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Adolescents' sleep quality in relation to peer, family and school factors: findings from the 2017/2018 HBSC study in Flanders

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Abstract

Purpose While a multitude of studies focused on biological and behavioral determinants of adolescents' sleep quality, a paucity of research examined the impact of social factors. The current study therefore examines the relationship between adolescents' sleep quality and peer, family and school factors.

Methods Data of Flemish participants in the 2017/2018 Health Behavior in School-aged Children survey (HBSC) were used, which is representative of the adolescent population (11–18 years) in Flanders. Adolescents' sleep quality was linked to individual-level data on peer relationships (i.e., peer support), family relationships (i.e., family support, perceived family wealth, caregiving responsibilities) and school relationships (i.e., teacher support, school support, school pressure) and contextual-level data on the school culture. Three-level multilevel models were fitted to account for the clustering of individuals ($N=8153$) within classes ($N=769$) and classes within schools ($N=177$).

Results The individual-level results indicated that adolescents' sleep quality was positively related to family support, teacher support, student support and perceived family wealth. In contrast, adolescents' sleep quality was negatively related to caregiving responsibilities and school pressure. In addition, the contextual-level results pointed out that adolescents tended to report better sleep quality in less-demanding schools.

Conclusion These findings highlight the need to consider social factors in promoting better sleep in adolescence.

Keywords Sleep · Social factors · HBSC · Multilevel analysis

Introduction

Over the past decade, there has been a growing recognition of the importance of sleep for adolescents' physical and mental health [1, 2]. Poor sleep quality has been associated with obesity and malnutrition [3], elevated blood pressure [4], chronic inflammation [5], substance abuse [6], impairments in emotional competence [7, 8] and mental health issues [9, 10]. In addition, many studies have demonstrated a relationship between sleep difficulties and poor school performance [11].

Given these adverse effects on adolescents' wellbeing, it is critical to gain an improved understanding of the factors contributing to poor sleep. To date, medical researchers have attributed the decrease in sleep quality in adolescence to the decline in the nocturnal secretion of melatonin, a sleep-inducing hormone [12]. Public health scientists for their part have repeatedly shown that excessive screen viewing, sedentary behavior, physical inactivity and caffeine use undermine sleep quality in adolescence [13, 14]. Furthermore, growing

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evidence shows that delays in school start times positively impact adolescent sleep [15, 16], while stress and anxiety have been found to contribute to sleep difficulties [17]. In contrast, relatively little is known about the social determinants of adolescents' sleep quality. This is unfortunate since many studies have noted that other health behaviors and health outcomes are strongly embedded in social structures [18, 19].

The *peer group, the family and the school* are among the most critical settings in which adolescents reside and to which they are exposed [20]. Accordingly, these contexts all have the potential to impact young people's wellbeing, for better or for worse. While a large body of work exists on the impact of peer, family and school relationships on a wide range of health behaviors and health outcomes, such as drinking frequency [21], overall health [22] and mental health [23, 24], there is a paucity of research on their relation to adolescents' sleep. Among the few studies that did address this issue, Maume [2] has shown that supportive social ties to family, peers and schools have a greater influence on adolescents' sleep habits than do biological factors (i.e., going through puberty). In addition, Schmeer and colleagues [25] have demonstrated that family stressors significantly relate to less sleep among adolescents.

In the current study, we aim to extend the work of these authors by simultaneously examining the relation of peer, family and school factors to adolescents' sleep quality. With regard to *peer factors*, we expect perceived support from friends to be positively related to sleep quality. In addition, we hypothesize that *family factors* such as parental support, perceived family wealth and the absence of caregiving responsibilities are associated with better sleep quality in adolescence. With regard to *school factors*, we develop expectations for both their individual (i.e., within-school associations) and contextual influences (i.e., between-school associations). This is in agreement with previous studies describing that school culture additionally yields contextual effects on pupils' health, over and above individual school experiences [26, 27]. For instance, Torsheim and Wold [27] have shown that academic stress at the class level has an impact on pupils' health complaints, irrespective of the importance of individual-level perceptions of academic stress. Along the same line, we expect that student support, teacher support and low degrees of school pressure relate to adolescents' sleep quality through both individual and contextual-level processes.

