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ORIGINAL ARTICLE

Estimated prevalence of antenatal depression in the US population

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Abstract The purpose of this study is to determine the prevalence of minor and major depression among pregnant women in the USA. Also, we compare prevalence of depression among pregnant and non-pregnant women while controlling for relevant covariates. A population-representative sample of pregnant women ($n = 3010$) surveyed for the 2006 Behavioral Risk Factor Surveillance System was compared to a sample of women who were not pregnant ($n = 68{,}620$). Binary logistic regression was used to determine prevalence ratios of depression for pregnant and non-pregnant women while controlling for the effects of age, race, annual income, employment status, educational level, marital status, general health, and availability of emotional support. Depression was measured by the Patient Health Questionnaire-8 (PHQ-8). The prevalence of major depression was no greater among pregnant women (6.1 %) compared to non-pregnant women (7 %; adjusted prevalence ratio (PR) = 1.1, 95 % confidence interval (CI) .8 and 1.5). The prevalence of minor depression was greater among pregnant women (16.6 %) compared to non-pregnant women (11.4 %; adjusted PR = 1.5, 95 % CI 1.2 and 1.9). Prevalence ratios are adjusted for the effects of covariates noted above. Prevalence of major depression is not associated with pregnancy, but minor depression is more likely among women who are pregnant.

Keywords Antenatal · Depression · Pregnancy · Prevalence · Risk factors · Women · Mental health · BRFSS · PHQ-8

Antenatal depression is the occurrence of depressive symptoms in women while pregnant. Multiple studies provide evidence for detrimental effects of antenatal depression on the mother, on the developing fetus, on the birthing process, and on post-natal child development (Alder et al. 2007; Blier 2006; Chung et al. 2001; Cohen et al. 2006; Correia and Linhares 2007; Lindgren 2001; Suri et al. 2007). Because of the potential negative consequences of antenatal depression, research into the prevalence and risk factors of the disorder is important.

Pregnant women who are depressed and/or anxious were found to experience more nausea and vomiting, a higher number of sick days, and more frequent doctor visits than their non-depressed counterparts (Andersson et al. 2004). Increased reports of back pain and leg pain have also been noted (Field et al. 2008). A high occurrence of sleeping problems is also observed among depressed pregnant women (Field et al. 2008; Jomeen and Martin 2007; Ross et al. 2005; Wolfson et al. 2003).

Pregnant women who experience many depressive symptoms are nearly twice as likely to report poor health and functional limitations compared to pregnant women with few or no depressive symptoms (Orr et al. 2007). Antenatal depression is also associated with increased negative emotions, particularly anger and anxiety (Field et al. 2008), and has been linked to fear of childbirth (Andersson et al. 2004). Women who discontinue antidepressant medication during pregnancy are at a high risk for relapse (Blier 2006).

Antenatal depression does not differ from the diagnosis of major depression found in the *Diagnostic and Statistical Manual of Mental Disorders 5th Edition* (DSM 5)

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(American Psychiatric Association (APA) 2013). Major depression requires the presence of five or more symptoms occurring over a span of 2 weeks. At least one of the reported symptoms must be either a persistent depressed mood or loss of interest in the usual activities of daily life.

Minor depression is the presence during a 2-week period of two to four of the symptoms of major depression, one of which must be either depressed mood or loss of pleasure (APA 2000). In DSM 5, depressive episode with insufficient symptoms most closely aligns with the meaning of the minor depression category. The diagnosis of depressive episode with insufficient symptoms requires depressed mood and at least one other symptom of depression (APA 2013, p. 183). The inclusion of this diagnostic category in DSM 5 reflects the clinical utility of a sub-threshold level of depression. For convenience, we refer to minor depression throughout the paper.

The estimated prevalence of antenatal depression varies widely across studies depending on factors such as sampling method, country/culture, stage of pregnancy, and method of assessing depression. Estimates of the prevalence of major depression during the antenatal period range between 20 (Hatton et al. 2007) and 27 % (Bowen and Muhajarine 2006b). Bowen and Muhajarine (2006b) also report the prevalence of minor depression of 45 % in a predominately low-income and minority sample. Although it does not distinguish between major and minor depression, a study using women's medical records to determine whether they were depressed during pregnancy yielded a prevalence of 6.9 % (Dietz et al. 2007).

