Sleep apnea, psychopathology, and mental health care

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Abstract

OBJECTIVE—Sleep apnea has been shown to be associated with mental health conditions. This study examined the association between sleep apnea and psychopathology and mental health service utilization in a U.S. nationally representative sample.

DESIGN—National Survey on Drug Use and Health (NSDUH).

SETTING—United States.

PARTICIPANTS—We used data on 264,653 individuals who participated in the 2008–2014 waves of the NSDUH, of which 5,498 (3.3%) reported having sleep apnea within the past year.

INTERVENTION—N/A.

MEASUREMENTS—Based on NSDUH responses, participants were categorized as having depression, suicidal ideation, anxiety, and serious psychological distress within the past year. Analyses consisted of using logistic regression models with sleep apnea as the main predictor and mental health conditions as the outcomes of interest, controlling for potential confounding variables.

RESULTS—Compared to those without sleep apnea, those reporting past year sleep apnea had 3.11 (95% Confidence Interval [CI]=2.77–3.50) times increased odds of having depression, 2.75 (95% CI=2.34–3.23) times increased odds of suicidal ideation, 3.68 (95% CI=3.30–4.10) increased odds of anxiety, and 2.88 (95% CI=2.61–3.17) times increased odds of severe psychological distress after controlling for confounders. Among those with each psychiatric outcome, individuals with sleep apnea were substantially more likely to report unmet need for mental health care, despite reporting greater mental health service use.

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CONCLUSIONS—Individuals with sleep apnea have increased risk for psychopathology, including suicidal ideation. Efforts to address the mental health care needs of those with sleep apnea are needed.

Keywords

sleep apnea; suicidal ideation; depression; anxiety; unmet need

INTRODUCTION

Sleep apnea is highly prevalent, affecting 13% of men and 6% of women in the general adult population in the United States,[1] and is commonly comorbid with numerous chronic health conditions,[2] including hypertension,[3,4] chronic obstructive pulmonary disease,[5] and obesity[6] among others. Studies show these health conditions to be risk factors for, exacerbated by, and develop subsequent to the onset of sleep apnea.[7] As such, efforts to manage physical health conditions among those with sleep apnea have been a top priority for research, public health policy, and clinical practice.[8]

Studies show an association between sleep apnea and mental health conditions—with mood, anxiety, and post-traumatic stress disorder, being highly comorbid with sleep apnea, and there are reports of higher risk of sleep apnea in psychosis and schizophrenia as well.[9] There is also more recent evidence to suggest an association between sleep apnea and suicidal thinking and behaviors,[10,11] but these have been primarily limited to studies with smaller sample sizes and case reports. Although epidemiological studies have demonstrated links between sleep disturbances (e.g., insomnia) and suicidal thinking and behavior,[12–14] suicidal ideation has not been fully examined specifically in sleep apnea patients. Understanding the role of sleep apnea in suicidality in addition to other psychopathology in a nationally representative sample may provide insights about their co-occurrence so as to inform population health.

Moreover, given the high prevalence of mental health conditions in sleep apnea, it is surprising that little research has examined the extent to which people with sleep apnea access mental health care (and their perceptions of whether it is addressing their needs). While sleep apnea has been shown to be associated with elevated overall health service use[15,16] and costs,[17] more research is needed to determine whether individuals with sleep apnea also have unmet needs for mental health care.

This study examined the association between sleep apnea and psychopathology (including depression, suicidal ideation, anxiety, and serious psychological distress) in a nationally representative sample of US adults, and whether needs for mental health care were met. We hypothesized that compared to individuals without sleep apnea, those with sleep apnea would show substantially greater risk of concurrent psychopathology. Additionally, we hypothesized that among those with the specific mental health conditions, individuals with sleep apnea would report greater use of mental healthcare services but also greater unmet need for care than the remaining sample.

