

Relationship Between Current Sleep Duration and Past Suicidal Ideation or Attempt Among Korean Adolescents

Sung-In Jang^{1,2}, Kwang-Sig Lee^{1,2}, Eun-Cheol Park^{1,2}

¹Department of Preventive Medicine, Yonsei University College of Medicine, Seoul; ²Health Services Research Institute, Yonsei University College of Medicine, Seoul, Korea

Objectives: To comprehensively examine the relationship between current sleep duration and past suicidal idea or attempt among Korean adolescents.

Methods: Data came from the 2009 Korea Youth Risk Behavior Web-based Survey with 75 066 participants (with the participation rate of 97.6%) in 800 middle and high schools. Binary logistic regression was conducted by gender and depressed mood to identify significant factors for suicidal ideation/attempt. The dependent variable was the log odds of suicidal ideation/attempt, while the independent/control variables were sleep duration and other demographic, socio-economic and health-related factors.

Results: A negative association between sleep duration and suicidal ideation or attempt was weaker for those with depressed mood than for those without such experience in Korea for Year 2009. The odds ratio of suicidal ideation/attempt regarding less than 4 hours of sleep compared to 6 to 7 hours of sleep, was smaller in a group with depressed mood than in a group without such experience, for example, 1.64 (95% confidence interval [CI], 1.29 to 2.08) vs. 2.06 (95% CI, 1.34 to 3.17) for men's suicidal ideation, 2.50 (95% CI, 1.69 to 3.69) vs. 3.89 (95% CI, 1.74 to 8.66) for men's suicidal attempt. A negative association between age (or self-rated health) and suicidal ideation/attempt was also weaker for those with depressed mood than for those without such experience in the nation for the year.

Conclusions: There was a negative association between sleep duration and suicidal ideation/attempt in Korea for Year 2009 and this association was weaker for those with depressed mood than for those without such experience. Based on the findings of this study, adolescents' better mental health and longer, more comfortable sleep might help to prevent their suicidal ideation and attempt in Korea.

Key words: Suicidal ideation, Suicidal attempt, Sleep duration, Depressed mood, Adolescent, Korea

INTRODUCTION

Suicide has become a major issue for adolescent health in the past decade [1,2]. In 2004, it was the second leading cause

of death for those aged 15 to 19 years in the world [1]. During 2001 to 2010, it replaced traffic accident as the first leading cause of death for the age group in Korea (Its mortality rate for the age group rose from 5.3 to 8.3 per 100 000 during the period) [2]. The premature death of adolescents is equivalent to the greatest loss of productivity in a nation (the Cost of Illness approach [3,4]), and setting up effective strategies for preventing adolescent suicide might be a top priority for the health and welfare policy of South Korea (Korea hereafter) at this point.

Existing literature states that short sleep and depression might be major factors for suicidal ideation or attempt [5-17]. They impair judgment and tolerance, which can cause suicidal ideation or attempt [9]. In fact, like depression [7,9-11,14,15],

Received: May 22, 2013; **Accepted:** October 4, 2013

Corresponding author: Kwang-Sig Lee, PhD

50 Yonsei-ro, Seodaemun-gu, Seoul 120-752, Korea

Tel: +82-2-2228-1876, **Fax:** +82-2-392-8133

E-mail: ecophy@yuhs.ac

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

shorter sleep was found to have a positive relationship with greater suicidal ideation or attempt in Japan [5,6], Korea [7-10], Switzerland [11] and the United States (US) [12-17] in the past two decades. This association was apparent especially for adolescents [8,9,11,13,16]. Although suicidal ideation and attempt were associated with depression and alcohol use disorders in Korean adults based on previous nationwide studies, it is still unclear whether sleep is associated with suicide in Korean adults [18,19]. Moreover, the strength of the association between short sleep and suicidal ideation or attempt seemed to be different from nation to nation. For example, as suicidal ideation was more common in Korea for Year 2007 than in the US for Year 2010 (i.e., 23.7% [9] vs. 5.8% [16]), the relationship between short/troubled sleep and suicidal ideation was weaker in the former nation than the latter (i.e., odds ratio [OR], 1.43 [95% confidence interval {CI}, 1.28 to 1.61] vs. 2.44 [95% CI, 1.03 to 5.75]).

Despite the increasing interest of Korean scholars in the association between adolescent sleep duration and suicidal ideation/attempt, their studies have largely been confined to a single urban area (i.e., the city of Incheon) [7,8,10]. Moreover, a scant amount of Korean research on the issue with nationally representative survey data lacked an in-depth analysis of depressed mood or other psychiatric factors [9]. In this vein, this work combines the strengths of previous studies on the topic, using nationally representative survey data and providing a comprehensive examination of the relationship between sleep duration and suicidal ideation or attempt among Korean adolescents.

