Published in final edited form as:

J Psychosom Res. 2015 May ; 78(5): 504–508. doi:10.1016/j.jpsychores.2014.11.013.

Psychiatric Disorders and Gestational Weight Gain among Women Who Quit Smoking During Pregnancy

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Abstract

Objective—Pregnancy is a common time for women to quit using cigarettes and other substances. Such changes in substance use as well as other psychiatric and psychosocial changes during pregnancy can affect gestational weight gain (GWG). Thus, we evaluated the relationship between psychiatric disorders and GWG among pregnant women who had quit smoking.

Methods—Pregnant former smokers ($n = 281$) enrolled in a larger trial for postpartum relapse prevention completed semi-structured psychiatric interviews and measures of prepregnancy nicotine dependence and smoking behavior, and were weighed to estimate gestational weight gain. Using linear regression and mixed-effect models, the relationship between a lifetime prevalence of each psychiatric disorder and total GWG was evaluated, controlling for variables previously related to GWG.

Results—Average GWG was $15.6 (\pm 8.5)$ kg, and 56% ($n = 157$) of women exceeded the GWG recommended by the Institute of Medicine (IOM) according to prepregnancy BMI. Over one-third (34.3%) of pregnant former smokers had a history of at least one diagnosable psychiatric disorder. History of psychiatric disorder was unrelated to GWG, with one exception; lifetime history of alcohol use disorder was associated with significantly larger GWG.

Conclusion—Women who quit smoking during pregnancy gain a considerable amount of gestational weight, and a previous history of alcohol use disorder is related to GWG. However, the benefits of smoking cessation to maternal and fetal health likely outweigh the disadvantage of weight gain, and other psychiatric disorders are not linked to GWG.

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Competing Interest Statement

The authors have no competing interests to report

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Keywords

pregnancy; gestational weight gain; psychiatric disorder; smokers

Introduction

Among women, pregnancy is strongly related to weight gain and obesity risk.^[1–9] Excessive gestational weight gain (GWG), or weight gain that exceeds the amount recommended by the Institute of Medicine (IOM)'s 2009 guidelines, is a robust predictor of postpartum weight retention,^[1, 10] and although the amount of weight retained after pregnancy varies widely,^[4] postpartum weight retention has been associated with long-term overweight and obesity more generally.^[1, 2, 11] Thus, understanding pregnancy related changes in weight has become a focus of research.

Importantly, pregnancy also is associated with changes in other health-related behaviors that may, in turn, affect changes in eating and weight-related behaviors. For example, pregnancy is a common time for women to quit smoking,^[12, 13] which has well-documented maternal and fetal health benefits.^[14, 15] However, smoking cessation also is robustly associated with weight gain in general.^[16, 17] Indeed, continuing to smoke during pregnancy has been linked to lower gestational weight gains, and quitting smoking, particularly quitting earlier in pregnancy,^[18] has been related larger GWG.^[19–21]

In addition to smoking cessation, pregnancy-related declines in the use of other substances as well as changes in psychiatric symptoms during pregnancy might affect GWG. Although research on psychosocial predictors of GWG has been limited, initial data suggest that self-reported depressive symptoms are associated with excessive GWG.^[1] Similarly, there is evidence that the presence of specific types of psychopathology can affect GWG. Using a Norwegian data set, researchers found that women with current or recent (i.e., within last 6 months) DSM-IV eating disorder symptoms gained more gestational weight than did those without eating disorder symptoms.^[22, 23] Finally, evidence suggests that smokers have high rates of psychiatric disorders^[24–27] and psychological distress,^[28, 29] which also have an impact on changes in weight.^[30, 31] For example, considerable evidence has linked mood disorders to weight gain and obesity in smokers^[30] as well as in the general population.^[32]

Given that psychiatric disorders are related to obesity and weight gain,^[33] and smokers have high rates of psychiatric disorders, it is plausible that psychiatric disorders affect GWG, particularly among women who have quit smoking as a result of pregnancy. Thus, in this study, we sought to examine the relationship between maternal psychiatric disorders and excessive GWG in a sample of former women smokers. We hypothesized that psychiatric disorders would be related to excessive GWG among women smokers. We further expected women with a history of mood or substance use disorders to gain more weight than those without a history of these disorders.