PARTICIPANTS AND METHODS

Data source

This study combined data from the 2008 to 2014 waves of the National Survey on Drug Use and Health (NSDUH).[18] The NSDUH is a cross-sectional national survey conducted annually by the Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. The NSDUH targets nationally representative non-institutionalized individuals in the United States who are 12 years old and older. The sample is randomly selected annually from 50 states and District of Columbia. The primary purpose of the NSDUH is to collect data to estimate state-level and national prevalence and patterns of substance use and mental health. The NSDUH data are collected by in-person interviews in study participants' homes, which last approximately an hour. The weighted NSDUH interview response rate across all years in our study ranged from 71.2% to 75.6%. Our study sample consisted of participants who were 18+ years old. Since only a small portion of observations had missing data (n = 6,667, 2.5% out of 271,320) for any one variable in our analysis, we conducted statistical analyses with complete cases (n = 264,653).

Measures

Sleep Apnea—NSDUH participants were asked "Which, if any, of these conditions did a doctor or other medical professional tell you that you had in the past 12 months?" of which sleep apnea was listed as a condition. Individuals were categorized as having sleep apnea based on an affirmative response to this question.

Psychopathology—*Depression*. A diagnosis of major depressive episode (based on criteria in the Diagnostic Statistical Manual of Mental Disorders [DSM-IV])[19] was obtained through use of structured diagnostic interview (adopted from the Composite International Diagnostic Interview [CIDI] administered in the National Comorbidity Survey Replication)[20] delivered by study staff. The CIDI depression module has been shown to have high concordance with other validated measures of psychopathology.[21] Individuals were identified as having a major depressive episode if they met five out of the following criteria within a past 12 month time interval: (i) depressed/irritated mood most of day within past 2-weeks, (ii) lower interest/pleasure derived from all activities, (iii) change in appetite and/or body weight, (iv) change in sleeping patterns, (v) change in activities or behaviors, (vi) low energy/fatigue, (vii) feelings of guilt or worthlessness, (viii) lower concentration, (ix) repeated thought of death. *Suicidal ideation*. Suicidal ideation was assessed through a single question: "At any time in the past 12 months, that is from [datefill] up to and including today, did you seriously think about trying to kill yourself?" with response options being yes or no. *Anxiety*. Participants were asked whether a doctor had told them they had an anxiety disorder (yes/no) within the past year. *Serious psychological distress*. Participants were categorized as having serious psychological distress based on a score of greater than or equal to 13 during the worst month of the past year on the K6 Kessler Psychological Distress Scale.[22] The K6 has been shown to have excellent internal consistency and reliability (area under the curve=0.89).[23]

Mental health service use patterns—NSDUH participants were asked to report whether they received a variety of mental health services in the prior year. We categorized individuals as having received any mental health services and those who did not.

Unmet need for mental health care—NSDUH participants were identified as having unmet need for care by response to the following question: "During the past 12 months, was there any time when you needed mental health treatment or counseling for yourself but didn't get it?" with response options being "yes" or "no."

Other variables—NSDUH also asked respondents to indicate their sex, age (18–25, 26–34, 35–49, 50–64, and 65+), race/ethnicity (white, black, other, Hispanic), income (< $20,000, $20,000–49,999, $50,000–74,999, $75,000+), marital (married, widowed, divorced or separated, never married) and employment status (full-time, part-time, unemployed, out of labor force), education (<high school, high school graduate, some college, college graduate), and past-year alcohol or illicit drug abuse/dependence, based on DSM-IV criteria. The details of assessment of past-year alcohol or illicit drug abuse/dependence are described in Appendix D ("Recoded Substance Dependence and Abuse Variable Documentation") in the NSDUH codebooks (NSDUH, 2008–2014).

