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ORIGINAL ARTICLE

Correlates of extended sitting time in older adults: an exploratory cross-sectional analysis of the Canadian Community Health Survey Healthy Aging Cycle

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Abstract
Objectives Sitting time has been identified as an independent predictor of health; however, little is known of the determinants of extended sitting time among older adults. The purpose of this study was to identify potential sociodemographic, physical environment, health-related and psychosocial correlates of extended sitting time among older adults living independently in the community.
Methods Data from adults over the age of 65 from the Canadian Community Health Survey (Healthy Aging Cycle, 2008–2009) were used for analysis ($n = 14{,}560$). Self-reported sitting time (<4 or ≥4 h/day) was the main outcome.
Results Age, retirement status, dwelling type, chronic disease, perceived health, body mass index, mood disorder and sense of belonging to community were associated with sitting for 4 or more hours/day. Very low, but not low or moderate, physical activity (OR 1.43; CI 1.19–1.72) was associated with sitting for 4 or more hours/day when compared to those classified as having high physical activity.
Conclusions Several specific correlates of extended sitting time were identified among older males and females; these findings have implications for public health strategies targeting older adults.

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Introduction

Despite strong evidence to support an important role for physical activity in the maintenance of health (Nelson et al. 2007), older adults spend approximately 8–10 h of waking time being sedentary (Swartz et al. 2012; Evenson et al. 2012). Sedentary behavior is characterized by too much sitting (i.e., extended sitting time) and is defined as any seated or reclined activity that requires an energy expenditure of less than 1.5 metabolic equivalents (Sedentary Behaviour Research Network 2012). It has been identified as a modifiable risk factor for several chronic cardiometabolic conditions, particularly among middle-aged and older adults. Among older adults, evidence suggests that those who are sedentary are more likely to have metabolic syndrome (Gardiner et al. 2011) and are more likely to have high total body fat (Swartz et al. 2012; Lord et al. 2011). Older adults who spend more time in sedentary activities are also at a higher risk of cardiovascular disease mortality and all-cause mortality (Katzmarzyk et al. 2009). Further, a recent investigation found that older adults who are sedentary are less likely to age successfully in the physical, psychological and sociological domains, regardless of their physical activity levels (Dogra and Stathokostas 2012).

Sedentary behavior is considered an emerging field of behavioral research. According to prominent researchers in the field, the priority at this stage is to identify correlates of sedentary behavior, particularly among groups with the highest total sitting time (Owen et al. 2011).

Correlates typically fall into three categories: personal, social and environmental. It is unclear at this point whether one of these categories is more important than the other, but according to the ecologic model of sedentary behavior proposed by Owen et al. (2011), interpersonal factors, perceived environment and behavior settings are central components. This was also found to be true in a systematic review of 109 peer-reviewed articles that identified several potential determinants of sedentary time among adults (Rhodes et al. 2012). Research on correlates of physical activity among older adults has indicated that social, behavioral and cognitive factors are important for long-term maintenance of physical activity (McAuley et al. 2003); however, it is not known whether these same factors will be associated with sedentary time. In fact, research in children has shown that correlates of physical activity and sedentary time are distinct (Nilsson et al. 2009); it stands to reason that this may be the case in older adults as well.

Given the strong link between extended sitting time and health, as well as the high levels of self-reported and measured sedentary time among older adults, it is essential that correlates of sedentary behavior be identified. While research has shown specific and unique correlates of sedentary behavior among children, youth and adults (Nilsson et al. 2009; Varo et al. 2003), there are limited data available among older adults. Knowledge of correlates can help inform public health strategies targeting sedentary behavior among older adults. For example, in Canada, guidelines targeting sedentary behavior among children and youth were created by the Canadian Society for Exercise Physiology. These were promoted through various public health agencies to increase awareness of the negative consequences of sedentary behaviors and emphasized specific and relevant activities such as television viewing, video games and computer time. At this point in time, limited knowledge exists to generate similar evidence-based guidelines for older adults. Further, a dearth of literature on correlates makes it difficult to determine whether separate guidelines would be required for young old and older old adults, for older adults of different socioeconomic status, for those with and without chronic conditions, or for other such sub-groups. Thus, identifying the correlates of extended sitting time among older adults is an important first step for informing wide-ranging public health strategies. The purpose of this analysis, therefore, was to identify potential correlates of extended sitting time among older adults living independently in the community. Specifically, the aim was to assess sociodemographic, physical environment, health-related and psychosocial variables to better understand their contribution to self-reported sitting time in older adults.