METHODS

Data

The data used for this study came from the 2009 Korea Youth Risk Behavior Web-based Survey (KYRBWS) conducted by the Korea Ministry of Education, Science and Technology, the Korea Ministry of Health and Welfare, and the Korea Center for Disease Control and Prevention (KCDC) (<http://yhs.cdc.go.kr>). The KYRBWS is an anonymous self-reporting on-line survey of Korean middle and high school students (grades 7 to 12), designed to build annual data on Korean youth risk behavior including smoking, drinking and physical activity (as basic information for the planning and evaluation of Korea youth health promotion programs). The survey involves clustered random sampling with a proportional allocation in each of 129 clusters across the

nation so that the population and the sample are consistent with each other in demographic composition. The 2009 surveys were done on September in school computer rooms for 75 066 participants (with the participation rate of 97.6%) in 400 middle schools and 400 high schools. Inconsistent responses were checked by cross-tabulation and no or inconsistent responses were excluded in the analysis of this study given that the non-response rate was lower than 2% for each survey item.

Suicidal Ideation/Attempt (Dependent Variable)

The KYRBWS questions on suicidal ideation and attempt were "Have you ever seriously thought about committing suicide in the past 12 months?" and "Have you attempted suicide in the past 12 months?", respectively.

Sleep Duration

The KYRBWS inquiry on sleep duration was "How many hours did you sleep on average in a weekday (Monday to Friday) in the past week?". For consistency with a previous study based on the same data source in Korea for Year 2007 [9], the responses were categorized into "0 to 4 hours of sleep (at/above 0, below 4)" "4 to 5 hours" "5 to 6 hours" "6 to 7 hours" "7 to 8 hours" and "at/above 8 hours."

Depressed Mood and Other Demographic/Socioeconomic/Health-related Factors

The KYRBWS question on depressed mood was "Have you ever had in the past 12 months, a sense of sadness or hopelessness to an extent that you had to stop your daily activities for at least two weeks?". The inquiries (and response choices) on other variables include grade (7 to 12), academic record ("high, middle-high, middle, middle-low, low" recoded into "high, middle, low"), economic conditions ("high, middle-high, middle, middle-low, low" recoded into "high, middle, low"), disease (having ever been diagnosed as asthma, rhinitis and/or atopic dermatitis; yes, no), father/mother's education (middle school or lower, high school, college or higher), self-rated health ("very good, good, neither good nor bad, bad, very bad" recoded into "good, neither good nor bad, bad"), drinking/smoking/drug consumption (having ever had at least a cup of alcohol/at least a cigarette/any drug; yes, no), physical activity for at least 30 minutes with a little shortness of breath (0, 1-2, 3-4, ≥ 5 days in the past week), leisure (sitting and watching TV, playing a game, surfing the internet, having chat, etc.; 0-1, 1-2, 2-3, 3-4, ≥ 4 hours per weekday in the past week).

Analysis

Binary logistic regression was conducted by gender to identify significant factors for suicidal ideation/attempt. The dependent variable was the log odds of suicidal ideation/attempt, while the independent/control variables were sleep duration, depressed mood and other demographic, socio-economic and health-related factors introduced above. In the first model, the sample was stratified by gender only. In the second model, the sample was stratified by both gender and depressed mood. The 5% level was applied for statistical significance in this study. The statistical analysis was done on weighted data using the SURVEYFREQ and SURVEYLOGISTIC procedures in SAS version 9.2 (SAS Inc., Cary, NC, USA) so that the population and the sample were consistent with each other in demographic composition.

RESULTS

Table 1 shows case numbers, proportions and *F*-test results for equal proportions of suicidal ideation/attempt in Korea for Year 2009 across the categories of sleep duration, depressed mood and other variables. 14.8% (4379)/2.9% (865) of 29 492 male respondents had suicidal ideation/attempt in the last year, while the figure for 28 365 female respondents was 23.0% (6515)/5.5% (1572). 26.3% (290)/8.5% (94) of 1101 male respondents with less than 4 hours of sleep per weekday in the last week had suicidal ideation/attempt in the past year. The figure for 1156 female respondents with the same category of sleep duration was 32.9% (380)/10.3% (119). Table 2 describes the ORs of suicidal ideation/attempt by gender regarding sleep duration, depressed mood and other factors (in this model, the sample has not been stratified based on depressed mood yet). Controlling demographic, socioeconomic and health-related factors, less than 4 hours of sleep (compared to 6-7 hours of sleep) might have led to higher odds of suicidal ideation and attempt for men and women in Korea for Year 2009 (OR, 1.72 [95% CI, 1.38 to 2.15] / OR, 2.68 [95% CI, 0.89 to 3.80] for men's suicidal ideation/attempt; OR, 1.35 [95% CI, 1.12 to 1.63]/OR, 1.71 [95% CI, 1.32 to 2.22] for women's suicidal ideation/attempt). Indeed, significant effects on the odds of suicidal ideation/attempt for men and women might have come from age (negative: e.g., OR, 1.70 [95% CI, 1.40 to 2.05]/2.45 [95% CI, 2.02 to 2.97] for suicidal ideation of men/women with grade 7 compared to grade 12), self-rated health (negative: e.g., OR, 2.01 [95% CI, 1.72 to 2.36]/OR, 1.83 [95% CI, 1.62 to 2.06] for suicidal ideation of men/women with unhealthy con-

