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Anxiety, Depression and Oral Health among U.S. Pregnant Women: 2010 Behavioral Risk Factor Surveillance System

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Abstract

Objectives—Maternal periodontal disease is associated with adverse perinatal outcomes.

Anxiety and depression adversely impact oral health in non-pregnant women; however this association has not been evaluated during pregnancy, a time characterized by higher rates of anxiety and depression. Therefore, we examined the association between these factors and oral disease and oral healthcare utilization among 402 pregnant respondents to the 2010 Behavioral Risk Factor Surveillance System.

Methods—Self-reported lifetime diagnoses of anxiety, depression, and current depression were assessed. Oral health outcomes included self-reported tooth loss and dental visits in the past year.

Results—One-fifth (21.2%) of respondents reported a tooth loss and 32.5% reported non-use of oral health services. The prevalence of lifetime diagnosed anxiety and depression was 13.6% and 11.3%, respectively, while 10.6% reported current depression. After adjusting for risk factors, pregnant women with diagnosed anxiety had increased odds of 1 tooth loss (odds ratio (OR)=3.30; 95% confidence interval (CI): 1.01–10.77) compared to those without the disorder. Similarly, after adjusting for socioeconomic factors, women with anxiety had increased odds of non-use of oral health services (OR=2.67; 95% CI: 1.03–6.90), however this was no longer

significant after adjusting for health behaviors and body mass index. We observed no significant association with depression.

Conclusions—In this population-based sample, we found a 2–3 fold increased odds of tooth loss and non-use of oral health services among pregnant women with a lifetime diagnosis of anxiety. To our knowledge, this is the first study to examine these associations among pregnant women.

Keywords

anxiety; depression; tooth loss; dental visits; pregnancy

Introduction

Oral health is increasingly recognized as an important public health concern, particularly among pregnant women. Maternal periodontal disease has been associated with adverse pregnancy and neonatal outcomes such as preterm birth and low birth weight, intrauterine growth restriction or small-for-gestational age, preeclampsia, and miscarriage or pregnancy loss (1). In addition, high bacterial titers in maternal saliva may lead to direct vertical transmission of cariogenic bacteria from mother to the child, thus elevating the risk for early childhood caries (2).

Pregnant women are at high risk for oral disease. For example, while an estimated 6% of reproductive aged U.S. women from the 1999–2004 National Health and Nutrition Examination Survey (NHANES) had periodontitis (3), up to 30% of pregnant women are affected by periodontal disease (4) and pregnant women have significantly higher mean gingival index scores as compared to non-pregnant women (5). Rates of oral disease during pregnancy are even higher in ethnic minority groups such as Hispanic women. In a recent study among pregnant low income Hispanic women (6), the prevalence of untreated dental caries was 93% in comparison to rates of 25% among reproductive aged U.S. women in NHANES (3). While demographic (i.e., low education or acculturation) and behavioral factors (i.e., not flossing) were associated with oral disease in bivariate analyses, ever having professional teeth cleaning was the only factor significantly and inversely associated with untreated disease in this population of pregnant Hispanic women (6).

Despite the higher risk for oral disease in pregnancy, pregnant women use dental services less frequently than the general population. Studies of oral healthcare utilization have shown that less than one half (23–42%) of women visit the dentist during pregnancy (7) as compared to rates of 66.6–70.1% during non-pregnancy (8). In these studies, Hispanic ethnicity, low education or income levels, not being married, and increasing parity were significantly associated with lower use of dental services during pregnancy (7), suggesting that other factors such as socioeconomic and demographic characteristics can lead to avoidance of dental treatment during pregnancy and can be more important in increasing the risk of oral disease than pregnancy itself.

Anxiety and depression may contribute to the risk of oral disease through a direct pathophysiological effect on host resistance via immunologic and neuroendocrine

mechanisms (9). Anxiety and depression may also impact oral disease via adverse health behaviors (e.g. poor oral hygiene, negative changes in diet, increase in smoking, etc.), which are known to potentiate oral disease (9). Women experience high levels of anxiety during pregnancy (10) and a recent meta-analysis reported point prevalence estimates for prenatal depression ranging from 8.5%–11.0% in different trimesters (11).

