

Health Reports

Meeting the *Canadian 24-Hour Movement Guidelines for Children and Youth*

by Karen C. Roberts, Xiaoquan Yao, Valerie Carson,
Jean-Philippe Chaput, Ian Janssen and Mark S. Tremblay

Release date: October 18, 2017



How to obtain more information

For information about this product or the wide range of services and data available from Statistics Canada, visit our website, www.statcan.gc.ca.

You can also contact us by

email at STATCAN.infostats-infostats.STATCAN@canada.ca

telephone, from Monday to Friday, 8:30 a.m. to 4:30 p.m., at the following numbers:

- | | |
|---|----------------|
| • Statistical Information Service | 1-800-263-1136 |
| • National telecommunications device for the hearing impaired | 1-800-363-7629 |
| • Fax line | 1-514-283-9350 |

Depository Services Program

- | | |
|------------------|----------------|
| • Inquiries line | 1-800-635-7943 |
| • Fax line | 1-800-565-7757 |

Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner. To this end, Statistics Canada has developed standards of service that its employees observe. To obtain a copy of these service standards, please contact Statistics Canada toll-free at 1-800-263-1136. The service standards are also published on www.statcan.gc.ca under “Contact us” > “Standards of service to the public.”

Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued co-operation and goodwill.

Standard table symbols

The following symbols are used in Statistics Canada publications:

- . not available for any reference period
- .. not available for a specific reference period
- ... not applicable
- 0 true zero or a value rounded to zero
- 0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- ^P preliminary
- ^r revised
- X suppressed to meet the confidentiality requirements of the *Statistics Act*
- ^E use with caution
- F too unreliable to be published
- * significantly different from reference category ($p < 0.05$)

Published by authority of the Minister responsible for Statistics Canada

© Minister of Industry, 2017

All rights reserved. Use of this publication is governed by the Statistics Canada [Open Licence Agreement](#).

An HTML version is also available.

Cette publication est aussi disponible en français.

Meeting the Canadian 24-Hour Movement Guidelines for Children and Youth

by Karen C. Roberts, Xiaoquan Yao, Valerie Carson, Jean-Philippe Chaput, Ian Janssen and Mark S. Tremblay

Abstract

Background: The *Canadian 24-Hour Movement Guidelines for Children and Youth: An Integration of Physical Activity, Sedentary Behaviour, and Sleep* provide specific recommendations on the amount of time over a typical 24-hour day that children and youth aged 5 to 17 should spend in moderate-to-vigorous physical activity (at least 60 minutes), recreational screen time (no more than 2 hours), and sleep (9 to 11 hours for 5- to 13-year-olds; 8 to 10 hours for 14- to 17-year-olds)

Data and methods: Based on combined results of cycles 2 (2009-to-2011) and 3 (2012-to-2013) of the Canadian Health Measures Survey, this analysis examines average daily moderate-to-vigorous physical activity, screen time and sleep duration of 5- to 11-year-olds and 12- to 17-year-olds, and the percentages meeting the *24-Hour Guidelines'* recommendations. Findings are presented overall and by age group and sex. Differences in average daily times between groups were tested for statistical significance, as were differences between groups in the percentages meeting each recommendation and combination of recommendations.

Results: Overall, 17.5% of children and youth met the *24-Hour Guidelines'* specific time recommendations. Higher percentages of children than youth (29.6% versus 5.5%) and boys than girls (22.9% versus 11.8%) met the recommendations. About a third (36.3%) met two of the three recommendations.

Interpretation: Recommendations for moderate-to-vigorous physical activity, sedentary behaviour, and sleep have higher levels of adherence among children than youth.

