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Research paper

Association between sleep duration, suicidal ideation, and suicidal attempts among Chinese adolescents: The moderating role of depressive symptoms

Lan Guo[a,c,1], Yan Xu[a,b,1], Jianxiong Deng[b,1], Jinghui Huang[b], Guoliang Huang[b], Xue Gao[b], Pengsheng Li[a], Hong Wu[a], Siyuan Pan[a], Wei-Hong Zhang[c,2], Ciyong Lu[a,*,2]

[a] Department of Medical statistics and Epidemiology, School of Public Health, Sun Yat-sen University, Guangzhou 510080, People's Republic of China
[b] Center for ADR monitoring of Guangdong, Guangzhou 510080, People's Republic of China
[c] Epidemiology, Biostatistics and Clinical Research Centre, School of Public Health, Université Libre de Bruxelles (ULB), Belgium

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ABSTRACT

Background: Suicidal ideation and attempts are still currently serious problems among adolescents worldwide, and there is evidence that sleep problem may be associated with increased rates of mental disorder. This study aimed to examine the associations between sleep duration and suicidal ideation and attempts among adolescents and to test whether depressive symptoms have moderating effects on the associations.
Methods: A 3-stage, stratified cluster, random sampling method was used to collect data from 20,130 high school students in southeast China.
Results: The weighted prevalence of short sleep among Chinese adolescents was 5.6% (95% CI, 5.3–6.0%), and the weighted prevalence of long sleep was 2.7% (95% CI, 2.5–3.0%). The final results demonstrated that short sleep was positively associated with suicidal ideation (AOR=2.28, 95% CI=1.96–2.66) and suicidal attempts (AOR=3.20, 95% CI=2.46–4.16), and long sleep was only significantly associated with suicidal attempts (AOR=2.47, 95% CI=1.70–3.58). Stratification analyses conducted separately for students with and without depressive symptoms demonstrated that depressive symptoms may have moderating effects on the associations between sleep duration and suicidality.
Limitations: Our study sample only included school students, and causal inference could not be examined due to the cross-sectional design.
Conclusions: Sleep duration was associated with suicidal ideation and attempts, and the association between sleep duration and suicidal attempts was U-shaped. These findings support that proper treatments services with the potential to restore adolescent normal sleep would be helpful in preventing suicidality among adolescents.

1. Introduction

Suicide is a huge public health problem causing nearly one million deaths worldwide in a given year (Mann et al., 2005). Pompli et al. illustrated that the phenomenon might be underreported, considering that their overview of the literature indicated that above 2% of the traffic accidents were suicidal behaviors, and suicides by car accidents might be reported as accidental in the national statistics (Pompili et al., 2012). Suicidal ideation and suicidal attempts have been reported to be important risk factors for suicide in adolescence (Cluver et al., 2015). Moreover, suicidal ideation and attempts are still currently serious problems among adolescents in both developing and developed countries (Gould et al., 2003), and these behaviors among youth can lead to a substantial economic, social and psychological burden for the individuals, families, and communities (World Health Organization, 2014).

Although suicidal behavior is multifactorial, sleep problem have been shown an early and important marker for suicidal behavior in adolescence (Wong et al., 2011). Previous studies have estimated that a large amount of adolescents have sleep problems, estimated prevalence of 25–40% (Ivanenko et al., 2005). Insufficient and irregular sleep among adolescents has become a major international health concern (Chung and Cheung, 2008). Previous studies have demonstrated that sleep quality and duration affect hormonal function such that sleep

* Correspondence to: Department of Medical Statistics and Epidemiology, School of Public Health, Sun Yat-sen University,74 Zhongshan Rd 2, Guangzhou, 510080, People's Republic of China.
E-mail address: luciyong@mail.sysu.edu.cn (C. Lu).
[1] These authors contributed equally in this work.
[2] These authors contributed equally in this work.

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disorders can contribute to psychological and physiological impairments, along with endocrine abnormalities (Morgan and Tsai, 2015; Spiegel et al., 2009). Although the mechanism of the association between sleep duration and suicidal behavior is still unclear, Kohyama et al. proposed that an increase in average sleep duration could decrease the likelihood of suicide through the elevation of serotonergic (5-hydroxytriptamine) activity (Kohyama, 2011). Moreover, in the adult population statistically significant associations between short sleep duration and suicidal ideation and attempts have been found in prior epidemiological studies (Jang et al., 2013; Wong et al., 2011), and a marginal association between long sleep duration and suicidal ideation has also been reported (Kim et al., 2013). Additionally, although a prior study did not report an significant association between insomnia and suicidal behavior, the study found that suicidal attempters with insomnia more frequently used violent methods, and this phenomenon should also be taken into serious consideration (Pompili et al., 2013). However, most of the previous studies were carried out among adults or patients in Western or developed countries, and only a handful of studies were conducted among general adolescents in developing countries.

