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Prenatal depressive symptoms and abnormalities of glucose tolerance during pregnancy among Hispanic women

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Abstract

The aim of this study is to prospectively examine the association between maternal depressive symptoms in early pregnancy and risk of abnormal glucose tolerance (AGT) and impaired glucose tolerance (IGT) in mid-pregnancy. We evaluated this association among 934 participants in Proyecto Buena Salud, a prospective cohort study of Hispanic (predominantly Puerto Rican) women in Western Massachusetts. Depressive symptoms were assessed in early pregnancy using the 10-item Edinburgh Postnatal Depression Scale. Scores ≥13 indicated at least probable minor depression and scores ≥15 indicated probable major depression. AGT and IGT were diagnosed using American Diabetes Association criteria. In early pregnancy, 247 (26.5 %) participants experienced at least minor depression and 163 (17.4 %) experienced major depression. A total of 123 (13.2 %) were classified with AGT and 56 (6.0 %) were classified with IGT. In fully-adjusted models, the odds ratio for AGTassociated with minor depression was 1.20 (95 % CI 0.77–1.89) and for major depression was 1.34 (95 % CI 0.81–2.23). The odds ratio for IGT associated with minor depression was 1.22 (95 % CI 0.62–2.40) and for major depression was 1.53 (95 % CI 0.73–3.22). We did not observe an association with continuous screening glucose measures. Findings in this prospective cohort of Hispanic women did not indicate a statistically significant association between minor or major depression in early pregnancy and AGT or screening glucose

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values in mid-pregnancy. Due to the small number of cases of IGT, our ability to evaluate the association between depression and IGT risk was constrained.

Keywords

Prenatal depression; Depressive symptoms; Abnormal glucose tolerance; Impaired glucose tolerance

Introduction

Gestational diabetes mellitus (GDM) is a condition defined as “glucose intolerance with onset or first recognition during pregnancy” (Metzger 1998). Women with a history of GDM as well as more mild forms of glucose intolerance have a high risk for future type 2 diabetes (Bellamy et al. 2009). Abnormal glucose tolerance during pregnancy is also associated with increased risk of adverse pregnancy outcomes, including preeclampsia, high birth weight, and preterm birth (Hapo Study Cooperative Research Group, Metzger et al. 2008). Indeed, recent studies have observed a consistent continuous increase in risk of adverse pregnancy outcomes over the range of maternal blood glucose levels even at degrees not diagnostic of GDM (Hapo Study Cooperative Research Group, Metzger et al. 2008; Hapo Study Cooperative Research Group 2009). Therefore, recommendations from the International Association of Diabetes and Pregnancy Study Groups suggest lowering the threshold for GDM diagnosis (International Association of Diabetes and Pregnancy Study Groups Consensus Panel 2010). While such changes to the diagnostic criteria have not been universally adopted and debate continues, recent research provides strong evidence for considering maternal glucose levels below current diagnostic cutoffs.

Depressive symptoms and type 2 diabetes mellitus commonly co-occur with an estimated 31 % of individuals with diabetes having high depressive symptoms (Anderson et al. 2001). There is an ongoing debate regarding whether depression is a consequence of diabetes or whether depressive symptoms are a risk factor for diabetes (Renn et al. 2011), but two recent reviews found stronger evidence for depressive symptoms preceding diabetes compared to diabetes preceding depression (Mezuk et al. 2008; Renn et al. 2011).

Depression is common during pregnancy, affecting up to 18 % of women at some point during pregnancy (Gavin et al. 2005), and has been identified as a potential risk factor for adverse maternal and fetal disorders. The prevalence of prenatal depression varies by race and ethnicity (Gavin et al. 2011), with some studies among Hispanic populations finding estimates of probable prenatal depression as high as 33 % (Chasan-Taber et al. 2010). Depression may influence glucose tolerance via hypothalamic-pituitary-adrenal axis hyperactivity, which reduces glucose transport, or, alternatively, via sympathomedullary activation, which increases insulin resistance (Rustad 2011). In addition, depression is associated with poor health behaviors (smoking, physical inactivity, and caloric intake) and central obesity, which may in turn increase risk of abnormalities of glucose tolerance.

