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Objectively measured and self-reported sedentary time in older Canadians

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ABSTRACT

Objective. The aim of this study was to examine objectively measured total and self-reported leisure sedentary time among older Canadians by work status.

Methods. The analysis was based on 1729 older adults (60–79 years) from the 2007/09 and 2010/11 Canadian Health Measures Survey. Work status, functional limitations, smoking, and perceived health were assessed by self-report and waist circumference (WC) was measured. Total sedentary time (ST) and physical activity (PA) were objectively measured by accelerometer and leisure sedentary activities were assessed by questionnaire.

Results. 93.6% of individuals were sedentary for 8 or more hours per day. Measured ST did not differ by work status, while self-reported leisure ST was higher in those not working compared to those working (239 vs. 207 minutes/day, $p < 0.05$). Correlates of measured ST were fair/poor perceived health (β: 28.76, $p < 0.01$), smoking (β: 17.12, $p < 0.05$), high-risk WC (β: 13.14, $p < 0.05$), and not meeting PA guidelines (β: 35.67, $p < 0.001$). For self-reported leisure ST, working status (β: 33.80, $p < 0.001$) and functional limitations (β: 16.31, $p < 0.05$) were significant correlates.

Conclusions. Older adults accumulate substantial ST regardless of their working status and ST is correlated with indicators of health risk. Older adults are an important target population for interventions to reduce ST.

It is well known that physical activity (PA) reduces the risk of morbidity, mortality and loss of independence as we age (Paterson and Warburton, 2010). Recently, sedentary behaviour has emerged as an independent risk factor for chronic disease (Owen et al., 2009; Lord et al., 2011) and although current guidelines for sedentary behaviour focus on children and youth, the potential health consequences of prolonged sedentary time (ST) for older adults are significant. Gardiner et al. (2011b) found a positive association between overall self-reported ST and metabolic syndrome and a recent systematic review concluded there is a relationship between ST and mortality among older adults (de Rezende et al., 2014). These findings are particularly important in light of evidence that the amount of time spent sedentary increases with age (Colley et al., 2011; Dogra and Stathokostas, 2014; Godfrey et al., 2014). Despite this, there are few studies examining the correlates of objectively measured ST among older adults.

The workplace is a key setting for prolonged bouts of ST (Thorp et al., 2012) and although the relationship between work and leisure behaviours is complex (Wu and Porell, 2000), McCrady and Levine (2009) used objective measures to demonstrate that work days are associated with more sitting and less walking compared to leisure days. Mabry et al. (2012) also found that women who were employed reported 49% more sitting time compared to those who were not. In light of these findings, it seems reasonable to assume that retirement might provide an opportunity for both increased leisure-time PA and reduced ST among older adults. However, previous studies addressing the effect of retirement on PA and health have produced conflicting results (Chung et al., 2009; Henkens et al., 2008) and there are far fewer studies of older adults that have examined the relationship between sedentary behaviour and working status. This may be particularly important since an increasing life expectancy combined with a decline in the working age population means that more Canadians will continue working into their 60s and 70s (Payne and Doyal, 2010). Recently, Dogra and Stathokostas (2014) reported that retired men were 1.36 times more likely to report sitting for 4 or more hours/day than those who were not retired. In contrast, Godfrey et al. (2014) used objective measurements to show that individuals who were retired spent a lower percentage of their time sedentary compared to those who were still employed. These markedly different findings warrant further examination. Thus, the purpose of this study was to use a large nationally representative dataset to examine sociodemographic, anthropometric, and behavioural correlates of both objectively measured total ST and self-reported leisure ST among working and not-working older Canadians.

