Neighbourhood correlates of sitting time for Australian adults in new suburbs. Results from RESIDE

ABSTRACT

The neighbourhood influences on walking are well recognised, yet less is known about how the environment impacts sedentary behaviours. This study used a social ecological model to examine the correlates of sitting time, independent of walking behaviour. Objective built environment measures and self-reported community participation were examined for associations with sitting time for 1179 residents in Perth, Western Australia. Neighbourhood built environment and social factors were significantly associated with women's sitting time only. In particular, the presence of community infrastructure was negatively associated with women's weekday sitting (relative reduction 0.951 p=0.037), but statistical significance weakened after accounting for community participation (relative reduction 0.951 p=0.057). Community participation was independently associated with both women's weekday and weekend sitting (both p<0.001). More walkable neighbourhoods may help limit women's sitting time by providing better access to community infrastructure, as local venues may afford additional opportunities for social interaction and participation.

Keywords: Sitting time; sedentary behaviour; community participation; community infrastructure, walkability

INTRODUCTION

There is now considerable evidence that 'walkable' environments, as characterised by higher residential densities, street connectivity and mixed land-uses, can promote walking (Durand, Andalib, Dunton, Wolch, & Pentz, 2011; Giles-Corti et al., 2013; Ogilvie et al., 2007; Owen, Humpel, Leslie, Bauman, & Sallis, 2004; Saelens & Handy, 2008). The widespread acceptance of this evidence is demonstrated by extensive advocacy to change the planning, transport and urban design policies that dictate the location and accessibility of activities required for day-to-day living (CDC, 2007; Gebel, Bauman, Owen, Foster, & Giles-Corti, 2009; Kopelman, Jebb, & Butland, 2007; National Heart Foundation, Planning Institute of Australia, & Australian Local Government Association, 2009; National Institute for Health and Clinical Excellence, 2008; National Preventive Health Taskforce, 2009). It has also been proposed that built environments could influence the sedentary behaviour of local residents, as 'environmental barriers that discourage participation in outdoor physical activity may make sedentary behaviours an easier default option' (Sugiyama, Salmon, Dunstan, Bauman, & Owen, 2007, p.444).

Sedentary behaviour, as distinct from physical inactivity (i.e., performing insufficient amounts of moderate to vigorous physical activity), is now recognised as an independent risk factor for chronic disease (Boyle, Fritschi, Heyworth, & Bull, 2011; Hamer, Stamatakis, & Mishra, 2010; Tremblay, Colley, Saunders, Healy, & Owen, 2010). Sedentary behaviour is defined as 'any waking behaviour characterised by an energy expenditure of ≤1.5 METs while in a sitting or reclining posture' (Sedentary Behaviour Research Network, 2012), and includes behaviours such as television viewing, screen based entertainment, occupational sitting and vehicle travel (Yates et al., 2011). Notably, even for those who meet recommended levels of physical activity; extended periods of sitting still appear to compromise their health (Owen, Healy, Matthews, & Dunstan, 2010).

Evidence indicating the built environment can impact sedentary behaviours is relatively scant. While several studies have examined the premise that a more walkable built environment might also limit residents' sitting time, results are mixed (Coogan, White, Evans, Palmer, & Rosenberg, 2012; Frank, Andresen, & Schmid, 2004; Kozo et al., 2012; Lee, Scherezade, Mama, & Adamus-Leach, 2012; Sugiyama et al., 2007; Van Dyck et al., 2010; Van Dyck et al., 2012). For instance, a study using pooled data from several settings (i.e., Australia, USA, Belgium) found a scale including perceived aesthetics and destination proximity was negatively correlated with overall self-report sitting time, although the association was stronger for men than women, and was non-significant for Belgian adults (Van Dyck et al., 2012) . Indeed, evidence suggests that Belgian residents in high walkable neighbourhoods (as rated by objective measures) actually sit more than their counterparts in less walkable neighbourhoods (Van Dyck et al., 2010).

Others have focused on specific dimensions of sitting time, such as vehicle travel time or TV watching. Van Dyck et al. (2012) reported that neighbourhoods perceived to be more 'activity friendly' were negatively associated with motorised transport time, and in this instance their finding was consistent across countries and gender. Similarly, Frank et al. (2004) found a negative correlation between the objectively measured components of a walkable neighbourhood and vehicle travel in the USA. In contrast, Coogan et al. (2012) found no association between neighbourhood walkability and TV viewing for African American women, whereas Sugiyama et al. (2007) identified a significant negative association between walkability and TV watching for Australian women (Sugiyama et al., 2007). While walkable neighbourhoods are theorised to limit sitting time by promoting physical activity; Sugiyama and colleagues controlled for physical activity. This may hint at an alternative pathway through which built environments might affect sitting, other than simply through the mechanism of increased walking or physical activity.

