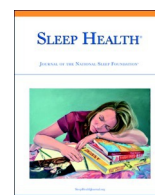




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Sleep health characteristics and positive mental health in Canadian youth: A cross-sectional analysis of the Health Behaviour in School-aged Children study



Joses Robinson, MPH^{a,1}, Jean-Philippe Chaput, PhD^{b,c,2}, Karen C. Roberts, MSc^{a,3}, Gary S. Goldfield, PhD^{b,c,4}, Suzy L. Wong, PhD^{d,10}, Ian Janssen, PhD^{e,f,5}, Geneviève Garépy, PhD^{a,g,6}, Stephanie A. Prince, PhD^{a,h,7}, Colin A. Capaldi, PhD^{a,8}, Justin J. Lang, PhD^{a,b,h,i,*9}

^a Centre for Surveillance and Applied Research, Public Health Agency of Canada, Ottawa, Ontario, Canada

^b Healthy Active Living and Obesity Research Group, Children's Hospital of Eastern Ontario Research Institute, Ottawa, Ontario, Canada

^c Department of Pediatrics, Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada

^d Centre for Health Promotion, Public Health Agency of Canada, Ottawa, Ontario, Canada

^e Department of Public Health Sciences, Queen's University, Kingston, Ontario, Canada

^f School of Kinesiology and Health Studies, Queen's University, Kingston, Ontario, Canada

^g School of Public Health, University of Montreal, Montreal, Quebec, Canada

^h School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada

ⁱ Alliance for Research in Exercise, Nutrition and Activity (ARENA), University of South Australia, Adelaide, South Australia, Australia

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ABSTRACT

Objectives: This study investigated the associations between specific sleep health characteristics and indicators of positive mental health among Canadian youth in grades 6–10.

Methods: We used cross-sectional data from the Canadian 2017/2018 Health Behaviour in School-aged Children study, a nationally representative sample of Canadian students. Our analyses included 14,868 participants (53.1% girls). We assessed the following self-reported characteristics of sleep health: nighttime insomnia symptoms, sleep duration, problems with daytime wakefulness, and weekend catch-up sleep. Positive mental health measures included self-reported life satisfaction, positive affect, self-efficacy, and self-confidence. Logistic regression models were used to assess associations while controlling for confounders.

Results: Participants who had no or little nighttime insomnia symptoms, who met sleep duration recommendations, who had no or rare daytime wakefulness problems, and who had no or little weekend catch-up sleep were more likely to report high life satisfaction (range of adjusted odds ratios = 1.29–2.50), high positive affect (range of adjusted odds ratios = 1.35–3.60), high self-efficacy (range of adjusted odds ratios = 1.22–2.54), and high self-confidence (range of adjusted odds ratios = 1.28–2.31). Almost all of the associations remained significant in the gender- and age-stratified analyses.

Conclusion: The findings suggest that good sleep health is associated with higher odds of positive mental health among Canadian youth in grades 6–10. Further research is needed to understand the temporality of the associations and the underlying mechanisms.

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* Corresponding author: Justin J. Lang, PhD, Applied Research Division, Centre for Surveillance and Applied Research, Public Health Agency of Canada, 785 Carling Ave., Ottawa, ON K1A 0K9, Canada.

E-mail address: justin.lang@phac-aspc.gc.ca (J.J. Lang).

¹ ORCID: 0009-0001-6268-1011

² ORCID: 0000-0002-5607-5736

³ ORCID: 0000-0002-1232-5078

⁴ ORCID: 0000-0001-6216-7824

⁵ ORCID: 0000-0003-2159-3012

⁶ ORCID: 0000-0001-9209-4240

⁷ ORCID: 0000-0001-6729-5649

⁸ ORCID: 0000-0001-7168-7047

⁹ ORCID: 0000-0002-1768-319X

¹⁰ ORCID: 0009-0004-5201-5738

Background

Sleep is important for physical and mental health.^{1,2} The behavior of sleeping has been broken down into several measurable characteristics that, combined, help describe an individual's sleep health. Some of these characteristics include sleep quality (i.e., an estimation of good or poor sleep), daytime wakefulness (i.e., the ability to sustain attentive wakefulness during the day), sleep timing (i.e., the placement of sleep within the 24-hour day), sleep continuity (i.e., the ease of falling asleep and returning to sleep), sleep regularity (i.e., consistent bedtime and wake-up time or sleep duration consistency during the week and weekends), and sleep duration (i.e., the amount of sleep in a 24-hour period).³ Sleep duration is usually described as adherence to the sleep duration recommendations, which are 9–11 hours/night for youth aged 5–13 years, and 8–10 hours/night for youth aged 14–17 years.⁴ These components are vital in measuring youth sleep health as presented in the Peds B-SATED (Behavior, Satisfaction/Quality, Alertness/Sleepiness, Timing, Efficiency, and Duration) model, and monitored in the Physical Activity, Sedentary Behaviour and Sleep (PASS) Indicators by the Public Health Agency of Canada (PHAC).^{3,5}