Keywords: Accelerometer, exercise, motor activity, physical activity, screen time, sleep

For children and youth, regular moderate-to-vigorous physical activity (MVPA) has positive impacts on physical and mental health in the short- and long-term.¹⁻³ But although MVPA tends to be the focus of attention, all movement behaviours are related to health.⁴⁻⁷ Notably, independent benefits of limiting sedentary time (specifically, screen time) for adiposity, fitness, self-esteem, academic performance, and pro-social behaviour have been documented.⁸⁻¹⁰ Evidence also suggests that inadequate sleep is associated with weight gain, depression, and poor academic performance.¹¹⁻¹³

Research^{1,3,4} has highlighted the importance of an integrated approach that considers all behaviours across the movement continuum.^{9,14,15} The *Canadian 24-Hour Movement Guidelines for Children and Youth: An Integration of Physical Activity, Sedentary Behaviour, and Sleep*¹⁴ were released in June 2016. These *Guidelines* provide general recommendations for children and youth aged 5 to 17 related to MVPA, light physical activity, sedentary behaviour and sleep, and specific recommendations on the time that should be spent in MVPA, recreational screen time, and sleep during a typical 24-hour day.

This article uses combined data from two cycles of the Canadian Health Measures Survey to examine the extent to which children and youth meet the recommendations in the *Guidelines*.

Methods

Data source

The Canadian Health Measures Survey (CHMS) collects data from a nationally representative sample of the population aged 3 to 79 living in private households.¹⁶ The survey excludes residents of Indian reserves, institutions and remote regions and full-time members of the Canadian Forces, who together account for about 4% of the target population.

Ethics approval for the CHMS was obtained from the Health Canada Research Ethics Board. For children aged 5 to 13, a parent or legal guardian gave written informed consent, and assent was obtained from the child. Youth aged 14 or older provided independent written informed consent. Participation was voluntary; respondents could withdraw at any point.

This study pertains to 5- to 17-year-olds. To increase sample size and the precision of estimates, data from CHMS cycles 2 (2009-to-2011) and 3 (2012-to-2013) were combined.¹⁷

Respondents answered an interviewer-administered questionnaire at home and visited a mobile examination centre (MEC) where physical measures were taken. For children aged 5 to 11, the household questionnaire was answered by a parent/guardian.

After the MEC visit, ambulatory respondents were asked to wear an Actical accelerometer (Phillips – Respironics, Oregon, USA) over their right hip on an elasticized belt during waking

hours for 7 consecutive days. The accelerometers were initialized to start collecting data at midnight following the MEC visit. Data were collected in 60-second epochs for all respondents in cycle 2, and for those aged 6 or older in cycle 3. In cycle 3, data for 5-year-olds were collected in 15-second epochs to align with current research.¹⁸ When cycle 2 and cycle 3 data were combined, correction equations¹⁹ were applied to adjust for the difference in epoch length for 5-year-olds. The accelerometer cut-points used in the CHMS to define MVPA for 5-year-olds (288 counts per 15-seconds) and for 6- to 17-year-olds (1,500 counts per minute) were obtained from energy expenditure calibration studies.^{20,21} Descriptions of the survey design, sample, interview procedures, MEC protocols, and activity monitor (accelerometer) are published elsewhere.^{16,22,23}

A total of 4,123 respondents aged 5 to 17 completed the household questionnaire and visited the MEC; 3,119 (75.6%) of them returned accelerometers with a minimum of 4 valid days of data.²² Of these respondents, 8 were excluded for incomplete screen-time information. The final sample (3,111) was evenly split between boys (1,553) and girls (1,541). Because of oversampling of younger children, 5- to 11-year-olds (1,985) outnumbered 12- to 17-year-olds (1,126); however, the weighted percentages of each age group were the same (49.9% and 50.1%).

A valid day was 5 or more hours of accelerometer wear time during waking hours for 5-year-olds, and 10 or more hours for 6- to 17-year-olds.¹⁸ Wear time was calculated by subtracting non-wear time (periods of at least 60 consecutive minutes of zero counts, allowing up to 2 minutes of counts between zero and 100) from 24 hours. Mean wear time for valid days was 12.3 hours for 5-year-olds, and 13.6 hours for 6- to 17-year-olds.

