

Mental Disorders and Nicotine Dependence Among Pregnant Women in the United States

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OBJECTIVE: To investigate the association between mental disorders and cigarette use and nicotine dependence among pregnant women in the United States.

METHODS: A face-to-face general population survey was conducted on participants in the 2001–2002 National Epidemiologic Survey on Alcohol and Related Conditions. One thousand five hundred sixteen women reporting a pregnancy in the past year were captured. Primary outcomes were seven *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*–defined mood and anxiety disorders and eight personality disorders, which were measured with the Alcohol Use Disorder and Associated Disabilities Interview Schedule.

RESULTS: Among pregnant women, 21.7% reported cigarette use and 12.4% met the criteria for nicotine dependence. Among pregnant women with cigarette use, 45.1% met criteria for at least one mental disorder, and among those with nicotine dependence, 57.5% met criteria for at least one other mental disorder. After adjusting for demographics and comorbidity, nicotine dependence during pregnancy significantly predicted any mental disorder (odds ratio [OR] 3.3, 95% confidence interval [CI] 2.1–5.1), any mood disorder (OR 2.5, 95% CI 1.5–4.0), major depression (OR 2.07, 95% CI 1.3–3.4), dysthymia (OR 6.2, 95% CI 2.9–13.1), and panic disorder (OR 3.1, 95% CI 1.6–6.1) in the past year. No significant associations were found between nondependent cigarette use and mental disorders.

CONCLUSION: Our results suggest an association between mental disorders and nicotine dependence among pregnant women in the United States. This association has far-reaching implications for both the mental and physical

health of women and potentially for their children. (*Obstet Gynecol* 2007;109:875–83)

LEVEL OF EVIDENCE: III

There has been growing evidence of the detrimental health impact of prenatal cigarette smoking on the health of children, both in infancy and later in life. Evidence coming from clinical and epidemiologic studies suggests that smoking during pregnancy is associated with a higher frequency of obstetric complications, such as spontaneous abortions, ectopic pregnancies, preterm birth, placenta previa, abruption placentae, and premature rupture of membranes.^{1–3} Prenatal exposure to nicotine also increases the risk for pediatric asthma, wheezing illness, and bronchitis.⁴

In addition to negative physical effects, several studies have shown that prenatal smoking adversely affects cognitive development and behavior during childhood and adolescence.⁵ Children who have been previously exposed to nicotine are at increased risk for decreased cognitive abilities, and difficulties with speech and motor development.⁵ Prenatal smoking has also been implicated as a risk factor for neurodevelopmental and behavioral problems, and there is growing evidence that prenatal smoking is associated with antisocial behavior,² symptoms of attention-deficit hyperactivity disorder,² conduct disorder,⁶ and panic attacks in youth.⁷

In 1997, more than one in 10 (13.2%) women in the United States reported smoking cigarettes during pregnancy.¹ Rates for prenatal smoking have been shown to be highest among unmarried women. In addition, women with less than a high school education and lower incomes are more likely to smoke while pregnant.^{8,9} For instance, 35% of pregnant women who were Medicaid enrollees reported smoking during pregnancy.¹⁰ There are similar risk factors for nicotine dependence in pregnant and nonpregnant populations (such as socioeconomic and marital status).⁹ Although pregnancy is often considered an

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effective motivator for smoking cessation, few studies in the United States have reported significantly higher rates of cessation among expectant mothers as compared with the general population of smokers.^{8,9} In sum, evidence suggests that prenatal smoking most commonly occurs among vulnerable populations, although little information is available beyond demographic correlates.

In light of these data, it is particularly important to identify associated risk factors for prenatal smoking to increase and improve smoking cessation efforts for pregnant women, and to develop better methods of prevention. For instance, several population-based studies have shown strong cross-sectional associations between depression and anxiety disorders and increased rates of cigarette use and nicotine dependence.^{11,12} Evidence from longitudinal studies has also suggested that depression and anxiety disorders are associated with increased risk of smoking and nicotine dependence onset.^{13,14} To date, however, our understanding of the relationship between mental disorders and cigarette use among pregnant women in the United States remains limited.