However, to our knowledge, there are no published prospective studies examining whether depressive symptoms are associated with onset of abnormalities of glucose tolerance during

pregnancy. In contrast, the majority of prior studies have evaluated the association between diagnosis of GDM and subsequent onset of prenatal or postpartum depression (Kim et al. 2005; Kozhimannil 2009; Mautner et al. 2009; Katon 2011).

The high prevalence of glucose abnormalities during pregnancy make identifying and intervening upon modifiable risk factors such as prenatal depression an important public health goal. Therefore, the aim of this study was to examine the prospective association between elevated maternal depressive symptoms in early pregnancy and risk of subsequent diagnosis of abnormal glucose tolerance (AGT) and impaired glucose tolerance (IGT) in mid-pregnancy among participants in Proyecto Buena Salud, a prospective cohort study of Hispanic (predominantly Puerto Rican) women in Western Massachusetts. We hypothesized that women with elevated depressive symptoms (minor and major depression) in early pregnancy would be more likely to experience AGT and IGT compared to women without elevated depressive symptoms.

Methods

Study setting

Proyecto Buena Salud was conducted from 2006 to 2011 in the ambulatory obstetrical practices of a large tertiary care facility in Western Massachusetts. Details of the study have been presented elsewhere (Chasan-Taber et al. 2010). The overall goal of Proyecto Buena Salud was to examine the relationship between physical activity, psychosocial stress, and the risk of GDM in Hispanic women. Bilingual interviewers recruited patients at prenatal care visits early in pregnancy (up to 20 weeks gestation), informed them of the aims and procedures of the study, and obtained written informed consent. This study was approved by the institutional review boards of the University of Massachusetts-Amherst and Baystate Health.

At the time of enrollment (mean=12.5, median=12.7 weeks gestation, and interquartile range (IQR)=5.6), bilingual interviewers collected information on sociodemographic, acculturation, behavioral, and psychosocial factors. Clinical characteristics of the pregnancy as well as obstetrical and medical history were abstracted from the medical record after delivery. Interviews were conducted in Spanish or English (based on patient preference) in order to eliminate potential language or literacy barriers.

Eligibility

Eligibility was restricted to women of Puerto Rican or Dominican Republic heritage (i.e., Caribbean Islanders). Exclusion criteria included (1) current medications that adversely influence glucose tolerance, (2) multiple gestation, (3) history of diagnosis of diabetes, hypertension, heart disease, or chronic renal disease, and (4) age less than 16 years or over 40 years. A total of 1,604 prenatal care patients were enrolled in Proyecto Buena Salud. For the current analysis, we excluded 38 participants who were missing interview information, 69 participants who experienced a miscarriage, 133 participants who did not deliver at Baystate, and 105 participants who did not have a GDM screen. From 1,259 eligible participants, information on at least one depression measure prior to the GDM screen was

available for 1,067 participants. Reasons for missing information on depression included inability to locate women at the clinic or over the telephone (e.g., due to disconnected telephone) and preterm delivery. Participants with information on depression did not differ from those missing this information in terms of education, income, marital status, language preference, generation in the US, parity, or pre-pregnancy body mass index (BMI); however, they were younger, more likely to have public health insurance, more likely to report no family history of diabetes, and less likely to respond that they did not know their family history of diabetes. Finally, we excluded women with missing information on covariates for our final sample of 934.

Depressive symptoms

Depressive symptoms were assessed by bilingual interviewers in early pregnancy using the 10-item Edinburgh Postnatal Depression Scale (EPDS) available in English (Cox et al. 1987) and Spanish (Jadresic et al. 1995). The EPDS consists of ten items asking respondents to indicate how frequently they have felt various mood states during the past 7 days. Examples of items on the EPDS include “I have been so unhappy that I have been crying” and “Things have been getting on top of me.” Responses are on a 4-point scale ranging from “no, never” to “yes, most of the time” with corresponding scores of 0 (never) to 3 (most of the time). Scores are summed with total scores ranging from 0–30. Scores greater than or equal to 13 are indicative of “at least probable minor depression” and those 15 or higher indicate “probable major depression” (Matthey et al. 2006).