The overall response rate for the household questionnaire, MEC visit, and return of an accelerometer with sufficient valid days was 40.7% for cycles 2 and 3 combined. To correct for the

potential bias of the low response rate to the accelerometer portion of the survey, and for bias introduced by differences between respondents with and without valid data, Statistics Canada generated separate survey weights for the accelerometer subsample.¹⁷ Details about combining CHMS cycles and collecting and processing the accelerometer data are published elsewhere.^{17,18,22}

Respondent age was determined at the time of the household interview. For consistency with previous physical activity and sedentary behaviour guidelines^{24,25} and previous CHMS analyses,²⁶ respondents were grouped into children (ages 5 to 11) and youth (ages 12 to 17).

Meeting the 24-Hour Guidelines

The *Guidelines* provide general recommendations related to MVPA, light physical activity, sedentary behaviour, and sleep for a 24-hour day, and specific daily time recommendations for MVPA (at least 60 minutes), recreational screen-time (no more than 2 hours), and uninterrupted sleep (9 to 11 hours at ages 5 to 13; 8 to 10 hours at ages 14 to 17). Individuals were considered to have met the *Guidelines* if, on average, during a week they met all three specific time recommendations.¹⁴

Physical activity

Physical activity information was derived from the accelerometer data. The number of minutes of MVPA on each valid day was summed, and daily totals were averaged.

Sleep

Sleep duration was parent-reported (ages 5 to 11) or self-reported (ages 12 to 17). Average daily sleep time was determined from the question: “How many hours do you usually spend sleeping in a 24-hour period, excluding time spent resting?” Answers were rounded to the closest half hour by the interviewer. Respondents were categorized as meeting the recommendations if the amount of time fell within the appropriate range for the age group.

What is already known on this subject?

- Regular moderate-to-vigorous physical activity (MVPA) has positive impacts on physical and mental health.
- Independent benefits of limiting sedentary time (specifically, screen time) have been documented.
- Inadequate sleep is associated with negative physical and mental health outcomes.
- The *Canadian 24-Hour Movement Guidelines for Children and Youth: An Integration of Physical Activity, Sedentary Behaviour, and Sleep* provide recommendations for children and youth related to MVPA, light physical activity, sedentary behaviour and sleep.

What does this study add?

- Based on combined results of cycles 2 (2009-to-2011) and 3 (2012-to-2013) of the Canadian Health Measures Survey, about a third of children and youth met the *Guidelines* MVPA recommendation; almost half met the screen-time recommendation; and three-quarters met the sleep recommendation.
- Children aged 5 to 11 were more likely than 12- to 17-year-olds to meet the recommendations for MVPA, screen time, and sleep duration.
- The percentage of boys meeting the MVPA recommendation was almost double that of girls.
- Overall, 17.5% of children and youth met all three specific time recommendations; 10.7% did not meet any of the recommendations.

Screen time

Screen time was estimated separately for children aged 5 to 11 and youth aged 12 to 17. For children, the parent/guardian was asked, on average, how many hours per day the child spends: 1) watching

TV or videos or playing video games; and 2) on a computer. The response categories differed between cycle 2 (none, less than 1, 1 to 2, 3 to 4, 5 to 6, 7 or more) and cycle 3 (none, less than 1, 1 to less than 3, 3 to less than 5, 5 to less than 7, 7 or more). For cycle 2, average daily screen time was derived using the mid-point of the response category (0, 0.5, 1.5, 3.5, 5.5, 7). To maintain consistency, the same values were assigned to each of the respective categories for cycle 3. Responses to the two questions were summed to determine average daily screen time.

Youth aged 12 to 17 were asked how much time they spent in a typical week over the past three months: 1) on a computer; 2) playing video games; and 3) watching television, DVDs or videos. Responses were summed across all questions, and average daily screen time was calculated. The video game questions differed between cycles. Cycle 2 asked a single question, whereas cycle 3 asked about active video games separately from other video games. Active video game time was excluded from the screen-time estimate for cycle 3 respondents. Respondents were cat-

egorized as meeting the screen-time recommendation if they reported no more than 2 hours per day.

Statistical analyses

All analyses were performed with SAS Enterprise Guide version 5.1 (SAS Institute, Cary, NC). Accelerometer survey weights for the combined cycles 2 and 3 were used to ensure that results were representative of the Canadian population aged 5 to 17.

