Original quantitative research

Investigating the association between sleep and aspects of mental health in children: findings from the Canadian Health Survey on Children and Youth

Chinchin Wang, MSc (1,2,3); Raelyne L. Dopko, PhD (1); Zahra M. Clayborne, PhD (1,4); Colin A. Capaldi, PhD (1); Karen C. Roberts, MSc (1); Marisol T. Betancourt, MSc, MD (1)

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Abstract

Introduction: Sufficient sleep and good quality sleep are crucial aspects of children's healthy development. While previous research has suggested associations between sleep and positive mental health, few studies have been conducted in Canadian children.

Methods: This study used data from the 2019 Canadian Health Survey on Children and Youth. Parents of children aged 5 to 11 years (N = 16 170) reported on their children's sleep habits and mental health. Descriptive statistics were used to calculate means and percentages for sleep and mental health indicators. Logistic regression was used to compare mental health outcomes by meeting sleep duration recommendations (9–11 hours of sleep vs. < 9 or > 11 hours of sleep), sleep quality (difficulties getting to sleep) and having enforced rules for bedtime.

Results: Overall, 86.2% of children aged 5 to 11 years met sleep duration recommendations (9–11 hours of sleep), 90.0% had high sleep quality and 83.1% had enforced rules for bedtime. While 83.0% of children had high general mental health, mental health diagnoses were reported for 9.5% of children, and 15.8% of children required or received mental health care. High sleep quality was consistently associated with better mental health, enforced rules for bedtime were associated with some negative mental health outcomes and meeting sleep duration recommendations tended not to be associated with mental health outcomes.

Conclusion: Sleep quality was strongly associated with mental health among children in this study. Future research should explore longitudinal associations between sleep and mental health in Canadian children.

Keywords: *sleep, sleeplessness, mental health, anxiety, depression, child functioning, Canadian children*

Introduction

Adequate nighttime sleep is important for optimal physical and mental development in children.[1] In 2016, the *Canadian 24-Hour Movement Guidelines for Children and Youth: An Integration of Physical Activity,* *Sedentary Behaviour, and Sleep* were released. These guidelines provide evidence-based recommendations for sleep, including sleeping an uninterrupted 9 to 11 hours per night for children aged 5 to 13 years, with consistent bed- and wake-up times.[2] Based on data from 2014–2015,

Highlights

- This study examined the relationships between indices of sleep health and mental health in children aged 5 to 11 years.
- In general, children had good sleep health and mental health.
- Sleep quality was strongly associated with mental health.
- The enforcement of bedtime rules was associated with poorer mental health.
- Meeting sleep duration recommendations tended not to be associated with mental health.

84% of Canadian children meet sleep duration recommendations.[3] Insufficient sleep in children has been associated with a range of negative outcomes, including obesity, lower academic achievement and lower health-related quality of life.[1,4,5]

Among children, good sleep health includes not only sleep duration but consideration of sleep quality (i.e. difficulties in getting to sleep) and sleep hygiene (i.e. practices that are conducive to sleep).[6] Data from 2014–2015 indicate that 8% of Canadian children have difficulties falling asleep or staying asleep most nights.[3] Like insufficient sleep, poor sleep quality is associated with a broad range of negative outcomes in children, including obesity, lower health-related quality of life and

Author references:

1. Public Health Agency of Canada, Ottawa, Ontario, Canada
2. Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Montréal, Quebec, Canada
3. Centre for Clinical Epidemiology, Lady Davis Institute for Medical Research, Montréal, Quebec, Canada
4. School of Epidemiology and Public Health, University of Ottawa, Ontario, Canada

Correspondence: Colin A. Capaldi, Public Health Agency of Canada, 785 Carling Ave., Ottawa, ON K1A 0K9; Tel: 613-299-7714; Email: colin.capaldi@phac-aspc.gc.ca

reduced cognitive development.[7-12] Enforcement of proper sleep hygiene in the form of consistent bedtime routines is associated with longer sleep duration and better sleep quality.[13]

Mental health difficulties are also a concern among children, with first onset of lifetime mental disorders typically occurring in childhood or adolescence.[14] One study found that 20% of Ontario children have parent- or teacher-reported symptoms of mental disorder.[15] An emerging body of evidence demonstrates associations between insufficient sleep duration, poor sleep quality and negative mental health outcomes (i.e. mental disorders and psychosocial difficulties) across childhood. Longitudinal studies have found that children with disturbed sleep have increased odds of depression compared to those without disturbed sleep.[16] Shorter sleep duration and lower sleep quality during childhood have been associated with greater internalizing symptoms (i.e. anxiety and depression) and inattention and/or hyperactivity both cross-sectionally[17,18] and into adulthood.[19] The associations between a child's sleep and mental health may be bidirectional, with some evidence of negative mental health outcomes predicting poor sleep.[20-22] Overall, sleep can have substantial implications for children's short- and long-term mental health and development.