The EPDS has been validated as a depression screening tool in pregnant and postpartum Hispanic women and has a sensitivity of 90–100 % and a specificity of 78–88 % for the identification of major and minor depression (Cox et al. 1987; Yonkers et al. 2001). Our exposure is the earliest available depression score for each participant. The median gestational age at depression assessment was 13.7 weeks, with 75 % of participants completing the EPDS before 18 weeks gestation (IQR=7.1).

AGT and IGT

The ambulatory obstetrical practices routinely screen all prenatal care patients for GDM between 24 and 28 weeks of gestation. The screening test consists of a random oral glucose challenge test in which venous blood is sampled 1 h after a 50-g oral glucose load. If the plasma glucose concentration is >135 mg/dL, a 3-h fasting 100-g oral glucose tolerance test (OGTT) is performed with blood sampled at fasting, and at 1, 2, and 3 h. A positive screen (>135 mg/dL) on the 50-g oral glucose challenge test was used to define AGT, regardless of the results on the 3-h OGTT. IGT was defined as one or more elevated values on the 3-h OGTT, based on the American Diabetes Association criteria of 95, 180, 155, and 140 mg/dL, at fasting, 1, 2, and 3 h, respectively (American Diabetes Association 2004). Frank GDM (defined as two or more elevated values on the 3-h OGTT, and confirmed by an obstetrician who reviewed the medical records of each suspected case) was not included as an independent outcome variable due to low power (e.g., three cases of GDM among women with major depression); however, women with GDM were included in the categorizations for AGT and IGT as appropriate. Lastly, we considered the screening glucose scores from the 1-h OGTT as a continuous outcome.

Covariates

At the time of enrollment, interviewers collected information on sociodemographic characteristics, such as age, education, annual household income, marital status, language preference for speaking/reading (English, Spanish), generation in the continental US, and type of health insurance. Alcohol consumption and cigarette smoking were assessed at each interview using questions designed by the Pregnancy Risk Assessment Monitoring System (Williams et al. 2003). Physical activity during pre-pregnancy (1 year prior) and early pregnancy was assessed at the time of enrollment using the Pregnancy Physical Activity Questionnaire (Chasan-Taber et al. 2004). Early pregnancy perceived stress was measured by Cohen's perceived stress scale (Cohen et al. 1983) and anxiety was measured by the Spielberger State–Trait Anxiety Inventory (Spielberger et al. 1982).

Medical and obstetrical history was abstracted from medical records and included pre-pregnancy BMI, parity, clinical characteristics of the current pregnancy, previous history of GDM, and family history of diabetes. Rate of gestational weight gain (GWG) was calculated as the difference between the most recent weight prior to depression assessment and self-reported maternal pre-pregnancy weight, divided by gestational age at the time of assessment of the pregnancy weight.

Data analysis

We examined the distribution of the EPDS score and defined indicators of “at least probable minor depression” and “probable major depression.” We examined the association of depression measures with AGT and IGT, using chi-square tests (or Fisher's exact test, in cases of small cell size). We also examined correlations between the continuous depression scores and screening glucose levels.

We performed unadjusted and multivariable logistic regression to calculate odds ratios (ORs) and 95 % confidence intervals (CI) for the associations of minor and major depression with AGT and IGT. We assessed confounding by evaluating changes in the estimate for depression when each covariate was added to the regression model; a change of 10 % or greater indicated confounding. We constructed a series of models for each outcome as follows: model 1 was unadjusted; model 2 included sociodemographic factors (age, education, parity, marital status, annual household income, and generation in the US). Model 3 included additional adjustment for pre-pregnancy BMI, language preference, and smoking during pregnancy. Additional adjustment for health insurance, alcohol consumption, physical activity during pregnancy, family history of diabetes, rate of GWG, and prior history of gestational diabetes did not change depression estimates by greater than 10 % and, therefore, were not included in the final multivariable models. Finally, due to their high correlation with depressive symptoms (r=0.66–0.81, p <0.01), early pregnancy perceived stress and anxiety were not included in multivariable models (Alder et al. 2007). Statistical analyses were conducted using SAS 9.3 software (SAS Institute Inc, Cary, North Carolina).