ditions compared to healthy conditions), smoking (positive: e.g., OR, 1.23 [95% CI, 1.13 to 1.35]/OR, 1.54 [95% CI, 1.39 to 1.71] for suicidal ideation of men/women with smoking compared to no such experience), drug consumption (positive: e.g., OR, 1.65 [95% CI, 1.23 to 2.20]/OR, 2.26 [95% CI, 1.62 to 3.15] for suicidal ideation of men/women with drug consumption compared to no such experience) and depressed mood (positive: e.g., OR, 9.24 [95% CI, 8.36 to 10.20]/OR, 6.70 [95% CI, 6.16 to 7.29] for suicidal ideation of men/women with depressed mood compared to no such experience). Tables 3 and 4 present the ORs of suicidal ideation/attempt by gender and by depressed mood regarding sleep duration and other significant factors (in this model, the sample has been stratified based on depressed mood as well). The negative association between sleep duration and suicidal ideation or attempt was weaker for those with depressed mood than for those without such experience in Korea for Year 2009. The OR of suicidal ideation/attempt regarding less than 4 hours of sleep compared to 6 to 7 hours of sleep, was smaller in a group with depressed mood than in a group without such experience, i.e., 1) 1.64 (95% CI, 1.29 to 2.08) vs. 2.06 (95% CI, 1.34 to 3.17) for men's suicidal ideation; 2) 2.50 (95% CI, 1.69 to 3.69) vs. 3.89 (95% CI, 1.95 to 7.99) for men's suicidal attempt; 3) 1.35 (95% CI, 1.11 to 1.65) vs. 1.40 (95% CI, 0.92 to 2.13) for women's suicidal ideation; and 4) 1.59 (95% CI, 1.19 to 2.14) vs. 2.96 (95% CI, 1.39 to 6.33) for women's suicidal attempt. The negative association between age (or self-rated health) and suicidal ideation or attempt was also weaker for those with depressed mood than for those without such experience in the nation for Year 2009. For example, the OR of suicidal ideation/attempt regarding unhealthy conditions compared to healthy conditions, was smaller in a group with depressed mood than in a group with no such experience, i.e., 1) 1.87 (95% CI, 1.57 to 2.23) vs. 2.46 (95% CI, 1.88 to 3.22) for men's suicidal ideation; 2) 2.15 (95% CI, 1.62 to 2.85) vs. 3.95 (95% CI, 1.74 to 8.66) for men's suicidal attempt; 3) 1.72 (95% CI, 1.50 to 1.97) vs. 2.15 (95% CI, 1.68 to 2.75) for women's suicidal ideation, and 4) 1.89 (95% CI, 1.52 to 2.33) vs. 1.96 (95% CI, 1.05 to 3.66) for women's suicidal attempt.

DISCUSSION

Main Findings of This Study

Firstly, controlling demographic, socioeconomic and health-related factors, less than 4 hours of sleep (compared to 6-7 hours of sleep) might have led to higher odds of suicidal ide-

Table 1. Case numbers, proportions and F test results for equal proportions of SI/SA in Korea for Year 2009

