


# Sleep duration and sleeping difficulties among adolescents: exploring associations with school stress, self-perception and technology use

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## Sleep duration and sleeping difficulties among adolescents: exploring associations with school stress, self-perception and technology use

Sleeping problems are increasing among adolescents worldwide. This study aimed to describe the prevalence of self-reported sleep duration and sleeping difficulties, as well as to explore their associations with school stress, self-perception, that is how adolescents perceive their appearance and happiness, and technology use among adolescents. Data were collected in 2015 using a questionnaire. A total of 937 ninth grade adolescents, 15–16 years, from a city in western Sweden participated, resulting in a response rate of 83%. The result

showed that 55% of the adolescents slept less than the recommended 8 hours per night and 11% had sleeping difficulties. School stress and technology use were associated with short sleep duration. School stress and self-perception were associated with sleeping difficulties. The girls had worse outcomes for sleeping difficulties, school stress, self-perception and technology use than the boys. Based on the results, there is a need for school nurses to implement preventive measures to improve adolescents' sleep.

**Keywords:** adolescents, school nurse, school stress, self-perception, sleep, technology use.

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## Introduction

This study has focused on sleeping problems in form of sleep duration and sleeping difficulties, that is difficulties of falling asleep, waking up at night and not feeling rested in the morning. The proportion of adolescents with sleeping difficulties has increased in recent years in Sweden and worldwide (1, 2). The sleep recommendation for adolescents is at least 8–10 hours each night (3). Adolescents who suffer from sleeping difficulties are at risk of a wide range of psychological, medical and physical problems. The quality of the previous night's sleep has an impact on mood changes and cognitive performance in adolescents (4); it affects their learning ability, memory, concentration and reaction time. Recurrent sleeping difficulties might also be associated with health risks, such as self-injury, drug use, reckless driving, hyperactivity, aggression, neuroticism and insomnia

(5, 6). Additional consequences of sleeping difficulties among adolescents include depression, anxiety, concentration difficulties, hyperactivity, poorer performance in school, immune deficiency, obesity and diabetes (6–9).

Adolescents can suffer from sleeping difficulties for a variety of reasons, such as their school situation, psychological factors and personal habits. To our knowledge, there is a lack of studies focusing on associations between sleep difficulties, specifically in regards to school stress and self-perception among adolescents, which are common factors in the context of adolescents' daily life and health outcomes (10).

Research has shown that school stress is high among adolescents (10, 11). Bris – Children's Rights in Society (12), a politically and religiously independent children's rights organisation, has noted that school stress can include an individual's struggle to succeed at school and to achieve high grades. It can also be the result of other factors, such as the pressure to be popular, an individual's friendship status, feeling insecure due to bullying or a stressful and noisy school environment. Today, school stress and stress-related illness are increasing among adolescents, and it has been shown that weak school

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performance is associated with short sleep duration and sleeping difficulties (9, 13). Additional evidence from Feld et al. (14) has found an association between general stress and short sleep duration. However, knowledge is lacking about how specifically school stress and sleep are associated.

Negative self-perception, which is common among adolescents (6, 10), is another factor that might affect sleep. Self-perception refers to how adolescents perceive their appearance and the level of happiness that they have with themselves, their clothes and their personal attributes. Self-perception also deals with the extent to which adolescents believe that others positively value them or how others actually value them (15). Fredriksen et al. (16) have explored the related concept, self-esteem, among adolescents. They reported that low self-esteem and depression are predicted by sleep loss. To our knowledge, few published studies have focused on the associations between self-perception and sleep duration and sleeping difficulties among adolescents.

Technology use, including personal computers, iPads and mobile phones, is a third factor that is likely to undermine the quality of adolescents' sleep. Night sleep is affected by technology use that occurs during the daytime, evening and, unquestionably, at bedtime (8). Adolescents often use their mobile phones after they have gone to bed with the intention of sleeping. Messages and notifications risk waking them up (17). Hale et al. (18) reviewed 67 studies about the association between technology use and sleep; they found that 90% of the studies reported that technology use is adversely associated with sleep in the form of increased risk of sleeping problems, delayed bedtime and shorter sleep duration. This demonstrates that technology use is a contemporary variable to consider when investigating the factors that impact adolescents' sleep.