Few prevalence studies of depression among pregnant women utilize a US population-representative sample, and consequently, the generalizability of findings to the broader population is questionable. The current study estimates the population prevalence of current minor and major depression among women who are pregnant. We also estimate the prevalence of depression among a group of women who are not pregnant to determine if pregnancy constitutes a risk of depression. In addition, the latter analysis controls for the effects of variables that are related to depression. A prospective clinical study comparing women in late pregnancy and postpartum period to a matched sample of non-childbearing women found no difference in prevalence of depression diagnoses between the two groups using standardized interview methods (O'Hara et al. 1990). However, women report more symptoms of depression late in pregnancy, including both cognitive-emotional and somatic symptoms.

We expect that the prevalence of both major and minor depression would be lower among pregnant women in a population-representative sample as compared to the prevalence reported from clinical samples. This is based on findings that pregnant women who experience depressive symptoms present for medical care more frequently than those who do not (Andersson et al. 2004). Based on research suggesting that the prevalence of depression during pregnancy may be higher than would typically be expected for women, we hypothesized that the prevalence of both major and minor depression would be greater among pregnant women compared to women who are not pregnant (Bowen and Muhajarine 2006b; Hatton et al. 2007).

Materials and methods

Sample

This study was exempted from review by the Institutional Review Board at Auburn University at Montgomery. The Behavioral Risk Factor Surveillance System (BRFSS) is a telephone survey conducted annually throughout the USA (Centers for Disease Control (CDC) 2006a). The BRFSS selects participants for telephone surveys based on random sampling of phone numbers in the USA, comprised of the 50 states, the District of Columbia, Guam, Puerto Rico, and the US Virgin Islands. The intent of the BRFSS is to produce a sample that is representative of the adult US population. This study uses data from the 2006 BRFSS survey (CDC 2006b) participants who administered the depression and anxiety survey module.

A total of 220,302 women participated in the 2006 BRFSS survey, and only women between the ages of 18 and 44 years ($n = 74{,}518$) were asked, "To your knowledge, are you now pregnant?" Some respondents expressed uncertainty ($n = 258$), and some refused to answer the question ($n = 213$) and these participants were excluded from further analysis. Of the remaining number ($n = 74{,}047$), 71,771 provided complete data for the Patient Health Questionnaire-8 (PHQ-8) depression scale items. An additional 141 cases dropped from the analysis because of missing values on predictor variables. The final sample ($n = 71{,}630$) contained 3010 pregnant women and 68,620 non-pregnant women who were given the PHQ-8 questions (CDC 2006b). Therefore, the analysis is based on 96.1 % of the women's 18–44-year age group and no steps were taken to impute missing values for deleted cases. The average age of the sample was 33.9 years (SD = 7.1). Table 1 summarizes the demographic characteristics and variables of interest for the samples of pregnant and non-pregnant women.

Measurement: major and minor depression

The PHQ-8 questions ask respondents to report the number of days out of the previous 14 that they experienced a given symptom of depression. The PHQ-8 is based on the Patient Health Questionnaire-9 depression scale (PHQ-9) (Kroenke et al. 2001; Kroenke and Spitzer 2002). The PHQ-8 excludes the item about recurrent thoughts about death and suicide. This adjustment is made because telephone survey

Table 1 Raw number and weighted percent for demographic and risk factor comparison of pregnant and not pregnant woman respondents