Many studies have demonstrated an association between sleep duration and negative aspects of mental health. For instance, a systematic review found that shorter sleep duration in youth was significantly associated with greater odds of anger, depressed moods, and anxiety.⁶ Additional evidence suggests a dose-response relationship between sleep duration and suicidal behaviors in youth, with an 11% reduction in suicide plans for every 1 hour increase in sleep.⁷ Youth who experience sleep disturbances, such as sleep-wake cycle disturbances and short sleep duration, are also at an increased risk of developing clinical mental disorders such as depressive, bipolar, and psychotic disorders.⁸ Despite the strong evidence linking sleep duration and negative aspects of mental health, there is a need to further investigate other components of sleep health and the associations with indicators of positive mental health.

The PHAC defines positive mental health as “the capacity of each and all of us to feel, think, and act in ways that enhance our ability to enjoy life and deal with challenges we face.”⁹ Positive mental health and mental illness are distinct constructs; the absence of a mental illness does not imply the presence of positive mental health (or vice versa).¹⁰ Contemporary research often delineates positive mental health into two components, namely hedonia or feeling good (i.e., positive affect, life satisfaction, and low negative affect) and eudaimonia or functioning well (i.e., psychological and social well-being).¹¹ Few studies have investigated the link between sleep health and positive mental health, with the majority of studies investigating only a single component of sleep health (usually sleep duration) or positive mental health.⁶ For example, one Portuguese cross-sectional study found increased odds of higher life satisfaction among youth who reported always having a good night's sleep and who met sleep duration recommendations compared with those who did not.¹² The Portuguese findings were similar to those reported among Chinese youth.¹³ Canadian research on the relationship between sleep and positive mental health has shown mixed associations. One Canadian study examining youth found that meeting sleep duration recommendations was associated with high self-rated mental health, happiness, and community belonging, but not with high life satisfaction (or high psychological well-being after adjustment).¹⁴ Sleep quality and continuity was consistently associated with the five examined positive mental health outcomes among youth.¹⁴ Another Canadian study reported that short sleep duration was not associated with self-rated mental health in youth aged 14 to 17 years,¹⁵ while other research found a significant association between meeting sleep duration recommendations and self-rated mental health.¹⁶ These inconsistent findings may be the result of different measures of sleep health and positive mental health, different study age groups, different populations sampled, and different confounding variables in the statistical models.

Given the inconsistent evidence, there is a need for additional investigations of sleep health characteristics and positive mental health indicators among Canadian youth to provide a clearer understanding of how these factors relate. Studying these relationships can demonstrate the importance of sleep health in the context of wellbeing. It can also inform policies and programs to promote Canadian youth sleep. There is also a need to consider gender and age differences in these associations. The literature suggests there are differences in sleep health between genders and stages of development, with poorer sleep health reported more frequently among girls than other genders, and older compared to younger youth.^{17–20} A World Health Organization report indicated that boys and younger adolescents report higher levels of life satisfaction and excellent health, with lower levels of multiple health complaints.²¹ Other research suggests gender differences in the association of sleep and mental health.^{22,23}

Thus, the primary objective of this study was to assess the associations between multiple indicators of sleep health and positive mental health among Canadian youth. The secondary objective was to assess whether these associations differ by gender and grade. We hypothesized that those with better sleep health characteristics would have higher levels of positive mental health. Given the observed differences in sleep health and mental health by gender and age in the literature, we expect that there will be a significant difference in the association between sleep health and positive mental health by gender and grade, with boys having significantly stronger associations compared to girls and younger youth having stronger associations compared to older youth.

Methods

This study used nationally-representative, cross-sectional data from the Canadian 2017/2018 Health Behaviour in School-aged Children (HBSC) study.²⁴ The HBSC study collects data from students in grades 6 to 10 using youth self-reported questionnaires, with the aim to gain knowledge on youth well-being, health behaviors, and social contexts. The HBSC is a World Health Organization collaborative, cross-national research study. The data are collected every 4 years to help explore and compare trends. PHAC funds Queen's University to conduct the HBSC in Canada. The HBSC sampling frame excludes the roughly 7% of youth who are schooled at home, attending private schools or schools on reserves (First Nations), detained, or out of school. Multistage cluster sampling was used to select participants according to language of instruction, public/Roman Catholic designation (where applicable), and community size. From these clusters, a list of eligible school jurisdictions was created, and schools were randomly selected from the list. Research ethics for the HBSC study in Canada was obtained from the Queen's University and PHAC research ethics boards. Participation was voluntary and anonymous. Consent was provided by school boards, schools, parents or guardians and participants.