To our knowledge, no prior studies have evaluated the association between psychosocial factors and oral health during pregnancy. Among men and non-pregnant women, prior research is sparse and conflicting. The few prior studies have been conducted among a community-dwelling sample of the U.S. population (12), periodontal patients (13), male employees (14), and health science students (15). None of these studies were conducted among a population of pregnant women, a group at high risk for oral disease.

Therefore, we examined the association between anxiety and depression and risk of oral disease and oral healthcare utilization among pregnant women using data from the 2010 Behavioral Risk Factor Surveillance System (BRFSS). We hypothesized that anxiety and depression would be positively associated with tooth loss and inversely associated with oral healthcare utilization.

Materials and Methods

Study Design

The BRFSS is a state-based surveillance system established by the Centers for Disease Control and Prevention designed to measure behavioral risk factors among the adult population (18 years of age or older) living in households (16). Briefly, in 1984, an independent probability sample of households with telephones was selected from among the non-institutionalized adult population in the United States. In 2010, 50 states and the District of Columbia used a disproportionate stratified sample design. Guam, Puerto Rico, and the U.S. Virgin Islands used a simple random sample design. Data were collected through monthly telephone interviews and weighted to reflect the respondent's probability of selection and the age and sex-specific or race/ethnicity-, age- and sex specific population of the state/territory. The BRFSS study has been approved by the Human Research Review Boards of the Centers for Disease Control and Prevention and the state departments of health. In 2010, 13 states administered the optional Anxiety and Depression Module (ADM). Female respondents were asked about their current pregnancy status at the time of the survey. A total of 19 (4%) participants were missing information on anxiety and/or depression. Therefore, the current analyses were limited to pregnant women with complete data on anxiety, depression and oral health from those 13 states (n=402).

Lifetime Anxiety

Lifetime anxiety was assessed via the ADM. Specifically, respondents were asked: "Has a doctor or other healthcare provider ever told you that you had an anxiety disorder (including acute stress disorder, anxiety, generalized anxiety disorder, obsessive-compulsive disorder, panic disorder, phobia, post-traumatic stress disorder or social anxiety disorder)?"

Lifetime Depression

Similarly, lifetime depression was assessed via the ADM using the question: “Has a doctor or other healthcare provider ever told you that you had a depressive disorder (including depression, major depression, dysthymia or minor depression)?”

Current Depression

Current depression was evaluated using a modified version of the Patient Health Questionnaire 8 (PHQ-8) (17). Respondents were asked about the number of days in the past two weeks they experienced a particular depression symptom. The scores for each item were summed to produce a total score between 0 and 24 points. Women with a total score 10 or more were categorized as having current depression based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV).

In addition, current depressive symptoms were defined according to severity as none (total score 0–4), mild (total score 5–9), moderate (total score 10–14), moderately severe (total score 15–19), and severe (total score 20–24) (17).

Validity of Anxiety and Depression Measures

The PHQ-8 is adapted from the 9-item scale (i.e. PHQ-9) (17). Construct validity has been demonstrated by a strong association between PHQ scores and functional status, disability days, and symptom related difficulty. The cut-point for current depression is well-established with a high sensitivity (100%) and specificity (95%) for major depression validated against the Structured Clinical Interview for DSM-IV (SCID) (17). Receiver Operating Characteristic (ROC) analysis has shown an area under the curve of 0.95 for the PHQ, indicating that the scale discriminates well between persons with and without major depression. The PHQ-8 has been validated in the general population (17). In addition, the PHQ has been validated for detecting depression in the perinatal period (18).