Statistical analyses

We completed a three-stage analysis. First, we pooled data from all survey years (i.e., 2008–2014) to examine demographic characteristics comparing past year sleep apnea to that of the remaining sample, and used Rao–Scott F adjusted chi-square statistics to assess differences across these groups. Second, we assessed the association between past year sleep apnea and depression, suicidal ideation, anxiety, and serious psychological distress. Four separate logistic regression models were estimated with each of the four conditions serving as the outcomes, and past year sleep apnea as the predictor of interest. These regression models also controlled for participant sex, age, race/ethnicity, income, marital status, employment status, education, and any illicit drug or alcohol abuse/dependence. In order to control for any temporal trends over the study period, we also controlled for survey year using dummy-variables with the 2008 year serving as the reference. Finally, in order to determine whether there were differences in mental health service use patterns between those with and without sleep apnea, we conducted logistic regression models with sleep apnea as the outcome and the mental health service use as the predictor. We also repeated these analyses with unmet need as the predictor. These analyses were limited to those with each mental health condition under consideration in this study, and adjusted for the same variables as in previous analysis stages. All analyses were conducted in Stata Version 13 (StataCorp, College Station, TX), and accounted for complex sampling design using survey design variables and population weights provided by NSDUH, by using "svy" command.

RESULTS

Across all years of our study (e.g., 2008–2014), approximately 3.3% (n=5,498) of respondents reported they had sleep apnea in the past year and 96.7% (n=259,155) did not. Compared to those who did not have sleep apnea in the past year, those with sleep apnea

were on average older, less likely to be of race/ethnicity minority status and have illicit drug and alcohol abuse/dependence, and more likely to have higher income, to be married, to be out of the labor force, and to have higher levels of education (all p's <0.01) (Table 1).

Past year sleep apnea was associated with a 3.11 (95% Confidence Interval [CI]=2.77–3.50) times increase in the odds of reporting depression in the past year compared to those who did not have sleep apnea after controlling for potential confounders (Table 2). Additionally, compared to those without sleep apnea, past year sleep apnea was associated with a 2.75 (95% CI=2.34–3.23) times increased odds of suicidal ideation, 3.68 (95% CI=3.30–4.10) increased odds of anxiety, and 2.88 (95% CI=2.61–3.17) times increased odds of severe psychological distress (Table 2).

Individuals with sleep apnea were on average more likely to report use of mental health services compared to those without sleep apnea. Mental health service use was more common among the sleep apnea group versus the no sleep apnea group for those with depression (AOR=2.12, 95% CI=1.66–2.72), suicide ideation (AOR=2.53, 95% CI=1.76–3.63), and serious psychological distress (AOR=2.77, 95% CI=2.22–3.46) (Table 3). Individuals with sleep apnea were also more likely to report unmet need for mental health care. Unmet need was more common in the sleep apnea group (versus the no sleep apnea group) for those with depression (AOR=1.25, 95% CI=1.02–1.53), suicide ideation (AOR=1.56, 95% CI=1.23–1.98), anxiety (AOR=1.53, 95% CI=1.23–1.89), and severe psychological distress (AOR=1.39, 95% CI=1.18–1.64) (Table 4).

DISCUSSION

Sleep apnea represents a substantial public health burden that is expected to become more pronounced over the next 20 years.[8] Its high prevalence, conflated by the rising obesity rate and growing incidence of chronic health conditions, makes it imperative that sleep apnea is addressed and properly managed. Addressing the mental healthcare needs of sleep apnea patients may be an important component of these efforts. Our study found that individuals with sleep apnea were at substantially greater risk of having psychopathology, even including suicidal ideation. We also found that those with sleep apnea were more likely to report perceived unmet need for mental health care compared to the remaining sample.

Our study confirms previous reports of a link between sleep apnea and mental health conditions. A study among veterans with sleep apnea seen in the Veterans Administration Healthcare System found that a fifth had comorbid depression, 17% had anxiety, and 12% had PTSD diagnoses,[9] all within the range of prevalence our study found. Data from the Wisconsin Sleep Cohort Study suggests a dose-response relationship between sleep apnea severity and risk for future development of depression, showing an overall doubling increased risk.[24] Our study adds to these investigations by showing patients with sleep apnea are at risk for having a range of mental health conditions including suicidal ideation, even after controlling for demographic and clinical characteristics all for which have been shown to increase risk for mental health problems.

