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# Physical activity, screen time and sleep duration: Combined associations with psychosocial health among Canadian children and youth

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# Physical activity, screen time and sleep duration: Combined associations with psychosocial health among Canadian children and youth

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## Abstract

**Background:** Canada recently adopted the 24-Hour Movement Guidelines for Children and Youth (24-Hour Guidelines) for young people aged 5 to 17 years—an international first, providing integrated recommendations for physical activity, sedentary time and sleep. Since the release of the guidelines, very few studies have examined the associations of adherence to the 24-Hour Guidelines with health outcomes—and none focus on psychosocial health. Therefore, the objective of this study was to assess the associations of meeting the 24-Hour Guidelines and their behaviour-specific recommendations with psychosocial health among Canadian children and youth.

**Methods:** This cross-sectional study included 4,250 children and youth aged 5 to 17 years with valid accelerometer data. The study data were collected from 2009 to 2015 with the Canadian Health Measures Survey and pooled. Moderate-to-vigorous physical activity was measured using accelerometers; screen time, sleep duration and measures of psychosocial health were self- or proxy-reported. Multivariate logistic regression models were used to examine the associations of meeting individual or different combined recommendations from the 24-Hour Guidelines with psychosocial health.

**Results:** There was low overall adherence to all three 24-Hour Guidelines recommendations, especially among youth (children: 13.9%, youth: 4.8%). Meeting two or more of the recommendations was associated with higher odds of positive psychosocial health among youth (odds ratio [OR] = 3.10; 95% confidence interval [CI]: 1.17–8.19). Sleep duration and screen time were strongly associated with social behaviour and psychosocial health among Canadian youth.

**Interpretation:** Adherence to the 24-Hour Guidelines was significantly associated with better psychosocial health among Canadian youth.

**Keywords:** motor activity, sedentary behaviour, sleep, screen time, mental health, children, youth

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Adequate sleep duration, physical activity and low sedentary time are all independently associated with better health status among children and youth.<sup>1-4</sup> Recently, in an international first, Canada adopted the 24-Hour Movement Guidelines for Children and Youth (24-Hour Guidelines),<sup>5</sup> which provide integrated recommendations for physical activity, sedentary time and sleep.

The 24-Hour Guidelines recommend that children and youth have at least 60 minutes of moderate-to-vigorous physical activity (MVPA) per day.<sup>5</sup> Physical activity is known to have both physical and psychosocial health benefits, including better general psychosocial health (e.g., behavioural conduct, quality of life, self-esteem and lower psychological distress), physical health (e.g., motor development, body composition, cardiometabolic health, fitness and bone health) and improved cognitive development (e.g., cognition and academic achievement).<sup>3</sup> The majority of Canadian children and youth (64%) are not meeting the current MVPA recommendations.<sup>6</sup>

Sedentary behaviour is defined as any waking behaviour with a low energy expenditure ( $\leq 1.5$  metabolic equivalents) while in a sitting, reclining or lying position.<sup>7</sup> Physical activity and sedentary behaviour are distinct from one another and must be examined separately.<sup>8</sup> An individual can be highly physically active but also highly sedentary. The 24-Hour Guidelines for school-aged children recommend that recreational screen time

be restricted to a maximum of two hours per day, and that sitting for extended periods be limited. Examples of recreational screen time include computer or Internet use, television viewing and video gaming. Higher duration and frequency of screen time and television viewing are known to be associated with poorer body composition, higher cardiometabolic risk, and unfavourable behavioural conduct and prosocial behaviour (e.g., behavioural problems, aggression and inattention).<sup>1</sup> A consistent association between screen time and poorer mental health status among children and youth has also been found.<sup>9</sup> About half of Canadian children and youth (51%) are not meeting screen time recommendations.<sup>6</sup>

The 24-Hour Guidelines also include sleep recommendations that call for consistent bedtimes and wake-up times, with 9 to 11 hours of uninterrupted sleep per night for children aged 5 to 13 years and 8 to 10 hours of uninterrupted sleep per night for youth aged 14 to 17 years.<sup>5</sup> Sleep is essential for optimal health and functioning. Longer sleep duration has been associated with lower adiposity, better emotional regulation, higher academic achievement, and greater quality of life and well-being in children and youth.<sup>2</sup> Evidence suggests inadequate sleep among children and youth is associated with negative psychosocial health, including low self-esteem, depression, poor perceived mental health, low life satisfaction, poor relations with parents and poor social support.<sup>10</sup> American data from the nationally

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## What is already known on this subject?

