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Sleep and dropout from upper secondary school: A register-linked study

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ABSTRACT

Objective: The present study investigates the association between sleep in late adolescence and completion of upper secondary school.
Methods: The data are drawn from the youth@hordaland study, a large population-based study conducted in 2012, linked with official educational data in Norway ($N = 8838$).
Results: High school dropout was more prevalent among adolescents who had insomnia (20.6%) compared to those without insomnia (14.3%; adjusted risk ratios = 1.50; 95% confidence intervals: [2.19-2.92]). There was also a higher rate of school dropout among those who had symptoms of delayed sleep-wake phase (21%) compared to those without delayed sleep-wake phase (14.3%); adjusted risk ratios = 1.43, 95% confidence intervals: (1.28-1.59). School noncompleters were also characterized by reporting 44 minutes shorter sleep duration, longer sleep onset latency, and wake after sleep onset (both approx. 15 minutes) compared to school completers.
Conclusion: The importance of sleep for high school dropout rates highlights the importance of including sleep as a risk indicator and a possible target for preventive interventions in late adolescence.

Introduction

Completing upper secondary education is a prerequisite for all further education; and noncompletion is related to poorer health and reduced participation in the workforce.[1] Still, a large proportion of adolescents do not complete upper secondary school.[2] A meta-analysis identified a wide range of risk factors for school dropout among youth, including mental health problems, substance abuse, and learning difficulties.[3] Despite the wide range of individual, familial, academic, and school-related risk factors that have been investigated in relation to school dropout,[4] no studies have investigated the importance of sleep problems as exemplified by the lack of sleep problems in the mentioned meta-analysis.[3] Since sleep problems and short sleep duration have been linked to increased school absence,[5–7] a known precursor to school dropout,[8] sleep problems may also be a likely risk factor for school noncompletion. Similarly, sleep problems are related to other known predictors of school dropout, such as reduced academic performance and impaired cognitive functioning, which further supports it as a likely risk indicator of school dropout.[9–13]

Sleep during late adolescence is characterized by a delay in sleep timing and variability in sleep duration.[14] These changes are multifactorial and related both to biological changes, such as puberty-related circadian shifts, and environmental factors, such as more independence and less parental control, and earlier school times.[15,16] Short sleep duration driven by late bedtimes, long sleep onset latency, and early wake-up times is characteristic of the adolescent years. The importance of addressing sleep measures as a precursor of school dropout is underlined by indications that sleep deficit is on the rise among adolescents,[17] and short sleep duration during adolescence is related to higher rates of absenteeism.[5]

Sleep problems are multifaceted during adolescence, spanning from circadian rhythm-related difficulties to reduced sleep quality and quantity. Regarding sleep quality, insomnia often debuts, and is the most prevalent sleep problem during the adolescent years.[18] Insomnia is characterized by difficulties initiating and/or maintaining sleep over time and is associated with impaired daytime functioning,

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including a documented impact on school absenteeism[5,6,19] and failed school courses.[20] Another hallmark of adolescent sleep is the general delayed sleep timing. This sleep-phase shift is a consequence of a biological delay in the circadian rhythm during puberty, as well as later leisure and social activities.[21] Social constraints on the delayed sleep timing, such as early school start times during the weekdays, contribute to large differences in sleep timing and duration between weekdays and weekends during adolescence termed social jetlag.[22] While the delayed sleep phase is a normative developmental pattern in adolescence, for some, this will be more pronounced and result in severe functional impairments, fulfilling the diagnostic criteria for delayed sleep-wake phase disorder. Delayed sleep phase may directly impact school dropout by the high rate of oversleeping and subsequent absenteeism, while delayed sleep-wake phase disorder and insomnia are separate conditions that often co-occur during adolescence,[23] likely emerging from interacting sleep regulation processes,[24] and, thus, may also have overlapping influences on school outcomes.

Overall, the importance of sleep for school performance and school absenteeism is well known, but the association with secondary school dropout seems to be a neglected research area. Furthermore, given that sleep quantity and sleep quality have differential associations on school performance,[10,25] the impact of sleep on school dropout may also be expected to differ across types of sleep problems.

