Association Between Suicidal Behaviors and Obstructive Sleep Apnea Based on the STOP-Bang Questionnaire:

A Nationwide Population-Based Study

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Abstract

Objectives: We studied the association between obstructive sleep apnea (OSA) based on STOP-Bang questionnaire and suicidal risk behaviors (ideations, plans, and attempts) in the general population using a nationally representative sample from South Korea.

Methods: Data were obtained from 11,917 adults (aged ≥40 years) who participated in the Korea National Health and Nutrition Examination Survey (2019–2020). Multiple logistic regression analyses were used to evaluate the association between suicidal behaviors and intermediate-high risk OSA (STOP-Bang score ≥3).

Results: Poor health status, severe stress, less sleep time, poor quality of life, and depression were significantly more common in the intermediate-high risk OSA group compared to the low risk OSA group. The proportions of the intermediate-high risk OSA group who had suicidal ideation (2.5%), suicidal planning (1.8%), and suicidal attempts (0.5%) were higher than those in the low risk OSA group (1.1%, 1.2%, 0.1%; $P < .001$, respectively). A multivariate analysis after adjusting revealed that the odds ratios for suicidal ideations, planning, and attempts were 1.42 (95% confidence interval [CI]: 1.00–2.02), 1.21 (95% CI: 1.01–1.77), and 3.29 (95% CI: 1.50–7.24), respectively, in the intermediate-high risk OSA group.

Conclusions: Moderate-high risk groups of OSA based on the STOP-Bang questionnaire were associated with suicidal behaviors in a Korean population.

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Obstructive sleep apnea (OSA) is a sleep disorder in which breathing is interrupted during sleep. OSA, and sleep disturbances in general, has been linked to a variety of psychiatric illnesses such as depression, including suicidal ideation.[1,2] A recent study of 48,000 Danish adults with OSA[3] showed that suicide may be more common in people who have symptoms of sleep apnea. This study discovered that 1.9% of people with OSA died by suicide, compared to 1.5% of people without OSA. Early detection of OSA is critical, but investigating OSA is difficult due to the time required, the high cost, and the requirement for overnight polysomnography. So, a sensitive, easy to use, and practical screening method is required for screening OSA. The STOP-Bang questionnaire can be used as a screening method to identify patients with suspected OSA, according to a recent meta-analysis.[4] The STOP-Bang questionnaire includes 4 self-reporting questions (STOP: Snoring, Tiredness, Observed apnea, and elevated blood Pressure) and 4 demographic questions (BANG: Body mass index [BMI], Age, Neck circumference, and male Gender).[5] A score of more than 3 on the STOP-Bang questionnaire demonstrated sensitivity levels of 84%, 93%, and 100% for identifying mild, moderate, and severe OSA, respectively.[6] Based on the above evidence, we hypothesized that OSA is associated with an increased risk of suicide. Suicide is a major public health issue in South Korea and throughout the world. In Korea, the suicide rate has skyrocketed, and it is now the fourth leading cause of death.[7] However, no studies have studied the risk of suicidal behaviors in a nationally representative group of patients using a simple method like the STOP-Bang questionnaire. The purpose of this study was to discover a link between suicidal behavior and OSA as measured by the STOP-Bang questionnaire, using nationwide data from the Korean National Health and Nutrition Survey (KNHANES) from 2019 to 2020.

Editor's Note
We encourage authors to submit papers for consideration as a part of our Focus on Suicide section. Please contact Philippe Courtet, MD, PhD, at pcourtet@psychiatrist.com.

Clinical Points

- We investigated the association between suicidal behaviors and obstructive sleep apnea (OSA) using the simple STOP-Bang questionnaire.
- Suicidal behaviors may be more common in patients with OSA than in those without OSA.

METHODS

Study Participants

The KNHANES is made up of several surveys about general health and nutritional status, as well as health examinations and laboratory tests.[8] To represent the Korean adult population, a stratified multistage probability sampling method was used, and the method took into account geographic area, gender, and age group by referring to household registries. KNHANES VIII-1 (2019) and VIII-2 (2019) had a total of 15,469 participants (2020). Participants who did not complete the STOP-Bang questionnaire and other confounding factors were excluded. Finally, this study included information from 11,917 people aged 40–80 years. The Korea Centers for Disease Control and Prevention's institutional review board approved this study (2018-01-03-C-A in 2019 and 2018-01-03-2C-A in 2020). Written informed consent was obtained from study participants.

