The Association Between Sleep Apnea and Suicidal Thought and Behavior:
An Analysis of National Survey Data

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ABSTRACT

Objective: Sleep disturbances have been associated with increased risk for suicidal thought and behavior. The literature in regard to sleep and suicide, however, has focused predominantly on generalized sleep disturbance or insomnia. The purpose of the current study is to examine relationships among sleep apnea and suicidal thought and behavior using a nationally representative sample.

Methods: We conducted a secondary analysis of 2014 data from the National Survey on Drug Use and Health. Respondents from a random sample of US households who were 18 years or older (N = 40,149) completed an interview including items assessing past-year sleep apnea, suicidal ideation, suicide planning, and suicide attempt.

Results: Among respondents with sleep apnea (2.9%; n = 1,155), prevalence of suicidality was reported to be 9.7% for suicidal ideation, 3.4% for suicide planning, and 1.0% for suicide attempt compared with 4.9%, 1.4%, and 0.7%, respectively, for those without sleep apnea. Multiple logistic regression analyses revealed that sleep apnea was significantly associated with both suicidal ideation (OR = 1.50; 95% CI, 1.18–1.91) and suicide planning (OR = 1.56; 95% CI, 1.08–2.26) after controlling for age, sex, ethnicity, past-year substance use disorder, self-rated overall health, past-year sedative-hypnotic misuse, past-year depressive episode, heart disease, high blood pressure, stroke, diabetes, and body mass index. Sleep apnea was not significantly associated with report of past-year suicide attempt (OR = 1.22; 95% CI, 0.66–2.26).

Conclusions: Suicidal ideation and suicide planning were more likely to be endorsed by respondents with sleep apnea compared to those without after accounting for key covariates. Diagnosis of sleep apnea may represent an early opportunity for providers to discuss suicide and mental health with their patients.

J Clin Psychiatry 2018;79(1):17m11480

To cite: Bishop TM, Ashrafioun L, Pigeon WR. The association between sleep apnea and suicidal thought and behavior: an analysis of national survey data. *J Clin Psychiatry.* 2018;79(1):17m11480.

To share: https://doi.org/10.4088/JCP.17m11480

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Suicide is a leading cause of death in the United States and represents a significant public health concern.[1] Rates of both fatal and nonfatal suicide attempts are also most likely underreported (eg, nearly 2% of automotive accidents may be considered suicidal behavior, but these are often incorrectly reported as accidental[2]). However, unlike with other leading causes of death, it remains difficult to identify those who will die by suicide.[3] Therefore, it is paramount to identify modifiable upstream factors that may contribute to suicide risk.[4] Sleep disturbance has been identified as one such risk factor.[5,6]

The literature supporting the relationship between sleep disturbance and suicidal thought and behavior has grown in breadth and depth.[5–9] This includes evidence suggesting that a sleep disturbance contributes to suicide risk beyond its association with frequently co-occurring risk factors (eg, depression).[6,10] In addition, sleep disturbance may be related to not only the presence but also the trajectory of suicidal thought and behavior. For example, in a recent survival analysis of suicide decedents, the time to death was reported to be significantly shorter for decedents with a documented sleep disorder in their medical record.[11]

Despite the established relationship of generalized sleep disturbance to suicidal thought and behavior, there remain significant gaps in this literature. Foremost among them is the fact that the majority of the research regarding sleep and suicide has focused on either generalized sleep disturbance or insomnia.[7,8] It is critical to investigate the relationship between insomnia and suicide risk, particularly as insomnia is the most prevalent of the sleep disorders. The relationship of sleep apnea with suicidal thought and behavior, however, is largely unexplored. This is a particularly glaring gap in the literature given the increasing prevalence of sleep apnea[12] and its associated health consequences (eg, depression,[13] fatigue,[14] diabetes,[15] cardiovascular disease[16]).