When investigating sleep and school dropout, some third variables need to be considered. The social gradient in school dropout is well established,[26] and similarly, adolescents from low socioeconomic strata have more sleep problems during the adolescent years.[27] Furthermore, sleep has been suggested as one factor that could account for the achievement gap related to socioeconomic status (SES).[28] A similar pattern has been observed in a previous report from the present study, with a higher rate of noncompletion among youth whose parents have lower education.[29] Furthermore, the expected sex pattern of more dropouts among boys than girls has been confirmed.[29] Sleep problems also have sex-specific patterns, with girls being more prone to insomnia symptoms, while short sleep duration is often more prevalent among adolescent boys.[30–32]

Based on these considerations, the present study aimed to investigate the association between self-reported adolescent sleep (insomnia, delayed sleep phase, and sleep duration measures) and registry-based school dropout rates while adjusting for SES and sex. Based on the previous literature, we hypothesize that there will be an increased risk of school dropout for adolescents with insomnia, delayed sleep phase, shorter sleep duration, and more social jetlag.

Methods

Procedure

This population-based study used data from the youth@hordaland study of adolescents in Hordaland County in Western Norway. All adolescents born between 1993 and 1995 were invited to participate in 2012 with an aim to reach all adolescents in late adolescence (age range 16-19) and during upper secondary education. The main aim of the survey was to assess the prevalence of mental health problems and service use in adolescents. Adolescents in upper secondary education received study information via e-mail, and 1 classroom school hour was allocated for completing the questionnaire. Those not in school received information by postal mail to their home address. The questionnaire was web based. It covered a broad range of mental health issues, daily life functioning, use of health care and social services, and demographic characteristics, as well as a request for permission to obtain school data and link the information with national health registries. The data from the youth@hordaland study were linked for those who consented to registry linkage.

Sample

All adolescents born between 1993 and 1995 were invited (N = 19,430) to participate in the epidemiological study during the first months of 2012, of which 10,257 agreed, yielding a participation rate of 53%. Of these, 9166 consented to linkage to national registries. This subsample was nearly identical to the total sample regarding age and sex distribution, and self-reported sociodemographic characteristics.[33] The present sample included 8838 adolescents who had valid data on the educational variables and sleep variables. The validity of sleep data were assessed manually, with participants providing obvious invalid responses being omitted from further analyses. Invalid responses included: 1) sleep onset latency (SOL) or wake after sleep onset (WASO) more than 12 hours; 2) SOL + WASO longer than time in bed (TIB); and 3) negative values of sleep duration and sleep efficiency.

Instruments

Sociodemographics

Sex (biological sex at birth) and date of birth were identified through the personal identity number in the Norwegian National Population Register. The exact age was estimated by calculating the interval of time between the date of birth and the date of participation. Socioeconomic status was indicated by parental educational status, retrieved from the Norwegian educational database. Mothers' and fathers' highest educations when the participants were 16 years old were reported separately and categorized into "primary", "secondary" or "college/university".

Sleep measures

Insomnia was operationalized in alignment with the DSM-5 criteria.[34] Difficulties initiating and maintaining sleep (DIMS) were rated on a 3-point Likert scale with response options "not true," "somewhat true," and "certainly true." If confirmed (ie, "somewhat true" or "certainly true"), adolescents were asked how many days per week they experienced problems either initiating or maintaining sleep. Adolescents also provided information on the duration of DIMS. A joint question on tiredness or sleepiness was rated on a 3-point Likert scale with response options "not true," "somewhat true," and "certainly true." If confirmed, adolescents reported the number of days per week they experienced sleepiness and tiredness, respectively. To meet the DSM-5 criteria for insomnia, adolescents had to report DIMS at least 3 times a week, with a duration of 3 months or more, as well as tiredness or sleepiness at least 3 days per week.

Delayed sleep-wake phase (DSWP) were assessed by the following questions: "at what time do you usually go to bed," "how much time does it take before you fall asleep (hours and minutes)," "when do you usually get out of bed in the morning," "how many nights per week do you have difficulties falling asleep (0-7)," and "how often do you oversleep ("never," "seldom," "sometimes," "mostly," and "always")." The participants provided sleep data separately for weekdays and weekends. No information regarding the time frame of these symptoms was available. To establish a proxy for assessing DSWP (as close as possible given the available sleep items) in line with the International Classification of Sleep Disorders-2,[35] we employed the following criteria (as specified in ref.[18]): 1) minimum 1-hour shift in sleep onset and wake times from the weekdays to the weekend; 2) complaint of frequent (≥3 days per week) difficulty falling asleep; 3) report of little or no (≤1 day per week) difficulty

maintaining sleep; and 4) frequent difficulty awakening (oversleep "sometimes" or more often).