The absence of mental disorders does not imply complete mental health.[23,24] Complete mental health comprises both the absence of mental disorders and the presence of well-being or positive mental health.[23] Well-being is modifiable, even in the presence of mental disorders.[24,25] Several studies have examined associations between children's sleep and positive mental health outcomes.[26-28] Both longer sleep duration and fewer sleep disturbances have been cross-sectionally associated with higher psychosocial well-being in children.[26] While meeting sleep duration recommendations has not been associated with fewer psychosocial difficulties in Canadian children, in Canadian youth, meeting sleep duration recommendations has been associated with higher life satisfaction, fewer emotional problems, higher self-rated mental health and higher prosocial behaviour.[27]

To our knowledge, no studies to date have examined associations between other sleep indicators (e.g. sleep quality and sleep hygiene) and positive or negative mental health in Canadian children. This research is needed to provide a more nuanced view of how sleep and children's mental health are intertwined, and to inform the development of targeted strategies for improving sleep and mental health outcomes in Canadian children.

The aim of this study is to examine the associations between three sleep indicators (meeting sleep duration recommendations, sleep quality and rules around bedtime) and indices of positive and negative mental health in a sample of Canadian children aged 5 to 11 years. This study also provides pre COVID-19 pandemic estimates on various sleep and mental health indicators among a sample of Canadian children.

Methods

Data source

Data used in this study are from the 2019 Canadian Health Survey on Children and Youth (CHSCY). CHSCY was a voluntary, cross-sectional survey conducted by Statistics Canada. It covered a sample of children and youth aged 1 to 17 years living in every province and territory in Canada, but excluded those living on First Nations reserves and other Indigenous settlements, those living in foster homes and the institutionalized population. The sampling frame comprised beneficiaries of the Canada child benefit, which covers 98% of the Canadian population aged 1 to 17 years in all provinces and 96% in all territories. Data collection occurred between February and August 2019. Data for children aged 1 to 11 years were collected by electronic questionnaires or telephone interviews, with the "person-most-knowledgeable" as the respondent. The person-most-knowledgeable was most often a parent of the child (98%).

This study focussed on children aged 5 to 11 years. Although nighttime sleep data were also collected for children aged 3 to 4 years, they were excluded from analyses because of high variability in responses (large coefficients of variation) and small sample sizes for this age range. Additionally, the Canadian sleep recommendations for this age range include naps, which were not assessed in the 2019 CHSCY.[29]

The overall response rate for children aged 5 to 11 years in the 2019 CHSCY was 57.8%. Statistics Canada generated sampling weights for each respondent based on the probability of selection, including an adjustment factor to attempt to account for nonresponse. Further details on the calculation of sampling weights are provided elsewhere.[30] There were 20 113 respondents on behalf of children aged 5 to 11 years; 16 170 (80.4%) respondents had complete sociodemographic and sleep data, and were included in this study. Approval for the conduct of CHSCY was obtained from Health Canada's Research Ethics Board, and informed consent and assent were obtained from all participants.

Measures

Sleep
Meeting sleep duration recommendations
Respondents were asked for the usual time their child fell asleep and woke up on weekdays and weekends. Average sleep duration was calculated as a weighted average over weekdays and weekends of the number of hours between sleep and wake time. Children were classified as meeting sleep duration recommendations if their average sleep duration was between 9 hours and 0 minutes and 11 hours and 0 minutes, and as not meeting recommendations if their average sleep duration was outside this range.[2] As a sensitivity analysis, children were classified as above sleep duration recommendations if their average sleep duration was over 11 hours and 0 minutes, and as below sleep duration recommendations if their average sleep duration was below 9 hours and 0 minutes.

Sleep quality
Respondents were asked how often their child had difficulties in getting to sleep in the past six months. High sleep quality was defined as having difficulties rarely or never, about once a month, or about once a week. Low sleep quality was defined as having difficulties getting to sleep more than once a week or most days. This coding aligns with the diagnostic criteria for insomnia (sleep difficulty ≥ 3 times a week)[31] and other studies.[32]

Rules around bedtime
Respondents were asked if there were rules for the time their child goes to bed (yes/no) and whether these rules were usually enforced (yes/no) as a measure of sleep hygiene.[33,34] Those with enforced

rules were considered to have rules around bedtime, while those without rules or with unenforced rules were considered not to have rules around bedtime.

Mental health
Overall mental health indicators
General mental health
Respondents were asked how their child's mental health was in general (excellent, very good, good, fair, or poor). Following the coding of a similar variable in the Positive Mental Health Surveillance Indicator Framework,[35] high general mental health was defined as excellent or very good. Further details on the development of this framework are provided elsewhere.[36]

Low anxiousness and sadness
Respondents were asked how often their child seemed very anxious, nervous or worried, as well as how often their child seemed very sad or depressed (daily, weekly, monthly, a few times a year, or never). Daily or weekly was classified as high anxiousness or high sadness; less often was classified as low anxiousness or low sadness. These items were from the Washington Group/UNICEF Module on Child Functioning.[37] Further details on its development are provided elsewhere.[38] The module only classifies "daily" responses as high anxiousness or sadness; however, we also classified "weekly" as high anxiousness or sadness based on response distributions, and to assess both severe and less severe emotional difficulties.

Psychosocial difficulty indicators
Psychosocial difficulties
Respondents were asked the degree to which their child had difficulties with (1) concentrating on an activity that they enjoy doing; (2) accepting changes in their routine; (3) controlling their behaviour compared to other children of the same age; and (4) making friends (no difficulty, some difficulty, a lot of difficulty, or cannot do at all). These items were from the Washington Group/UNICEF Module on Child Functioning. While this module classifies no or some difficulty as low difficulty, we classified children as having no difficulties versus any difficulties (some, a lot, or cannot do at all) based on response distributions, and to assess both severe and less severe psychosocial difficulties.