Sleep is multidimensional in nature, and insomnia and sleep-related breathing disorders are etiologically distinct. Insomnia, for example, is typically characterized by difficulty initiating or maintaining sleep, resulting in a loss of total sleep time and emotional distress/mood disturbance.[17] Sleep apnea, in contrast, is characterized by frequent awakenings that disrupt sleep architecture and the natural progression of sleep cycles. A patient with sleep apnea may in fact obtain more total sleep time than the typical insomnia patient; however, the sleep of the apnea patient may be more fragmented and less restorative. Because of this etiologic difference, it is unclear what aspect of generalized sleep disturbance contributes to suicide risk. For example, if the sleep-suicide relationship is a function of the loss of total sleep time, then sleep disorders that do not significantly reduce total sleep time should not be associated with increased suicide risk. However, if the sleep-suicide relationship is associated with other aspects of sleep disturbance (eg, hypersomnolence, fatigue, distress over poor sleep and its consequences, and/or neurophysiologic changes), then sleep apnea and other sleep disorders may emerge as being associated with suicide risk.

Clinical Points

- The relationship between sleep disturbance and suicidal thought and behavior is well established. To date, however, the majority of the research has focused on insomnia and generalized sleep disturbance. Sleep disorders differentially affect functioning, and the relationship between sleep apnea and suicide has yet to be established.
- If a patient presents with a sleep disorder, consider using the associated symptoms as a springboard to screen for, or discuss, mental health difficulties including thoughts of suicide.

Sleep apnea has previously been associated with both increased presence[13] and severity[18,19] of depressive symptomatology, with the estimated prevalence of depression among sleep apnea patients ranging from 5% to 63%.[20] Despite the literature regarding sleep apnea and depression, few studies have assessed suicide risk among apnea populations. To our knowledge, a total of 3 published observational studies[21–23] and 1 case study[24] have described the relationship between sleep apnea and suicidality. It remains unclear what the prevalence rates of suicidal ideation, planning, and attempts are among those with sleep apnea or whether previous reports of a relationship between suicidal ideation and sleep apnea would remain significant after controlling for key covariates (eg, depression). Therefore, additional examination of relationships among sleep apnea and suicidal thought and behavior is warranted and would help to further explicate the sleep-suicide relationship. The present analyses, in contrast to previous studies that have utilized small, clinic-based samples, were conducted with a large, national dataset and allowed for the inclusion of known risk factors for suicide in the analysis.

We hypothesized that sleep apnea would be significantly associated with suicidal ideation, suicide planning, and suicide attempts. However, as depression has long been recognized as one of the primary drivers of suicide risk,[25] we anticipated that relationships among sleep apnea and suicidal thought and behavior would no longer be significant when depression was included as a covariate.

METHOD

Data Source and Participants

The present study was approved by the University of Rochester Medical Center Institutional Review Board. To perform this secondary analysis, we obtained the 2014 data, which was the most recent publicly available data at the time of the study, from the National Survey on Drug Use and Health (NSDUH) via the Interuniversity Consortium for Political and Social Research (https://www.icpsr.umich.edu/icpsrweb/).[26] The NSDUH is conducted annually with the intention of providing nationally representative data on trends, prevalence, and correlates of substance use in the United States. Respondents to the survey comprised individuals 12 years or older from a random sample of US households. Participants completed assessments via laptop and were reimbursed $30 for their participation. Response rate was adequate, with 71.2% of individuals approached agreeing to complete the survey. A full detailing of NSDUH methodology can be found elsewhere.[26] The total sample size was 55,271. We excluded participants under the age of 18 years for the present analyses, as they were not asked questions regarding suicide, resulting in a sample size of 41,671. An additional 1,522 participants were excluded for having incomplete data, leaving a final sample of 40,149.

Participants were relatively diverse, with 37.2% of the sample identifying as nonwhite and 53.3% as female. Age was also well distributed: 18–25 years (31.2%), 26–34 years (20.1%), 35–49 years (27.0%), 50–64 years (12.9%), and 65+ years (8.7%). The sample reported their overall health to be excellent (23.7%; n = 9,516), very good (38.3%; n = 15,376), good (26.8%; n = 10,769), or fair/poor (11.2%; n = 4,488).

Variables

Suicide. The NSDUH assessed suicidal thought and behavior over the previous 12 months using 3 items with yes/no response options. Participants were asked whether they had seriously thought about, made plans, or attempted to kill themselves in the past 12 months. Skip logic was employed for these items such that only participants who endorsed suicidal ideation were asked about suicide planning, and only participants who endorsed planning were asked about suicide attempts.

Sleep apnea. Single yes/no items were used to assess presence of self-reported sleep apnea for both lifetime and past 12 months. Participants were asked to report whether a doctor or other medical professional had told them that they had sleep apnea.

