jones, 1992). Interestingly, although the restraint tends to be inversely correlated with weight gain, and thus might be related to lower GWG, elevated dietary restraint *prior* to pregnancy has been associated with excessive GWG (Conway et al., 1999; Mumford et al., 2008). However, the relationship between restrained eating and GWG has not been studied during pregnancy, only prior. Disinhibition is associated with loss of control over eating, overeating and overweight (Latner, Hildebrandt, Rosewall, Chisholm, & Hayashi, 2007; Lawson et al., 1995). Binge eating, which is similar to the behaviors assessed by disinhibition scales, is associated with greater GWG when it occurs during pregnancy (Nunes, Pinheiro, Camey, & Schmidt, 2012; Soares et al., 2009). Yet, disinhibition, outside of frank disordered eating behavior, has not been examined in relation to pregnancy and GWG. Thus, although restraint and disinhibition are linked to weight changes in general, the relationship of these eating behaviors to pregnancy-related weight changes is less clear, and their association with excessive GWG is unknown.

Accordingly, the present study examined the relationship between self-reported eating behaviors at the end of pregnancy and GWG in a sample of pregnant women who quit

smoking. Given that restraint prior to pregnancy is associated with excessive GWG (Conway et al., 1999; Mumford et al., 2008), we hypothesized that dietary restraint would be positively associated with greater GWG. We also predicted that disinhibition would be associated with greater GWG because of the relationship between binge eating and greater GWG (Nunes et al., 2012; Soares et al., 2009) and the strong correlation between binge eating and disinhibition (d'Amore et al., 2001).

Method

The present study utilized a subset of data from two studies of women smokers who quit as a result of pregnancy. In both studies, participants were initially assessed in the third trimester (i.e., at least 28 weeks gestation). The combined group of women included in the present study were participating in either an ongoing randomized controlled trial designed to examine the efficacy of two approaches to prevent postpartum smoking relapse ($n = 141$; Levine, Cheng, Marcus & Kalarchian, 2013) or a naturalistic study aimed at identifying predictors of postpartum relapse ($n = 112$; Levine, Marcus, Kalarchian, Houck, & Cheng, 2010).

Participants

Only women from whom both pre-pregnancy body weight and third trimester weight are available were included. Fifty-six percent of participants were Caucasian ($n = 142$), thirty-eight percent were African American ($n = 97$), four percent were multi-racial ($n = 11$), and one participant was Asian. Two women did not indicate their ethnicities. Importantly, there were no differences in demographic characteristics between women recruited from the different studies, although women from the naturalistic study were assessed earlier in pregnancy (7.96 ± 3.27 vs. 3.87 ± 2.18 weeks until delivery; $t(162) = 10.63$ $p < .001$). Participants ($n=5$) with GWGs that had standardized (z) scores in excess of 3.29 (Tabachnick & Fidell, 2007) were excluded from analyses. Thus, the final sample of 248 participants comprised 138 participants from the randomized controlled trial and 110 participants from the naturalistic study. This research was approved by the Institutional Review Board of the University of Pittsburgh.

Materials

Weight—Women self-reported height and pre-pregnancy weight which were used to calculate pre-pregnancy BMI. Pre-pregnancy weight was self-reported and third-trimester weight was assessed in-person on a digital scale. GWG was calculated by subtracting pre-pregnancy weight from third-trimester weight. Although weight at the very end of pregnancy was not available, a weight taken at the end of third-trimester provides a useful time point to examine potential influences on GWG. Women were, on average, 34 weeks pregnant at the time of assessment. Importantly, we controlled for time until delivery (see Pregnancy Descriptives) in order to account for changes across women in weight gain between the assessment time point and delivery. GWG categories (inadequate, adequate, excessive) were determined based on whether women's third-trimester weight gain fell below, within, or above IOM weight gain recommendations based on their self-reported, pre-pregnancy BMI (see IOM, 2009 for recommended weight gain ranges).