Variables	Pregnant ($n = 3010$)	Not pregnant ($n = 68,620$)
Age	29.2 (SD = 5.6)	34 (SD = 7.1)[a]
Race		
White	2,015 (59.5 %)	47,984 (63.1 %)
Black	316 (10.1 %)	7,599 (11.1 %)
Hispanic	415 (23.0 %)	8,066 (19 %)
Other race (non-Hispanic)	193 (5.6 %)	3,270 (4.9 %)
Multiracial (non-Hispanic	63 (1.8 %)	1,309 (1.4 %)
Unknown	8 (.06 %)	392 (.5 %)
Employment status		
Employed	1,768 (56.5 %)	47,108 (62.7 %)
Unemployed	221 (8.5 %)	3,781 (6.4 %)
Homemaker	767 (25.9 %)	11,093 (17.6 %)
Student	139 (5 %)	3,847 (10.2 %)
Retired	2 (.02 %)	97 (.1 %)
Unable to work	111 (4.1 %)	2,559 (2.9 %)
Refused	2 (.04 %)	135 (.25 %)
Income level (annual)		
$75,000 or more	713 (22.1 %)	15,604 (23.7 %)
$50,000–$74,999	529 (15.6 %)	11,302 (15.6 %)
$35,000–$49,999	446 13.5 %)	10,381 (13.7 %)
$25,000–$34,999	297 (8.4 %)	7,568 (10.4 %)
$20,000–$24,999	257 (10.3 %)	5,644 (7.8 %)
$15,000–$19,999	178 (7.9 %)	4,521 (6.5 %)
$10,000–$14,999	113 (5.6 %)	3,055 (4.4 %)
Less than $10,000	148 (5 %)	3,546 (5.6 %)
Unknown	329 (11.6 %)	6,999 (12.6 %)
Education status		
College graduate	1,253 (36.6 %)	24,761 (33.1 %)
1–3-year college	732 (22.6 %)	20,253 (29.8 %)
High school	742 (28.4 %)	17,946 (26.3 %)
Grades 9–11	204 (8.7 %)	4,103 (7.2 %)
Grades 1–8	76 (3.7 %)	1,390 (3.2 %)
None	2 (.03 %)	87 (.2 %)
Unknown	1 (0 %)	80 (.1 %)
Marital status		
Married	2,169 (67.6 %)	38,669 (54.5 %)
Not married	841 (32.4 %)	29,951 (45.5 %)
General health status		
Excellent	918 (29.4 %)	16,800 (23.9 %)
Very good	1,077 (32.4 %)	24,939 (35.6 %)
Good	824 (30.9 %)	19,368 (29.6 %)
Fair	159 (6 %)	5,866 (9 %)
Poor	28 (1.3 %)	1,521 (1.8 %)
Unknown	4 (.1 %)	126 (.2 %)
Availability of emotional support		
Always	1,568 (52.4 %)	30,640 (44.7 %)
Usually	966 (28.9 %)	23,161 (32.4 %)
Sometimes	266 (9.5 %)	8,583 (12.4 %)
Rarely	68 (2.5 %)	2,246 (3.3 %)
Never	65 (2.9 %)	1,786 (2.7 %)
Unknown	77 (3.9 %)	2,204 (4.4 %)

[a] t test $t\,(71,628) = -37.2$, $p < .0001$

interviewers cannot intervene appropriately with individuals who express suicidal ideation (Kroenke and Spitzer 2002; Kroenke et al. 2009). Recurrent thoughts of death and suicidal ideation are infrequently endorsed compared to the other eight symptoms of a depression, and the item exclusion does not affect test validity (Kroenke et al. 2001).

PHQ-8 item responses were converted to scores based on a scoring algorithm used by Fan et al. (2009). Scores of 4 or less were indicative of no depression. Scores between 5 and 9 were indicative of minor depression, and scores of 10 or higher were classified as major depression. Kroenke et al. (2009) reported that PHQ-8 scores of 10 or higher have sensitivity of 100 % and a specificity of 95 % for major depression. The sensitivity and the specificity of this cut score for detecting any depressive disorder are 70 % and 98 %, respectively.

Measurement: risk factor variables

The covariates used in this study have been associated with antenatal depression in other studies (Bowen and Muhajarine 2006a; Correia and Linhares 2007; Faisal-Cury and Menezes 2007; Field et al. 2008; Marcus et al. 2003; Records and Rice 2007). The covariates are classified as demographic characteristics and behavioral risk factors. The variables in the demographic domain include age in years, race (six categories), employment status (seven categories), income level (nine categories), education status (seven categories), and marital status (married vs. not married). Variables classified as behavioral risk factors of depression were general health status and availability of emotional support. Survey participants were asked to rate their general health as *excellent*, *very good*, *good*, *fair*, or *poor* (CDC 2006a). Participants were also asked "How often do you get the social and emotional support you need?" to which they responded, *always*, *usually*, *sometimes*, *rarely*, or *never*.