Depression. Similar to the methodology used to identify substance use disorders, participants were asked to respond to a series of items based on *DSM-IV*[27] criteria in order to assess presence of past-year depressive episode. Participants first responded to a series of items to assess whether they had experienced a depressive episode in their *lifetime*. In order to meet these criteria, they had to positively endorse 5 of the 9 symptoms for a depressive episode as occurring in the same 2-week period, with at least 1 of the symptoms being depressed mood or loss of interest in daily activities. Participants were considered to have experienced a *past-year* depressive episode if they endorsed either depressed mood or loss of interest in the past 12 months that persisted for 2 or more weeks in addition to having other symptoms of a depressive episode.

General health. Participants rated their overall health using the following item: "This question is about your overall health. Would you say your health in general is excellent, very good, good, fair, or poor?" Participant responses were re-coded by the survey administrators (ie, "fair" and "poor" were combined), resulting in the following categories: 1 = excellent, 2 = very good, 3 = good, 4 = fair/poor.

Sedative-hypnotic misuse. We included sedative-hypnotic misuse in the analyses as it has been previously associated with suicidal ideation, planning, and attempts.[28,29]

Table 1. Participant Characteristics[a]

Characteristic	Full Sample (N = 40,149)	Reported Apnea (n = 1,155)	Did Not Report Apnea (n = 38,994)	χ^2	*df*	*P*
Age, y[b]						
18–25	12,544 (31.2)	93 (8.1)	12,451 (31.9)	589.93	4	<.001
26–34	8,074 (20.1)	132 (11.4)	7,942 (20.4)			
35–49	10,825 (27.0)	404 (35.0)	10,421 (26.7)			
50–64	5,196 (12.9)	317 (27.4)	4,879 (12.5)			
65+	3,510 (8.7)	209 (18.1)	3,301 (8.5)			
Sex						
Male	18,748 (46.7)	659 (57.1)	18,089 (46.4)	51.28	1	<.001
Female	21,401 (53.3)	496 (42.9)	20,905 (53.6)			
Race/ethnicity[c]						
White	25,447 (63.4)	832 (72.0)	24,615 (63.1)	56.41	6	<.001
Black	4,656 (11.6)	124 (10.7)	4,532 (11.6)			
Native American/Alaskan	634 (1.6)	10 (0.9)	624 (1.6)			
Native Hawaiian/other Pacific Islander	191 (0.5)	6 (0.5)	185 (0.5)			
Asian	1,749 (4.4)	27 (2.3)	1,722 (4.4)			
More than 1 race	1,208 (3.0)	42 (3.6)	1,166 (3.0)			
Hispanic	6,264 (15.6)	114 (9.9)	6,150 (15.8)			
Overall health[d]						
Excellent	9,516 (23.7)	69 (6.0)	9,447 (24.2)	719.86	3	<.001
Very good	15,376 (38.3)	306 (26.5)	15,070 (38.6)			
Good	10,769 (26.8)	403 (34.9)	10,366 (26.6)			
Fair/poor	4,488 (11.2)	377 (32.6)	4,111 (10.5)			
Heart disease	936 (2.3)	124 (10.7)	812 (2.1)	368.93	1	<.001
High blood pressure	5,167 (12.9)	480 (41.6)	4,687 (12.0)	872.88	1	<.001
Stroke	131 (0.3)	20 (1.7)	111 (0.3)	72.22	1	<.001
Diabetes	1,992 (5.0)	228 (19.7)	1,764 (4.5)	550.83	1	<.001
Body mass index,[e] mean (SD)	27.74 (6.35)	33.86 (7.02)	27.56 (6.24)	−33.72	40,147	<.001
Depressive episode	3,117 (7.8)	196 (17.0)	2,921 (7.5)	140.75	1	<.001
Substance use disorder	4,334 (10.8)	84 (7.3)	4,250 (10.9)	15.32	1	<.001
Sedative/hypnotic misuse	359 (0.9)	17 (1.5)	342 (0.9)	4.48	1	.034
Suicidal ideation	2,025 (5.0)	112 (9.7)	1,913 (4.9)	53.77	1	<.001
Suicide planning	603 (1.5)	39 (3.4)	564 (1.4)	28.25	1	<.001
Suicide attempt	295 (0.7)	12 (1.0)	283 (0.7)	1.51	1	.219

[a]Data are N (%) except where otherwise noted. All disease states, unless otherwise indicated, reflect self-reported "past year" diagnosis by a medical provider.
[b]Reference group was aged 65+ years.
[c]Reference group was "white."
[d]Reference group was "excellent."
[e]For body mass index, we reported means and standard deviations and performed an independent samples *t* test.

