Catalogue no. 82-003-X
ISSN 1209-1367

Health Reports

The missing middle: Exploring light-intensity physical activity and how it relates to health among adults in Canada

by Isabelle Michaud, Rachel C. Colley, Karen C. Roberts, Stephanie A. Prince and Marisol T. Betancourt

Release date: September 16, 2026

Statistics Canada Statistique Canada

Canada

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 infostats@statcan.gc.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

Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner. To this end, the Agency has developed standards of service which its employees observe in serving its clients. 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.

The missing middle: Exploring light-intensity physical activity and how it relates to health among adults in Canada

by Isabelle Michaud, Rachel C. Colley, Karen C. Roberts, Stephanie A. Prince and Marisol T. Betancourt

DOI: https://www.doi.org/10.25318/82-003-x202600900001-eng

Abstract

Background: The health benefits of moderate-to-vigorous physical activity (MVPA) are well established, as are the detrimental impacts of excess sedentary time. Less is known about the benefits of activity undertaken at intensities between sedentary and moderate. This study examines how average daily minutes spent in each movement intensity and average daily steps accumulated in each intensity band varied across population groups by age and sex. It also examines the associations between movement intensities and health indicators.

Data and Methods: The Actical accelerometer subsample data, household data and clinic data of the Canadian Health Measures Survey (2007 to 2019) were used for this analysis. Light-intensity physical activity (LPA) was subdivided into three intensities based on tertiles: low, mid and high.

Results: Females and older adults accumulated fewer minutes of physical activity and fewer steps than their counterparts, in mid LPA, high LPA, and MVPA. After adjusting for MVPA and covariates, minutes and steps spent in mid LPA were significantly associated with reduced odds of having cardiovascular disease (CVD), two or more chronic conditions, and poor or fair general health, while minutes and steps in high LPA were significantly associated with reduced odds of having CVD.

Interpretations: While spending time in MVPA is positive for health, this study suggests that increasing daily minutes and steps in higher intensity LPA is also associated with health benefits. This study is consistent with previous studies that show that all movement is beneficial, including LPA, particularly when it replaces sedentary behaviour.

Keywords: Sedentary, steps, obesity, older adults, chronic conditions, cardiovascular disease, type 2 diabetes, hypertension, general health

Authors

Isabelle Michaud is with the Economic Statistics Methods Division at Statistics Canada. Rachel C. Colley is with the Health Analysis and Modelling Division at Statistics Canada. Karen C. Roberts, Stephanie A. Prince and Marisol T. Betancourt are with the Centre for Surveillance and Applied Research at the Public Health Agency of Canada. Stephanie A. Prince is also with the University of Ottawa.

What is already known on this subject?

- Less than half of Canadian adults meet the moderate-to-vigorous physical activity (MVPA) recommendations, and about one-quarter meet current recommendations for sedentary behaviour.
- While the benefits of MVPA and the detrimental impacts of sedentary time are well established, less is known about the health effects of light-intensity physical activity (LPA).

What does this study add?

- Most daily steps are accumulated during LPA.
- Females and older adults accumulate fewer minutes and steps in mid and high LPA and MVPA.
- Mid and high LPA appear sufficient to confer health benefits in adults, with mid LPA representing a "tipping point" where protective associations begin, showing at least similar effects to MVPA.
- Examining LPA as a single intensity range may mask important findings showing that mid and high LPA are associated with health benefits.

Introduction

On average, 46% of Canadian adults obtain the recommended 150 minutes per week of moderate-to-vigorous physical activity (MVPA), and 26% meet the sedentary behaviour recommendations (less than 9 hours per day of sedentary time measured by device[1] and 3 hours or less per day of self-reported recreational screen time).[2] The health benefits of MVPA are well established[3] as are the detrimental impacts of excess sedentary time.[4] Less is known about the benefits of activity undertaken at intensities between sedentary and moderate. The Canadian Health Measures Survey (CHMS) collected Actical accelerometer data from 2007 to 2019 on representative samples of people living in the 10 Canadian provinces. Descriptive profiles of movement during waking hours using the CHMS accelerometer data have historically focused on MVPA and sedentary time.[5-7] Light-intensity physical activity (LPA), the range of incidental movement that occurs throughout the day between sedentary and moderate-intensity activities (i.e., between 1.6 and 2.9 metabolic equivalents of task [METs], like slow walking or stepping, household shores and light gardening), has received relatively less attention in the research literature.[8]

Males generally accumulate more MVPA than females, with a 10-percentage-point difference in adherence to the MVPA recommendation.[9] Average daily step counts, another metric captured by the accelerometers, has not been the focus of CHMS analyses or physical activity surveillance in Canada. Daily step counts are an increasingly popular indicator of physical activity given the increasing popularity of smartwatches, smartphones, and other wearables that capture these metrics. Average daily step counts capture total daily movement across the day accumulated at various intensities. From 2007 to 2009, adult males accumulated an average of 9,544 steps per day and females accumulated an average of 8,385 steps per day. There is presently no published daily step count benchmark in Canada and globally. About one-third of Canadian adults accumulated 10,000 steps per day from 2007 to 2009, with older adults less likely than younger adults to get this amount.[5] From 2022 to 2024, 32% of Canadian adults were accumulating 7,500 steps per day.[10]

There is presently no benchmark to define a healthy dose of LPA. The Canadian 24-Hour Movement Guidelines include recommendations for physical activity (MVPA and strength training), sedentary behaviour (screen time and sitting time) and sleep[1] (www.csep.ca). In addition to a specific recommendation for the amount of MVPA that should be obtained, the guidelines mention that adults should accumulate "several hours of light physical activities, including standing" daily. At the time the guidelines were developed, there was not enough evidence to set a specific threshold for LPA. Possible explanations for why research on LPA and its role in health is less common include the low variation between individuals in average daily minutes of LPA, the difficulty in recall of these activities (before the use of accelerometers), and the lack of a clear and consistent association between LPA and health. Most Canadian adults accumulate about three to four hours per day of LPA, with little variation by sex, age group, or body mass index (BMI) category.[5] Systematic reviews have concluded that LPA is inversely associated with all-cause mortality and favourably associated with indicators of cardiometabolic health, even after adjustment for MVPA.[11, 12] Other studies have not observed an association between LPA and health once MVPA was considered.[13, 14] Another study found that transferring time from sedentary behaviour to LPA was beneficial only among older adults (aged 50 to 79 years) and those who were overweight or obese.[15] Similarly, consensus on a daily step count threshold is difficult given that the dose-response relationship for steps differs by the outcome of interest.[16] Research is mixed, with one study reporting that about 2,700 daily steps can lead to mortality benefits and cardiovascular disease (CVD) benefits, with progressive risk reductions up to about 7,000 to 9,000 daily steps.[17] Other research has suggested that important risk reductions can be obtained with 4,000 to 5,000 steps per day.[18]

MVPA refers to movement that significantly raises one's heart rate or breathing with an energy expenditure of 3.0 METs or higher. Current Canadian population-level accelerometer analyses rely on uniform cut-points applied to device-recorded acceleration data to identify periods when people are engaged in MVPA. This one-size-fits-all approach is based on absolute intensity and can misclassify relative movement intensity for some individuals.[19] To illustrate, a person with obesity moves less efficiently than someone of normal weight, meaning they expend more energy for the same acceleration of movement. For people with obesity, time spent moving at lower intensities may be classified as LPA by an absolute accelerometer cut-point, yet could represent a relative state of exertion more consistent with MVPA. This can also be true for older adults, people with chronic health conditions, people with low fitness, and people with gait difficulties. Previous studies that solely focused on device-measured MVPA may therefore have missed an important source of daily movement in a large proportion of the population. This study aimed to better understand the distribution of device-measured LPA in the Canadian adult population and its potential role in promoting health.