Mental health diagnoses and care indicators
Mood/anxiety/attention disorder diagnosis
Respondents were asked if their child had ever been diagnosed with (1) a mood disorder (e.g. depression, bipolar disorder, mania, dysthymia); (2) an anxiety disorder (e.g. phobia, obsessive-compulsive disorder, panic disorder); and (3) an attention deficit disorder or attention deficit hyperactivity disorder. If respondents answered yes to any of these questions, the child was coded as having been diagnosed with a mood/attention/anxiety disorder. These disorders were grouped together in the reporting of associations with sleep because there were few children diagnosed with each disorder.

Requiring/receiving mental health care
Respondents were asked if their child required or received services in the past 12 months for mental health issues or difficulties focussing or controlling behaviour, or from a psychologist, counsellor or psychiatrist. If respondents answered yes to any of these questions, the child was coded as requiring/receiving mental health care. These variables were grouped together because there were few children who required or received services.

Covariates
Several covariates were identified as potential confounders of the relationship between sleep and mental health: age (in years), sex, household income quintile, racialized group status, immigrant status and self-reported mental health of the person-most-knowledgeable.

Household income quintile
Respondents were asked for their total household income. Quintiles were calculated using sampling weights to account for the survey design. Income was determined using donor imputation for those who did not respond (8% of participants). Household income is a measure of socioeconomic status, which has been associated with both sleep[39] and mental health.[40]

Racialized group status
Respondents were asked about their child's cultural or ethnic background. Those who identified as White were classified as not part of a racialized group. Those who identified as having other backgrounds, including Indigenous, were designated as part of a racialized group. Racialized group status has been associated with both sleep and mental health.[41,42]

Immigrant status
Individuals were asked whether their child had ever been a landed immigrant (vs. born in Canada or had never been a landed immigrant). Immigrant status has been associated with both sleep and mental health.[42,43]

Self-reported mental health of person-most-knowledgeable
Respondents were asked how their mental health was in general (excellent, very good, good, fair, or poor). High general mental health was defined as excellent or very good. Parents' mental health has been associated with both their child's sleep and mental health.[44,45]

Analysis

Descriptive statistics were used to calculate means, percentages and 95% confidence intervals (CIs) for sociodemographic characteristics and sleep and mental health indicators overall and by sex (male, female). Overall percentages were also calculated for certain mental health indicators (low anxiousness, sadness and psychosocial difficulties) using the Washington Group/UNICEF Module on Child Functioning classification. Two-tailed hypothesis tests were used to identify differences between sexes under a significance level of 0.05.

Logistic regression was used to determine whether children who met sleep duration recommendations, when compared to children who did not meet recommendations, were more likely to have high general mental health, low anxiousness and low sadness, less likely to have psychosocial difficulties and a mood/anxiety/attention disorder diagnosis, and less likely to have required or received mental health care services in the past year. Sensitivity analyses were conducted comparing mental health outcomes between children who were above sleep duration recommendations with those who met recommendations, and children who were below sleep duration recommendations with those who met recommendations. Separate logistic regression analyses were also conducted using sleep quality and rules around bedtime as predictor variables.

Both unadjusted analyses and analyses with adjustment for potential confounders (age of child [in years], sex of child, household income quintile, racialized group status, immigrant status and self-reported mental health of the person-most-knowledgeable) were conducted. Significant differences by sex were assessed by including an interaction term between each sleep variable and sex in

the adjusted analyses. Sex-stratified analyses were also conducted. Associations were presented as odds ratios with 95% CIs. Associations with CIs that excluded the null odds ratio of 1.00 were considered statistically significant. Sensitivity analyses were conducted for the associations between sleep indicators and certain mental health indicators (low anxiousness, sadness and psychosocial difficulties) using the Washington Group/UNICEF Module on Child Functioning classification.

Sampling weights provided by Statistics Canada were used to attempt to account for nonresponse. Variance was estimated using the bootstrap resampling method with 1000 replications to account for the complex sampling design. Analyses were conducted in SAS Enterprise Guide version 7.1 (SAS Institute, Cary, NC, USA).

Results

Descriptive statistics for sleep, sociodemographic characteristics and mental health outcomes are presented in Table 1. Overall, 86.2% of children aged 5 to 11 years met sleep duration recommendations, with an average sleep duration of 10.2 hours (range: 5.5–14.2 hours). More children exceeded recommendations (10.3%) than were below recommendations (3.5%). High sleep quality was reported for 90.0% of children, and enforcement of bedtime rules was reported for 83.1% of children. There were no sex differences for any of these sleep measures.

The majority of children were reported as having high general mental health (83.0%), low anxiousness (82.7%; 95.0% using original Washington Group/UNICEF module classification) and low sadness (93.9%; 98.9% using original classification). The most commonly reported psychosocial issues were difficulty accepting changes in routine (32.3%; 5.3% using original classification), followed by difficulty controlling behaviour (28.3%; 4.3% using original classification), difficulty making friends (17.1%; 3.1% using original classification) and difficulty concentrating (9.2%; 1.2% using original classification). Mood/anxiety/attention disorder diagnoses were reported for 9.5% of children, with attention disorders being most common (7.6%) followed by anxiety (3.2%) and mood disorders (0.6%), and 15.8% of children required or received mental health care in the past 12 months. High general mental health was more common

in females (85.3%) than males (80.8%). Psychosocial difficulties, mood/anxiety/attention disorder diagnoses, and requiring or receiving mental health care in the past year were more common in males than females. The sex difference for mood/anxiety/attention disorders was largely driven by a relatively high proportion of males having been diagnosed with attention disorders (10.8% vs. 4.2% for females).