Sociodemographic and Health-Related Characteristics

Indicators of sociodemographic variables such as cigarette smoking,[9] alcohol consumption,[10] and amount of exercise[11] are associated with suicidal thoughts. Therefore, the current study used self-reported questionnaires to evaluate health-related behaviors like smoking, drinking, and regular exercise. Smoking more than 100 cigarettes over a lifetime was the criterion for being classified in the smoking group.[12] Current frequent drinker was considered as being more than 12 times in previous year.[13] Participants who walked for more than 30 minutes on more than 5 days in the previous week were considered to be exercising.[14]

Married and not married (single, separated, divorced, or widowed) were the 2 categories for marital status. The 2 categories of employment status were employed (full- or part-time job) and unemployed. Using techniques advised by the Organization for Economic Cooperation and Development, monthly income was split into low, moderate-low, moderate-high, and high quartiles.[15] The 4 grades of elementary school, middle school, high school, and college or higher were used to describe educational levels. Any self-reported comorbidities were investigated, including depression, cerebral stroke, hypertension, and diabetes mellitus.

Mental Health Measures

Suicidal behavior can be influenced by psychosocial variables, and vice versa: suicidal behavior may also be regarded as a sign of psychosocial problems. So, we adjusted mental health variables for suicidal behaviors. Participants classified their stress level as none to mild, moderate, or severe, with self-rated health status categorized as good, moderate, and bad. Average sleep duration was calculated as (5 × weekday sleep duration + 2 × weekend sleep duration) / 7. Sleep time was divided into 5 subcategories: ≤5, 6, 7, 8, and ≥9 hours. Short sleep has been defined by most epidemiologic studies as a sleep duration of less than 6 hours.[16] Participants' positive responses to the question "Did you consider committing suicide in the last 12 months?" were used to assess suicidal ideation. Suicidal plans and attempts were defined as planning or attempting to commit suicide in the previous 12 months.

Health-Related Quality-of-Life (HRQoL) Measures

HRQoL was evaluated using the EuroQol 5-dimensional (EQ-5D) questionnaire. The EQ-5D is a short, self-completed instrument used to describe and assess the level of health states as defined by the EQ-5D index. Average scores of the EQ-5D index were calculated to assess HRQoL, which is a preference-based health status index.[17,18] The EQ-5D index's average scores varied from −0.17 to 1, with 1 denoting the absence of any problems in any of the 5 dimensions, zero denoting death, and negative values denoting health conditions worse than death.

Survey for OSA

The STOP-Bang questionnaire is a useful triage tool for determining the likelihood of OSA. The higher the risk of the disease, the higher the score. The sum of the scores from the 8 dichotomous yes/no questionnaires ranges from 0 to 8.[19] Patients aged ≥40 years were asked about the risk factors associated with OSA using the STOP-Bang questionnaire, which contains 4 questions and 4 objective measures; (1) S (snoring): Do you snore loudly? (2) T (tired): Do you often feel tired, fatigued, or sleepy during the daytime? (3) O (observed): Has anyone observed you stop breathing or choking during your sleep? (4) P (pressure): Do you have high blood pressure? (5) B (BMI): Is your BMI >35 kg/m^2? (6) A (age): Are you over 50 years? (7) N (neck circumference); Is your neck circumference >40 cm? and (8) G (gender); Are you a male?

Individuals with a score of 0–2 were considered to be at a low risk of OSA, those with a score of 3–4 were considered to be at an intermediate risk of OSA, and

those with a score of 5–8 were considered to be at a high risk of OSA.[20] The associations and relationships between OSA risk and health behaviors are perceived as a serious public health concern.[21] Based on STOP-Bang questionnaire validation studies and clinical trials using STOP-Bang to identify patients who may benefit from OSA treatment, a score of STOP-Bang ≥3 was used to demarcate patients with OSA.[20] So, we categorized low-risk OSA (STOP-Bang score <3) and intermediate-high-risk OSA (STOP-Bang score ≥3) groups, respectively.

Data Analysis

The Korea Centers for Disease Control conducts an annual national survey known as the KNHANES. To represent general noninstitutionalized Korean citizens, the KNHANES dataset was created using a multistage clustered probability design. Individuals in the sample were assigned sampling weights, and all statistical analyses were carried out using complex sample analyses. The weighted prevalence of OSA based on the STOP-Bang score was calculated. Complex sample logistic regression analysis adjusted for age and gender in model 1; adjusted for age, gender, residence, smoking, alcohol, exercise, BMI, marital status, job, family income, education levels, and physician-diagnosed diseases (diabetes, hypertension, stroke) in model 2; and adjusted for age, sex, residence, smoking, alcohol, exercise, BMI, marital status, job, family income, education levels, physician-diagnosed diseases (diabetes, hypertension, and stroke), stress, perceived health status, sleep time, quality of life (EQ-5D index), and depression in model 3. All tests were 2-tailed, and the threshold for statistical significance was set at $P < .05$. IBM SPSS Statistics for Windows was used for all statistical analyses (version 24.0; IBM Corp., Armonk, NY).

