

Sleep Disturbances, Psychosocial Difficulties, and Health Risk Behavior in 16,781 Dutch Adolescents



Sanne Verkooijen, PhD; Nelleke de Vos, Msc; Betty J.W. Bakker-Camu, Msc; Susan J.T. Branje, PhD; René S. Kahn, MD, PhD; Roel A. Ophoff, PhD; Carolien M. Plevier, Msc; Marco P.M. Boks, MD, PhD

From the Department of Psychiatry, Brain Center Rudolf Magnus, University Medical Center Utrecht (Drs Verkooijen, Kahn, Ophoff and Boks); Research Center Adolescent Development, Utrecht University (Dr Branje), Utrecht; Community Health Service Greater Utrecht Area (GGD Region Utrecht) (Drs de Vos, Bakker-Camu and Plevier), Zeist, The Netherlands; Department of Psychiatry, Icahn School of Medicine, Mount Sinai (Dr Kahn), New York, NY; and Center for Neurobehavioral Genetics, University of California (Dr Ophoff), Los Angeles, Calif

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Address correspondence to Sanne Verkooijen, PhD, Department of Psychiatry, Brain Center Rudolf Magnus, University Medical Center Utrecht, Heidelberglaan 100, P.O. Box 85500, 3508 GA, Utrecht, The Netherlands (e-mail: m.p.m.boks@umcutrecht.nl).

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ABSTRACT

OBJECTIVE: To investigate the prevalence of adolescent sleep disturbances and their relation to psychosocial difficulties and health risk behaviors with the use of data from a province-wide health survey (n = 16,781).

METHODS: Psychosocial difficulties were measured with the Strength and Difficulties Questionnaire. Additional assessments included self-reported sleep disturbances, suicidality, and health risk behaviors including current use of tobacco, alcohol, and drugs, physical inactivity, and compulsive use of multimedia. We used multilevel analyses to investigate the relationships, including differences, between boys and girls, as well as the mediating role of emotional problems.

RESULTS: Just under 20% of adolescents reported sleep disturbances in the previous month. These sleep disturbances were associated with psychosocial problems (odds ratio [OR], 6.42; $P < .001$), suicidality (OR, 3.90–4.14; $P < .001$), and all health risk behaviors (OR, 1.62–2.66; $P < .001$), but not with physical inactivity. We found moderation by gender for the relations

between sleep and suicide attempts (OR, 0.38; $P < .002$) and between sleep and cannabis use (OR, 0.52; $P = .002$), indicating attenuated relationships in girls compared with boys. Emotional problems partially mediated the relationships between sleep disturbances and multimedia use.

CONCLUSIONS: This study reiterates the high prevalence of sleep disturbances during adolescence. These sleep disturbances were strongly related to psychosocial problems and a wide range of health risk behaviors. Although the direction of causality cannot be inferred, this study emphasizes the need for awareness of impaired sleep in adolescents. Moreover, the gender differences in associated suicide attempts and cannabis use call for further research into tailored intervention strategies.

KEYWORDS: adolescents; health risk behavior; psychosocial problems; sleep

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WHAT'S NEW

Aside from confirming strong associations between adolescent sleep disturbances, psychosocial difficulties, and health risk behavior, this is the first study to show a gender difference in the relationship between sleep disturbances, attempted suicide, and cannabis use.

ALTERATIONS IN SLEEP-WAKE pattern are among the many developmental changes that occur during adolescence. Several studies report that adolescents have an increased need for sleep. The average adolescent requires ~9 hours of sleep per night.¹ However, it is also generally accepted that this age group is specifically vulnerable for experiencing sleep disturbances. Data from the Youth Risk Behavior Surveillance System showed that only 27.3% of American students in grades 9–12 attained ≥ 8 hours of sleep per night, which, according to the American Academy of Pediatrics, is the required sleep duration for teenagers 13–

18 years of age.^{2,3} Moreover, prevalence rates of insomnia range from 4% to 24%.^{4–6}

