Sleep Duration is Closely Associated with Suicidal Ideation and Suicide Attempt in Korean Adults: A Nationwide Cross-sectional Study

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Abstract

Introduction: Suicidal ideation and suicide attempts are major risk factors for suicidal death, and sleep problems are associated with an increased risk for mental disorders. We investigated the relationship between sleep duration and suicidal ideation and suicide attempts in a representative sample of the Korean general population from a nationwide survey.

Methods: We analyzed data collected from the Korea National Health and Nutrition Examination Survey VI and VII (2013–2018). Suicidal ideation was identified via self-report and we accessed suicide attempt history. Sleep duration was divided into three categories: short sleep duration (SSD) (≤ 5 h), normal sleep duration (NSD) (>5 and <9 h), and long sleep duration (LSD) (≥ 9 h). Sampling weights were applied to obtain estimates for the general Korean population.

Results: Overall, 4015 (12.0%), 25,609 (76.5%), and 3857 (11.5%) participants were in the SSD, NSD, and LSD groups, respectively. Among these groups, 7.2%, 2.8%, and 3.3% reported suicidal ideation, 1.2%, 0.4%, and 0.7% reported a history of suicide attempts. Multiple regression analyses revealed that SSD was significantly more strongly associated with suicidal ideation (adjusted odds ratio [AOR] 1.46, $p < 0.001$) and attempts (AOR 2.05, $p = 0.003$) than NSD. No association was found between LSD and suicidal ideation/attempts.

Conclusion: Sleep duration is significantly associated with suicidal behavior, and SSD was particularly closely related with an increased risk for suicidal ideation and suicide attempt. Clinicians should carefully consider sleep duration in suicidal patients.

Introduction

Suicide is a major health problem worldwide, with nearly one million deaths to suicide per year¹. In Korea, the suicide rate was 29.1 per 100,000 people in 2013, ranking first among developed countries, and was the fourth cause of death after cancer, cardiovascular disease, and cerebrovascular disease². Suicidal ideation and suicide attempts are some of the strongest risk factors for suicidal death, and can result in injuries and hospitalizations that represent a financial societal burden of billions of dollars³. Therefore, investigating the risk factors for suicidal ideation and attempts is considered an important element of formulating suicide prevention strategies.

Sociocultural, environmental, psychological, and biological factors contribute to suicidal ideation and suicide attempts^{4–6}. Recently, sleep disorders such as insomnia and excessive sleep have been reported to be risk factors for suicidal ideation and suicide attempts⁷. Sleep is essential for health and well-being, including cognitive abilities, physiological processes, emotional regulation, physical development, and quality of life⁸. Sleep is also known to be closely related to depression and mental disorders such as bipolar disorder and anxiety disorder⁹. Previous studies have reported that a short sleep duration is associated with a heightened suicide risk^{7,10,11}. However, whether sleep duration and suicidality exist

independently of other mental disorders is unclear, and the direct mechanisms underlying a potential causal relationship between sleep time and suicide have not been identified ¹².

Although multiple factors such as socioeconomic environment and mental health problems are associated with suicide, few studies have investigated the relationship between sleep duration and suicidal ideation after correcting for depression, health status, and sociodemographic factors in the general adult population in Asia ^{13,14}. One previous study that did correct for these factors found an association between sleep duration and suicidal ideation in Korean adults ¹¹. However, that study did not consider suicide attempts, which, along with suicidal ideation, are a major risk factor for suicide.

To address this, we conducted a cross-sectional study using a large-scale sample representing Korean adults. We corrected for potential confounders such as depressive mood, health status, and sociodemographic factors to comprehensively evaluate the association between sleep duration and suicidal ideation and suicide attempts.

Materials And Methods

Study population and sampling

We analyzed data collected between 2013 and 2018 as part of the Korea National Health and Nutrition Examination Survey (KNHANES) version VI (2013–2015) and VII (2016–2018). The Korea Centers for Disease Control and Prevention (KCDC) conducts annual surveys to evaluate the health and nutritional status of Korean families. This national, cluster, multi-level, stratified survey has a random sampling method, and has been proportionally distributed by region, sex, and age in the Korean population since 1998. Survey participants vary from year to year and are not continuously monitored. There are three main components: a health interview survey, a health examination survey, and a nutrition survey. Participants under 18 years of age and those who did not complete the sleep duration survey were excluded from the present study.