	Men (n=29 492)		Women (n=28 365)	
	SI ¹	SA ²	SI ¹	SA ²
Total	4379 (14.8)	865 (2.9)	6515 (23.0)	1572 (5.5)
Grade	*	†	†	*
7	638 (14.4)	147 (3.3)	1018 (25.5)	319 (8.0)
8	697 (14.7)	137 (2.9)	1043 (23.6)	284 (6.4)
9	788 (15.2)	159 (3.1)	1051 (22.6)	264 (5.7)
10	766 (13.8)	146 (2.6)	1061 (22.9)	268 (5.8)
11	755 (15.3)	143 (2.9)	1188 (22.1)	238 (4.4)
12	735 (15.6)	133 (2.8)	1154 (21.9)	199 (3.8)
Academic record	*	*	*	*
High	1508 (12.9)	259 (2.2)	2017 (19.4)	426 (4.1)
Middle	1145 (14.2)	223 (2.8)	1660 (21.0)	361 (4.6)
Low	1726 (17.7)	383 (3.9)	2838 (28.1)	785 (7.8)
Economic conditions	*	†	*	*
High	1312 (13.4)	269 (2.8)	1540 (21.1)	419 (5.8)
Middle	1843 (13.7)	327 (2.4)	2922 (20.2)	627 (4.3)
Low	1224 (19.5)	269 (4.3)	2053 (31.0)	526 (7.9)
Disease ³	*	*	*	†
Yes	1787 (17.3)	362 (3.5)	2868 (26.9)	763 (7.2)
No	2592 (13.5)	503 (2.6)	3647 (20.6)	809 (4.6)
Father's education	*	*	*	*
Middle school grad ⁴	378 (16.7)	77 (3.4)	607 (27.6)	161 (7.3)
High school grad	1813 (14.1)	382 (3.0)	2985 (23.0)	710 (5.5)
College grad/higher	2188 (15.2)	406 (2.8)	2923 (22.2)	701 (5.3)
Mother's education	*	*	*	*
Middle school grad ⁴	362 (16.5)	88 (4.0)	604 (27.1)	139 (6.2)
High school grad	2332 (14.1)	448 (2.7)	3836 (22.6)	920 (5.4)
College grad/higher	1685 (15.7)	329 (3.1)	2075 (22.6)	513 (5.6)
Self-rated health	*	*	*	*
Healthy	2550 (12.3)	467 (2.3)	3135 (18.4)	708 (4.1)
Neither healthy nor unhealthy	1287 (18.7)	262 (3.8)	2289 (26.7)	535 (6.2)
Unhealthy	542 (28.1)	136 (7.1)	1091 (40.1)	329 (12.1)
Drinking ⁵	*	*	*	*
No	1485 (12.3)	249 (2.1)	2137 (17.1)	447 (3.6)
Yes	2894 (16.7)	616 (3.5)	4378 (27.6)	1125 (7.1)
Smoking ⁵	*	†	*	*
No	2427 (12.5)	400 (2.1)	4506 (19.6)	941 (4.1)
Yes	1952 (19.4)	465 (4.6)	2009 (37.2)	631 (11.7)
Drug consumption ⁵	*	*	*	*
No	4245 (14.6)	802 (2.8)	6395 (22.7)	1504 (5.3)
Yes	134 (31.6)	63 (14.9)	120 (54.1)	68 (30.6)
Physical activity ⁶	*	*	*	*
0	938 (16.5)	181 (3.2)	2408 (22.9)	545 (5.2)
1-2	1776 (14.2)	333 (2.7)	2712 (22.4)	634 (5.2)
3-4	993 (14.6)	197 (2.9)	971 (23.9)	275 (6.8)
≥5	672 (14.8)	154 (3.4)	424 (25.1)	118 (7.0)
Leisure ⁷	*	*	*	*
0-1	1138 (14.4)	207 (2.6)	1605 (21.0)	353 (4.6)
1-2	1224 (13.7)	217 (2.4)	1719 (20.9)	381 (4.6)
2-3	930 (14.6)	205 (3.2)	1362 (23.1)	353 (6.0)
3-4	436 (15.2)	84 (2.9)	765 (26.5)	190 (6.6)
≥4	651 (19.1)	152 (4.5)	1064 (28.5)	295 (7.9)
Sleep duration ⁸	*	*	*	*
0-4	290 (26.3)	94 (8.5)	380 (32.9)	119 (10.3)
4-5	705 (18.7)	122 (3.2)	1372 (28.0)	313 (6.4)
5-6	1082 (15.5)	198 (2.8)	1669 (22.3)	381 (5.1)
6-7	1238 (13.8)	240 (2.7)	1804 (21.6)	440 (5.3)
7-8	792 (12.4)	152 (2.4)	929 (19.5)	234 (4.9)
≥8	272 (11.9)	59 (2.6)	361 (21.2)	85 (5.0)
Depressed mood ⁹	*	*	*	*
No	967 (4.8)	134 (0.7)	1274 (8.0)	186 (1.2)
Yes	3412 (35.8)	731 (7.7)	5241 (42.1)	1386 (11.1)

ation and attempt for men and women in Korea for Year 2009. Indeed, significant effects on the odds of suicidal ideation/attempt for men and women might have come from age (negative), self-rated health (negative), smoking (positive), drug consumption (positive) and depressed mood (positive). Secondly, the negative association between sleep duration and suicidal ideation or attempt was weaker for those with depressed mood than for those without such experience in Korea for Year 2009. The negative association between age (or self-rated health) and suicidal ideation or attempt was also weaker for those with depressed mood than for those without such experience in the nation for the year.

What is Already Known on This Topic

Shorter sleep and depression might lead to greater suicidal ideation or attempt in an advanced nation. This relationship was apparent both for adolescents and the general population. Likewise, this association remained intact in a cross-sectional or longitudinal setting. However, the strength of the association between short sleep and suicidal ideation/attempt was different from nation to nation.