Results

Participants in Proyecto Buena Salud were young (72 % younger than 25 years old) with low levels of education (47 % did not graduate from high school) and income (31 % had annual household income of $15,000 or less) (Table 1). Almost one half of women (45 %) were overweight or obese. In early pregnancy, 247 (26.5 %) participants experienced at least probable minor depression and 163 (17.5 %) experienced probable major depression. Lower levels of education, lower household income, and being a current smoker were statistically significantly associated with both minor and major depression in bivariate analyses (Table 1).

A total of 123 women (13 %) were classified with AGT during pregnancy (Table 2). Compared to women without depression, the prevalence of AGT was higher among women with at least probable minor depression (14.6 vs. 12.7 %) and among women with probable major depression (15.3 vs. 12.7 %), but the differences were not statistically significant. In unadjusted logistic regression models, the odds ratio for AGT associated with at least probable minor depression was 1.18 (95 % CI 0.77–1.79) and for major depression was 1.24 (95 % CI 0.77–2.00) (Table 2). After adjusting for sociodemographic factors in model 2 as well as BMI in model 3, odds ratios were slightly higher, but remained nonsignificant. In the fully adjusted model (model 3), the odds ratio for AGT associated with at least probable minor depression was 1.20 (95 % CI 0.77–1.89) and for major depression was 1.34 (95 % CI 0.81–2.23).

A total of 56 women (6 %) were classified with IGT during pregnancy. There were no statistically significant differences in prevalence of IGT among women with and without at least probable minor or major depression (Table 3). In the fully adjusted model (model 3), the odds ratio for IGT associated with minor depression was 1.22 (95 % CI 0.62–2.40) and the odds ratio for IGT associated with major depression was 1.53 (95 % CI 0.73–3.22) (Table 3).

When evaluating the association between depression and the continuous glucose screening values, neither probable minor depression nor probable major depression were associated with a statistically significant difference in screening glucose values (p =0.89 and p =0.80, respectively) (Table 4). Finally, we did not observe a linear relationship between continuous EPDS depression scores and screening glucose (Spearman correlation coefficient −0.03; p =0.31).

Discussion

Findings in this prospective cohort of Hispanic women did not indicate a statistically significant association between minor or major depression in early pregnancy and AGT or screening glucose values in mid-pregnancy. Due to the small number of cases for IGT, our ability to evaluate the association between depression and IGT risk was constrained.

Prior studies on this topic are sparse, and have evaluated the reverse association; that is, whether a diagnosis of GDM increases risk of subsequent perinatal depression (Kim 2005; Kozhimannil 2009; Mautner, Greimel et al. 2009; Katon 2011). Katon et al. conducted a

cross-sectional analysis using baseline data from a prospective cohort study of 2,398 pregnant women receiving prenatal care at the University of Washington Medical Center clinic (Katon 2011). The Patient Health Questionnaire-9 was used to assess prenatal depression in the second or third trimester and GDM diagnosis was abstracted from the medical record. Those with GDM did not have a significant increased risk of “any antenatal depression” (adjusted OR=0.95, 95 % CI 0.68–1.33) or “major antenatal depression” (adjusted OR=0.90, 95 % CI 0.61–1.32). Kim et al. conducted a prospective cohort study (*n*=1445) in the San Francisco area that included 35 % Hispanic women (Kim 2005). Retrospective report of pre-pregnancy depressive symptoms were assessed prior to GDM screening between 12 and 20 weeks gestation using the Center for Epidemiologic Studies-Depression Scale. Women with GDM (*n* =64) did not report a higher history of depressive symptoms prior to pregnancy (7.8 %) as compared to women without GDM or pregnancy induced hypertension (11.6 %), but multivariable analyses adjusting for important GDM risk factors were not conducted. The authors also found that women with GDM had a similar increase in depressive symptoms from pre-pregnancy to postpartum as compared to women without this disorder (adjusted OR=1.22, 95 % CI 0.54–2.77).