RESULTS

Prevalence of OSA

The characteristics of the study population (N = 11,917), which was divided into the low risk OSA (STOP-Bang score <3, N = 7,520) and intermediate-high risk OSA (STOP-Bang score ≥3, N = 4,397) groups, are shown in Table 1. In this study, the prevalence of low-risk OSA (STOP-Bang score: 0–2) was 63.7%. Intermediate risk OSA (STOP-Bang score: 3–4) was 31.0%, and high risk OSA (STOP-Bang score: 5–8) was 5.3%.

Sociodemographic Characteristics of the Participants

The intermediate-high risk OSA (STOP-Bang score ≥3) group had a significantly higher frequency of male sex, rural living, smoking and alcohol use, high BMI, married status, employed status, low family income, low educational status, and more comorbidities (DM, hypertension, stroke) compared to the low risk OSA (STOP-Bang score <3) group.

Table 1.

Clinical Characteristics of Study Populations

	Low-risk OSA (n = 7,520)	Intermediate-high-risk OSA (n = 4,397)	*P* value
Age, mean ± SD, y	55.4 ± 11.2	60.1 ± 10.4	<.001[a]
Sex, n (%)[b]			<.001[c]
Male	1974 (31.5)	3,227 (78.2)	
Female	5,546 (68.5)	1,170 (21.8)	
Residence, n (%)[b]			<.001[c]
Urban	5,975 (83.8)	3,317 (80.9)	
Rural	1,545 (16.2)	1,000 (19.1)	
Smoking, n (%)[b]			<.001[c]
Smoker	654 (13.6)	964 (24.6)	
Nonsmoker	6,661 (86.4)	3,429 (75.4)	
Alcohol, n (%)[b]	3,158 (45.9)	2,453 (59.3)	<.001[c]
Exercise, n (%)[b]	2,918 (39.9)	1,711 (39.8)	.786[c]
BMI, kg/m²	23.6 ± 3.1	25.5 ± 3.4	<.001[a]
Marital status, n (%)[b]			<.001[c]
Married	5,718 (78.8)	3,527 (82.2)	
Unmarried	1,802 (21.2)	870 (17.8)	
Job, n (%)[b]			<.001[c]
Employed	4,408 (62.1)	2,596 (66.1)	
Unemployed	3,112 (37.9)	1,801 (33.9)	
Income, n (%)[b]			<.001[c]
Low	1,415 (15.0)	1,116 (20.1)	
Moderate-low	1,869 (23.5)	1,148 (24.7)	
Moderate-high	2,031 (29.3)	1,049 (25.6)	
High	2,205 (32.2)	1,084 (29.6)	
Education, n (%)[b]			<.001[c]
≦ Elementary	1,632 (16.4)	1,188 (20.0)	
Middle school	886 (10.0)	656 (13.6)	
High school	2,537 (36.8)	1,340 (33.1)	
≧ College	2,465 (37.3)	1,213 (33.3)	
DM, n (%)[b]	722 (8.8)	941 (19.1)	<.001[c]
Hypertension, n (%)[b]	1,218 (13.7)	2,767 (57.8)	<.001[c]
Stroke, n (%)[b]	155 (1.8)	207 (4.0)	<.001[c]

[a]Linear regression analysis with complex sampling, significance at $P < .05$.
[b]Estimated mean or rate-adjusted recommended weighted value.
[c]Chi-square test with Rao-Scott correction, significance at $P < .05$.
Abbreviations: BMI = body mass index, DM = diabetes mellitus, OSA = obstructive sleep apnea.

Psychological Characteristics of the Participants

The differences in psychological variables between the groups are shown in Table 2. Poor health status, severe stress, less sleep time, and depression were significantly more common in the intermediate-high risk OSA group compared to the low risk OSA group. The mean EQ-5D index score was significantly lower in the intermediate-high risk OSA group than in the low risk OSA group. The mean EQ-5D index score was 0.89 in those with intermediate-high risk of OSA and 0.92 in those with low risk of OSA ($P < .001$). The proportions of the intermediate-high risk OSA group who had suicidal

Table 2.