A notable finding is the magnitude of the effect sizes seen for the association between sleep apnea and psychopathology. These associations were substantially higher than those seen in previous studies examining simply sleep disturbances (e.g., insomnia or disturbed sleep) and psychopathology. For example, meta-analyses have shown insomnia to be associated with a 2.27 times increased pooled risk for depression,[25] and a 1.94 times increased adjusted risk of suicide ideation,[14] below those observed in our study (3.11 for depression, 2.75 for suicide ideation). It is possible that there may be additive effects that magnify the risk for psychopathology among those with sleep apnea beyond the resulting impaired sleep inherent in the disorder. Future research may seek to identify whether any additive effect of sleep apnea may translate to negative mental health outcomes.

It should be acknowledged that the observed associations between sleep apnea and psychopathology may in fact be artificially amplified for a couple of reasons. First, respondents reported whether a doctor had told them they had sleep apnea (e.g., diagnosed). However, sleep apnea has a spectrum of severity, and in light of previous studies showing a dose-response relationship of apnea severity with mental health outcomes,[24] our study results may only be based on the more severe cases (e.g., sleep apnea cases more likely to be recognized by a physician). Indeed, the prevalence of self-reported sleep apnea in our sample was about half of what previous studies have found based on objective sleep apnea measurement.[1] Because NSDUH participants did not report sleep apnea severity, we were unable to evaluate this point; regardless, more studies are needed to explore how sleep apnea severity may correlate with psychopathology and health service use in a population sample. Secondly, individuals with mental health conditions overall have greater contact with the healthcare system, and may thus be more likely to be referred for sleep apnea assessment. For example, individuals with depression (a condition commonly associated with poor sleep) may be more likely to be queried about sleep problems and referred to a sleep medicine clinic yielding a diagnosis of sleep apnea. This may have introduced a substantial source of bias in the study and again may have inflated results of the association.

Based on results from our study, it is unclear what the specific mechanisms are for the observed associations between sleep apnea and psychopathology. Given its cross-sectional nature, this study was unable to assess these mechanistic questions. New methodology utilizing experience sampling methods (i.e., frequent reports of psychological states), may help shed light on the near- and long-term precursors to the link between sleep apnea and psychological symptoms. Additionally, future studies in large longitudinal cohort studies may also help identify longer-term mechanisms.

In the context of elevated rates of psychopathology, we found that individuals with sleep apnea and the psychiatric conditions considered in this study reported greater use of mental health care services, confirming past studies of elevated health service use. However, we were surprised to also find that those with sleep apnea reported elevated rates of perceived unmet need for mental health care as well. This indicates an important area for future mental healthcare needs assessments among those with sleep apnea, and a greater understanding of the specific barriers for which are leading to these perceived unmet needs. Developing tools to identify those at risk for mental health conditions, and even implementing them in mental health service settings may be an important piece of these efforts. Secondarily, gaining a

greater understanding of the outcomes of sleep apnea treatment in those with unmet mental healthcare needs might also inform the development of programs to address mental healthcare in these patients overall.

Findings from this study suggest sleep apnea patients should be regularly screened for mental health conditions throughout their treatment. Not only might addressing the mental healthcare needs of sleep apnea patients improve their quality of life, but it may in fact improve compliance with sleep apnea treatment. Compliance for sleep apnea therapy (primarily continuous positive airway pressure; CPAP) is notoriously low,[26] especially among those with mental health conditions,[27] and non-compliance to CPAP may lead to further physical health complications. The delivery of mental health screening instruments in sleep clinics may help identify those at greater risk for developing psychopathology, and help connect these at-risk patients with mental health services to address their unique needs.