Methods

Study participants and design

Data from Flemish pupils participating in the 2017/2018 Health Behavior in School-aged Children survey (HBSC) were used. The Flemish sample was collected and surveyed in accordance with the international research protocol [28]. Cluster probability sampling was used to select pupils, with school classes as the primary sampling unit. The pupils were then surveyed by means of standardized questionnaires that needed to be completed under supervised conditions in the classroom. Informed consent was obtained from parents of all participating pupils and the study design was approved by the Ethics Committee of the University Hospital Ghent (EC UZG 2013/1145).

In total, 194 Flemish schools participated in the study (response rate = 21.6%), representing 817 classes and 11,035 pupils (response rate = 72.2%). The pupils were highly representative of the adolescent population in primary (fifth and sixth grade; ± 11–12 years old) and secondary schools (grade one to six; ± 13–18 years old) due to the strict sampling methodology that was used. The analysis excluded schools with fewer than 10 pupils to safeguard the validity of contextual effects (0.5%). In addition, we removed pupils with missing values on the variables of interest (the proportion of missing values per variable varied from 0.8% to 8.1%). These restrictions resulted in a final sample of 8153 adolescents spread across 177 schools.

Individual-level measures

The dependent variable

Adolescents' *sleep quality* was assessed using a 5-item scale. Each item asked the respondents to evaluate a statement concerning sleep quality in the past school week (Sunday to Thursday): 'I feel that I slept poorly', 'It took me more than half an hour to fall asleep, 'I feel that I didn't get enough sleep', 'After I woke up, I had trouble falling asleep again' and 'I felt rested after waking up in the morning' (Cronbach's $\alpha = 0.71$). These items were retrieved from the Groningen Sleep Quality Scale [29] and were scored on a 5-point Likert basis ranging from 'never' to 'always'. The item scores were scaled in the same direction (i.e., higher scores indicating a better sleep quality) and mean scores were calculated for respondents with at least three valid answers.

The independent variables

The variables **at the individual level** include peer support, family support, perceived family wealth, caregiving responsibilities, teacher support, student support and school pressure. *Peer support* was assessed by the average of 4 items: 'My friends really try to help me', 'I can count on my friends when things go wrong', 'I have friends with whom I can share my joys and sorrows', 'I can talk about my problems with my friends' (Cronbach's $\alpha = 0.92$). Answers were given

on a 7-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. *Family support* consisted of the average score on 4 items: 'My family tries to help', 'I get emotional help from my family', 'I can talk about problems with my family', 'My family helps me with my decisions' (Cronbach's α = 0.94). Answers were again recorded on a 7-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. *Perceived family wealth* was measured by asking 'How well off do you think your family is?', with five ordinal responses going from 'not at all well off' to 'very well of'. *Caregiving responsibilities* was assessed by 4 items from the Young Carer of Parents Inventory (YCOPI-A) [30]: 'I sometimes miss school because I have to help a household member', 'I sometimes feel tired at school because I have been helping a household member', 'Because of helping a household member, I sometimes feel too tired or too busy to study', 'Helping a household member stops me from doing paid work' (Cronbach's α = 0.83). For each item, 5 response options were provided, going from 'strongly disagree' to 'strongly agree'. The item scores were then averaged, so that higher scores reflect stronger interference of caregiving responsibilities with school and work. *Teacher support* was defined as the mean score of the following items: 'I feel that my teachers accept me as I am', 'I feel that my teachers care about me as a person', 'I feel a lot of trust in my teachers' (Cronbach's α = 0.87). Answers were given on a 5-point Likert scale, with higher scores indicating more perceived support from teachers. *Student support* consisted of the average score on 3 items: 'The students in my class enjoy being together', 'Most of the students in my class are kind and helpful', 'Other students accept me as I am'. (Cronbach's α = 0.77). Response options were similar to those for teacher support. Finally, *school pressure* was measured by a single item, with answers ranging from 1 ('Not at all') to 4 ('A lot).

