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Public Health

journal homepage: www.elsevier.com/puhe

Short Communication

Are Canadian children and adolescents sleep deprived?

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ARTICLE INFO

Article history:

Received 11 May 2016

Received in revised form

11 July 2016

Accepted 11 September 2016

Introduction

Sleep is essential to human health and healthy sleep requires adequate duration, good quality, appropriate timing and regularity and the absence of sleep disturbances or disorders. However, insufficient sleep has become common in modern societies with studies showing declines in sleep duration and more sleep problems and tiredness now compared with decades ago in children and adolescents.^{1,2} An accumulating body of evidence shows that insufficient sleep is associated with adverse physical and mental health outcomes. For example, a recent systematic review that examined the relationships between sleep duration and various health outcomes in children and adolescents from 40 different countries found that longer sleep duration was associated with lower adiposity, better emotional regulation, better academic achievement and better quality of life/well-being.³

The National Sleep Foundation in the USA recommends that children aged 6–13 years sleep 9–11 h/night and

adolescents aged 14–17 years sleep 8–10 h/night.⁴ These sleep duration recommendations have recently been supported and adopted in Canada.⁵ Although the ideal amount of sleep may vary from one person to another, sleep duration recommendations are important for surveillance and help to inform public policies, interventions, and the population of healthy sleep behaviours.

There is no doubt that sleep is increasingly recognized as an important component for optimal health; however, studies reporting on sleep using a representative sample of Canadian children and adolescents are lacking. Knowing the proportion of children and adolescents getting insufficient sleep is important given that sleep is critical for healthy growth and development and will allow to determine the extent of the problem. This information will also help to better tailor and target future interventions aimed at improving sleep habits in this paediatric population. Therefore, the objective of this study was to provide recent sleep duration and quality estimates of Canadian children and adolescents, and to determine the proportion of them adhering to current sleep duration guidelines.

Data used in this study were from the Canadian Health Measures Survey (CHMS), an ongoing cross-sectional survey that collects data from a representative sample of the population living in Canada. Cycle 1 (2007–2009), cycle 2 (2009–2011) and cycle 3 (2012–2013) were used for the present analyses. Health Canada's Research Ethics Board approved the conduct of CHMS and written informed consent and assent were obtained.

In the present study, 6–17 years old participants from CHMS' Cycles 1–3 were included. For descriptive and

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<http://dx.doi.org/10.1016/j.puhe.2016.09.009>

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comparative purposes, participants were grouped into the following age categories: school-aged children (6–13 years old; $n = 2043$ boys, 1980 girls) and adolescents (14–17 years old; $n = 829$ boys, 778 girls). Comparisons were also made across genders ($n = 2872$ boys, 2758 girls). Responses to the questionnaire were provided by the parent or legal guardian for 80.1% of children and 1.9% of adolescents.

Sleep duration and quality were either parent-reported (ages 6–11 years) or self-reported (ages 12–17 years). CHMS assessed the amount of sleep using the following question in the household questionnaire: ‘How many hours do you usually spend sleeping in a 24-hour period, excluding time spent resting?’ Responses were rounded to the closest half hour by the interviewer. In addition to sleep duration, sleep quality was assessed using the following questions: (1) ‘how often do you have trouble going to sleep or staying asleep?’ and (2) ‘how often do you find it difficult to stay awake during your normal waking hours when you want to?’ For both questions, response options were ‘never’, ‘rarely’, ‘sometimes’, ‘most of the time’ and ‘all of the time’. Participants who responded ‘don’t know’ or who did not answer the question were removed from the analyses ($n = 3$). Finally, participants were classified as meeting the recommended range of sleep duration (9–11 h/night for 6–13 years old or 8–10 h/night for 14–17 years old), sleeping less than the recommended range or sleeping longer than the recommended range.^{4,5}

To account for the survey design, the means and percentages were estimated using survey weights and their variances were estimated using the survey bootstrap technique. Then, 95% confidence intervals were calculated and small percentage confidence intervals were used by SUDAAN version 11 for estimated percentages $\leq 5\%$. *t*-Tests were performed to compare means and proportions between different domains. *P*-values were adjusted for multiple comparisons using the false discovery rate (FDR) adjustment method and differences between estimates were tested for statistical significance at a FDR adjusted *P*-value < 0.05 . All analyses were conducted with SAS version 9.3 and SUDAAN version 11.