In addition, 2015 NSDUH data (which are not yet publically available for analysis) indicate that over 70% of respondents who were misusing sedatives reported that the main reasoning for use was to help with sleep.[30] We created a composite item for past-year sedative-hypnotic misuse by combining items for general sedative misuse and zolpidem misuse. Participants were asked if they had used sedatives in the past 12 months that were not prescribed for them or if they took the substance only for the feeling that it caused. A similar question was asked regarding zolpidem use in the past 12 months. Responses were recoded as yes = 1 (ie, an affirmative response for either item) and no = 0.

Demographics. The following demographic variables were included in the present analyses: age (18–25, 26–34, 35–49, 50–64, and 65+ years), gender (male or female), and race/ethnicity (non-Hispanic white versus other).

Analysis Plan

Descriptive statistics were calculated to assess the prevalence of sleep apnea and suicidal thought and behavior. The sample was further characterized by providing frequency data and identifying group differences (reported apnea versus no reported apnea) on the covariates of interest via χ^2 (see Table 1). Unadjusted odds ratios (ORs) for suicidal ideation, suicide planning, and suicide attempt in participants with and without sleep apnea were calculated. We next used multiple logistic regression to assess relationships among sleep apnea (past 12 months) and suicidal ideation, suicide planning, and suicide attempt (past 12 months), while controlling for age, sex, ethnicity, self-rated overall health, body mass index (BMI), substance use disorder (past 12 months), sedative-hypnotic misuse (past 12 months), and depressive episode (past 12 months). We also controlled for the following medical comorbidities known to be associated with sleep apnea: heart disease, high blood pressure, stroke, and diabetes. As insomnia was not assessed outside of the context of depressive episode, we were unable to control for this key covariate. We present all adjusted ORs with 95% confidence intervals (CIs).

RESULTS

Sleep apnea was reported by 2.9% (n = 1,155) of the sample. Prevalence of suicidality among participants with

sleep apnea was 9.7% for suicidal ideation, 3.4% for suicide planning, and 1.0% for suicide attempt compared with 4.9%, 1.4%, and 0.7%, respectively, for those without sleep apnea. Chi-square analyses revealed that individuals who self-reported sleep apnea were significantly more likely to also report past-year medical comorbidities including heart disease, high blood pressure, stroke, and diabetes (Table 1). Participants reporting past-year apnea also tended to have a higher BMI and a greater likelihood of a depressive episode or substance use disorder. Unadjusted logistic regression analyses (Table 2) revealed that sleep apnea was associated with suicide ideation (OR = 2.08; 95% CI, 1.70–2.54) and suicide planning (OR = 2.38; 95% CI, 1.71–3.31) but not suicide attempt (OR = 1.44; 95% CI, 0.80–2.57).

A second set of logistic regression analyses (Table 3) were conducted and included key covariates of suicide risk. Sleep apnea was associated with both suicidal ideation (OR = 1.50; 95% CI, 1.18–1.91) and suicide planning (OR = 1.56; 95% CI, 1.08–2.26) after controlling for age, sex, ethnicity, past-year substance use disorder, self-rated overall health, past-year sedative-hypnotic misuse, past-year depressive episode, heart disease, high blood pressure, stroke, diabetes, and BMI. Sleep apnea was again not significantly associated with past-year suicide attempt (OR = 1.22; 95% CI, 0.66–2.26). Of note, associations among sleep apnea to suicidal thought and planning remained statistically significant despite covariates such as depressive episode being included in the model. Past-year depressive episode was the greatest predictor of past-year suicidal ideation, planning, and attempts. Significant associations to past-year suicide attempt were the endorsement of 18–25 years of age, Black or Native American/Alaskan, female sex, fair/poor health, stroke, past-year depressive episode, and past-year substance use disorder (see Table 3).