Interpretation of our results should be considered in light of this study's limitations. While it was our hypothesis that elevated depressive symptoms would lead to glucose abnormalities in pregnancy, and we included only measures of depressive symptoms that occurred before glucose measures were taken, we were not able to directly test causal processes. Thus, we cannot rule out the possibility that preclinical glucose perturbations preceded and perhaps caused depressive symptoms even before GDM screening in mid-pregnancy. However, the literature on diabetes outside of pregnancy and depression indicates that though the relationship may be bidirectional, depression appears to be stronger in predicting diabetes than diabetes predicting depression (Mezuk et al. 2008).

A second limitation is the lack of information about history of depression, which may be an important effect modifier of the relationship between prenatal depressive symptoms and AGT. Depression relapse rates are particularly high during pregnancy (Cohen et al. 2006); therefore, we would anticipate that a large portion of women with a pre-pregnancy history of depression would also report depression during pregnancy. It should also be noted that the EPDS is a screening tool that measures probable depression, and is not a clinical diagnosis of depression.

Finally, due to a relatively small number of cases (6 %), our study has limited power to detect relationships with IGT, and we could not examine relationships with GDM due to small numbers of cases (*n* =3). Sample size calculations were based on the power to detect AGTand IGT for a range of relative risks comparing those with at least probable minor depression and probable major depression to those without depression. Given our observed prevalences, we had power to detect an increased risk of AGT of 1.56 or greater associated with minor depression, and 1.65 or greater associated with major depression (Dean et al. 2011). For IGT, we had power to detect an increased risk of 1.90 or greater associated with minor depression, and 2.00 or greater associated with major depression (Dean et al. 2011). These increases in risk are clinically significant, but given the lack of prior studies in this area, it is unknown if they would be within the range of expected relative risks. Finally, we

had excellent power (>99 %) to detect a clinically significant mean difference (1 mg/dl) in screening glucose levels (Hintze 2013).

These study limitations notwithstanding, this investigation adds to the literature in several important ways. To our knowledge, this is the first prospective analysis to examine elevated depressive symptoms as a risk factor for AGT and IGT. We were able to control for a wide array of potential confounding factors and used a measure of depressive symptoms validated for use during pregnancy that has previously been used in Hispanic women in the perinatal period.

In summary, we found that depressive symptoms in early pregnancy were not statistically significantly associated with an elevated risk of AGT and IGT, though we had limited power to detect associations due to small numbers of cases in this young cohort. Given the sparse research in this area, in conjunction with the high prevalence of prenatal depression, additional studies are needed to examine the prospective relationship between depression in pregnancy and risk of abnormalities of glucose tolerance. As a potentially modifiable risk factor, understanding if prenatal depression confers risk of glucose abnormalities may lead to important clinical guidelines related to depression screening and referral in preconception and prenatal care.

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Table 1

Characteristics of the study population (*n* =934); Proyecto Buena Salud, Western Massachusetts, 2006–2011