Proportion of children and adolescents meeting the sleep duration recommendations

Overall, with the three cycles combined ($n = 5625$), mean self-reported sleep duration was 9.43 h/night (95% CI 9.37–9.48) for 6–13 years old and 8.07 h/night (95% CI 7.96–8.19) for 14–17 years old. Adolescents slept significantly less than children (by ~1.4 h on average) and sleep duration was not significantly different between boys and girls. Trends over time revealed no significant differences in sleep duration.

With regard to sleep quality, 32.4% (95% CI 29.4–35.4) of 6–13 years old and 42.0% (95% CI 38.3–45.8) of 14–17 years old reported trouble going to sleep or staying asleep ‘sometimes/most of the time/all of the time’ when all three cycles of the CHMS were combined ($n = 5628$). Likewise, 11.0% (95% CI 9.1–13.3) of 6–13 years old and 31.5% (95% CI 28.5–34.7) of 14–17 years old reported difficulty staying awake during normal waking hours ‘sometimes/most of the time/all of the

time’ in the combined cycles ($n = 5629$; $P < 0.05$ between children and adolescents). Trends over time did not really reveal differences and there were no significant differences between boys and girls.

Table 1 shows the proportion of children and adolescents meeting the current recommendations for sleep duration. Overall, 78.2% (95% CI 76.0–80.2) of children met the sleep duration recommendations, 20.2% (95% CI 18.2–22.4) were short sleepers, and 1.6% (95% CI 1.2–2.0) were long sleepers with all three cycles combined ($n = 4020$). In adolescents, 67.8% (95% CI 64.2–71.3) met the sleep duration recommendations, 29.8% (95% CI 26.2–33.8) were short sleepers, and 2.4% (95% CI 1.2–4.0) were long sleepers ($n = 1605$). Trends over time did not really reveal significant changes and differences between boys and girls were minimal. Although the proportion of short sleepers was generally higher in adolescents compared to children, very few comparisons turned out to be significant after adjustment for multiple comparisons.

Public health implications of these findings

Short sleep duration and poor sleep quality are highly prevalent in Canadian youth, especially in adolescents. The finding that about one-third of adolescents sleep less than the recommended amount may be concerning given the well-documented adverse effects of insufficient sleep on physical and mental health. However, one needs to remember that sleeping less than the recommended amount does not necessarily imply that it will adversely impact health (our sleep needs are largely explained by our genes and can be different between individuals). Future research is needed to determine the proportion of these short sleepers having adverse health outcomes. More efforts should also be deployed to find ways to improve sleep hygiene, particularly in teenagers.

A key finding of this study is the fact that more adolescents than children are short sleepers and report sleep problems and tiredness during the day. This suggests that future public health policies or intervention strategies may want to particularly target this adolescent population. For example, early school start times have been shown to contribute to insufficient sleep in teenagers who normally should go to bed later due to biological changes associated with puberty (teenagers have a phase delay of up to 2 h relative to middle childhood).^{6,7} Intervention research has shown that delaying school start times approximately 1 h later increases students’ sleep duration, decreases daytime sleepiness and provides important benefits with regard to physical and mental health, safety and academic achievement.^{6,7} Other factors to consider include excessive demands on students’ time because of homework, extracurricular activities, after-school employment, social activities, electronic media use, caffeine/alcohol use and lack of parental monitoring or rules about bedtimes.⁸

Findings observed in the present study also show that long sleepers are rare and comprise approximately 2% of the sample. Future sleep duration recommendations for children and adolescents should consider using a threshold value

Table 1 – Proportion of children and adolescents meeting the sleep duration recommendations.^a