Methods

Participants

Participants for the current study were enrolled in a larger randomized controlled trial investigating the efficacy of a postpartum smoking relapse prevention intervention. Eligibility for the larger study, which has been detailed elsewhere,^[34] required women to have stopped smoking during or immediately prior to this pregnancy. Participants for this study were 281 pregnant former smokers who completed the Structured Clinical Interview for DSM-IV-TR Axis I Disorders: Non-Patient Version (SCID-I/NP) and had GWG data available. Descriptive information about the final sample is shown in Table 1.

Procedure

Women who had quit smoking for their current pregnancy and provided biochemical verification of cessation completed demographic and smoking assessments during their third trimester of pregnancy (i.e., between 34 and 38 weeks gestation). As shown in Figure 1, participants for the current study completed the SCID-I/NP either during pregnancy at the time of study enrollment (n = 215) or after delivery (n = 66). Women who had already delivered were contacted and asked to complete the SCID-I/NP postpartum. Psychiatric interviews that occurred postpartum were completed within 55 weeks of delivery. Diagnostic interviews that occurred during pregnancy were completed between 33 and 41 weeks gestation. Women who were assessed during pregnancy and those postpartum did not differ in demographic variables, total GWG ($p = .78$), rates of excessive GWG ($p = .15$) or rates of psychiatric disorders (p 's $> .32$).

Assessments

Demographic and pregnancy-related information—Women reported demographic and pregnancy-related information, including age, race, income, education, and parity at study enrollment.

Smoking behavior—Because women were required to be abstinent at the time of entry into the study, women were asked to think back to the last time they had smoked every day for at least one month and complete the Fagerstrom Test of Nicotine Dependence (FTND). Women also provided information on the number of cigarettes smoked per day prior to quitting, the number of years they had been smoking, and when and how they had quit smoking for their current pregnancy.

Gestational weight gain—Women were weighed in street clothing without shoes using a digital scale and height was measured using a portable stadiometer. Women self-reported their pre-pregnancy weight. The use of self-reported weight is common in studies of GWG as women usually do not present for care until the middle of the first trimester, and thus there is necessarily a reliance on self-reported pre-pregnancy weight.^[35] Pre-pregnancy body mass index (BMI) was calculated as pre-pregnancy weight in kilograms divided by height in meters squared. Total GWG was calculated by subtracting pre-pregnancy weight from weight obtained at study enrollment. Excessive or inadequate GWG was subsequently determined according to the IOM guidelines using pre-pregnancy BMI.

Lifetime psychiatric diagnoses—Lifetime history of psychiatric disorders was assessed by trained clinicians using the SCID-I/NP. Although the psychiatric diagnoses included in this study were scored based on DSM-IV-TR criteria, the categories of disorders are reported using DSM-5. For instance, obsessive compulsive disorder and posttraumatic stress disorder were treated as individual categories of disorders rather than included with the overall anxiety disorders.

Analysis Plan

We first examined the lifetime prevalence of each category of disorder as well as the lifetime presence of having had any disorder in this sample. Next using t-tests, we evaluated the relationship between having a disorder and total GWG. We then used linear regression to evaluate the relationship between categories of psychiatric disorder and total GWG controlling for parity, race, income, prepregnancy BMI, the number of weeks between GWG assessment and delivery, and levels of nicotine dependence prior to quitting. In the case of significantly unequal variances between the group of participants who had a disorder and the group of those who did not (see Table 3), we used mixed-effect models including group as a random term to model different variances. We also examined the relationship between the presence of a psychiatric disorder and the likelihood of meeting criteria for excessive, adequate, or inadequate GWG according to the IOM guidelines, using multinomial logistic regression while adjusting for all relevant covariates.