One plausible pathway connecting more walkable neighbourhoods with less sedentary behaviour may be via the social environment. For instance, the higher residential densities that characterise walkable neighbourhoods could also provide residents with a greater variety of community activities and more social infrastructure, and these social opportunities may themselves contribute to reducing sitting time. Yet few studies have examined the relationship between the built environment, social factors and sedentary behaviour (Prince et al., 2011; Teychenne, Ball, & Salmon, 2012). For example, Teychenne et al. (2012) found intra-personal and social factors (i.e., social cohesion and social support) partly mediated the association between socio-economic status and Australian women's television viewing, while perceptions of the built environment were non-significant (Teychenne et al., 2012). However, overall, the role of social factors in decreasing sedentary behaviour have been largely overlooked.

Social-ecological models posit that an individual's behaviours are influenced by the social and physical environments in which they live (Stokols, 1992). Recently, researchers have highlighted the need for studies with greater socio-ecological breadth (Rhodes, Mark, & Temmel, 2012), as improved knowledge of both built environment and social correlates would help target interventions to reduce sitting time (Owen et al., 2010; Owen et al., 2011; Rhodes et al., 2012). Notably, Owen et al. (2011) developed a comprehensive ecological model summarising the domains influencing sedentary behaviours (e.g., household, occupation, leisure time and transport), which are likely to have distinct determinants. Importantly, the neighbourhood environment could govern sedentary behaviours across several domains, as a more walkable local neighbourhood might support physical activity behaviours (i.e., walking, cycling and sporting infrastructure), active transport (i.e., public transit infrastructure and services); minimise vehicle travel time (i.e., proximate access to shops, services and employment opportunities), and create opportunities for social engagement and community participation (i.e., social infrastructure such as cafes, restaurants, community halls).

Given the inconsistencies in the evidence on the built environment and sedentary time, and the dearth of studies exploring the role of the social environment, this study uses a social-ecological model to examine associations between neighbourhood planning attributes, community participation and sedentary behaviour. We examined: (1) the association between objectively measured neighbourhood attributes and self-reported sitting time; and (2) whether any association between the built environment and sitting can be explained by higher levels of community participation.

METHODS

Sample

The sample comprised 1179 participants in the RESIDential Environments (RESIDE) Project (response rate 33.4%). Participants were new home buyers who moved into residential developments located across the Perth metropolitan area (n=73 developments). These developments were classified by the state government's Department of Planning as: 'liveable' (i.e., complying with the 'Liveable Neighbourhoods Guidelines' - a subdivision design code based on new urbanism principles) (n=18); 'hybrid' (i.e., having *some* liveable neighbourhood attributes) (n=11); or 'conventional' (i.e., not complying with the guidelines) (n=44). The Liveable Neighbourhoods Guidelines aimed to create pedestrian friendly neighbourhoods, and objective measures (e.g., street connectivity, residential density and land-use mix) indicate these developments are more supportive of walking (Christian et al., 2013).

All people building new homes in the study areas were invited to participate by the state water authority following the land transfer transaction. They were proficient in English, >18 years old, and agreed to complete 3 surveys during the study. This paper is a cross-sectional analysis focusing on participants who had lived in their new neighbourhood for about 32 months (time point 3: collected 2006-2008). Objective environmental measures were generated for each participant's 1600m neighbourhood using Geographic Information Systems (GIS). RESIDE is fully described elsewhere (Giles-Corti et al., 2008). Ethics approval was provided by The University of Western Australia's Human Research Ethics Committee.

Context

The RESIDE study was set in suburban neighbourhoods, with most participants living in new Greenfield developments on the urban fringe. Residential developments were located across 48 suburbs, but were similar in terms of the housing stock (i.e., single family detached houses) and infrastructure provided. In particular, participants were well served by public open space and walking infrastructure, which are typically implemented early in the land development process by Australian developers (Hooper, Giles-Corti, & Knuiman, 2014), In contrast, minimal land was allocated to retail, with relatively few participants having good access to shops and services (Christian et al., 2013; Foster, Giles-Corti, & Knuiman, 2010).