- The Canadian 24-Hour Movement Guidelines for Children and Youth are an international first, providing integrated recommendations for physical activity, sedentary time and sleep.
- Adequate moderate-to-vigorous physical activity and sleep are associated with positive physical and mental health outcomes.
- Greater screen time is associated with poorer mental health in children and youth.
- A large proportion of Canadian children and youth are not meeting the 24-Hour Movement Guidelines recommendations.

## What does this study add?

- Meeting two or more of the 24-Hour Movement Guidelines recommendations was associated with an increased likelihood of positive psychosocial health among youth.
- Sleep duration and screen time were strongly associated with social behaviour and psychosocial health among Canadian youth.
- Overall, adherence to the 24-Hour Movement Guidelines is significantly associated with better psychosocial health among Canadian youth.

representative 2003 National Survey of Children's Health found that children with inadequate sleep (based on a parental report of inadequate past-week sleep) were more likely to report depressive symptoms.<sup>11</sup> A substantial proportion of Canadian children and youth (about 25%) are not meeting sleep recommendations.<sup>6,12,13</sup>

The 24-Hour Guidelines recognize that all movement behaviours across a 24-hour period are important for overall health.<sup>14</sup> To date, few studies have

investigated the association between adherence to the 24-Hour Guidelines and health among children and youth,<sup>15-17</sup> and none have focused exclusively on psychosocial health. It is important to understand how the 24-hour movement continuum and meeting the 24-Hour Guidelines may influence the psychosocial health of Canadian children and youth. Therefore, the objective of this study was to determine the associations between adherence to the 24-Hour Guidelines, its component recommendations (i.e., physical activity, screen time and sleep duration) and psychosocial health (i.e., social, emotional and behavioural) among Canadian children and youth. Adherence to the 24-Hour Guidelines was expected to be associated with better psychosocial health among Canadian children and youth.

## Methods

### Data source

Data used in this study were from the Canadian Health Measures Survey (CHMS), an ongoing cross-sectional survey that collects health data from a representative sample of the Canadian population.<sup>18</sup> The target population of the CHMS includes people aged 3 to 79 years living in the 10 Canadian provinces, and excludes people living in the three territories, people living on reserves and other Aboriginal settlements, full-time Canadian Forces members, the institutionalized population, and residents of certain remote regions.<sup>18</sup> The CHMS includes a questionnaire administered by an interviewer in the homes of respondents and a visit to a mobile examination centre (MEC) where the physical measures of respondents are taken. A parent or guardian of children aged 5 to 11 answers the household questionnaire on their behalf. Ambulatory respondents are asked to wear an Actical accelerometer over their right hip on an elasticized belt for seven consecutive days following their visit to the MEC. The CHMS was approved by Health Canada's Research Ethics Board, and written informed consent and assent are required from all participants.

Data from Cycle 2 (2009 to 2011), Cycle 3 (2012 to 2013) and Cycle 4 (2014 to 2015) were used in these analyses. Cycle 1 data were excluded because Cycle 1 did not collect data from children aged 3 to 5 years. Analyses were restricted to children (5 to 11 years) and youth (12 to 17 years) with a minimum of four days of valid accelerometer data.<sup>19</sup> For 5-year-old children, a valid day of wear time was at least 5 hours, while for those aged 6 years and older, valid wear time was defined as 10 or more hours per day.<sup>19</sup> The overall response rates for the household questionnaire, MEC visit and return of sufficient valid accelerometer data were 42.4% for 2009 to 2011, 38.8% for 2012 to 2013 and 37.5% for 2014 to 2015. Statistics Canada's survey weights specific to the accelerometer subsample were used. CHMS cycles were combined following Statistics Canada guidelines, where survey weights were adjusted by dividing by the number of cycles used.<sup>20</sup> Weights account for the potential bias introduced by nonresponse at the household, questionnaire and MEC levels, as well as differences between people with and without valid accelerometer data.<sup>21</sup> Details on the CHMS survey design and sampling frame are available via Statistics Canada.<sup>18</sup>

