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Original Article

Association between short time in bed, health-risk behaviors and poor academic achievement among Norwegian adolescents

T.H. Stea *, T. Knutsen, M.K. Torstveit

University of Agder, Faculty of Sport and Health Sciences, Kristiansand, Norway

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ABSTRACT

Objective: To investigate the prevalence of short time in bed (<8 h/day) and to examine the association between time in bed, overweight/obesity, health-risk behaviors and academic achievement in adolescents.
Methods: This study included a sample of adolescents (n = 2432) aged 15–17 years in the southern part of Norway (participation rate, 98.7%). A self-report questionnaire was used to assess time in bed, body mass index, dietary habits, physical activity habits, sedentary behavior, smoking and snuffing habits, and academic achievement.
Results: A total of 32.3% of the students reported short time in bed (<8 h/day) on an average school night. Several health-risk behaviors were associated with short sleep duration, including not being physically active for ⩾60 min for ⩾5 days/week (adjusted odds ratio, 1.33; 95% confidence interval, 1.05–1.68); using television/computer >2 h/day (1.63; 1.23–2.17); being a current smoker (2.46; 1.80–3.35) or snuffer (2.11; 1.57–2.85); having an irregular meal pattern (1.33; 1.05–1.68); intake of sweets/candy ⩾4 times/week (0.51; 0.32–0.83); and poor academic achievement (1.62; 1.26–2.09). All odds ratios were adjusted for sex, age and parental education.
Conclusions: In Norwegian adolescents, short time in bed is associated with several health-risk behaviors and poor academic achievement.

1. Introduction

Adolescents' sleep duration has decreased over the past century, and research has also indicated that the pattern of decreased sleep duration increases with age [1,2]. Studies have estimated that most adolescents need 8–9 h of sleep per night [3,4], and the National Sleep Foundation, a US-based non-profit organization, has estimated that most adolescents need 9 h of sleep, and that <8 h of sleep on weeknights is characterized as insufficient sleep duration [3]. Although European guidelines for sleep duration are lacking, several studies have shown that short sleep duration (<8 h/day) is associated with several negative health consequences such as high blood pressure [5,6], insulin resistance and diabetes [7–9], decreased immune response [10,11] and mental health problems [12–18]. If left untreated, sleep disturbances at age 16 years have been shown to predict sleep disturbances in adulthood [19].

Several cross-sectional studies have shown that short sleep duration is associated with high body mass index (BMI; kg/m^2) and a prevalence of obesity in children and adolescents [20–22]. Some studies suggest, however, that these associations are apparent only in girls, not in boys [23,24]. Longitudinal studies have also reported conflicting results; some confirm an inverse association [25–27], whereas other studies have not detected any association between sleep duration and obesity [28,29]. Moreover, another longitudinal study reported that the association between sleep duration and BMI varied by sex and age, with stronger associations in boys than girls and in younger children compared with adolescents [30].

Previous studies have also shown inconsistent findings regarding the association between sleep duration and food intake, with a study reporting that one night of reduced sleep subsequently increased food intake among young healthy men [31]. However, a recent study reported that sleep restriction was associated with a small negative energy balance driven by an increased energy expenditure from prolonged wakefulness, and a concomitant decreased energy intake and motivation to eat in male teenagers [32]. Other studies have shown an association between short sleep duration and low meal frequency [33], high intakes of snacks [34]

* Corresponding author. Address: University of Agder, Faculty of Sport and Health Sciences, PO Box 422, 4604 Kristiansand, Norway. Tel./fax: +47 38142324.
E-mail address: tonje.h.stea@uia.no (T.H. Stea).

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and soft drinks [35,36], as well as low intakes of fruits and vegetables among children and adolescents [21].

Several studies have reported an association between sleep duration and screen time, whereas short sleep duration has been associated with using a computer ⩾2–3 h per/day [36,37] and watching television >2 h per/day in adolescence [21]. In addition, several studies have shown that short sleep duration is associated with low levels of physical activity in high school students [21,36,37].

Furthermore, smoking cigarettes in adolescence has been associated with insufficient sleep on weekdays [36,38], inconsistent sleep patterns between weekdays and weekends [39,40], delayed sleep phase and other sleep disorders [41,42]. Few studies have focused on the relationship between the use of snuff and sleeping habits in adolescent years; however, a study targeting an adult population reported that the use of snuff has increased the odds of insufficient sleep compared with those not using these tobacco products [43].

Insufficient sleep duration may reduce the ability to concentrate and retain information [44], and shortened sleep duration and delayed sleep have been inversely associated with school performance [33,41,45]. A meta-analysis by Dewald et al. [46] also concluded that sleepiness and a low sleep quality were associated with a poor school performance. Nevertheless, other studies have reported no association between sleep duration and academic achievement in adolescents [38,47].