Adolescence is a natural stage in life when many emotional and physiological changes occur; it is also a phase of life that offers great opportunities to build enduring habits (19). According to Ott et al. (20), adolescents consider their health to be a responsibility they share with the adults in their lives. This further reinforces that adolescents are influenced by others. In addition to parents, school health services have a specific responsibility for adolescents at school. For example, Wernette et al. (21) found an association between adolescents with late-night bedtimes and increased school nurse visits and lower academic performance. The school nurse supports students' health so they fulfil their learning objectives in school. Thus, to direct adequate promotional efforts it is important that school nurses have knowledge about the extent to which school stress, self-perception and technology use are associated with short sleep duration and sleeping difficulties. The position of the school nurse offers a unique possibility to promote adolescents' health; thus,

they need to know what factors can possibly contribute to short sleep duration or sleeping difficulties.

## Aims

The study aimed to describe the prevalence of self-reported sleep duration and sleeping difficulties and to explore their associations with school stress, self-perception and technology use among adolescents.

## Method

### *Design*

This descriptive study used a cross-sectional study design (22). The setting consisted of 13 secondary schools, nine in the municipality sector and four in the private sector, in a Swedish city with approximately 100 000 residents. The municipalities consisted of rural and urban areas that are socioeconomically similar to the national average. Together, the 13 schools had 1128 students (15–16 years old) in the ninth grade, which is the last year of secondary school for this age group before applying to 3 years of upper secondary education. This study used a cross-sectional design, and data were collected at one time in May and June 2015 using a questionnaire where the adolescents answered questions about their sleeping habits, school situation, their psychological and physical self-perception and their use of technology, as well as some background information, such as gender, housing, ethnicity and grades. Of the 944 available students that were asked to participate, 937 chose to participate, resulting in a response rate of 83%. Research data, such as sample, questionnaire and collected data are available from the authors on request.

### *Measures*

The questionnaire included an information sheet, and the questions were compiled from three questionnaires (23–25). The content of the questions was carefully selected to address the aims of this study. The following five areas were measured: (1) demographic characteristics: gender, housing, ethnicity and grades; (2) sleep duration and sleeping difficulties; (3) school stress; (4) self-perception; and (5) technology use. The questionnaire contained a total of 26 questions. The last question was open-ended; it was used to assess the adolescents' views of the possible causes of their sleeping difficulties. It will be analysed in a forthcoming study, as will seven questions about the reasons for school stress.

The following demographic characteristics were measured: gender, ethnicity (Swedish or foreign born) and housing (cohabiting or noncohabiting parents). Cohabiting refers to living in a nuclear family. In Sweden,

seven out of 10 families are nuclear families (26). Grades were also measured from a minimum of 0 credits to a maximum of 340 credits that a student can receive in an annual course. A minimum of 170 credits is required to apply for secondary school. In the city in which this study was conducted, the average number of credits was 237 credits; the national average in Sweden is 225 credits.

The Minimal Insomnia Symptom Scale (MISS) (23) was used to investigate sleep duration and sleeping difficulties. Sleep duration was measured by the statement: I sleep on average this number of hours per night, with 10 response categories:  $\leq 3$ , 4, 5, 6, 7, 8, 9, 10, 11 and  $\geq 12$  hours. Short sleep duration was defined as  $< 8$  hours a night, based on guidelines from National Sleep Foundation (3). In dichotomisation, the frequencies were collapsed into binary variables (0 = short sleep duration, 1 = long sleep duration). Sleeping difficulties focus on the difficulty of falling asleep, waking up at night and not feeling rested in the morning. Sleeping difficulties were measured using three questions: (i) How large a problem do you have falling asleep in the evening? (ii) How large a problem do you have waking up at night? and (iii) How large a problem do you have with not feeling rested in the morning? The response categories were rated using a 5-point Likert-scale, ranging from 'none' (0) to 'very large' (5). The total score for this measure was 12 points, and the cut-off score that implies the presence of sleeping difficulties was  $\geq 7$ . In dichotomisation, the frequencies were collapsed into binary variables (0 = sleeping difficulties, 1 = no sleeping difficulties). MISS is considered to be a valid questionnaire (27). In this study, the Cronbach's alpha for the three items was 0.65.