Eating Behaviors—The Three-Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985) was used to assess levels of dietary restraint and disinhibition. The TFEQ assess two factor scales of interest in the present study: Restraint and Disinhibition. The Restraint factor is a measure of conscious attempts to limit, control, or reduce food intake. The Disinhibition factor reflects a tendency towards overeating in response to emotions or social situations.

Smoking and Nicotine Dependence—Pre-pregnancy daily smoking habits were assessed by asking: “How much did you smoke prior to becoming pregnant/quitting?” In addition, the Fagerstrom Test for Nicotine Dependence (Fagerstrom, Heatherton, & Kozlowski, 1990), a well-validated, six-item self-report measure was used to assess pre-pregnancy nicotine dependence.

Pregnancy Descriptives—Women self-reported parity. The number of weeks between the third trimester assessment and each woman’s precise delivery date was calculated by determining the number of weeks between the third-trimester assessment and delivery date for each participant. This variable was used as a precise marker of the length of gestation at the point in the third trimester at which weight and other assessments occurred. The current analyses are focused on the influence of eating behaviors on weight assessed at the same assessment point, while accounting for the fact that each woman has a varying number of additional weeks that they could continue to gain gestational weight. Thus, this “weeks until delivery” variable was included in all models of weight gain to control for variation in the timing of assessment of GWG.

Analytic Plan

Two sets of analyses were conducted to examine the influence of eating behaviors and covariates on GWG. Separate, linear regression models were used to examine restraint and disinhibition as correlates of overall GWG. We controlled for pre-pregnancy BMI and age as both have been associated with GWG (Olson & Strawderman, 2003; Stotland et al., 2005). In addition, because our sample consisted of women who had quit smoking, which is associated with GWG (Adegboye et al., 2010; Groff et al., 1997; Mongoven et al., 1996; Washio, et al., 2011), we controlled for pre-pregnancy nicotine dependence. We also controlled for the time between assessment in pregnancy and actual delivery because women were assessed at a varying number of weeks prior to delivery. “Weeks to delivery” was included in the analyses so that we could determine the influence of eating behaviors on third-trimester weight (i.e., GWG) while at the same time accounting for the number of additional weeks prior to delivery that each woman could continue to gain weight. Race was also controlled for in analyses. Finally, parity has been associated with GWG (Olson & Strawderman, 2003), but it was only assessed in women from the ongoing randomized controlled trial ($n = 138$). Given that inclusion of this variable would result in listwise deletion in the logistic regression and the fact that it was unrelated to GWG in the current sample ($p = .34$), parity was not included the final analyses.

Logistic regression models were used to examine the association of restraint and disinhibition with GWG categories (i.e., inadequate, adequate, excessive). Because there are three nominal categories, multinomial logistic regression was used so that both inadequate

and excessive GWG groups could be directly compared to the adequate GWG group (reference category). The same variables were controlled for in this analysis as in the linear regression models (i.e., age, pre-pregnancy BMI, pre-pregnancy nicotine dependence, weeks until delivery, and race).

Descriptives and Mean Differences

Descriptive statistics for the full sample as well as two pre-pregnancy BMI groups (i.e., underweight/normal weight vs. overweight/obese) are shown in Table 1. On average, pre-pregnancy BMI was 26.33 and 4%, 50%, 21%, and 25% of women were underweight, normal weight, overweight, and obese prior to pregnancy, respectively. The average GWG was 14.60 (+7.64) kg. Women who were overweight/obese prior to pregnancy were significantly older than those who were underweight/normal weight prior to pregnancy (25.73 ± 5.54 vs. 24.04 ± 5.11 ; $t(246) = -2.50, p = .01$). Levels of dietary restraint did not differ significantly between the overweight/obese and normal weight groups, but levels of disinhibition were greater in the underweight/normal weight group compared to the overweight/obese group (8.95 ± 2.49 vs. 8.01 ± 2.71 ; $t(246) = 2.84, p = .005$). Almost 50% of the full sample gained excessive GWG or weight above the IOM guidelines. Women who gained excessive GWG were 25.54 (5.67) years old on average, had a mean BMI of 27.61 (6.54) prior to pregnancy, and gained a mean of 20.03 (6.18) kg during their pregnancy.