Table 2. Unadjusted and Adjusted Odds Ratios (95% CI) for Suicidal Thought and Behavior in the Past 12 Months as a Function of Sleep Apnea

	Unadjusted OR	Adjusted OR[a]
Suicidal ideation	2.08 (1.70–2.54)**	1.50 (1.18–1.91)**
Suicide planning	2.38 (1.71–3.31)**	1.56 (1.08–2.26)*
Suicide attempt	1.44 (0.80–2.57)	1.22 (0.66–2.26)

[a]Odds ratios adjusted for age, sex, ethnicity, self-rated overall health, body mass index, past-year depressive episode, past-year substance use disorder, and past-year sedative-hypnotic misuse, heart disease, high blood pressure, stroke, and diabetes.
*$P < .05$. **$P < .001$.

DISCUSSION

Self-reported sleep apnea was significantly associated with suicidal ideation and suicide planning. Highlighting the potential importance of this finding is the fact that sleep apnea's association with ideation and planning remained significant even after controlling for key covariates such as depression, substance use disorders, and comorbid physical health conditions. This finding further emphasizes the

Table 3. Multiple Logistic Regression for Suicidal Thought and Behavior, Sleep Apnea, and Depression in the 2014 National Survey on Drug Use and Health (N = 40,149)[a]

	Suicidal Ideation	Suicide Planning	Suicide Attempt
Age, y[b]			
18–25	3.99 (3.00–5.31)**	2.81 (1.77–4.45)**	3.49 (1.69–7.23)**
26–34	2.01 (1.49–2.70)**	1.38 (0.85–2.25)	1.48 (0.69–3.20)
35–49	1.77 (1.33–2.35)**	1.27 (0.80–2.03)	1.75 (0.84–3.63)
50–64	1.55 (1.14–2.10)*	0.90 (0.54–1.49)	0.80 (0.35–1.87)
Sex	1.00 (0.91–1.11)	1.06 (.89–1.26)	1.34 (1.05–1.72)*
Race/ethnicity[c]			
Black	0.78 (0.66–0.92)*	1.13 (0.87–1.48)	1.49 (1.05–2.12)*
Native American/Alaskan	1.03 (0.72–1.49)	1.41 (0.80–2.50)	2.88 (1.58–5.26)**
Native Hawaiian/other Pacific Islander	0.36 (0.14–0.90)*	0.29 (0.04–2.15)	0.00 (0.00–0.00)
Asian	1.01 (0.78–1.30)	1.05 (0.66–1.69)	1.49 (0.83–2.68)
More than 1 race	1.14 (0.90–1.45)	1.08 (0.72–1.64)	1.17 (0.65–2.09)
Hispanic	0.79 (0.69–0.92)*	0.94 (0.74–1.20)	1.20 (0.87–1.66)
Overall health[d]			
Very good	1.43 (1.22–1.67)**	1.84 (1.34–2.52)**	1.47 (0.97–2.22)
Good	1.77 (1.51–2.09)**	2.32 (1.34–3.21)**	2.08 (1.37–3.15)**
Fair/poor	3.04 (2.53–3.65)**	4.59 (3.27–6.44)**	3.61 (2.31–5.65)**
Heart disease	0.93 (0.65–1.35)	1.12 (0.64–1.94)	1.63 (0.75–3.56)
High blood pressure	0.96 (0.81–1.14)	0.85 (0.60–1.10)	0.90 (0.58–1.40)
Stroke	2.48 (1.28–4.78)*	3.24 (1.31–8.00)*	3.85 (1.12–13.22)*
Diabetes	0.93 (0.72–1.19)	1.31 (0.89–1.93)	0.88 (0.45–1.69)
Body mass index	1.01 (1.00–1.02)*	1.01 (0.99–1.02)	0.99 (0.97–1.01)
Depressive episode	12.81 (11.54–14.21)**	12.49 (10.45–14.93)**	8.09 (6.30–10.39)**
Substance use disorder	2.32 (2.06–2.62)**	2.51 (2.07–3.04)**	3.75 (2.91–4.84)**
Sedative/hypnotic misuse	0.98 (1.01–0.49)	1.67 (1.03–2.72)*	1.01 (0.48–2.13)
Sleep apnea	1.50 (1.18–1.91)**	1.56 (1.08–2.26)*	1.22 (0.66–2.26)

[a]Values presented are adjusted odds ratios followed by 95% confidence intervals in parentheses. All disease states, unless otherwise indicated, reflect self-reported past-year diagnosis by a medical provider.
[b]Reference group was aged 65+ years.
[c]Reference group was "white."
[d]Reference group was "excellent."
*$P < .05$. **$P < .001$.

importance of sleep in the course and development of suicidal thought and expands the observed sleep-suicide relationship beyond the role of insomnia. Given its prevalence and known associations with depression and comorbid physical illness, sleep apnea may have utility in the identification of individuals who are at risk for suicide and may provide a conduit for early intervention.