While the self-reported measures of lifetime diagnosed anxiety and lifetime diagnosed depression, as assessed via the ADM, have not been validated per se, these measures have been found to be statistically significant predictors of such important health outcomes as obesity and health risk behaviors such as physical inactivity, smoking and heavy alcohol consumption (19). Structured questionnaires like the ADM are the most frequently used type of cognitive assessment, and are designed to have high content validity (i.e., the sample of thoughts included in the questionnaire are representative of the actual thoughts of the individual in the population they are tested) (20).

Oral Health Outcomes

Oral disease was assessed via self-reported tooth loss. Respondents' tooth loss was assessed by asking the question “How many of your permanent teeth have been removed because of tooth decay or gum disease? Include teeth lost due to infection, but do not include teeth lost for other reasons, such as injury or orthodontics”. Tooth loss was analyzed as a binary variable (none vs. 1 or more) consistent with prior literature (12).

Oral healthcare utilization was assessed via number of dental visits and/or teeth cleanings in the past year. Respondents were asked: (1) How long has it been since you last visited a dentist or a dental clinic for any reason? and (2) How long has it been since you had your teeth cleaned by a dentist or dental hygienist? Respondents who reported never having visited a dentist or missing all their permanent teeth were not asked about their teeth cleaning. In the present analyses, oral healthcare utilization was defined as having either a dental visit and/or reported teeth cleaning within the past year (no vs. yes) consistent with prior literature (12).

Previous studies have demonstrated high validity of self-reported number of teeth present (21). Similarly, self-reported dental visits has been observed to correlate with patient dental records (percent concordance: 84–91%; kappa: 0.68–0.81) (22).

Covariates

At the time of interview, information was collected on age, race/ethnicity, education, annual household income, health insurance, current employment, marital status, and number of children (less than 18 years of age) in the household. Data were also collected on behaviors such as cigarette smoking status and alcohol consumption. Current BMI was calculated from self-reported height and weight. All covariates were categorized for analyses.

Data Analysis

We examined the distribution of baseline characteristics according to tooth loss and oral healthcare utilization using chi square tests. Individual unadjusted and multivariable logistic regression models were used to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for the association between psychosocial factors – anxiety and depression, and oral health outcomes – tooth loss and oral healthcare utilization. Variables associated with the outcomes in unadjusted logistic models at $p < 0.20$ were evaluated as potential confounders, consistent with the recommendation to use a more modest type 1 error rate to ensure that we did not miss an important covariate (23). Variables of known importance such as demographic and socioeconomic factors (e.g., income and health insurance) were also assessed as potential confounders. We further tested for confounding by health behaviors and BMI. All covariates that caused greater than 10 percent change in the coefficient estimate for anxiety or depression were retained in the final models. Final logistic regression models adjusted for socio-demographic factors (Model 1) and behavioral and medical health factors (Model 2).

Sensitivity analyses were conducted comparing characteristics of participants with complete data on anxiety and depression to those missing data on anxiety and depression. Statistical analysis was conducted using the SAS-callable SUDAAN® to account for the complex disproportionate stratified sampling design.

Results

A total of 21.2% of respondents reported oral disease as assessed via self-reported tooth loss, while 32.5% of respondents reported no oral healthcare utilization in the past year as assessed via number of dental visits and/or teeth cleanings.

Overall, the majority of respondents were non-Hispanic White (62%), with almost half reporting a college education (46%), and an annual household income >\$50,000 (44%) (Table 1). Approximately 92% of the respondents had health insurance, and over one-half of the respondents were currently employed (55%) and married (66%). Approximately 58% of the respondents were overweight or obese.

Respondents who were of Hispanic ethnicity, had lower levels of education or lower income were significantly more likely to report tooth loss as compared to those without these factors, respectively (Table 1). Hispanic ethnicity, low levels of education and income, lack of health insurance, being currently unemployed and never married were each significantly associated with no oral healthcare utilization in the past year.

The prevalence of lifetime diagnoses of anxiety and depression was 13.6% and 11.3%, respectively (Table 2). Approximately 10.6% of respondents reported current depression with the majority (8%) reporting moderate symptoms. The mean current depression score was 4.4 (standard deviation (SD) 0.3) out of a possible range of 0 to 24.