Self-reported usual bedtime and rise time were indicated in hours and minutes using a scroll-down menu; data were reported separately for weekdays and weekends. TIB was calculated as the difference between bedtime and rise time. SOL and WASO were indicated in hours and minutes, and sleep duration was defined as TIB minus SOL and WASO. Weekday-to-weekend differences (WWDs) were calculated for sleep duration, bedtime, and rise time. Weekday sleep efficiency was calculated as sleep duration divided by TIB multiplied by 100 (reported as a percentage; higher scores reflect greater sleep efficiency). Sleep efficiency was analyzed as a continuous variable, with less than 85% as the cutoff for indications of poor sleep quality in accordance with Lacks and Morin.[36]

Social jetlag was defined as the difference in sleep midpoints between weekdays and free days (weekends). The measure of social jetlag was analyzed both as a continuous variable and a dichotomous measure using 4 hours as the cutoff value.

Completion of upper secondary education

Information on school dropout was retrieved from the Norwegian educational database. Completion of upper secondary school was defined according to the national definition used by Statistics Norway[37] as graduation within 5 years of beginning upper secondary school for students enrolled in general tracks and within 6 years for students enrolled in vocational tracks. Participants who had not completed upper secondary school within 5/6 years were defined as having dropped out of school.

Statistics

IBM SPSS version 28 (SPSS Inc., Chicago, IL, United States) for Windows was used for all analyses. Pearson chi-squared tests were used to examine differences in demographic variables and the prevalence of insomnia and DSWP among adolescents who had completed compared to those who had not completed secondary school. Log-link binomial regression analyses were used to calculate effect sizes, adjusting for sex and parental education. Results are presented as risk ratios (RR) with 95% confidence intervals. Briefly explained an RR is the risk of an event (eg, school dropout) in 1 group (eg, adolescents with insomnia) relative to that in a control group (eg, adolescents without insomnia). While an RR of 1.00 indicates that the risk is comparable in the 2 groups, a value greater than 1.00 indicates increased risk; a value lower than 1.00 indicates decreased risk. Estimated marginal means, adjusting for age, sex, and parental education, were calculated for all continuous sleep parameters (SOL, WASO, weekday sleep duration and sleep efficiency, weekday and weekend bedtime and rise time, bedtime, rise time and sleep duration WWD, and social jetlag), among adolescents who had completed versus not completed secondary school. Effect sizes were measured by Cohen's *d* and Cohen's *h* (for proportions), where effect sizes of about 0.2 are interpreted as small effects, 0.5 are interpreted as medium effects, and effect sizes larger than 0.8 are interpreted as large.[38] The predicted probability of dropout at different levels of sleep duration for boys and girls was calculated and visualized using Stata 17.[39]

Ethics

The study was approved by the Regional Committee for Medical and Health Research Ethics in Western Norway (2011/811/REK Vest) and SIKT (371974). A Data Protection Impact Assessment was conducted for the linkage.

Following the regulations from the Norwegian health authorities, adolescents aged 16 years and older can make decisions regarding their health (including participation in health studies) and, thus, gave consent to participate in the current study and for the linkage to registries. Parents or guardians have the right to be informed, and in the current study, all parents or guardians received information about the study in advance.

Table 1
Sample characteristics of the linked youth@hordaland study and the Norwegian Education Database ($N = 8838$).

	% (n)
Girls	53.5% (4724)
Age in years, mean (SD)	17.4 (0.83)
Mother's highest educational level	
Primary	16.4% (1438)
Secondary	41.5% (3650)
College/university	42.1% (3632)
Missing	0.9% (78)
Father's highest educational level	
Primary	15.6% (1348)
Secondary	49.5% (4280)
College/University	34.2% (2960)
Missing	0.7% (63)

Results

Characteristics of the sample

The total sample ($n = 8838$) consisted of 53.4% girls, and the mean age was 17.4 years (SD = 0.83), ranging from 16 to 19 years (see Table 1 for details). The percentage who had not completed upper secondary education was 13.1 for girls and 18.9 for boys. There was a higher dropout rate among adolescents whose parents had lower education ($P < .001$), and school dropouts were slightly younger at the time of the survey ($P = .012$).