The strengths of this study include the large nationally representative sample, and comprehensive battery of queries on sleep apnea, mental health outcomes, and mental health service use patterns. However, this study should also be interpreted in the context of its limitations. First, the study was cross-sectional, and therefore we cannot infer the temporal sequence related to progression of sleep apnea and psychopathology. More research will be needed to ascertain the longitudinal association of sleep apnea incidence and preexisting and future occurrence of a range of mental health conditions in a large population sample. Second, data were obtained by self-report only, and diagnoses related to sleep apnea or the mental health conditions under consideration were not confirmed by clinicians. This may explain why the prevalence of sleep apnea in our study was somewhat lower than in previous studies which diagnosed sleep apnea with polysomnography.[1] Future research may seek to assess the relationships between these associations using data obtained from medical records, or within large clinical settings. Third, individuals were only asked about whether a doctor had told them they had sleep apnea, which may have not identified those who were unaware they had sleep apnea—studies suggest sleep apnea to be unrecognized or under diagnosed.[28] Future studies may seek to use validated self-report sleep apnea screening instruments to ascertain sleep apnea diagnosis, such as the STOP-Bang questionnaire.[29] On a related note, the sleep apnea query did not differentiate between obstructive and central apnea, which have different etiologies and may show different patterns with psychopathology. Finally, our study has limited generalizability to non-US countries with different healthcare resources and availability of mental health treatment, and repeating such a study in international settings may shed light on this issue.

CONCLUSIONS

Overall, our study shows that sleep apnea patients are at substantial risk for depression, suicidal ideation, anxiety, and serious psychological distress, indicating an urgent need to identify those most at risk and to connect them with mental health services. Future research should further investigate the mechanisms, and direct and indirect effects of sleep apnea on mental health. Future research may also seek to validate the use of common mental health screening instruments in those with sleep apnea, identifying ways to improve access to

mental healthcare, and identifying the needs of mental health treatment among those who may be receiving services but may still have a need for more care.

Acknowledgments

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Table 1

Study participant characteristics.

Characteristic	All participants (N = 264,653)		Had sleep apnea past year (N = 5,498)		Did not have sleep apnea past year (N = 259,155)		p-value
	%	SE	%	SE	%	SE	
Dependent variables							
Depression (past year)	6.8	0.1	15.8	0.7	6.5	0.1	<0.01
Suicidal ideation (past year)	3.8	0.1	8.3	0.5	3.7	0.1	<0.01
Anxiety (past year)	5.8	0.1	16.2	0.7	5.5	0.1	<0.01
Distress (past year)	10.5	0.1	19.1	0.7	10.2	0.1	<0.01
Service Use							
No service use, no unmet needs	83.7	0.1	64.4	0.8	84.3	0.1	<0.01
Service use, no unmet needs	11.4	0.1	27.2	0.8	10.9	0.1	
No service use, unmet needs	2.3	0.0	2.0	0.2	2.3	0.0	
Service use, unmet needs	2.6	0.0	6.4	0.4	2.4	0.0	
Independent variables							
Sex							
Men	48.1	0.2	60.0	1.0	47.7	0.2	<0.01
Women	51.9	0.2	40.0	1.0	52.3	0.2	
Age group							
18–25	14.6	0.1	3.1	0.1	15.0	0.1	<0.01
26–34	15.8	0.1	6.2	0.4	16.1	0.1	
35–49	26.7	0.1	25.7	0.7	26.8	0.1	
50–64	25.4	0.2	40.6	1.0	24.9	0.2	
65 or older	17.5	0.2	24.4	0.9	17.3	0.2	
Race/ethnicity							
White	67.4	0.2	77.7	0.9	67.0	0.2	<0.01
Black	11.5	0.2	10.1	0.7	11.6	0.2	
Other	6.8	0.1	4.6	0.5	6.9	0.1	
Hispanic	14.3	0.1	7.6	0.4	14.5	0.1	
Income							