School stress was measured using a single item selected from a recurrent survey of students' attitudes about school in Sweden, which was conducted by The Swedish National Agency for Education (24). The adolescents rated their response to the question, How often do you feel stressed at school? using a 5-point Likert-type scale ranging from 'never' (0) to 'daily' (5). Being stressed daily or several times a week was defined as a high risk of school stress, according to The Swedish National Agency for Education (24). In dichotomisation, the frequencies were collapsed into binary variables (0 = high degree of school stress, 1 = low degree of school stress).

Self-perception was measured using five of the 52 questions from The European KIDSCREEN approach to measure quality of life and well-being in adolescents (25). All five questions started with, If you think about last week... followed by: (i) Were you satisfied with yourself? (ii) Were you satisfied with your clothes? (iii) 'Were you unhappy with your appearance?' (iv) Were you jealous of others' appearance? and (v) Did you want to change something on your body? The response categories for the five items were rated from 'never' (0) to 'always' (4), with a total

index ranging from 0 to 20. The cut-off was set at 14, which was the median in the sample. A rating of  $\leq 14$  indicated low self-perception. In dichotomisation, the frequencies were collapsed into binary variables (0 = low degree of self-perception, 1 = high degree of self-perception). Cronbach's alpha for these items was 0.81.

A Swedish instrument measuring the frequency of technology use, especially at bedtime, was not found. Therefore, questions related to technology use were constructed after reviewing the literature and discussing the questions with colleagues at several seminars. The questions were formulated to capture the number of hours of technology use at leisure during a school day and at bedtime. Technology use at leisure during a school day was measured by one question: How many hours on average do you use a computer, iPad and mobile phone at leisure time during a school day? Response categories were as follows: 1 hour or less, 1–2 hours, 3–4 hours, 5–6 hours, 7–8 hours and 9 or more hours. Frequent technology use at leisure was defined as  $\geq 3$  hours, which also defined the cut-off, since technology use above 2 hours is a risk factor (28). In dichotomisation, the frequencies were collapsed into binary variables (0 = low degree of technology use at leisure during a school day, 1 = high degree of technology use at leisure during a school day). Technology use at bedtime was measured by three questions: (i) How often do you use a computer, iPad or mobile phone during the last hour before you go to sleep? (ii) How often do you use a computer, iPad or mobile phone after you have gone to bed? and (iii) How often do you wake up at night from notifications from SMS, Instagram and Facebook? The response categories were rated using a 5-point Likert-scale ranging from 'never' (0) to 'always' (5). The total score was 15 points. The cut-off was set at  $\leq 9$ , according to the median in the sample, and it implies a low level of technology use. A rating of  $\geq 10$  indicated a high technology use at bedtime. In dichotomisation, the frequencies were collapsed into binary variables (0 = low degree of technology use at bedtime, 1 = high degree of technology use at bedtime). Cronbach's alpha was 0.57.

The instrument was tested on a convenience sample of 10 adolescents. This was done in order to control the logistics of the trial, determine the relevance of the questions, identify the technology usage and estimate the expected time to answer the questions (22). The test led to small revisions, such as reformulation of the questions about technology use and adapting the text to include vocabulary used by adolescents.

### Procedures

The first author contacted the principals at all 13 schools and informed them about the study. All the principals gave their permission to conduct the study, and they provided the researchers with the names of teachers.

Thereafter, the principals received the same information in written form, and information was also sent to the adolescents' parents. The teachers were informed about the study via e-mail, and they suggested times for the researchers to visit the school. Two of the authors visited each school and all of the present adolescents were informed about the study, verbally and in writing. The adolescents were informed that participation was voluntary. They were guaranteed confidentiality and anonymity in the presentation of the study results. All adolescents, except  $n = 7$ , gave their informed consent to participate.

Two of the authors were present when the participants completed the questionnaire. The questionnaire took about 10 minutes to complete. The adolescents placed their answered questionnaires in a collection envelope. The response rate was 83% ( $n = 937$ ).