Associations between mental health outcomes and meeting, exceeding or being below sleep duration recommendations are presented as odds ratios in Table 2. Children who met recommendations were less likely to have difficulty concentrating, accepting change and controlling behaviour, but not after covariates were controlled for. Meeting sleep duration recommendations was not associated with any other mental health outcomes overall. However, females who met recommendations were more likely to have high general mental health than females who did not meet recommendations, and males who met recommendations were less likely to have difficulty concentrating than males who did not meet recommendations in adjusted analyses (although interaction terms between sex and meeting sleep duration recommendations were not statistically significant for these outcomes). There were no other associations when stratified by sex. In sensitivity analyses, not getting enough sleep tended to be more highly associated with poorer mental health than getting too much sleep.

Associations between mental health outcomes and sleep quality are presented in Table 3. Children with high sleep quality were more likely to have high general mental health, low anxiousness and low sadness, and less likely to have psychosocial difficulties, to have a mood/anxiety/attention disorder diagnosis and to have required or received mental health care in the past year both overall (unadjusted and adjusted for covariates) and when stratified by sex.

Associations between mental health outcomes and enforced rules around bedtime are presented in Table 4. Children with enforced rules around bedtime were more likely to have a mood/anxiety/attention disorder diagnosis, require or receive mental health care, have high anxiousness,

and have difficulty accepting changes in routine and controlling their behaviour both overall (unadjusted and adjusted for covariates) and when stratified by sex. Having enforced rules around bedtime was associated with difficulty making friends overall, but not when stratified by sex. Having enforced rules around bedtime was not associated with general mental health, sadness, or difficulty concentrating overall or when stratified by sex.

When certain mental health outcomes (low anxiousness, low sadness, and psychosocial difficulties) were defined using the Washington Group/UNICEF Module on Child Functioning classification, associations with sleep quality were in the same direction but of a larger magnitude than the primary results (data not shown due to high sampling variability). Associations with meeting sleep duration recommendations and enforced rules around bedtime were similar to the primary results.

Discussion

The objective of this study was to assess associations between sleep indices and mental health measures in children aged 5 to 11 years. Overall, high sleep quality was consistently associated with better mental health, enforcement of bedtime rules was associated with some negative mental health outcomes, and meeting sleep duration recommendations tended to not be associated with mental health outcomes. Although males generally had lower mental health than females, sex tended to not moderate the association between sleep and mental health in this study (except for high sleep quality's negative association with some psychosocial difficulties and mood/anxiety/attention disorder diagnoses being stronger for males than females).

The *Canadian 24-Hour Movement Guidelines for Children and Youth: An Integration of Physical Activity, Sedentary Behaviour, and Sleep* recommend that children aged 5 to 13 years obtain 9 to 11 hours of uninterrupted sleep per night for optimal health benefits, with consistent bed and wake times.[2] Most previous studies, but not all, have found associations between longer sleep duration and better emotional regulation (e.g. less stress and anxiety, and fewer depressive symptoms) in children.[1] Meeting sleep duration recommendations was associated with higher life satisfaction,

TABLE 1
Descriptive statistics for sleep variables, mental health outcomes and covariates for children aged 5 to 11 years, 2019 CHSCY

	Overall (N = 16 170)			Female (N = 7831)			Male (N = 8339)			Sex comparison (significance level)[a]
	%	95% CI Lower	95% CI Upper	%	95% CI Lower	95% CI Upper	%	95% CI Lower	95% CI Upper	
Total	100.0	N/A	N/A	48.8	48.6	50.0	51.2	51.0	51.4	
Sleep										
Met sleep duration recommendations (9–11 hours per night)	86.2	85.4	86.9	85.4	84.3	86.4	86.9	85.9	88.0	*
Exceeded sleep duration recommendations (> 11 hours per night)	10.3	9.6	10.9	11.2	10.2	12.1	9.4	8.6	10.3	**
Below sleep duration recommendations (< 9 hours per night)	3.5	3.1	3.9	3.5	2.8	4.1	3.6	3.0	4.2	
High sleep quality (difficulties getting to sleep ≤ once a week)	90.0	89.3	90.7	90.0	89.0	91.0	90.1	89.1	91.0	
Enforced rules around bedtime	83.1	82.3	83.9	82.5	81.3	83.7	83.6	82.5	84.7	
Child mental health										
Overall mental health										
High general mental health (excellent or very good mental health)	83.0	82.2	83.9	85.3	84.2	86.5	80.8	79.6	82.0	***
Low anxiousness (seems very anxious, nervous, or worried less than weekly)	82.7	81.9	83.5	83.8	82.6	84.9	81.7	80.4	82.9	**
Low sadness (seems very sad or depressed less than weekly)	93.9	93.4	94.5	94.7	94.0	95.4	93.2	92.4	94.0	*
Psychosocial difficulties										
At least some difficulty concentrating	9.2	8.5	9.9	7.3	6.5	8.2	11.0	10.0	12.1	***
At least some difficulty accepting changes in routine	32.3	31.3	33.3	28.6	27.2	30.0	35.8	34.3	37.3	***
At least some difficulty controlling behaviour	28.3	27.3	29.3	21.2	19.9	24.5	35.0	33.5	36.5	***
At least some difficulty making friends	17.1	16.2	17.9	14.8	13.7	15.9	19.2	18.0	20.4	***
Mental health diagnoses and care										
Mood/anxiety/attention disorder diagnosis	9.5	8.9	10.2	6.0	5.2	6.8	12.9	11.8	14.0	***
Mood disorder diagnosis	0.6	0.4	0.8	0.3[c]	0.1	0.4	0.9[c]	0.7	1.2	***
Anxiety disorder diagnosis	3.2	2.8	3.6	2.5	2.0	3.0	3.9	3.3	4.5	***
Attention disorder diagnosis	7.6	7.0	8.2	4.2	3.5	4.9	10.8	9.8	11.8	***
Required/received mental health care in the past 12 months	15.8	14.9	16.6	11.7	10.7	12.8	19.6	18.3	20.9	***
Covariates										
Racialized group	33.3	32.2	34.3	32.5	31.1	34.0	33.9	32.5	35.4	
Immigrant	7.7	7.1	8.4	7.8	7.0	8.6	7.7	6.8	8.6	
Person-most-knowledgeable self-rated high mental health (excellent or very good mental health)	71.5	70.6	72.5	71.4	70.0	72.8	71.7	70.3	73.1	
Median household income[b] (CAD)	89 963	49 834	139 909	89 926	49 403	139 740	90 931	50 982	144 758	