A total of 21,745 Canadian youth took part in the 2017/2018 HBSC study. We excluded 2001 participants who had missing sleep data, 1463 participants with missing positive mental health data, and 3413 participants due to missing covariate data. We also excluded 12 participants who were 18 years and above. Of the 3413 participants with missing covariate data, the socioeconomic status (SES) variable was the most incomplete ($n = 2846$). The final sample size after exclusions was 14,868 participants. Participants who were excluded from this study were significantly different from the included sample by gender, age, grade, total screen time, daily physical activity, life satisfaction, positive affect, and self-efficacy (see [Supplementary Table A.1](#)).

Sleep health

Measures of sleep health in this study included nighttime insomnia symptoms, sleep duration, daytime wakefulness, and weekend catch-up sleep. The selection of these sleep health characteristics was guided by the Peds B-SATED model and the PASS indicator framework.^{3,5}

Nighttime insomnia symptoms were assessed by asking participants how often they had trouble going to sleep or staying asleep, with five response options: “never,” “rarely,” “sometimes,” “most of the time,” and “all the time.” Participants who responded “never” or “rarely” or “sometimes” were categorized as having no or little nighttime insomnia symptoms.²⁵

Sleep duration was assessed by asking participants when they usually go to bed when they have school the next day and when they usually wake up on school mornings; this information was used to determine sleep duration during the week. Participants were also asked what time they go to bed on weekends and holidays and what time they usually wake up on weekends and holidays. These items were used to determine time in bed during the weekend and holidays, as a proxy for sleep duration. We obtained average sleep duration by calculating the weighted average of sleep duration during the week and sleep duration during the weekend and compared the values to the sleep duration recommendations included in the Canadian 24-Hour Movement Guidelines.⁴ Youth were categorized as meeting the sleep duration recommendation if their average nightly sleep duration was 9–11 hours for 8–13 year olds and 8–10 hours for 14–17 year olds. The cutoffs were informed by extensive reviews of the literature and stakeholder consultation.⁴

Problems with daytime wakefulness was measured by asking how often participants had trouble staying awake during the daytime when they want to be awake.²⁶ The response options were “never,” “rarely,” “sometimes,” “most of the time,” and “all the time.” Participants who responded “never” or “rarely” were categorized as having no or rare daytime wakefulness problems.

Weekend catch-up sleep was measured by calculating the difference between participants’ sleep duration time on school days and their sleep duration on weekends or holidays.²⁷ Participants who reported a difference of less than 2 hours were categorized as having no or little weekend catch-up sleep.²⁸

Positive mental health

The measures of positive mental health in this study captured multiple aspects well-being, and conceptually overlap with some of the indicators in the Positive Mental Health Surveillance Indicator Framework.²⁹

Life satisfaction was assessed using the Cantril Ladder.³⁰ Participants were provided with a picture of a ladder numbered 0 to 10 where the top of the ladder (i.e., 10) is the best possible life and the bottom of the ladder (i.e., 0) is the worst possible life. Participants were asked where they felt they stood on the ladder at that moment of completing the questionnaire. Responses greater than or equal to 9 were categorized as “high life satisfaction” while scores less than or equal to 8 were categorized as “not high life satisfaction.”²⁹ This measure has been validated for use with youth.³⁰ A cut-off of 6 was also used for sensitivity analysis.

Positive affect was assessed using the WHO-5 Well-being Index.^{31,32} Participants were asked how often they felt the following in the last 2 weeks: (1) “felt cheerful and in good spirits,” (2) “felt calm and relaxed,” (3) “felt active and energetic,” (4) “woken up feeling fresh and rested,” and (5) “had your daily life filled with things that interest you.” Response options included “all of the time,” “most of the time,” “more than half of the time,” “less than half of the time,” “some of the time,” and “at no time.” Response options were rescaled as 5, 4, 3, 2, 1, and 0 respectively, were summed and multiplied by 4 so that the lowest possible score was 0 and the highest possible score was 100. Scores greater than or equal to 50 indicated “high positive affect,” whereas scores below 50 represented “low positive affect.” This measure has been validated and recommended as a measure of population positive mental health by the OECD.^{31,32}

Self-efficacy, adapted from the Generalized Self-Efficacy Scale,³³ was assessed by asking participants to rate their ability to handle

“unexpected and difficult problems” and “day-to-day demands in [their] life.” Response options included “excellent,” “very good,” “good,” “fair,” and “poor,” with responses rescored from 5 (i.e., excellent) to 1 (i.e., poor). The items were summed with scores ranging from 2–10; scores greater than or equal to 6 were categorized as “high self-efficacy” and scores less than or equal to 5 were categorized as “low self-efficacy.”³⁴

Self-confidence was assessed by asking participants how much they agreed or disagreed with the statement: “I have self-confidence in myself.” Response options included “strongly agree,” “agree,” “neither agree nor disagree,” “disagree,” or “strongly disagree.” Participants who responded with “strongly agree” or “agree” were categorized as having “high self-confidence,” with the remaining three response options being categorized as “low self-confidence.”