Mental Health of Study Populations

	Low-risk OSA (n = 7,520)	Intermediate-high-risk OSA (n = 4,397)	*P* value
Stress, n (%[a])			<.001[b]
Moderate to severe	1,699 (23.1)	1,087 (26.4)	
None to mild	5,821 (76.9)	3,310 (73.6)	
Perceived health status, n (%[a])			<.001[a,b]
Good	2,193 (30.4)	981 (23.3)	
Moderate	4,083 (54.5)	2,236 (52.3)	
Bad	1,244 (15.1)	1,170 (24.4)	
Sleep time, n (%[a])			<.001[b]
≤5 h	1,501 (19.0)	1,079 (23.1)	
6 h	2,045 (27.9)	1,083 (25.0)	
7 h	2,216 (30.2)	1,247 (30.6)	
8 h	1,409 (18.6)	755 (16.7)	
≧9 h	349 (4.3)	233 (4.6)	
Depression, n (%[a])	722 (8.6)	941 (19.1)	<.001[c]
EQ-5D index score, mean ± SD	0.92 ± 0.07	0.89 ± 0.11	<.001[b]
Suicidal ideation, n (%[a])	108 (1.1)	118 (2.5)	<.001[b]
Suicidal planning, n (%[a])	103 (1.2)	94 (1.8)	<.001[b]
Suicidal attempts, n (%[a])	17 (0.1)	29 (0.5)	<.001[b]

[a]Estimated mean or rate-adjusted recommended weighted value.
[b]Chi-square test with Rao-Scott correction, significance at $P < .05$.
[c]Linear regression analysis with complex sampling, significance at $P < .05$.
Abbreviations: EQ-5D = EuroQol-5D, OSA = obstructive sleep apnea.

Table 3.

Odds Ratios (95% CI) of Suicidal Behaviors for Intermediate-High-Risk OSA[a]

	Suicidal ideation		Suicidal planning		Suicidal attempts	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Model 1	1.91 (1.41–2.59)	<.001	1.80 (1.30–2.50)	<.001	3.60 (1.81–7.18)	<.001
Model 2	1.96 (1.39–2.77)	.003	1.75 (1.20–2.54)	.021	4.85 (2.28–10.30)	<.001
Model 3	1.42 (1.00–2.02)	.028	1.21 (1.01–1.77)	.042	3.29 (1.50–7.24)	.003

[a]Adjusted for age and sex in model 1. Adjusted for age, sex, residence, smoking, alcohol, exercise, BMI, marital status, job, family income, education levels, and physician diagnosed diseases (diabetes, hypertension, and stroke) in model 2. Adjusted for age, sex, residence, smoking, alcohol, exercise, BMI, marital status, job, family income, education levels, physician diagnosed diseases (diabetes, hypertension, and stroke), stress, perceived health status, sleep time, quality of life (EQ-5D index), and depression in model 3.
Abbreviations: CI = confidence interval, OR = odds ratio, OSA = obstructive sleep apnea.

ideation (2.5%), suicidal planning (1.8%), and suicidal attempts (0.5%) were higher than those in the low risk OSA group (1.1%, 1.2%, 0.1%; $P < .001$, respectively).

Odds Ratios (ORs) of Suicidal Behaviors

The ORs of suicidal ideation, planning, and attempts among the intermediate-high risk OSA group in comparison to the low risk OSA group are presented in Table 3. A multivariate analysis adjusting for age and sex (model 1) revealed that the ORs for suicidal ideations, planning, and attempts were 1.91 (95% confidence interval [CI]: 1.41–2.59), 1.80 (95% CI: 1.30–2.50) and 3.60 (95% CI: 1.81–7.18), respectively. When additional adjustments were performed for socioeconomic factors (ie, residence, smoking, alcohol, exercise, BMI, marital status, job, family income, education levels, and physician diagnosed diseases [diabetes, hypertension, and stroke]; model 2), the ORs for suicidal ideations planning and attempts were 1.96 (95% CI: 1.39–2.77), 1.75 (95% CI: 1.20–2.54) and 4.85 (95% CI: 2.28–10.30), respectively. After additional adjustments for age, sex, residence, smoking, alcohol, exercise, BMI, marital status, job, family income, education levels, physician-diagnosed diseases (diabetes, hypertension, stroke), stress, perceived health status, sleep time, quality of life (EQ-5D index), and depression: model 3, the ORs for suicidal ideations, planning, and attempts were 1.42 (95% CI: 1.00–2.02),

1.21 (95% CI: 1.01–1.77), and 3.29 (95% CI: 1.50–7.24), respectively.