Sitting time

Self-report sitting on a weekday and weekend day was collected using modified International Physical Activity Questionnaire (IPAQ) items: (1) in a usual week, how much time do you spend sitting on a week day; and (2) in a usual week, how much time do you spend sitting on a weekend day (minutes). Studies assessing IPAQ have reported good test-retest reliability (Spearman correlations ranged from .40 to 1.0) and fair criterion validity (i.e., most Spearman correlations above .25) (Rosenberg, Bull, Marshall, Sallis, & Bauman, 2008).

Individual characteristics

Individual characteristics included age, education, household income, marital status, number of children, age of children, number of hours worked and physical activity level at work. Body Mass Index (BMI) (kg/m^2) was calculated using self-report height and weight. Walking inside the neighbourhood (minutes/week) was measured using the Neighbourhood Physical Activity Questionnaire (NPAQ), which has acceptable reliability (Giles-Corti et al., 2006).

Social factors

Community participation was based on the count of activities in which participants were involved in their local area during the past year (Lindström, Hanson, & Östergren, 2001). Activities (n=29) include social or community service participation (e.g., book club, hobby class, artistic activity, fund raising activity, resident's association, community action group, volunteer/service organisation, school-related group/activity, social contact through children's sport, street/neighbourhood party, church/religious group, mothers' group, fete) and sporting, exercise or recreational club participation (i.e., as a participant, coach/instructor or spectator) (M=2.31, SD=2.66, range=0-18) (Cronbach's alpha=0.744).

Built environment

All objective built environment measures were generated using Geographic Information Systems (GIS) for the 1600m road network distance from home, rather than using the Euclidean ('as the crow flies') distance, or an arbitrary statistical boundary (e.g., suburb or census collection district). The 1600m road network distance was chosen to represent the maximum distance a person could walk in 15 minutes (using the accepted speed 6km/h), regardless of whether their local streets are well connected (i.e., traditional gridded street patterns versus curvilinear street layouts). Each participant's environmental measures were unique to their home address (i.e., individual-level, person-specific measures).

Neighborhood walkability was measured using a modified transport walkability index (Frank, Schmid, Sallis, Chapman, & Saelens, 2005) which combined: (1) street connectivity (the count of three or more-way intersections, where more three or more-way intersections represent a better connected street network with more route choices); (2) residential density (ratio of the area in residential use to the number of residential dwellings in the area); (3) land-use mix (evenness of development across specified land-uses: residential; retail; office; health community and welfare; and entertainment, culture and recreation) (Christian et al., 2011); and (4) transit stops (count of bus or train stops). Data were supplied courtesy of The Western Australian Land Information Authority. The component z-scores were summed to form the walkability index, and component raw scores were examined individually.

As the mix and evenness of land-uses across the neighbourhood (as captured by the land-use mix 'entropy' measure) may not be as relevant to an outcome as the simple presence of specific destinations (Brown et al., 2009), we also created an objective measure of community infrastructure. This was generated from a commercial listings directory (i.e., Sensis) and supplemented with school information. The additive scale comprised the count of specific destinations within 1600m of each participant's home that were potential sites for both formal and informal interaction, including: schools; churches, synagogues/temples; community halls; clubs; hotels/taverns; libraries; fast food outlets; cafes/restaurants; sports fields; swimming pools; and fitness/recreation centres (*M*=22.18, *SD*=14.58, range=0-81).

Statistical analysis

A negative binomial model (with log link) was used to compute the percentage change in time spent sitting per day (rate ratios) per one standard deviation (SD) increase in the exposure variables. A log link allows the relative effect of variables on sitting time to be estimated (i.e., percentage change in sitting time). This model has been applied elsewhere (Van Dyck et al., 2012) and is appropriate because sitting time is non-negative, positively skewed, and has a variance that exceeds its mean. Clustering of participants within residential developments was accommodated using a random effect. Analyses were conducted separately for men and women in SPSS version 21.

Initially, the univariate association of each socio-demographic factor with sitting time was assessed. Subsequent analyses examining associations between the built environment and community participation variables and sitting time controlled for socio-demographic factors (i.e., age, education, income, marital status, number of children, hours worked, physical activity level at work, walking and BMI). Each built environment and social factor was examined separately, and a further multivariable model including all significant variables simultaneously was fitted. Results are presented as estimates (and 95% confidence intervals) for the relative change in sitting time per change in one SD for the continuous variables. Relative change estimates are translated into approximate absolute effects using the overall mean of sitting time.