Covariates

Grade (dichotomized into grades 6–8 and grades 9–10) (we used grade instead of age because the HBSC study samples from classrooms of youth in grades 6–10) and gender (boy or girl; we excluded the gender diverse group because there were too few participants in this group to carry out an analysis) were explored as confounding variables in the analyses. Grade and gender were obtained by asking the youth “What grade are you in?” and “Are you male or female,” respectively. The gender variable had a response option for “neither term describes me.” Confounding variables were selected based on the literature having been shown to be associated with either sleep health, positive mental health, or both.^{12,13,35,36} In addition to grade and gender, the confounding variables included cultural/racial background (White; Black; Latin American, Arab and West Indian; East and Southeast Asian; East Indian and South Asian; and Other including mixed; we included Indigenous Peoples in the “other” group to adhere to national ethics requirements), which was obtained by asking the youth “people living in Canada come from many different cultural and racial backgrounds. How do you describe yourself?” SES (categorized as low, average, and high), physical activity (minutes/day), and screen time (hours/day). We assessed SES using the self-report question “How well off do you think your family is?” The responses included “very well off,” “quite well off,” “average,” “not very well off,” and “not at all well off.” The first two categories and the last two categories were combined to form high and low categories, respectively, resulting in a three-level measure.³⁷ Physical activity and screen time were used as continuous variables. We summed daily minutes of physical activity from five different domains (school curriculum, organized sports, exercise, outdoor play, and active transport). We calculated a weighted average of daily screen time (in hours) by summing weekday and weekend daytime spent watching television, playing games on devices, and using electronic devices for other purposes (browsing web, social media, etc.).

Statistical analysis

Descriptive statistics were calculated as frequencies and means with 95% confidence intervals (CIs). Chi-square tests and *t* tests were used to detect statistically significant differences between groups where appropriate, and a *p*-value of .01 was used to detect between group differences. A sleep health composite variable was derived by combining the four sleep variables into a single variable, reflecting the number of sleep health variables attained. Logistic regression analyses were carried out to assess the association between individual and combined sleep health characteristics (independent variables) and indicators of positive mental health (dependent variables). Logistic regression models were presented as unadjusted and fully adjusted for covariates. School level clusters and sample weights were incorporated into all models to account for the complex survey design. Wald tests were used to detect significant associations. We used interaction terms to test for the potential gender and grade differences in the association between sleep health and positive mental health. The analysis was conducted using SAS

EG 7.1 and a p -value of $<.01$ was used for statistical significance to account for the multiple comparisons.

We conducted several additional analyses. We explored weekend catch-up sleep for more than 30 minutes and more than 1 hour (reference: no or little weekend catch-up sleep), sleep midpoint (i.e., the clock time that represents the midpoint between clock time of bedtime and wake time), social jetlag (i.e., the difference between sleep midpoint during the week and sleep midpoint during the weekend), and screen time before bed.

Results

Descriptive characteristics of the study participants by gender and grade are presented in Table 1. Boys reported significantly better sleep health characteristics (except meeting sleep duration recommendation) and better positive mental health across all variables when compared to girls. Youth in grades 6–8 had significantly better daytime wakefulness, lower weekend catch-up sleep, higher life satisfaction, higher positive affect, and higher self-confidence when compared to youth in grades 9–10.

The overall unadjusted (OR) and adjusted odds ratios (aOR) for the association between sleep health and positive mental health are presented in Table 2. Overall, there were consistent and significant greater odds for having high positive mental health when good sleep health characteristics were present. Having no or little nighttime insomnia symptoms was associated with a 2.30–3.60 times higher odds of having high positive mental health in adjusted analyses. Meeting sleep duration recommendations was associated with all the positive mental health indicators, with aORs ranging from 1.31 to 1.87. This trend was consistent with having no or rare daytime wakefulness problems (aORs ranged from 2.21 to 3.26) and having no or little weekend catch-up sleep (aORs ranged from 1.22 to 1.35).

Thirty of the 32 interaction terms between gender and grade with sleep health were not statistically significant. The two exceptions were the gender interactions between no or rare daytime wakefulness and high life satisfaction ($p = .005$) (although both associations were significant, there was a stronger association in girls compared with boys), and no or rare daytime wakefulness and high positive affect ($p = .003$) (although both associations were significant, there was a stronger association in the variables in girls compared with boys). The gender and grade stratified analyses are presented in Supplementary Tables A2 and A3, respectively.

The OR and aOR between weekend catch-up sleep (30 minutes and 1 hour), sleep midpoint, social jetlag, screen time before bed, and positive mental health are presented in Supplementary Table A4. Life satisfaction was associated with all additional sleep health variables except sleep midpoint (late vs. average), positive affect was associated with all the additional sleep health indicators except weekend catch-up sleep for 30 minutes and no or little screen time (reference: screen time before bed more than 2 nights a week). Self-efficacy was associated with weekend catch-up sleep for 2 hours, sleep midpoint (late vs. average), and no or little screen time before bed, but not with weekend catch-up sleep for 1 hour and 30 minutes, and sleep midpoint (early vs. average). Self-confidence was associated with all the additional sleep health variables.