Statistical analyses

Analyses were to account for potential bias in BRFSS participant selection due to non-response, non-coverage, and survey design effects. Sample weighting during analysis adjusts for the number of telephones and adults in a household and the

probability of a telephone number being randomly selected. Weighted estimates were used to determine prevalence estimates and ratios. Multivariate binary logistic regression (SAS survey logistic module) was used to determine the associations between current pregnancy and depression while controlling for the effects of covariates.

Results

Among the total sample of women, 11.7 % met the criterion for minor depression and 6.9 % met the criterion for major depression. With respect to minor depression, 16.6 % of pregnant women met the criterion (PHQ-8 score between 5 and 9) compared to 11.4 % of women who were not pregnant. Among pregnant women, 6.1 % met the criterion for major depression (PHQ-8 score ≥10) compared to 7 % of non-pregnant women who met this criterion.

To determine the prevalence ratios of minor and major depression, a binary logistic regression model was constructed with pregnancy status as the outcome variable (pregnant-not pregnant) and depression status as the variable of interest. Covariates described earlier were included in the model. Model fit was assessed with the likelihood ratio test, and the model including all the variables was superior to the null model ($\chi^2_{(39)} = 1946715.9$, $p < .0001$). The pseudo R^2 for the model is .09.

Table 2 presents the type 3 analysis of effects, in which each effect is adjusted for the presence of all other variables in the model. Every variable in the model is significantly related to pregnancy status, owing at least in part to the large sample size. However, of primary interest in this study, Table 3 shows that depression is significantly related to pregnancy status while controlling for the effects of the other variables in the model. The pseudo R^2 for the model is .09.

Odds ratios adjusted for the effects of model covariates are presented in Table 3. Table 3 also presents odds ratios for the individual covariates included in the model. The main finding

Table 2 Type III analysis of effects

Variable	*df*	Wald χ^2	*P* value
Depression	2	13.6	.001
Age	1	389.2	<.0001
Race	5	25.1	.0001
Employment	6	58.1	<.0001
Annual income	8	19	.01
Education	6	40.9	<.0001
Marital status	1	99.3	<.0001
General health	5	14.3	.01
Emotional support	5	13	.02

Table 3 Adjusted odds ratio estimates for pregnancy status, comparing pregnant woman respondents to woman respondents who are not pregnant

Variables	Adjusted odds ratios	95 % confidence interval
Depression (PHQ-8)	–	–
None (PHQ-8 ≤ 4)	–	–
Minor (5 ≤ PHQ-8 ≤ 9)	1.5	1.2–1.9
Major (PHQ-8 ≥ 10)	1.1	.8–1.5
Age	.9	.88–.9
Race	–	
White	–	–
Black	1.2	1–1.5
Hispanic	1.2	.9–1.6
Other race	1.2	.9–1.6
Multiracial (non-Hispanic)	1.5	.8–2.8
Unknown	.1	.04–.3
Employment status		
Employed	–	–
Unemployed	1.4	1–1.8
Homemaker	1.4	1.1–1.7
Student	.4	.3–.5
Retired	.3	.08–1.5
Unable to work	2.7	1.6–4.8
Refused	.2	.05–1.3
Income level (annual)		
$75,000 or more	–	–
$50,000–$74,999	1	.8–1.2
$35,000–$49,999	1	.7–1.2
$25,000–$34,999	.8	.6–1
$20,000–$24,999	1.3	.9–1.7
$15,000–$19,999	1.3	.9–1.8
$10,000–$14,999	1.5	1–2.3
Less than $10,000	1	.6–1.5
Unknown	.8	.6–1
Education	–	–
College graduate	–	–
1–3-year college	.6	.5–.7
High school	.7	.6–.9
Grades 9–11	.7	.5–1
Grades 1–8	.7	.4–1.1
None	.08	.01–.5
Unknown	.03	.004–.26
Marital status		
Married	–	–
Not married	.35	.28–.43
General health status		
Excellent	–	–
Very good	.8	.6–.9
Good	.8	.7–1
Fair	.5	.4–.8