We then evaluated the association between anxiety and depression and oral disease (Table 3). After adjusting for socio-demographic characteristics, health behaviors, and BMI, we found that respondents with lifetime diagnosed anxiety had a 3.30 times greater odds of tooth loss as compared to those without anxiety (95% CI: 1.01–10.77). Similarly, we found that respondents with lifetime diagnosed depression had a 1.45 times increased odds of oral disease after adjusting for demographic factors, behaviors such as smoking and alcohol consumption, and BMI (95% CI: 0.54–3.85), however the association was not statistically significant. In the final adjusted models, those with current depression had a 1.18-fold (95% CI: 0.44–3.16) greater odds of tooth loss compared with those without the disorder; however, this association was not statistically significant.

We then evaluated the association between anxiety and depression and oral healthcare utilization. After adjusting for socioeconomic factors, respondents with lifetime diagnosed anxiety had a 2.67 times greater odds of no oral healthcare utilization in the past year compared to those without the disorder (95% CI: 1.03–6.90) (Table 4). However, after adjusting for health behaviors and BMI, this was slightly attenuated and no longer statistically significant (OR=2.48, 95% CI: 0.90–6.85). There was no statistically significant association between lifetime diagnosed depression and no oral healthcare utilization (OR=0.82; 95% CI: 0.26–2.63). Similarly, current depression was not statistically significantly associated with no oral healthcare utilization OR=1.04; 95% CI: 0.35–3.09), after adjusting for socio-demographic, behavioral, and medical history factors.

Respondents missing information on anxiety and depression did not differ significantly from those not missing data in terms of any of the study variables (i.e., age, race, education, household income, insurance, marital status, children in the household, and smoking and alcohol habits).

Discussion

In this analysis of 402 pregnant participants in the 2010 BRFSS, we found that women with lifetime anxiety had a 3-fold increased odds of at least one tooth loss compared to those without the disorder after adjusting for socio-demographic, behavioral, and medical risk factors. Similarly, after adjusting for socioeconomic factors, women with lifetime anxiety had a 2-fold increased odds of non-use of oral health services during pregnancy, however this was slightly attenuated and no longer statistically significant after adjusting for health behaviors and BMI. We did not observe significant associations between lifetime and current depression and oral health outcomes.

While prior studies have not examined the association between psychosocial factors and oral health among pregnant women, our findings of a positive association between lifetime anxiety and tooth loss were consistent with the one prior study which evaluated this association in non-pregnant adults. Specifically, in an analysis of 80,486 adult participants (52% female) from the 2008 BRFSS (12), Okoro et al. found that those with lifetime diagnosis of anxiety (measured via a single question on the ADM) were 1.2 times more likely to report at least one tooth removed than those without the disorder, when adjusted for socio-demographic factors and dental visit or cleaning in the past 12 months (95% CI: 1.1–1.2).

In terms of the association between anxiety and use of oral health services, two of the three prior studies which evaluated this association in non-pregnant adults did not find significant associations (12, 24). However, Marques-Vidal et al. found that anxiety as measured by the Hospital Anxiety and Depression Scale (HADS) was positively associated with dental visits (15) among 388 Portuguese students (75% female). In contrast, we found that lifetime anxiety was associated with a 2-fold increased odds of not utilizing oral healthcare services (assessed via number of dental visits and/or teeth cleaning in the past year). Contrasting findings are likely due to differences in the socio-demographic characteristics and healthcare seeking behavior between the study populations. The Marques-Vidal et al. cohort included health sciences students with greater access to dental care. Specifically, dentist attendance within the past 12 months in this cohort was approximately 81% as compared to 68% in our study population.