Definition of sleep duration, suicidal ideation, and suicide attempts

Sleep duration was identified using self-reported data, specifically, responses to the question “How many hours do you usually sleep a day?” The participants were categorized as having a short sleep duration (SSD) (≤ 5 h), normal sleep duration (NSD) (> 5 and < 9 h), or long sleep duration (LSD) (≥ 9 h) according to the guidelines of the National Sleep Foundation ¹⁵.

The individuals who answered “yes” to the question “Have you ever seriously considered suicide in the last year?” were defined as having suicidal ideation. Those who answered “yes” were asked if they had attempted suicide. This indicator is a well-documented predictor of suicide attempts and has been previously used in other surveys of adults ¹⁶.

Description of demographic variables

The demographic characteristics, socioeconomic status, and personal history including the medical and lifestyle habits of the participants were examined via health examinations and interviews. Diagnoses of any major comorbidity such as high blood pressure, diabetes, dyslipidemia, stroke, ischemic heart disease (myocardial infarction, angina), asthma, and malignant tumor (lung, stomach, liver, colon, breast, uterine, or cervical) were assessed for all participants.

Body mass index (BMI) was determined for each participant as weight divided by height squared. Smoking status was classified as nonsmoker, ex-smoker, and current smoker. Alcohol habit was categorized based on the frequency of drinking alcohol: none, ≤ 1 drink/month, 2 drinks/month to 3 drinks/week, and ≥ 4 drinks/week. Educational level was categorized as ≤ 6 years (elementary school), 7 to 9 years (middle school), 10 to 12 years (high school), and ≥ 13 years (college or university). Household income level was divided into quartiles. Occupations were unemployed, simple labor (e.g., technicians and low-level laborers), agriculture, fishery, sales and services, and office workers. Physical activity was defined as follows: mid-intensity physical activity for at least 2 h 30 min per week, high-intensity physical activity for > 1 h 15 min, or a combination of middle and high intensity physical activity for a greater time period than stated above (1 min of high intensity activity was defined as 2 min of mid-intensity activity)¹⁷.

Marital status was single, married, separated, divorced, and separated by death. Perceived health status was examined via a question regarding how each individual felt about his or her health, i.e., “How do you perceive your own health?” The responses were categorized as follows: very good, good, average, bad, and very bad. Depressive mood was assessed via a “yes” or “no” answer to the question “In the past year, have you ever been depressed or desperate enough that it interfered with your daily life for more than 2 weeks?”

Statistical Analysis

We used IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA) for statistical analyses. We used the Student's t-test to compare the continuous variables and the chi-square test for the categorical variables. Multiple logistic regression analyses were performed to confirm that the difference caused by the confounding variable was not due to sleep duration. To this end, we used the following three different models; model 1, unadjusted odds ratio; model 2, adjusted by age and sex; model 3, fully adjusted by age, sex, and other environmental factors such as smoking, alcohol consumption, educational level, household income, occupation, physical activity, sleep duration, marital status, perceived health status, depressive symptoms, and comorbidities. Sampling weights were applied in the analyses so that the estimates were representative of the Korean population. Statistical significance was defined as $p < 0.05$.

Ethics Statement

The VI and VII version of the KNHANES was approved by the KCDC Institutional Review Board (approval no. 2013-12EXP-03-5C, 2018-01-03-P-A).

Informed consent was obtained from each participant.

The study was conducted in accordance with the principles of the Declaration of Helsinki. All study procedures were performed in accordance with the relevant guidelines and regulations.

Data Availability

The data files are available from the KCDC and Prevention database on the following webpage:

https://knhanes.cdc.go.kr/knhanes/sub03/sub03_02_05.do. Anyone who wishes to check the data can access the web page and receive the raw data after meeting appropriate qualifications.

Results

A total of 42,217 people participated in the KNHANES examination and health survey during the study period. Excluding those under the age of 18 (10,110 people) and those who did not complete the sleep duration survey (3626 people), data from 33,481 people were included in the analyses (Fig. 1).

Demographics of participants according to sleep duration

Of the 33,481 participants in the study, 4015 (12.0%) people had a SSD, 25,609 (76.5%) had a NSD, and 3857 (11.5%) had a LSD. The sleep duration in each group was 4.61, 7.03, and 9.41 h, respectively. Overall, 1208 (3.6%) people reported suicidal ideation. When classified by sleep status, 287 (7.2%) in the SSD, 704 (2.8%) in the NSD, and 127 (3.3%) participants in the LSD group reported suicidal ideation. In terms of suicide attempts, 187 (0.6%) people reported attempting suicide, of which 49 (1.2%) were from the SSD, 110 (0.4%) from the NSD, and 28 (0.7%) from the LSD group. Suicidal ideation and suicide attempts were the most common in the SSD group ($p < 0.001$). Age, sex, height, weight, alcohol consumption, educational level, occupation, household income, physical activity, marital status, perceived health status, depressive symptom, and comorbidities were also significantly different between the three groups ($p < 0.001$) (Table 1).