Fig. 1 illustrates the sleep health composite variable and the association with positive mental health. For all four positive mental health outcomes, there was a dose-response relationship, where attaining more sleep health measures was associated with an increased odds of having high positive mental health when compared with attaining no sleep health measures.

Discussion

This study examined the relationship between sleep health characteristics and indicators of positive mental health using a

nationally representative sample of Canadian youth in grades 6–10. Consistent with our hypothesis, youth who had no or little nighttime insomnia symptoms, met sleep duration recommendations, had no or rare daytime wakefulness problems, and had no or little weekend catch-up sleep showed significantly higher odds of having high life satisfaction, high positive affect, high self-efficacy, and high self-confidence. Overall, there was little evidence of gender and grade acting as effect modifiers of these relationships. We also identified a clear positive dose-response relationship between attaining sleep health characteristics and higher odds of having positive mental health. Furthermore, the magnitude of the associations identified in this study are large and should be considered as meaningful findings.

Meeting the recommended sleep duration was significantly associated with higher odds of having high life satisfaction in this study, consistent with findings from other studies among youth.^{12,38} Another study suggested that sleep duration on school nights was positively associated with psychological well-being and self-efficacy.³⁹ Although many studies suggest meeting sleep duration recommendations is positively associated with positive mental health, one study showed inconsistent associations. This study identified that meeting sleep duration recommendations was significantly associated with high self-rated mental health, high levels of happiness, and high community belonging, but not with high life satisfaction and high psychological well-being (after adjustment) among Canadian youth, partially supporting our findings.¹⁴ Research identified that meeting sleep duration recommendations may have a greater influence on stress and mental health than other movement behaviors (i.e., physical activity, sedentary behavior).¹⁶ This observation could be the result of sleep duration being a vital part of physiological development, mental state and resilience through development.¹³ Additionally, youth who sleep longer tend to face the day-to-day demands of life better, showing more confidence and better attitudes toward life while youth with better psychological well-being also tend to sleep longer.¹³

Our study suggests that having no or little insomnia symptoms is associated with higher levels of positive mental health among youth. Roberts et al.⁴⁰ observed a positive association between baseline insomnia (categorized as high, moderate and low (reference) insomnia) and risk of life dissatisfaction at follow-up among youth aged 11 to 17 years. This study also showed a positive association between baseline insomnia with poor self-esteem, and perceived mental health problems.⁴⁰ Although our analysis focused on the cross-sectional association between no or rare insomnia symptoms and high positive mental health, there are similarities in the strength of the association between this study and the findings reported by Roberts et al.⁴⁰ Furthermore, a Canadian study observed that reporting fewer difficulties staying asleep or falling asleep (nighttime insomnia symptoms) was positively associated with high life satisfaction, high psychological well-being, high self-rated mental health, high levels of happiness, and high community belonging among youth.¹⁴ This is not surprising as insomnia symptoms are important in the assessment of depression.⁴⁰ The mechanism for this observation may be due to neurobiological processes; insomnia may play a role in the development of mood and anxiety disorders.⁴¹ Another possible mechanism is low levels of positive mental health may lead to increased disturbed sleep. Sleep and mental health likely have bidirectional associations, with low levels of positive mental health leading to disturbed sleep through cognitive, physiological, and behavioral pathways.⁴²

No or little weekend catch-up sleep was positively and significantly associated with measures of positive mental health. A possible explanation for this observation is that high weekend catch-up sleep can disrupt sleep/wake cycles and lead to emotional imbalances which impede positive mental health.⁴³ Mathew et al's study among adolescents aged 14 to 18 years showed positive mood was not associated with an objective measure of free night catch-up sleep (weekend catch-up sleep).⁴⁴ However, Kim et al demonstrated

Table 1
Descriptive statistics for sleep health characteristics and positive mental health, by gender and grade group, 2017-18 Canadian Health Behaviours in School-aged Children study (N = 14,868)