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Methods

The present study used data from cycles 1 and 2 of the Canadian Health Measures Survey (CHMS). Approximately 96% of the Canadian population is represented in the CHMS: residents of Indian Reserves or Crown lands, institutions, certain remote regions, and full-time members of the Canadian Forces were excluded. Data were collected from March 2007 to February 2009 (cycle 1) and from August 2009 to November 2011 (cycle 2). Data collection consisted of a questionnaire on socio-demographic characteristics and health behaviours administered at the respondent's home, followed by anthropometric and fitness tests at a subsequent visit to a mobile examination centre. Of the households selected across both cycles of the survey, 72.7% provided the sex and date of birth of all household members and one or two members were then selected to participate. Of those selected, 89.3% completed the questionnaire, and 83.3% of those participated in the visit to the mobile clinic. The final response rate after adjusting for the sampling strategy was 53.5% (Statistics Canada, 2013). The final sample size for the combined cycles 1 and 2 was 11,398 respondents aged 6 to 79. The target sample for the present analysis was older adults aged 60 to 79 years ($n = 2194$). Of those, 447 had incomplete accelerometry data, and an additional 18 had incomplete working status information. Therefore, the present analysis is based on 1729 older adults aged 60 to 79 years. Ethics approval for the CHMS was obtained from Health Canada's and the Public Health Agency of Canada's Research Ethics Board and informed, written consent was obtained from all participants (Day et al., 2007).

Working status

Respondents were classified as "working" if they answered yes to the question "Last week, did you work at a job or business?" or to the question "Last week, did you have a job or business from which you were absent?" Respondents were classified as "not working" if they indicated they were retired, or if they answered no to the questions above. All respondents aged 76 to 79 were assumed to be "not working" since they were not asked any questions related to employment during the household interview.

Sedentary time

All ambulatory respondents were provided with an Actical accelerometer to wear over the right hip during all waking hours for 7 days (Statistics Canada, 2010, 2012). The Actical accelerometer measures the acceleration of movement in all directions (omnidirectional); movement is captured and recorded as a digitized value that is summed over 1 minute intervals resulting in 10,080 activity counts per minute (cpm) values in a week. Accelerometer data reduction followed published guidelines to identify and remove invalid data (Colley et al., 2010). Total daily accelerometer wear time was determined by identifying non-wear time which was defined as periods of at least 60 consecutive minutes of zero counts, with an allowance for 1 or 2 min of counts between 0 and 100 cpm. A valid day was defined as having at least 10 h of wear-time and only participants with at least four valid days of data were included in this analysis (Colley et al., 2010). Sedentary time was defined as ≤100 cpm and total ST (in minutes) per day was determined. Respondents were also grouped as ≥8 or <8 hour daily ST.

Leisure ST was determined using information collected in the questionnaire. Participants were asked how many hours per week they typically spent doing the following 4 activities outside of work: watching TV, playing video games, using computers, or reading. In cycle 1, answers were collected in categories (e.g. none, less than 1 h, 1 to 2 h, etc.) but were collected as continuous responses (e.g. number of hours entered as a numeric value) in cycle 2. For purposes of consistency between cycles, the number of hours reported for the various activities in cycle 2 was calculated as a grouped variable using the same categories presented in cycle 1. This grouped variable was used to calculate the total number of minutes of leisure ST per day.

Health indicators

Detailed descriptions of the measurement procedures for each of the CHMS physical measurement components are available elsewhere (Statistics Canada, 2010, 2012). In cycle 1, WC was measured as per the World Health Organization (WHO) protocol and in cycle 2, WC was measured as per the National Institutes of Health (NIH) protocol. In order to compare between cycles, a prediction equation developed by Patry-Patrisien et al. (2012)) was used to calculate a predicted NIH-WC value based on the WHO-WC measurements collected in cycle 1. Ardern et al. (2004) identified threshold waist circumference values within different BMI categories that identify individuals with increased health risk. These values were used in the present analysis and each respondent was categorized as either "below" or "above" the BMI-specific threshold value for increased risk. For men, the thresholds are 90, 100, 110, and 125 cm for normal weight, overweight, obese class I, and obese class II and III, respectively. For women, the thresholds are 80, 90, 105, 115 and 125 cm for normal weight, overweight, obese class I, obese class II, and obese class III, respectively (Ardern et al., 2004).

PA was determined based on data collected from the accelerometer with a cut-point of ≥1535 cpm used to identify minutes of moderate-to-vigorous PA (MVPA) during wear-time, which were summed for each valid day. Based on the weekly total, respondents were categorized as either "meeting the guidelines" (≥150 minute MVPA per week) or "not meeting the guidelines" (<150 minute MVPA per week).