The goal of the current study was to begin to fill this gap by addressing several key objectives. The primary aim of this study is to estimate the prevalence of mental disorders among women who use cigarettes or who have nicotine dependence during pregnancy compared with pregnant women who do not smoke, in the United States. We will also examine the degree to which the association between mental disorders and cigarette use and nicotine dependence is explained by differences in demographic characteristics between smokers and nonsmokers as well as comorbidity of more than one mood, anxiety, substance use, or personality disorder. Based on previous findings of linkages between mental disorders and nicotine dependence among adults, we hypothesized that mental disorders would be associated with increased prevalence of cigarette use and nicotine dependence among pregnant women in the United States.

MATERIALS AND METHODS

The sample was drawn from participants in the 2001–2002 the National Epidemiologic Survey of Alcohol and Related Conditions, a nationally representative United States survey of 43,093 civilian non-institutionalized participants aged 18 years and older, sampled cross-sectionally. Details of the sampling frame are described elsewhere.^{15–17} The National Institute on Alcohol Abuse and Alcoholism sponsored the study and supervised the fieldwork, conducted by the U.S. Bureau of the Census. Young adults, Hispan-

ics, and African Americans were oversampled, and the study achieved an overall response rate of 81%. To adjust for nonresponse and selection probability, the sample was weighted and adjusted to reflect the U.S. population from the 2000 Decennial Census in terms of age, race, sex, and ethnicity. The research protocol, including informed consent procedures, received full ethical review and approval from the U.S. Census Bureau and U.S. Office of Management and Budget. The present analyses include only those women reporting pregnancy in the past year ($n=1,517$). One woman was removed from the analysis due to noncigarette nicotine dependence (cigar dependence), making the final sample size 1,516.

Interviewing was conducted by 1,800 professional interviewers from the Census Bureau using computer-assisted software with built-in skip, logic, and consistency checks. Details of the interview training and procedure are described elsewhere.¹⁸

Diagnoses were made with the National Institute on Alcohol Abuse and Alcoholism Alcohol Use Disorder and Associated Disabilities Interview Schedule DSM-IV (AUDADIS-IV).¹⁹ This instrument was specifically designed for experienced lay interviewers and was developed to advance measurement of substance use and mental disorders in large-scale surveys. Nicotine dependence is assessed in a unique module separate from the assessment of other substance use. Respondents are considered to have ever used cigarettes if they have smoked 100 or more cigarettes during their lifetime. Those that have ever smoked 100 or more cigarettes are considered current users if they have smoked in the past year. For the analyses included in this study, “cigarette use” included women who had ever smoked 100 or more cigarettes and reported that they have smoked in the past year. The test–retest reliability of the nicotine use variables as well as other AUDADIS-IV nicotine use measures (eg, frequency and duration of use) were excellent, with interclass correlation coefficients of 0.83 to 0.84.¹⁸

The AUDADIS-IV used an extensive list of more than 40 questions to assess nicotine dependence, and obtained extensive information on time frames of nicotine use and dependence. Diagnoses were indicated according to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV)²⁰; a respondent needs at least three of seven criteria for nicotine dependence. Criteria for nicotine dependence include 1) need more nicotine to achieve desired effect, 2) meets criteria for nicotine withdrawal syndromes, 3) using tobacco more than intended, 4) persistent desire or unsuccessful efforts to cut down on nicotine use, 5) great deal of time spent using tobacco (eg, chain smoking), 6) giving up activ-



ities in favor of nicotine use, and 7) continued use despite recurrent physical or psychological problems likely to have been caused by nicotine use. Nicotine withdrawal was assessed as a syndrome as described by the DSM-IV based on four symptoms: 1) use of nicotine upon waking, 2) use of nicotine after being in a situation in which nicotine was restricted, 3) use of nicotine to relieve or avoid withdrawal symptoms, and 4) waking up in the middle of the night to use nicotine. Time frame for diagnosis included the previous 12-month period.