Abbreviations: CAD, Canadian dollars; CHSCY, Canadian Health Survey on Children and Youth; CI, confidence interval.

[a] Significance level for the difference between females and males.

[b] The median household income (CAD), quartile 1, and quartile 3 are presented in place of %, 95% CI lower and 95% CI upper.

[c] Estimate should be interpreted with caution due to high sampling variability.

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

TABLE 2

Odds ratios for mental health among children aged 5 to 11 years by whether they meet sleep duration recommendations (9–11 hours of sleep per night), 2019 CHSCY

| | Univariate models | | | Adjusted models | | | | | | | | | Sex comparison (significance level)[a] |
| | Both sexes (N = 16 170) | | | Both sexes (N = 16 170) | | | Females (N = 7831) | | | Males (N = 8339) | | | |
	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	
Meeting vs. not meeting sleep duration recommendations													
Overall mental health													
High general mental health (excellent or very good mental health)	1.12	0.94	1.34	1.15	0.94	1.40	**1.40**	1.04	1.88	0.98	0.75	1.27	
Low anxiousness (seems very anxious, nervous or worried less than weekly)	0.95	0.80	1.13	0.97	0.80	1.16	1.02	0.78	1.35	0.92	0.72	1.18	
Low sadness (seems very sad or depressed less than weekly)	0.94	0.71	1.22	0.89	0.67	1.18	0.83	0.56	1.23	0.93	0.63	1.38	
Psychosocial difficulties													
At least some difficulty concentrating	**0.78**	0.62	0.97	0.81	0.65	1.01	0.92	0.64	1.32	**0.74**	0.56	0.98	
At least some difficulty accepting changes in routine	**0.86**	0.75	0.99	0.88	0.77	1.01	0.83	0.68	1.01	0.94	0.78	1.13	
At least some difficulty controlling behaviour	**0.84**	0.73	0.67	0.87	0.75	1.01	0.85	0.68	1.06	0.89	0.73	1.08	
At least some difficulty making friends	1.01	0.85	1.19	0.99	0.83	1.18	0.94	0.71	1.24	1.04	0.83	1.31	
Mental health diagnoses and care													
Mood/anxiety/attention disorder diagnosis	0.96	0.77	1.20	0.83	0.66	1.04	0.80	0.53	1.22	0.85	0.65	1.12	
Required/received mental health care in the past 12 months	0.94	0.79	1.13	0.88	0.73	1.06	0.85	0.62	1.15	0.91	0.71	1.15	
Exceeding vs. meeting sleep duration recommendations													
General mental health													
High general mental health (excellent or very good mental health)	**1.25**	1.01	1.54	1.04	0.82	1.31	0.99	0.68	1.45	1.07	0.79	1.44	
Low anxiousness (seems very anxious, nervous or worried less than weekly)	**1.23**	1.01	1.51	1.13	0.91	1.40	1.14	0.83	1.57	1.11	0.83	1.49	
Low sadness (seems very sad or depressed less than weekly)	1.33	0.96	1.85	1.33	0.95	1.88	1.71	0.98	3.00	1.12	0.73	1.72	
Psychosocial difficulties													
At least some difficulty concentrating	1.19	0.93	1.54	1.17	0.90	1.53	1.03	0.68	1.57	1.29	0.92	1.81	
At least some difficulty accepting changes in routine	1.09	0.94	1.26	1.06	0.91	1.23	1.22	0.98	1.52	0.91	0.74	1.13	
At least some difficulty controlling behaviour	1.12	0.96	1.31	1.07	0.90	1.26	1.10	0.85	1.41	1.04	0.83	1.31	
At least some difficulty making friends	0.85	0.69	1.05	0.92	0.74	1.16	0.98	0.69	1.40	0.88	0.67	1.16	

Continued on the following page

TABLE 2 (continued)