Impaired sleep in adolescents is associated with a wide range of psychosocial problems and general health issues. Adolescents who report sleep disturbances have increased risks for depressed mood, anxiety disorders, and suicide attempts.^{7–9} Moreover, a recent prospective study found that insufficient sleep in the preschool and early school years is associated with psychosocial difficulties in mid-childhood.¹⁰ Lack of sleep is also associated with a wide range of health risk behaviors, such as increased substance use, electronic multimedia use, and physical inactivity.^{11–13} Because these health risk behaviors frequently co-occur with emotional problems, the question remains whether the link between sleep disturbances and health risk behavior is (partly) mediated by emotional problems.¹⁴

In addition to the role of emotional problems, another important modifier is gender. Whereas the relationship between sleep and psychosocial difficulties has gained increasing

attention, the presence of gender differences has remained largely unnoticed. However, evidence suggests that compared with boys, fewer girls attain the recommended 8 hours of sleep.² Girls have a higher incidence of sleep disturbances, a finding that most likely emerges after the onset of menses.⁴ Gender differences are also prevalent for psychosocial problems and health risk behaviors. Boys more frequently report the use of drugs, excessive multimedia, and tobacco, whereas girls have a higher incidence of suicidal behavior.^{2,15} Therefore, to adequately assess the sleep disturbances in adolescents and their relationship with psychosocial problems and health risk behaviors, it is necessary to investigate gender differences to refine these relationships per gender.

The present study investigated the prevalence of sleep disturbances in a large sample of secondary school adolescents in the Netherlands. We examined the associations among reported sleep disturbances, psychosocial difficulties, and health risk behaviors including substance use, physical inactivity, and compulsive multimedia use. We subsequently assessed differences in these relationships between boys and girls and investigated the potential mediating role of emotional problems.

METHODS

SAMPLE

This study used data from a Youth Health Care questionnaire by the Dutch Community Health Service of the greater Utrecht area. This area, located in the central part of the country, contains both urban and rural communities, and 76.7% of the 12–18-year-olds in the area are native Dutch.

In the Netherlands, children around age 12 change from primary to secondary school. Based on their academic levels, students enter 1 of 4 different educational attainment levels: prevocational, higher prevocational, higher secondary, and preuniversity. Schools can offer 1 or more of these 4 educational attainment levels.

The primary aim of the Youth Health Care questionnaire was to identify 2nd- and 4th-year students at risk for developing psychosocial and general health problems to provide follow-up from a Community Health Service nurse if needed. Dutch 2nd-year students are ~13 years old, similar to the 2nd year of middle school in the American school system. Fourth-year students are ~15 years old, similar to sophomores in American high schools.

All participating schools were provided with a digital health check questionnaire, which students completed in school under the supervision of a teacher. Participation was not mandatory. We used anonymized data that were acquired in the academic year of 2014–2015. A total of 9,535 2nd-year students and 9,747 4th-year students from 55 schools were invited to participate in the survey. The response rate for 2nd-year students was 91% and for 4th-year students 83%. Reasons for not participating were refusal by the student or their parents or absence due to illness, doctor visits, or internships. In 3 schools, data were available for only a small selection of students, because screening for

Table 1. Sample Characteristics (n = 16,781)

Characteristic	n (%)
Age, y	
12	110 (0.7%)
13	4660 (27.8)
14	3740 (22.3%)
15	4366 (26.0%)
16	3238 (19.3%)
17	631 (3.8%)
18	36 (0.2%)
Male gender	8479 (50.5%)
Level of education	
Prevocational	1686 (10.0%)
Higher prevocational	4455 (26.5%)
Higher secondary	5994 (35.7%)
Preuniversity	4642 (27.7%)
2nd year of education (vs 4th)	8666 (51.6%)
Dutch ethnicity	15,306 (91.2%)
Sleep disturbances	3337 (19.9%)
Clinical SDQ score	1539 (9.2%)
Emotional problems subscale	1290 (7.7%)
Suicide attempt	144 (0.9%)
Suicidal ideation	1766 (10.5%)
Current smokers	1180 (7.0%)
Energy drinks (daily)	190 (1.1%)
Alcohol (past 4 wk)	3035 (18.1%)
Cannabis (past 4 wk)	438 (2.6%)
Hard drugs (ever)	142 (0.8%)
Physical inactivity (Dutch guidelines)	10,992 (65.5%)
Physical inactivity (<1 h/wk)	123 (0.7%)
Compulsive social media use	4008 (23.9%)
Compulsive gaming	2636 (15.1%)