RESULTS

Compared with women, men reported more weekday sitting (men 324 minutes, women 300 minutes; p=0.028) and weekend day sitting (men 282 minutes, women 258 minutes; p=0.004). The unadjusted associations between the socio-demographic variables and sitting time for men and women are presented in Tables 1 and 2 (respectively). For men, income was associated with sitting time on both weekdays and weekend days, whereas physical activity at work was associated with weekday sitting only, and walking and BMI with weekend sitting only. For example, higher income men and those who were inactive at work tended to spend more time sitting on weekdays. For women, physical activity at work was also associated with weekday sitting, whereas number of children, hours worked and BMI were significantly associated with both weekday and weekend sitting. For example, women with no children tended to sit more than those with children, and overweight or obese women sat more than those with a healthy weight.

The associations between the built environment and social factors and sitting time, after controlling for socio-demographic variables are presented in Tables 3 and 4 (i.e., one exposure per model, adjusted for socio-demographics). For men, most associations between the built environment and sitting time were in the anticipated direction, although non-significant. For example, for every SD increase in the walkability index, minutes of weekday sitting reduced by almost 5 percent (relative reduction 0.951; p=0.098). A 5 percent change in weekday sitting time for an average man (based on 324 mins/day) would equate to reduction of about 16 minutes/day. Examination of the walkability index sub-components revealed that land-use mix had the strongest association with weekday sitting time (relative reduction 0.950; p=0.083). For weekend day sitting time only transit stops approached statistical significance (relative reduction 0.955; p=0.074).

For women, there was a similar weak negative association between the walkability index and weekday sitting time (relative reduction 0.958; p=0.084). Analysis of the sub-components revealed that residential density (relative reduction 0.948; p=0.029) and transit stops (relative reduction 0.941; p=0.018) had stronger associations with weekday sitting than land-use mix or street connectivity. None of the built environment measures considered were associated with women's weekend day sitting.

The presence of community infrastructure was not associated with either outcome for men, but was negatively associated with women's weekday sitting. For every SD increase in community infrastructure, women's weekday sitting time reduced by over six percent (relative reduction 0.936; p=0.004). A six percent change in weekday sitting time for an average woman (based on 300 minutes/day) would equate to reduction of about 18 minutes/day. Consistent with this, community participation was not associated with either outcome for men, but was negatively associated with both weekday and weekend sitting for women. For every SD increase in community participation, women's sitting time reduced by about eight percent for weekdays (relative reduction 0.914; $p<0.001$) and weekend days (relative reduction 0.922; $p<0.001$). For an average woman in our sample, this would equate to a 24 minutes/day reduction in weekday sitting (based on 300 minutes/day) and a 21 minutes/day reduction in weekend sitting (based on 258 minutes/day).

A further multivariable model simultaneously examined the significant ($p<0.05$) built environment correlates of women's weekday sitting time (i.e., residential density and community infrastructure). Transit stops were omitted due to a high correlation with community infrastructure (Pearson correlation=0.691, $p=0.000$). In this model, the association between residential density and weekday sitting attenuated (relative reduction 0.970 $p=0.211$), whereas community infrastructure retained a significant negative association with sitting (relative reduction 0.951 $p=0.037$). Finally, community participation was added to the model. This social measure remained strongly associated with weekday sitting (relative reduction 0.922; $p=0.001$), whereas the statistical significance of community infrastructure weakened slightly (relative reduction 0.951 $p=0.057$).

DISCUSSION

This study adds to the small body of evidence suggesting the attributes of a more walkable built environment contribute to less sitting time in adult populations (Frank et al., 2004; Kozo et al., 2012; Sugiyama et al., 2007; Van Dyck et al., 2012). While neighbourhood walkability was not significantly correlated with sitting time (i.e., $p<0.1$ for men's and women's weekday sitting time); the associations were in the anticipated direction for both genders, with increased walkability associated with less weekday sitting.

Consistent with others (Stafford, Cummins, Macintyre, Ellaway, & Marmot, 2005) our results suggest that the residential environment may be more important to women's health. Of the built environment variables examined, the strongest association was between community infrastructure and women's weekday sitting time. In the fully adjusted models, an increase in community infrastructure was associated with a five percent decrease in weekday sitting (i.e., a reduction of about 15 minutes for an average woman in our sample). While the estimated effect sizes for the built environment exposures and sitting time are small, if such changes were to occur across the population, it is likely that they would translate to a meaningful impact on health.