The reliability and validity of the tobacco dependence diagnosis was assessed by random subsample of 347 respondents who were reinterviewed with the nicotine dependence module up to 10 weeks after initial appraisal. The procedures used were similar to those used in the German National Health Interview and Examination Survey.²¹ The reliability of the previous 12-month (ie, current) diagnosis was good ($\kappa=0.63$). Further, a series of linear regression analyses were used to validate the diagnoses by examining the association between nicotine dependence and Short-Form-12v2 (an often used measure of generic quality of life that generates 10 component and profile scores assessing various dimensions of physical and mental disability) physical disability scores.²²

Primary outcomes were seven DSM-IV-defined mood and anxiety disorders and eight personality disorders. Mood and anxiety disorders assessed by the AUDADIS-IV included primary major depression, dysthymia, bipolar, generalized anxiety disorder, panic disorder with or without agoraphobia, social phobia, and specific phobia. Diagnoses included for the present analysis were those made for the previous 12 month period. Diagnoses included a requirement of distress or social or occupational dysfunction (as per DSM-IV requirement). Rule outs included substance-induced disorders or those due to bereavement. The reliability and validity of mood and anxiety disorder diagnoses and symptom items were fair to good ($\kappa .42-.64^{18,23,24}$), including test-retest and clinical reappraisal studies. Each mood and anxiety disorder has been further validated by showing highly significant associations with disability.^{19,20,25,26} Details of the depression,²⁷ generalized anxiety,²⁸ bipolar,²⁹ social anxiety,²⁸ and panic³⁰ diagnoses have been described in detail elsewhere.

Axis II personality disorders included in the present analyses include avoidant, dependent, obsessive-compulsive, paranoid, schizoid, histrionic, conduct, and antisocial personality disorders. The reliability of these diagnosis have been tested in a subsample of National Epidemiologic Survey of Al-

cohol and Related Conditions respondents and shown to be fair to good, ranging from a κ of 0.40 for histrionic personality disorder to 0.67 for antisocial personality disorder. Further details of the measurement of these diagnoses have been described elsewhere.¹²

All analyses were conducted using SUDAAN²³ to obtain standard errors that are adjusted for the complex sample characteristics of the National Epidemiologic Survey of Alcohol and Related Conditions.²² Cross-tabulations were used to calculate the prevalence of specific disorders among women who were pregnant and used cigarettes (both those who are nicotine dependent and those who are not). After these descriptive statistics, we used logistic regressions to present the likelihood of cigarette use and nicotine dependence if diagnosed with a current (ie, past 12 months) psychiatric disorder. Analyses are presented uncontrolled and then subsequently controlled for race (five groups: non-Hispanic white, non-Hispanic African-American, non-Hispanic American Indian or Alaska native, non-Hispanic Asian or native Hawaiian or Pacific Islander, and Hispanic), location (in a central city, not in a central city), marital status (never married, widowed or separated or divorced, married), education (below high school education, high school education, above high school education), and children (one or more, none). Analyses were further adjusted for any axis I disorder other than that which is the main predictor, and any other axis II disorder.

RESULTS

Among pregnant women in the United States, 21.7% (standard error [SE] 1.4) reported cigarette use and 12.4% (SE 1.1) met criteria for nicotine dependence. Among pregnant women with cigarette use, 57.2% (SE 3.6) met criteria for nicotine dependence and 45.1% (SE 3.4) met criteria for at least one mental disorder. Among pregnant women with nicotine dependence, 57.5% (SE 4.4) met criteria for at least one mental disorder.

There were numerous differences in demographic characteristics among women who used cigarettes and were nicotine dependent during pregnancy, compared with those who did not (Table 1). There was a higher proportion of cigarette use and nicotine dependence among pregnant women who were younger, never married or who had been previously widowed or separated or divorced, and who had lower levels of education and income. Pregnant women living in the Midwest had the highest proportion of nicotine dependence compared with women living in other areas of the country. There did not



Table 1. Prevalence of Cigarette Use and Nicotine Dependence in the United States by Demographic Characteristics