Sleep and secondary school dropout

Prevalence and RR for school dropout for adolescents with and without insomnia and DSWP are presented in Table 2. School dropout was more prevalent among adolescents with insomnia (20.6%) compared to those without insomnia (14.3%; RR = 1.50; and 95% CI: [1.27-1.61]). There was also a higher rate of school dropout among those with DSWP (21%) compared to those without DSWP (14.3%; RR = 1.43, and 95% CI: [1.28-1.59]).

Among the noncompleters, 24.6% fulfilled the criteria for insomnia compared with 17.3% of completers. For DSWP, the prevalence was 2.9% for noncompleters in comparison to 1.9% for completers.

As displayed in Fig. 1, the predicted probability of school dropout was inversely associated with sleep duration for both boys and girls: the shorter the sleep duration, the higher the probability of school dropout.

Detailed weekday and weekend sleep estimates among completers versus noncompleters, adjusting for sex and parental education, are displayed in Table 3. Those who completed secondary school had 44 minutes longer sleep duration than adolescents who had not completed secondary school. The noncompleters reported 16 minutes longer SOL and 15 minutes longer WASO than the completers. Noncompleters also had larger WWDs for bedtime, rise time,

Table 2
Risk of secondary school dropout according to insomnia and DSWP status.

	Unadjusted		Adjusted for sex and parental education	
	RR	95% CI	RR	95% CI
Insomnia	1.44	1.27-1.61	1.50	1.34-1.68
DSWP	1.46	1.16-1.84	1.45	1.14-1.84

RR, relative risk; DSWP, delayed sleep-wake phase.

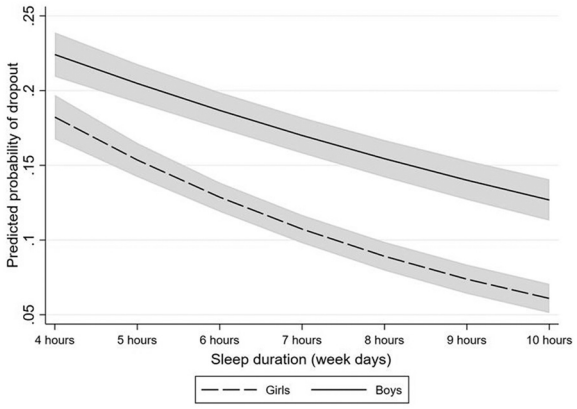

Fig. 1. Predicted probability of school dropout by sleep duration (weekdays) for boys and girls. The gray shaded area represents 95% confidence intervals.

and sleep duration, in addition to more social jetlag, compared to school completers. The effect sizes were all in the small-to-moderate range (see Table 3 for details).

Discussion

In this population-based study linked with official educational data, sleep quality, and sleep quantity in late adolescence were associated with school dropout. There was an increased risk of school dropout among adolescents who fulfilled the criteria for insomnia or DSWP, and those who dropped out of school were characterized by poorer sleep across most sleep parameters, such as shorter sleep duration and lower sleep efficiency relative to those who completed school.

The present study is novel in investigating the association between sleep characteristics and objective school dropout data, and thus, comparison to previous studies is limited. However, it builds on previous evidence of the importance of sleep for other school-related outcomes, such as school performance[10] and school absenteeism,[6] all of which may be important steps in a line of events from school problems to school dropout. Insomnia, DSWP, short sleep duration, and social jetlag were precursors of school dropout in the present study; thus, there was a general risk across sleep measures, and we did not find support for more specific associations dependent on the type of sleep problem.

The mechanisms linking sleep to later school dropout were not specifically addressed in the current study. School dropout can be considered an endpoint of a gradual process, with school absenteeism and school underperformance as possible precursors. Sleep may be of importance in this process through a variety of mechanisms. For instance, delayed bedtime and oversleeping may give rise to school absenteeism, which again is related to school performance. Furthermore, sleepiness following short sleep duration and sleep problems may impact motivation and school performance.