The findings suggest different factors may impact sitting time on weekdays and weekends. It seems self-evident that weekday and weekend schedules differ (Australian Bureau of Statistics, 2011), and for many women, work and child care commitments (and commuting to and from these destinations) will shape weekday routines. Furthermore, access to daily routine activities is dictated by the attributes of a more walkable neighbourhood (i.e., with sufficient residential densities to support businesses and transit) (Owen et al., 2011). In contrast, neighbourhood attributes had little association with residents' weekend sitting. In car dominated cities like Perth, (Newman & Kenworthy, 1999) weekend activities may be undertaken across the wider metropolitan area. Furthermore, as our sample typically lived in new suburbs on the urban fringe, many destinations for weekend activities may not yet be available locally.

Consistent with Sugiyama et al. (2007), our findings suggest there may be an alternative pathway through which environments discourage sitting time in women, other than by promoting walking. We hypothesised that community participation would help explain the association between walkable neighbourhood attributes and sitting time, as more walkable neighbourhoods might provide more opportunities for community participation. However, our findings indicate that both community infrastructure *and* community participation appear to be independently associated with women's sitting time (although the former was marginally significant). Further, as our community participation measure comprised many activities that are typically sedentary in nature (e.g., book club, hobby class); the findings suggest that incidental activity may also have a role in reducing sitting time.

Overall women in this study were involved in more community activities than men (women: M=2.50, SD=2.77; men: M=2.02, SD=2.45; t(1068)=3.115; p=0.002) and community participation was negatively correlated with sitting time for women only. One explanation for the different participation levels in men and women may relate to the inclusion of 'child-centric' activities in the community participation variable (e.g., social contact through children's sport, mothers group). Indeed, number of children was a highly significant predictor of less sitting time on weekdays and weekends for women, but not men. Thus, for participants with children, women might assume a greater share of the day-to-day parenting (Craig, 2006; Craig & Mullan, 2011; Doucet, 2001; Thompson & Walker, 1989), and actively participate in their community via their child's activities (Wood, Giles-Corti, Zubrick, & Bulsara, 2013).

This pattern fits with a previous Australian study that found women were less likely to be 'low participators' (Baum et al., 2000). Women were more likely to participate in social activities (e.g., school-related groups, hobby groups); while men were more likely to attend social clubs and play sport. Women were also more likely to participate in social activities set in informal settings such as cafés or restaurants (Baum et al., 2000). However, opportunities to participate may only limit the sedentary behaviour of those willing to be drawn into community life. Hamer (2010) proposes an alternative pathway whereby excessive periods of sedentary time can increase social isolation and hinder integration into social networks, to the detriment of mental well-being (Hamer et al., 2010, p.379).

Our findings support the notion that busy people are less sedentary, however they also have implications for neighbourhood design. Others have highlighted the importance of providing social infrastructure to promote participation (Baum & Palmer, 2002; Wood et al., 2013) and community activities require both formal (e.g., community centre) and informal venues (e.g., café) to host these activities. It is plausible that neighbourhoods with higher residential densities might support a greater range of activities, appealing to the diverse interests of local residents, and possibly resulting in greater community participation (i.e., areas with higher residential densities may have more people to support local activities). Moreover, higher population densities ensure that the local businesses that provide venues for informal activities are financially viable (Giles-Corti, Ryan, & Foster, 2012). For instance, in our study there was a moderate correlation between residential density and the provision of community infrastructure (Pearson correlation=0.442, p=0.000).

The suggestion that community infrastructure may have a role in helping to minimise women's weekday sitting time could have implications for both government and developers. As new neighbourhoods develop, social infrastructure often follows, rather than precedes development. Given its relevance to creating communities and encouraging participation, particularly for women, it may be necessary to provide financial incentives to facilitate the establishment of social infrastructure in new neighbourhoods earlier in the land development process (Baum & Palmer, 2002). This is likely to be health protective by providing necessary local services, promoting local walking and potentially helping to minimise sitting time. Conversely, creating new neighbourhoods without adequate social infrastructure may harm residents' health, particularly those who spend more time in the neighbourhood (e.g., parents of young children, retirees, unemployed).