Characteristic	All participants (N = 264,653)		Had sleep apnea past year (N = 5,498)		Did not have sleep apnea past year (N = 259,155)		p-value
	%	SE	%	SE	%	SE	
<$20,000	18.0	0.2	15.9	0.7	18.1	0.2	<0.01
$20,000–49,999	32.3	0.2	29.5	1.0	32.4	0.2	
$50,000–74,999	17.2	0.2	18.7	0.8	17.2	0.1	
$75,000 or more	32.4	0.3	35.9	1.1	32.3	0.3	
Marital status							<0.01
Married	53.3	0.2	63.7	1.0	53.0	0.2	
Widowed	6.0	0.1	6.5	0.6	6.0	0.1	
Divorced or Separated	13.9	0.1	16.8	0.7	13.8	0.1	
Never married	26.8	0.2	13.0	0.6	27.2	0.2	
Employment status							<0.01
Full-time	51.0	0.2	44.1	1.1	51.2	0.2	
Part-time	14.0	0.1	9.8	0.6	14.1	0.1	
Unemployed	5.4	0.1	3.8	0.4	5.4	0.1	
Out of labor force	29.7	0.2	42.3	1.1	29.2	0.2	
Educational attainment							<0.01
Less than high school	14.1	0.1	10.9	0.6	14.2	0.1	
High school graduate	30.1	0.2	30.0	0.9	30.1	0.2	
Some college	26.3	0.2	27.9	0.9	26.2	0.2	
College graduate	29.5	0.2	31.2	1.0	29.4	0.2	
Illicit drug or alcohol abuse/dependence (past year)	8.7	0.1	7.2	0.4	8.7	0.1	<0.01
Survey year							<0.01
2008	13.8	0.1	11.0	0.8	13.9	0.1	
2009	14.0	0.1	11.5	0.6	14.1	0.1	
2010	14.1	0.1	12.5	0.7	14.2	0.1	
2011	14.3	0.1	14.3	0.7	14.3	0.1	
2012	14.5	0.1	15.2	0.7	14.4	0.1	
2013	14.6	0.1	17.1	0.8	14.5	0.1	
2014	14.7	0.1	18.3	0.6	14.6	0.1	

Note: Percentages were weighted by the NSDUH survey weight. *p*-value based on Rao–Scott F adjusted chi-square statistics taking into account the NSDUH survey weight.

Table 2

Multivariate models examining the association of past year sleep apnea with mental health outcomes