### Independent variables

#### Physical activity

MVPA was measured using accelerometers.<sup>19</sup> Average minutes per day were calculated as total physical activity minutes per number of valid days. Physical activity was coded as a binary variable ( $\geq 60$  minutes per day compared with  $< 60$  minutes per day), with people who failed to meet the recommendation of an average of 60 minutes per day of MVPA being used as the reference group compared with those who met the recommendation.

#### Screen time

The 24-Hour Guidelines provide specific recommendations for screen time. In the CHMS, screen time was either parent-reported (children aged 6 to 11 years) or self-reported (youth aged 12 to 17

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years). Screen time was assessed using the following questions on the household interview:

1. “In a typical week in the past 3 months, how much time did you (your child) usually spend on a computer, tablet or iPad, including watching videos, playing computer games, emailing or using the Internet?”
2. “In a typical week in the past 3 months, how much time did you (your child) usually spend playing other types of video games on a game console or hand-held electronic device?”
3. “In a typical week in the past 3 months, how much time did you (your child) usually spend watching television, DVDs or videos?”

Screen time was categorized as a binary variable based on meeting (or not meeting) the recommended maximum of two hours per day of recreational screen time. Response options from 2009 to 2011 (none, less than one hour, one to two hours, three to four hours, five to six hours and seven or more hours) differed from those of 2012 to 2015 (none, less than one hour, one hour to less than three hours, three to less than five hours, five to less than seven hours and seven or more hours). For consistency, mid-point values of the six response options from 2009 to 2011 were assigned to those from 2012 to 2015.<sup>6</sup>

### *Sleep duration*

Sleep duration was either parent-reported (children aged 5 to 11 years) or self-reported (youth aged 12 to 17 years) in the CHMS household questionnaire. Participants responded to the question “How many hours do you (your child) usually spend sleeping in a 24-hour period, excluding time spent resting?” Responses were rounded to the closest half hour by the interviewer. Sufficient sleep was defined based on the 24-Hour Guidelines thresholds: 9 to 11 hours per night for children aged 5 to 13 years, and 8 to 10 hours per night for youth aged 14 to 17 years.<sup>5</sup> Sleep was coded as a binary variable with those who did not meet age-specific recommenda-

tions being used as the reference group for comparison with those who met the recommendations.

### *24-Hour Guidelines adherence*

The 24-Hour Guidelines consist of a series of recommendations for physical activity, sedentary behaviour and sleep. As recommended, children and youth were considered to have met the 24-Hour Guidelines if, on average, they met the time-specific recommendations for MVPA, recreational screen time and sleep duration.<sup>4</sup>

## **Dependent variables**

### *Social difficulties*

The Strengths and Difficulties Questionnaire (SDQ) is used to measure emotional and behavioural difficulties in children and youth.<sup>22</sup> The SDQ is a 25-question measure that assesses some of the fundamental domains of child psychosocial health. The SDQ was administered as part of the household questionnaire and was completed by a parent or guardian for both children and youth. The SDQ is scored across five subscales, including emotional symptoms, conduct problems, hyperactivity or inattention, peer relationship problems and prosocial behaviour. For the present analysis, a total difficulties score was computed by summing scores from all of the subscales, excluding the prosocial scale. It yielded a possible range of 0 to 40, categorized into normal, borderline, and abnormal behaviour ratings.<sup>22</sup> Total difficulties were recoded as a binary variable by collapsing borderline and abnormal into a single category (scores ranging from 14 to 40) called “at risk of psychopathology,” compared with “normal” (scores from 0 to 13). The SDQ has been shown to have moderate test/retest reliability (ICC = 0.84),<sup>23</sup> internal consistency (Cronbach’s alpha = 0.73–0.78),<sup>24,25</sup> good concurrent validity<sup>25</sup> and good discriminant validity.<sup>26</sup>

### *Stress*

Respondents aged 12 years and older were asked to self-report their level of stress by responding to the following

question: “Thinking about the amount of stress in your life, would you say that most days are: (not at all stressful, not very stressful, a bit stressful, quite a bit stressful, or extremely stressful)?” Stress was coded as a binary variable. Those who responded “quite a bit stressful” or “extremely stressful” were categorized as having high stress, compared with those who reported little to no stress.