Individual-level control variables included *sex* (boy = reference category), *age* (measured continuously in years), *age-by-sex* interaction, *parental education* as a social class indicator (measured as the highest educational level completed by the pupil's father or mother; tertiary educated = reference category), *ethnicity* (born in Belgium = reference category), *family structure* ('intact family' was selected as the reference category and was opposed to 'lone-parent family', 'stepfamily' and 'non-parental family') and *siblings living at home* (yes = reference category). In addition, we controlled for other covariates including, *alcohol use* in the last 30 days (measured continuously, ranging from 0 to 30 days), *smoking* in the last 30 days (measured continuously, ranging from 0 to 30 days), *screen time* (measured continuously, indicating the average overall amount of screen time per day [i.e., TV use, computer use and game playing]) and *physical activity* in the past 7 days (measured continuously, indicating the number of days with at least 60 min of physical activity). These covariates measured behavioral factors that have been shown to influence adolescents' sleep quality [13, 14]. Finally, we controlled for *self-perceived health* (measured continuously, with higher scores indicating better health) to absorb some of the effects of ill-health states on adolescents' sleep quality [31, 32].

Contextual-level measures

Three different variables are defined **at the school level:** culture of teacher support, culture of student support and the level of academic demand. These variables were calculated using a manifest aggregation strategy [33]. That is, for each school, we estimated the observed mean score of individual perceptions of teacher support, student support and school pressure, respectively. While manifest multilevel regression models do not account for sampling error [34], they are likely to perform well in case of moderate to large within-group sampling ratios with small to moderate group sizes [35] – which is typically the case in large-scale school surveys, such as the HBSC study. Moreover, we decided to apply a manifest aggregation strategy, as estimations of the 'mean rater reliability' revealed high reliability of class-mean ratings. The mean rater reliability [36] is based on the intra-class correlation (ICC) in a one-way analysis of variance. The ICC was defined as the [(Between Mean Square – Within Mean Square) / Between Mean Square]). For all three measures, the ICC exceeded the threshold of 0.60 (teacher support: 0.91, student support 0.84 and school pressure: 0.91 at school level), indicating that the class-mean ratings closely reflect the true value of the group-level variables being measured.

Statistical analyses

Three-level multilevel analysis was performed to account for the nesting structure of the data: students ($N_i = 8153$) were clustered within classes ($N_j = 769$), which in turn were clustered within schools ($N_k = 177$). We included fixed effects (FEs) and random effects (REs) at both the student and school level, while we specified only REs at the classroom level. We adhered to Schmidt-Catran and Fairbrother's [37] recommendation to "include REs at all potentially relevant levels, even if there are no FEs included at that level" (p.34) by accounting for REs at the classroom level. The models were estimated in RStudio version 3.5.2 (using the lme4 package) and were fitted with the Restricted Maximum Likelihood (REML) procedure. Statistical significance was set at alpha 0.05.

We estimated four models. The first model, the baseline model, included only the control variables. The variables related to peer, family and school factors were entered in

the second, third and fourth model, respectively. Moreover, the school-related factors were added at both the individual level (*i*) and the school level (*k*). Individual-level school characteristics were group-mean centered and thus estimated within-school parameters, whereas school-level characteristics were grand-mean centered and thus estimated between-school parameters. Previous studies on school effects have used a similar approach (e.g., [27]). Apart from the school-related factors, other continuous variables at the individual level were all centered on the grand mean to aid interpretation. Finally, we presented for each model the BIC, AIC and -2LogLikelihood, which provided an indication of the overall goodness of the model fit, with lower scores indicating a better model.