The main strength of this study was the inclusion of objective built environment measures specific to each participant's 1600m neighbourhood; however there are several limitations. First, this study was cross-sectional, so causality cannot be determined. We hypothesised that neighbourhood characteristics might contribute to less sitting time; however it is equally possible that those preferring sedentary lifestyles relocate to neighbourhoods supporting this preference (i.e., self-selection). Longitudinal studies are necessary to understand whether environmental changes and increased community participation actually influence sitting behaviours.

We examined overall sitting (rather than domain specific sitting) and adjusted for a range of individual and workplace factors. While this is a relatively coarse measure of sitting time, we theorised that attributes of the neighbourhood environment could influence sitting across multiple domains (e.g., household, leisure time and transport), as urban planning characteristics dictate proximity to employment, shops and services, public transit, and social and recreational opportunities. Furthermore, sitting time is particularly sensitive to recall bias, as these behaviours 'are repetitive and often non-interactive' (Owen et al., 2010, p.156). For self-reported measures of sitting time, specific sitting behaviours (e.g., TV viewing, workplace sitting) appear easier to recall than overall sitting (e.g., usual weekday or weekend day) (Healy et al., 2011). Moreover, it is possible that when asked to recall 'sitting time' people do not recall time spent sitting when out socialising, but only recall sitting time at home or work. Ideally, studies examining sitting time would combine accelerometry with self-reported sitting to capture domain and behaviour specific sedentary time (Healy et al., 2011).

Participants were homeowners in relatively new suburban neighbourhoods, and the limited environmental variability may have reduced the magnitude of the observed associations. This is particularly relevant to our walkability and community infrastructure findings, which may be affected by the evolution of new neighbourhoods. However, new suburbs remain an important environment to examine sitting time, as participants have typically moved to the urban fringe, with larger commute times and fewer shops and services. Furthermore, given the study setting, the findings may not be generalisable to other places and populations (i.e., lower SES groups). Indeed, evidence suggests that local infrastructure may be more important to the behaviour of women living in lower socio-economic environments (Lee, Cubbin, & Winkleby, 2007).

Finally, the response rate was somewhat low at 33.4 percent. Potential participants were undergoing a major change, and study participation may have been a low priority (Petticrew et al., 2005). The study criteria may have also affected the response rate, as participants were required to move into their new home by a specified time (i.e., December 2005). However, once recruited, considerable effort was made to keep participants in the study (Giles-Corti et al., 2008).

CONCLUSION

While there is a considerable body of evidence confirming a relationship between neighbourhood walkability and transport walking, our results provide some evidence that the attributes of a walkable neighbourhood may also relate to women's sitting time. In this study of residents in new suburban neighbourhoods, both the objective presence of community infrastructure and self-reported community participation were negatively associated with women's sitting time. The findings provide some preliminary evidence to suggest that policies that facilitate the development of social and community infrastructure in new suburbs on the urban fringe may have role in limiting sitting time.

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Table 1: Men's descriptive information and univariate associations with: (1) weekday sitting time; and (2) weekend sitting time.