Finally, all respondents were asked to report their perceived health status as either poor, fair, good, very good, or excellent. For the purpose of this analysis, poor and fair were grouped together.

Covariates

Other covariates considered were age, gender, education (post-secondary graduate, yes/no), smoking status (smoker/non-smoker), and an indicator of functional limitations (yes/no) based on the Health Utility Index function codes for mobility trouble and activities prevented by pain. Respondents were considered to have a functional limitation if they indicated having any mobility problem or pain that prevents any activity.

Statistical analysis

Conventional descriptive statistics were used to describe the sample distribution and to summarize measured total ST, prolonged ST, and self-reported leisure ST, by age group, gender, and working status. Differences in ST by gender or by working status were evaluated using *t*-tests, using a *p*-value of <0.05 to indicate significance. Separate linear regression models were used to evaluate the associations between ST and working status, WC risk, self-perceived health, and PA level. The models were adjusted for age, gender, education, smoking status and functional limitations, and results are presented in minutes per day. A multivariate linear regression model was used to evaluate the association between measured total ST and leisure ST, adjusted for age, gender, education, smoking status, and functional limitations. All models where measured ST was the outcome of interest were also adjusted for accelerometer wear-time (hours), to account for differences in total wear-time throughout the week. When self-reported leisure ST was the outcome of interest, the models were also adjusted for sleep time (hours). Sleep was not adjusted for in the objectively measured ST models as the accelerometer wear-time acts as a proxy for sleep since respondents are asked to wear the device for all waking hours.

All analyses were completed using SAS v9.2 and SUDAAN v10. All results were weighted using the activity monitor sub-sample weights

(Statistics Canada, 2013). Standard errors, coefficients of variation and 95% CI were calculated using the bootstrap technique. The CHMS combined cycle 1 and 2 study design requires that 24 degrees of freedom be specified in the software (Statistics Canada, 2013).

Results

Sample characteristics are described in Table 1.

According to objectively measured data, 93.6% of individuals were sedentary for 8 or more hours per day (Table 2). On average, participants spent 600 min/day in ST and reported 228 min/day of leisure ST. No differences were noted for measured ST between working and not working men or women. Self-reported leisure ST was significantly higher in those not working compared to those working (239 vs. 207 min/day).

Table 3 shows that ST was significantly higher among older adults with a high risk WC and those who were not meeting PA guidelines. None of the variables assessed were significantly associated with ≥8 h of ST in the combined sample or men and women separately (data not shown).

Linear regression models adjusting for gender, education, smoking status, functional limitations, working status, WC, self-perceived health, and PA levels are presented in Table 4. Overall, these models explain 32% of the variance in measured ST and 5% of the variance in self-reported leisure ST. Significant correlates of measured ST were fair/poor ($p < 0.01$) and good self-perceived health ($p < 0.05$), high risk WC ($p < 0.05$) as well as not meeting the PA guidelines ($p < 0.001$). For self-reported leisure ST, only working status ($p < 0.001$) and functional limitations ($p < 0.05$) were significant correlates.

Discussion

The primary finding of this study was that although older adults who are working report lower levels of leisure ST compared to older adults who are not working, there were no differences between groups in

Table 1
Sample characteristics (%).

Characteristic		Total	Men	Women
		($n = 1729$)	($n = 831$)	($n = 898$)
Age (%)	60 to 75 years	88.5	87.2	89.6
	76 to 79 years	11.5	12.8	10.4[a]
Marital status	Married or common-law	72.2	82.0	63.4*
	Widowed, separated or divorced	23.0	14.1	31.1*
	Single, never married	4.8	3.9[a]	5.5[a]
Education	Post-secondary graduate	51.8	54.1	49.6
	Less than post-secondary	48.2	45.9	50.4
Smoking status	Smoker	12.9	13.7	12.3
	Non-smoker	87.1	86.4	87.7
Functional limitations	No functional limitations	80.3	84.3	76.7*
	Some limitations	19.7	15.7	23.3*
Working status[b] (%)	Working	32.5	37.1	28.3*
	Not working	67.5	62.9	71.7*
Self-perceived health	Poor/Fair	14.6	16.2	13.2
	Good	38.4	38.9	38
	Very Good	34.1	31.2	36.7
	Excellent	12.9	13.7	12.1
Waist circumference	Below risk threshold	71.5	72.3	70.7
	At or above risk threshold	28.5	27.7	29.3
Physical activity	Meets physical activity guidelines	11.4	13.4	9.6*
	Does not meet guidelines	88.6	86.6	90.4*