Methods

Data and participants

The Healthy Aging cycle of the Canadian Community Health Survey (CCHS-HA; 2008–2009) was used for the current analysis. This survey collects data on factors, influences and processes that contribute to healthy aging through a multidisciplinary approach focusing on health, social and economic correlates. One of the main objectives of the CCHS-HA is to examine how lifestyle correlates affect health as people age.

The CCHS-HA is a cross-sectional sample survey that used the 2006 Census as its sampling frame. All dwellings within the ten Canadian provinces containing at least one household member aged 43 and over were included in the sampling population. Out of 41,496 eligible households, 33,517 agreed to participate in the survey, resulting in an overall household-level response rate of 80.8 %. Among responding households, 33,517 individuals (one per household) were selected to participate in the survey; 30,865 individuals completed the survey resulting in an overall person-level response rate of 92.1 %. At the national level, this yields a combined (household and person) response rate of 74.4 % for the CCHS-HA.

Data were collected in-person for 94 % of the cases. The CCHS-HA uses computer-assisted interviewing. All data contained in this survey were self-reported and all participants provided informed consent prior to participation. The total sample size of the CCHS-HA is 30,865. For purposes of the current analysis, the sample was limited to those 65 years and older ($n = 16{,}369$; M = 6,639; F = 9,730) with normal cognitive function, i.e., those categorized as having difficulty remembering according to the Health Utility Index were eliminated from the sample ($n = 14{,}560$; M = 5,881; F = 8,679). Detailed information on data collection methods and data weighting can be found in the CCHS user guide (Statistics Canada 2008–2009).

Measures

Outcome

Participants were asked how often they engaged in a variety of sitting activities such as reading, watching television, computer activities or doing handicrafts. Responses were categorized as never, seldom (1–2 days/week), sometimes (3–4 days/week) or often (5–7 days/week). The average number of hours spent in such sitting activities per day were reported in categories of: <30 min, 30 min to <1 h, 1 to <2 h, 2 to <4 h or 4 or more hours. This was

then dichotomized to less than 4 h of sitting time per day and 4 or more hours of sitting time per day. This 4-h cut-point was based on a median split of the data of the sample.

Exposures

Potential correlates of sitting time from the database were identified based on the ecological model described above (Owen et al. 2011) and the systematic review conducted by Rhodes et al. (2012).

Sociodemographic characteristics Age was categorized in 5-year categories starting with 65–69 years and ending with 85 years and older. Marital status was categorized as either married/common law, widowed, or divorced/separated. Highest respondent education was categorized as: less than secondary school graduation, secondary school graduation but no post-secondary education, some post-secondary education, and post-secondary degree or diploma. Total household income from all sources was categorized as >$20,000, $20,000–39,000, $40,000–59,000, $60,000–79,000, and $80,000 or more. Retirement status was grouped into retired or not completely retired (included those who were not retired or partially retired).

Physical environment correlates Metropolitan area was determined based on census data; urban areas with a population of at least 100,000 were classified as a metropolitan area. Dwelling type was based on two questions and classified as either single detached, apartment or other. Participants were asked which form of transportation they most commonly used. Response options were passenger in motor vehicle, public transportation, walking or cycling and drive a motor vehicle.