Table 1
Baseline characteristics according to sleep duration for the study population.

	SSD (N = 4015)	NSD (N = 25609)	LSD (N = 3857)	P-value
Age, yrs	56.8 ± 16.27	49.97 ± 16.19	52.18 ± 19.52	< 0.001
Sex, n (%)				< 0.001
Male	1478 (36.8)	11396 (44.5)	1527 (39.6)	
Female	2537 (63.2)	14213 (55.5)	2330 (60.4)	
Height, cm	160.15 ± 9.75	163.25 ± 9.22	161.41 ± 9.27	< 0.001
Weight, kg	62.6 ± 12.48	63.78 ± 12.2	61.79 ± 11.93	< 0.001
BMI, kg/m ²	24.3 ± 3.63	23.84 ± 3.47	23.66 ± 3.68	< 0.001
Smoking status, n (%)				0.1857
Non-/Ex-smoker	3278 (81.6)	20828 (81.3)	3184 (82.6)	
Current smoker	737 (18.4)	4781 (18.7)	673 (17.4)	
Alcohol consumption, n (%)				< 0.001
None	1484 (37.0)	6704 (26.2)	1318 (34.2)	
≤1 drink/mo	981 (24.4)	7333 (28.6)	1045 (27.0)	
2 drinks/mo to 3 drinks/wk	1204 (30.0)	9947 (38.8)	1195 (31.0)	
≥4 drinks/wk	346 (8.6)	1625 (6.4)	299 (7.8)	
Education level, n (%) [†]				< 0.001
≤6 y	1465 (36.8)	4747 (18.4)	1161 (30.2)	
7–9 y	498 (12.1)	2617 (9.9)	458 (11.7)	
10–12 y	1147 (28.6)	8677 (34.1)	1156 (30.0)	
≥13 y	905 (22.5)	9568 (37.6)	1082 (28.1)	
Occupation, n (%)				< 0.001
Unemployed (student, housewife, etc.)	1905 (48.1)	9534 (37.6)	1940 (50.8)	
Office work	640 (15.8)	6650 (26.1)	601 (15.5)	
Sales and services	472 (11.6)	3416 (13.2)	445 (11.4)	
Agriculture, forestry, and fishery	529 (13.0)	3798 (14.7)	533 (13.7)	

	SSD (N = 4015)	NSD (N = 25609)	LSD (N = 3857)	P-value
Machine fitting and simple labor	469 (11.5)	2211 (8.4)	338 (8.6)	
Household income, n (%) [‡]				< 0.001
Low	1190 (29.7)	4178 (16.3)	1084 (28.1)	
Low-moderate	1052 (26.2)	6210 (24.3)	1016 (26.4)	
Moderate-high	915 (22.8)	7258 (28.4)	987 (25.6)	
High	858 (21.4)	7963 (31.1)	770 (20.0)	
Physical activity, n (%)	1024 (26.2)	8248 (32.9)	793 (20.9)	< 0.001
Duration of sleep, h	4.61 ± 0.7	7.03 ± 0.78	9.41 ± 0.72	< 0.001
Marital status, n (%)				< 0.001
Single	461 (11.5)	4274 (16.7)	735 (19.1)	
Married	2551 (63.5)	18256 (71.3)	2514 (65.2)	
Separated	37 (0.9)	153 (0.6)	20 (0.5)	
Separated by death	709 (17.7)	1917 (7.5)	453 (11.7)	
Divorced	257 (6.4)	1009 (3.9)	135 (3.5)	
Perceived health status, n (%)				< 0.001
Very good	200 (4.6)	1263 (4.7)	179 (4.5)	
Good	719 (17.9)	6613 (25.9)	815 (21.1)	
Average	1916 (47.9)	13224 (52.2)	1909 (49.8)	
Bad	855 (21.3)	3569 (13.8)	713 (18.5)	
Very bad	325 (8.3)	940 (3.4)	241 (6.1)	
Depressive symptom, n (%)	443 (11.0)	1381 (5.4)	272 (7.1)	< 0.001
Suicidal ideation, n (%)	287 (7.2)	704 (2.8)	127 (3.3)	< 0.001
Suicide attempt, n (%)	49 (1.2)	110 (0.4)	28 (0.7)	< 0.001
Comorbidities, n (%)				
Hypertension	1268 (31.6)	5508 (21.5)	1076 (27.9)	< 0.001
Diabetes	505 (12.6)	2127 (8.3)	444 (11.5)	< 0.001
Dyslipidemia	871 (21.7)	3977 (15.5)	642 (16.7)	< 0.001