[a] Interpret with caution (coefficient of variation from 13.3 to 16.6%).
[b] Respondents aged 76 to 79 years were not asked the labour force questions, and are therefore assumed to be 'Not working'.
* Significantly different from estimate for men ($p < 0.05$).

Table 2
Mean (95% CI) measured and self-reported sedentary time in minutes per day and percent (95% CI) of prolonged sedentary time (measured) by age, sex, and working status[a].

		Total			Men			Women		
		Measured ST (min/day)	SR ST (min/day)	≥8 h (%)	Measured ST (min/day)	SR ST (min/day)	≥8 h (%)	Measured ST (min/day)	SR ST (min/day)	≥8 h (%)
Total	Total	600 (595–605)	228 (219–238)	93.6 (91.3–95.3)	594 (585–604)	228 (215–241)	92.9 (90.4–94.8)	606 (596–615)	229 (220–238)	94.2 (89.8–96.8)
	Working[b]	597 (588–607)	204 (189–218)	92.7 (87.8–95.7)	590 (576–603)	204 (188–219)	91.4 (86–94.8)	607 (587–627)	204 (183–225)	94.3 (82.1–98.4)
	Not working	601 (596–607)	240* (231–250)	94 (90.9–96.1)	597 (586–609)	242* (226–258)	93.8 (90.3–96.1)	605 (596–614)	239* (228–250)	94.1 (89.1–96.9)
60 to 75	Total	599 (594–604)	225 (217–234)	93.9 (91.9–95.4)	592 (582–602)	225 (212–239)	92.7 (90–94.7)	605 (595–615)	226 (217–234)	95 (91.3–97.2)
	Working[b]	597 (588–607)	204 (189–218)	92.7 (87.8–95.7)	590 (576–603)	204 (188–219)	91.4 (86–94.8)	607 (587–627)	204 (183–225)	94.3 (82.1–98.4)
	Not working	600 (593–606)	238* (229–247)	94.6 (92.3–96.3)	594 (581–607)	242* (224–259)	93.7 (90.1–96)	604 (594–614)	235* (225–245)	95.3 (92.1–97.2)
76 to 79	Not working	609 (592–627)	252 (225–278)	91 (75.3–97.1)	611 (591–631)	245 (216–273)	94.3 (80.9–98.5)	608 (578–638)	260 (230–289)	87.3 (57.7–97.2)

[a] Respondents aged 76 to 79 years were not asked the labour force questions, and are therefore assumed to be 'Not working'.
[b] Reference category.
* Significantly different from reference category ($p < 0.05$).

Table 3
Mean (95% CI) measured and self-reported sedentary time in minutes per day and odds ratio (95% CI) for prolonged sedentary time (measured), overall and stratified by sex for working status and other health-related characteristics.