What This Study Adds

Based on nationally representative survey data, this study provides a comprehensive analysis of the association between sleep duration and suicidal ideation/attempt among Korean adolescents. Existing literature on the topic in Korea has largely been confined to a single urban area (i.e., the city of Incheon) [7-8,10], whereas a scant amount of Korean research on the issue with nationally representative survey data lacked an in-depth examination of depressed mood or other psychiatric factors [9]. This work combined the strengths of previous studies on the topic, illuminating a relationship between sleep duration and suicidal ideation/attempt with representative, com-

Values are presented as number (%).

SI, suicidal ideation; SA, suicidal attempt.

¹Having ever seriously thought about committing suicide in the past 12 months.

²Having ever attempted suicide in the past 12 months.

³Having ever been diagnosed as asthma, rhinitis and/or atopic dermatitis.

⁴Middle school graduation or lower (grad: graduated).

⁵Having ever had at least a cup of alcohol/at least a cigarette/any drug.

⁶Days of physical activity for at least 30 minutes with a little shortness of breath in the past week.

⁷Hours of sitting and watching TV, playing a game, surfing the internet, having chat, etc., per weekday in the past week.

⁸Hours of sleep per weekday in the past week.

⁹Having ever had in the past 12 months, a sense of sadness or hopelessness to an extent that one had to stop one's daily activities for at least two weeks.

* $p < 0.05$.

[†] p -value greater than $p > 0.05$ (F -test for the means/proportions of categories, e.g., high vs. middle vs. low for academic record).

Table 2. The odds ratios and 95% confidence intervals (CIs) of SI/SA by gender regarding sleep duration, depressed mood and other factors in Korea for Year 2009

	Men		Women	
	SI (95% CI)	SA (95% CI)	SI* (95% CI)	SA* (95% CI)
Grade				
7	1.70 (1.40, 2.05)	2.97 (2.12, 4.16)	2.45 (2.02, 2.97)	4.44 (3.28, 6.02)
8	1.57 (1.31, 1.89)	2.41 (1.70, 3.41)	1.82 (1.52, 2.17)	2.69 (2.01, 3.60)
9	1.28 (1.08, 1.52)	1.89 (1.36, 2.62)	1.58 (1.36, 1.84)	2.52 (1.90, 3.34)
10	1.07 (0.91, 1.24)	1.53 (1.09, 2.15)	1.31 (1.10, 1.55)	1.91 (1.40, 2.60)
11	1.09 (0.95, 1.25)	1.49 (1.05, 2.12)	1.19 (1.02, 1.38)	1.50 (1.15, 1.95)
12	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Academic record				
High	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Middle	1.05 (0.94, 1.17)	1.19 (0.94, 1.50)	1.00 (0.90, 1.12)	1.11 (0.92, 1.33)
Low	1.09 (0.98, 1.22)	1.05 (0.84, 1.31)	1.17 (1.06, 1.29)	1.47 (1.22, 1.77)
Economic conditions				
High	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Middle	1.06 (0.95, 1.18)	0.90 (0.70, 1.17)	0.97 (0.87, 1.07)	0.72 (0.60, 0.86)
Low	1.31 (1.14, 1.50)	1.25 (0.96, 1.62)	1.34 (1.20, 1.51)	1.07 (0.87, 1.31)
Disease				
Yes	1.13 (1.04, 1.23)	1.09 (0.91, 1.31)	1.18 (1.09, 1.28)	1.34 (1.15, 1.56)
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Father's education				
Middle school grad	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
High school grad	1.00 (0.84, 1.20)	1.32 (0.95, 1.85)	0.88 (0.75, 1.04)	0.99 (0.76, 1.29)
College grad/higher	1.08 (0.90, 1.29)	1.15 (0.80, 1.65)	0.90 (0.76, 1.08)	1.02 (0.74, 1.42)
Mother's education				
Middle school grad	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
High school grad	0.88 (0.74, 1.04)	0.66 (0.49, 0.88)	0.93 (0.79, 1.11)	1.04 (0.77, 1.40)
College grad/higher	0.99 (0.82, 1.19)	0.85 (0.59, 1.22)	0.97 (0.79, 1.18)	1.07 (0.76, 1.50)
Self-rated health				
Healthy	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Neither healthy nor unhealthy	1.39 (1.26, 1.53)	1.50 (1.24, 1.81)	1.37 (1.26, 1.48)	1.23 (1.08, 1.41)
Unhealthy	2.01 (1.72, 2.36)	2.35 (1.81, 3.06)	1.83 (1.62, 2.06)	1.89 (1.56, 2.30)
Drinking				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	1.11 (1.01, 1.22)	1.14 (0.91, 1.42)	1.33 (1.21, 1.46)	1.31 (1.11, 1.55)
Smoking				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	1.23 (1.13, 1.35)	1.51 (1.25, 1.81)	1.54 (1.39, 1.71)	1.91 (1.60, 2.29)
Drug consumption				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	1.65 (1.23, 2.20)	3.56 (2.49, 5.10)	2.26 (1.62, 3.15)	3.37 (2.24, 5.08)
Physical activity				
0	1.23 (1.06, 1.44)	1.06 (0.81, 1.39)	1.02 (0.86, 1.22)	0.90 (0.68, 1.19)
1-2	1.02 (0.90, 1.16)	0.83 (0.64, 1.07)	1.05 (0.87, 1.26)	0.90 (0.69, 1.19)
3-4	1.04 (0.90, 1.19)	0.88 (0.66, 1.18)	1.07 (0.89, 1.29)	1.10 (0.81, 1.49)
≥5	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Leisure				
0-1	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
1-2	0.98 (0.86, 1.11)	1.04 (0.83, 1.29)	0.92 (0.83, 1.02)	1.03 (0.83, 1.27)
2-3	0.99 (0.86, 1.13)	1.09 (0.85, 1.40)	0.98 (0.86, 1.12)	1.19 (0.94, 1.51)
3-4	1.03 (0.87, 1.22)	1.10 (0.81, 1.51)	1.08 (0.94, 1.23)	1.09 (0.85, 1.39)
≥4	1.20 (1.03, 1.39)	1.34 (1.02, 1.75)	1.07 (0.95, 1.22)	1.19 (0.95, 1.49)
Sleep duration				
0-4	1.72 (1.38, 2.15)	2.68 (1.89, 3.80)	1.35 (1.12, 1.63)	1.71 (1.32, 2.22)
4-5	1.21 (1.04, 1.40)	1.17 (0.84, 1.62)	1.33 (1.19, 1.50)	1.27 (1.02, 1.57)
5-6	1.05 (0.93, 1.19)	1.01 (0.78, 1.31)	0.98 (0.88, 1.09)	0.94 (0.76, 1.17)
6-7	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
7-8	0.96 (0.84, 1.09)	0.94 (0.72, 1.22)	0.88 (0.78, 1.00)	0.92 (0.74, 1.14)
≥8	0.79 (0.65, 0.94)	0.89 (0.62, 1.29)	0.85 (0.70, 1.03)	0.83 (0.61, 1.14)
Depressed mood				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	9.24 (8.36, 10.20)	10.44 (8.27, 13.18)	6.70 (6.16, 7.29)	7.97 (6.50, 9.77)