Descriptive statistics were used to examine average daily MVPA, screen time and sleep duration, and the percentage of respondents meeting the recommendations for each movement behaviour separately and for all possible groupings.

Findings are presented for the entire sample and by age group and sex. A surveyreg procedure was used to test the significance of differences in average daily behaviour times between groups. Rao-Scott chi-square test was used to test for differences between groups in the percentage of respondents meeting each recommendation and combination of recommendations. Statistical significance was set at a p value of 0.05.

The 95% confidence intervals and coefficients of variation were derived using the bootstrap re-sampling method to account for the complex sampling design of the CHMS.^{18,27}

Results

Compared with 12- to 17-year-olds, children aged 5 to 11 averaged significantly more MVPA (61.3 versus 46.3 minutes per day), less screen time (2.3 versus 3.8 hours), and more sleep (9.6 versus 8.3 hours) (Table 1). Boys had more MVPA (60.1 versus 47.1 minutes) and screen time (3.3 versus 2.8 hours) than did girls. Average sleep duration did not differ between the sexes in either age group.

About a third (36.0%) of children and youth met the specific time MVPA recommendation; almost half (49.3%) met the screen-time recommendation; and three quarters (75.3%) met the sleep rec-

Table 1
Average daily physical activity, screen time and sleep, by sex and age group, household population aged 5 to 17, Canada, 2009-to-2011 and 2012-to-2013 combined

Age group and sex	Number	Moderate-to-vigorous physical activity			Screen time			Sleep		
		Average minutes	95% confidence interval		Average hours	95% confidence interval		Average hours	95% confidence interval	
			from	to		from	to		from	to
Total	3,111	53.8	50.6	57.0	3.1	2.9	3.2	9.0	8.9	9.1
Sex										
Boys	1,553	60.1	55.8	64.4	3.3	3.1	3.5	9.0	8.9	9.1
Girls	1,558	47.1 [†]	44.6	49.7	2.8 [†]	2.6	3.0	9.0	8.9	9.1
Age group (years)										
5 to 11	1,985	61.3 [‡]	57.8	64.7	2.3 [‡]	2.2	2.5	9.6 [‡]	9.5	9.7
Boys	980	68.3	63.3	73.2	2.4	2.2	2.5	9.6	9.5	9.7
Girls	1,005	54.0 [†]	51.1	56.8	2.3	2.1	2.5	9.7	9.6	9.8
12 to 17	1,126	46.3	42.5	50.1	3.8	3.5	4.0	8.3	8.2	8.5
Boys	573	52.0	46.9	57.1	4.2	3.8	4.5	8.4	8.2	8.6
Girls	553	40.3 [†]	36.9	43.6	3.4 [†]	3.0	3.7	8.2	8.1	8.4

[†] significantly different from boys in same age range (p < 0.05)

[‡] significantly different from ages 12 to 17 (p < 0.05)

Source: 2009-to-2011 and 2012-to-2013 Canadian Health Measures Survey (combined).

Table 2
Percentages meeting specific time recommendations of 24-Hour Movement Guidelines for Children and Youth, by sex and age group, household population aged 5 to 17, Canada, 2009-to-2011 and 2012-to-2013 combined

Recommendations met	Ages 5 to 17			Ages 5 to 11			Ages 12 to 17		
	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls
	Percentage			Percentage			Percentage		
None	10.7	9.6	11.9	4.2 [‡]	4.1	4.4	17.1	15.0	19.4
Sleep duration	75.3	77.2	73.3	82.6 [‡]	82.7	82.4	68.1	71.7	64.3
Physical activity	36.0	46.8	24.6 [†]	47.6 [†]	59.6	35.0 [†]	24.4	34.1	14.1 [†]
Screen time	49.3	46.7	52.0	70.6 [†]	70.1	71.2	28.1	23.6	32.8 [†]
Sleep duration and physical activity	28.1	37.4	18.2 [†]	40.5 [†]	50.9	29.6 [†]	15.7	24.2	6.8 [†]
Sleep duration and screen time	40.0	39.1	41.0	59.5 [†]	59.1	60.0	20.6	19.3	21.9
Physical activity and screen time	20.7	26.6	14.4 [†]	34.6 [†]	43.8	25.0 [†]	6.8	9.7	3.8
All three	17.5	22.9	11.8 [†]	29.6 [†]	37.3	21.6 [†]	5.5	8.7	2.0

[†] significantly different from boys in same age range (p < 0.05)

[‡] significantly different from ages 12 to 17 (p < 0.05)

Notes: Based on respondents with 4 or more valid days of accelerometer data. For 2012-to-2013 data, active video games were excluded from screen time.