Age and gender group	Cycle 1 (2007–2009) n = 1881			Cycle 2 (2009–2011) n = 1914			Cycle 3 (2012–2013) n = 1830		
	Recommended	Short sleep	Long sleep	Recommended	Short sleep	Long sleep	Recommended	Short sleep	Long sleep
Both genders	81.2 (76.9–84.8)	16.4 (12.7–20.9)	2.4 (1.7–3.4)	75.4 (71.4–79.1)	23.5 (19.8–27.6)	1.1 (0.6–1.8) ^d	78.8 (74.6–82.4)	19.8 (16.2–24.0)	1.5 (0.8–2.5) ^d
6–13 years	67.3 (60.3–73.6)	31.1 (24.6–38.3)	1.6 (0.7–3.2)	67.9 (62.1–73.1)	29.0 (23.3–35.5)	3.1 (0.6–9.3)	68.1 (59.9–75.4) ^b	29.6 (22.1–38.4)	2.3 (0.9–4.8)
Boys	82.2 (76.6–86.6)	15.5 (11.5–20.6)	2.3 (1.3–3.7)	77.4 (71.8–82.2)	21.4 (16.6–27.2)	1.2 (0.5–2.3)	81.3 (76.0–85.7)	18.0 (13.6–23.4)	0.7 (0.2–1.8)
6–13 years	71.5 (61.0–80.0)	28.1 (19.3–38.9)	0.5 (0.0–2.3)	72.8 (64.8–79.5)	23.1 (18.0–29.3)	4.1 (0.4–14.9)	66.6 (50.4–79.7)	32.6 (19.7–48.9)	0.7 (0.1–2.6)
Girls	80.0 (75.6–83.8)	17.4 (13.0–22.8)	2.6 (1.4–4.4)	73.4 (66.0–79.6)	25.7 (19.5–33.0)	0.9 (0.4–2.0)	76.1 (68.9–82.1)	21.7 (15.7–29.2)	2.2 (0.8–4.8)
6–13 years	63.0 (54.3–70.9) ^b	34.2 (26.7–42.6) ^b	2.9 (1.1–6.0)	62.3 (53.8–70.1)	35.7 (27.4–45.0) ^c	2.0 (0.1–9.2)	69.7 (64.4–74.6)	26.3 (21.7–31.5)	4.0 (1.2–9.6)

Data are presented as percentage and 95% confidence interval (CI). An adjustment for multiple comparisons was performed to detect significant differences.

^a Sleep duration recommendations are 9–11 h/night for 6–13 years old and 8–10 h/night for 14–17 years old.

^b Significantly different from estimate for 6–13 years old children within same gender.

^c Significantly different from estimate for boys within the same age group.

^d Significantly different from estimate for cycle 1 within the same age group.

instead of a range. A sleep duration range implies that there is a U-shaped relationship between sleep duration and health outcomes. However, a recent comprehensive systematic review including 141 articles concluded that more sleep is better for children and adolescents, i.e. there is no health risk associated with long sleep.³ It is increasingly recognized that the two peaks of the U-shaped association between sleep duration and health outcomes do not mean the same thing.⁹ While short sleep is consistently associated with adverse health outcomes, long sleep is generally associated with other health problems that may confound the association (so long sleep is not a problem per se).

The present findings should be interpreted in light of the following limitations. First, our data provided information on sleep duration and quality but other sleep characteristics such as timing, architecture, consistency and continuity are important. To study these sleep characteristics, we would need data about bedtime and wake up time (to assess sleep timing) and data differentiating weekdays and weekend days (to assess catch-up sleep on weekends). Second, self-reported sleep duration generally overestimates actual sleep duration¹⁰ and are subject to recall and/or social desirability bias. However, this provides several advantages in epidemiology (e.g. cost saving, less burdensome for participants, etc.) and sleep duration recommendations rely heavily on subjective sleep data. Third, a longer time span between survey cycles would be required to adequately assess possible sleep changes over time. Finally, sleeping less than the recommended amount does not necessarily imply that it will adversely impact health. Future research should aim to determine the proportion of short sleepers having adverse health outcomes.

In conclusion, short sleep duration and poor sleep quality are highly prevalent in Canadian youth, especially in adolescents. Surveillance efforts should continue to monitor sleep and future research should help to inform public policies and interventions aimed at improving sleep habits of children and adolescents.

Author statements

Acknowledgements

The authors would like to thank the participants of the Canadian Health Measures Survey as well as all staff at Statistics Canada involved in the operations of the survey.

Ethical approval

Health Canada's Research Ethics Board approved the conduct of this study.

Funding

None.

Competing interests

None declared.

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