Men (n=463)		Weekday sitting time (minutes)		Weekend day sitting time (minutes)	
Characteristic	n (%)	Mean (SD)	*p*	Mean (SD)	*p*
All	463 (100.0)	324.5 (186.9)		282.4 (150.1)	
Age			0.813		0.418
20-39 years	176 (38.0)	321.4 (179.6)		272.0 (148.4)	
40-59 years	208 (44.9)	330.3 (191.1)		292.2 (153.0)	
60+ years	79 (17.1)	316.0 (193.6)		279.9 (146.4)	
Education			0.090		0.129
Bachelor or higher	127 (27.4)	351.1 (189.3)		266.4 (142.6)	
Trade/apprentice	222 (47.9)	305.9 (180.4)		279.7 (146.9)	
Secondary or less	114 (24.6)	331.1 (194.2)		305.5 (162.6)	
Income			**0.001**		**0.045**
Less than $50,000	59 (12.7)	261.8 (152.8)		271.7 (153.4)	
$50,000-$69,000	76 (16.4)	302.4 (178.8)		311.4 (168.0)	
$70,000-$89,000	89 (19.2)	298.9 (179.0)		307.7 (145.6)	
$90,000 or more	239 (51.6)	356.6 (194.4)		266.4 (143.1)	
Marital status			0.722		0.184
No partner	49 (10.6)	315.6 (186.5)		318.37 (154.0)	
Married/de facto	414 (89.4)	325.6 (187.2)		278.18 (149.3)	
Number of children			0.826		0.401
0	107 (23.1)	336.9 (196.8)		301.9 (166.3)	
1	63 (13.6)	332.6 (197.0)		281.4 (150.7)	
2	151 (32.6)	318.7 (174.6)		281.9 (148.4)	
3+	142 (30.7)	324.5 (186.9)		268.7 (138.4)	
PA level at work			**0.000**		0.138
Physically inactive	142 (30.7)	418.4 (180.6)		302.2 (155.5)	
Regular walking	143 (30.9)	304.6 (166.3)		277.8 (140.0)	
Moderately active	107 (23.1)	271.3 (192.5)		256.8 (150.5)	
Vigorously active	28 (6.0)	215.4 (149.7)		268.9 (137.0)	
Not in workforce	43 (9.3)	284.0 (159.1)		304.9 (165.9)	
Number of hours worked			0.330		0.335
19 hours per week	30 (6.5)	288.0 (170.5)		245.5 (135.7)	
20-38 hours per week	77 (16.8)	322.5 (194.4)		267.9 (142.4)	
39-59 hours per week	273 (59.6)	336.1 (186.5)		289.6 (152.0)	
60 hours+ per week	35 (7.6)	324.6 (217.7)		270.0 (150.7)	
Not in workforce	43 (9.4)	284.0 (159.1)		304.9 (165.9)	
Walking inside the neighbourhood			0.534		**0.006**
None	195 (42.1)	328.5 (187.9)		308.6 (161.3)	
Less 30 minutes/day	200 (43.2)	328.6 (188.4)		261.7 (127.3)	
More than 30 minutes/day	67 (14.5)	301.6 (181.6)		268.7 (169.9)	
BMI			0.081		**0.044**
Healthy	127 (27.4)	303.6 (183.9)		262.4 (126.1)	
Overweight	227 (49.0)	333.3 (190.3)		285.7 (151.3)	
Obese	86 (18.6)	349.0 (180.3)		314.4 (171.8)	
No response	23 (5.0)	261.3 (179.9)		241.3 (156.8)	

Table 2: Women's descriptive information and univariate associations with: (1) weekday sitting time; and (2) weekend sitting time.

Women (n=716)		Weekday sitting time (minutes)		Weekend day sitting time (minutes)	
Characteristic	n (%)	Mean (SD)	*p*	Mean (SD)	*p*
All	716 (100.0)	300.25 (184.3)		258.00 (131.9)	
Age			0.819		0.515
20-39 years	302 (42.2)	296.3 (178.2)		255.3 (130.3)	
40-59 years	336 (46.9)	304.9 (195.1)		256.6 (132.6)	
60+ years	78 (10.9)	295.5 (159.5)		274.6 (135.3)	
Education			0.793		0.335
Bachelor or higher	175 (24.4)	308.1 (181.2)		253.1 (121.3)	
Trade/apprentice	237 (33.1)	299.7 (179.0)		250.8 (130.5)	
Secondary or less	304 (42.5)	296.1 (190.4)		266.5 (138.6)	
Income			0.371		0.468
Less than $50,000	131 (18.3)	297.5 (175.4)		270.3 (132.8)	
$50,000-$69,000	125 (17.5)	276.1 (198.7)		245.6 (133.5)	
$70,000-$89,000	121 (16.9)	302.6 (174.3)		263.6 (122.5)	
$90,000 or more	339 (47.3)	309.4 (185.6)		255.8 (134.3)	
Marital status			0.104		0.112
No partner	113 (15.8)	327.1 (187.4)		276.6 (136.6)	
Married/de facto	603 (84.2)	295.2 (183.4)		254.5 (130.8)	
Number of children			**0.000**		**0.012**
0	162 (22.6)	366.7 (203.9)		288.9 (149.3)	
1	94 (13.1)	270.0 (143.7)		250.0 (126.6)	
2	273 (38.1)	286.6 (174.3)		250.4 (127.2)	
3+	187 (26.1)	277.8 (186.2)		246.3 (121.8)	
PA level at work			**0.000**		0.169
Physically inactive	252 (35.4)	379.5 (188.2)		266.0 (137.7)	
Regular walking	166 (23.3)	274.5 (164.2)		257.0 (125.4)	
Moderately active	78 (11.0)	229.0 (146.6)		247.2 (113.0)	
Vigorously active	27 (3.8)	295.0 (248.8)		305.6 (196.0)	
Not in workforce	189 (26.5)	247.0 (161.6)		244.8 (125.6)	
Number of hours worked			**0.000**		**0.000**
19 hours per week	114 (16.0)	286.0 (169.0)		278.2 (142.1)	
20-38 hours per week	247 (34.7)	295.4 (174.4)		240.0 (116.3)	
39-59 hours per week	142 (19.9)	373.3 (208.5)		294.9 (151.2)	
60 hours+ per week	20 (2.8)	375.0 (202.2)		240.0 (104.8)	
Not in workforce	189 (26.5)	247.0 (161.6)		244.8 (125.6)	
Walking inside the neighbourhood			0.076		0.061
None	218 (30.4)	322.1 (187.0)		274.8 (138.3)	
Less 30 minutes/day	379 (52.9)	294.9 (187.1)		248.0 (123.8)	
More than 30 minutes/day	119 (16.6)	277.3 (162.6)		259.0 (142.5)	
BMI			**0.016**		**0.010**
Healthy	348 (48.6)	281.2 (178.0)		244.4 (122.1)	
Overweight	210 (29.3)	309.9 (187.1)		258.4 (135.9)	
Obese	120 (16.8)	342.8 (201.6)		291.5 (147.4)	
No response	38 (5.3)	286.6 (143.7)		274.7 (129.1)	