### *General mental health*

Respondents aged 12 years or older were asked to rate their general mental health by responding to the following question: “In general, would you say your mental health is: (excellent, very good, good, fair, or poor)?” General mental health was coded as a binary variable. Those who responded “good,” “fair” or “poor” were categorized as “good to poor,” compared with those who reported very good or excellent general mental health, categorized as “very good to excellent”.

## **Covariates**

Potential covariates included sex (male or female), highest level of household education (college or university compared with less than college or university), family status (married or common-law parents compared with single parents) and body mass index (BMI) z-score (a continuous score based on the World Health Organization growth reference curves for school-aged children).<sup>27</sup> BMI was calculated using measured height and weight data collected from respondents at the MEC visit. All other covariates were self- or parent-reported. The covariates were added to the models for their potential to influence any of the outcomes and for their bivariate association with meeting 24-Hour Guidelines recommendations. Previous research has indicated that household education has a significant correlation with sleep duration and sedentary time among Canadian youth.<sup>28-30</sup>

## **Statistical analysis**

Analyses were conducted using survey procedures in SAS EG version 5.1 (SAS Institute Inc., Cary, North Carolina),

incorporating appropriate survey and bootstrap weights provided by Statistics Canada. Respondents missing physical activity, screen time, sleep duration or covariate data were excluded from the analyses. Descriptive analyses generated proportions and 95% confidence intervals (CIs) of all independent, covariate and dependent variables. Differences in the proportion of baseline characteristics between children and youth were identified with chi-square tests. Differences in group means for continuous measures (e.g., BMI z-score) were identified using t-tests. Results were considered statistically significant when  $p$  was less than 0.05 (two-sided tests).

Initially, binary unadjusted logistic regression was used to assess the associations between meeting individual or different combined recommenda-