Results

Descriptive statistics

Sample descriptive characteristics are shown in Table 1 and Table 2. As can be seen from Table 1, the final sample included 8153 adolescents, of which 53% were girls and with a mean age of 14 years (SD = 2). Furthermore, the mean sleep quality score was 3.29 and ranged from 1 (low quality) to 5 (high quality) across the full sample (SD = 0.8). Regarding the independent variables, it can be observed that adolescents generally reported relatively high levels of perceived support from peers ($\bar{x}$ = 5.61, SD = 1.45, range = 1–7), family ($\bar{x}$ = 5.78, SD = 1.51, range = 1–7), teachers ($\bar{x}$ = 3.88, SD = 0.93, range = 1–5) and students ($\bar{x}$ = 3.98, SD = 0.78, range = 1–5), average levels of perceived family wealth ($\bar{x}$ = 3.11, SD = 0.70, range = 1–5), relatively low levels of caregiving responsibilities ($\bar{x}$ = 1.63, SD = 0.80, range = 1–5) and average levels of school pressure ($\bar{x}$ = 2.20, SD = 0.87, range = 1–4). Table 2 shows that boys generally reported a better sleep quality than girls, except for the youngest age group.

Furthermore, Table 3 provides the Pearson correlation matrix of the continuous variables. As can be seen, sleep quality was positively related to peer support (r = 0.120), perceived family wealth (r = 0.238), family support (r = 0.143), teacher support (0.226), student support (r = 0.227), culture of teacher support (r = 0.156) and culture of student support (0.142). In contrast, sleep quality appeared to be negatively related to caregiving responsibilities (r = − 0.143), school pressure (r = − 0.282) and the level of academic demand (r = − 0.139).

In addition, according to the intra-class correlation coefficient (ICC), 5.2% of the variance in sleep quality was at the school level.

Multilevel results

Table 4 shows the results of the multilevel analysis. All models were controlled for adolescents' demographic characteristics and other relevant factors. The estimated coefficients of most of these variables were in line with theoretical expectations. As can be seen in Model 1 (Table 4), a better sleep quality was related to better self-perceived health, less alcohol use and smoking, less screen time and more physical activity. In addition, sleep quality deteriorated with aging, particularly among girls. We also noticed that adolescents who had siblings living at home reported worse sleep quality compared to adolescents without siblings living at home. Finally, family structure was significantly related to sleep quality: adolescents from intact families experienced better sleep than adolescents from either lone-parent families, stepfamilies or non-parental families. These differences in sleep quality between family structures, however, were accounted for by the variables that were entered in Model 2 to Model 4 (i.e., the variables that refer to peer, family and school perceptions).

Model 2 revealed that social support from peers was positively associated with better sleep quality among adolescents (b = 0.051; SD = 0.007); however, this association disappeared once school-related variables were considered (Model 4). Furthermore, Model 3 provided evidence of the importance of family relationships for the sleep quality of young individuals. First, the results indicated that adolescents tended to report better sleep quality when they had positive perceptions of their family wealth (b = 0.083; SD = 0.012). Second, we observed a significant relationship between family support and sleep quality: adolescents who experienced more support from their family were more likely to enjoy better sleep (b = 0.066; SD = 0.006). Third, we found that the interference of caregiving responsibilities with adolescents' school and work was negatively related to their sleep quality (b = − 0.094; SD = 0.011).

Model 4 highlighted the contribution of school-related factors to adolescents' sleep quality. At the individual level, all three *within*-school associations were significant and in the expected direction. We found that adolescents who perceived more teacher support (b = 0.090; SD = 0.012), more student support (b = 0.060; SD = 0.011) and less school pressure (b = − 0.175; SD = 0.011) than their schoolmates tended to report better sleep quality. Finally, we observed a positive *between*-school relationship between sleep quality and one contextual factor. That is, adolescents generally experienced worse sleep in schools with more demanding academic programs as opposed to schools with less-demanding standards (b = − 0.218; SD = 0.045). In contrast, the contextual effects of teacher support and student support were not significant.

To conclude, we estimated how much of the variance in sleep quality was explained by each set of variables.