	Depression AOR (95% CI)	Suicidal Ideation AOR (95% CI)	Anxiety AOR (95% CI)	Psychological Distress AOR (95% CI)
Sleep apnea (past year)				
No	Ref.	Ref.	Ref.	Ref.
Yes	**3.11 (2.77 – 3.50)**	**2.75 (2.34 – 3.23)**	**3.68 (3.30 – 4.10)**	**2.88 (2.61 – 3.17)**
Sex				
Men	Ref.	Ref.	Ref.	Ref.
Women	**1.86 (1.75 – 1.98)**	**1.14 (1.07 – 1.22)**	**2.21 (2.09 – 2.33)**	**1.76 (1.68 – 1.84)**
Age group				
18–25	Ref.	Ref.	Ref.	Ref.
26–34	**1.20 (1.13 – 1.27)**	**0.80 (0.74 – 0.86)**	**1.59 (1.49 – 1.70)**	0.97 (0.93 – 1.01)
35–49	**1.31 (1.23 – 1.40)**	**0.87 (0.80 – 0.96)**	**1.50 (1.38 – 1.63)**	**0.80 (0.75 – 0.84)**
50–64	1.07 (1.00 – 1.15)	**0.64 (0.57 – 0.72)**	1.09 (0.98 – 1.20)	**0.51 (0.47 – 0.55)**
65 or older	**0.25 (0.22 – 0.29)**	**0.24 (0.20 – 0.29)**	**0.40 (0.35 – 0.47)**	**0.16 (0.15 – 0.19)**
Race/ethnicity				
White	Ref.	Ref.	Ref.	Ref.
Black	**0.55 (0.52 – 0.59)**	**0.62 (0.58 – 0.68)**	**0.29 (0.27 – 0.32)**	**0.66 (0.63 – 0.71)**
Other	**0.66 (0.60 – 0.74)**	0.93 (0.82 – 1.06)	**0.43 (0.37 – 0.51)**	**0.84 (0.77 – 0.91)**
Hispanic	**0.64 (0.59 – 0.70)**	**0.59 (0.55 – 0.65)**	**0.42 (0.39 – 0.46)**	**0.69 (0.65 – 0.73)**
Income				
< $20,000	Ref.	Ref.	Ref.	Ref.
$20,000–49,999	**0.85 (0.80 – 0.90)**	**0.92 (0.86 – 0.98)**	**0.87 (0.81 – 0.94)**	**0.81 (0.77 – 0.86)**
$50,000–74,999	**0.79 (0.73 – 0.86)**	**0.80 (0.72 – 0.88)**	**0.77 (0.70 – 0.84)**	**0.73 (0.68 – 0.78)**
$75,000 or more	**0.62 (0.58 – 0.67)**	**0.68 (0.62 – 0.74)**	**0.74 (0.67 – 0.82)**	**0.59 (0.55 – 0.63)**
Marital status				
Married	Ref.	Ref.	Ref.	Ref.
Widowed	**1.37 (1.16 – 1.62)**	**1.42 (1.12 – 1.81)**	1.06 (0.89 – 1.26)	**1.54 (1.33 – 1.79)**
Divorced or Separated	**1.88 (1.73 – 2.03)**	**1.87 (1.69 – 2.06)**	**1.60 (1.46 – 1.76)**	**1.76 (1.65 – 1.88)**
Never married	**1.48 (1.38 – 1.60)**	**1.50 (1.38 – 1.64)**	**1.31 (1.21 – 1.42)**	**1.37 (1.29 – 1.45)**
Employment status				
Full-time	Ref.	Ref.	Ref.	Ref.
Part-time	**1.37 (1.28 – 1.47)**	**1.38 (1.26 – 1.51)**	**1.35 (1.24 – 1.47)**	**1.22 (1.15 – 1.30)**
Unemployed	**1.75 (1.59 – 1.93)**	**1.78 (1.59 – 1.98)**	**1.54 (1.40 – 1.69)**	**1.58 (1.46 – 1.71)**
Out of labor force	**2.11 (1.98 – 2.24)**	**1.91 (1.76 – 2.06)**	**2.43 (2.27 – 2.59)**	**1.81 (1.71 – 1.91)**
Educational attainment				
Less than high school	Ref.	Ref.	Ref.	Ref.
High school graduate	1.06 (0.99 – 1.15)	0.97 (0.88 – 1.07)	1.03 (0.95 – 1.13)	**0.85 (0.80 – 0.91)**
Some college	**1.23 (1.13 – 1.34)**	1.03 (0.93 – 1.13)	**1.19 (1.08 – 1.30)**	**0.89 (0.83 – 0.95)**
College graduate	**1.17 (1.07 – 1.28)**	0.90 (0.81 – 1.00)	1.04 (0.96 – 1.14)	**0.78 (0.73 – 0.83)**
Illicit drug or alcohol abuse/dependence (past year)				