Results

Eating Behaviors and Overall GWG

As shown in Table 2, higher self-reported dietary restraint at the end of pregnancy was associated with greater total GWG. This positive relationship between dietary restraint and total GWG remained significant after controlling for pre-pregnancy BMI, weeks to delivery, age, race, and nicotine dependence. In contrast, disinhibition was not associated with overall GWG. As expected, lower pre-pregnancy BMI and being assessed later in pregnancy were significant covariates, although age, race, and nicotine dependence were not related to total GWG.

Eating Behaviors and Inadequate or Excessive GWG

Both restraint and disinhibition were not significantly related to inadequate or excessive GWG compared to adequate GWG. However, in both models, weeks until delivery and pre-pregnancy BMI were associated with excessive GWG (see Table 3). As expected, being weighed closer to actual delivery and having a higher pre-pregnancy BMI were associated with an increased likelihood of falling in the excessive GWG category compared to the adequate GWG category.

Discussion

This study examined the influence of dietary restraint and disinhibition on GWG. As hypothesized, restraint was positively associated with total GWG. Disinhibition scores were not associated with GWG. Results suggest that dietary restraint, an eating behavior that has been associated with weight changes outside of pregnancy (Hays & Roberts, 2008;

Heatherton et al., 1991; Latner et al., 2007; Lawson et al., 1995), is related to GWG. Although previous studies have indicated a relationship between pre-pregnancy restraint and excessive GWG (Conway et al., 1999; Mumford et al., 2008), the present findings highlight the role of dietary restraint during pregnancy on GWG.

Although the concurrent measurement of restraint and disinhibition with GWG extends previous findings, it also raises some questions. First, it is unclear whether elevations of dietary restraint occur in response to increasing GWG or if dietary restraint itself contributes to increased GWG. That is, women with greater weight gains prior to the third trimester assessment may be trying to control their dietary intake to a larger extent than those who have gained less. Alternatively, it is possible that the women with greater GWG have high levels of dietary restraint *throughout* their pregnancy and that this restraint leads to overeating in response to dietary restriction (Polivy & Herman, 1985), contributing to greater GWG. Regardless of the direction of the relationship between dietary restraint and GWG, the present findings highlight the potential influence of dietary restraint during pregnancy on overall levels of GWG.

A second question raised by the present results is the lack of association between disinhibition and GWG. Previously studies have indicated associations between binge eating and increased GWG (Nunes et al., 2012; Soares et al., 2009). However, differences in the timing of measurement may have contributed to discrepancies in findings. Alternatively, it is possible that disinhibition, which relates to, but is not the same as binge eating, influences GWG in a different way than binge eating itself. Moreover, if disinhibition were measured earlier in pregnancy, rather than late in the third trimester, different findings may have emerged. Indeed, Fairburn and colleagues (1992) found that overeating tends to decrease in late pregnancy compared to early pregnancy. Notably, women who are overweight or obese prior to pregnancy have a greater risk of gaining excessive gestational weight, and in the present study this group had significantly lower disinhibition than women who were under or normal weight (see Table 1). Thus, although findings were not significant, disinhibition may be an important eating behavior to consider in future work examining influences on GWG, particularly among women at increased risk to gain excessive GWG.