Table 3: Estimated relative changes for built environment and social factors associated with**:** (1) weekday sitting time; and (2) weekend sitting time for men, after adjustment for individual factors*

Men (n=463)					
		Weekday sitting time (minutes)		Weekend day sitting time (minutes)	
Characteristic	Mean (SD)	Relative change (CI)	p	Relative change (CI)	p
Built environment					
Walkability Index	-0.056 (2.38)	0.951 (0.894-1.009)	0.098	0.969 (0.919-1.024)	0.260
Connectivity	78.20 (25.18)	0.975 (0.927-1.025)	0.440	1.000 (0.951-1.052)	0.935
Residential density	14.36 (3.71)	0.996 (0.938-1.057)	0.867	0.982 (0.931-1.033)	0.463
Land-use mix	0.16 (0.11)	0.950 (0.897-1.007)	0.083	0.987 (0.937-1.038)	0.604
Transit stops	22.35 (15.10)	0.956 (0.899-1.015)	0.189	0.955 (0.899-1.000)	0.074
Community infrastructure	9.58 (11.49)	0.966 (0.891-1.035)	0.317	0.966 (0.891-1.035)	0.317
Social factors					
Community participation	2.02 (2.45)	1.002 (0.944-1.065)	0.914	1.002 (0.944-1.065)	0.914

*Adjusted for age, education, income, marital status, number of children, number of hours worked, PA level at work, walking inside the neighbourhood (minutes) and BMI.
Estimate represents relative change to sitting time per 1(SD) increase in exposure variable.

Table 4: Estimated relative changes for built environment and social factors associated with**:** (1) weekday sitting time; and (2) weekend sitting time for women, after adjustment for individual factors*

Women (n=716)					
		Weekday sitting time (minutes)		Weekend day sitting time (minutes)	
Characteristic	Mean (SD)	Relative change (CI)	p	Relative change (CI)	p
Built environment					
Walkability Index	-0.01 (2.35)	0.958 (0.913-1.005)	0.084	1.005 (0.960-1.048)	0.852
Connectivity	78.97 (26.48)	0.974 (0.923-1.027)	0.513	1.000 (0.974-1.054)	0.640
Residential density	14.26 (3.79)	0.948 (0.905-0.996)	**0.029**	0.985 (0.944-1.031)	0.532
Land-use mix	0.16 (0.11)	1.012 (0.966-1.060)	0.601	1.006 (0.964-1.051)	0.768
Transit stops	22.51 (15.25)	0.941 (0.898-0.985)	**0.018**	1.000 (0.955-1.048)	0.848
Community infrastructure	8.87 (8.29)	0.936 (0.890-0.975)	**0.004**	0.992 (0.951-1.034)	0.669
Social factors					
Community participation	2.50 (2.77)	0.914 (0.873-0.959)	**0.000**	0.922 (0.885-0.959)	**0.000**

*Adjusted for age, education, income, marital status, number of children, number of hours worked, PA level at work, walking inside the neighbourhood (minutes) and BMI.
Estimate represents relative change to sitting time per 1(SD) increase in exposure variable.