The relationship between general anxiety and dental anxiety and avoidance of dental treatment likely influenced our findings. For example, individuals with dental fear or dental anxiety are more likely to have at least one other co-morbid mental health disorder, primarily other anxiety disorders, and are less likely to use regular dental services (25). This could have led to an over estimate of our observed associations. However, due to lack of information on dental anxiety, we were unable to test this hypothesis.

In terms of depression, we observed a non-statistically significant increased report of tooth loss among those reporting lifetime depression (OR=1.45, 95% CI: 0.54–3.85). Associations of depression with increased tooth loss have been observed in two of the four prior studies of this topic in non-pregnant adults (12, 13). Among 80,486 non-pregnant adult participants from the 2008 BRFSS, Okoro et al. found that those with lifetime and current depression

were 1.07 and 1.14 times more likely to have at least one tooth loss respectively, than those without these disorders (12). Similarly, Rosania et al. observed that every 1-point higher the depression score (measured by the CES-D) was statistically significantly associated with a 0.7 times higher tooth loss (assessed via dental examination) among 45 periodontal patients (69% female) (13).

Finally, in terms of depression and health care utilization, similar to Okoro et al. using 2008 BRFSS data (12), we found no association between lifetime diagnosed depression and likelihood of past year dental visits. In contrast, while we found no association between current depression and oral health care utilization, two of the three prior studies on this topic found an inverse association (12, 24). For example, Okoro et al. (12) found that current depression measured using a modified version of the PHQ-8 was associated with a 1.2 times higher likelihood of no past year dental visits (95% CI: 1.1–1.3) among 80, 486 non-pregnant adult participants from the 2008 BRFSS. Similarly, depressive symptoms were inversely associated with 0.95 times lower likelihood of having a dental visit in two years among 8,463 adults (52% female) from the 1966 Northern Finland birth cohort (95% CI: 0.91–0.99). Notably, both of these studies had substantially larger sample sizes than the current study and differences in findings may be due, in part, to their greater ability to detect these small differences in effect.

Our study had several limitations. As data on anxiety, depression and oral health attributes were self-reported, there is likelihood of under or over reporting. However, our study relied on widely used and validated measures for current depression (PHQ-8) (17, 18) and for oral health outcomes (21, 22). Although we adjusted for a number of socio-demographic, behavioral and medical health factors, we were unable to evaluate the effect of other factors associated with use of dental services or tooth loss, such as dental insurance and oral hygiene behaviors such as tooth brushing and dental flossing. To the extent that these factors are associated with anxiety or depression, residual confounding could have occurred.

Treatment for mental disorders (e.g., the use of anti-anxiety or anti-depressant medications) could have influenced our findings. For example, individuals with untreated mental disorders are more likely to engage in negative health behaviors such as non-use of healthcare services during pregnancy (26). However, due to lack of information on treatment, we were unable to evaluate its effect on our findings. While BMI is a simple, reliable tool to measure obesity, its use is often restricted to the pre-pregnancy, early pregnancy, or postpartum time periods. BMI is calculated using self-reported or measured height and weight according to the World Health Organization classification (27). Our study lacked information on women's stages of pregnancy thus limiting our ability to assess the effect of pre-pregnancy BMI or trimester-specific gestational weight gain on our findings.

The cross-sectional design of the study precludes the establishment of temporality, as information on both exposure and outcome was collected concurrently. Thus, it is possible that anxiety and depression result from oral health issues, rather than the converse. For example, oral disease or infrequent use of dental services may contribute to anxiety or depression via low self-esteem co-existing with low socioeconomic status, inadequate social support, other unhealthy lifestyles such as cigarette smoking, and health conditions requiring

greater resources and management (12). However, studies support the role of anxiety and depression in the down regulation of the cellular immune response thus increasing susceptibility to oral disease (28). Through neuroendocrine mechanisms, both anxiety and depression can activate the hypothalamic-pituitary-adrenocortical (HPA) axis leading to an impaired immune response. Alterations in the host response to inflammation through these mechanisms can lead to increased colonization and susceptibility to oral pathogens causing disease. Epidemiological evidence from longitudinal studies supports prospective associations between psychosocial factors such as negative emotional personality (29) and psychological distress (30) and oral disease. Nevertheless, studies with prospective assessment of oral health in pregnant women with psychosocial factors and other risk factors measured at baseline are necessary to conclude temporal ordering of associations among these factors.