	Pregnant, No Cigarette Use, No Dependence	Pregnant, Cigarette Use, No Dependence	Pregnant, Cigarette Use, Nicotine Dependence	P*
Age (y)				
18–29	73.9 (2.0)	10.9 (1.4)	15.2 (1.6)	
30–44	85.0 (1.8)	6.9 (1.1)	8.2 (1.4)	<.001
Race				
White	71.5 (2.0)	11.8 (1.5)	16.7 (1.6)	
African American	82.7 (2.8)	7.9 (1.8)	9.4 (2.3)	
Native American	74.9 (9.3)	11.4 (7.9)	13.7 (6.0)	
Asian or Pacific Islander	94.8 (2.6)	1.0 (0.8)	4.2 (2.4)	
Hispanic	90.1 (2.2)	5.2 (1.6)	4.7 (1.3)	<.001
Marital status				
Married or living with someone as if married	83.4 (1.5)	7.4 (1.1)	9.3 (1.2)	
Widowed, separated, or divorced	43.7 (6.3)	16.7 (4.6)	39.6 (6.7)	
Never married	66.7 (3.7)	15.0 (2.6)	18.3 (3.0)	<.001
Education				
Less than high school	69.0 (4.2)	10.6 (2.4)	20.4 (3.8)	
High school	70.1 (2.7)	12.0 (2.3)	17.9 (2.2)	
Some college or higher	84.9 (1.4)	7.6 (1.0)	7.5 (1.1)	<.001
Personal income (\$)				
0–19,999	75.0 (1.9)	10.0 (1.3)	15.0 (1.5)	
20,000–34,999	81.9 (2.8)	8.9 (2.1)	9.2 (2.0)	
35,000–69,999	90.4 (2.5)	6.2 (1.9)	3.4 (1.8)	
More than 70,000	92.7 (4.5)	6.7 (4.5)	0.6 (0.6)	<.001
Urbanicity				
Urban	77.7 (2.4)	8.4 (1.4)	13.9 (2.0)	
Rural	78.6 (1.8)	9.7 (1.3)	11.7 (1.4)	.54
Region				
Northeast	79.3 (3.4)	10.9 (2.5)	9.8 (2.2)	
Midwest	72.3 (2.7)	9.6 (2.0)	18.0 (2.6)	
South	76.2 (2.5)	10.5 (1.9)	13.4 (2.0)	
West	86.2 (2.2)	6.1 (1.5)	7.7 (1.6)	.03

Data are % (standard error).

* Chi-square tests.

appear to be rural–urban differences in cigarette use and nicotine dependence among pregnant women.

Results suggest that approximately 30% of pregnant women who use cigarettes have a mental disorder (Table 2). Personality disorders (23.7%), major depressive disorder (12.4%), and specific phobia (7.4%) were among the most common disorders. Comparison with prevalence of mental disorders among pregnant women who did not use cigarettes showed that pregnant women who used cigarettes were significantly more likely to have any mental disorders (odds ratio [OR] 1.64, 95% confidence interval [CI] 1.03–2.62) and any personality disorder (OR 1.98, 95% CI 1.1–3.48). Associations with other specific mental disorders were not statistically significant (Table 3). After adjusting for differences in demographic characteristics, the associations between any mental disorder and any personality disorder and cigarette use among pregnant women was no longer statistically significant.

Mental disorders were common among a majority of pregnant women with nicotine dependence (57.2%) (Table 2). All mental disorders were significantly more frequent among women with nicotine dependence, compared with those who did not use cigarettes during pregnancy (Table 4). Strong associations were observed between any Axis I mental disorder (OR 5.07, 95% CI 3.48–7.38), any mood disorder (OR 5.4, 95% CI 3.53–8.26), any anxiety disorder (OR 2.79, 95% CI 1.93–4.04), and any personality disorder (OR 4.15, 95% CI 2.82–6.11) and nicotine dependence. These associations persisted, although they were attenuated, after adjusting for differences in demographic characteristics and comorbid mental disorders, with the exception of any anxiety disorder, which was no longer significant after adjustment for any personality disorders. In terms of specific mental disorders, the strongest associations were between dysthymia (OR 16.9, 95% CI 6.24–45.75), panic disorder (OR 6.84, 95% CI 3.37–13.85), and major depressive disorder (OR 4.91, 95% CI 3.18–



Table 2. Prevalence of Mental Disorders Among Pregnant Women With Cigarette Use and Nicotine Dependence in the United States