SDQ indicates Strengths and Difficulties Questionnaire.

health difficulties was done face to face. Data from those schools were excluded from further analyses (n = 22). The remaining 53 schools represented 82.8% of all schools in the greater Utrecht area, with an average of 418 included students per school (range, 63–616). In 22 schools, face-to-face screening was preferred over questionnaires for prevocational-level students. Data from those schools included only higher prevocational, higher secondary, and preuniversity students. This resulted in a relative underrepresentation of prevocational students as 10% of the total sample (Table 1).

MEASURES

SLEEP DISTURBANCES

We determined the presence of sleep disturbances with the question “In the past 4 weeks, how often did you experience trouble sleeping?” which was answered with “never,” “almost never,” “sometimes,” “often,” or “very often.” This question was dichotomized into (almost) never/sometimes versus (very) often.

STRENGTHS AND DIFFICULTIES QUESTIONNAIRE

We assessed the presence of psychosocial problems with the self-report version of the Strength and Difficulties Questionnaire (SDQ).¹⁶ This behavioral screening measure was originally designed for children of ages 11–16, although

research also proved its construct validity in a wider age range (10–19 y).¹⁷ It encompasses 25 items, all answered on a 3-point scale of “not true,” “somewhat true,” or “certainly true.” The items are divided into 5 subscales: emotional problems, behavioral problems, hyperactivity-inattention, peer problems, and prosocial behavior, of which the first 4 subscales are summed to generate a total difficulties score. To aid clinical interpretation of the results, we used validated categorization of the questionnaire into “normal,” “borderline,” and “clinical”¹⁶ and focused on clinical outcomes relative to normal and borderline. Validation of the Dutch version of the SDQ indicated that the total difficulties score has sufficient internal consistency ($\alpha = 0.70$ – 0.78). The emotional problems subscale, which was used as mediator, was found to have similar sufficient internal consistency ($\alpha = 0.63$ – 0.71).^{18,19}

SUICIDALITY

Suicidal ideation was assessed with the question “In the previous year, have you seriously considered ending your own life?” Students rated this question on a 5-point scale (“never,” “once or twice,” “sometimes,” “often,” or “very often”). We dichotomized suicidal ideation into present versus absent. Suicide attempts were assessed with the question “In the previous year, have you tried to commit suicide?” to which either “yes” or “no” was answered.

HEALTH RISK BEHAVIORS

A short version of the Compulsive Internet Use Scale (CIUS)²⁰ was used to inquire about compulsive use of social media and games. All 6 questions were answered on a 5-point scale ranging from “never” to “very often” and provided information regarding risky behavior, including the inability to spend less time using multimedia, whether multimedia use was preferred over face-to-face contact, whether it affected their mood, and if homework was neglected owing to multimedia use. Average scores of ≥ 3 are indicative of compulsive use of social media and games.

In addition, use of the following substances was examined: current use of tobacco, daily consumption of energy drinks, use of alcohol and cannabis in the past 4 weeks, and life-time use of drugs other than cannabis (hard drugs). Finally, we inquired how many days the respondent was physically active for at least an hour in the previous week. This resulted in 2 activity variables. First, following the Dutch guidelines for moderate physical activity,²¹ students were rated as inactive when they were not physically active for at least 1 hour on a daily basis. For the 2nd activity variable, we rated students as inactive when they were not physically active for an hour on any of the previous 7 days.