Physical health and physical activity Body mass index was categorized as underweight (18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2) or obese (30 kg/m^2 and higher). Four chronic disease categories were created: musculoskeletal disease (arthritis, osteoporosis, back pain), cardiovascular disease (hypertension, heart attack or heart disease), respiratory disease (asthma, emphysema or chronic obstructive pulmonary disease) and metabolic disease (diabetes or thyroid condition). Perceived health was reported as excellent, very good, good, fair or poor based on a single question. Physical activity levels were based on responses to five questions. Respondents were asked how many hours they participated in walking, light sport or recreational activity, moderate sport or recreational activity, strenuous sport or recreational activity or muscle strengthening activities. The CCHS-HA grouped these responses into less than 30 min, 30 min to less than 1 h, 1 to less than 2 h, 2 or more hours. The responses for each of these five questions were tallied to create one all-inclusive physical activity variable. In the new variable, those who completed any of the five activities for <30 min/day, 30 min to <1 h/day, 1 to <2 h/day and 2 or more hours/day were classified as very low, low, moderate and high, respectively. This more inclusive variable allowed for us to preserve the sample size as many of the respondents did not participate in any of the recreation activities or strengthening exercises.

Psychosocial correlates Participants were asked whether they had a physician diagnosis of a mood disorder such as depression, bipolar disorder, mania or dysthymia. The three-item loneliness scale was used to calculate loneliness on a scale of 3–9 based on questions related to companionship and isolation (Hughes et al. 2004). The satisfaction with life scale was based on participant responses to five questions and classified participants as either extremely dissatisfied, dissatisfied, slightly dissatisfied, neutral, slight satisfied, satisfied or extremely satisfied. Sense of belonging to community was based on a single item and was classified as very strong, somewhat strong, somewhat weak or very weak.

Statistical analysis

Frequencies for age, education, retirement status and sitting time were performed for males and females separately, as well as for males and females combined. Chi-squares and standardized adjusted residuals were used to determine if there were significant differences between males and females for these variables. Logistic regressions were performed using sitting time as the outcome and age as the exposure (controlling for sex when using the combined sample of males and females). Multivariate logistic regression analyses were conducted using sitting time as the outcome. Each potential correlate, age and sex were entered into the model. Analyses were then conducted for males and females separately (adjusting for age only). All statistics were conducted in SPSS and alpha was set at 0.05. A normalized master weight was applied to all analyses to ensure representativeness of the sample to the Canadian population.

Results

Sample characteristics are presented in Table 1. Nearly 30 % of the sample was 85 years and older; there were significantly more females in the two oldest age categories. Over 45 % of the samples were married, with a significantly higher proportion of males being married and a

significantly higher proportion of women being widowed. Significantly fewer women had post-secondary education with nearly 50 % of the sample having a post-secondary education overall. Nearly 85 % of the samples self-reported 2 or more hours of sitting time per day, while 47.3 % of the samples self-reported 4 or more hours of sitting time per day.

Age was a significant correlate of extended sitting time among the total sample (adjusting for sex) such that those who were younger were less likely to sit for 4 or more hours when compared to those aged 85 and older (Table 2).

In the combined sample of males and females, being in a married or common-law relationship was associated with 24 % lower odds of sitting for 4 or more hours per day (OR 0.76; CI 0.58–0.98) compared to those who were single (Table 3). Retirement status was significantly associated with sitting time such that those who were completely retired were 1.36 (CI 1.10–1.69) times more likely to sit for 4 or more hours/day than those who were not completely retired. This association was significant among males (OR 1.54; CI 1.16–2.04, adjusted for age) but not among females (OR 1.22; CI 0.89–1.69, adjusted for age).

Dwelling type and transportation mode were associated with sitting time among the sample of combined males and females when adjusting for age and sex (Table 4). Compared to those living in single detached homes, those living in apartments were 46 % (OR 1.46; CI 1.27–1.67) more likely to sit for 4 or more hours/day. Compared to those who drove their own vehicle, those who reported being a passenger in a vehicle were 23 % (OR 1.23; CI 1.08–1.40) more likely to sit for 4 or more hours per day.