Table 1 Descriptive statistics across the full Flemish sample ($N = 8153$)

Continuous variables	Range	Mean	SD
Individual level			
Sleep quality	1–5	3.29	0.83
Age	7–23	14	2
Self-perceived health	0–3	2.04	0.67
Alcohol consumption	1–7	1.71	1.20
Smoking	1–7	1.30	1.15
Screen time	0–21	6.91	4.18
Physical activity	0–7	4.19	2.01
Peer support	1–7	5.61	1.45
Perceived family wealth	1–5	3.11	0.70
Family support	1–7	5.78	1.51
Caregiving responsibilities	1–5	1.63	0.80
Teacher support	1–5	3.88	0.93
Student support	1–5	3.98	0.78
School pressure	1–4	2.20	0.87
School level			
Culture of teacher support	3–5	3.87	0.42
Culture of student support	3–5	3.98	0.25
The level of demand	1–4	2.21	0.37
Categorical variables		%	*N*
Individual level			
Sex (boy)		46.6	3800
Parental education			
No education		0.8	67
Primary education		2.4	198
Secondary education		26.9	2194
Tertiary education		65.6	5347
Educational level unknown		4.3	347
Born in country (yes)		91.8	7486
Family structure			
Intact family		71.0	5787
Lone-parent family		19.7	1608
Stepfamily		6.8	551
Non-parental family		2.5	207
Siblings living at home (yes)		89.8	7319

Peer support appeared to explain only 1% (i.e., [0.580 – 0.575]/0.580) of the individual-level variance in sleep quality, while family-related variables accounted for 3% (i.e.,[0.575–0.558]/0.575) of the individual-level variance in sleep quality. In addition, school-related variables explained 5% (i.e., [0.558–0.529]/0.558) of the variance at the individual level and 25% (i.e., [0.008–0.006]/0.008) of the variance at the school level.

Discussion

Given the prevalence and detrimental consequences of poor sleep among adolescents, efforts should be devoted to identifying potential mechanisms that contribute to sleep difficulties. While earlier studies have mainly focused on the impact of biological [12] and behavioral factors [13,

Table 2 Mean score of sleep quality by age group for boys and girls

Age group	Sex						Sex differences [a]
	Total		Boys		Girls		
	Mean	SD	Mean	SD	Mean	SD	t-value
11–12 years	3.45	0.81	3.47	0.79	3.44	0.82	0.71
13–14 years	3.40	0.84	3.48	0.84	3.32	0.84	4.08 ***
15–16 years	3.27	0.81	3.49	0.76	3.08	0.81	11.23***
17–18 years	3.10	0.82	3.30	0.79	2.94	0.81	11.32***
Total	3.29	0.83	3.42	0.80	3.17	0.84	13.87 ***

	Model 1		Model 2		Model 3		Model 4	
	b (SE)	*p*	*b* (SE)	*p*	*b* (SE)	*p*	*b* (SE)	*p*
School context								
Teacher support [a]							0.090 (0.012)	***
Student support [a]							0.060 (0.011)	***
School pressure [a]							− 0.175 (0.011)	***
Culture of teacher support							− 0.014 (0.052)	
Culture of student support							0.120 (0.061)	
Level of demand of the school							− 0.218 (0.045)	***
Variance								
School level	0.009		0.009		0.008		0.006	
Class level	0.013		0.012		0.011		0.009	
Individual level	0.580		0.575		0.558		0.529	
BIC	19,196.4		19,140.8		18,940.2		18,564.9	
AIC	19,049.3		18,986.7		18,765.0		18,347.7	
− 2 LogLikelihood	19,007.3		18,942.7		18,715.0		18,285.7	

*$p < .05$; **$p < .01$; *** $p < .001$ (two-tailed test)

All continuous variables are grand-mean centered, with the exception of [a] which are group-mean centered

[a]Results of independent-samples t-tests that compared mean scores for sleep quality between boys and girls; ***$p < .001$ (two-tailed test)

14], the current study was among the first to investigate the relationship between social factors and sleep quality.