Groups	Total[c]		Men		Women	
	Measured[a] ST (min/day)	Self-reported[b] ST (min/day)	Measured[a] ST (min/day)	Self-reported[b] ST (min/day)	Measured[a] ST (min/day)	Self-reported[b] ST (min/day)
Working status[e]						
Working[d]	598 (588–609)	207 (192–221)	589 (574–603)	207 (190–223)	609 (592–626)	205 (183–227)
Not working	601 (595–607)	239* (229–249)	598 (588–608)	240* (224–257)	604 (596–613)	239* (228–249)
Waist circumference						
Below risk threshold[d]	596 (590–603)	225 (216–233)	592 (582–601)	224 (212–236)	600 (591–609)	226 (216–236)
At or above risk threshold	610* (602–619)	238 (221–255)	601 (585–618)	238 (216–260)	619* (608–630)	237 (214–259)
Self-perceived health						
Poor/Fair	615* (602–628)	224 (203–246)	613* (599–626)	225 (204–245)	616* (598–634)	225 (196–253)
Good	606* (597–616)	230 (214–246)	598* (584–612)	229 (207–250)	614* (601–626)	229 (210–249)
Very good	594 (586–602)	231 (221–242)	590 (578–602)	235 (222–248)	598 (584–612)	228 (215–241)
Excellent[d]	581 (569–594)	222 (209–236)	571 (547–595)	212 (188–236)	591 (581–602)	236 (215–256)
Physical activity						
Meets guidelines[d]	566 (547–585)	233 (216–250)	567 (539–594)	249 (226–273)	564 (548–579)	214 (192–236)
Does not meet guidelines	605* (600–610)	228 (219–237)	599* (589–608)	225* (212–237)	610* (601–619)	231 (221–240)

[a] Estimates adjusted for age, education (post-secondary grad yes/no), smoking status (smoker/non-smoker), functional limitations (yes/no), and average wear time (h).
[b] Estimates adjusted for age, education (post-secondary grad yes/no), smoking status (smoker/non-smoker), functional limitations (yes/no), and self-reported sleep (h).
[c] Estimates for 'Total' are also adjusted for sex.
[d] Reference category.
[e] Respondents aged 76 to 79 years were not asked the labour force questions, and are therefore assumed to be 'Not working'.
* Significantly different from reference category ($p < 0.05$).

total ST as measured by an accelerometer. The secondary finding was that WC, self-perceived health, smoking status and PA were significant correlates of measured ST in older adults, while only working status and functional limitations were found to be related to self-reported leisure ST. These data are the first to compare measured and self-reported ST in Canadian older adults by working status, and have implications for public health promotion strategies, such as the development of sedentary behaviour guidelines for older adults.

Table 4
Beta estimates for measured[a] and self-reported[b] sedentary time.

	Sedentary (measured)[a] ($r^2 = 0.32$)				Sedentary (self-reported)[b] ($r^2 = 0.05$)			
	β estimate	Lower 95% CI	Upper 95% CI	p-Value (β)	β estimate	Lower 95% CI	Upper 95% CI	p-Value (β)
Sex								
Males[c]	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	
Females	12.0804	−1.0895	25.2503	0.0705	−3.4177	−17.6623	10.8269	0.6250
Working status[d]								
Working[c]	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	
Not working	6.3053	−6.1098	18.7203	0.3050	33.8010	19.6255	47.9765	0.0001
Waist circumference risk								
Below risk threshold[c]	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	
At or above risk threshold	13.1405	0.9705	25.3104	0.0355	16.2345	−1.3027	33.7716	0.0681
Self-perceived health								
Fair/poor	28.7647	8.0725	49.4569	0.0085	−2.9691	−26.8478	20.9096	0.7997
Good	22.3695	4.0817	40.6573	0.0186	4.1460	−13.6824	21.9744	0.6356
Very good	9.9504	−3.8770	23.7777	0.1505	5.5374	−8.8392	19.9139	0.4344
Excellent[c]	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	
Physical activity								
Meets guidelines[c]	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	
Does not meet guidelines	35.6739	17.2605	54.0874	0.0005	−1.1608	−15.0554	12.7338	0.8645
Education								
Post-secondary grad[c]	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	
Less than post-secondary	−6.8164	−18.0171	4.3844	0.2212	−11.3046	−25.4737	2.8645	0.1127
Smoking status								
Smoker	17.1287	3.1424	31.1149	0.0185	−8.5831	−30.1058	12.9395	0.4186
Non-smoker[c]	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	
Functional limitations								
No functional limitations[c]	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	
Some limitations	12.0341	0.0114	24.0568	0.0498	16.3096	2.6525	29.9667	0.0213

Note: All parameters presented in this table were included in the same model.
[a] Measured beta estimates are also adjusted for age and average accelerometer wear time (h).
[b] Self-reported beta estimates are also adjusted for age and self-reported sleep (h).
[c] Reference category.
[d] Respondents aged 76 to 79 years were not asked the labour force questions, and are therefore assumed to be 'Not working'.