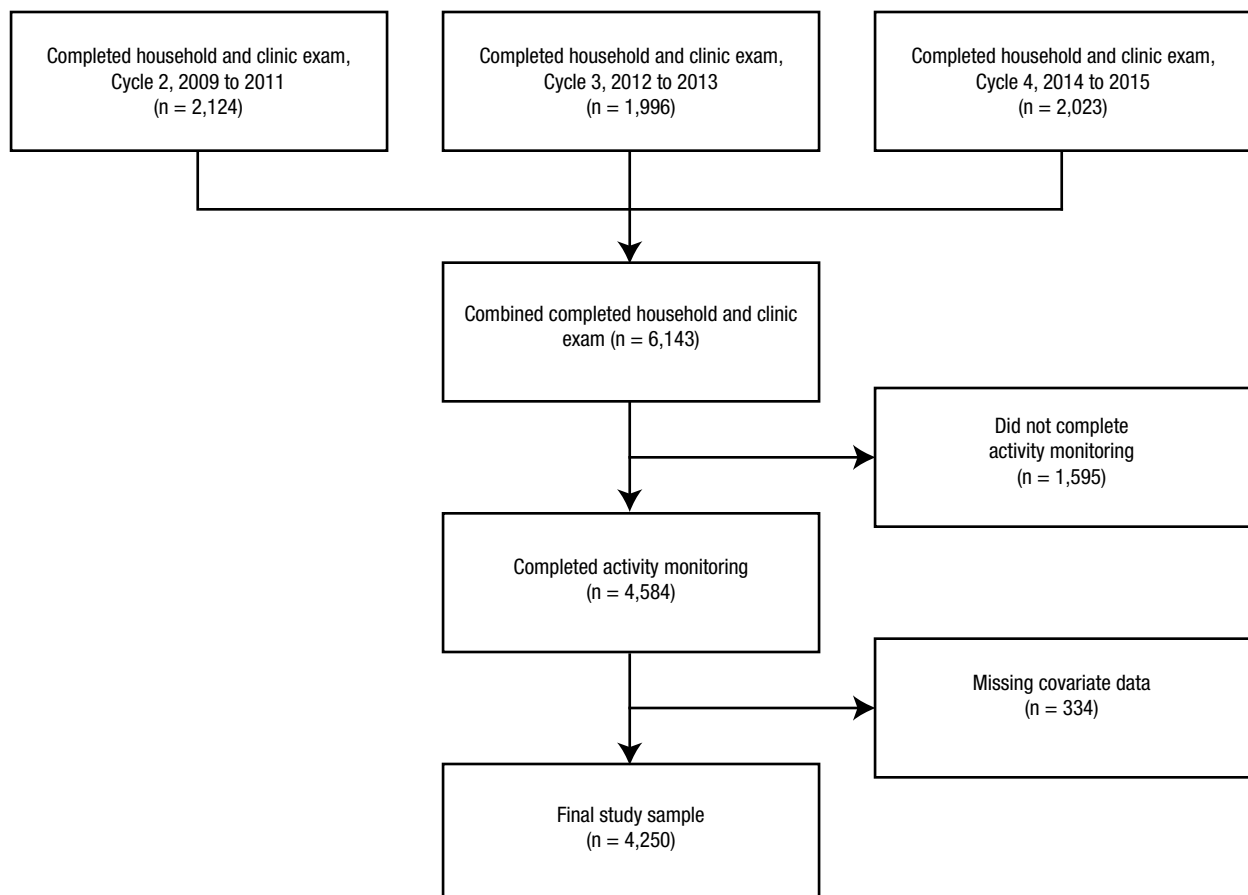
tions from the 24-Hour Guidelines and covariates with each of the individual psychosocial outcomes for children and youth, separately. Covariates that were significantly associated with the psychosocial outcomes in the unadjusted analysis were included in the multivariate logistic regression models. The final multivariate models were adjusted for sex, household education, family status (married or common-law parents) and BMI z-score. Specific details on the Hosmer–Lemeshow forward model building strategy can be found elsewhere.<sup>18</sup> All analyses were age stratified between children (5 to 11 years) and youth (12 to 17 years) since available outcome measures differed between the two groups. Multivariate model odds ratios (ORs) and their 95% CIs are reported.

## Results

After three cycles of the CHMS were combined, a total of 4,584 respondents aged 5 to 17 years were identified as having completed the household, clinic and activity monitoring components of the survey (Figure 1). After respondents without sleep, screen time, physical activity or covariate data were excluded, the final unweighted sample used for analyses was 4,250 respondents. The final sample comprised of 2,773 children and 1,477 youth, with 1,539 respondents for 2009 to 2011, 1,398 for 2012 to 2013, and 1,313 for 2014 to 2015.

Table 1 provides descriptive characteristics of the weighted sample. The sample was split almost evenly between boys and girls. The majority of children and youth were from households where

**Figure 1**  
**Study sample flow diagram**



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**Table 1**  
**Weighted population characteristics**