The associations between health outcomes and physical activity with sitting time are presented in Table 5. For the combined sample of males and females, all four groups of chronic disease, self-perceived health and body mass index were significantly associated with sitting time (adjusted for age and sex). Further, having very low physical activity levels were associated with increased odds of sitting for 4 or more hours/day (OR 1.43; CI 1.19–1.72) compared to those with high levels of physical activity. The association between very low physical activity and sitting time was also significant among males (OR 1.61; CI 1.22–2.13, adjusted for age) but not among females (OR 1.28; CI 1.00–1.65, adjusted for age).

Among the psychosocial variables, mood disorder and sense of belonging to community were significantly associated with sitting time in the combined sample of males

Table 1 Characteristics of the sample (Canada, 2008–2009)

Characteristic	Combined (n = 14,560)	Males (n = 5,881)	Females (n = 8,679)
Age			
65–69	24.6	29.4	21.5*
70–74	18.5	20.8	17.0*
75–79	16.7	16.8	16.5
80–84	13.4	10.4	15.4*
85 and older	26.9	22.6	29.6*
Marital status			
Married	46.7	67.0	33.7*
Widowed	41.1	20.2	54.6*
Divorced/separated	7.5	7.7	7.4
Single	4.6	5.2	4.3
Education			
<Secondary	44.8	41.1	47.1*
Secondary grad	13.7	12.1	14.6*
Other post-secondary	4.4	4.5	4.3
Post-secondary grad	37.2	42.2	34.0*
Sedentary time			
Less than 4 h	47.3	49.5	45.9*
4 or more hours	52.7	50.5	54.1*
Sedentary time			
Less than 2 h	14.9	15.8	14.3
2 or more hours	85.1	84.2	85.7

Frequencies are presented as a percent of the sample; columns total 100 %

* $p < 0.05$

Table 2 Association between age and sitting time by sex (Canada, 2008–2009)

Characteristic	Category (years)	Both sexes		Males		Females	
		OR	CI	OR	CI	OR	CI
Age	65–69	0.48*	0.41–0.56	0.53*	0.42–0.68	0.46*	0.38–0.56
	70–74	0.53*	0.45–0.62	0.63*	0.49–0.82	0.48*	0.39–0.59
	75–79	0.63*	0.53–0.74	0.69*	0.52–0.91	0.60*	0.49–0.75
	80–84	0.82*	0.66–0.98	0.80	0.58–1.10	0.83	0.66–1.03
	85+	1.00	Referent	1.00	Referent	1.00	Referent

Analysis for the sample of both sexes was adjusted for sex

OR odds ratio, *CI* confidence intervals

* $p < 0.05$

Table 3 Association between sociodemographic characteristics and sitting time by sex (Canada, 2008–2009)

Characteristic	Category	Both sexes		Males		Females	
		OR	CI	OR	CI	OR	CI
Marital status	Married or common law	0.76*	0.58–0.98	0.76	0.52–1.12	0.75	0.52–1.06
	Widowed	1.05	0.80–1.37	0.95	0.62–1.47	1.08	0.76–1.53
	Divorced or separated	1.03	0.75–1.42	1.09	0.67–1.76	1.00	0.66–1.53
	Single	1.00	Referent	1.00	Referent	1.00	Referent
Education	<Secondary	0.95	0.84–1.07	0.99	0.81–1.19	0.93	0.80–1.09
	Secondary grad	0.89	0.75–1.05	0.81	0.61–1.07	0.93	0.75–1.16
	Other post-secondary	1.27	0.97–1.67	1.06	0.69–1.62	1.46*	1.01–2.10
	Post-secondary grad	1.00	Referent	1.00	Referent	1.00	Referent
Income	<$20,000	1.26	1.00–1.59	1.30	0.91–1.84	1.24	0.86–1.74
	$20–39,999	1.08	0.87–1.33	1.12	0.84–1.49	1.06	0.76–1.47
	$40–59,999	0.98	0.78–1.25	0.96	0.71–1.32	1.01	0.71–1.46
	$60–79,999	1.03	0.78–1.36	0.98	0.68–1.41	1.10	0.72–1.69
	$80,000 or higher	1.00	Referent	1.00	Referent	1.00	Referent
Retirement status	Completely retired	1.36*	1.10–1.69	1.54*	1.16–2.04	1.22	0.89–1.69
	Not completely retired	1.00	Referent	1.00	Referent	1.00	Referent

