

## Weekend catch-up sleep is independently associated with suicide attempts and self-injury in Korean adolescents

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### Abstract

The current study aims to determine the associations of insufficient sleep with suicide attempts and self-injury in a large, school-based Korean adolescent sample.

A sample of 4553 middle- and high-school students (grades 7–10) was recruited in this study. Finally, 4145 students completed self-report questionnaires including items on sleep duration (weekday/weekend), self-injury, suicide attempts during the past year, the Suicidal Ideation Questionnaire (SIQ), and the Beck Depression Inventory (BDI).

A multiple linear regression model showed that higher SIQ scores were associated with longer weekend catch-up sleep duration ( $p = 0.009$ ), higher BDI score ( $p < 0.001$ ), and longer time spent in a private educational institute ( $p = 0.025$ ). The multiple logistic regression analysis revealed that longer weekend catch-up sleep duration ( $p = 0.011$ ), higher BDI score ( $p < 0.001$ ), longer time spent in a private educational institute ( $p = 0.046$ ), and poorer academic record ( $p = 0.029$ ) were associated with suicide attempt and self-injury during the past year.

The present results suggest that weekend catch-up sleep duration – which is an indicator of insufficient weekday sleep – might be associated with suicide attempts and self-injury in Korean adolescents.

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### 1. Introduction

Sufficient sleep is critical for the mental and physical health of adolescents, with sleep being particularly important for their emotion regulation, cognition, attention, psychosocial development, and physical growth. Research has found that the optimal sleep period for adolescents is 9 h/night under controlled conditions (i.e., without clocks or lighting cues), and at least 8.5–9.25 h/night is recommended [1,2]. However, adolescents in modern society tend not to take

enough sleep because of various factors, such as their academic workload, depression, insomnia, and delayed sleep phase.

The most commonly suggested reason for insufficient sleep among adolescents is self-induced sleep restriction and wake extension, a condition that is known as behaviorally induced insufficient sleep syndrome (BISS). Since Korean adolescents are subjected to strong psychological pressure to perform well in their university entrance examinations, they often try to spend more time studying at the cost of insufficient sleep. The prevalence of BISS among Korean adolescents was reported to be 18.78% in our previous study [3]. Korean adolescents have a shorter sleep duration and longer weekend oversleeps than their peers in North America and Europe [4]. One study found that Korean 10th-, 11th-, and 12th-grade adolescents were severely sleep deprived,

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with mean total weekday sleep durations of 6.0, 5.6, and 4.9 h, respectively [5]. Classes in Korean schools usually start at 07:00 ~ 08:30 and end at 16:00 ~ 18:30; moreover, almost all Korean adolescents attend night school, go to a private educational institute (or hagwon (i.e., a for-profit private institute, academy, or cram school) in Korean) for extra after-school tuition, often until 21:00–24:00 [3]. Although in 2009 several local governments began to restrict the closing time of private educational institutes to 22:00, many institutes violate that curfew to teach more night-time classes.

Suicide is a tragic event, and is one of the leading causes of death among adolescents; however, it is potentially preventable. According to the statistics of the Organization for Economic Cooperation and Development countries, South Korea ranks highest with respect to suicide rates [6]. The Korean suicide rate among teenagers overall was 10.7 per 100,000 annually [7], while that among Korean adolescents and young adults (aged from 15 to 24 years) was reported to be 15.3 per 100,000 in 2009 and 13.0 per 100,000 in 2010; suicide is reportedly the leading cause of mortality in this age group [7,8]. The previous studies reported that prevalence of suicidal attempt in the Korean adolescents was 5.3% and 3.9% [9,10]. Adolescents are known to be vulnerable to self-harm or suicide attempts, and to be at increased risk of emotional instability and impulsive behaviors [11,12]. Accordingly, the suicide rate, lack of sleep, and the burden of academic pressure among Korean adolescents are becoming serious social issues that require a solution.

While sleep disturbance has not been included in the lists of suicide risk factors reported by World Health Organization, there are many articles and reviews about the adult population that associate sleep disturbances with suicidal thoughts and behaviors [13–16]. Since both suicide and insufficient sleep are important health issues for adolescents, there have been several investigations regarding possible associations between these two problems [3,17–19].

We have recently reported that BISS in adolescents is associated with suicidal ideation, independent of confounding factors including depressed mood, daytime sleepiness, snoring, and insomnia [3]. That study was the first to investigate an association between BISS and suicidality among adolescents [3]. The biological sleep requirement varies among individuals; thus, a short sleep duration does not always reflect insufficient sleep [20]. A longer sleep duration during the weekend compared with weekdays may reflect the actual sleep needed. The weekend catch-up sleep may therefore be a better indicator of sleep insufficiency [21].

Self-injury and suicide attempts have been regarded as the most important predictors of completed suicide [22]. Although in our previous study we found that BISS among Korean adolescents is associated with increased suicidal ideation, based on the Beck Scale for Suicidal Ideation score, we did not investigate suicidal behaviors such as self-injury or suicide attempt. Therefore, the aim of the present study was to determine the relationship between insufficient sleep

and heightened suicide risk by determining whether or not insufficient sleep is related to an increase in the incidence of suicidal behaviors among Korean adolescents. In addition, in order to validate our former notion of an association between sleep duration and suicidal ideation, we used a different scale to measure the latter in the independent large-scale sample.

The aim of the current study was to determine the relationship between sleep insufficiency and suicidality – including not only suicidal ideation but also suicidal behaviors – in a school-based Korean adolescent sample.

## 2. Methods

### 2.1. Subjects

We recruited adolescent middle- and high-school students in Incheon as participants. Questionnaires were distributed to a total of 4553 students at 9 middle schools and 7 high schools, all of whom gave their consent to participate in this study. A total of 4145 students completed the entire questionnaire, among which 2297 (55.4%) were male and 1847 (44.6%) were female; all were 7th–10th graders aged  $15.3 \pm 1.5$  (mean  $\pm$  SD) years. Written informed consent was obtained from the students' parents, and consent to participate was provided by all of the students. The study protocol was approved by the Institutional Review Board of Gachon University of Medicine and Science.

### 2.2. Assessments

Sleep durations on weekdays and weekends were assessed using a self-report questionnaire. The questionnaire asked: "On average, how many hours do you sleep on weekdays and weekends?" Individual weekend catch-up sleep durations were calculated as weekend sleep duration minus weekday sleep duration.

The severity of suicidal ideation was measured using the Korean version of the Suicidal Ideation Questionnaire (SIQ), developed by Reynolds [23] and standardized by Shin et al. [24], which the participants were asked to complete. This questionnaire is a 30-item self-report scale that assesses specific thoughts about suicide and death experienced by the participant over the past month. Another self-report questionnaire was used to measure the suicide attempts and self-injuries during the past year, which asked: "Have you made any intentional suicide attempt or performed any self-injury over the past 1-year period?"

The Korean version of the 21-item Beck Depression Inventory (BDI) was administered to evaluate the students' depressive symptoms [25,26]. In addition, the questionnaire included an item about the time spent in a private educational institute and a self-report on the academic record: Likert scale of 1–4, where 1 = within the top ten in class, 2 = 10th–20th in class, 3 = 20th–30th in class, and 4 = below 30th in class.

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