There is evidence that sleep disorder may be associated with increased rates of mental disorder (Hartmann et al., 1972). Having depressive symptoms is a type of mental disorder, and our previous study has found a significant association between sleep problems and depressive symptoms among adolescents (Guo et al., 2014). Moreover, previous cross-sectional studies and longitudinal investigations have demonstrated that depressive symptoms increase the risk of suicidal behavior among adolescents (Dvorak et al., 2013). Therefore, depressive symptoms may play a moderating role in the associations between sleep duration and suicidality, but few study has examined the potential moderating effects. Additionally, there is also a paucity of studies considering the confounding effects of family status (i.e., living arrangement, family economic status) (Lee et al., 2012; Liu, 2004), school dynamics (i.e., relationships with classmates or teachers) (Hysing et al., 2015; Jang et al., 2013; Lee et al., 2012; Liu, 2004), and personal characteristics (i.e., smoking and drinking) (Hysing et al., 2015; Lee et al., 2012; Liu, 2004) on the associations between sleep duration and suicidality.

Therefore, we conducted this large-scale cross-sectional study in China to estimate the prevalence of sleep duration, depressive symptoms, and suicidality among Chinese adolescents, to comprehensively evaluate the associations between short (or long) sleep duration and suicidality, and to investigate whether these associations vary in relation to the presence of depressive symptoms.

2. Methods

2.1. Study design and participants

This is a school-based cross-sectional study in adolescent students from the Fujian province in southeast China. Students were selected by a 3-stage, stratified cluster, random sampling method. In stage 1, we divided Fujian province into three economic stratifications by per capita GDP (high-level, middle-level, and low-level), and then selected two representative cities (or primary sampling units) from each stratification by simple randomization using SAS software. In stage 2, schools (or secondary sampling units) in each representative city were divided into three categories: junior high schools (i.e., grades 7–9), senior high schools (i.e., grades 10–12), and vocational high schools (i.e., grades 7–12). Based on the proportions of these three types of schools, four junior high schools, four senior high schools, and two vocational high schools were randomly selected from each representative city. In stage 3, two classes (or the minimum sampling units) were randomly selected from each grade within the selected schools. All available students in the selected classes were invited to participate in our study voluntarily. Of the 22,000 students who were invited to participate, 20,130 students' questionnaires were completed and qualified for the survey, resulting in a response rate of 91.5%.

2.2. Data collection

To protect the privacy of the students, the anonymity of the self-reported questionnaires was guaranteed, and the questionnaires were written by students during the normal class period (45 min), and administered by research assistants in the classrooms without the presence of teachers (to avoid any potential information bias). All data were collected from 2012 to 2013.

2.3. Ethical statement

The study was approved by the Sun Yat-Sen University, School of Public Health Institutional Review Board. After procedure had been fully explained, written informed consents were obtained from each participating student who was at least 18 years of age. If the student was under 18 years of age, a written informed consent was obtained from one of the student's parents (or legal guardian).

2.4. Measures

2.4.1. Suicidal ideation and suicidal attempts

Suicidal ideation was defined as responding "1 or more times" to the question "During the past 12 months, how many times did you seriously consider attempting suicide?" Suicidal attempt was assessed by the question "During the past 12 months, how many times did you actually attempt suicide?" and asked that the student rate on a scale of zero or once or more. (Guo et al., 2016b; Langille et al., 2015; Woods et al., 1997).

2.4.2. Sleep duration

Sociocultural conventions and school schedules have been shown to be associated with sleep duration among adolescents, (Gradisar et al., 2011; Hansen et al., 2005) and most schools start earlier than 07:00 a.m. in China. It is well known that Chinese students, especially high school students, are burdened with tremendous academic pressure even to the extent of sacrificing sleep time. (Chen et al., 2014) Based on literature review and the practical situations related to the sleep duration of adolescents, (Blasco-Fontecilla et al., 2011; Fitzgerald et al., 2011; Patel et al., 2012; Thorpy, 2012) sleep duration was assessed by the question "How many hours do you usually sleep each school day? " The response of total sleep time (TST) was categorized into "≤5 h," "5–7 h," "7–9 h," or "≥9 h", and we selected "7–9 h" as our reference group and labeled it as moderate rather than optimal.

2.4.3. Depressive symptoms

The *Center for Epidemiology Scale for Depression* (*CES-D*) in Chinese was used to identify whether individuals had depressive symptoms. The Chinese version of CES-D scale used in our study was translated into Mandarin Chinese to better correspond to the meaning of the original items in CES-D, and the Chinese version of this scale has been validated (Cheng et al., 2012; Lee et al., 2008; Zhang Jie, 2010), and extensively utilized in Chinese studies (Yen et al., 2000). The respondents were asked to rate the frequency, of 20 symptoms of depression by choosing one of four response options ranging from 'rarely or none of the time' to 'most or all of the time' (Myers and Weissman, 1980). Higher scores indicate more severe depressive symptomatology, with a maximum score of 60 (Anon, 1977). According the report of Radloff (the founder of the CES-D) in 1991, a cutoff score of 16 points (corresponding to the 80th percentile) and a cutoff score of 28 points (corresponding to the 95th percentile) were both recommended to appropriately differentiate respondents with depressive symptoms, but a higher cutoff score (above 28) was used to select more severe cases (Radloff, 1991). With the changing times and