Past Year	No Cigarette Use or Nicotine Dependence (n=1,203)	Cigarette Use, No Nicotine Dependence (n=143)	Cigarette Use and Nicotine Dependence (n=170)
Any Axis I diagnosis*	19.8 (1.3)	28.8 (4.4)	57.2 (4.4)
Any mood disorder†	9.6 (1.0)	12.4 (3.3)	37.3 (4.5)
Major depressive disorder	8.3 (0.9)	10.2 (3.0)	31.5 (4.2)
Dysthymia	0.6 (0.2)	1.2 (0.9)	9.5 (3.1)
Hypomania	1.2 (0.4)	1.3 (1.0)	5.0 (2.0)
Any anxiety‡	12.4 (1.1)	12.6 (3.5)	28.6 (3.7)
Panic disorder	1.7 (0.4)	5.2 (2.7)	12.6 (3.0)
Social phobia	2.4 (0.5)	0.4 (0.3)	7.7 (2.4)
Specific phobia	8.9 (0.9)	7.4 (2.2)	18.6 (3.0)
Generalized anxiety disorder	1.7 (0.5)	1.1 (0.9)	5.9 (1.7)
Any personality disorder§	13.6 (1.1)	23.7 (4.6)	41.8 (4.2)

Data are % (standard error).

* Includes all mood and anxiety disorders.

† Includes Major Depressive Disorder, Dysthymia, and Hypomania.

‡ Includes Panic Disorder, Social Phobia, Specific Phobia, and Generalized Anxiety Disorder.

§ Includes avoidant, dependent, obsessive-compulsive, paranoid, schizoid, histrionic, conduct, and antisocial personality disorders.

Table 3. Adjusted Association Between Mental Disorders and Cigarette Smoking Among Pregnant Women in the United States

If Diagnosed Within Past Year	Among Pregnant Women, Odds of Past Year Cigarette Use			
	Unadjusted	Adjusted for Demographics*	Adjusted for Demographics and Other Axis I Disorders	Adjusted for Demographics and Other Axis I and Axis II Disorders
Any Axis I diagnosis	1.64 (1.03–2.62)†	1.46 (0.89–2.38)	–	1.34 (0.77–2.33)
Any mood disorder	1.35 (0.69–2.63)	1.02 (0.46–2.24)	1.05 (0.43–2.55)	0.92 (0.35–2.46)
Major depressive disorder	1.26 (0.62–2.55)	1.05 (0.44–2.52)	0.94 (0.37–2.39)	0.91 (0.36–2.32)
Dysthymia	2.12 (0.28–16.09)	2.33 (0.23–23.89)	2.00 (0.21–19.34)	1.97 (0.21–18.76)
Hypomania	1.09 (0.21–5.56)	0.80 (0.11–5.95)	0.61 (0.08–4.54)	0.56 (0.07–4.16)
Any anxiety	0.99 (0.52–1.91)	0.92 (0.46–1.87)	0.91 (0.40–2.06)	0.77 (0.33–1.76)
Panic disorder	3.22 (0.93–11.08)	3.75 (0.91–15.43)	3.31 (0.72–15.24)	2.85 (0.70–11.62)
Social phobia	0.16 (0.04–0.72)	0.13 (0.02–0.68)	0.10 (0.02–0.57)	0.09 (0.02–0.51)
Specific phobia	0.83 (0.42–1.66)	0.78 (0.35–1.71)	0.68 (0.30–1.56)	0.64 (0.27–1.48)
Generalized anxiety disorder	0.63 (0.11–3.61)	0.37 (0.07–2.08)	0.28 (0.05–1.60)	0.27 (0.05–1.50)
Any personality disorder	1.98 (1.13–3.48)†	1.68 (0.93–3.06)	1.89 (0.97–3.71)	–

Data are odds ratio (95% confidence interval).

* Age, race/ethnicity, marital status, education, and income.

† $P < .05$.

7.6) and nicotine dependence. After adjustment for demographic differences, comorbid Axis I and Axis II mental disorders, the associations between major depressive disorder (OR 2.07, 95% CI 1.26–3.38), dysthymia (OR 6.18, 95% CI 2.91–13.12), and panic disorder (OR 3.1, 95% CI 1.58–6.09) are the only specific disorders that remain significantly associated with nicotine dependence among pregnant women.