	Children (5 to 11 years)			Youth (12 to 17 years)			p-value
	N = 2,773			N = 1,477			
	percent	LCL	UCL	percent	LCL	UCL	
<b>Demographic variables</b>							
Girls	48.7	47.5	49.9	48.8	46.6	50.9	0.95
Household education (college or university or higher)	87.1	84.3	89.9	85.5	81.7	89.3	0.37
Family status (married or common law)	85.4	82.9	87.8	78.2	73.9	89.5	<0.05
BMI z-score (mean, standard error)	0.4	0.0	...	0.4	0.1	...	0.25
<b>Independent variables</b>							
Met all three guideline recommendations	13.9	11.4	16.4	4.8 <sup>‡</sup>	2.6	7.1	<0.05
Met two or more guideline recommendations	57.4	53.9	61.0	29.9	25.4	34.4	<0.05
Met one or more guideline recommendations	93.0	91.4	94.6	80.5	76.1	84.8	<0.05
Physical activity and screen time	15.6	12.9	18.3	6.0	3.8	8.1	<0.05
Sleep and physical activity	40.9	37.0	44.8	16.7	13.2	20.3	<0.05
Sleep and screen time	28.7	25.5	31.8	16.9	13.2	20.5	<0.05
Screen time recommendation met	32.6	29.3	35.0	24.7	21.1	28.2	<0.05
Physical activity recommendation met	47.7	43.5	51.8	25.8	21.1	30.5	<0.05
Sleep recommendation met	84.0	81.5	86.6	64.7	60.2	69.2	<0.05
<b>Dependent variables</b>							
Not stressed <sup>†</sup>	...	...	...	84.0	79.4	88.6	...
Very good to excellent general mental health <sup>†</sup>	...	...	...	77.8	74.3	81.3	...
Not at risk, Strengths and Difficulties questionnaire	87.1	84.5	89.6	87.5	83.8	91.2	0.80

... not applicable

<sup>‡</sup> use with caution

<sup>†</sup> Includes data only from those aged 12 years and older.

LCL refers to lower confidence limit.

UCL refers to upper confidence limit.

BMI refers to body mass index.

**Note:** Data are presented as a proportion (%) and a 95% confidence interval unless otherwise stated.

**Source:** Statistics Canada, Canadian Health Measures Survey, 2009 to 2015.

the highest education level was the college or university level and where they lived with parents who were married or common law. The average BMI z-scores were 0.39 (SD = 0.04) among children and 0.44 (SD = 0.05) among youth.

The proportion of children and youth who met all three 24-Hour Guidelines recommendations was low: 13.9% of children and 4.8% of youth. When the component recommendations are examined separately, the sleep recommendations were met the most (84.0% among children and 64.7% among youth), followed by the recommendations for MVPA (47.7% among children and 25.8% among youth) and screen time (32.6% among children and 24.7% among youth). Table 1 also provides the proportion of the sample that met individual and combined recommendations. Children were more likely to meet all of the individual and combined recommendations than youth. The majority of children (87.1%) and youth (87.5%) had SDQ scores that were not considered at

risk for poor psychosocial health. While 77.8% (just over three-quarters) of youth reported that they had very good to excellent general mental health, 84.0% reported they were not stressed.

Results from the multivariate logistic regression analyses are presented in Table 2. The statistically significant findings related to the SDQ were found only among youth. Among youth, meeting two or more of the 24-Hour Guidelines recommendations was associated with substantially higher odds of possessing a normal SDQ score compared to those not meeting any of the guidelines (OR = 3.10; 95% CI: 1.17–8.19). Those who met the combination of sleep and MVPA recommendations had higher odds of good psychosocial health compared with those who did not meet those recommendations. Youth who met the screen time recommendations had just over 2.6 times higher odds of good psychosocial health (OR = 2.64; 95% CI: 1.21–5.73) compared to those who did not meet the screen time recommendations.

In addition to the SDQ results, youth who met the sleep recommendations were also found to have a higher likelihood of not being stressed compared with those who did not (OR = 1.96; 95% CI: 1.16–3.29). There was also a significant association between sleep and mental health among youth, whereby meeting the sleep recommendations increased the odds of them reporting very good to excellent mental health (OR = 1.67; 95% CI: 1.18–2.39).

## Discussion

This study examined the association between adherence to the 24-Hour Guidelines and psychosocial health among Canadian children and youth. A small proportion of children and youth met all three time-specific recommendations from the 24-Hour Guidelines, while the majority met only one or two recommendations. Sleep duration was the recommendation most often met by both children and youth. Overall, children were more likely to meet individual recommendations than youth. Greater adherence to the recommendations was found to be associated with increased odds of good psychosocial health among youth. Sleep duration was also associated with stress and mental health among youth. Those who met the sleep duration recommendations had higher odds of reporting lower stress and better mental health status than those who did not meet the sleep recommendations.