All associations are adjusted for age; both sexes also adjusted for sex

OR odds ratio, *CI* confidence intervals

* $p < 0.05$

Table 4 Association between geographical and environmental variables with sitting time by sex (Canada, 2008–2009)

Characteristic	Category	Both sexes		Males		Females	
		OR	CI	OR	CI	OR	CI
Census metro area	Metro area	0.95	0.85–1.05	1.02	0.86–1.21	0.90	0.78–1.03
	Non-metro area	1.00	Referent	1.00	Referent	1.00	Referent
Dwelling type	Single detached	1.00	Referent	1.00	Referent	1.00	Referent
	Apartment	1.46*	1.27–1.67	1.77*	1.39–2.26	1.32*	1.12–1.56
	Other	1.22*	1.04–1.44	1.46*	1.13–1.91	1.08	0.88–1.33
Transportation in past month	Passenger in vehicle	1.23*	1.08–1.40	1.27	0.99–1.63	1.21*	1.03–1.41
	Public transit	0.98	0.77–1.24	0.94	0.61–1.43	0.99	0.75–1.32
	Walking, cycling	1.10	0.81–1.50	1.16	0.68–1.96	1.06	0.72–1.56
	Drive vehicle	1.00	Referent	1.00	Referent	1.00	Referent

All associations are adjusted for age; both sexes also adjusted for sex

OR odds ratio, *CI* confidence intervals

* $p < 0.05$

and females after adjusting for age and sex (Table 6). Satisfaction with life and loneliness was also associated with sitting time, but not consistently.

Discussion

Cross-sectional data from older adults were analyzed to identify correlates of self-reported sitting time. The primary correlates of extended sitting time among this sample appear to be age, retirement status, dwelling type, chronic disease, perceived health, body mass index, mood disorder and sense of belonging to community. Only those with the lowest levels of self-reported physical activity were more likely to sit for 4 or more hours/day. These data are some of the first to explore potential correlates of extended sitting time among older adults and highlight the unique nature of sitting time among our aging population.

The sociodemographic variables that emerged as correlates of extended sitting time were age and retirement status. The association with age was as expected given

Table 5 Association between health and health behaviors with sitting time by sex (Canada, 2008–2009)