Results

Total GWG ranged from a loss of 12.5 kg to a gain of 50.9 kg, with an average GWG of 15.6 ($\pm$ 8.5) kg. Overall, more than half of the women (56%, $n = 157$) gained excessively according to the IOM guidelines for their prepregnancy BMI. More than one-third (34.3%, $n = 96$) of pregnant former smokers had a lifetime history of at least one diagnosable psychiatric disorder, 14.3% ($n = 40$) had a lifetime history of two disorders, and 8.2% ($n = 23$) had a lifetime history of 3 or more disorders. The remaining 43.2% ($n = 121$) had no history of psychiatric disorder. As shown in Table 2, lifetime rates of mood (32.7%, $n = 92$), anxiety (15.7%, $n = 44$), and substance use (30.6%, $n = 86$) disorders were high, but only 5 (1.8%) women had a lifetime history of eating disorder.

Maternal psychiatric disorders and GWG

Table 3 details differences in GWG between women with and without psychiatric disorder and by disorder categories. Generally, GWG amounts did not differ between women with and without a history of psychiatric disorders, with the exception of alcohol use disorder. Additionally, there was a small difference in total GWG between women with and without a diagnosis of posttraumatic stress disorder. However, rates of posttraumatic stress disorder were low, and this difference was marginally significant ($p=.053$)

Predicting GWG from maternal psychiatric disorders, controlling for correlates of GWG

As shown in Table 4, the presence of lifetime history of any disorder was not related to total GWG, and there was no relationship between mood, substance use, posttraumatic stress disorder, or anxiety disorder history, and total or excessive GWG, when covariates of GWG

were included. However, a lifetime history of alcohol use disorder was associated with greater total GWG after controlling for the relevant (6) covariates (18.2 vs. 15.0 kg p = .01), although those with a history of alcohol use disorder were no more likely to gain excessive GWG (65% vs 53%).

Given the association between a history of alcohol use disorder and GWG among pregnant former smokers, we examined additional smoking related factors that might differentiate women with a history of alcohol use disorder from those who did not have this history. Women with a lifetime history of alcohol use disorder started smoking at a younger age (14.0 ± 3.1 vs 15.4 ± 3.2 years, $p = .004$) and, relatedly, reported being regular smokers for a longer period of time (10.3 ± 4.7 vs 8.0 ± 5.9 years, $p = .005$). Women with alcohol use disorder did not differ from those without a history of alcohol use disorder in nicotine dependence (3.3 vs 3.1) or number of daily cigarettes smoked prior to quitting (10.1 vs 11.2).

Discussion

Smoking cessation and the regulation of gestational weight are important behavioral health goals for pregnant women. Results from the current analysis suggest that a large proportion of women who quit smoking in association with pregnancy have a history of diagnosable psychiatric disorder and that more than one third of the women who stop smoking exceed the IOM guidelines for GWG. However, contrary to expectations, a history of psychiatric disorder generally was not associated with GWG, with one notable exception. Women who reported a history of alcohol use disorder gained more GWG than those without such a history. Taken together, results from this sample suggest several reasons that attending to psychiatric conditions among pregnant women quitting smoking may be important.

First, rates of psychiatric disorders are high among pregnant former smokers. The link between cigarette smoking and psychiatric disorders is well established,^[25] and the rates of disorder among these women is consistent with those seen among older samples of smokers.^[28, 36] However, given that the average age of these women is 25.6 years, the lifetime rates of some disorders in this sample are striking. For example, rates of mood and anxiety disorder among individuals surveyed in the population-based National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) study are 9.2% and 11.1%, respectively.^[37] Similarly, in other older samples, major depression was diagnosed in 8.3% of individuals with comorbid nicotine dependence and anxiety in 25.9%.^[38] In comparison, nearly 33% of the young women in this sample have had a mood disorder and 15% have a lifetime history of anxiety disorder.