DISCUSSION

These data suggest that cigarette use and nicotine dependence are not uncommon among women who

are pregnant in the United States, with more than one in four pregnant women using cigarettes during pregnancy, and approximately one in ten having a diagnosis of nicotine dependence. Second, the data show that although there is an association between cigarette use (without nicotine dependence) and mental disorders during pregnancy using unadjusted modeling, this association is explained by the confounding effects of demographic characteristics. Third, mental disorders seem to be strongly associated with nicotine dependence among women who are pregnant. The link between mental disorders, specifically major



Table 4. Adjusted Association Between Mental Disorders and Nicotine Dependence Among Pregnant Women in the United States

If Diagnosed Within Past Year	Among Pregnant Women, Odds of Past Year Nicotine Dependence			
	Unadjusted	Adjusted for Demographics*	Adjusted for Demographics and Other Axis I Disorders	Adjusted for Demographics and Other Axis I and Axis II Disorders
Any Axis I diagnosis	5.07 (3.48–7.38) [†]	4.18 (2.83–6.17) [†]	–	3.26 (2.09–5.09) [†]
Any mood disorder	5.40 (3.53–8.26) [†]	3.77 (2.49–5.72) [†]	3.20 (2.03–5.05) [†]	2.48 (1.54–4.01) [†]
Major depressive disorder	4.91 (3.18–7.60) [†]	3.39 (2.18–5.29) [†]	2.04 (1.23–3.37) [†]	2.07 (1.26–3.38) [†]
Dysthymia	16.90 (6.24–45.75) [†]	9.94 (4.18–23.63) [†]	5.52 (2.61–11.70) [†]	6.18 (2.91–13.12) [†]
Hypomania	4.23 (1.60–11.16) [†]	2.70 (0.90–8.12)	1.48 (0.42–5.21)	1.57 (0.46–5.42)
Any anxiety	2.79 (1.93–4.04) [†]	2.50 (1.66–3.79) [†]	1.74 (1.09–2.76) [†]	1.44 (0.87–2.40)
Panic disorder	6.84 (3.37–13.85) [†]	5.47 (2.81–10.65) [†]	3.02 (1.51–6.06) [†]	3.10 (1.58–6.09) [†]
Social phobia	3.78 (1.67–8.56) [†]	2.53 (1.12–5.68) [†]	1.38 (0.57–3.30)	1.39 (0.61–3.20)
Specific phobia	2.34 (1.55–3.54) [†]	2.27 (1.44–3.57) [†]	1.52 (0.93–2.49)	1.57 (0.97–2.54)
Generalized anxiety disorder	3.69 (1.64–8.26) [†]	2.82 (0.96–8.33)	1.52 (0.49–4.66)	1.61 (0.55–4.73)
Any personality disorder	4.15 (2.82–6.11) [†]	3.36 (2.19–5.17) [†]	2.23 (1.36–3.66) [†]	–

Data are odds ratio (95% confidence interval).

* Age, race/ethnicity, marital status, education, and income.

[†] $P < .05$.

depression, dysthymia, and panic disorder, does not seem to be explained by either demographic factors or comorbid mental disorders. Below we will review these findings in the context of previous work, and then discuss them in terms of implications for future research.

Cigarette smoking during pregnancy is the single most preventable cause of illness and mortality among mothers and infants, yet cigarette use continues among pregnant women in the United States.^{31,32} Our study indicates that one of every five (21.7%) pregnant women use cigarettes, and approximately one of every 10 pregnant women (12.4%) are nicotine dependent in the United States. These results are consistent with previous reports, such as a study done by Wang et al² showing that approximately one of every 10 (13.2%) women used cigarettes while pregnant in the United States in 1997. In addition, our study provides detailed information in terms of the distribution of these behaviors across demographic groups in the United States population, as well as new data on prevalence of nicotine dependence among pregnant women. Similar to general trends in cigarette use, these results suggest that cigarette use and nicotine dependence are most common among women who are unmarried, have less than high school education, and lower personal incomes.^{24,33} These findings are not surprising, but are distressing for a number of reasons that relate both to the health of women in the United States and to the future health of their offspring. First, the data suggest that prenatal smoking occurs most frequently among women al-

ready in vulnerable circumstances, which are likely to include poverty and limited access to health care services, thereby potentially reducing sources of exposure to smoking cessation resources.³³ This reduction in access may passively contribute to a decrease in the likelihood of some women quitting smoking upon becoming pregnant and thereby increase rates of the resultant adverse outcomes in these groups.²⁶ According to the Centers for Disease Control and Prevention, upwards of 70% of those individuals who smoke would like to quit.²⁷ Previous clinical findings also suggest that the majority of women who smoke do not quit during pregnancy, and that those with nicotine dependence are even less likely to quit later in life.²⁷ Given the previously described health impact of prenatal smoking on the fetus, the potential importance of reaching this underserved, vulnerable population cannot be underestimated. Although previous studies have shown that increasing cessation rates among women is likely to be slow, progress can be made with the aid of intervention programs. For instance, in Britain, approximately one in four smokers in intervention programs were shown to give up smoking during pregnancy and in the United States, cessation rates of around 40% are reported among pregnant smokers in cessation studies.⁸