	SSD (N = 4015)	NSD (N = 25609)	LSD (N = 3857)	P-value
Stroke	131 (3.3)	529 (2.1)	148 (3.8)	< 0.001
Myocardial infarction	51 (1.3)	242 (0.9)	50 (1.3)	0.0334
Angina	122 (3.0)	445 (1.7)	93 (2.4)	< 0.001
Asthma	166 (4.1)	707 (2.8)	143 (3.7)	< 0.001
Malignancy	88 (2.2)	427 (1.7)	76 (2.0)	0.0376
<p>Numeric parameters are expressed as mean $\pm$ standard deviation and categorical parameters are expressed as counts and percentages in parentheses. SSD, short sleep duration; NSD, normal sleep duration; LSD, long sleep duration; BMI, body mass index.</p> <p>†Educational level was categorized into the following four groups: ≤ 6 years (elementary school), 7–9 years (middle school), 10–12 years (high school), and ≥ 13 years (college or university).</p> <p>‡Household income level was measured at the level when compared with the standard amount for each age, and then was grouped into quartiles.</p>				

Association between suicidal ideation and sleep duration

The estimated odds ratios of suicidal ideation and sleep duration from the multiple logistic regression analyses are presented in Table 2. In model 1, which was unadjusted, the odds of suicidal ideation in participants in the SSD group were 2.67 (95% confidence interval [CI] 2.27–3.14, $p < 0.001$) times greater than that in the NSD group. In model 2, which was adjusted by age and sex, the odds of suicidal ideation in the SSD group were 2.46 times higher than that in the NSD group (95% CI 2.08–2.91, $p < 0.001$). In model 3, which was fully adjusted by age, sex, and other environmental factors such as smoking, alcohol consumption, educational level, household income, occupation, physical activity, duration of sleep, marital status, perceived health status, depressive symptoms, and comorbidities, the odds of suicidal ideation in SSD group were significantly higher than those in the NSD group (OR 1.46, 95% CI 1.18–1.81, $p < 0.001$) (Fig. 2). The LSD group did not show any significant differences among the data calculated using the three models for suicidal ideation.

Table 2
Association between sleep duration and suicidal ideation.

Model 1				Model 2			Model 3		
	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
SSD	2.67	2.27–3.14	< 0.001	2.46	2.08–2.91	< 0.001	1.46	1.18–1.81	< 0.001
NSD	1			1			1		
LSD	1.12	0.90–1.40	0.301	1.10	0.88–1.37	0.398	0.83	0.64–1.08	0.166
OR, odds ratio; CI, confidence interval; SSD, short sleep duration; NSD, normal sleep duration; LSD, long sleep duration. Model 1 was the unadjusted odds ratio. Model 2 was adjusted by age and sex. Model 3 was fully adjusted by age, sex, and other environmental factors such as smoking, alcohol consumption, educational level, household income, occupation, physical activity, duration of sleep, marital status, perceived health status, depressive symptoms, and comorbidities.									

Association between suicide attempts and sleep duration

The results of the multiple logistic regression analyses for suicide attempts and sleep duration are shown in Table 3. The SSD group showed a more strongly positive association with suicide attempts than the LSD group. In model 3, the rate of suicide attempts in the SSD group was 2.05 times higher than that in the NSD groups (95% CI 1.18–3.26, $p = 0.003$), and the odds ratio was significantly higher than that of suicidal ideation (20.5 vs. 1.46) (Fig. 2). The LSD group was not statistically significantly related to suicide attempts compared to the NSD group.

Table 3
Association between duration of sleep and suicide attempts.

Model 1				Model 2			Model 3		
	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
SSD	3.65	2.56–5.20	< 0.001	3.74	2.59–5.39	< 0.001	2.05	1.28–3.26	0.003
NSD	1			1			1		
LSD	1.56	0.98–2.48	0.062	1.48	0.92–2.37	0.105	1.30	0.75–2.28	0.349
OR, odds ratio; CI, confidence interval. Model 1 was the unadjusted odds ratio. Model 2 was adjusted by age and sex. Model 3 was fully adjusted by age, sex, and other environmental factors such as smoking, alcohol consumption, educational level, household income, occupation, physical activity, duration of sleep, marital status, perceived health status, depressive symptoms, and comorbidities.									