Variables	Gender		p-value	Grade		p-value
	Boys (n = 6979) Weighted % (95% CI) or mean (95% CI)	Girls (n = 7889) Weighted % (95% CI) or mean (95% CI)		Grade 6-8 (n = 8631) Weighted % (95% CI) or mean (95% CI)	Grade 9-10 (n = 6237) Weighted % (95% CI) or mean (95% CI)	
<i>Age group</i>						
Less than 14 years	50.4 (44.5, 56.4)	49.5 (43.8, 55.2)	.515	84.8 (81.7, 87.9)	1.1 (0.5, 1.7)	<.001
14 years and older	49.6 (43.6, 55.5)	50.5 (44.8, 56.2)		15.2 (12.1, 18.3)	98.9 (98.3, 99.5)	
<i>Cultural and racial background, %</i>						
White	72.3 (67.5, 77.1)	70.8 (65.5, 76.2)	.531	73.5 (68.6, 78.5)	68.7 (61.9, 75.5)	.402
Black	3.3 (2.2, 4.4)	4.1 (2.2, 6.0)		3.5 (2.4, 4.7)	4.0 (1.8, 6.2)	
Latin American, Arab and West Indian	2.9 (1.8, 3.9)	3.3 (2.0, 4.5)		2.8 (1.8, 4.0)	3.4 (2.0, 4.7)	
East and Southeast Asian	3.6 (2.3, 5.0)	3.1 (1.6, 4.6)		3.3 (1.5, 5.1)	3.4 (1.9, 4.9)	
East Indian and South Asian	3.2 (1.7, 4.7)	3.4 (1.9, 5.0)		1.9 (1.1, 2.8)	5.3 (2.2, 8.5)	
Other (including Indigenous)	14.6 (12.1, 17.1)	15.3 (12.7, 17.8)		14.8 (12.3, 17.4)	15.2 (12.2, 18.2)	
<i>Socioeconomic status, %</i>						
High	58.7 (56.4, 61.1)	52.7 (50.5, 55.0)	<.001	56.6 (54.0, 59.2)	54.0 (51.6, 56.3)	<.001
Average	33.8 (31.7, 35.9)	38.7 (36.7, 40.6)		34.6 (32.5, 36.7)	39.0 (36.7, 41.2)	
Low	7.5 (6.5, 8.4)	8.6 (7.6, 9.6)		8.8 (7.8, 9.7)	7.1 (6.2, 7.9)	
<i>Recreational screen time, hours per day</i>						
Daily screen time	4.9 (4.8, 5.0)	4.3 (4.2, 4.4)	<.001	4.4 (4.3, 4.5)	4.8 (4.7, 4.9)	<.001
<i>Physical activity, minutes per week</i>						
Daily physical activity	83.8 (80.6, 86.9)	71.1 (68.1, 74.2)	<.001	79.0 (76.1, 81.9)	74.2 (70.6, 77.7)	.003
<i>Sleep health, %</i>						
No or little nighttime insomnia symptoms	81.8 (80.2, 83.3)	71.5 (69.5, 73.4)	<.001	77.2 (75.4, 78.9)	75.0 (72.9, 77.1)	.105
Meets sleep duration recommendation	67.2 (64.9, 69.4)	65.9 (63.4, 68.5)	.326	66.0 (63.3, 68.6)	67.3 (64.7, 69.9)	.432
No or rare daytime wakefulness problems	68.5 (66.3, 70.7)	58.1 (55.5, 60.8)	<.001	71.6 (69.5, 73.7)	50.9 (48.9, 53.0)	<.001
No or little weekend catch-up sleep	70.6 (68.2, 73.0)	63.4 (60.6, 66.2)	<.001	71.8 (69.7, 73.8)	59.8 (56.5, 63.1)	<.001
<i>Good sleep health composite score, %</i>						
Meets 0	2.2 (1.6, 2.7)	5.3 (4.6, 6.1)	<.001	3.0 (2.4, 3.5)	5.1 (4.1, 6.0)	<.001
Meets 1	11.1 (9.6, 12.5)	15.9 (14.4, 17.3)		10.7 (9.4, 12.1)	17.6 (16.0, 19.3)	
Meets 2	24.7 (23.1, 26.4)	26.2 (24.4, 28.0)		23.7 (21.9, 25.6)	28.0 (26.2, 29.8)	
Meets 3	36.7 (35.0, 38.4)	31.1 (29.5, 32.6)		34.8 (33.3, 36.4)	32.2 (30.5, 33.8)	
Meets 4	25.4 (23.3, 27.4)	21.5 (19.3, 23.7)		27.7 (25.3, 30.1)	17.1 (14.9, 19.3)	
<i>Positive mental health, %</i>						
High life satisfaction	88.3 (87.1, 89.5)	78.0 (76.3, 79.6)	<.001	84.7 (83.2, 86.1)	80.1 (78.3, 81.9)	<.001
High positive affect	82.6 (81.2, 84.0)	68.6 (66.1, 71.2)	<.001	80.8 (79.1, 82.5)	67.2 (64.7, 69.8)	<.001
High self-efficacy	85.1 (83.8, 86.4)	76.0 (74.1, 78.0)	<.001	81.1 (79.5, 82.8)	79.0 (77.2, 80.9)	.067
High self-confidence	70.4 (68.4, 72.4)	50.1 (47.9, 52.4)	<.001	63.1 (61.0, 65.2)	54.6 (52.2, 57.1)	<.001

Abbreviation: CI, confidence interval. Chi-square test (frequencies) and *t* tests (means) were performed to obtain *p*-values.

that weekday-to-weekend sleep differences was negatively associated with life satisfaction, consistent with findings in our study.⁴⁵ Another study showed that weekend catch-up sleep was negatively associated with subjective well-being, social well-being, and psychological well-being in youth who slept less than 7 hours but not significant in youth who slept more than 7 hours.²⁸ This finding suggests that weekend catch-up sleep greater than 2 hours is associated with subjective well-being in only sleep-deprived youth. Perhaps the well-being of youth is already influenced by sleep deprivation which leads to longer weekend catch-up sleep.