	Total sample		Minor depression[d]					Major depression[e]				
			No		Yes			No		Yes		
	N	%	N	%	N	%	*p* value[f]	N	%	N	%	*p* value[f]
Total	934	100.00	687	73.55	247	26.45		771	82.55	163	17.45	
Age (years)												
16–19	303	32.44	235	77.56	68	22.44	0.02	260	85.81	43	14.19	0.20
20–24	368	39.40	267	72.55	101	27.45		299	81.25	69	18.75	
25–29	168	17.99	110	65.48	58	34.52		132	78.57	36	21.43	
30 and above	95	10.17	75	78.95	20	21.05		80	84.21	15	15.79	
Educational status												
Less than high school	438	46.90	298	68.04	140	31.96	<0.01	339	77.40	99	22.60	<0.01
High school graduate	313	33.51	240	76.68	73	23.32		268	85.62	45	14.38	
Some college/graduate	183	19.59	149	81.42	34	18.58		164	89.62	19	10.38	
Annual household income												
≤$15,000	285	30.51	191	67.02	94	32.98	0.01	220	77.19	65	22.81	0.01
>$15,000–30,000	131	14.03	105	80.15	26	19.85		113	86.26	18	13.74	
>$30,000	69	7.39	57	82.61	12	17.39		63	91.30	6	8.70	
Don't know/refused/missing	449	48.07	334	74.39	115	25.61		375	83.52	74	16.48	
Marital status												
Never married	763	81.69	552	72.35	211	27.65	0.07	624	81.78	139	18.22	0.13
Married	105	11.24	87	82.86	18	17.14		94	89.52	11	10.48	
Other: separated/divorced/widowed	66	7.07	48	72.73	18	27.27		53	80.30	13	19.70	
Language preference for speaking/reading												
English	718	76.87	518	72.14	200	27.86	0.07	589	82.03	129	17.97	0.45
Spanish	216	23.13	169	78.24	47	21.76		182	84.26	34	15.74	
Generation in the continental US[b]												
Born in PR/DR	449	48.07	332	73.94	117	26.06	0.01	375	83.52	74	16.48	0.11
Parent born in PR/DR	429	45.93	305	71.10	124	28.90		345	80.42	84	19.58	

	Total sample		Minor depression[d]					Major depression[e]				
			No		Yes			No		Yes		
	N	%	N	%	N	%	*p* value[f]	N	%	N	%	*p* value[f]
Grandparent born in PR/DR	56	6.00	50	89.29	6	10.71		51	91.07	5	8.93	
Pre-pregnancy body mass index (BMI)												
Underweight (less than 18.5)	60	6.42	48	80.00	12	20.00	0.11	51	85.00	9	15.00	0.29
Normal (18.5–<25)	455	48.72	330	72.53	125	27.47		367	80.66	88	19.34	
Overweight (25–<30)	208	22.27	163	78.37	45	21.63		180	86.54	28	13.46	
Obese (30 or greater)	211	22.59	146	69.19	65	30.81		173	81.99	38	18.01	
Parity												
0	393	42.08	307	78.12	86	21.88	0.02	334	84.99	59	15.01	0.23
1	295	31.58	210	71.19	85	28.81		240	81.36	55	18.64	
≥2	246	26.34	170	69.11	76	30.89		197	80.08	49	19.92	
Smoking during pregnancy												
Never	636	68.09	482	75.79	154	24.21	0.03	539	84.75	97	15.25	0.01
Former	182	19.49	130	71.43	52	28.57		146	80.22	36	19.78	
Current (ever during pregnancy)	116	12.42	75	64.66	41	35.34		86	74.14	30	25.86	

[a] Numbers may not sum to 934 due to missing data

[b] Puerto Rico/Dominican Republic (*PR/DR*)

[c] Metabolic equivalent (*MET*)

[d] Women who scored ≥13 on the Edinburgh Postnatal Depression Scale (*EPDS*)

[e] Women who scored ≥15 on the Edinburgh Postnatal Depression Scale (*EPDS*)

[f] *P* values from chi-square tests for categorical variables

Table 2

Unadjusted and multivariable odds ratios (OR) and 95% confidence intervals (CI) for abnormal glucose tolerance (AGT) during pregnancy (*n* =934); Proyecto Buena Salud, Western Massachusetts, 2006–2011