Similar to previous studies, the proportion of children and youth who met the 24-Hour Guidelines was low.<sup>6,15,16</sup> The difference in the proportions of children and youth who met all three movement recommendations was significant. In most of the categories examined, the proportion of youth who met the recommendations was no more than half the proportion of children in the same categories. This is consistent with previous research into individual behaviours, which found declines in these behaviours as children aged.<sup>6,12,13</sup>

Youth who met two or more recommendations had reduced odds of being

**Table 2**  
**Multivariate logistic regression results of the associations between meeting the 24-Hour Guidelines and psychosocial health, Canadian children and youth (reference group = abnormal)**

Recommendation	Good psychosocial health (SDQ)				Good psychosocial health (SDQ)				Not stressed				Good mental health				
	Children (n = 2,612)				Youth (n = 1,301)				Youth (n = 1,168)				Youth (n = 1,440)				
	OR	LCL	UCL	p-value	OR	LCL	UCL	p-value	OR	LCL	UCL	p-value	OR	LCL	UCL	p-value	
<b>Number of recommendations met</b>																	
None <sup>†</sup>	1.00	...	...	...	1.00	...	...	...	1.00	...	...	...	1.00	...	...	...	...
One	1.68	0.85	3.31	0.13	1.00	0.48	2.08	1.00	1.88	0.97	3.64	0.06	1.29	0.78	2.13	0.32	
Two or more	2.01	0.96	4.21	0.07	3.10 <sup>*E</sup>	1.17 <sup>*</sup>	8.19 <sup>*</sup>	0.02 <sup>*</sup>	1.83 <sup>E</sup>	0.76	4.43	0.18	1.71	0.94	3.12	0.08	
Sleep recommendation met	1.65	1.00	2.73	0.05	1.88 <sup>E</sup>	0.98	3.62	0.06	1.96 <sup>*E</sup>	1.16 <sup>*</sup>	3.29 <sup>*</sup>	0.01 <sup>*</sup>	1.67 <sup>*</sup>	1.18 <sup>*</sup>	2.39 <sup>*</sup>	<0.05	
Physical activity recommendation met	1.05	0.69	1.59	0.83	0.84 <sup>E</sup>	0.42	1.68	0.62	1.44 <sup>E</sup>	0.61	3.37	0.40	0.85 <sup>E</sup>	0.51	1.42	0.53	
Screen time recommendation met	1.18 <sup>E</sup>	0.73	1.92	0.50	2.64 <sup>*E</sup>	1.21 <sup>*</sup>	5.73 <sup>*</sup>	0.01 <sup>*</sup>	0.71 <sup>E</sup>	0.37	1.37	0.31	1.02 <sup>E</sup>	0.63	1.65	0.93	
Physical activity and screen time	1.16 <sup>E</sup>	0.72	1.87	0.54	F	F	F	F	F	F	F	F	F	F	F	F	
Sleep and physical activity	1.19 <sup>E</sup>	0.76	1.88	0.45	3.04 <sup>*E</sup>	1.33 <sup>*</sup>	6.98 <sup>*</sup>	0.01 <sup>*</sup>	F	F	F	F	1.05 <sup>E</sup>	0.55	2.00	0.88	
Sleep and screen time	1.12 <sup>E</sup>	0.66	1.92	0.67	F	F	F	F	F	F	F	F	1.30 <sup>E</sup>	0.70	2.39	0.40	

... not applicable

<sup>E</sup> use with caution

F too unreliable to be published

\* significantly different from reference category ( $p < 0.05$ )

<sup>†</sup> reference category

LCL refers to lower confidence limit.

OR refers to odds ratio.

SDQ refers to the Strengths and Difficulties Questionnaire.

UCL refers to upper confidence limit.

**Notes:** Adjusted for age, sex, household education, family status and BMI z-score.

**Source:** Statistics Canada, Canadian Health Measures Survey, 2009 to 2015.

at risk for poor psychosocial health, compared with those who met none of the recommendations. The findings from this present study further highlight the importance of the 24-hour movement continuum<sup>14</sup> and the association of adequate sleep, sufficient physical activity and limited sedentary time (especially screen time) with psychosocial health.