	Depression AOR (95% CI)	Suicidal Ideation AOR (95% CI)	Anxiety AOR (95% CI)	Psychological Distress AOR (95% CI)
No	Ref.	Ref.	Ref.	Ref.
Yes	**2.96 (2.78 – 3.14)**	**3.24 (3.01 – 3.49)**	**2.50 (2.35 – 2.66)**	**3.22 (3.07 – 3.38)**
Survey year				
2008	Ref.	Ref.	Ref.	Ref.
2009	0.94 (0.84 – 1.04)	0.98 (0.86 – 1.11)	1.06 (0.95 – 1.19)	0.95 (0.88 – 1.03)
2010	0.94 (0.85 – 1.05)	1.00 (0.88 – 1.12)	1.07 (0.96 – 1.19)	0.96 (0.88 – 1.04)
2011	0.93 (0.84 – 1.02)	0.98 (0.90 – 1.08)	1.06 (0.95 – 1.19)	0.96 (0.89 – 1.03)
2012	0.98 (0.89 – 1.09)	1.02 (0.89 – 1.17)	**1.21 (1.08 – 1.36)**	1.02 (0.95 – 1.10)
2013	0.95 (0.87 – 1.05)	1.08 (0.97 – 1.19)	**1.33 (1.20 – 1.47)**	1.03 (0.95 – 1.11)
2014	0.96 (0.89 – 1.04)	1.09 (0.98 – 1.20)	**1.50 (1.36 – 1.64)**	1.03 (0.96 – 1.10)

Notes: Bolded values are statistically significant at $p<0.05$. AOR=adjusted odds ratio; 95% CI=95% confidence interval. All variables adjusted for each other. All analyses account for the complex sampling design of the NSDUH

Table 3

Multivariate models comparing past year mental health service use between those with and without sleep apnea.

	No Sleep Apnea	Sleep Apnea	Comparison
	n (%)	n (%)	AOR (95% CI)
Depression			
No service use	10,258 (45.6)	258 (24.8)	Ref.
Service use	9,929 (54.4)	811 (75.2)	**2.12 (1.66 – 2.72)**
Suicidal ideation			
No service use	7,860 (52.6)	165 (26.9)	Ref.
Service use	5,772 (47.4)	465 (73.2)	**2.53 (1.76 – 3.63)**
Anxiety			
No service use	3,552 (19.6)	186 (16.2)	Ref.
Service use	12,400 (80.4)	962 (83.8)	1.21 (0.88 – 1.67)
Psychological distress			
No service use	22,579 (55.4)	378 (25.9)	Ref.
Service use	14,354 (44.6)	1,016 (74.1)	**2.77 (2.22 – 3.46)**

Notes: Bolded values are statistically significant at p<0.05. All percentages are from column totals. AOR=adjusted odds ratio; 95% CI=95% confidence interval. Models adjusted for sex, age, race/ethnicity, income, marital status, employment status, education, illicit drug or alcohol abuse/dependence, and survey year. All analyses account for the complex sampling design of the NSDUH.

Table 4

Multivariate models comparing past-year unmet need for mental health services between those with and without sleep apnea.

	No Sleep Apnea n (%)	Sleep Apnea n (%)	Comparison AOR (95% CI)
Depression			
No unmet need	13,028 (68.3)	638 (67.7)	Ref.
Unmet need	7,159 (31.7)	431 (32.3)	**1.25 (1.02 – 1.53)**
Suicidal ideation			
No unmet need	8,581 (65.7)	344 (60.3)	Ref.
Unmet need	5,051 (34.3)	286 (39.7)	**1.56 (1.23 – 1.98)**
Anxiety			
No unmet need	11,493 (77.1)	779 (73.7)	Ref.
Unmet need	4,459 (22.9)	369 (26.3)	**1.53 (1.23 – 1.89)**
Psychological distress			
No unmet need	26,380 (73.1)	871 (68.0)	Ref.
Unmet need	10,553 (26.9)	523 (32.0)	**1.39 (1.18 – 1.64)**

Notes: Bolded values are statistically significant at p<0.05. All percentages are from column totals. AOR=adjusted odds ratio; 95% CI=95% confidence interval. Models adjusted for sex, age, race/ethnicity, income, marital status, employment status, education, illicit drug or alcohol abuse/dependence, and survey year. All analyses account for the complex sampling design of the NSDUH.