STATISTICAL ANALYSES

All analyses were performed using R statistical software²² and SPSS 23.0. We had 14 missing values for the sleep disturbances questionnaire, 82 for the SDQ, 55 for suicidality, and 8–115 for the various health risk behaviors. All missing

data were deleted listwise, resulting in 0.3–1% of dropped cases per analysis. Differences in characteristics between adolescents with and without reported sleep disturbances were analysed by means of Mann-Whitney *U* rank sum test. The associations between sleep disturbances and psychosocial difficulties were analyzed with the use of multilevel logistic regression analyses with total SDQ score and suicidality as dependent variables and sleep disturbance as independent variable. School and year were added as random factors to account for the possibility of a nested structure of the data (ie, data nested within school and within year). Similarly, the associations between sleep disturbances and health risk behaviors were analyzed with the use of separate multilevel logistic regression analyses for all types of health risk behavior as dependent variables and sleep disturbance as independent variable.

For all health risk behavior measures that were significantly associated with sleep disturbance, we investigated whether emotional problems mediated this relationship. Because both the mediator (emotional problems) and the outcome (health risk behaviors) were dichotomous variables, we used a method based on the analyses of Mackinnon and Dwyer.²³ To account for the fact that predictor and outcome variables have different scales in logistic regression, we standardized the coefficients (for details see Supplemental Materials). To test whether the indirect effect of emotional problems on health risk behavior was significantly different from 0, we calculated Sobel *Z*. In case of significant mediation, we reported the corresponding proportion mediated.

Finally, the interaction between sleep disturbance and gender was tested by adding an interaction term for sleep disturbance \times gender to the previous psychosocial and health risk regression analyses. In case of significant interaction terms, stratified analyses by gender were performed.

To adjust for age, gender, and educational level, we added these variables as covariates to all regression analyses. Bonferroni-corrected *P* value was set at .0045 to adjust for the separate analyses of psychosocial difficulties and health risk behaviors.

RESULTS

SAMPLE CHARACTERISTICS

Table 1 presents the characteristics of the complete sample, which consisted of 8479 boys (50.5%) and 8302 girls (49.5%). Age ranged from 12 to 18 years, with a mean age of 14.5 ± 1.2 years. About one-half of the students ($n = 8666$; 51.6%) attended the 2nd year of secondary education and 8112 students (48.3%) attended the 4th year. In total, 3337 adolescents (19.9%) reported sleep disturbances. Age, grade, and ethnicity did not differ between adolescents with and without sleep disturbances ($U = 22204789.0$, $P = .40$; $U = 22252384.0$, $P = .49$; and $U = 21837543.5$, $P = .31$), but significantly more girls reported sleep disturbances compared with boys ($U = 19120672.0$; $P < .001$). Also, level of education differed between the 2 groups, with more sleep-disturbed adolescents in lower educational levels ($U = 20615952.5$; $P < .001$).

Table 2. Association Between Sleep Disturbances, Clinical SDQ Score and Suicidality, n (%)

Variable	Sleep Disturbances (n = 3,337)	No Sleep Disturbances (n = 13,430)	OR	95% CI	P Value
Clinical SDQ score	848 (25.4%)	689 (5.1%)	6.42	5.32–7.76	<.001*
Suicide attempt	88 (2.6%)	56 (0.4%)	4.14	2.97–5.77	<.001*
Suicidal ideation	817 (24.5%)	949 (7.1%)	3.90	3.51–4.33	<.001*

Age, gender, and level of education were added as covariates and school and year as random factors (with no sleep disturbances as reference category). OR indicates odds ratio; CI, confidence interval; SDQ, Strengths and Difficulties Questionnaire.

*Significant at Bonferroni-corrected *P* value of .0045.

ASSOCIATION BETWEEN SLEEP DISTURBANCES AND PSYCHOSOCIAL PROBLEMS

Table 2 presents a summary of the multilevel logistic regression analyses of the associations between sleep disturbances and psychosocial difficulties. We found that the presence of sleep disturbances was associated with a borderline-clinical score on the SDQ, as well as previous suicide attempts and suicidal ideation.