A second consideration concerns the fact that more than half of these former smokers (56%) gained excessive gestational weight according to the IOM guidelines. In reports from samples of women not selected for having quit smoking, approximately 44% of women exceed IOM guidelines for GWG.^[39] The fact that psychiatric disorders are associated with weight gain among nonpregnant individuals may help to explain the high rates of excessive GWG in this sample of young women, many of whom have a history of a psychiatric disorder. The high rates of lifetime disorders and excessive GWG suggest that young

pregnant women who quit smoking may be a vulnerable population in need of specialized or targeted interventions to sustain positive health related behavior changes, such as smoking cessation and to prevent excessive weight gain and other issues.

Third, the association between a lifetime history of alcohol use disorder and larger total GWG among former smokers is provocative and requires further study. Although women were not more likely to exceed IOM guidelines for excessive weight gain, it is possible that the increased weight gain among women with a history of alcohol use disorder reflects difficulties with self-regulation in general. Previous work has suggested that self-regulatory failure is a core feature of addictive behaviors, and individuals with an underlying deficit in self-regulation are predisposed toward appetitive or rewarding stimuli.^[40] Indeed, self-regulatory deficits are associated with heavy alcohol use and cigarette smoking,^[41] as well as with the overconsumption of palatable foods.^[42] Thus, women with a vulnerability to addiction may be at risk of gaining more weight in pregnancy as a consequence of poor self-regulatory control.

There are several limitations to this study. First, women were recruited for a larger trial designed to prevent postpartum smoking relapse^[34] and thus the generalizability of the sample is limited and direct comparison to rates of excessive GWG or psychiatric disorders among women who had not quit smoking is not possible. Second, psychiatric disorders were assessed with an interview designed using DSM-IV criteria, and DSM-5 criteria are now available. Although we used the DSM-5 categorization of disorders when possible, there remains the potential that rates of disorders assessed using a strictly DSM-5 interview would differ from those reported here. Finally, although common in studies of GWG, prepregnancy weights were self-reported.

Given the importance of pregnancy to the future health of mothers and their offspring, understanding psychosocial factors associated with health behaviors like weight and smoking during pregnancy are an important research priority. Indeed, there are well-established benefits of prenatal smoking cessation for both maternal and neonatal health^[14, 15, 43] and these benefits outweigh the potential risks of excessive GWG. Nonetheless, the current data documenting high rates of psychiatric disorder and excessive GWG among former smokers as well as initial evidence linking alcohol use disorder to GWG suggest topics for additional research in this important population.

Acknowledgments

This research was supported by R01DA021608 (PI: Levine). We acknowledge the skilled psychiatric interviewing of Jennifer Grace and thank the women who participated in the research.

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Highlights

- 57% of women who quit smoking for pregnancy have had a past psychiatric disorder
- 56% of women who stop smoking for pregnancy gain excessive gestational weight
- History of alcohol use disorder is associated with larger gestational weight gain

Figure 1.
Flow of Participants in the Study.

Table 1

Participants Characteristics (N = 281)

Demographic Characteristics	Mean	SD
Age (years)	25.58	5.74
Prepregnancy cigarettes per day	10.96	9.58
Years smoking	8.53	5.74
Number of previous quit attempts	3.51	3.56
Fagerstrom Test of Nicotine Dependence	3.24	2.06
Weeks quit at baseline	17.12	11.78
Wks. between baseline and delivery	4.01	1.97
Prepregnancy body mass index	27.28	7.65
Total gestational weight gain (kg)	15.84	8.76

	%	n
Race (% black)	54.80	154
Education level (% high school degree)	46.26	130
Household income (% < \$30,000)	79.57	222
Parity (% nulliparous)	51.08	142
Inadequate gestational weight gain	16.73	47
Adequate gestational weight gain	27.40	77
Excessive gestational weight gain	55.87	157

Table 2
Lifetime Rates of Psychiatric Disorders among Pregnant Former Smokers (DSM-5 criteria).