These are, to our knowledge, the first analyses to report significant associations among sleep apnea and suicidal ideation and planning in a large, national sample. Three observational studies have reported positive associations between apnea and suicide. First, Krakow and colleagues[22] reported data from a cross-sectional study of female sexual assault survivors with posttraumatic stress disorder (N = 153). They found that probable presence of a sleep-related breathing disorder (as indicated by self-report questions regarding snoring and daytime sleepiness) was associated with greater severity of both depression and suicidality.[22] Second, Choi and colleagues[23] provided one of the first estimates of the prevalence of suicidal ideation among individuals with untreated obstructive sleep apnea (OSA). The authors reported that among 117 subjects, 20.5% (n = 24) endorsed suicidal ideation based on a single self-report item. Last, Edwards and colleagues[21] built on this literature with their reported findings that among 426 consecutive sleep clinic patients assessed for OSA, depression severity was associated with more severe baseline OSA. Participants with moderate to severe OSA were offered treatment (n = 293) in the form of continuous positive airway pressure (CPAP), the gold standard in OSA treatment. Significant decreases in depression and OSA severity were observed following 3 months of CPAP among those participants who adhered to CPAP (n = 228). Further, among the subsample of participants who reported baseline suicidal ideation (n = 41), none endorsed suicidal ideation at a 3-month follow-up. The authors, however, did not collect follow-up data from those participants who were nonadherent to CPAP (n = 65), precluding a more detailed examination of whether the observed changes in suicidal ideation and depression were better attributable to the treatment effects of CPAP or to other factors.[21] While these studies have suggested that a positive association may exist between sleep apnea and suicidal ideation, the present study provides a larger scale examination of the prevalence of suicidal thought and behavior among those with and without sleep apnea.

Nearly 10% of participants with sleep apnea in the present sample endorsed suicidal ideation. While this is lower than estimates of around 20% provided in prior research,[21,23] the discrepancy is not wholly unexpected given that those samples consisted of sleep clinic patients with untreated sleep apnea, whereas the present sample was recruited from the general population, a proportion of which may have been receiving treatment for sleep apnea. An additional strength of the current study is that we were able to compare individuals *with* sleep apnea to individuals *without* sleep apnea. Previous studies have examined suicidal ideation only *within* samples of sleep apnea patients.

Importantly, the current study assessed the relationship between sleep apnea and suicide planning and attempts, in addition to suicidal ideation. This relationship may manifest through several hypothesized mechanisms. Krakow and colleagues[22] previously proposed that repeated arousals during sleep, such as those caused by sleep apnea, may contribute to the exacerbation of suicidality through the fragmentation of sleep and the reduction of sleep quality. Further, the chronic disruption of the sleep cycle, which can significantly impact mental and physical energy,[14,31] may potentially inhibit one's ability to effectively cope with stressors or existing mental health difficulties.[22] Disrupted sleep also directly affects mental functioning in several ways including increased impulsivity, decreased executive functioning, and emotional dysregulation,[32] all of which may diminish capacity to inhibit suicidal thought and behavior. Further, sleep apnea has been linked with the development and exacerbation of physical and mental health comorbidities (eg, cardiovascular disease and depression) that not only contribute to decreased quality of life, but also are associated with increased suicide risk.

While ideation and planning emerged as being significantly associated with self-reported sleep apnea, suicide attempt did not (OR = 1.22; 95% CI, 0.66–2.26). The most likely explanation for this finding is the low number of suicide attempts reported among individuals with self-reported sleep apnea (n = 12), which reduced power to detect an association. Alternatively, sleep apnea is typically associated with excessive daytime sleepiness, and individuals with sleep apnea may simply not have the mental or physical energy to act on their thoughts of suicide.