The specific objectives of this study were to (1) examine how average daily minutes of each movement intensity (i.e., sedentary, LPA and MVPA) and average daily steps accumulated in each intensity band vary across age, and sex groups, and (2) examine associations between movement intensities and health indicators. For this study, LPA was further subdivided using tertiles into three intensities (low, mid, and high) to better understand the nuances of this broad intensity band.

Methods

Data source

Data are from Statistics Canada's CHMS, a repeated cross-sectional, nationally representative survey that collects self-reported and directly measured health information from the Canadian population aged 3 to 79 years (aged 6 to 79 in Cycle 1) living in private dwellings in the 10 provinces. People living in the three territories or on reserves and settlements in the provinces, the institutionalized population, residents

of certain remote regions, and full-time members of the Canadian Armed Forces are excluded (about 4% of the Canadian population). A questionnaire on sociodemographic characteristics and health behaviours was administered at the respondent's home. This was followed by an appointment at a mobile examination centre, where additional questions were asked, a series of physical measurements (e.g., height, weight, and blood pressure) was administered, and accelerometers were provided to participants. The accelerometer subsample data, household data, and clinic data from cycles 1 to 6 (2007 to 2019) of the CHMS were pooled and used for the present analysis. Data from Cycle 7 (2022 to 2024) were not comparable and were excluded because of a change in accelerometer. Data were collected from March 2007 to February 2009 (Cycle 1), August 2009 to November 2011 (Cycle 2), January 2012 to December 2013 (Cycle 3), January 2014 to December 2015 (Cycle 4), January 2016 to December 2017 (Cycle 5), and January 2018 to December 2019 (Cycle 6). The scope of the study was limited to adults aged 18 to 79 years with valid accelerometer-measured physical activity and step count pooled data (n = 15,217).[20] The response rate for the CHMS was 38% (reflecting the analytical requirement of having at least four valid days of accelerometer data).[20]

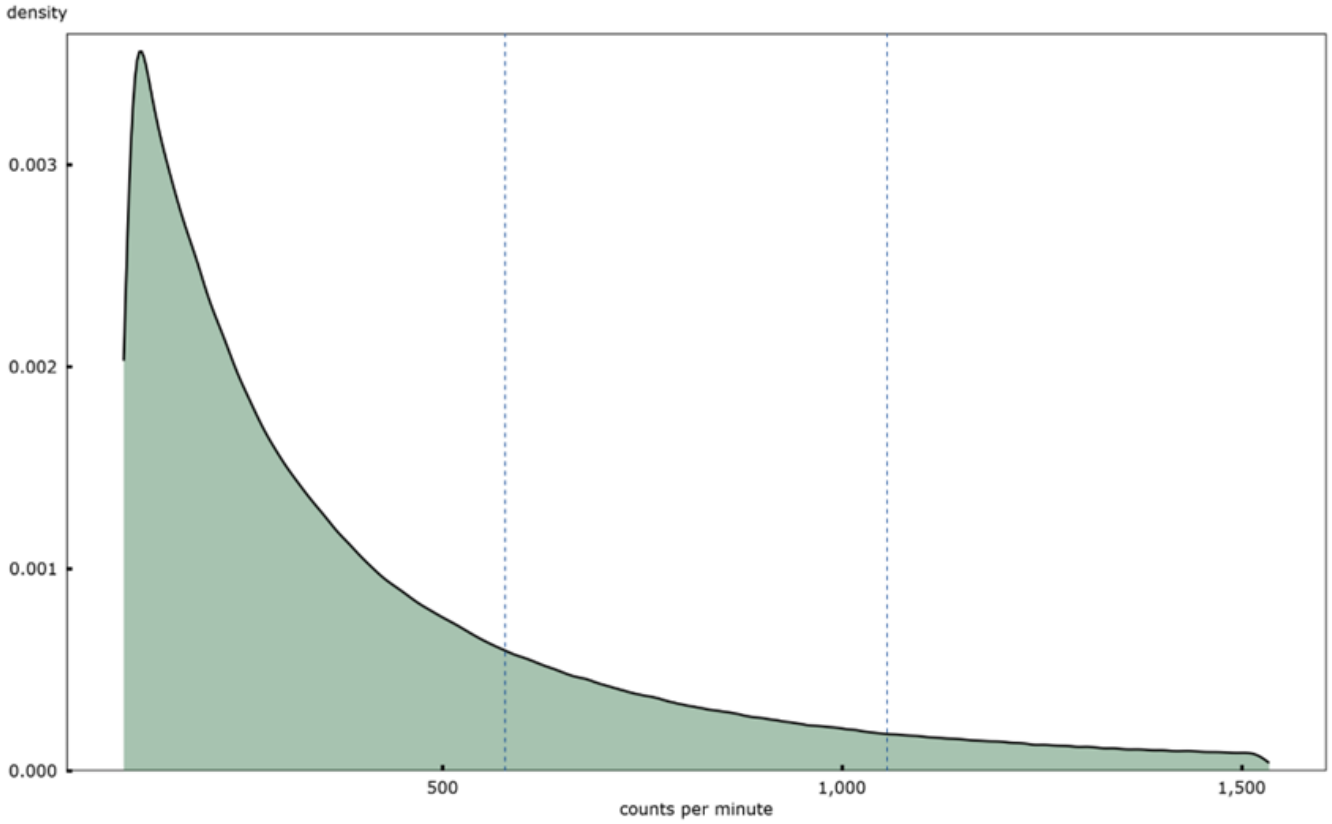
Accelerometer-measured physical activity

During their mobile examination centre visit, all ambulatory respondents were provided with an Actical accelerometer (Philips Respironics, Oregon, United States) to wear on an elasticized belt over the right hip during their waking hours for seven consecutive days. A valid day was defined as having at least 10 hours of wear time, and only participants with at least four valid days of data were included in this analysis. Wear time was determined by subtracting non-wear time from 24 hours. Non-wear time was defined as at least 60 consecutive minutes of zero counts, with allowance for one to two minutes of counts between 0 and 100. Details of the accelerometer data reduction and analytical procedures are available elsewhere.[21]