Characteristic	Category	Both sexes		Males		Females	
		OR	CI	OR	CI	OR	CI
Musculoskeletal disease	Yes	1.27*	1.13–1.42	1.39*	1.18–1.66	1.18*	1.01–1.37
	No	1.00	Referent	1.00	Referent	1.00	Referent
Cardiovascular disease	Yes	1.28*	1.14–1.43	1.29*	1.08–1.54	1.26*	1.09–1.46
	No	1.00	Referent	1.00	Referent	1.00	Referent
Respiratory disease	Yes	1.42*	1.19–1.68	1.56*	1.18–2.07	1.34*	1.07–1.66
	No	1.00	Referent	1.00	Referent	1.00	Referent
Metabolic disease	Yes	1.14*	1.01–1.28	1.23*	1.01–1.50	1.09	0.94–1.26
	No	1.00	Referent	1.00	Referent	1.00	Referent
Body mass index	Underweight	0.61*	0.42–0.90	0.95	0.30–2.98	0.55*	0.36–0.84
	Normal weight	0.64*	0.55–0.76	0.70*	0.54–0.90	0.61*	0.50–0.75
	Overweight	0.72*	0.61–0.85	0.79	0.62–1.02	0.67*	0.54–0.83
	Obese	1.00	Referent	1.00	Referent	1.00	Referent
Self-perceived health	Poor	0.41*	0.31–0.55	0.34*	0.21–0.53	0.47*	0.32–0.68
	Fair	0.47*	0.36–0.61	0.39*	0.26–0.60	0.52*	0.37–0.73
	Good	0.52*	0.40–0.68	0.43*	0.28–0.66	0.59*	0.42–0.83
	Very good	0.65*	0.49–0.86	0.57*	0.36–0.89	0.70	0.49–1.00
	Excellent	1.00	Referent	1.00	Referent	1.00	Referent
Physical activity levels	Poor	1.43*	1.19–1.72	1.61*	1.22–2.13	1.28	1.00–1.65
	Low	1.13	0.95–1.34	1.26	0.98–1.62	1.02	0.80–1.30
	Moderate	0.92	0.77–1.11	1.02	0.78–1.34	0.84	0.65–1.08
	High	1.00	Referent	1.00	Referent	1.00	Referent

All associations are adjusted for age; both sexes also adjusted for sex

OR odds ratio, *CI* confidence intervals

* $p < 0.05$

previous cross-sectional accelerometry data that shows higher sedentary time in older age categories (Colley et al. 2011). Retirement status was significantly associated with extended sitting time among males, but not among females. This sex difference was quite interesting as research has suggested that among older adults, females are less sedentary than males (Hansen et al. 2012). Thus, the difference in extended sitting time may be because women generally carry out more hours of unpaid and domestic work than men (Payne and Doyal 2010) and continue to do so into retirement (Chastin et al. 2011). Whereas when men retire, they no longer break up their sitting time with work-related activities, and thus end up sitting for extended periods of time. Given that fragmented sedentary behavior is associated with better health outcomes than prolonged, unbroken periods of inactivity, older women may have a significant advantage after retirement when compared to men (Chastin et al. 2011). Future research should assess such sex differences in greater detail and use breaks in sitting time as an outcome instead of total sitting time.

Research on the importance of neighborhood and household characteristics in predicting sedentary time is growing; specifically, dwelling type may be a matter of importance among older adults. In a study conducted by Chad et al. (2005), significantly lower physical activity levels were observed in those individuals living alone and those living in senior's housing due to home maintenance type activities. This is in line with the findings of the present study, as those living in apartments and "other" types of dwellings were significantly more likely to spend 4 or more hours sitting compared to those owning single/detached homes. Results also indicated that being a passenger in a vehicle, as compared to driving a vehicle, is associated with extended sitting time. Previous research has found that car time is associated with physical inactivity and obesity (Frank et al. 2004); however, there is limited data assessing the difference between being a driver versus being a passenger in a car. Of note, both dwelling type and transportation may be influenced by functional capacity, i.e., those who are functionally independent may live in detached homes and drive their own cars; thus, functional capacity may be an important modifier in the association between these variables and extended sitting time.

Table 6 Association between psychosocial variables and sitting time by sex (Canada, 2008–2009)