First, we found sleep quality to be related to *family factors*. Adolescents who experienced more family support, perceived their family to be well off and felt less burdened by caregiving responsibilities were more likely to report better sleep quality. These findings were in line with our expectations and correspond to other social research showing the importance of family conditions in health promotion [22, 38]. One way of understanding these results is to recognize the role of family stressors [2, 25]. Disadvantaged family structures, such as low family cohesion, economic hardship and caregiver distress, may add stress to families [25] and accordingly may induce feelings of insecurity and anxiety among adolescents, which can interfere with sleep [7]. On the contrary, when family stressors are low, adolescents may experience feelings of stability and safety, which in turn are protective against poor sleep [39]. Another, not mutually exclusive, explanation might be that favorable family conditions, such as those investigated in this study, relate to higher levels of parental control with respect to setting bedtimes and the use of electronic media [2] and therefore protect adolescents' sleep quality [7].

Second, the results also indicated the significance of *school factors* for healthful sleep in adolescence. At the individual level, we found better self-reports of sleep quality among adolescents who experienced more teacher support and student support than their schoolmates. These findings add evidence to previous studies, suggesting an important role of teachers and fellow students in promoting health [38, 40]. Close personal connections with important others at school may improve adolescents' sleep quality by generating a sense of belonging, increasing self-esteem and lending instrumental support (such as practical help with schoolwork) [38]. In addition, we observed a strong association between adolescents' sleep quality and their appraisal of school-related stress. Adolescents who felt more pressured by schoolwork than their schoolmates, were more likely to report poor sleep quality. A related finding was obtained by Vandendriessche and colleagues

Table 3 Pearson correlation matrix of the continuous variables

Individual level	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Sleep quality		− 0.176**	0.281**	− 0.151**	− 0.136**	− 0.142**	0.119**	0.120**	0.238**	0.143**	− 0.148**	0.226**	0.227**	− 0.282**
(2) Age			− 0.149**	0.528**	0.273**	0.198**	− 0.117**	− 0.026*	− 0.177**	− 0.069**	0.069**	− 0.366**	− 0.207**	0.267**
(3) Self-perceived health				− 0.114**	− 0.161**	− 0.163**	0.224**	0.134**	0.195**	0.171**	− 0.116**	0.157**	0.211**	− 0.145**
(4) Alcohol consumption					0.426**	0.136**	− 0.030**	0.031**	− 0.139**	0.029**	0.089**	− 0.280**	− 0.140**	0.144**
(5) Smoking						0.114**	− 0.061**	− 0.019	− 0.149**	− 0.027*	0.098**	− 0.186**	− 0.111**	0.063**
(6) Screen time							− 0.139**	− 0.036**	− 0.131**	− 0.049**	0.129**	− 0.140**	− 0.095**	0.045**
(7) Physical Activity								0.057**	0.092**	0.114**	− 0.020	0.032**	0.065**	− 0.067**
(8) Peer support									0.352**	0.055**	− 0.098**	0.125**	0.258**	− 0.081**
(9) Perceived family wealth										0.111**	− 0.162**	0.234**	0.198**	− 0.125**
(10) Family support											− 0.045**	0.024*	0.100**	− 0.052**
(11) Caregiving responsibilities												− 0.097**	− 0.109**	0.080**
(12) Teacher support													0.349**	− 0.286**
(13) Student support														− 0.155**
(14) School pressure														
School level				(1)			(15)				(16)			(17)
(15) Culture of teacher support				0.156**							0.635**			− 0.673**
(16) Culture of student support				0.142**			0.635**							− 0.296**
(17) The level of demand				− 0.139**			− 0.673**				− 0.296**			

*$p < .05$; **$p < .01$ (two-tailed test)

Table 4 Results of the multilevel analysis (N_{school} = 177, N_{class} = 769, $N_{individuals}$ = 8153)