Discussion

In this nationwide cross-sectional study based on a representative sample of the general population in Korea, we investigated the association between sleep duration and suicidal ideation and suicide attempts. We found that SSD (≤ 5 h) is an independent risk factor for suicidal ideation and suicide attempts.

When faced with suicidal patients, clinicians tend to focus on identifying events or stressors that may have triggered suicidal behaviors and treating any mood symptoms such as depression or anxiety. However, our data indicate that sleep duration, particularly SSD, is one of the strongest risk factors for suicide attempts, as well as suicidal ideation. This finding is consistent with previous studies, which have shown a U-shaped relationship between sleep duration and suicidal risk^{10,11,18}, where suicidal risk is higher in short sleepers. In addition, a recent study reported that LSD is related to suicidal ideation and that SSD is related to suicidal behaviors in general¹⁹. Therefore, clinicians should be aware that sleep duration is closely related with suicidality and thus carefully monitor sleep duration when treating suicidal patients.

Sleeping for a normal duration is necessary to regulate body functions and resources that are depleted during the day and plays an important role in the functional recovery of the central nervous system, which is essential for maintaining overall health¹⁵. However, insufficient sleep can lead to various psychological and physiological disorders, including impaired judgment, decreased concentration, and poor impulse control, along with endocrine and immunological changes^{20,21}. Although the exact mechanism of the association between sleep disturbance and suicidal tendencies has not been clearly elucidated, it may be related to the inhibition of 5-hydroxytryptamine^{22,23}. In addition, inflammation markers, particularly interleukin-6, may be associated with suicidal risk in patients with sleep disorders¹⁹. As we did not explore the mechanisms linking sleep and suicide risk in the present study, additional clinical trials are needed.

Low socioeconomic status, vulnerable health status, disability, and depression are well-known risk factors for suicide, and other factors such as marital status and family history have also been reported^{24,25}. An epidemiological survey of mental health conditions which was conducted nationwide in Korea indicated that mental disorders, alcohol consumption, and smoking were related to suicidal behaviors²⁶. In this study, we adjusted not only for socioeconomic factors, marital status, health behavior, and health status, but also for depressive symptoms. We found that the odds ratio of suicidal ideation and suicide attempts in the SSD group gradually decreased as we increased the number of adjustments. This suggests that suicidal risk can be mediated by these factors.

The major strength of this study is the large, population-based dataset, which enabled us to evaluate the relationship between sleep duration and suicidal ideation and suicide attempts in the general population. Our results are consistent with those of previous studies on the relationship between sleep duration and suicidality conducted in Korea and China^{10,11}. Therefore, our findings can potentially be generalized not

only to the Korean population but also to general Asian populations. To the best of our knowledge, this is the largest study to examine the association between sleep duration and suicidal ideation and suicide attempts in an Asian population.

However, some limitations must be considered. First, this study had a cross-sectional design and used data from a national health survey. Therefore, we were only able to evaluate simple correlations, and thus did not examine the causal relationship between sleep quantity and suicidal ideation and suicide attempts. Second, the relationship between sleep duration and suicide may vary depending on ethnicity and race. Because the KNHANES survey is based on the general population of Korea, care should be taken when applying findings from this dataset to other population groups. Third, we were unable to evaluate the mechanisms underlying the relationship between sleep and suicide risk. Therefore, a future well-designed large-scale study is needed to overcome these limitations.

Conclusion

Sleep duration was strongly associated with suicidal ideation and suicide attempts. Specifically, suicidal ideation and suicide attempts were significantly more frequent in people who had fewer hours of sleep, and short sleep duration was particularly strongly associated with suicide attempts. As such, sleep duration can be considered an independent and strong risk factor for suicidality, with important clinical implications for patients with suicidal ideation and who attempt suicide.

Declarations

Author's contributions

SH designed the study. SH and JEM performed the analysis and YK wrote the manuscript. YK contributed to the interpretation of the results. SH conduct of the cross-sectional study as well as in critical reviewing of the manuscript. All authors approved the final version.

Conflicts of interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Consent for publication

Not applicable.

Acknowledgments

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Figures

Figure 1

Flow chart of study subjects included in the 2013 to 2018 Korea National Health and Nutrition Examination Surveys (KNHANES VI and VII).

Figure 2

Association between sleep duration and suicidal ideation and suicide attempts. The logistic regression model was fully adjusted in terms of age, sex, and other environmental factors such as smoking, alcohol consumption, educational level, household income, occupation, physical activity, duration of sleep, marital status, perceived health status, depressive symptoms, and comorbidities. * $p < 0.05$.