Characteristic	Category	Both sexes		Males		Females	
		OR	CI	OR	CI	OR	CI
Mood disorder	Yes	1.49*	1.15–1.95	1.23	0.80–1.89	1.68*	1.20–2.36
	No	1.00	Referent	1.00	Referent	1.00	Referent
Loneliness scale	3	0.61*	0.39–0.93	0.64	0.31–1.33	0.58*	0.34–0.99
	4	0.71	0.45–1.11	0.80	0.37–1.73	0.67	0.38–1.16
	5	0.75	0.47–1.19	0.63	0.28–1.39	0.81	0.46–1.43
	6	0.68	0.43–1.10	0.70	0.31–1.58	0.67	0.38–1.21
	7	0.92	0.53–1.60	0.66	0.26–1.69	1.09	0.56–2.15
	8	0.84	0.41–1.72	0.56	0.17–1.80	1.11	0.45–2.79
	9	1.00	Referent	1.00	Referent	1.00	Referent
Satisfaction with life scale	Extremely dissatisfied	1.91	0.89–4.10	2.10	0.65–6.75	1.78	0.65-4.86
	Dissatisfied	2.05*	1.38–3.05	1.68	0.87–3.21	2.29*	1.38–3.78
	Slightly dissatisfied	1.52*	1.16–1.99	1.77	1.13–2.78	1.40	0.99–1.97
	Neutral	1.05	0.69–1.61	0.76	0.37–1.58	1.24	0.74–2.10
	Slightly satisfied	1.38*	1.14–1.66	1.45*	1.07–1.96	1.38*	1.05–1.70
	Satisfied	1.03	0.90–1.18	1.05	0.84–1.30	1.02	0.85–1.22
	Extremely satisfied	1.00	Referent	1.00	Referent	1.00	Referent
Sense of belonging to community	Very strong	0.71*	0.57–0.87	0.71*	0.71–1.00	0.71*	0.54–0.92
	Somewhat strong	0.66*	0.54–0.81	0.66*	0.47–0.92	0.67*	0.52–0.87
	Somewhat weak	0.79*	0.63–0.99	0.80	0.56–1.16	0.79	0.59–1.05
	Very weak	1.00	Referent	1.00	Referent	1.00	Referent

All associations are adjusted for age; both sexes also adjusted for sex

OR odds ratio, *CI* confidence intervals

* $p < 0.05$

There was a robust association between all four categories of chronic disease and sitting time, such that having a chronic disease was associated with sitting for 4 or more hours/day. Given the nature of some of the conditions, this is not surprising. For example, having painful arthritis, or activity induced angina would certainly lead to a more sedentary lifestyle. While many older adults with chronic diseases are educated about the benefits of physical activity, few are educated on the negative effects of extended sitting time. Thus, education about the health benefits of breaking up long bouts of sedentary time may have a significant impact on chronic disease outcomes.

Those with lower levels of perceived health were more likely to be sedentary than those with excellent perceived health. It has been shown that those who have poor perceived health are less physically active (Södergren et al. 2012). Further, perceived health has been shown to be a stronger predictor of physical activity levels than chronic disease (Dogra 2011). Limited research has been done on perceived health and sitting time, however, according to research conducted by Buman et al. (2010) using a sample of adults 66 years and older ($n = 862$), sedentary time is negatively associated with the well-being. It appears that perceived health could be an important target for interventions when attempting to decrease extended sitting time among older adults.

Buman et al. (2010) also found that sedentary behavior was independently associated with body mass index. This is similar to the findings of our study; those who were normal weight and overweight were less likely to spend 4 or more hours/day sitting compared to those who were obese. This association lends further support to the importance of decreasing sedentary time in older adults, as obesity is considered to be a risk factor for several chronic diseases and is associated with poorer quality of life (McNaughton et al. 2012).

Very low levels of physical activity were associated with extended sitting time in this sample of older adults. This is in line with findings of Kikuchi et al. (2013) from a sample of older Japanese adults. They found that moderate to vigorous physical activity was a correlate of sitting time in both males and females. The authors used a 2 h/day cut-point for self-reported sitting time while we used a 4 h/day cut-point. A review assessing the association between sitting time and physical activity among adults found that there was some evidence for a negative association between television viewing and general screen viewing with physical activity, no relationship was apparent for

computer use or sedentary behavior in general (Rhodes et al. 2012). This raises an interesting point. Perhaps assessment of sitting time in older adults should be based on the type of sitting activity. A study on cognitive function and sitting time (Kesse-Guyot et al. 2012) found differential effects for different modes of sedentary behavior. Thus, it may be prudent for future research to make a distinction in the mode of sitting time, as some of these activities may have a positive impact on health, while others may have a negative impact.