The majority of individuals (93.6%) had 8 or more hours per day of sedentary time. Older adults accumulated, on average, 600 min per day of ST, which is comparable to objectively measured ST among older adults in Portugal (Santos et al., 2012). Lord et al. (2011) measured 747 min per day of ST among older adults in the UK; however, their participants were significantly older than the present sample.

The association between working status and ST was a novel exploration in this study as only a few studies have examined this association and most have focused on PA and used self-reported data. No difference was found in objectively measured total ST between older adults who were working compared to those who were not. This is interesting since the workplace is often cited as a source of prolonged ST. Others have reported differences based on working status; however, the findings have not been consistent. Golubic et al. (2014) analysed data from older adults aged 60–64 years and found that measured ST was higher in retired individuals compared to those who were still working. In contrast, Godfrey et al. (2014) found that measured ST was lower among retired older adults compared to those who were still working. The relationship between working status and ST is complex and is likely influenced by several factors, including the physical demands of a given job. An examination of sedentary time among different occupational types was beyond the scope of this study; however, we did adjust for education which may influence the type of occupation. The effect of work status on ST may also be influenced by the reasons for not working, as individuals who are not working due to illness or disability may be more likely to have high amounts of ST. The present study controlled for functional limitations making it less likely that there were significant differences in functional capacity between the groups.

Individuals who were working reported spending less leisure time in sedentary activities (TV viewing, computer use, and reading) compared to those who were not working, despite the fact that objectively measured total daily ST was not different between groups. It is plausible that leisure ST is lower among those who are still working, but that ST accumulated at work is enough to counteract the difference and make total ST equal between groups. However, it is also possible that this finding is evidence of a discrepancy between self-reported and directly measured ST. Several studies have examined self-reported sedentary time in older adults and found weak to moderate correlations with objective measurements (Gardiner et al., 2011a; Hekler et al., 2012; Visser and Koster, 2013). Typically participants tend to report less sedentary time (Gardiner et al., 2011a; Hekler et al., 2012), and more physical activity (Hekler et al., 2012) than is measured by accelerometer. Golubic et al. (2014) found that older adults who were currently employed reported more total daily ST despite the fact that objectively measured ST was higher in retired individuals. Visser and Koster (2013) found that self-report of 6 specific sedentary activities had the strongest correlations with objectively measured ST and the questionnaire used in the present study only addressed two of those six activities (TV and reading). Thus, it is possible that using a different self-report tool may have produced different results. However, the present results support the importance of objective measures since only measured total ST was associated with health indicators and lifestyle behaviours such as WC, smoking, perceived health, and PA.

Total ST was significantly greater among individuals with a high risk WC for their BMI, with fair or poor perceived health, and those who were not meeting Canada's PA guidelines. The cross-sectional nature of CHMS data means we cannot comment with certainty on the direction of these relationships, but regardless of whether or not prolonged ST causes poor health and visceral adiposity, or vice versa, these results suggest that older adults who are not regularly active, smoke, have a high risk WC, and poor perceived health, are an important target population for interventions to reduce ST.

The strengths of the current analysis are the use of a large, nationally representative sample, and objective measurements of ST, WC and PA. As previously noted, the main limitation is the cross-sectional study design. Also, the CHMS does not pose labour force questions to individuals over the age of 75 years, so these individuals were assumed to be not working. Another limitation of the present analysis is that we did not assess breaks in ST or domain specific ST. Future studies should further examine the pattern and types of sedentary behaviours.

In conclusion, older Canadians aged 60 to 79 years accumulate substantial ST regardless of their working status, and ST is correlated with indicators of health risk. Older adults are the fastest growing demographic in Canada. As we learn more about the health implications of prolonged sedentary time, there is a clear need for sedentary behaviour guidelines for the older adult population.

Conflict of interest

The authors declare no conflict of interest.

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