ASSOCIATION BETWEEN SLEEP DISTURBANCES AND HEALTH RISK BEHAVIOR

Table 3 presents the results of the multilevel logistic regression analyses testing the association between sleep disturbances and health risk behaviors. Except for physical inactivity, all measures of health risk behavior were related to sleep disturbances. Analyzing no days of physical activity versus at least 1 day of physical activity, we found that sleep disturbances were related to physical inactivity with an odds ratio (OR) of 1.45 (95% confidence interval [CI], 1.02–2.05) and *P* = .036. However, this *P* value did not

exceed the Bonferroni-corrected *P* value of .0045. The emotional problems subscale was a significant mediator in all health risk behaviors, although it survived corrections for multiple testing only in the relationship between sleep disturbances and compulsive use of social media and gaming (Table 4). Given that the direct effect (*c'*) remained significant in both the relationship between sleep disturbances and compulsive use of social media and compulsive gaming, emotional problems were considered to be a partial mediator (Figs. 1 and 2).

GENDER DIFFERENCES

The interaction term sleep disturbances × gender had a significant relationship to suicide attempts (OR, −0.96; *P* < .001) and cannabis use (OR, −0.65; *P* < .001). Stratified analyses (Fig. 3A) further showed that the association between sleep disturbances and suicide attempts was more pronounced for girls (OR, 5.71 [95% CI, 3.78–8.63]; *P* < .001) than for boys (OR, 2.32 [1.47–3.65]; *P* < .001). In addition, we found that girls with sleep disturbances more often reported cannabis use (OR, 3.66 [2.67–5.02]; *P* < .001)

Table 3. Association Between Sleep Disturbances and Health Risk Behaviors

Health Risk Behavior	Sleep Disturbances (n = 3,337)	No Sleep Disturbances (n = 13,430)	OR	95% CI	P Value
Current smoker	396 (11.9%)	784 (5.8%)	2.13	1.85–2.44	<.001*
Energy drinks (daily)	66 (2.0%)	124 (0.9%)	1.95	1.48–2.56	<.001*
Alcohol (past 4 wk)	780 (23.4%)	2255 (16.8%)	1.62	1.45–1.80	<.001*
Cannabis (past 4 wk)	166 (5.0%)	272 (2.0%)	2.42	1.96–2.98	<.001*
Hard drugs (ever)	66 (2.0%)	76 (0.6%)	2.66	1.92–3.69	<.001*
Physical inactivity	2189 (65.6%)	8802 (65.5%)	1.02	0.94–1.11	.578
Compulsive social media use	1281 (38.4%)	2726 (20.3%)	2.20	2.02–2.40	<.001*
Compulsive gaming	628 (18.8%)	1908 (14.2%)	2.16	1.92–2.42	<.001*

Age, gender, and level of education were added as covariates and school and grade as random factors (no sleep disturbances as reference category). Abbreviations as in Table 2.

*Significant at Bonferroni-corrected *P* value of .0045.

Table 4. Mediation Effect of Emotional Problems on Health Risk Behaviors

Health Risk Behavior	Mediated Effect	Sobel Z	P Value	Proportion Mediated
Current smoker	0.01	2.35	.02	...
Energy drinks (daily)	0.03	2.10	.04	...
Alcohol (past 4 wk)	0.00	−0.39	.69	...
Cannabis (past 4 wk)	0.04	2.16	.03	...
Hard drugs (ever)	0.02	3.06	.002	...
Physical inactivity†
Compulsive social media use	0.03	10.80	<.001*	0.24
Compulsive gaming	0.04	4.68	<.001*	0.16

*Significant at Bonferroni-corrected *P* value of .0045.

†Mediation analysis was not performed for physical inactivity, because it was unrelated to sleep disturbances.

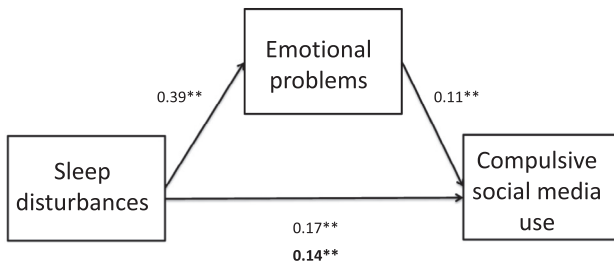


Figure 1. Standardized coefficients showing the association between sleep disturbances and compulsive social media use, mediated by emotional problems. Value for indirect path (c') in bold. **P < .001.

compared with boys (OR, 1.93 [1.50–2.47]; P < .001; Fig. 1B).