Daytime wakefulness was significantly associated with life satisfaction, positive affect, self-efficacy, and self-confidence in this study. Most of sleep research focuses on sleepiness and aspects of negative mental health among youth.^{46,47} One study showed that youth with no morning tiredness were more likely to have very happy life satisfaction.⁴⁸ Another study highlighted that the effect of short sleep on positive attitude toward life was mediated by daytime tiredness.⁴⁹ This hints that feeling tired or sleepy during the day leads to a less positive attitude toward life and explains the relationship between short sleep and positive attitude toward life.

Our findings suggest that meeting sleep duration recommendations, absence of nighttime insomnia symptoms, absence of daytime wakefulness problems, and no or little weekend catch-up sleep are

associated with higher odds of positive mental health among youth at the population level. It is important to further explore interventions that could promote healthy sleep habits – sleep indices explored in this study – as this could have a significant impact on mental health among youth. Guidance around proper sleep habits among youth may have an impact on improving mental health.

Strengths and limitations

The major strengths of this study are the use of a large and nationally representative sample of youth in grades 6-10, the examination of several positive mental health variables that incorporated hedonic and eudemonic components in tandem with several sleep health characteristics that provided a detailed investigation into associations between the two broad constructs. However, several limitations should be noted. First, this study utilized self-reported measures for all the variables which could have introduced reporting biases that may impact the effect size of the associations through misclassification. Second, the usage of a cross-sectional study design impedes the ability to draw inferences on the temporality of the associations; some longitudinal cohort studies have demonstrated that positive mental health influences sleep health. Third, we found significant differences between those with and without missing data. The exclusion of cases with missing data may

Table 2
Unadjusted and adjusted odds ratios for the association between sleep health characteristics and positive mental health, Canadian Health Behaviours in School-aged Children 2017–18 (N = 14,868)

	Unadjusted OR (95% CI)	aOR ^a (95% CI)	p-value for aOR
<i>Life satisfaction (high vs. not high)</i>			
No or little nighttime insomnia symptoms (ref: presence of nighttime insomnia symptoms)	2.73 (2.31, 3.22)	2.30 (1.96, 2.70)	<.001
Meets sleep duration recommendations (ref: does not meet recommended sleep duration)	1.67 (1.42, 1.97)	1.47 (1.25, 1.73)	<.001
No or rare daytime wakefulness problems (ref: presence of daytime wakefulness problems)	3.20 (2.86, 3.59)	2.50 (2.25, 2.79)	<.001
No or little weekend catch-up sleep (ref: weekend catch-up sleep; ≥2 h)	1.55 (1.37, 1.76)	1.29 (1.14, 1.46)	<.001
<i>Positive affect (high vs. low)</i>			
No or little nighttime insomnia symptoms (ref: presence of nighttime insomnia symptoms)	4.17 (3.67, 4.75)	3.60 (3.17, 4.09)	<.001
Meets sleep duration recommendations (ref: does not meet recommended sleep duration)	2.00 (1.76, 2.27)	1.87 (1.64, 2.12)	<.001
No or rare daytime wakefulness problems (ref: presence of daytime wakefulness problems)	4.16 (3.74, 4.62)	3.26 (2.94, 3.61)	<.001
No or little weekend catch-up sleep (ref: high weekend catch-up sleep; ≥2 h)	1.67 (1.46, 1.91)	1.35 (1.17, 1.56)	<.001
<i>Self-efficacy (high vs. low)</i>			
No or little nighttime insomnia symptoms (ref: presence of nighttime insomnia symptoms)	2.88 (2.53, 3.29)	2.38 (2.07, 2.74)	<.001
Meets sleep duration recommendations (ref: does not meet recommended sleep duration)	1.50 (1.31, 1.71)	1.31 (1.14, 1.50)	<.001
No or rare daytime wakefulness problems (ref: presence of daytime wakefulness problems)	2.91 (2.56, 3.31)	2.54 (2.23, 2.90)	<.001
No or little weekend catch-up sleep (ref: high weekend catch-up sleep; ≥2 h)	1.40 (1.25, 1.56)	1.22 (1.08, 1.37)	.001
<i>Self-confidence (high vs. low)</i>			
No or little nighttime insomnia symptoms (ref: presence of nighttime insomnia symptoms)	2.79 (2.43, 3.20)	2.31 (2.03, 2.64)	<.001
Meets sleep duration recommendations (ref: does not meet recommended sleep duration)	1.70 (1.55, 1.87)	1.58 (1.44, 1.74)	<.001
No or rare daytime wakefulness problems (ref: presence of daytime wakefulness problems)	2.69 (2.45, 2.95)	2.21 (1.99, 2.45)	<.001
No or little weekend catch-up sleep (ref: high weekend catch-up sleep; ≥2 h)	1.49 (1.32, 1.69)	1.28 (1.14, 1.44)	<.001

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.