SI, suicidal ideation; SA, suicidal attempt.
* $p < 0.05$.

Table 3. The odds ratios and 95% confidence intervals (CIs) of men's suicidal ideation/attempt by depressed mood regarding sleep duration and other significant factors in Korea for Year 2009

	Suicidal ideation		Suicidal attempt	
	Depressed mood (95% CI)	No depressed mood (95% CI)	Depressed mood (95% CI)	No depressed mood (95% CI)
Grade				
7	1.59 (1.31, 1.94)	2.03 (1.42, 2.89)	2.53 (1.77, 3.60)	7.84 (3.36, 18.30)
8	1.41 (1.14, 1.74)	2.02 (1.45, 2.81)	2.14 (1.48, 3.12)	5.03 (2.19, 11.56)
9	1.21 (1.01, 1.45)	1.51 (1.08, 2.10)	1.70 (1.20, 2.40)	4.01 (1.75, 9.22)
10	1.09 (0.94, 1.27)	1.01 (0.71, 1.44)	1.51 (1.08, 2.11)	1.73 (0.71, 4.19)
11	1.10 (0.95, 1.27)	1.10 (0.82, 1.47)	1.36 (0.96, 1.93)	2.77 (1.09, 7.00)
12	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Self-rated health				
Healthy	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Neither healthy nor unhealthy	1.30 (1.15, 1.47)	1.60 (1.35, 1.90)	1.36 (1.11, 1.67)	2.42 (1.36, 4.31)
Unhealthy	1.87 (1.57, 2.23)	2.46 (1.88, 3.22)	2.15 (1.62, 2.85)	3.95 (1.95, 7.99)
Sleep duration				
0-4	1.64 (1.29, 2.08)	2.06 (1.34, 3.17)	2.50 (1.69, 3.69)	3.89 (1.74, 8.66)
4-5	1.12 (0.93, 1.34)	1.52 (1.17, 1.97)	1.09 (0.78, 1.52)	1.70 (0.79, 3.69)
5-6	1.02 (0.88, 1.19)	1.12 (0.89, 1.41)	0.97 (0.74, 1.27)	1.24 (0.66, 2.35)
6-7	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
7-8	1.01 (0.86, 1.20)	0.85 (0.67, 1.08)	0.95 (0.70, 1.29)	0.87 (0.46, 1.64)
≥8	0.95 (0.77, 1.19)	0.51 (0.35, 0.73)	1.11 (0.74, 1.65)	0.15 (0.05, 0.49)

prehensive coverage in data and variables.