In summary, the present study provides initial evidence that eating behaviors during pregnancy are associated with GWG; however, some limitations should be noted. First, as stated previously, restraint and disinhibition were assessed at the same time as the final gestational weight, and the influence of restraint and disinhibition during the first and second trimesters of pregnancy on overall GWG was not evaluated. These cross-sectional data therefore do not permit a full evaluation of the role of eating behaviors on GWG over time. However, our research group is currently involved in a project repeatedly assessing the restraint and disinhibition throughout the pregnancy to better determine the relationship between these and other psychosocial behaviors as predictors of GWG. Second, this study utilized a convenience sample of former smokers which could decrease the generalizability of the findings to never smokers. However, despite previous research indicating that GWG increases with a greater reduction in cigarettes smoked (Favaretto et al., 2007), nicotine dependence was not associated with GWG in the present study. A third limitation of the present findings is that GWG as measured in this data set did not represent the total overall

GWG. GWG was calculated using a weight obtained during the third trimester of pregnancy and not at delivery. Given that the women in the sample, on average, had their baseline weight assessed 5.61 weeks before their delivery, more women might have fallen into the excessive GWG category had a final weight prior to delivery been used. Thus, findings in the logistic regression models predicting the binary outcome of excessive GWG may have been impacted. Importantly, the number of weeks between delivery and assessment of weight was included as a covariate in the linear and logistic regression models and the inclusion of this variable did not alter the relationships between eating behaviors and GWG. Lastly, pregnancy history, specifically parity, was only assessed in women from the ongoing randomized controlled trial ($n = 138$) and thus, was not available on the full sample. Although there was no significant difference in GWG for women who reported that it was their first pregnancy ($n = 55$; $M=32.57$, $SD=16.12$) compared to women who reported being pregnant before ($n = 81$; $M=32.35$, $SD=18.22$; $t(134)=-0.74$, ns), this is a potentially important covariate that should be considered in future research.

Implications for Practice and/or Policy

The present study provides novel information about the influence of self-reported dietary restraint and disinhibition during the third trimester of pregnancy on GWG and is the first data on modifiable eating behaviors measured during pregnancy. Results indicate that increased restraint during pregnancy is associated with greater GWG. Although longitudinal research is needed to determine the temporal relationship between eating behaviors and GWG, the present findings have some useful clinical implications.

First, regardless of the precipitant to dietary restraint during pregnancy, pregnant women and their health care providers should be cognizant of the potential dangers of severe caloric restriction. Providers may want to encourage pregnant women to engage in more effective means for avoiding excessive GWG in lieu of dietary restraint. For example, there is strong support for the incorporation of exercise during pregnancy as a means of controlling GWG (Nascimento, Surita, & Cecatti, 2012). Further, if dietary restraint during pregnancy is indeed a predictor of excessive GWG, providers should encourage pregnant women to try and increase healthy food (e.g., fruit and vegetables) consumption instead of restricting overall dietary intake (Ledoux, Hingle, & Baranowski, 2011). Second, although the present data do not indicate an association between disinhibition and GWG, providers are encouraged to assess disinhibited eating, particularly among women who are at higher risk for gaining excessive GWG, such as women who are overweight prior to pregnancy.

Similarly, research indicates that many pregnant women lack knowledge about effective weight management during pregnancy (Campbell, Johnson, Messina, Guillaume, & Goyder, 2011). We are currently assessing women's knowledge of eating and weight expectations during pregnancy and expect that women's beliefs about eating (e.g., "eating for two" means doubling your calories) and women's lack of information about GWG, such as the fact that weight gain recommendations vary depending on pre-pregnancy BMI, will be associated with GWG. Thus, in addition to educating women about weight experiences in pregnancy, providers may want to assess modifiable eating behaviors and their association with GWG.

Understanding these modifiable behaviors may help decrease rates of excessive GWG and thereby improve the health of mothers and their children.

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Table 1

Descriptive characteristics of sample by pre-pregnancy BMI (overall N =248).