DISCUSSION

In this large sample of Dutch secondary school adolescents (n = 16,781) we found a prevalence of sleep disturbances of just under 20%. Sleep disturbances were associated with psychosocial difficulties and suicidality, with girls showing a stronger relationship between sleep disturbances and suicide attempts compared with boys. Furthermore, sleep disturbances were related to nearly all assessed health risk behaviors, including the use of substances (ie, alcohol, tobacco, cannabis, and other illicit drugs) and compulsive multimedia use. We found that girls who

reported sleep disturbances more likely used cannabis compared with boys.

The incidence of sleep disturbances corroborates previous studies that estimated the prevalence of adolescent sleep disturbances to be 7%–36%.²⁴ Similarly, a nationwide survey of students in the United States (Youth Risk Behavior Surveillance) found that only 27.3% of students in grades 9–12 attained ≥8 hours of sleep, with an even lower prevalence in girls than in boys.² This age-dependent vulnerability for sleep disturbance is thought to originate from a multitude of interacting factors. For one, the preferred bedtime delays markedly during the early teen years.²⁵ However, because the majority of school times follow strict morning schedules, total sleep time is reduced significantly during weekdays. To compensate for the acquired “sleep debt,” adolescents often increase the total sleep time and delay their bedtimes during weekends, thereby shifting their sleep pattern, which increases subsequent difficulties initiating and maintaining sleep during the following weekdays.¹ These delayed sleep patterns have been linked to circadian phase delays, such as self-report phase preference and delayed dim-light melatonin onset.²⁶ This problem is compounded by developmental and psychosocial changes that accompany adolescence (ie, increased late-night social activities, screen time, and preferred autonomy regarding bedtimes) and further aggravates the disruptions of the sleep-wake pattern.²⁶

We showed that the presence of sleep disturbances is strongly associated with psychosocial difficulties and suicidality. These results are consistent with various studies that report on the relationships between adolescent sleep, mood, and anxiety disorders and suicidal behavior.^{7–9} Possibly, these disorders result from impaired emotion regulation that follows sleep disturbances. Indeed, a recent study found that impaired emotion regulation strategies (such as decreased problem solving, suppression, and rumination) mediated the relation between sleep disturbances and both anxiety and mood disorders.²⁷ We also showed that sleep disturbances are related to several health risk behaviors. A possible explanation lies in the impaired inhibition and emotion regulation that accompany sleep disturbances and fatigue,

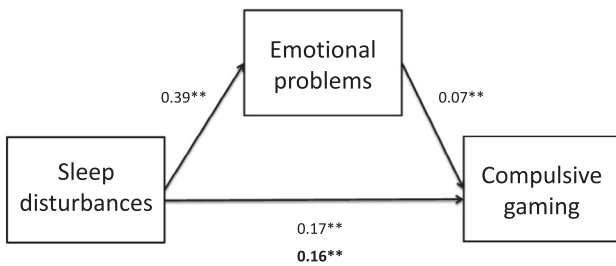


Figure 2. Standardized coefficients showing the association between sleep disturbances and compulsive gaming, mediated by emotional problems. Value for indirect path (c') in bold. **P < .001.