			Model 1[d]		Model 2[e]		Model 3[f]	
	N	**% Cases**	**OR**	**95 % CI**	**OR**	**95 % CI**	**OR**	**95 % CI**
Total	934	13.17						
At least probable minor depression[a]								
No	687	12.66	1.00	Referent	1.00	Referent	1.00	Referent
Yes	247	14.57	1.18	(0.77, 1.79)	1.20	(0.77, 1.87)	1.20	(0.77, 1.89)
Probable major depression[b]								
No	771	12.71	1.00	Referent	1.00	Referent	1.00	Referent
Yes	163	15.34	1.24	(0.77, 2.00)	1.29	(0.78, 2.14)	1.34	(0.81, 2.23)

[a] Women who scored ≥13 on the Edinburgh Postnatal Depression Scale (*EPDS*)

[b] Women who scored ≥15 on the Edinburgh Postnatal Depression Scale (*EPDS*)

[c] Women with glucose levels >135 mg/dL from a 50 g, 1-h glucose tolerance test (*OGTT*) were classified as abnormal glucose tolerance (*AGT*)

[d] Model 1: unadjusted

[e] Model 2: adjusted for age, education, parity, marital status, annual household income, and generation in the US

[f] Model 3: adjusted for covariates in model 2 and pre-pregnancy body mass index (*BMI*)

Table 3

Unadjusted and multivariable odds ratios (OR) and 95 % confidence intervals (CI) for impaired glucose tolerance (IGT) (*n* =934); Proyecto Buena Salud, Western Massachusetts, 2006–2011

			Model 1[d]		Model 2[e]		Model 3[f]	
	N	**% Cases**	**OR**	**95 % CI**	**OR**	**95 % CI**	**OR**	**95 % CI**
Total	934	6.00						
At least probable minor depression[a]								
No	687	5.97	1.00	Referent	1.00	Referent	1.00	Referent
Yes	247	6.07	1.02	(0.55, 1.88)	1.18	(0.61, 2.28)	1.22	(0.62, 2.40)
Probable major depression[b]								
No	771	5.84	1.00	Referent	1.00	Referent	1.00	Referent
Yes	163	6.75	1.17	(0.59, 2.31)	1.42	(0.69, 2.94)	1.53	(0.73, 3.22)

[a] Women who scored ≥13 on the Edinburgh Postnatal Depression Scale (*EPDS*)

[b] Women who scored ≥15 on the Edinburgh Postnatal Depression Scale (*EPDS*)

[c] Women with glucose levels >135 mg/dL from a 50 g, 1-h glucose tolerance test (*OGTT*), and exceeded at least one cut-point on the 100 g 3-h OGTT were classified as impaired glucose tolerance (*IGT*)

[d] Model 1: unadjusted

[e] Model 2: adjusted for age, education, parity, marital status, annual household income, and generation in the US

[f] Model 3: adjusted for covariates in model 2 and pre-pregnancy body mass index (*BMP*), language preference, and smoking during pregnancy (for minor depression), and pre-pregnancy BMI (for major depression)

Table 4

Linear regression of 1-h oral glucose tolerance test (1-h OGTT) plasma values (mg/dL) on depression status; Proyecto Buena Salud, Western Massachusetts, 2006–2011

	Model 1[c]			Model 2[d]			Model 3[e]		
	Beta	**SE**	***p* value**	**Beta**	**SE**	***p* value**	**Beta**	**SE**	***p* value**
At least probable minor depression[a]									
No		Referent			Referent			Referent	
Yes	−0.55	1.95	0.78	−0.16	1.93	0.93	−0.26	1.93	0.89
Probable major depression[b]									
No		Referent			Referent			Referent	
Yes	0.16	2.26	0.94	0.62	2.23	0.78	0.57	2.23	0.80

[a] Women who scored ≥13 on the Edinburgh Postnatal Depression Scale (*EPDS*)

[b] Women who scored ≥15 on the Edinburgh Postnatal Depression Scale (*EPDS*)

[c] Model 1: unadjusted

[d] Model 2: adjusted for age, education, parity, marital status, annual household income, and generation in the US

[e] Model 3: adjusted for covariates in model 2 and pre-pregnancy body mass index (*BMI*), language preference, and smoking during pregnancy