Because previous studies have shown inconsistent results, there is a need for additional research on sleep habits and associations with negative health consequences, health-risk behaviors and school performance. Thus, the main aims of the present study were to investigate the prevalence of short sleep duration (<8 h), and to examine possible associations between short sleep duration, overweight/obesity, several health-risk behaviors and academic achievement in Norwegian adolescents. We hypothesized that short time in bed is associated with overweight/obesity and the following health-risks behaviors: low physical activity level, high screen time, smoking and snuffing, an irregular meal pattern and high intake of unhealthy food and beverages, as well as poor academic achievement.

2. Methods

2.1. Study design and participants

This cross-sectional study is part of a large, school-based cluster-randomized intervention study, 'Active and Healthy Youth', that promotes a healthy diet and activity patterns, and aims to prevent disordered eating among adolescents. The target group was 15–17-year-old high school students living in the southern part of Norway, and in agreement with school boards/school principals, a total of 17 out of 23 schools (73.9%) decided to participate in the present study. The main reason why the six schools did not want to participate was due to lack of time (five schools) and participation in similar public health projects (one school). A total of 2619 out of 2653 eligible students agreed to participate (98.7%) and the data collection was conducted in the period from October 2010 to February 2011. During the data analyses, a total of 187 students were excluded because they did not meet the age requirements for participation. Hence the data analyses in the present study were based on a total number of 2432 participants between the ages of 15 and 17 years.

The Regional Committee for Medical Research Ethics approved the study protocol, and written consents were obtained from all students prior to participation in this study.

2.2. Measurement methods and procedures

The participants were asked to complete a 15-page questionnaire that included questions about bedtime and wake time, body weight, height, exercise habits, screen time activity, smoking and snuff use, dietary intake, meal frequencies and paternal and maternal education level.

In order to test the reliability of the questions used in the present study, the questionnaire was test–retested in a method study among 143 adolescents, aged 15–17 years. Test–retest reliability was measured by the intraclass coefficient (ICC). The questions included in this study demonstrated good test–retest reliability with a correlation coefficient ranging from 0.68 to 0.99. The students used ~30 min answering the self-reporting questionnaire, with at least one member of the project team present to provide information about the project and answer possible questions.

Sleep duration was assessed by asking: 'When do you usually get out of bed on a school day?' and 'When do you usually go to bed on a school night?' on a typical weekday. These items were used to compute the average total hours of daily time in bed, and responses were dichotomized into <8 h (short time in bed) and ⩾8 h. The ICC (95% CI) was 0.83 (0.75–0.89) for bed time and 0.73 (0.61–0.82) for wake time.

Self-reported weight and height were used to calculate BMI; categories were calculated using sex- and age-specific International Obesity Task Force (IOTF) cut-off points for defining overweight and obesity in children and adolescents aged 2–18 years [48], though, due to small numbers, the overweight and obese groups were collapsed into one group. The ICC (95% CI) was 0.98 (0.98–0.99) for weight and 0.99 (0.98–0.99) for height.

Diet was assessed by a food frequency questionnaire of 13 items, including both food items and drinks. The questions had eight different response alternatives, ranging from never to more than once a day, and the response alternatives were further dichotomized into having a high or low intake of the selected food items and drinks. Having soft drinks, sweets and candy and a salty snack ⩾4 times a week, respectively, was categorized as a high intake. The ICC (95% CI) was 0.85 (0.77–0.90) for soft drinks, 0.80 (0.70–0.86) for sweets and candy and 0.75 (0.63–0.83) for salty snacks.

Meal frequency was assessed by questions such as: 'How often do you have breakfast each week?', with the same asked for lunch, dinner and the evening meal. Response alternatives ranged from never or seldom to seven days a week, and in a statistical analysis the numbers of days reported eating breakfast, lunch, dinner and evening meals were then dichotomized into having an irregular meal pattern (omitted these main meals at least once a week) and having a regular meal pattern (intake of these main meals every day). These dichotomous variables were then combined to create a summary variable referred to as 'irregular all four meals', i.e. those skipping one of the main meals at least once a week versus those eating all meals every day. The ICC (95% CI) was 0.91 (0.86–0.94) for breakfast, 0.78 (0.68–0.85) for lunch, 0.68 (0.55–0.79) for dinner and 0.89 (0.83–0.93) for evening meal.

Physical activity level was estimated by asking: 'How many hours per week do you spend on doing sports/physical activity in a way that makes you breathless or sweat?' Response alternatives were: '0 h, 1–2 h, 3–4 h, 5–7 h, 8–10 h and 11 h or more.' For the statistical analysis, not participating in 60 min of physical activity every day was characterized as health-risk behavior. Thus, the response alternatives were dichotomized into participating in 60 min of physical activity every day or more versus not engaging in recommended levels of physical activity (<60 min of physical activity every day). The ICC (95% CI) was 0.91 (0.87–0.93) for physical activity.

Television viewing and computer use were enquired about as follows: 'Excluding school hours on a regular weekday, how many