Odds ratios for mental health among children aged 5 to 11 years by whether they meet sleep duration recommendations (9–11 hours of sleep per night), 2019 CHSCY

| | Univariate models | | | Adjusted models | | | | | | | | | Sex comparison (significance level)[a] |
| | Both sexes (N = 16 170) | | | Both sexes (N = 16 170) | | | Females (N = 7831) | | | Males (N = 8339) | | | |
	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	
Mental health diagnoses and care													
Mood/anxiety/attention disorder diagnosis	**0.64**	0.47	0.86	0.97	0.71	1.32	1.03	0.55	1.91	0.93	0.66	1.32	
Required/received mental health care in the past 12 months	0.88	0.71	1.08	1.10	0.88	1.37	1.18	0.83	1.69	1.04	0.77	1.39	
Being below vs. meeting sleep duration recommendations													
Overall mental health													
High general mental health (excellent or very good mental health)	**0.44**	0.33	0.58	**0.63**	0.45	0.90	**0.39**	0.23	0.65	0.95	0.58	1.56	**
Low anxiousness (seems very anxious, nervous or worried less than weekly)	**0.72**	0.53	0.97	0.86	0.62	1.19	0.69	0.43	1.11	1.04	0.68	1.58	
Low sadness (seems very sad or depressed less than weekly)	0.67	0.44	1.02	0.82	0.53	1.23	0.66	0.39	1.11	0.99	0.49	2.01	
Psychosocial difficulties													
At least some difficulty concentrating	**1.58**	1.05	2.36	1.40	0.93	2.10	1.26	0.62	2.56	1.49	0.90	2.46	
At least some difficulty accepting changes in routine	**1.38**	1.06	1.80	**1.36**	1.04	1.78	1.15	0.76	1.75	**1.55**	1.09	2.20	
At least some difficulty controlling behaviour	**1.40**	1.07	1.83	**1.40**	1.06	1.86	1.45	0.92	2.28	1.37	0.95	1.96	
At least some difficulty making friends	**1.47**	1.11	1.96	1.21	0.90	1.62	1.30	0.84	2.00	1.14	0.76	1.72	
Mental health diagnoses and care													
Mood/anxiety/attention disorder diagnosis	**2.43**	1.74	3.41	**1.58**	1.13	2.21	1.57	0.89	2.77	**1.58**	1.02	2.43	
Required/received mental health care in the past 12 months	**1.67**	1.22	2.27	1.22	0.88	1.68	1.18	0.68	2.05	1.24	0.82	1.89	

Abbreviations: CHSCY, Canadian Health Survey on Children and Youth; CI, confidence interval; OR, odds ratio.

Notes: Adjusted models for both sexes, females and males included age of child in years, racialized group status, immigrant status, household income quintile and person-most-knowledgeable self-rated mental health as covariates. The both-sexes adjusted models also included sex as a covariate.
Bolded estimates have confidence intervals that exclude the null odds ratio of 1.00, and are considered statistically significant.

[a] Significance level for a difference in odds ratio by sex, based on including a sex interaction term in the both-sexes adjusted model.

* *p* < 0.05

** *p* < 0.01

*** *p* < 0.001

fewer emotional problems and higher prosocial behaviour in a representative sample of Canadians aged 10 to 17 years,[28] although it was not associated with psychosocial difficulties in Canadians aged 5 to 11 years using national data from 2015.[27] We found little evidence of associations between meeting sleep duration recommendations and mental health. However, sensitivity analyses showed some associations between not getting enough sleep and poorer mental health. Mental health difficulties tend to manifest and be diagnosed later in childhood,[15] and more Canadian children meet sleep duration recommendations than youth.[27] Therefore, associations with sleep duration recommendations may be less apparent in the 5 to 11 years age group.

Consistent with prior research,[9,21,26] high sleep quality was associated with better mental health. Associations were strongest for mood/anxiety/attention disorder diagnosis and requiring/receiving mental health care. These were indicative of more severe mental health difficulties, while general mental health, anxiousness and sadness, and psychosocial difficulties grouped those with both severe and less

TABLE 3

Odds ratios for mental health among children aged 5 to 11 years with high sleep quality (difficulties getting to sleep ≤ once a week) versus low sleep quality (difficulties getting to sleep ≥ 3 times per week), 2019 CHSCY

	Univariate models			Adjusted models									Sex comparison (significance level)[a]
	Both sexes (N = 16 170)			Both sexes (N = 16 170)			Females (N = 7831)			Males (N = 8339)			
	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	
Overall mental health													
High general mental health (excellent or very good mental health)	**4.27**	3.62	5.03	**3.40**	2.75	4.19	**3.05**	2.19	4.25	**3.75**	2.84	4.96	
Low anxiousness (seems very anxious, nervous or worried less than weekly)	**4.24**	3.10	4.98	**3.48**	2.92	4.15	**3.21**	2.51	5.27	**3.79**	2.98	4.81	
Low sadness (seems very sad or depressed less than weekly)	**4.39**	3.51	5.47	**3.56**	2.83	4.49	**2.95**	2.10	4.15	**4.20**	3.08	5.72	
Psychosocial difficulties													
At least some difficulty concentrating	**0.32**	0.26	0.39	**0.38**	0.31	0.47	**0.42**	0.31	0.56	**0.36**	0.27	0.47	
At least some difficulty accepting changes in routine	**0.34**	0.29	0.39	**0.39**	0.33	0.46	**0.50**	0.40	0.62	**0.30**	0.24	0.38	**
At least some difficulty controlling behaviour	**0.29**	0.25	0.34	**0.33**	0.28	0.38	**0.38**	0.30	0.48	**0.28**	0.22	0.35	*
At least some difficulty making friends	**0.38**	0.32	0.45	**0.45**	0.38	0.53	**0.57**	0.44	0.73	**0.37**	0.29	0.46	**
Mental health care and diagnoses													
Mood/anxiety/attention disorder diagnosis	**0.20**	0.16	0.24	**0.24**	0.19	0.29	**0.30**	0.21	0.41	**0.20**	0.16	0.26	*
Required/received mental health care in the past 12 months	**0.17**	0.13	0.21	**0.23**	0.18	0.29	**0.22**	0.15	0.32	**0.23**	0.17	0.32	