Table 3 (continued)

Variables	Adjusted odds ratios	95 % confidence interval
Poor	.7	.2–1.8
Unknown	.5	.1–1.6
Availability of emotional support	–	–
Always	–	–
Usually	.8	.7–1
Sometimes	.7	.5–.9
Rarely	.6	.4–1.1
Never	1	.6–1.8
Unknown	.8	.5–1.3

of interest is that the odds of obtaining a score on the PHQ-8 indicative of minor depression are about 50 % greater for pregnant women compared to women who are not pregnant (adjusted OR = 1.5, 95 % CI 1.2 and 1.9). However, the odds of major depression are not related to pregnancy status.

Discussion

This study provides US population-based prevalence estimates of minor and major depression in a non-clinical sample of pregnant women between ages 18 and 44. An additional purpose of the current study was to determine if pregnancy was associated with greater prevalence of minor and major depression than women who were not pregnant while controlling for the effects of potential confounding variables. We hypothesized that pregnancy would be associated with a higher prevalence of minor and major depression. The results indicate that pregnant women have a higher prevalence of minor depression but the same prevalence of major depression compared to the non-pregnant cohort.

Our prevalence estimates are 16.6 % for minor and 6.1 % for major depression. These estimates are higher than those presented by Gaynes et al. (2005) who reported a meta-analysis of 30 prevalence studies. The prevalence of major depression during pregnancy was estimated to be between 3.1 and 4.9 %, and for major and minor depression, combined prevalence estimates ranged from 8.5 to 11 %. Variation in sampling methods and methods of measuring depression may account for the differences in prevalence estimates.

The current study is limited in a few important ways. First, although the PHQ-8 is an effective tool for identifying the symptoms of current depression, without additional information, it is not possible to separate, for example, cases of major depression from cases of bipolar disorder. Second, some depression symptoms may be attributable to the physical changes that accompany pregnancy. When using the PHQ-8 scores, it is possible that the pregnant woman's answers to questions based on the physically oriented symptoms of depression (e.g., appetite, energy, and sleep) will indicate minor depression ($5 \leq$ PHQ-8 ≤ 9) in the absence of one of the required emotional symptoms of depression (i.e., sadness and loss of pleasure) (APA 2013). This suggests that the 16.6 % prevalence of minor depression reported in this study might be an overestimate. It may further indicate that the finding that pregnant women are 1.5 times more likely to experience minor depression than women who are not pregnant may also be a function of pregnant women endorsing these PHQ-8 physical symptom items.

Finally, the BRFSS survey data does not permit the study of some factors that may be of interest when researching antenatal depressive episodes. Indeed, pregnancy status itself is indicated by a response to a single survey question and cannot be verified. Prior studies have reported differences in prevalence of depression based on trimester of pregnancy, with a higher prevalence of depressive symptoms reported in the third trimester (Alami et al. 2006; Bennett et al. 2004; Records and Rice 2007). The BRFSS does not ask about current pregnancy trimester or number of prior pregnancies (parity). Parity has also been linked to the development of depressive symptoms (Alami et al. 2006). Prevalence of depressive symptoms was lower during first pregnancies compared to subsequent pregnancies. It is reasonable to assume that the women in the current study represent a range of pregnancy trimesters in addition to varied parity, thus causing the results to average across these dimensions.

In summary, the current study demonstrates that, using the PHQ-8, pregnant women have a higher prevalence of minor but not major depression compared to women who are not pregnant. Pregnancy is not associated with an increased prevalence of major depression. Major depression during pregnancy, however, is still a cause for concern. Considering the links between antenatal depression and potential negative effects on the mother, the developing fetus, the birthing process, and later child development, the burden of depressive episodes during pregnancy should not be overlooked. Health care providers who interact with pregnant women should routinely screen for depression. Screening for depression will alert providers to potential problems, which should lead to appropriate interventions. Awareness of antenatal depression may encourage more help-seeking and lead to better pregnancy outcomes.

Compliance with ethical standards The authors have no conflicts of interest to declare.

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