### *Data analysis*

Statistical Package for the Social Sciences (SPSS) for Windows version 22 (SPSS Inc., Chicago, IL, USA) was used for data analysis. Data are presented descriptively as frequencies ( $n$ ) and percentage (%) or mean ( $m$ ) with standard deviation (SD), according to the scale level for the variables: gender, housing, ethnicity, grades, sleep duration and sleeping difficulties (22). The independent variables, school stress, self-perception and technology use at leisure time during a school day and at bedtime, were presented descriptively by min-max and median ( $md$ ). These independent variables were dichotomised. The chi-squared test ( $X^2$ ) was used to measure the differences in sleep durations and sleeping difficulties based on the variables, gender, housing, ethnicity and grades. The chi-squared test also measured the differences between boys' and girls' level of school stress, self-perception and technology use at leisure time during a school day and at bedtime. Associations with  $p$ -values  $< 0.05$  were considered to be statistically significant. Logistic regression analyses were performed to examine the associations between the following dependent variables, sleep duration ( $\geq 8$  hours or  $< 8$  hours) and sleeping difficulties (yes or no), with the following independent variables, school stress, self-perception and technology use at leisure time during a school day and at bedtime. The internal loss of data was minimal, and data were neither replaced nor imputed (22).

### *Ethical considerations*

Based on Swedish Law, we did not need the approval of an Ethical Committee to carry out the study SFS 2003:460 § 2 (29). In all schools, the study was approved by the management officers. Conventional research ethical principles in humanitarian and social

science research as formulated in ethical research guidelines and in Swedish ethics testing legislation have been carefully followed throughout, taking into account information, consent, confidentiality and usage requirements (30). All the adolescents were 15–16 years of age. Thus, parental consent for the adolescents' participation in the study was not required. However, parents received written information about the study with the researchers' contact information in case they had any questions. In accordance with the World Medical Association (31), all the adolescents were given written and oral information about the study aims, the possible risks and benefits of participating, and that they were free to withdraw from the project at any time without providing reasons. They were guaranteed confidentiality and anonymity in the presentation of the study results. All the adolescents gave their informed consent to participate.

## **Results**

### *Descriptive characteristics*

All the participants ( $n = 937$ ) were 15–16 years old; 70% lived with cohabiting parents and 28% had noncohabiting parents. In terms of place of birth, 14% were born outside of Sweden, 30% had a mother who was born outside of Sweden, and 32% had a father who was born outside of Sweden. The average grade was 237 credits for the total sample; the grades were significantly higher for girls ( $m = 250$ ,  $SD = 47.4$ ) than boys ( $m = 223$ ,  $SD = 51.8$ ) ( $p \leq 0.001$ ).

### *Sleep duration and sleeping difficulties*

The average sleep duration of the adolescents ( $n = 937$ ) in the study was 7.28 hours ( $SD = 1.83$ ); 55% of the adolescents slept less than the recommended 8 hours a night and 26% slept 6 hours or less. A significant difference (18 minutes) was seen in the sleep duration between adolescents who had cohabiting parents (7.29 hours,  $SD = 0.49$ ) and those that had noncohabiting parents (6.99 hours,  $SD = 0.90$ ). In total, 11% of the adolescents had sleeping difficulties; they were above the cut-off for sleeping difficulties. A significant difference in sleeping difficulties was observed between the adolescents that had cohabiting parents and those that had noncohabiting parents (Table 1). Girls had significantly more sleeping difficulties than boys, and a higher percentage of girls slept  $< 8$  hours a night (Table 1). Significant differences were also seen between boys and girls for the remaining self-assessed variables: school stress, self-perception and technology use at leisure time during a school day and at bedtime (Table 2).

**Table 1** Sleep duration and sleeping difficulties as perceived by adolescents (n = 937) across gender, housing, ethnicity and grades

	n (%)	≥8 hours	<8 hours <sup>a</sup>	p-Value <sup>b</sup>	No sleeping difficulties	Sleeping difficulties	p-Value <sup>b</sup>
Gender							
Boys	467 (51)	48%	51%	0.016	93%	7%	0.001
Girls	454 (49)	41%	59%		86%	14%	
Housing							
Cohabiting parents	659 (71)	47%	52%	0.004	90%	10%	0.036
Noncohabiting parents	266 (29)	37%	62%		86%	14%	
Ethnicity							
Born in Sweden	785 (85)	44%	55%	0.753	90%	10%	0.053
Born abroad	135 (15)	42%	56%		87%	13%	
Grades (m = 237 credits) <sup>c</sup>							
Grades ≤237	366 (47)	40%	59%	0.030	89%	11%	0.013
Grades ≥237	419 (53)	48%	52%		90%	10%	

<sup>a</sup>Less than the recommended hours of sleep for adolescents.