Source: 2009-to-2011 and 2012-to-2013 Canadian Health Measures Survey (combined).

Table 3
Percentages meeting none, one, two or three specific time recommendations of 24-Hour Movement Guidelines for Children and Youth, by sex and age group, household population aged 5 to 17, Canada, 2009-to-2011 and 2012-to-2013 combined

Number of recommendations met	Ages 5 to 17			Ages 5 to 11			Ages 12 to 17		
	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls
	Percentage			Percentage			Percentage		
None	10.7	9.6	11.9	4.2 [†]	4.1	4.4	17.1	15.0	19.4
One	35.5	33.1	38.1	20.4 [†]	16.7	24.2 [†]	50.6	49.3	52.0
Two	36.3	34.4	38.2	45.8 [‡]	42.0	49.8	26.8	27.0	26.6
Three	17.5	22.9	11.8 [†]	29.6 [†]	37.3	21.6 [†]	5.5	8.7	2.0

[†] significantly different from boys in same age range ($p < 0.05$)

[‡] significantly different from ages 12 to 17 ($p < 0.05$)

Source: 2009-to-2011 and 2012-to-2013 Canadian Health Measures Survey (combined).

ommendation (Table 2). Children aged 5 to 11 were more likely than 12- to 17-year-olds to meet the recommendations for MVPA (47.6% versus 24.4%), screen time (70.6% versus 28.1%), and sleep (82.6% versus 68.1%).

The percentage of boys meeting the MVPA recommendation was almost double that of girls: 46.8% versus 24.6%. Differences between boys and girls were significant at ages 5 to 11 (59.6% versus 35.0%) and at ages 12 to 17 (34.1% versus 14.1%) for MVPA. Among youth (but not children), the percentage of girls meeting the screen-time recommendation was higher than the percentage of boys: 32.8% versus 23.6%. Differences in the percentages meeting the sleep duration recommendation were not significant.

Overall, 17.5% of children and youth met all three recommendations (Table 3). The percentage was significantly higher at ages 5 to 11 (29.6%) than at ages 12 to 17 (5.5%). This difference between age groups was apparent among boys (37.3% versus 8.7%) and among girls (21.6% versus 2.0%). More than one-fifth (22.9%) of boys met all three recommendations, compared with 11.8% of girls.

More than one in ten (10.7%) children and youth did not meet any of the recommendations; just over half (53.8%) met at least two. Almost half of 5- to 11-year-olds (45.8%) met two recommendations; the figure was lower (26.8%) at ages 12 to 17.

Discussion

The 24-Hour Guidelines recommendation for MVPA is identical to that of the previous guidelines,²⁴ the methodology for determining adherence differs.¹⁴ A threshold of 60 minutes of MVPA on at least 6 days of the week has historically been used.²⁶ By contrast, the Guidelines use *average* daily MVPA, which allows for normal day-to-day variability and ensures consistency in the approach for each movement behaviour.^{2,14} Consequently, the percentage of children and youth who were reported to meet the recommendation in this study (36.0%) is not directly comparable to previous estimates based on CHMS data (9.3%).²⁸ However, minutes of MVPA per day and trends by age and sex are comparable with earlier reports.²⁹

Previously, Canada did not have guidelines for sleep; instead, an expert consensus statement³⁰ was used for national surveillance reporting.²⁸ The thresholds differed slightly from those of the Guidelines for 5-year-olds (10 to 13 hours instead of 9 to 11 hours per day), but the percentages of children and youth obtaining adequate sleep were similar: 75.3% in the present study, compared with 74.6% based on the 2012-to-2013 CHMS.²⁸

The screen-time recommendation in the Guidelines is identical to that of the previous Canadian guidelines.²⁵ Results of this study align with those previously reported.²⁸

Strengths and limitations

Despite limitations in accelerometers' ability to capture MVPA during some activities (such as cycling and upper body exercises) and for activities during which the device is not worn (such as swimming), the data are considered to be more robust than self-reports.