DISCUSSION

According to our study, sleep apnea assessed with the STOP-Bang questionnaire was associated with experiencing more stress, suicidal ideation, plans, and attempts than no sleep apnea. Even after controlling for elements known to influence suicidality, such as socioeconomic status, chronic medical conditions, and depression, sleep apnea was still linked to an increased risk for suicidal behaviors (ideas, plans, and attempts). To our knowledge, this is the first study to use sleep apnea assessed the STOP-Bang questionnaire to investigate the association between sleep apnea and suicidal behaviors using national and population-based data while adjusting for multiple important confounding variables.

Although the STOP-Bang questionnaire is not a diagnostic tool but assesses the risk of presenting with sleep apnea, our findings might suggest the linkage between suicidal behaviors and OSA. Anxiety disorders and mood disorders such as depression have been strongly related with suicidal risk.[22,23] Furthermore, OSA is linked to cardiovascular disease, which is linked to an increased risk of suicide.[24] As a result, our findings were somewhat predictable. Despite the fact that patients with OSA have several evidence-based risk factors for suicide, the current study's poor late outcome may be attributed primarily to the association with anxiety or depressive symptoms. Although the risk of suicide in OSA patients has never been studied, an increased risk of suicide attempts, suicidal ideation, and planning has been described.[1,25] This link was highlighted in a study by Bishop et al,[25] who found that insomnia and sleep-related breathing disorders, including OSA, were linked to suicide attempts among US veterans. However, sleep-related breathing issues were no longer positively correlated with suicidal ideation after adjusting for obesity and a number of psychiatric comorbidities. Given that Bishop et al[26] used a retrospective method, starting with the result (suicide attempts) and tracing back to analyze exposures, this inconsistency in regard to our study may be explained by the differences in analysis plan or study design. Another study conducted by Bishop et al[26] found that patients with self-reported OSA were more likely to report suicidal thoughts and behavior, lending credence to our findings. In contrast to our findings, the authors reported that suicide attempts were not related to OSA. Different study designs are better suited for establishing a potential relationship. Another intriguing explanatory hypothesis advanced by the authors is that patients with OSA may lack the mental or physical energy to act on suicidal thoughts, ie, patients with OSA have poor executive function.

Sleeping less than 5 hours reflects sleep depriviation, as it could reflect sleep insufficiency. In fact, chronic sleep deprivation could potentially be a confounding factor in the association between the risk of sleep apnea and suicidal behavior,[27] so we adjusted sleep hours variable for suicidal behaviors.

Actual executive function, reflecting planning and execution, is found to be impaired in patients with OSA.[28]

Sleep quality is measured by whether or not someone's sleep is restful and restorative. This means that when those with OSA are impacted by symptoms that interrupt their sleep patterns, their mental health can also be negatively impacted.[29] Some ways to reduce screen time and prepare for a good night's sleep include avoiding using screens an hour before bedtime, monitoring use of screens throughout the day, including set limits for consumption, and leaving screens outside the bedroom to charge at night.

There are several limitations to our study. First, the subjects' OSA was not clinically confirmed using polysomnography. The risk stratification was solely based on the self-reporting questionnaire completed by the participants. The fact that the prevalence of high risk OSA in our study was comparable to that of previous population-based studies suggests that our sampling strategy was fairly reliable. Second, because our sample excluded patients under the age of 40 years, the biased sample may have influenced the true clinical significance of our data. Previous data show, however, that utilization of health care is only significant in OSA patients over the age of 40, supporting the KHANES policy of only administering the STOP-Bang questionnaire to those over the age of 40.[30] As a result, in terms of social welfare, populations over the age of 40 should be prioritized for early OSA detection. Finally, given the retrospective analysis of the existing dataset, this study had to be conducted with a cross-sectional design. As a result, the causal relationships between high-risk OSA and suicidal behavior remain unclear. However, because this study benefited from data retrieved from a nationally representative survey sample with a high response rate, a large amount of data was provided to overcome potential confounding issues. Furthermore, because our data came from a large sample, it improved the precision of our findings and allowed for numerous statistical adjustments.

In conclusion, our study is the first to report the associations between moderate-high risk groups of OSA based on the STOP-Bang questionnaire and suicidal behaviors in a Korean population.

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