The results of this study agree with what has been previously reported. Previous studies examining data from the CHMS also found that adhering to the 24-Hour Guidelines was associated with indicators of positive psychosocial health (SDQ, emotional problems, prosocial behaviours and life satisfaction). Specifically, a dose-response relationship has also been reported, whereby meeting a greater number of recommendations was associated with greater positive psychosocial health outcomes.<sup>15,16</sup> A review of the literature found no other international publications that examined integrated 24-hour movement guidelines for children and youth and their associations with psychosocial health.

Although it is important to meet all of the 24-Hour Guidelines recommenda-

tions, sleep appears to be a key correlate of psychosocial health among youth. Across all four psychosocial health outcomes, meeting sleep duration recommendations was associated with lower odds of self-reported stress and increased odds of very good to excellent mental health, and was borderline significant in the SDQ models. With a larger sample size, it is expected that meeting sleep duration recommendations would also have a statistically significant association with lower odds of being at risk for poor psychosocial health.<sup>16</sup> The sleep duration findings are considered clinically meaningful. The combination of meeting sleep and MVPA recommendations was associated with lower odds of at-risk SDQ scores among youth.

In contrast to previous research,<sup>3,9,31,32</sup> meeting physical activity recommendations individually or in combination with sleep or screen recommendations did not have a significant association with psychosocial health outcomes. It is possible that the dimensions of psychosocial health status that were assessed by CHMS measures were not sensitive to the effects of regular MVPA.

Previous research has shown that although time spent sleeping, doing

MVPA and looking at a screen may be related, they do not directly displace one another.<sup>8</sup> A decrease in sedentary time may not result in an increase in MVPA or sleep duration. It is important to note that light physical activity makes up the largest proportion of waking time likely to be displaced with sedentary behaviour. A previous compositional analysis found that the total complement of movement behaviours (physical activity, sedentary behaviour and sleep) over a 24-hour period was integral to optimal physical, social and emotional health.<sup>33</sup> Combined with the findings of the present study, the literature suggests that adherence to all components of the 24-Hour Guidelines is important for general health, but screen and sleep behaviours appear to be more strongly related to the measures of psychosocial health used in this study.

Similar to psychosocial health findings from the Canadian Community Health Survey,<sup>34</sup> a very high proportion of Canadian children and youth have good self-rated mental health, low self-rated stress and normal SDQ scores. However, this limits precision and the ability to detect a relationship between meeting the 24-Hour Guidelines and psychosocial health. Additionally, a very



low proportion of the sample met all three movement recommendations, creating a high variance for this exposure. This required collapsing children and youth who met two or three guidelines into a single category.

### Limitations

This study has limitations that should be acknowledged. First, all household questionnaire data were proxy-reported by a parent or guardian for children aged 5 to 11 years, and self-reported for youth aged 12 to 17 years. There is often a mismatch between self- or proxy-reported data and observed or device-measured behaviours.<sup>35,36,37</sup> This mismatch may have resulted in misclassification bias, which would have affected the findings of this study.

Changes in the response options for survey questions used to measure recreational screen time between Cycles 2 and 3 of the CHMS pose a challenge when

combining cycles. This study applied a similar methodology as previous studies that also combined CHMS cycles,<sup>6,15</sup> in that the same values for corresponding response categories were used. However, unlike in previous studies, the corresponding values for the response options provided by Cycle 3, rather than Cycle 2, were used. This was felt to better align with the current surveillance estimates being reported.<sup>38,39</sup>

Because of the cross-sectional design of this study, causal inferences and directionality cannot be identified. Furthermore, it is possible that other factors not studied here, either at the respondent or the parental level, are on the causal pathway. However, this study improves on previous studies with similar limitations since it used a nationally representative sample, overcoming previous issues attributed to convenience samples.

### Conclusion

Very few Canadian children and youth, in particular, adhere to the new Canadian 24-Hour Guidelines. Adherence to individual (especially sleep and screen time) and/or combined recommendations were generally associated with better psychosocial and mental health among youth.

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