Women were asked to recall tooth loss and dental visits within the last year. Therefore, it is possible that for some women, this time period occurred immediately prior to their pregnancy as the BRFSS was not designed with the goal of assessing pregnancy-specific exposures. However, in spite of this limitation, the BRFSS has the advantage of providing unique data on a well-characterized nationally representative population. The current study, therefore, represents an important first step to test the association between anxiety and depression and oral health in pregnant women. Finally, as factors associated with telephone coverage e.g. race/ethnicity, geographic location and socioeconomic status may be associated with anxiety, depression and oral health; we cannot generalize our findings to pregnant women without telephone coverage.

To summarize, the current study represents the first, to our knowledge, to examine the association between anxiety and depression and oral health attributes among pregnant women. Pregnancy represents a vulnerable period where women experience high rates of anxiety and depression, and increased risk of oral diseases. While we found that anxiety was associated with poor oral health and non-use of oral health services during pregnancy, we found that other factors such as belonging to racial/ethnic minorities, being unmarried, having low income or no health insurance, and not receiving early prenatal care can also influence oral health during pregnancy, highlighting the importance of accounting for access to care and demographic characteristics. Our findings have important clinical and public health implications in the incorporation of prenatal psychosocial counseling by prenatal and other health care providers to prevent adverse oral health outcomes and their consequences during pregnancy. In addition, public policies that address psychosocial health among pregnant women would aid in increasing use of oral health services and increase the potential for obtaining improved oral health among this underserved population. Further research is critical to assess the potential of prenatal psychosocial counseling in increasing use of oral health services and improving oral health among this under studied population. Finally, our significant findings for anxiety but not depression highlight the need for future research in order to determine the role of anxiety-specific influences in the development of adverse oral health outcomes, via pathways independent of depression.

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Table 1
Baseline Characteristics of Study Population According to Oral Health; Behavioral Risk Factor Surveillance System, 2010.

	Total Sample			Tooth Loss			No Oral Healthcare Utilization ^d		
	n	N	% (95% CI)	n	%	p-value ^c	n	%	p-value ^c
Age (years)									
24	90	96918	23.6 (17.7, 30.8)	17	14.8	0.36	34	46.5	0.10
25–29	123	114961	28.0 (22.1, 34.8)	36	29.7		43	34.2	
30–34	112	145167	35.4 (28.5, 43.0)	28	19.9		28	27.6	
35–39	61	40408	9.9 (6.6, 14.5)	17	20.4		15	15.4	
40	14	12555	3.1 (1.4, 6.5)	5	26.3		1	20.0	
Race/ethnicity									
White, non-Hispanic	235	251782	61.7 (54.4, 68.5)	40	15.6	0.03	65	29.4	0.02
Black, non-Hispanic	74	70663	17.3 (12.9, 22.9)	24	27.9		26	41.3	
Hispanic	34	38393	9.4 (6.0, 14.6)	15	44.5		16	60.3	
Other ^a	56	47077	11.5 (7.4, 17.6)	25	25.3		13	14.0	
Educational status									
Less than high school	42	45199	11.0 (7.4, 16.1)	18	27.0	0.02	17	44.7	<.0001
High school graduate	86	75277	18.4 (13.4, 24.6)	29	34.6		40	60.2	
Some college	112	103120	25.1 (19.6, 31.7)	33	26.3		34	40.3	
College graduate	162	186711	45.5 (38.1, 53.1)	25	12.8		30	14.0	
Annual Household Income									
<\$15,000	50	57009	13.9 (9.6, 19.6)	25	50.0	0.001	25	54.7	0.03
\$15,000–<\$25,000	59	46146	11.3 (7.7, 16.2)	25	42.3		26	42.4	
\$25,000–<\$35,000	39	42160	10.3 (6.3, 16.4)	11	19.8		13	44.6	
\$35,000–<\$50,000	45	35238	8.6 (5.5, 13.1)	12	13.8		15	25.2	
>\$50,000	160	180413	44.0 (36.7, 51.6)	20	11.0		29	20.3	
Don't know/not sure/missing	49	49341	12.0 (8.3, 17.1)	12	16.2		13	36.7	
Health Insurance									
No	35	31618	7.7 (4.9, 12.2)	10	33.2	0.26	16	61.6	0.04
Yes	367	378689	92.3 (87.8, 95.2)	95	20.8		105	30.0	
Current employment status									