Derivation of accelerometer movement variables

Total time on each valid day spent on sedentary activity, LPA and MVPA was determined based on published cut-points: minutes accumulated under 100 counts per minute (cpm) for sedentary time, minutes accumulated from 100 to 1,534 cpm for LPA, and minutes accumulated at or above 1,535 cpm for MVPA.[22, 23] For the current study, the LPA band was further divided into absolute tertiles, as shown in Figure 1: low LPA (100 to 578 cpm), mid LPA (579 to 1,056 cpm), and high LPA (1,057 to 1,534 cpm). The average daily time spent at each intensity was calculated as the total number of minutes for all valid days, divided by the number of valid days. To account for possible variation in wear time, estimates for all intensities (sedentary, low LPA, mid LPA, high LPA and MVPA) were also converted into the percentage of waking hours. The sum of steps accumulated within each intensity band was derived. While the concept of sedentary does not typically include stepping, accelerometry analysis is designed in a way that allows some steps to be accumulated when an accelerometer threshold denotes sedentary intensity. Data are aggregated to 60-second intervals, meaning that some steps can be accumulated within a portion of a minute that also contains little or no movement—a situation where the accelerometer will classify the minute as sedentary (i.e., less than 100 cpm) and a small number of steps will be accumulated. Adherence to the physical activity recommendation from the guidelines was assessed based on respondents with a weekly sum of at least 150 minutes of MVPA.[1]

Figure 1
Density plot of counts per minute accumulated within the light-intensity physical activity band



Notes: Dotted blue lines demark the absolute tertile cut-points of 578 and 1,056 counts per minute.
Source: Statistics Canada, Canadian Health Measures Survey, 2007 to 2019.

Health indicators

Health indicators included the self-reported presence of two or more chronic conditions and general health. Respondents were instructed to include only health conditions that had lasted or were expected to last at least six months and that had been diagnosed by a health professional. The chronic conditions module included the following conditions: asthma, respiratory conditions, fibromyalgia, arthritis, back problems, high blood pressure, high cholesterol, chronic bronchitis, emphysema, chronic obstructive pulmonary disease, diabetes, heart disease, heart attack, cancer, effects of a stroke, thyroid disease, mood disorder, kidney dysfunction, liver or gallbladder problems, hepatitis, and any other chronic health conditions not already asked about. High blood pressure, type 2 diabetes, and CVD (including having been diagnosed with heart disease, having had a heart attack or suffering from the effects of a stroke) were also examined as separate conditions because of mechanistic evidence linking lower intensity movement and disruption to sedentary behaviour to better cardiometabolic health.[12, 24, 25] Self-rated general health was dichotomized into fair or poor versus good, very good, or excellent.

Sociodemographic covariates

Covariates were chosen based on their known associations with physical activity and indicators of health, and on data availability. Sex (male or female) and age were reported during the visit to the mobile examination centre. Three age groups were created: 18 to 39, 40 to 59, and 60 to 79 years. The highest level of respondent educational attainment was categorized as less than a secondary school education, secondary school graduation, and a postsecondary degree or diploma. Marital status was dichotomized

into married or common-law versus single, widowed, separated or divorced. Adjusted household income quintiles were derived by using a modified version of the equivalence score method, where total household income is adjusted by a weight factor based on the number of people in the household.[26] Smoking status was dichotomized into daily smoker or not, and alcohol consumption was dichotomized into regular drinker (two to three times per month or more) or not. Daily frequency of fruit and vegetable consumption was used as a proxy for diet quality.[27] BMI was derived from measured height and weight and categorized as normal or underweight (less than 25.0 kg/m^2), overweight (25.0 to 29.9 kg/m^2), and obese (30.0 kg/m^2 or more).[28]

Statistical analysis

Average daily minutes and steps accumulated within each intensity band (sedentary, all LPA, low LPA, mid LPA, high LPA and MVPA) were examined by sex and age group. The percentage of waking hours in each intensity was also examined by sex and age group. Logistic regression analyses assessed the association between average daily minutes and steps of each intensity band and health indicators. Models were created for each health indicator separately using each intensity as a single predictor. To generate meaningful odds ratios, daily time was transformed into 10-minute units, and daily steps were transformed into 1,000-step units. Logistic regressions were performed for the whole sample. Models were (1) not adjusted, then adjusted for (2) average daily MVPA and (3) average daily MVPA and covariates.

To account for the survey's complex sampling design, all analyses were weighted using the combined accelerometer subsample survey weights from CHMS cycles 1 to 6, as generated by Statistics Canada.[20] Variance estimation (95% confidence intervals) was assessed using the replicate weights generated by Statistics Canada, and the denominator degrees of freedom were defined as 68. Analyses were conducted using R version 4.4.1. All analyses, figure and charts were generated using the survey, srvyr and ggplot2 packages in R.

Results

An overview of the sample distribution by different characteristics is presented in Table 1. About one-quarter of the population was in the obese category, and 57% did not meet the physical activity recommendation. Almost 40% of individuals had two or more chronic conditions. Average daily minutes and average daily steps accumulated in sedentary activity, LPA (all, low, mid, and high) and MVPA are presented in Table 2. Females and older adults had fewer minutes and steps than their counterparts in mid LPA, high LPA, and MVPA.

Table 1
Weighted proportion distribution across selected characteristics, adults aged 18 to 79 years, 2007 to 2019

		95% confidence interval	
	Weighted estimate	from	to
	percent		
Sex			
Males	49.9	49.6	50.2
Females	50.1	49.8	50.4
Age group			
18 to 39	38.5	38.1	38.9
40 to 59	38.0	37.8	38.3
60 to 79	23.5	23.2	23.7
Body mass index category			
Underweight or normal	38.7	36.8	40.6
Overweight	35.9	34.5	37.4
Obese	25.4	23.3	27.4
Physical activity recommendation met			
Yes	43.0	40.5	45.5
No	57.0	54.5	59.5
Less than two chronic conditions			
Yes	62.1	60.7	63.5
No	37.9	36.5	39.3
	hours per day		
Wear time	13.7	13.7	13.8

Source: Statistics Canada, Canadian Health Measures Survey, 2007 to 2019 combined.