Maternal characteristic	Full Sample (n = 248)	Pre-pregnancy BMI Category			t value	Pairwise Contrast
		Under or Normal weight (n = 121–137)	Overweight or Obese (n = 100–111)			
Age (years)	24.79 (5.37)	24.04 (5.11)	25.73 (5.54)	-2.50	.01	
Pre-pregnancy cigarettes per day	13.98 (7.58)	13.96 (7.67)	13.99 (7.51)	-.03	.98	
Restraint	10.58 (1.94)	10.74 (1.86)	10.38 (2.04)	1.48	.14	
Disinhibition	8.53 (2.63)	8.95 (2.49)	8.01 (2.71)	2.84	.005	
Nicotine Dependence	3.45 (2.02)	3.59 (2.03)	3.27 (2.00)	1.25	.21	
Pre-pregnancy Weight (kg)	72.93 (20.60)	59.33 (7.42)	89.72 (19.24)	-15.72	<.001	
Pre-pregnancy BMI	26.33 (7.02)	21.40 (2.38)	32.42 (6.00)	-18.22	<.001	
Weeks until delivery	5.68 (3.39)	5.76 (3.29)	5.59 (3.53)	0.37	.71	
Gestational Weight Gain (kg)	14.60 (7.64)	14.99 (5.94)	14.13 (9.33)	0.85	.40	
% with Excessive Weight Gain ^a	47% (n=117)	34% (n=46)	65% (n=72)	--	--	

Note. Sample size varies due to some missing data for “weeks to delivery”.

^a $\chi^2(1, 247)=24.85, p<.001$.

Table 2

Linear regression predicting overall gestational weight gain

	B (SE)	p
<u>Model with Restraint</u>		
Restraint	1.40 (.58)	.02
Pre-pregnancy BMI	−0.50 (.16)	.002
Weeks until delivery	−0.82 (.33)	.02
Age	0.15 (.22)	.48
Nicotine Dependence	0.77 (.55)	.16
Race	−0.05 (2.41)	.98
R ²	.107	
<u>Model with Disinhibition</u>		
Disinhibition	−0.21 (.45)	.65
Prepregnancy BMI	−0.51 (.17)	.002
Weeks until delivery	−0.86 (.34)	.01
Age	0.15 (.22)	.51
Nicotine Dependence	0.63 (.56)	.26
Race	0.71 (2.42)	.77
R ²	.084	

Table 3

Multinomial logistic regression comparing individuals who gained inadequate or excessive gestational weight to those who gained adequate gestational weight (n = 79).

	Inadequate GWG (n = 51)		Excessive GWG (n = 123)	
	OR (95% CI)	p	OR (95% CI)	p
<u>Model with Restraint</u>				
Restraint	0.87 (0.71, 1.06)	.16	1.00 (0.84, 1.18)	.97
Weeks until delivery	1.03 (0.92, 1.15)	.61	0.89 (0.81, 0.98)	.02
Age	0.99 (0.91, 1.07)	.77	1.01 (0.95, 1.08)	.69
Nicotine Dependence	0.97 (0.80, 1.18)	.78	1.10 (0.94, 1.29)	.25
Pre-pregnancy BMI	1.05 (0.98, 1.12)	.14	1.09 (1.03, 1.15)	.003
Caucasian	1.29 (0.56, 2.95)	.55	0.58 (0.29, 1.18)	.14
<u>Model with Disinhibition</u>				
Disinhibition	0.98 (0.83, 1.15)	.76	0.91 (0.79, 1.03)	.14
Weeks until delivery	1.03 (0.92, 1.16)	.58	0.89 (0.81, 0.98)	.02
Age	0.99 (0.91, 1.07)	.73	1.01 (0.95, 1.07)	.84
Nicotine Dependence	0.98 (0.81, 1.19)	.85	1.09 (0.93, 1.28)	.28
Pre-pregnancy BMI	1.05 (0.98, 1.12)	.14	1.08 (1.02, 1.14)	.01
Race	1.39 (0.61, 3.13)	.43	0.59 (0.29, 1.20)	.14

Note. GWG = gestational weight gain, BMI = body mass index.