Self- (or parent-) reported data were used for screen time and sleep. Although subject to social desirability and recall bias, self-reported screen time has acceptable reliability and validity in children.³¹

Differences between cycles 2 and 3 in the response option categories for the screen-time questions for 6- to 11-year-olds introduced some imprecision in the estimation of adherence to the recommendations. Nonetheless, the distributions of responses in each category in the two cycles were similar, so it is unlikely that prevalence changed dramatically between cycles. Therefore, use of the same values for similar response categories (in this case, mid-points from cycle 2) was considered appropriate.

Inclusion of a question about active video games in cycle 3, but not cycle 2, may have affected comparability between cycles. Excluding time spent in active video games, even if possible only in cycle 3, was justifiable, given evidence that active video games are non-sedentary.³²

Objective measures of sleep and/or additional questions about sleep quality might better assess whether sleep is "uninterrupted." However, neither was available on the CHMS at the time of this analysis.

Conclusion

Rates of adherence to the 24-Hour Guidelines recommendations are useful for the development of public health policies, programs, and interventions. The percentages of Canadian children and youth meeting the Guidelines were low; fewer than 1 child in 3, and fewer than 1 youth in 20, met all three of the recommendations that have established cut-points. ■

References

1. Donnelly JE, Hillman CH, Castelli D, et al. Physical activity, fitness, cognitive function, and academic achievement in children: A systematic review. *Medicine and Science in Sports and Exercise* 2016; 48(6): 1197-222.
2. Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity* 2010; 7.
3. Poitras VJ, Gray CE, Borghese MM, et al. Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism* 2016; 41(6 Suppl 3): S197-239.
4. Buman MP, Winkler EAH, Kurka JM, et al. Reallocating time to sleep, sedentary behaviors, or active behaviors: Associations with cardiovascular disease risk biomarkers, NHANES 2005-2006. *American Journal of Epidemiology* 2014; 179(3): 323-34.
5. Chaput JP, Carson V, Gray CE, Tremblay MS. Importance of all movement behaviors in a 24-hour period for overall health. *International Journal of Environmental Research and Public Health* 2014; 11(12): 12575-81.
6. Chastin SFM, Palarea-Albaladejo J, Dontje ML, Skelton DA. Combined effects of time spent in physical activity, sedentary behaviors and sleep on obesity and cardio-metabolic health markers: A novel compositional data analysis approach. *PLoS ONE* 2015; 10(10).
7. Saunders TJ, Gray CE, Poitras V, et al. Combinations of physical activity, sedentary behaviour and sleep: Relationships with health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism* 2016; 41(6 Suppl 3): S283-93.
8. Chaput JP, Lambert M, Mathieu M, et al. Physical activity vs. sedentary time: Independent associations with adiposity in children. *Pediatric Obesity* 2012; 7(3): 251-8.
9. Carson V, Tremblay MS, Chaput JP, Chastin SF. Associations between sleep duration, sedentary time, physical activity, and health indicators among Canadian children and youth using compositional analyses. *Applied Physiology, Nutrition, and Metabolism* 2016; 41(6 Suppl 3): S294-302.
10. Salmon J, Tremblay MS, Marshall SJ, Hume C. Health risks, correlates, and interventions to reduce sedentary behavior in young people. *American Journal of Preventive Medicine* 2011; 41(2): 197-206.
11. Chaput JP. Is sleep deprivation a contributor to obesity in children? *Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity* 2016; 21(1): 5-11.