This study shows that the pattern of suicidal ideation/attempt in Korea might follow the pattern in other advanced nations in general but Korea might register some unique characteristics affected by the nation's distinctive sociocultural contexts (e.g., intense pressure for academic achievement and good performance on the national college entrance examination) [8,16,20, 21]. The ORs of suicidal ideation for Korean adolescents regarding less than 4 hours of sleep vs. 6 to 7 hours (1.72 [95% CI, 1.38 to 2.15] for men, 1.35 [95% CI, 1.12 to 1.63] for women) were smaller than the figures for US adolescents regarding having sleep problems vs. not having the problems (OR, 2.44; 95% CI, 1.03 to 5.75) [16]. One explanation for this gap might be that as suicidal ideation and attempt are much more common in Korea than in the US, their variations might be smaller in the former nation than in the latter (The share of adolescents with suicidal ideation was much higher in this research than in the US study, i.e., 18.8% for the last year vs. 5.8% for the last six months). Given that academic achievement and the results of the national college entrance examination are quite influential for the future success of middle/high school students, competition and pressure for good performances in the tasks are extremely intense among these adolescents, which might be a

Table 4. The odds ratios and 95% confidence intervals (CIs) of women's suicidal ideation/attempt by depressed mood regarding sleep duration and other significant factors in Korea for Year 2009

	Suicidal ideation		Suicidal attempt	
	Depressed mood (95% CI)	No depressed mood (95% CI)	Depressed mood (95% CI)	No depressed mood (95% CI)
Grade				
7	2.51 (2.05, 3.08)	2.37 (1.69, 3.32)	4.08 (3.06, 5.44)	7.82 (3.04, 20.13)
8	1.83 (1.51, 2.21)	1.81 (1.34, 2.44)	2.64 (1.96, 3.55)	3.39 (1.46, 7.84)
9	1.62 (1.38, 1.90)	1.48 (1.13, 1.96)	2.55 (1.91, 3.40)	2.52 (1.12, 5.67)
10	1.31 (1.08, 1.58)	1.32 (1.01, 1.72)	1.86 (1.37, 2.53)	2.44 (1.12, 5.30)
11	1.15 (0.97, 1.38)	1.26 (0.99, 1.60)	1.44 (1.09, 1.90)	2.08 (0.90, 4.78)
12	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Self-rated health				
Healthy	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Neither healthy nor unhealthy	1.26 (1.14, 1.39)	1.66 (1.42, 1.94)	1.23 (1.06, 1.44)	1.24 (0.83, 1.87)
Unhealthy	1.72 (1.50, 1.97)	2.15 (1.68, 2.75)	1.89 (1.52, 2.33)	1.96 (1.05, 3.66)
Sleep duration				
0-4	1.35 (1.11, 1.65)	1.40 (0.92, 2.13)	1.59 (1.19, 2.14)	2.96 (1.39, 6.33)
4-5	1.39 (1.19, 1.62)	1.17 (0.91, 1.50)	1.25 (0.99, 1.56)	1.50 (0.83, 2.70)
5-6	0.94 (0.82, 1.07)	1.08 (0.88, 1.33)	0.97 (0.77, 1.22)	0.76 (0.44, 1.30)
6-7	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
7-8	0.88 (0.76, 1.02)	0.89 (0.71, 1.11)	0.89 (0.70, 1.13)	1.03 (0.58, 1.82)
≥8	0.83 (0.67, 1.03)	0.91 (0.64, 1.31)	0.91 (0.64, 1.29)	0.52 (0.18, 1.47)

major contribution to their long study and short sleep [8,20]. Based on the findings of this study, adolescents' better mental health and longer, more comfortable sleep might help to prevent their suicidal ideation and attempt in Korea. Finland, an educational success story alongside Korea, adopted an educational model for the quality of education, characterized by broad curricula, creative learning, flexible standards and the smallest class hours among Organization for Economic Cooperation and Development nations [21,22]. Korea might need to put more focus on the quality of education for its adolescents, which might lead to their better mental health, longer, more comfortable sleep, and less suicidal ideation and attempt.

Limitations of This Study

Firstly, this study was cross-sectional. Longitudinal research might help to explain a causal relationship between sleep duration and suicidal ideation/attempt. Secondly, an inquiry on sleep duration was for 'the past week' while questions regarding suicidal ideation/attempt and depressed mood were for 'the past year'. A caution might be needed for establishing a chronological order among these variables. Thirdly, this work included only depressed mood, a subjective measure of psychiatric disorder. Incorporating more objective indicators of

mental illness might improve the analysis of their association with sleep duration and suicidal ideation/attempt. Finally, a comparative study of Korea and more nations with similar characteristics will bring more insights regarding the underlying mechanism and reduction strategies for suicidal ideation and attempt. In spite of these limitations, however, this study uses nationally representative survey data and provides a comprehensive analysis of the association between sleep duration and suicidal ideation/attempt among adolescents in Korea.