Disorder	%	n
Any Disorder (<i>n</i> = 281)	56.94	160
Any Mood Disorder (<i>n</i> = 281)	32.74	92
Major Depressive Disorder	24.91	70
Depressive Disorder NOS	5.69	16
Dysthymic Disorder	1.42	4
Substance-Induced Mood Disorder	0.71	2
Mood Disorder due to General Medical Condition	0.36	1
Any Anxiety Disorder (<i>n</i> = 280)	15.71	44
Panic Disorder	8.57	24
Social Phobia	2.86	8
Specific phobia	2.50	7
Anxiety Disorder NOS	2.14	6
Agoraphobia without Panic Disorder	1.08	3
Anxiety Disorder due to General Medical Condition	0.36	1
Obsessive Compulsive Disorder (<i>n</i> = 280)	1.79	5
Posttraumatic Stress Disorder (<i>n</i> = 278)	8.27	23
Any Bipolar Disorder (<i>n</i> = 281)	3.20	9
Bipolar I Disorder	2.14	6
Bipolar II Disorder	0.71	2
Other Bipolar Disorder	0.36	1
Any Eating Disorder (<i>n</i> = 281)	1.78	5
Anorexia Nervosa	1.07	3
Bulimia Nervosa	0.36	1
Binge Eating Disorder	0.36	1
Any Substance Use Disorder (<i>n</i> = 281)	30.60	86
Alcohol	23.13	65
Cannabis	14.59	41
Cocaine	2.14	6

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Disorder	n	%
Opioid	5	1.78
Hallucinogenics	3	1.07
Sedative-Hypnotic-Anxiolytic	2	0.71
Poly Drug	1	0.36

Table 3

Amount of Gestational Weight Gain by Psychiatric Disorders.

Variable	N	GWG		t test	
		Mean (kg)	SD	t	p
Any Disorder					
No disorder	121	15.00	8.46		
Any disorder	160	16.47	8.96	-1.39	0.17
Any Mood Disorder					
No mood disorder	189	16.27	8.94		
Any mood disorder	92	14.96	8.37	1.18	0.24
Any Anxiety Disorder					
No anxiety disorder	236	15.34	8.38		
Any anxiety disorder	44	18.39	10.36	-1.84*	0.07
Posttraumatic Stress Disorder					
No posttraumatic stress disorder	255	15.28	7.98		
Posttraumatic stress disorder	23	21.40	14.22	-2.04*	0.05
Any Substance Use Disorder					
No substance use disorder	195	15.27	8.21		
Any substance use disorder	86	17.14	9.83	-1.54*	0.13
Alcohol Use Disorder					
No alcohol use disorder	215	15.08	8.11		
Alcohol use disorder	65	18.27	10.37	-2.28*	0.03

* Denotes Satterthwaite t test for unequal variances, the remaining ones are pooled t tests for equal variances.

Table 4

Adjusted Regression Models of Psychiatric Disorders Predicting Gestational Weight Gain

Variable	B	SE	p
Any Disorder			
Intercept	49.90	6.32	<.0001
Any disorder	2.43	2.28	0.29
Any Mood Disorder			
Intercept	52.13	6.21	<.0001
Any mood disorder	−2.38	2.43	0.33
Any Anxiety Disorder			
Intercept	55.79	7.00	<.0001
Any anxiety disorder	−4.80	3.76	0.21
Posttraumatic Stress Disorder			
Intercept	63.80	9.17	<.0001
Posttraumatic stress disorder	−13.34	7.05	0.07
Any Substance Use Disorder			
Intercept	50.35	5.98	<.0001
Any substance use disorder	3.52	2.41	0.14
Alcohol Use Disorder			
Intercept	56.38	6.51	<.0001
Alcohol use disorder	−7.26	2.90	0.01

Note: All regression models adjusted for pre-pregnancy body mass index, weeks between baseline and delivery, Fagerstrom Test for Nicotine Dependence, parity, race, and income