<sup>b</sup>p-value is based on chi-squared test.

<sup>c</sup>Grades measured from min-max credits (0–340).

**Table 2** Gender differences among adolescents (n = 937) between school stress, self-perception and technology use at leisure during a school day and technology use at bedtime

	Boys n (%)	Girls n (%)	p-value
Degree of school stress (min = 0, max = 4, md 1, cut-off = 1)			
Low level of school stress = 2–4	282 (60)	108 (24)	0.001
High level of school stress = 0–1	186 (39)	345 (76)	
Degree of self-perception (min = 0, max = 20, md 14, cut-off 14)			
Low level of self-perception = 0–14	167 (35)	333 (73)	0.001
High level of self-perception = 15–20	299 (63)	118 (26)	
Degree of technology use at leisure <sup>a</sup> (min 0, max 5, md 2, cut-off 1)			
Low level = 0–1	107 (23)	76 (17)	0.020
High level = 2–5	359 (76)	376 (83)	
Degree of technology use at bedtime (min = 0, max = 15, md 9, cut-off 9)			
Low level = 0–9	299 (64)	230 (51)	0.001
High level = 10–15	170 (36)	223 (49)	

p-value is based on chi-squared test.

<sup>a</sup>During a school day.

### *Associations between school stress, self-perception and technology use and sleep duration and sleeping difficulties*

A logistic regression analysis was performed with sleep duration as the dependent variable and school stress, self-perception and technology use at leisure time during a school day and at bedtime as the predictor variables. A total of 898 cases were analysed and the full model significantly predicted sleep duration ( $X^2 = 80.33$ ,  $df = 4$ ,  $p \leq 0.001$ ). The model accounted for between 9% and 12% of the variance in sleep duration; overall, 63% of the predictions were accurate. The logistic regression analysis results show that school stress, technology use at leisure time during a school day and technology use at bedtime predicted short sleep duration. The values of the

coefficients reveal that technology use at leisure time during a school day and technology use at bedtime are associated with a decrease in the odds of sleep duration by a factor of 0.86 ( $p \leq 0.05$ ) and 0.89 ( $p \leq 0.001$ ), respectively. However, the values of the coefficients reveal that school stress is associated with an increase in the odds ratio (OR) of sleep duration by a factor of 1.24 ( $p \leq 0.001$ ) (Table 3).

A similar logistic regression analysis was performed with sleeping difficulties as the dependent variable and school stress, self-perception and technology use at leisure time during a school day and at bedtime as the predictor variables. A total of 895 cases were analysed, and the full model significantly predicted sleeping difficulties ( $X^2 = 86.21$ ,  $df = 4$ ,  $p \leq 0.001$ ). The model

**Table 3** Logistic regression for sleep duration among adolescents (n = 898)

Sleep Duration	B	SE	Wald	df	p-value	Exp (B)	95% C.I for Exp (B)	
							Lower	Upper
School stress	0.215	0.063	11.693	1	0.001	1.239	1.096	1.401
Self-perception	0.022	0.016	1.727	1	0.189	1.022	0.989	1.055
Technology use at leisure during a school day	-0.121	0.059	4.124	1	0.042	0.886	0.789	0.996
Technology use at bedtime	-0.145	0.026	31.248	1	0.001	0.865	0.822	0.910

**Table 4** Logistic regression for sleeping difficulties among adolescents (n = 898)

Sleeping difficulties	B	SE	Wald	df	p-value	Exp (B)	95% C.I for Exp (B)	
							Lower	Upper
School stress	-0.900	0.149	36.325	1	0.001	0.407	0.303	0.545
Self-perception	-0.080	0.025	10.168	1	0.001	0.923	0.879	0.970
Technology use at leisure during a school day	0.036	0.095	0.145	1	0.703	1.037	0.860	1.250
Technology use at bedtime	0.019	0.042	0.198	1	0.657	1.019	0.938	1.106

accounted for between 9% and 19% of the variance in sleeping difficulties; overall, 89% of the predictions were accurate. The logistic regression analysis results show that school stress and self-perception predicted sleeping difficulties. The values of the coefficients reveal that school stress and self-perception are associated with a decrease in the OR of sleeping difficulties by a factor of 0.41 ( $p \leq 0.001$ ) and 0.92 ( $p \leq 0.001$ ), respectively (Table 4).