Several psychosocial variables were also significantly associated with extended sitting time; however, the association with loneliness and satisfaction with life was inconsistent and weak. This lack of robust association is in line with previous research (Williams et al. 1999). Given that many recreational and social activities in which older adults engage are social, for example, bridge clubs, knitting clubs, etc., it is possible that sedentary older adults have adequate social circles despite being physically inactive. As suggested in the past, sitting time may have some beneficial effects on health, i.e., some recreational sitting activities may serve to reduce stress or the risk of injury and illness. In fact, a recent study found that certain sedentary activities are associated with better cognitive function in older adults (Kesse-Guyot et al. 2012). Thus, in contrast to the physical activity literature, the association between psychosocial variables and extended sitting time in this population may be consistently weak.

It should be noted that despite research indicating that health risk increases with 2 or more hours of sitting per day, the present analysis used a 4-h cut-point. This was done for two reasons: (1) to ensure appropriate comparison within the sample. From data in Table 1, it is clear that roughly 50 % of older adults are sitting for 4 h or more, while 85 % are sitting for 2 h or more. Thus, analysis using the 4-h cut-point better represents the low and high sitters of the sample and perhaps the population at large. (2) The 2-h cut-point recommendation comes primarily from research conducted in children and adults. Interestingly, analysis of this dataset using the 2-h cut-point (data not shown) identified far fewer correlates of extended sitting time in this sample. For example, none of the psychosocial variables (except for mood disorder), physical activity, body mass index or self-perceived health, were significantly associated with sitting time when using the 2-h cut-point. It is possible that the threshold for health risk among older adults is higher; however, given the categorical nature of the data in the CCHS-HA, an assessment of such a threshold was not possible in the present study.

Future research is required on each individual correlate identified in this analysis. The purpose of this analysis was simply to identify potential correlates to initiate further research in older adults. Thus, analyses were conducted with minimal adjustment for covariates. Well-thought-out research questions and comprehensive literature reviews should be conducted to better understand the impact of each correlate on extended sitting time among older adults. Further, research must differentiate between extended sitting time and total sitting time that accounts for breaks.

Limitations

There are several limitations of the present study that should be noted. First, the data in the CCHS-HA are self-reported. While objectively measured variables would increase the validity of the study, it would require large sums of money to fund a project of such an exploratory nature. Objectively measured sitting time and physical activity would have been preferred, but there is a research to suggest that cut-points for accelerometery data in older adults may be inaccurate (Evenson et al. 2012). As such, self-reported sitting time is still an important variable (Owen 2012). Further, according to research conducted by Van Uffelen et al. (2011), the accuracy of self-reported sitting time in older adults can be increased if domains are provided as examples (e.g., computer time, television, etc.,). The CCHS-HA did provide such examples, thus increasing the reliability of this self-reported measure. Nevertheless, the CCHS-HA did not use validated scales for measurement of sitting time. Future research should use valid and reliable self-report measures when objective data are not available. Second, the data presented are cross-sectional, thus reverse causality cannot be ruled out. A longitudinal design would allow for a better understanding of the determinants of long-term sedentary behavior in older adults.

In conclusion, using a large database of older adults, the present study found that age, retirement status, dwelling type, chronic disease, perceived health, body mass index, mood disorder and sense of belonging to community were significant correlates of sitting time in older adults. These data are some of the first to identify the correlates of sitting time in this population. While it may be premature to inform sedentary behavior guidelines for older adults, these data provide direction when considering public health strategies to combat the issue of extended sitting time in older adults by pinpointing high-risk sub-populations and by drawing attention to potential barriers and promoters.

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