	Model 1			Model 2			Model 3			Model 4		
	b	(SE)	*p*	*b*	(SE)	*p*	*b*	(SE)	*p*	*b*	(SE)	*p*
Intercept	3.422	(0.018)	***	3.425	(0.018)	***	3.598	(0.035)	***	3.567	(0.034)	***
Control variables												
Sex (boy = ref.)	− 0.208	(0.018)	***	− 0.219	(0.018)	***	− 0.207	(0.018)	***	− 0.186	(0.017)	***
Age	0.004	(0.006)		0.005	(0.006)		0.009	(0.006)		0.019	(0.008)	*
Age*Sex	− 0.042	(0.006)	***	− 0.041	(0.007)	***	− 0.041	(0.006)	***	− 0.029	(0.006)	***
Parental education (tertiary education = ref.)												
No education	− 0.109	(0.095)		− 0.092	(0.094)		− 0.034	(0.093)		− 0.089	(0.091)	
Primary education	− 0.045	(0.056)		− 0.033	(0.056)		0.028	(0.055)		0.039	(0.054)	
Secondary education	− 0.022	(0.020)		− 0.019	(0.020)		0.013	(0.020)		0.004	(0.020)	
Educational level unknown	0.027	(0.044)		0.036	(0.043)		0.036	(0.043)		0.065	(0.042)	
Born in country (yes = ref.)	0.018	(0.031)		0.019	(0.031)		0.017	(0.031)		0.011	(0.030)	
Family structure (intact family = ref.)												
Lone-parent family	− 0.098	(0.022)	***	− 0.086	(0.022)	***	− 0.044	(0.022)	*	− 0.039	(0.021)	
Stepfamily	− 0.086	(0.034)	*	− 0.085	(0.034)	*	− 0.051	(0.034)		− 0.045	(0.033)	
Non-parental family	− 0.150	(0.051)	**	− 0.136	(0.054)	*	− 0.046	(0.054)		− 0.056	(0.052)	
Siblings living at home (yes = ref.)	0.140	(0.028)	***	0.137	(0.028)	***	0.121	(0.028)	***	0.119	(0.027)	***
Self-perceived health	0.264	(0.014)	***	0.249	(0.014)	***	0.217	(0.013)	***	0.178	(0.013)	***
Alcohol use	− 0.043	(0.009)	***	− 0.047	(0.009)	***	− 0.042	(0.009)	***	− 0.037	(0.009)	***
Smoking	− 0.039	(0.008)	***	− 0.038	(0.008)	***	− 0.031	(0.008)	***	− 0.027	(0.008)	**
Screen time	− 0.017	(0.002)	***	− 0.017	(0.002)	***	− 0.015	(0.002)	***	− 0.013	(0.002)	***
Physical activity	0.011	(0.004)	*	0.009	(0.004)	*	0.009	(0.005)		0.009	(0.004)	*
Peers				0.051	(0.007)	***	0.025	(0.006)	***	0.007	(0.006)	
Peer support												
Family context												
Perceived family wealth							0.083	(0.012)	***	0.077	(0.012)	***
Family support							0.066	(0.006)	***	0.055	(0.006)	***
Caregiving responsibilities							− 0.094	(0.011)	***	− 0.074	(0.011)	***

[41], who showed that perceptions of school pressure was related to an increase in sleep onset difficulties.

Besides the individual-level associations between-school factors and adolescents' sleep quality, we found a contextual effect of the level of academic demand. Our results suggested that adolescents who attended schools with high demands experienced worse sleep quality than adolescents who attended less-demanding schools, regardless of their own appraisal of school-related stress. This finding fits well with a number of other studies advocating the need to consider the role of the school culture in promoting healthful behaviors [26, 27].

Third, *peer support* appeared to be less important to adolescents' sleep quality. Our results showed that the relationship between peer support and healthful sleep disappeared after adjustment for student support. This might indicate that adolescents' sleep quality is especially related to the support of friends with whom they interact regularly, like friends from school.