## Discussion

The study aimed to describe the prevalence of self-reported sleep duration and sleeping difficulties and to explore their associations with school stress, self-perception and technology use among adolescents. The response rate for the questionnaire was 83%, that is, 937 of the 1128 respondents completed and returned the survey.

The results showed that more than half of the students (55%) do not sleep the recommended number of hours each night. Additional main findings showed that school stress and technology use at leisure time during a school day and at bedtime were significantly associated with short sleep duration. School stress and self-perception were equivalently associated with sleeping difficulties. The prevalence of short sleep duration within 55% of the adolescents was consistent with the previous findings from similar surveys among adolescents in China and Brazil (32, 33). This can be compared with studies from Norway and Canada, which reported that the sleep duration was short in 30% of the adolescents (13, 34).

Furthermore, girls with noncohabiting parents and below-average grades were significantly associated with both short sleep duration and sleeping difficulties. Shortened sleep duration, whether occasional or over a longer period of time, has been reported to have no lasting physical effects (35), but it has been found to cause direct deterioration in school performance, learning difficulties and memory impairment (6, 9). However, a connection between long-lasting sleeping difficulties and serious illness, such as diabetes, heart disease and depression, has been seen in adults (7, 36). The risk for developing these problems seems high in our sample, which further emphasises the need to implement sleep-promoting efforts for adolescents.

In the present study, 14% of the girls and 7% of the boys indicated that they have sleeping difficulties. This finding is consistent with a national report from the Public Health Agency of Sweden (10), indicating a slightly higher percentage of sleeping difficulties for girls than for boys. The consequences of sleeping difficulties, such as impaired cognitive ability and physical symptoms, are similar to having long-term, short sleep duration.

Gender differences were observed for several of the variables. Girls displayed more sleeping difficulties, higher school stress, lower self-perception and higher technology use. The study also showed that girls use technology at bedtime more often than boys. This is mainly consistent with the findings reported in prior research stating that girls display more symptoms of weak self-perception and higher school stress (10, 37). In a study by Wiklund et al. (38), a clear gender difference was seen in self-assessed health in the form of headaches, sleeping difficulties,

high pressure and demands from school and anxiety. In the present study, girls reported two to three times more health complaints than boys. Co-rumination is another gender difference that can be included in this context; thus, extensively discussing and revisiting problems, speculating about problems and focusing on negative feelings with peers is more common among girls than boys (39). This probably also happens through social media, and it can explain some of the higher degree of technology use in girls than in boys. An important future research topic is to investigate whether these gender differences necessitate the implementation of diverse health-promoting interventions.

On average, adolescents living with noncohabiting parents sleep 18 minutes less than those living with cohabiting parents. They also had more sleeping difficulties. Previous studies have revealed that parental involvement in adolescents' sleep routines facilitates better sleep (40, 41). Adolescents who have good sleep habits and parents who decide on bed times have a longer duration of sleep per night (42, 43). Optionally, it can be more difficult to hold on to such procedures as a single parent, or when an adolescent switches accommodations between noncohabiting parents. The importance of parental involvement is confirmed by Ott et al. (20) that adolescents described their health as being a responsibility they shared with the adults in their lives. Moreover, it has been reported that the sleep habits of parents affect young people (32). However, additional studies are needed to better understand the phenomenon of the difference in sleep duration and sleeping difficulties based on whether or not an adolescent's parents live together.

As expected, the present study's findings indicated that most of the adolescents use technology during their leisure time for more than 2 hours (76% boys and 83% girls, respectively). The study also showed associations between high technology use at leisure during a school day and high technology use at bedtime and short sleep duration. This result is supported by Stockburger et al. (44) who confirmed that continuous technology use has a significant influence on sleeping difficulties. Because technology is available at all hours of the day and night, and adolescents are eager to be social with their friends (45), it is conceivable that they prioritise technology use over sleep. However, the present study did not find any association between use of technology and sleeping difficulties, only short sleep duration. One possible explanation for this could be that technology use was not measured by a validated questionnaire. Because technology use seems to have a strong influence on the sleep and health of adolescents (46, 47), it is important to have reliable ways to measure this factor.