Abbreviations: CHSCY, Canadian Health Survey on Children and Youth; CI, confidence interval; OR, odds ratio.

Notes: Adjusted models for both sexes, females and males included age of child in years, racialized group status, immigrant status, household income quintile and person-most-knowledgeable self-rated mental health as covariates. The both-sexes adjusted models also included sex as a covariate.
Bolded estimates have confidence intervals that exclude the null odds ratio of 1.00, and are considered statistically significant.

[a] Significance level for a difference in odds ratio by sex, based on including a sex interaction term in the both-sexes adjusted model.

* *p* < 0.05

** *p* < 0.01

*** *p* < 0.001

severe difficulties. When psychosocial difficulties were defined using the Washington Group/UNICEF Module classification (i.e. focussing on severe difficulties), associations were of similar magnitude as those for mood/anxiety/attention disorder diagnosis and requiring/receiving mental health care. Notably, associations between sleep quality and outcomes grouping severe and less severe difficulties were still of large magnitude.

Research suggests that associations between sleep quality and children's positive and negative mental health outcomes may be bidirectional.[20,21] Longitudinal studies, as opposed to cross-sectional studies, are needed to ascertain directionality. A systematic review found that most longitudinal studies supported a bidirectional relationship between insomnia and anxiety and depression, sleep quality and depression/anxiety and sleep quality and mental health status.[46] However, studies looking specifically at children identified unidirectional relationships between sleep problems and depression/anxiety.[46] The directionality between sleep quality and mental health may also depend on the mental health outcome being measured. Studies have found bidirectional relationships between childhood sleep problems and externalizing difficulties[21] as well as behavioural difficulties.[47] Although more longitudinal research is needed, current evidence suggests that both mental and sleep health promotion are important for optimal health and well-being.

Sleep hygiene was assessed in this study by the enforcement of rules around bedtime. Consistent bedtimes are a commonly recommended practice to promote longer and better quality sleep in children.[13,33] Having enforced rules for bedtime has been associated with longer sleep duration and higher sleep quality in American children,[33] and with meeting sleep recommendations on weekdays in a study of 1622 Ontario parents and their children.[34] Inconsistent sleep and wake times have been associated with emotional difficulties in Australian children.[48] Inconsistent sleep times were also associated with

TABLE 4

TABLE 4
Odds ratios for mental health among children aged 5 to 11 years with enforced rules for bedtime versus no enforced rules for bedtime, 2019 CHSCY

| | Univariate models | | | Adjusted models | | | | | | | | | Sex comparison (significance level)[a] |
| | Both sexes (N = 16 170) | | | Both sexes (N = 16 170) | | | Females (N = 7831) | | | Males (N = 8339) | | | |
	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	OR	95% CI Lower	95% CI Upper	
Overall mental health													
High general mental health (excellent or very good mental health)	0.85	0.72	1.00	0.92	0.75	1.12	0.89	0.67	1.19	0.95	0.73	1.23	
Low anxiousness (seems very anxious, nervous or worried less than weekly)	**0.58**	0.48	0.69	**0.65**	0.54	0.78	**0.63**	0.48	0.83	**0.66**	0.51	0.84	
Low sadness (seems very sad or depressed less than weekly)	1.04	0.81	1.35	1.10	0.84	1.44	1.27	0.88	1.83	0.96	0.67	1.38	
Psychosocial difficulties													
At least some difficulty concentrating	1.02	0.82	1.28	0.94	0.75	1.19	1.02	0.71	1.46	0.90	0.66	1.23	
At least some difficulty accepting changes in routine	**1.56**	1.37	1.79	**1.41**	1.22	1.63	**1.32**	1.07	1.63	**1.49**	1.23	1.81	
At least some difficulty controlling behaviour	**1.49**	1.30	1.71	**1.36**	1.16	1.58	**1.45**	1.14	1.85	**1.29**	1.05	1.59	
At least some difficulty making friends	**1.27**	1.08	1.50	**1.23**	1.03	1.45	1.22	0.93	1.59	1.23	0.98	1.55	
Mental health care and diagnoses													
Mood/anxiety/attention disorder diagnosis	**1.65**	1.28	2.13	**1.49**	1.13	1.97	**1.70**	1.03	2.79	**1.41**	1.00	1.97	
Required/received mental health care in the past 12 months	**1.69**	1.40	2.06	**1.48**	1.19	1.83	**1.73**	1.22	2.44	**1.34**	1.02	1.77	

Abbreviations: CHSCY, Canadian Health Survey on Children and Youth; CI, confidence interval; OR, odds ratio.