^a Models were adjusted for grade, gender, cultural/racial background, recreational screen time, physical activity, and socioeconomic status.

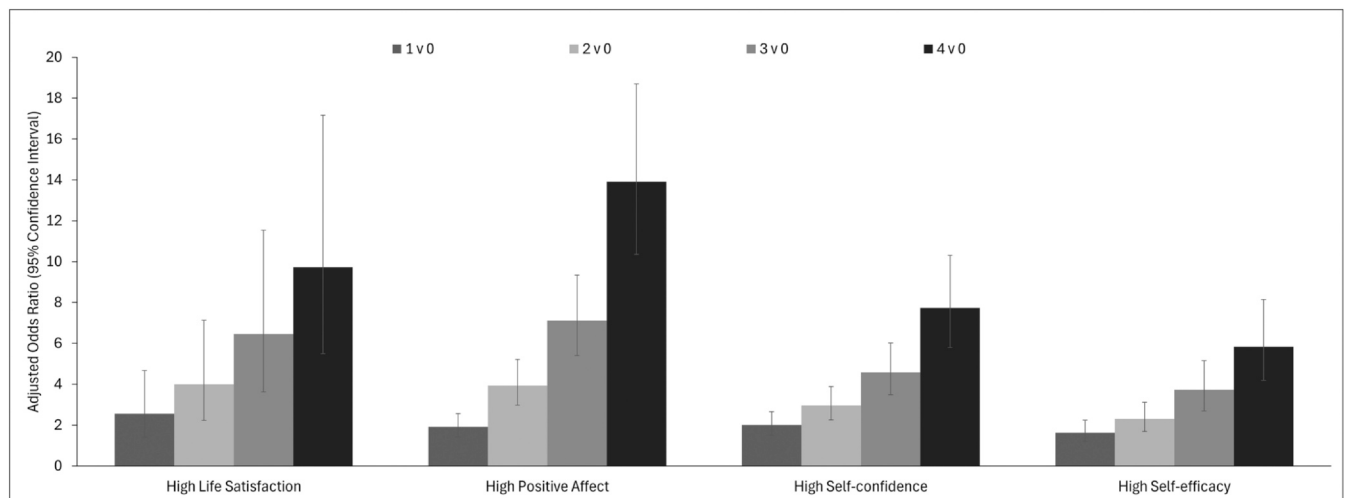


Fig. 1. Association between the sleep health composite score and positive mental health outcomes. Note: all models were adjusted for grade, gender, cultural/racial background, recreational screen time, physical activity, and socioeconomic status. 0 = meets no sleep health measures (reference group); 1 = meets one sleep health measure; 2 = meets two sleep health measures; 3 = meets three sleep health measures; 4 = meets all four sleep health measures.

have led to a response bias, but only if the associations of interest varied in cases with completed and incomplete data. Fourth, this study did not distinguish between short and long sleepers, which were both classified as not meeting sleep duration recommendations. Although there is some evidence to suggest that these groups are different, the long sleep duration group was rare in our sample (2.4%). Fifth, the 2017/2018 HBSC study did not distinguish between sex and gender. It is labeled gender in the current study and other HBSC reports, but the question asked, “are you male or female?” with the responses “male,” “female,” and “neither term describes me.” Sixth, the observed associations between sleep and positive affect could have been inflated as one of the items used in the WHO-5 Well-being Index asks about an aspect of sleep health (i.e., “I woke up feeling fresh and rested”). Finally, we were limited to the sleep data collected in the HBSC study.

Conclusion

Findings in this study suggest that good sleep health is strongly associated with higher odds of positive mental health (i.e., life satisfaction,

positive affect, self-confidence, and self-efficacy). These findings were largely consistent between boys and girls and younger and older adolescents. Further research is required to understand the temporality between sleep health and positive mental health, as well as underlying biopsychosocial mechanism by incorporating more longitudinal studies. Future studies may also benefit from the use of device-based measures of sleep health. Finally, it is important to study if strategies to improve sleep health will lead to improved positive mental health or vice versa.

Disclaimer

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

Author contributions

JR and JLL conceptualized the project and developed the methodology. JR ran the formal analysis and JLL validated the analysis. JR

wrote the original draft. All authors contributed to reviewing and editing the draft. JJL supervised and conducted the project administration.

Declaration of conflicts of interest

None declared.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.sleh.2024.09.008.

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