In addition, in the present study, school stress was weakly correlated to both short sleep duration and sleeping difficulties. There are reasons to believe that school

stress involves, for example, studying late at night or nocturnal musings. Earlier research (11, 48) reported increasing levels of school stress, which is also seen in the present study, especially among girls (girls 76%, boys 39%). Grades and high demands are highlighted explanations for this outcome (10).

A final important finding from the present study was that a low level of self-perception (girls 73%, boys 35%) is associated with sleeping difficulties. Other studies have reported that sleeping difficulties are related to similar factors, such as low self-esteem, friend problems, emotional problems and less satisfaction with life (6, 49). This reinforces the need to focus on how to strengthen how adolescents perceive themselves.

### *Limitations*

The present study has some limitations. During the progress of the research, a number of issues arose that might have influenced the results and conclusions. First, it is known that self-reporting can result in underestimating sleep duration (50, 51). This is a concern applicable to any study that uses self-assessment to collect data on sleep duration or sleeping difficulties. The choice of independent factors in this study, school stress, self-perception and technology use at leisure during a school day and at bedtime, were based on the need to obtain information about the highly relevant factors that impact the everyday lives of contemporary adolescents. However, these choices excluded factors that are known to be important for sleep, such as physical activity, neuropsychiatric diagnoses, pain, obesity, socioeconomic status, parenting, depression, stress, drugs and caffeine and alcohol consumption (32, 42). While this can be seen as a limitation, at the same time it justifies the rather low explanation power. Since technology use was measured using a nonvalidated questionnaire, both the validity and reliability of this measure can be called into questions.

### **School nursing implications**

The study results highlight the difficulties for adolescents in finding a workable balance between the activities they engage in each day and night. They feel compelled to meet requirements to perform well in school, be social online and be satisfied with their own body, while their bodies and brains need at least 8 hours of sleep each night. The school nurse has an informative mission with health education as a central element of health promotion both individually and in groups, classes and meetings with parents (52, 53). The aim of health promotion is to support the process of learning and critically reflect on various aspects of health so people can make wise decisions (54). Informing parents using evidence-based knowledge about the

importance of sleep could give them a better understanding of the need to support adolescents to 'get into bed' (55). Simultaneously providing information to adolescents and parents probably increases the effect. It is easier to discuss sleep at home if both adolescents and parents have received the same information. Based on the high school-related stress results of this study, school nurses should be advocates for students in a school environment, working with the school principal and teachers to find a balance between tests, homework and other tasks required of students. The school nurse should also remember to ask students about sleeping difficulties when they have difficulties with academic achievement. When sleeping difficulties and school difficulties occur simultaneously, school nurses could help students achieve better academic performance. The results of this study show that girls have worse outcomes on almost all the variables, which was also confirmed by earlier research. Generally, girls are in a more vulnerable situation at school, in social media and in society. This is something that school nurses have to consider when developing and implementing promotional activities.

## Conclusion

The study results show that more than half of the adolescents slept less than the recommended 8 hours per night. In addition, more than one adolescent out of 10 had sleeping difficulties. This implies negative consequences for adolescents both during their school hours and their leisure time, which should be viewed from the perspective of the impact on long-term health. School stress, self-perception and technology use are factors in an adolescent's daily life that are associated with sleeping difficulties. To increase opportunities for adolescents to achieve good health, well-being and satisfactory grades, the study results should be taken seriously by school nurses when developing and implementing health

promotions. Further research on the factors that interfere with adolescents' sleep can provide valuable knowledge.

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## Author contributions

MJ and KH designed the study and collected the data. MJ and GJ analysed the data. MJ and KH designed the study and collected the data. MJ, KJ and KH prepared the manuscript. Critical revision and supervision were provided by KH, KJ, GJ and LS.

## Conflict of interests

The authors declare no potential conflict of interests with respect to the research, authorship and/or publication of this article.

## Ethical approval

Based on Swedish Law, we did not need the approval of an Ethical Committee to carry out the study SFS 2003:460 § 2 (29).

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