	Total Sample			Tooth Loss			No Oral Healthcare Utilization ^d		
	n	N	% (95% CI)	n	%	p-value ^c	n	%	p-value ^c
Employed	217	225625	55.1 (47.7, 62.3)	45	17.3	0.14	53	26.2	0.05
Unemployed	43	30147	7.4 (4.8, 11.2)	19	17.3		20	61.3	
Not in labor force ^b	141	153575	37.5 (30.7, 44.8)	41	25.5		47	35.5	
Marital status									
Never married/unmarried couple	109	124421	30.4 (23.6, 38.0)	45	17.3	0.78	44	46.7	0.03
Married	269	268906	65.6 (57.9, 72.5)	19	36.5		68	26.2	
Divorced/Separated/Widowed	23	16644	4.1 (2.2, 7.4)	41	25.5		8	25.3	
Children (<18 yrs) in household									
0	109	129198	31.6 (24.7, 39.4)	20	14.7	0.16	39	33.3	0.94
1	126	124577	30.4 (24.0, 37.7)	28	22.5		33	29.4	
2	107	107828	26.4 (20.5, 33.2)	36	22.1		29	34.5	
3+	58	47688	11.7 (8.3, 16.1)	20	37.8		19	33.8	
Alcohol consumption in the past month									
No	377	383305	94.2 (88.9, 97.1)	95	21.1	0.61	114	33.7	0.09
Yes	18	23452	5.8 (2.9, 11.1)	7	29.5		6	12.0	
Smoking status									
Never smoker	270	268456	65.4 (57.8, 72.3)	61	18.8	0.20	66	27.2	0.05
Former smoker	96	105252	25.7 (19.6, 32.8)	27	22.3		40	48.3	
Current smoker	36	36598	8.9 (5.1, 15.2)	17	41.9		15	25.3	
BMI (kg/m ²)									
Neither overweight nor obese (<25)	148	157827	38.5 (31.3, 46.2)	31	13.3	0.07	38	23.5	0.18
Overweight (25–<30)	113	104500	25.5 (19.7, 32.3)	29	26.9		31	34.6	
Obese (≥ 30)	126	132770	32.4 (26.0, 39.4)	43	28.7		46	41.7	
Don't know/not sure/refused/missing	15	15209	3.7 (1.9, 7.3)	2	13.3		6	29.8	

n, unweighted sample size; N, population estimate; %, weighted percentage and 95% Confidence intervals (CI)

^aIncludes multiracial and other non-Hispanic race

^bIncludes student/homemaker/retired/unable to work

^cp-values from chi square tests for categorical variables

No Oral Healthcare Utilization defined as no dental visits or teeth cleaning in the past year

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Table 2

Anxiety and Depression in the Study Population; Behavioral Risk Factor Surveillance System, 2010.