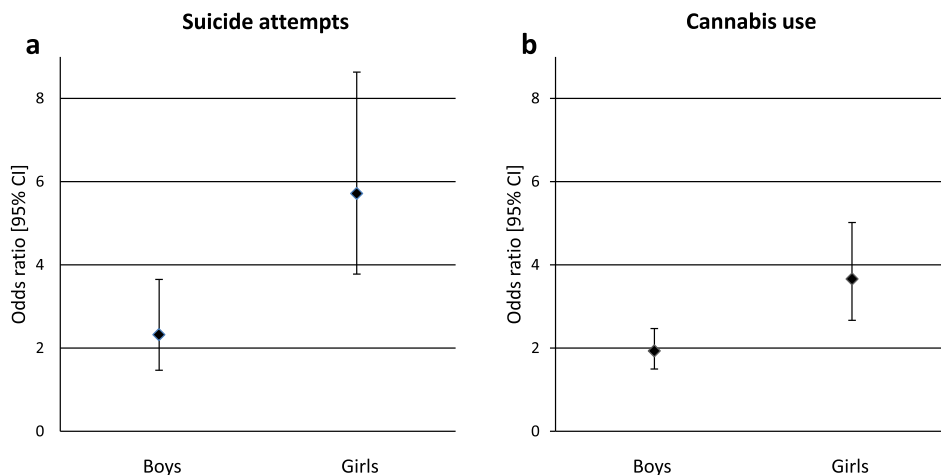


Figure 3. The relationships between sleep disturbance and (a) suicide attempts and (b) cannabis use, separately displayed for boys and girls. CI indicates confidence interval.

resulting in increased engagement in health risk behaviors.²⁸ Our study is one the first to show gender differences in the relationships between sleep disturbances, psychosocial difficulties, and health risk behaviors. These results may indicate that girls are more severely affected by sleep disturbances compared with boys. However, the opposite could also be true; perhaps girls are more vulnerable to the disruptive effects that health risk behaviors (such as use of cannabis) can have on sleep. Our results warrant further studies of gender differences in these relationships in an adolescent population.

We found that emotional problems partly mediate the relationship between sleep disturbance and compulsive use of multimedia and gaming. However emotional problems do not entirely explain this relationship. Sleep disturbances were still associated with a 2-fold increased risk for these health risk behaviors after adjustment for emotional problems. Also, emotional problems did not mediate the relationship between sleep disturbance and substance use. These results are consistent with suggestions that sleep disturbance in itself may lead to increased health risk behaviors.²⁹ Although the underlying mechanism for this relation remains elusive, a study by Gujar et al³⁰ found that sleep-deprived individuals show an amplified reactivity in the mesolimbic network after being exposed to pleasure-invoking stimuli, suggesting that sleep-deprived adolescents are more susceptible to an experience of reward following health risk behaviors.

Of note is that our cross-sectional design limits inferences of causality, so it is also possible that the health risk behaviors may have (partially) caused the reported sleep disturbances. The excessive use of electronic media and the daily consumption of energy drinks are particular factors that predispose to impaired sleep.³¹ Another limitation of this study concerns the fact that we inquired about sleep disturbances with 1 question (ie, whether respondents had trouble sleeping). Although this is the most prominent symptom of a diagnosis of insomnia, we were not able to separate specific sleep impairments (eg, difficulties initiating versus maintaining sleep), nor were we able to determine the validity of this measure compared with previous studies in adolescents that used multiquestion assessments of sleep disturbances.³² Furthermore, the time frame for the assessment of suicidality (previous year) and hard drugs (lifetime) was longer than the time frame used for the assessment of sleep disturbances (previous 4 weeks). Therefore, the possibility exists that in some individuals these behaviors did not coincide. Also, it is possible that the self-report nature of the study led to biased responses. However, a comparison between survey, sleep diary, and actigraphy measures showed that in adolescents these methods corresponded with medium to large correlations, supporting the validity of self-reported sleep estimates.³³ Another limitation comes from the fact that several schools did not include lower-level students, and without data from adolescents not participating in the survey, we were unable to examine whether nonresponse was in any way selective, for example, regarding socioeconomic status. At the same time, the large sample and 82.8% coverage of the greater Utrecht area does not suggest selection bias. The question does remain whether our results generalize to other countries outside the Netherlands.

In conclusion, we found evidence for strong associations between sleep disturbances and psychosocial problems. Moreover, we found that these sleep disturbances were related to an increased risk for health risk behaviors that could only partially be explained by the presence of emotional problems. The increased prevalence of both psychosocial problems and health risk behaviors warrant special attention from parents and school health care staff when sleep disturbances are reported by adolescents. This study is one of the first to identify gender differences in the association between sleep disturbances and mental health measures, and more research is warranted to determine tailored strategies for prevention and treatment of sleep disturbances in boys and girls.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at <https://doi.org/10.1016/j.acap.2018.03.003>.

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