12. Owens J, Au R, Carskadon M, et al. Insufficient sleep in adolescents and young adults: An update on causes and consequences. *Pediatrics* 2014; 134(3): e921-2.
13. Chaput JP, Gray CE, Poitras VJ, et al. Systematic review of the relationships between sleep duration and health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism* 2016; 41(6 Suppl 3): S266-82.
14. Tremblay MS, Carson V, Chaput JP, et al. Canadian 24-Hour Movement Guidelines for Children and Youth: An Integration of Physical Activity, Sedentary Behaviour, and Sleep. *Applied Physiology, Nutrition, and Metabolism* 2016; 41(6 Suppl 3): S311-27.
15. Brawley LR, Latimer AE. Physical activity guides for Canadians: Messaging strategies, realistic expectations for change, and evaluation. *Canadian Journal of Public Health* 2007; 98(Suppl 2): S170-84.
16. Tremblay MS, Connor Gorber S. Canadian health measures survey: Brief overview. *Canadian Journal of Public Health* 2007; 98(6): 453-6.
17. Statistics Canada. *Instructions for Combining Multiple Cycles of Canadian Health Measures Survey (CHMS) Data*. Ottawa: Statistics Canada, 2015. Available at: www23.statcan.gc.ca/imdb-bmdi/document/5071_D4_T9_V2-eng.htm
18. Statistics Canada. *Canadian Health Measures Survey (CHMS) Data User Guide: Cycle 3*. Ottawa: Statistics Canada, 2015.
19. Colley RC, Harvey A, Grattan KP, Adamo KB. Impact of accelerometer epoch length on physical activity and sedentary behaviour outcomes for preschool-aged children. *Health Reports* 2014; 25(1): 3-9.
20. Puyau MR, Adolph AL, Vohra FA, et al. Prediction of activity energy expenditure using accelerometers in children. *Medicine and Science in Sports and Exercise* 2004; 36(9): 1625-31.
21. Adolph AL, Puyau MR, Vohra FA, et al. Validation of uniaxial and triaxial accelerometers for the assessment of physical activity in preschool children. *Journal of Physical Activity and Health* 2012; 9(7): 944-53.
22. Colley R, Gorber SC, Tremblay MS. Quality control and data reduction procedures for accelerometry-derived measures of physical activity. *Health Reports* 2010; 21(1): 63-9.
23. Giroux S. Canadian Health Measures Survey: Sampling strategy overview. *Health Reports* 2007; 18(Suppl): 31-6.
24. Tremblay MS, Warburton DER, Janssen I, et al. New Canadian physical activity guidelines. *Applied Physiology, Nutrition, and Metabolism* 2011; 36(1): 36-46.
25. Tremblay MS, Leblanc AG, Janssen I, et al. Canadian sedentary behaviour guidelines for children and youth. *Applied Physiology, Nutrition, and Metabolism* 2011; 36(1): 59-64; 65-71.
26. Colley RC, Garriguet D, Janssen I, et al. Physical activity of Canadian children and youth: Accelerometer results from the 2007 to 2009 Canadian Health Measures Survey. *Health Reports* 2011; 22(1): 15-23.
27. Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research* 1996; 5(3): 283-310.
28. Centre for Chronic Disease Prevention, Public Health Agency of Canada. *Chronic Disease and Injury Indicator Framework: Quick Stats, 2015 Edition*. Ottawa: Public Health Agency of Canada, 2015.
29. Statistics Canada. Health Fact Sheets – Directly measured physical activity of children and youth, 2012 and 2013. Available at: www.statcan.gc.ca/pub/82-625-x/2015001/article/14136-eng.htm. Accessed July 12, 2016.
30. Gruber R, Carrey N, Weiss SK, et al. Position statement on pediatric sleep for psychiatrists. *Journal of the Canadian Academy of Child and Adolescent Psychiatry* 2014; 23(3): 174-95.
31. Lubans DR, Hesketh K, Cliff DP, et al. A systematic review of the validity and reliability of sedentary behaviour measures used with children and adolescents. *Obesity Reviews* 2011; 12(10): 781-99.
32. LeBlanc AG, Chaput JP, McFarlane A, et al. Active video games and health indicators in children and youth: A systematic review. *PLoS One* 2013; 8(6): e65351.