Limitations of the study

Some study limitations are worth mentioning to encourage further research on this topic. First, as a single-country study, the results refer exclusively to the Flemish context. For this reason, one should be careful in generalizing the results to other countries. For instance, the sample (which was highly representative of the Flemish population) comprised a relatively large proportion of highly educated families and adolescents born in the country, which might be reflected in the reported mean scores of sleep quality in Table 2. Moreover, the multilevel results should be interpreted in light of the Flemish educational system, which is rigidly tracked (i.e., students need to choose between general and vocational education at a rather young age). Previous studies have shown that the degree of tracking has a substantial impact on social inequalities in adolescent health [19, 42], with smaller inequalities being observed in countries with more comprehensive educational systems.

In line with this, it could be that the strength of the association between perceived family wealth and sleep quality depends on a country's educational system. Second, the cross-sectional nature of the HBSC data hinders causal interpretation, as we cannot exclude the possible existence of selection effects and reverse causation. For instance, it could be that poor sleep affects adolescents' perceptions of school pressure, rather than the other way around. Third, the data were self-reported by pupils, which could lead to recall or social desirability bias. Nevertheless, we deem that self-reported information offer an irreplaceable entry point into adolescents' own perceptions of sleep quality, which might be more interesting than assessments by others or objective measurement instruments in the context of the current study. This low response rate is due to the fact that Flemish schools are besieged with research requests. Fourth, it should be taken under consideration that, while the initial Groningen Sleep Quality Scale has been validated for adults [43], the validity of the shortened version has yet to be investigated in an adolescent population sample. Fifth, the school-level variables were calculated using a manifest aggregation strategy. Although calculations of the mean rater reliability justified this modeling approach, they also indicated that there was not perfect agreement within schools. As a consequence, sampling error in the aggregation of the school-level variables could not be completely eliminated. To address this issue, future studies should consider using MPlus latent variable software accounting for the unreliability of the group mean and draw on larger datasets, in which more students are sampled from each school.

Study implications

The included peer, family and school factors explained together about 9% of the individual variation in adolescents' sleep quality. While this is rather a small proportion, it is not negligible. Moreover, the level of academic demand accounted for 25% of the variation at the school level, indicating that school-level characteristics relate to the sleep quality of adolescents over and above individual factors. In sum, our results highlight the need to consider social factors in future studies and clinical recommendations. For instance, schools need to become more aware of their role in preventing sleep difficulties among adolescents. They need to maintain the balance between pedagogical purposes (encouraging students to do their very best) and health purposes (not putting too much pressure on students) and advocate a proactive role for teachers to support students' health. In addition, monitoring the sleep quality of adolescents involved in some type of family caregiving and adolescents from less well-off families is warranted.

Conclusion

This study was among the first to establish the central role of social factors in promoting better sleep during adolescence. While family support, teacher support, student support and perceived family wealth were found to be positively related to adolescents' sleep quality, caregiving responsibilities and school pressure were found to be negatively related. Future studies should examine other aspects of peer, family and school relationships (e.g., bullying, parent–child conflict, closeness of friendship) in relation to sleep quality in order to better understand how interventions can assist in improving adolescent sleep and reducing related health risks.

Author contributions The first author (KD) designed the study, had primary responsibility for writing and editing of the manuscript and supervised the data analysis. All co-authors helped interpreting the data and critically reviewed the manuscript. All authors gave final approval for the article to be published.

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Data Availability HBSC is an international study carried out in collaboration with WHO/EURO. The international coordinator of the 2017/18 study was Jo Inchley (University of Glasgow); and the data bank manager was Oddrun Samdal, (University of Bergen). A complete list of the participating researchers can be found on the HBSC website https://www.HBSC.org. This publication makes use of the data of Flanders (Belgium) only. The Principal Investigator of the 2017/18 HBSC Flanders was Bart De Clercq. The data are available upon request and approval from the authors.

Code availability The R code is available upon request from the corresponding author.

Compliance with ethical standards

Conflict of interests The authors declare that they have no conflict of interest.

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