Notes: Adjusted models for both sexes, females and males included age of child in years, racialized group status, immigrant status, household income quintile and person-most-knowledgeable self-rated mental health as covariates. The both-sexes adjusted models also included sex as a covariate.
Bolded estimates have confidence intervals that exclude the null odds ratio of 1.00, and are considered statistically significant.

[a] Significance level for a difference in odds ratio by sex, based on including a sex interaction term in the both-sexes adjusted model.

[*] $p < 0.05$

[**] $p < 0.01$

[***] $p < 0.001$

behavioural difficulties among children in the UK, and improvements in sleep time consistency were associated with behavioural improvements.[49] While the promotion of consistent sleep could have mental health benefits, we found that having enforced rules around bedtime was associated with high anxiety, difficulty accepting changes in routine and controlling behaviour, mood/anxiety/attention disorder diagnosis, and requiring/receiving mental health care.

The manner in which rules for bedtime are enforced may inform their associations with negative mental health outcomes. For example, harsh parenting (e.g. enforcing rules through raising one's voice/scolding/yelling) and highly controlling parenting have been linked to negative mental health outcomes in children and adolescents, particularly among males.[50-52] Meanwhile, authoritative parenting (enforcement of rules combined with parental warmth) has been linked to less negative outcomes.[52] These associations may be bidirectional, as there is evidence that parents of children who are known to have mental health difficulties are more likely to enforce rules harshly relative to those without difficulties.[51-53] Further research is needed in this area to best guide sleep hygiene recommendations.

Strengths and limitations

A major strength of the current study is the use of a survey that collected data on numerous sleep and mental health indicators among children aged 5 to 11 years living in every province and territory in Canada. These estimates can be used as a baseline to compare sleep and mental health outcomes before, during and after the COVID-19 pandemic. To our knowledge, this study was also the first to assess the association between multiple sleep indicators (meeting sleep duration recommendations, sleep quality and enforced rules around bedtime) and mental health in this population. Multiple covariates were controlled for, including the person-most-knowledgeable's self-reported mental health.

However, the cross-sectional study design prevents inferences on causality and the

directionality between sleep and mental health. The observed associations are likely a combination of the effects of sleep on mental health and mental health on sleep, as well as residual confounding of other factors related to both sleep and mental health (e.g. by physical activity, family structure, stress, trauma). Furthermore, sleep and mental health measures were reported by the person-most-knowledgeable, and may be prone to social desirability and recall biases as well as measurement error.[54] While self-reported and parent-reported measures of child mental health are positively associated, the correlation is not perfect[55] and initial analyses of the 2019 CHSCY suggest that discrepancies between youth and person-most-knowledgeable perceptions of youth general mental health are not uncommon.[56] The assessment of mental health may be affected by sociodemographic characteristics that we did not account for (e.g. education).

Sleep quality can be assessed in multiple ways, including difficulties falling or staying asleep, sleep efficiency (ratio of total sleep time to time in bed), time taken to fall asleep and the number and length of awakenings overnight.[6] This study was only able to assess difficulties falling asleep, as reported by the person-most-knowledgeable. Similarly, sleep hygiene encompasses a variety of practices that promote sleep, including consistent bedtimes, daytime exercise and limiting screen time.[57] This study only assessed the enforcement of rules around bedtime, which were associated with some negative mental health outcomes. Ascertaining the manner in which rules are enforced (e.g. harshly or warmly) may provide more context to the observed associations. Assessing additional sleep quality measures and sleep hygiene practices in future studies would better inform the relationship between sleep and mental health.

Despite the large sample size, there were few children who were diagnosed with a mood, anxiety or attention disorder, and few children who required or received services from a psychologist, counsellor or psychiatrist, or for mental health issues or difficulty focussing or controlling behaviour. Diagnosed mood disorder in particular had a low prevalence of 0.6%. Therefore, these variables were grouped together and results should not be interpreted as being applicable to a specific mental health disorder or service.

Assessing these variables individually could provide more information about associations between sleep and specific mental health disorders and services.

Furthermore, a large majority of children met sleep duration recommendations and had high sleep quality and enforced rules around bedtime, high mental health and low psychosocial difficulties. Oversampling children with mental health difficulties in subsequent surveys and studying longitudinal associations between childhood sleep and mental health at later ages (e.g. adolescence) may provide more insight into the relationship between sleep and mental health.

Finally, the majority of mental health outcomes we examined were negative outcomes. Future research should target additional positive mental health outcomes (e.g. life satisfaction).[25]

Conclusion

In this sample of Canadian children aged 5 to 11 years, high sleep quality was strongly and consistently associated with better mental health outcomes. In contrast, the enforcement of bedtime rules was modestly associated with some negative mental health outcomes, and meeting sleep duration recommendations tended not to be associated with the examined mental health outcomes. These findings suggest that poor sleep quality may be associated with severe and less severe mental health difficulties during childhood. Given their potentially bidirectional relationship, as documented in other literature, this highlights the importance of promoting both good sleep health and mental health in children. Future research should explore longitudinal associations between sleep and mental health in this population.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Authors' contributions and statement

RLD, CAC, KCR and MTB conceptualized the study. CW, RLD, CAC, KCR and MTB designed the study and analytic approach. CW conducted the statistical analyses. CW, RLD, ZMC and CAC interpreted the results. CW, RLD and ZMC drafted the

initial manuscript. All authors contributed to reviewing and editing the manuscript. All authors approved the manuscript for publication.

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