Limitations

The present study was subject to some limitations. First, many of the variables, including sleep apnea, were assessed by using single self-report items. Sleep apnea is best diagnosed via in-laboratory polysomnography, and assessment methodology used here very likely underestimates the prevalence of sleep apnea. It is, however, important to note that sleep was not a focus of the NSDUH, and the scope of the project was such that the inclusion of objective sleep testing would have been prohibitive. That participants were asked to endorse only health conditions diagnosed by a doctor lends some additional credibility to their self-report. Future epidemiologic studies would be enhanced by the use of validated self-report measures when assessing sleep. In this same vein, we were unable to include excessive daytime sleepiness, a frequent consequence of sleep apnea and nonrestorative sleep, as a covariate because these data were not collected. Second, the NSDUH did not assess for insomnia outside of the context of substance use disorders, meaning that we were unable to control for the presence of co-occurring insomnia. This is a fairly significant limitation given the frequency with which insomnia and apnea co-occur. Third, while quite likely not impacting the results of the analyses, the skip logic employed for the suicide thought and behavior items may have underestimated the

number of participants engaging in suicide planning or suicide attempts as a subset of suicide attempts occur without prior planning.[33] Fourth, a response rate of 71.2%, while adequate, means that a substantial subset of participants opted out of participation. Last, the cross-sectional nature of the data precludes us from drawing conclusions regarding temporal relationships between variables (eg, did the diagnosis of sleep apnea precede suicidal thought?).

Future Directions

Given the findings linking sleep apnea to suicidal ideation and suicide planning, several promising research directions emerge. As this is among the first studies known to the authors to report a significant association between a sleep-related breathing disorder and suicide planning, the results require replication. Further, these results should be replicated among a sample where the presence of sleep apnea has been established via objective sleep testing. Future research design could also be enhanced by including well-established measures of suicide risk (eg, Scale for Suicidal Ideation[34]).

The exploration of potential mediators and moderators of the sleep apnea–suicide relationship appear warranted. Perhaps most translatable from research to practice would be an investigation into the role that treatment adherence may play in this relationship. Specifically, whether greater treatment adherence to CPAP mediates the relationship between sleep apnea and suicide risk is an empirically testable question. If this relationship is significant, research examining the implementation of existing treatment enhancement/adherence interventions in high-risk populations (eg, suicide attempt survivors) may be of value.

The reported findings may also carry clinical implications. First, providers engaging with patients who have been diagnosed with sleep disorders may be able to use sleep as an entry point to discussing mental health difficulties, including not only depression, but also suicidal ideation. This is particularly relevant as it has been previously reported that nearly half of suicide decedents had a primary care encounter in the month prior to death.[35] Second, sleep clinics may be useful for identifying patients at increased risk for suicide. Given that both insomnia and sleep apnea appear to be related to suicidal thought and behavior, sleep clinic providers may wish to employ more thorough screening for suicide. Third, the relationship between sleep apnea and suicidal thought and behavior provides additional rationale for enhancing treatment adherence. CPAP represents the gold standard in sleep apnea treatment and has been demonstrated to be a highly efficacious and effective intervention in the reduction of sleep apnea.[36] Adherence rates to CPAP treatment, however, are poor as nearly 50% of individuals will either fail to initiate or no longer be using CPAP in the year following prescription.[37] Although data have not yet been reported linking CPAP treatment adherence to reductions in suicidal thought and behavior, special attention should be paid to patients who exhibit co-occurring sleep apnea and depressive symptomatology.

In sum, the reported findings suggest sleep apnea may be related to suicidal ideation and suicide planning, even after controlling for known risk factors for suicide such as depression. This association did not extend to suicide attempts. Further research utilizing objective markers of sleep apnea and/or validated self-report screens for apnea and excessive daytime sleepiness as well as more rigorous measurement strategies for suicide is warranted in order to replicate these findings. Clinicians may wish to use the assessment, diagnosis, and treatment of sleep disorders as a potential vehicle for discussing mental illness and suicide.

Submitted: January 23, 2017; accepted July 18, 2017.

Published online: December 19, 2017.

Potential conflicts of interest: Drs Bishop, Ashrafioun, and Pigeon have no conflicts of interest to disclose.

Funding/support: Supported, in part, by the VISN 2 Center of Excellence for Suicide Prevention at the Canandaigua VAMC.

Role of the sponsor: The sponsor did not have a role in the design or conduct of the study; the collection, management, analysis, or interpretation of data; or in the preparation, review, or approval of the manuscript.

Disclaimer: The authors' views or opinions do not necessarily represent those of the Department of Veterans Affairs or the United States government.

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