CONFLICT OF INTEREST

The authors have no conflicts of interest with the material presented in this paper.

REFERENCES

- Patton GC, Coffey C, Sawyer SM, Viner RM, Haller DM, Bose K, et al. Global patterns of mortality in young people: a systematic analysis of population health data. *Lancet* 2009;374(9693): 881-892.
- Korean Statistical Information Service. Cause-specific mortality by sex and age [cited 2013 May 16]. Available from: <http://kosis.kr/index/index.jsp> (Korean).
- Health Canada. Economic burden of illness in Canada, 1998. Ottawa: Health Canada; 2002, p. 37-43.
- Kim J, Hahm MI, Park EC, Park JH, Park JH, Kim SE, et al. Economic burden of cancer in South Korea for the year 2005. *J Prev Med Public Health* 2009;42(3):190-198 (Korean).
- Takada M, Suzuki A, Shima S, Inoue K, Kazukawa S, Hojoh M. Associations between lifestyle factors, working environment, depressive symptoms and suicidal ideation: a large-scale study in Japan. *Ind Health* 2009;47(6):649-655.
- Kohyama J. Sleep, serotonin, and suicide in Japan. *J Physiol Anthropol* 2011;30(1):1-8.
- Lee YJ, Kim SJ, Cho IH, Kim JH, Bae SM, Koh SH, et al. A study on the relationship between sleep duration and suicidal idea in an urban area of South Korea. *Sleep Med Psychophysiol* 2009;16(2):85-90 (Korean).
- Lee YJ, Cho SJ, Cho IH, Kim SJ. Insufficient sleep and suicidality in adolescents. *Sleep* 2012;35(4):455-460.
- Park JH, Yoo JH, Kim SH. Associations between non-restorative sleep, short sleep duration and suicidality: findings from a representative sample of Korean adolescents. *Psychiatry Clin Neurosci* 2013;67(1):28-34.

10. Bae SM, Lee YJ, Cho IH, Kim SJ, Im JS, Cho SJ. Risk factors for suicidal ideation of the general population. *J Korean Med Sci* 2013;28(4):602-607.
11. Rey Gex C, Narring F, Ferron C, Michaud PA. Suicide attempts among adolescents in Switzerland: prevalence, associated factors and comorbidity. *Acta Psychiatr Scand* 1998;98(1):28-33.
12. Goodwin RD, Marusic A. Association between short sleep and suicidal ideation and suicide attempt among adults in the general population. *Sleep* 2008;31(8):1097-1101.
13. Goldstein TR, Bridge JA, Brent DA. Sleep disturbance preceding completed suicide in adolescents. *J Consult Clin Psychol* 2008;76(1):84-91.
14. Wojnar M, Ilgen MA, Wojnar J, McCammon RJ, Valenstein M, Brower KJ. Sleep problems and suicidality in the National Comorbidity Survey Replication. *J Psychiatr Res* 2009;43(5):526-531.
15. McCall WV, Blocker JN, D'Agostino R Jr, Kimball J, Boggs N, Lasser B, et al. Insomnia severity is an indicator of suicidal ideation during a depression clinical trial. *Sleep Med* 2010;11(9):822-827.
16. Wong MM, Brower KJ, Zucker RA. Sleep problems, suicidal ideation, and self-harm behaviors in adolescence. *J Psychiatr Res* 2011;45(4):505-511.
17. Ribeiro JD, Pease JL, Gutierrez PM, Silva C, Bernert RA, Rudd MD, et al. Sleep problems outperform depression and hopelessness as cross-sectional and longitudinal predictors of suicidal ideation and behavior in young adults in the military. *J Affect Disord* 2012;136(3):743-750.
18. Jeon HJ, Lee JY, Lee YM, Hong JP, Won SH, Cho SJ, et al. Lifetime prevalence and correlates of suicidal ideation, plan, and single and multiple attempts in a Korean nationwide study. *J Nerv Ment Dis* 2010;198(9):643-646.
19. Jeon HJ, Lee JY, Lee YM, Hong JP, Won SH, Cho SJ, et al. Unplanned versus planned suicide attempters, precipitants, methods, and an association with mental disorders in a Korea-based community sample. *J Affect Disord* 2010;127(1-3):274-280.
20. Kim SJ, Lee YJ, Cho SJ, Cho IH, Lim W, Lim W. Relationship between weekend catch-up sleep and poor performance on attention tasks in Korean adolescents. *Arch Pediatr Adolesc Med* 2011;165(9):806-812.
21. Adams-Budde M, Crave J, Hegedus T. Finnish lessons: what can the world learn from educational change in Finland? *Int Rev Educ* 2012;58(5):709-710.
22. Organization for Economic Cooperation and Development. *Education at a glance 2012: OECD indicators*. Paris: OECD Publishing; 2012, p. 423-534.