Table 2
Weighted average daily minutes and steps accumulated in each activity intensity, by selected characteristics, adults aged 18 to 79 years, 2007 to 2019

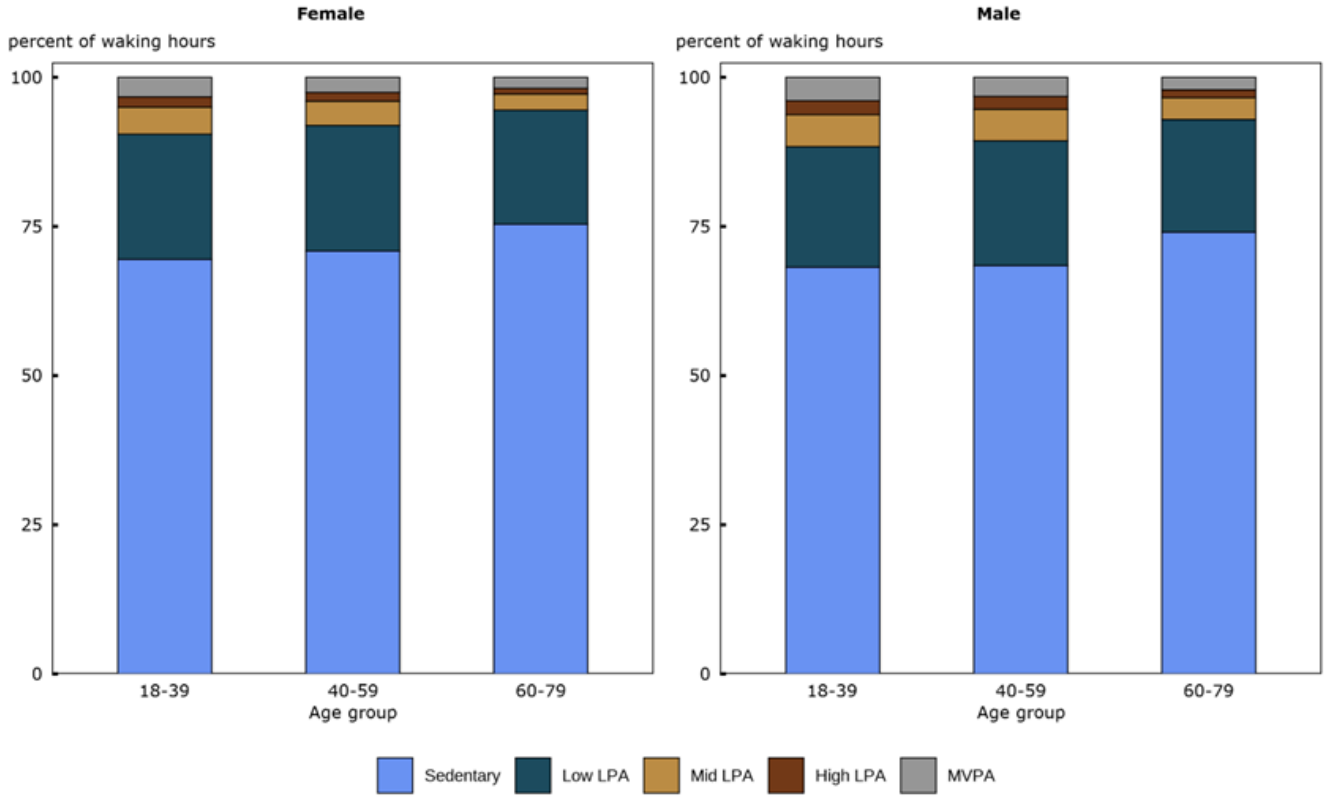
	Weighted average	95% confidence interval		Weighted average	95% confidence interval	
		from	to		from	to
	minutes per day			steps per day		
Sedentary						
Total	578.8	575.7	581.9	504	487	522
Sex						
Males	575.7	571.6	579.7	523	497	550
Females	581.9	578.0	585.8	486	469	503
Age group						
18 to 39	567.5	562.1	573.0	428	400	456
40 to 59	578.7	574.4	583.0	510	484	537
60 to 79	597.4	594.0	600.9	620	596	645
All LPA						
Total	220.5	216.3	224.6	5,553	5,420	5,686
Sex						
Males	227.8	222.4	233.1	5,956	5,789	6,123
Females	213.2	209.0	217.3	5,151	5,018	5,285
Age group						
18 to 39	229.4	223.0	235.9	5,627	5,428	5,827
40 to 59	230.8	226.3	235.3	5,908	5,751	6,064
60 to 79	188.9	184.4	193.4	4,855	4,714	4,996
Low LPA						
Total	169.0	166.0	172.0	3,055	2,982	3,128
Sex						
Males	168.9	165.3	172.5	3,122	3,033	3,211
Females	169.1	165.8	172.3	2,987	2,908	3,067
Age group						
18 to 39	171.3	166.5	176.0	2,917	2,805	3,029
40 to 59	176.0	172.7	179.3	3,231	3,141	3,321
60 to 79	153.8	150.5	157.1	2,994	2,913	3,076
Mid LPA						
Total	37.0	36.0	38.1	1,602	1,555	1,650
Sex						
Males	41.7	40.3	43.2	1,796	1,735	1,858
Females	32.3	31.3	33.3	1,409	1,362	1,456
Age group						
18 to 39	41.3	39.7	42.9	1,705	1,633	1,777
40 to 59	39.6	38.4	40.8	1,732	1,679	1,784
60 to 79	25.8	24.7	26.9	1,224	1,173	1,274
High LPA						
Total	14.5	14.0	14.9	896	869	923
Sex						
Males	17.1	16.5	17.7	1,037	1,001	1,074
Females	11.8	11.4	12.2	755	729	781
Age group						
18 to 39	16.9	16.2	17.5	1,005	966	1,045
40 to 59	15.2	14.5	15.8	945	907	984
60 to 79	9.3	8.9	9.7	637	609	665
MVPA						
Total	24.4	23.3	25.6	2,322	2,202	2,442
Sex						
Males	27.1	25.6	28.6	2,483	2,333	2,634
Females	21.8	20.5	23.0	2,161	2,029	2,293
Age group						
18 to 39	29.9	28.1	31.7	2,806	2,623	2,988
40 to 59	24.1	22.7	25.5	2,287	2,150	2,423
60 to 79	16.1	14.9	17.3	1,587	1,464	1,709

Notes: LPA: light-intensity physical activity; MVPA: moderate-to-vigorous physical activity.

Source: Statistics Canada, Canadian Health Measures Survey, 2007 to 2019 combined.