	Total Sample		
	n	N	% (95% CI)
Anxiety			
Lifetime diagnosed anxiety			
No	329	336180	86.4 (80.6, 90.6)
Yes	51	53023	13.6 (9.4, 19.4)
Depression			
Lifetime diagnosed depression			
No	333	347416	88.7 (83.4, 92.5)
Yes	48	44282	11.3 (7.5, 16.6)
Current depressive symptoms ^a			
No	338	351745	89.4 (84.4, 93.0)
Yes	45	41530	10.6 (7.0, 15.6)
Current depressive symptoms			
None (0–4)	244	241021	61.3 (53.5, 68.6)
Mild (5–9)	94	110724	28.2 (21.4, 36.1)
Moderate (10–14)	33	31619	8.0 (4.9, 12.9)
Moderately severe (15–19)	8	7321	1.9 (0.8, 4.3)
Severe (20–24)	4	2591	0.7 (0.2, 1.9)
Current depression score (Mean, SD)	4.4 (0.3)		

^aCurrent depressive symptoms as defined by total Patient Health Questionnaire (PHQ-8) score ≥ 10

n, unweighted sample size; N, population estimate; %, weighted percentage and 95% Confidence intervals (CI)

Table 3

Unadjusted and Multivariable Odds of Tooth Loss According to Anxiety and Depression; Behavioral Risk Factor Surveillance System, 2010.

	Tooth Loss ^a					
	Unadjusted		Model 1		Model 2	
	OR	95% CI	OR	95% CI	OR	95% CI
Anxiety						
Lifetime diagnosed anxiety						
No	1.00	referent	1.00	referent	1.00	referent
Yes	1.80	(0.80, 4.07)	3.28	(1.17, 9.19)	3.30	(1.01, 10.77)
Depression						
Lifetime diagnosed depression						
No	1.00	referent	1.00	referent	1.00	referent
Yes	1.76	(0.71, 4.33)	1.56	(0.62, 3.90)	1.45	(0.54, 3.85)
Current depressive symptoms ^b						
No	1.00	referent	1.00	referent	1.00	referent
Yes	1.51	(0.64, 3.55)	1.13	(0.42, 3.03)	1.18	(0.44, 3.16)
Current depression score	1.04	(0.97, 1.12)	1.04	(0.97, 1.12)	1.04	(0.96, 1.12)

Odds ratios (ORs) and 95% confidence intervals (CIs) from multivariable logistic regression models

Model 1 - adjusted for age, race/ethnicity, education, income, health insurance, employment, and marital status

Model 2 - additionally adjusted for smoking status, alcohol consumption, and body mass index

^a Adjusted for dental visits/teeth cleaning within the past year

^b Current depressive symptoms as defined by total Patient Health Questionnaire (PHQ-8) score

Unadjusted and Multivariable Odds of No Oral Healthcare Utilization According to Anxiety and Depression; Behavioral Risk Factor Surveillance System, 2010.

Table 4

	<i>b</i> No Oral Healthcare Utilization					
	Unadjusted			Model 1		
	OR	95% CI	OR	95% CI	OR	95% CI
Anxiety						
Lifetime diagnosed anxiety						
No	1.00	referent	1.00	referent	1.00	referent
Yes	1.73	(0.72, 4.14)	2.67	(1.03, 6.90)	2.48	(0.90, 6.85)
Depression						
Lifetime diagnosed depression						
No	1.00	referent	1.00	referent	1.00	referent
Yes	0.74	(0.28, 1.91)	1.09	(0.35, 3.39)	0.82	(0.26, 2.63)
Current depressive symptoms ^a						
No	1.00	referent	1.00	referent	1.00	referent
Yes	1.52	(0.63, 3.70)	0.99	(0.35, 2.80)	1.04	(0.35, 3.09)
Current depression score	1.04	(0.97, 1.12)	1.03	(0.95, 1.12)	1.02	(0.94, 1.12)

Odds ratios (ORs) and 95% confidence intervals (CIs) from multivariable logistic regression models

Model 1 - adjusted for age, race/ethnicity, education, income, health insurance, employment, and marital status

Model 2 - additionally adjusted for smoking status, alcohol consumption, and body mass index

^aCurrent depressive symptoms as defined by total Patient Health Questionnaire (PHQ-8) score 10

^bNo Oral Healthcare Utilization defined as no dental visits or teeth cleaning in the past year