In previous epidemiologic studies of mental disorders and cigarette use, major depression and panic disorder have shown a strong link with cigarette use and nicotine dependence. Therefore, our finding that these associations persist after adjustment is congruent with previous data.^{34–36} It was unexpected, how-



ever, that the strongest link emerged between dysthymia and nicotine dependence. Dysthymia is considered a chronic condition, with a duration of two years needed for diagnosis. As such it may be that smoking is entrenched among women with dysthymia and may impede efforts to quit among women who become pregnant. If replicated, this finding may have important implications for detection and prevention of smoking and mental health problems among pregnant women, especially those that may contribute to problematic health behavior.³⁷⁻⁴¹ In examining the differences in odds ratios after each subsequent adjustment, it seems that demographics play a considerable role in these linkages for both mood and anxiety disorders. For anxiety disorders, the majority of associations were no longer significant after adjustment for comorbid mood, anxiety, and other substance use disorders, suggesting these linkages were likely to have been strongly influenced by comorbid mood disorders. It is also noteworthy that personality disorders were independently associated with increased likelihood of nicotine dependence among pregnant women. Future studies will be needed to understand the implications of these links for women and children's health.

There are several limitations of this study that should be noted when interpreting results. First, because the data are cross-sectional, it is not possible to determine the mechanism of association between cigarette use and mental disorders. Future studies that can examine this link using longitudinal data would be beneficial toward understanding the cause and developing better methods of prevention. Second, because we did not have any biologic measures of tobacco use (ie, serum cotinine) we must rely on self-report of cigarette use, which is vulnerable to report bias. Third, because this study was not designed to specifically assess cigarette use during pregnancy, imprecise measures could lead to some misclassification bias. For instance, some women may have ceased smoking at the onset of their pregnancy, which these measures would not fully capture. Conversely, it is also feasible that women underreport cigarette use during pregnancy due to social stigma,⁴² and recent research indicates that pregnant smokers with a mood disorder are more likely to underreport cigarette use than smokers without a mood disorder.⁴³ Should this be the case in our data, the estimates reported are likely underestimates of the true association between smoking and psychopathology during pregnancy. The results of these data warrant study designs intended to assess this relationship using more precise measures; for instance, smoking by trimester.

Our results are troubling from an intervention perspective because previous results show that anxiety disorders and depression are associated with less success in quit attempts among smokers, due to numerous factors, including exacerbated withdrawal symptoms among individuals with anxiety disorders, as well as continued cigarette use to abate the symptoms of these disorders.^{25,26,44} As such, treatment of mental health disorders in this population, in conjunction with treatment for nicotine dependence, may be indicated.^{45,46} There is substantial evidence that maternal depression and anxiety disorders are associated with increased risk for both physical and mental health problems in offspring and therefore should be treated both in the presence or absence of nicotine dependence.⁴⁷⁻⁴⁹ It also should be kept in mind, however, that treatment strategies are likely to be limited to behavioral, rather than pharmacologic interventions during pregnancy due to unknown risk of exposure to the fetus to antidepressants and other psychopharmacologic agents.⁵⁰ As such, novel efforts to intervene in prenatal smoking or nicotine dependence are being conducted in various studies across the United States.^{39-41,51} Results suggest an urgent need for smoking cessation and nicotine dependence treatment and that mental health outreach programs might be indicated in conjunction with prenatal care, especially in underserved areas, as rates of high-risk behaviors that may lead to future complications to offspring have been high in such areas.⁵² The potential importance of these efforts cannot be underestimated as both untreated nicotine dependence and mental disorders may lead to undesirable consequences for both the mother and fetus, especially due to evidence that depressed mothers are more likely to use cigarettes, consume alcohol, have poor nutrition, exhibit suicidal behavior, and have prolonged or premature labor and low birth weights compared with those who are not depressed.⁵⁰

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