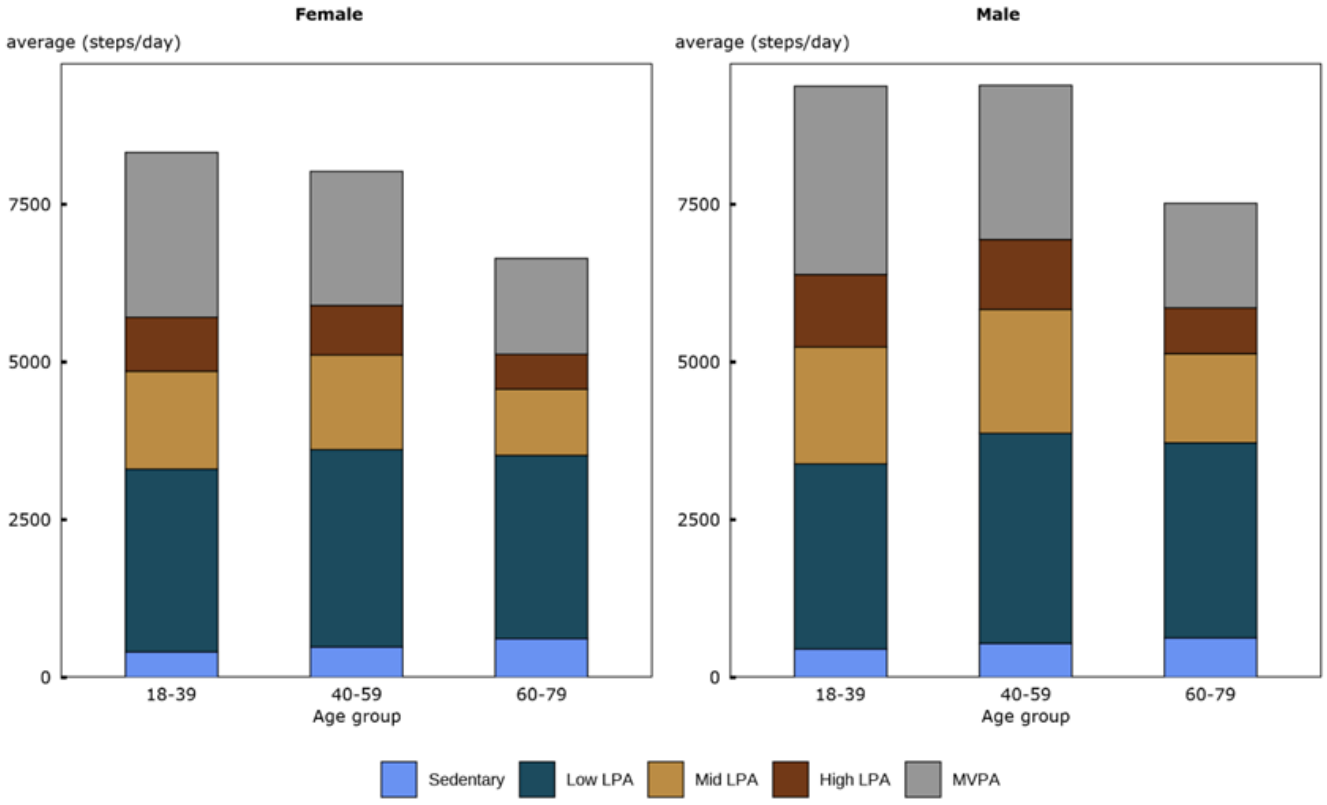
Chart 1a shows the percentage of waking hours spent in each intensity band. For both sexes, older adults spent a larger proportion of their waking hours sedentary than those in younger age groups, and a smaller proportion in low, mid, and high LPA and MVPA. Chart 1b shows the daily steps accumulated in each intensity band. More than half of daily steps were accumulated in the LPA band (i.e., low, mid and high LPA combined). For older adults, about half of daily steps were accumulated in sedentary activity and low LPA, while for adults in the two younger age groups, most of the steps were accumulated in mid LPA, high LPA and MVPA. For each age group, females accumulated fewer daily steps than males.

Chart 1.a
Percent of waking hours in each physical activity intensity, by sex and age group, household population aged 18 to 79 years, 2007 to 2019



Notes: LPA: Light-intensity physical activity; MVPA: Moderate-to-vigorous physical activity.
Source: Statistics Canada, Canadian Health Measures Survey, 2007 to 2019 combined.

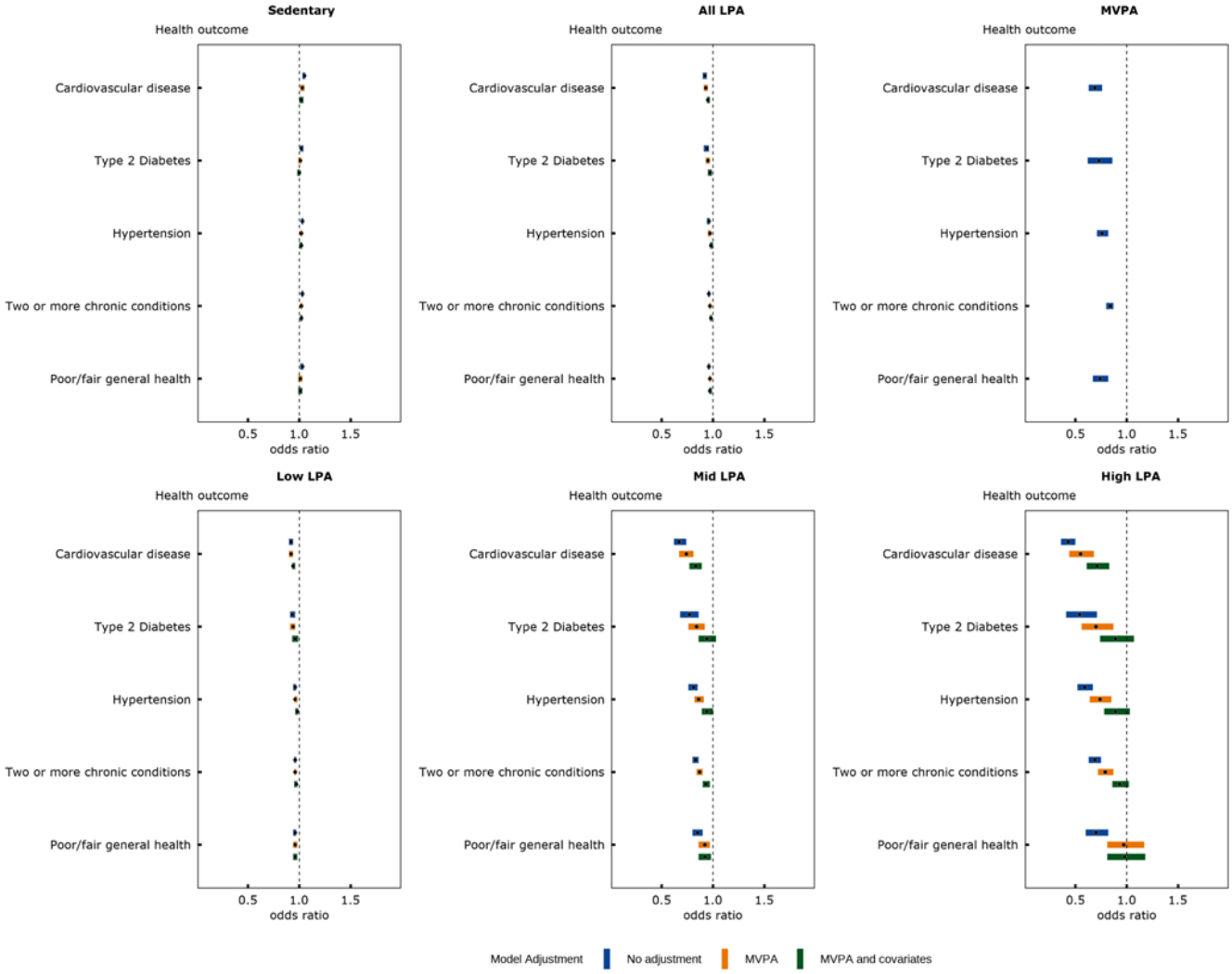
Chart 1.b
Steps accumulated in each physical activity intensity, by sex and age group, household population aged 18 to 79 years, 2007 to 2019



Notes: LPA: Light-intensity physical activity; MVPA: Moderate-to-vigorous physical activity.
Source: Statistics Canada. Canadian Health Measures Survey, 2007 to 2019 combined.