The associations between sleep and school dropout were stable after adjusting for sex and socioeconomic status, indicating that the link between sleep and school dropout is similar, although the base rate of the risk factors differs. Thus, while type and rate of sleep problems differ for adolescent boys and girls, with girls on average reporting more insomnia and boys reporting shorter sleep duration,[14] and a social gradient of sleep problems has been demonstrated,[40] sex and SES do not account for the association between sleep problems and school dropout in the present study.

Strengths and limitations

A strength of the present study is the large sample with both comprehensive sleep measures and school dropout objectively measured by using a national registry with high-quality data. However, the results should be interpreted considering some limitations. We did not have a time frame for the symptoms of DSWP and, thus, not all diagnostic criteria. Furthermore, the measure of insomnia was based on a proxy for the disorder based on the diagnostic criteria and the duration. The functional outcomes are more limited in the current operationalization, which might have led to an underestimation of the rate of insomnia. We only have information on sleep at 1-time points in adolescence and cannot address how trajectories of sleep changes over time are related to school dropout in the current study; similarly, the mechanisms involved need further investigation. The original study was conducted in 2012, and a long follow-up is able to estimate the dropout rate. While we expect sleep to be important for school completion a decade later, there might be factors such as the pandemic that might have impacted these associations, and future studies investigating how to sleep during the pandemic years impact school dropout should be done in the future. Furthermore, there might be other changes such as the increase in social media and screen time that might both impact the rate of sleep problems and possibly also its effect on school completion that deserves investigation in the future. In addition, longer-term follow-ups can elucidate the more long-term consequences of poor sleep and school dropout on work-life participation in adulthood.

Implications for school and health personnel

The main implication from these findings is that sleep problems should be seen as 1 of many important risk factors for school dropout and may be a target for preventive interventions. Sleep should be an integrated part of the assessment when meeting

Table 3
Sleep characteristics of adolescents who have dropped out of secondary school compared to school completers. Estimated marginal means adjusted for sex and parental education.

	School completers	School noncompleters	*P* value	Cohen's d
SOL (h: min)	00:45	01:01	< 0.001	0.39
WASO (h: min)	00:12	00:28	< 0.001	0.45
Sleep duration weekdays (h: min)	06:33	05:49	< 0.001	0.28
Sleep efficiency weekdays (%)	86.7%	78.6%	< 0.001	0.47
Bedtime weekdays (h: min)	23:45	23:57	< 0.001	0.20
Risetime weekdays (h: min)	06:55	06:57	0.316	0.03
Sleep duration WWD (h: min)	02:12	02:26	0.003	0.15
Bedtime WWD (h: min)	02:26	02:49	< 0.001	0.17
Risetime WWD (h: min)	04:28	04:58	< 0.001	0.31
Social jetlag (h: min)	03:22	03:45	< 0.001	0.33
Social jetlag 4 h +	24.5%	38.3%	< 0.001	0.30[a]

SOL, sleep onset latency; WASO, wake after sleep onset; WWD, weekday-to-weekend difference.
[a] Cohen's h (effect size between two proportions).

adolescents who are at risk of school dropout.[41] Similarly, when health personnel meets adolescents with sleep problems, school absence and risk of school dropout should be included as an important outcome measure given the high individual and societal cost of not completing secondary education. On a systemic level, universal preventive interventions could be considered, and when evaluating these, school absence and school dropout are important outcomes. Based on the current literature, both delayed school time[42] and preventive school-based interventions[43] could be possible targets for interventions aiming to prevent school dropout.

Conclusion

The present study clearly suggests that sleep problems are related to a higher risk of dropout from upper secondary school. These findings underline the importance of preventive interventions in the school setting to improve sleep, and identify and offer evidence-based interventions for adolescents with sleep problems who are at risk of noncompletion.

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CRediT authorship contribution statement

All authors contributed to the design of the study and data collection. MH, BS, and KGA contributed to the analysis. MH drafted the manuscript. All the authors wrote and revised the manuscript, and all approved the final version.

Declaration of conflicts of interest

We have no conflicts of interest to declare.

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