The odds ratios of having CVD, type 2 diabetes, hypertension, two or more chronic conditions, and poor or fair general health for each additional 10-minute increase in time spent in each activity intensity is presented in Chart 2. The odds ratios for low LPA were similar to those of all LPA, with mid LPA appearing to be the level where more meaningful associations start to emerge. After adjustment for MVPA and covariates, mid LPA was significantly associated with reduced odds of having CVD, hypertension, two or more chronic conditions, and poor or fair general health, while high LPA was significantly associated with reduced odds of having CVD. MVPA was associated with reduced odds of having all conditions and poor or fair general health. The odds ratios for high LPA were significantly lower than those of MVPA for CVD, hypertension, and two or more chronic conditions (i.e., denoting a greater decrease in the likelihood of having the health indicators); however, once adjusted for MVPA, the odds ratios for high LPA were attenuated.

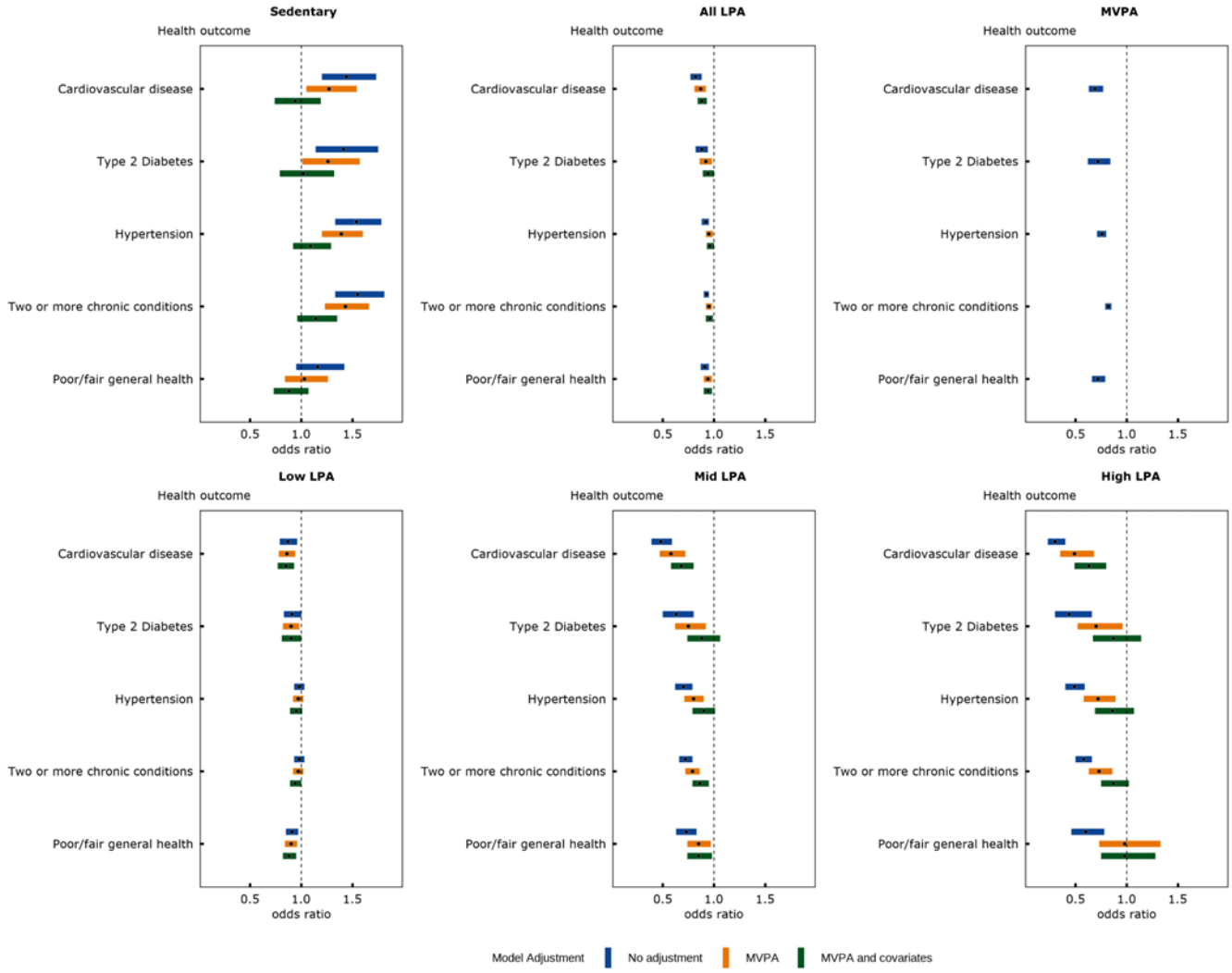
Chart 2
Odds of having a given health outcome, according to the number of minutes spent at each activity intensity, household population aged 18 to 79 years, 2007 to 2019



Notes: LPA: light-intensity physical activity; MVPA: moderate-to-vigorous physical activity. Models are either not adjusted, adjusted for MVPA, or adjusted for MVPA and covariates (sex, age group, body mass index category, marital status, adjusted income, education, smoking status, drinking status, and total fruit and vegetable consumption). Odds ratios are expressed for every 10-minute increase in time spent at each intensity.
Source: Statistics Canada, Canadian Health Measures Survey, 2007 to 2019 combined.

Models using steps accumulated at each intensity (Chart 3) showed greater variability in the estimates than for minutes of activity intensity, but overall, the same patterns were observed. Similar to minutes, it seems that higher intensities on the LPA band were associated with lower odds of having any of the health indicators. After adjusting for MVPA and covariates, steps in mid LPA were significantly associated with lower odds of having CVD, two or more chronic conditions, and poor or fair general health, while steps in high LPA were statistically significant for CVD. Steps in MVPA were associated with reduced odds of having all conditions and poor or fair general health. Also, the odds ratios for steps in high LPA were significantly lower than those of steps in MVPA for having CVD, hypertension, and two or more chronic conditions, but the effects weakened after adjusting high LPA for MVPA. Note that the odds ratios are expressed for every 1,000-step increase for each intensity. The 1,000-step increase is high for sedentary activity, and this could explain why there was a large increase in the odds of having each health indicator for sedentary activity for the first two models (i.e., not adjusted and adjusted for MVPA).

Chart 3
Odds of having a given health outcome, according to the number of steps at each activity intensity, household population aged 18 to 79 years, 2007 to 2019



Notes: LPA: light-intensity physical activity; MVPA: moderate-to-vigorous physical activity. Models are either not adjusted, adjusted for MVPA, or adjusted for MVPA and covariates (sex, age group, body mass index category, marital status, adjusted income, education, smoking status, drinking status, and total fruit and vegetable consumption). Odds ratios are expressed for every 1,000-step increase for each intensity.
Source: Statistics Canada, Canadian Health Measures Survey, 2007 to 2019 combined.

Discussion

This study found that average daily minutes and average daily steps accumulated in each physical activity intensity band varied across sex and age groups. Further subdividing LPA into three intensities (low, mid and high), in addition to sedentary activity and MVPA, uncovered that within the LPA band, higher intensities (i.e., mid and high LPA) tend to be more positively associated with better health indicators. In other words, examining LPA as a single intensity range masks important health benefits that appear to be more strongly associated with the top end of the LPA intensity range. On average, females and older adults accumulated fewer minutes and steps in mid LPA, high LPA, and MVPA than their counterparts. Consistent with prior research,[7] older adults allocated a greater proportion of their waking time to sedentary behaviours compared with younger adults. Also, about half of their daily steps were accumulated in sedentary activity and low LPA. Note that the published definition of sedentary behaviour does not directly align with step accumulation.[29] Indeed, accelerometer processing methods, particularly

the use of the 100 cpm threshold, can still classify some step accumulation as occurring during what the accelerometer defines as sedentary time.

This study also examined the associations between activity intensities (sedentary activity, all LPA, low LPA, mid LPA, high LPA and MVPA) and selected health indicators (CVD, type 2 diabetes, hypertension, two or more chronic conditions, and poor or fair general health). While more time in sedentary behaviour was associated with increased odds of adverse health outcomes, as observed in other studies,[4] this study confirmed that more time moving at a light intensity can be beneficial for health.[11, 12, 15, 18, 19] Namely, mid LPA appeared to represent the tipping point at which protective associations emerged, with the odds of the health indicator decreasing as minutes and steps accumulated at this intensity and higher increased. Across all examined health indicators, odds ratios for mid LPA were comparable to those observed for MVPA, whereas those for high LPA were often lower, suggesting that both mid and high LPA may be intense enough to confer health benefit for adults. Similar to other studies,[13, 14] associations between LPA and health were often rendered non-statistically significant after adjustment for MVPA and covariates, to various degrees, depending on the health indicator. This is because a 10-minute increase of MVPA represents a larger dose of expended energy than a 10-minute increase of LPA. Including MVPA in the model without standardizing intensities to equivalent energy expenditure can diminish the effect of lower intensities. Also, for individuals with lower movement efficiency or fitness, a given activity may require greater energy expenditure and represent a higher relative intensity, such that activities classified as light intensity may still provide meaningful health benefits. Absolute volumes ignore the importance of relative intensity, whereby some subgroups may require more relative effort to engage in activities at lower absolute intensities.[19]

Public health implications

Experts support the need for thinking of movement as a 24-hour paradigm that includes LPA.[30-33] They also recognize the importance of promoting LPA, with a push to define a specific LPA dose recommendation in future guidelines.[18] However, further work is needed to better understand how to characterize this range of movement intensity that captures a broad range of activities and its importance for health.

LPA represents a more accessible form of physical activity for many, especially those who currently do not engage in any MVPA.[18] Indeed, it is easier to transition from sedentary behaviour to LPA than from sedentary behaviour to MVPA, and the dose-response curve shows that the greatest benefit of movement comes at the very bottom (i.e., going from no physical activity to a little bit).[18, 19] The historical focus of the field of physical activity epidemiology on the link between MVPA and good health has evolved in a new direction that acknowledges that the whole day matters.[31-33] This newer approach emphasizes simplified messages (e.g., “sit less, move more, and more often”[19]) and easy-to-interpret metrics that individuals are familiar with (e.g., step counts from smartwatches and smartphones[17]) and that can be capitalized upon to enhance future guidelines.

Because step counts are accumulated across all intensity bands (i.e., from sedentary activity to MVPA), it is critical to characterize their distribution and health implications to inform the development of future physical activity recommendations. While getting many daily steps from MVPA is positive for health, this study suggests that increasing daily steps in mid and high LPA is also associated with health benefits. However, given the cross-sectional nature of the CHMS, causality between physical activity and health could not be determined.

Limitations and strengths

The classification of LPA into low, mid and high categories based on tertiles was data-driven. These thresholds were intended solely for exploratory use within this study and should not be regarded as universally applicable cut-points. However, the use of tertiles allowed a clearer understanding of the LPA range and the association of finer ranges of LPA with the health indicators.

Since the CHMS is a cross-sectional study, all associations reported in this paper are cross-sectional and don't allow for talking about causality or directionality.

Also, it was not possible to develop a multivariate regression model with all intensities in the model at the same time because of high correlation between the different intensities of physical activity. One movement variable was included in the models at a time (or two variables when models were adjusted for MVPA) to avoid multicollinearity issues.

Moreover, the independent variables in the regression models were converted to 10-minute and 1,000-step units because these scales are most meaningful for interpreting MVPA intensity. While this scaling is less intuitive for sedentary activity, the same units were applied to all intensities to maintain consistency across models.

Finally, for the odds ratio estimates, the confidence intervals tended to be wider when high LPA was used as the model's independent variable. This can be explained by the fact that only about 6.6% of total LPA time falls within this tertile and that step counts in the high LPA band account for only 16.1% of total LPA steps. On average, high LPA represents fewer minutes and steps than MVPA.

Conclusion

In conclusion, this study highlights that LPA represents a significant portion of daily waking time and that within this intensity band there is variability in the associations with health indicators. While MVPA is associated with health benefits, LPA may represent a more accessible form of physical activity for many adults. Health messaging could reinforce that all movement is beneficial, including lower intensities of physical activity, especially in place of being sedentary.

References

1. Ross R, Chaput J-P, Giangregorio LM, et al. Canadian 24-Hour Movement Guidelines for Adults aged 18–64 years and Adults aged 65 years or older: An integration of physical activity, sedentary behaviour, and sleep. *Applied Physiology, Nutrition, and Metabolism* 2020. https://doi.org/10.1139/apnm-2020-0467.

2. Center for Surveillance and Applied Research, Public Health Agency of Canada. Physical Activity, Sedentary behaviour and Sleep (PASS) indicators data tool, 2025 Edition. *Public Health Infobase*. Ottawa (ON): Public Health Agency of Canada 2025.

3. Warburton DER and Bredin SSD. Health benefits of physical activity: A systematic review of current systematic reviews. Current Opinion in Cardiology 2017 https://doi.org/10.1097/HCO.0000000000000437.

4. Saunders TJ, McIsaac T, Douillette K, et al. Sedentary behaviour and health in adults: An overview of systematic reviews. *Applied Physiology, Nutrition and Metabolism* 2020. https://doi.org/10.1139/apnm-2020-0272.

5. Colley RC, Garriguet D, Janssen I, et al. Physical activity of Canadian adults: Accelerometer results from the 2007 to 2009 Canadian Health Measures Survey. *Health Reports* 2011. https://www150.statcan.gc.ca/n1/pub/82-003-x/2011001/article/11396-eng.htm

6. Clarke J, Colley R, Janssen I, et al. Accelerometer-measured moderate-to-vigorous physical activity of Canadian adults, 2007 to 2017. *Health Reports* 2019. https://doi.org/10.25318/82-003-x201900800001-eng.

7. Prince SA, Melvin A, Roberts KC, et al. Sedentary behaviour surveillance in Canada: Trends, challenges and lessons learned. *International Journal of Behavioral Nutrition and Physical Activity* 2020. https://doi.org/10.1186/s12966-020-00925-8.

8. Prince SA, Chaput J-P, Colley RC, et al. Unlocking the potential of light-intensity physical activity for public health: A call to action for research. *British Journal of Sports Medicine* 2026. https://doi.org/10.1136/bjsports-2025-111179.

9. Colley RC, Guerrero M and Bushnik T. Intersecting risk factors for physical inactivity among Canadian adults. *Health Reports* 2023. https://www150.statcan.gc.ca/n1/pub/82-003-x/2023011/article/00002-eng.htm

10. ParticipACTION. Moving Beyond Stagnation: Elevating Physical Activity in Canada – 2025 ParticipACTION Report Card on Physical Activity for Adults, https://www.participaction.com/the-science/adult-report-card/ (2025, accessed April 21, 2026).

11. Amagasa S, Machida M, Fukushima N, et al. Is objectively measured light-intensity physical activity associated with health outcomes after adjustment for moderate-to-vigorous physical activity in adults? A systematic review. *International Journal of Behavioral Nutrition and Physical Activity* 2018. https://doi.org/10.1186/s12966-018-0695-z.

12. Chastin SFM, De Craemer M, De Cocker K, et al. How does light-intensity physical activity associate with adult cardiometabolic health and mortality? Systematic review with meta-analysis of experimental and observational studies. *British Journal of Sports Medicine* 2019. https://doi.org/10.1136/bjsports-2017-097563.

13. Rao DP, Orpana H and Krewski D. Physical activity and non-movement behaviours: Their independent and combined associations with metabolic syndrome. *International Journal of Behavioral Nutrition and Physical Activity* 2016. https://www150.statcan.gc.ca/n1/pub/82-003-x/2023011/article/00002-eng.htm

14. McGregor DE, Carson V, Palarea-Albaladejo J, et al. Compositional Analysis of the associations between 24-h movement behaviours and health indicators among adults and older adults from the Canadian Health Measure Survey. *International Journal of Environmental Research Public Health* 2018. https://doi.org/10.3390/ijerph15081779.

15. Colley RC, Michaud I and Garriguet D. Reallocating time between sleep, sedentary and active behaviours: Associations with obesity and health in Canadian adults. *Health Report*s 2018. https://www150.statcan.gc.ca/n1/pub/82-003-x/2018004/article/54951-eng.htm

16. Ding D, Nguyen B, Nau T, et al. Daily steps and health outcomes in adults: A systematic review and dose-response meta-analysis. *The Lancet Public Health* 2025. https://www.sciencedirect.com/science/article/pii/S2468266725001641

17. Stens NA, Bakker EA, Mañas A, et al. Relationship of daily step counts to all-cause mortality and cardiovascular events. *Journal of the American College of Cardiology* 2023. https://doi.org/10.1016/j.jacc.2023.07.029.

18. Lee I-M, Powell KE, Sarmiento OL, et al. Even a small dose of physical activity can be good medicine. *Nature Medicine* 2025. https://doi.org/10.1038/s41591-024-03396-7.

19. Ekelund U, Dalene KE, Tarp J, et al. Physical activity and mortality: What is the dose response and how big is the effect? *British Journal of Sports Medicine* 2020. https://doi.org/10.1136/bjsports-2019-101765.

20. Statistics Canada. Canadian Health Measures Survey (CHMS) Data User Guide: Cycles 1 to 6, https://www.statcan.gc.ca/en/statistical-programs/document/5071_D4_V3 (2020, accessed July 2025).

21. Colley R, Connor Gorber S and Tremblay MS. Quality control and data reduction procedures for accelerometry-derived measures of physical activity. *Health Reports* 2010. https://www150.statcan.gc.ca/n1/pub/82-003-x/2010001/article/11066-eng.htm

22. Colley RC and Tremblay MS. Moderate and vigorous physical activity intensity cut-points for the Actical accelerometer. *Journal of Sports Science* 2011. https://doi.org/10.1080/02640414.2011.557744.

23. Wong SL, Colley R, Connor Gorber S, et al. Actical accelerometer sedentary activity thresholds for adults. *Journal of Physical Activity and Health* 2011. https://doi.org/10.1123/jpah.8.4.587.

24. Aune D, Norat T, Leitzmann M, et al. Physical activity and the risk of type 2 diabetes: A systematic review and dose–response meta-analysis. *European Journal of Epidemiology* 2015. https://doi.org/10.1007/s10654-015-0056-z.

25. Xie B, Cai X, Zhu Y, et al. Accelerometer-measured light-intensity physical activity and the risk of cardiovascular disease or death in older adults: A meta-analysis. *Polish Heart Journal* 2022. https://doi.org/10.33963/KP.a2022.0120.

26. Carson J. Family spending power. *Perspectives on Labour and Income* 2002. https://www.proquest.com/scholarly-journals/family-spending-power/docview/213993757/se-2

27. Bushnik T, Garriguet D and Colley R. Parent-Child association in body weight status. *Health Reports* 2017. https://www150.statcan.gc.ca/n1/pub/82-003-x/2017006/article/14828-eng.htm

28. World Health Organization. Body mass index (BMI), https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/body-mass-index (2026, accessed February 9, 2026).

29. Tremblay MS, Aubert S, Barnes JD, et al. Sedentary Behavior Research Network (SBRN) - Terminology Consensus Project process and outcome. *International Journal of Behavioral Nutrition and Physical Activity* 2017. https://doi.org/10.1186/s12966-017-0525-8.

30. Lavie CJ, Lin G-M and Ross R. Invited Commentary: Health benefits associated with an active lifestyle in the elderly population: Unique opportunities associated with light-intensity physical activity. *Canadian Journal of Cardiology* 2025. https://onlinecjc.ca/article/S0828-282X(24)00570-1/fulltext

31. Tremblay MS and Ross R. How should we move for health? The case for the 24-hour movement paradigm. *Canadian Medical Association Journal* 2020. https://doi.org/10.1503/cmaj.202345.

32. Tremblay MS, Esliger DW, Tremblay A, et al. Incidental movement, lifestyle-embedded activity and sleep: New frontiers in physical activity assessment. *Canadian Journal of Public Health* 2007. https://cdnsciencepub.com/doi/full/10.1139/H07-130

33. Ross R, Janssen I and Tremblay MS. Public health importance of light intensity physical activity. *Journal of Sport and Health Science* 2024. https://doi.org/10.1016/j.jshs.2024.01.010.