

Comparison of Self-Reported Week-Day and Weekend-Day Sitting Time and Weekly Time-Use: Results from the Australian Longitudinal Study on Women's Health

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Abstract

Background The study of sedentary behavior is a relatively new area in population health research, and little is known about patterns of sitting time on week-days and weekend-days.

Purpose To compare self-reported week-day and weekend-day sitting time with reported weekly time spent in other activities.

Method Data were from 8,717 women born between 1973 and 1978 ('younger'), and 10,490 women born between 1946 and 1951 ('mid-age') who completed surveys for the Australian Longitudinal Study on Women's Health in 2003 and 2001, respectively. They were asked about time spent sitting on week-days and weekend-days. The women were also asked to report time spent in employment, active leisure, passive leisure, home duties, and studying. Mean week-day and weekend-day sitting times were compared with time-use using analysis of variance.

Results Younger women sat more than mid-aged women, and sitting time was higher on week-days than on weekend-days in both cohorts. There were marked positive associations between week-day and weekend-day sitting times and time spent in passive leisure in both cohorts, and with time spent studying on week-days for the younger women. Week-day sitting time was markedly higher in women who reported >35 h in employment, compared with those who worked <35 h. In contrast, there were inverse associations between sitting time and time spent in home duties. Associations between sitting and active leisure were less consistent.

Conclusion Although week-day sitting time was higher than weekend-day sitting time, the patterns of the relationships between week-day and weekend-day sitting and time-use were largely similar, except for time spent in employment.

Keywords Sedentary behavior · Time-use · Epidemiologic assessment · Survey · Women

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Introduction

Since 2000, more than 50 cross-sectional and prospective epidemiological studies have reported a positive relationship between increased time spent in sedentary behaviors and health outcomes such as overweight and obesity [1–6], and other indicators of cardiovascular [5, 7] and metabolic disease [4, 8–10]. Although some studies have used objective measures of sitting time [10, 11], to date most have relied on self-report questionnaires to provide subjective measures of sitting time. The majority of these

studies have used self-reported leisure time screen behavior (mostly time spent watching TV) to operationalize ‘sedentariness’, but some have also assessed time spent sitting in different settings, such as passive transport, socializing, and sitting at work [2, 12].

In recent years, researchers have suggested that measures of sitting time should be included in epidemiological studies of the association between sedentary behaviors and health [13, 14]. Such measures would be useful for describing patterns of sitting time in different subgroups of the population, and on week-days and weekend-days. This is important as there are currently few data on week-day and weekend-day sitting time. The main aim of this study was therefore to compare self-reported sitting time on week-days and weekend-days with reported weekly time spent in other activities, including employment, home duties, passive and active leisure, and studying, in population-based samples of young and mid-aged Australian women.

Methods

Australian Longitudinal Study on Women’s Health

Data for this study were derived from the Australian Longitudinal Study on Women’s Health (ALSWH). The ALSWH is a prospective study of factors affecting the health and well-being of three cohorts of Australian women born in 1973–1978 (younger), 1946–1951 (mid-age), and 1921–1926 (older) [15]. The women were aged 18–23, 45–50, and 70–75 years, respectively, at the start of the study in 1996. They were randomly selected from the national health insurance database, which includes all Australian citizens and permanent residents [16]. Women from rural and remote areas were intentionally oversampled. Since 1998, surveys have been administered to each cohort on a 3-year rolling basis. More details about the study can be found at www.alswh.org.au. The study was approved by the ethics committees of the University of Queensland and the University of Newcastle, and written informed consent was received from all participants.

Participants and Surveys

This study uses data from the third (2003) survey of the younger women (when they were 25–30 years old; $n=9,081$) and the third (2001) survey of the mid-age women (when they were 50–55 years old; $n=11,200$). Because time-use data were not collected in the older cohort, older women are not included in these analyses. The descriptive variables described below were assessed in the third surveys for both cohorts, except for country of birth (both cohorts) and

highest level of education (women born in 1946–1951), which were assessed in the first surveys in 1996.

Descriptive Variables

Physical activity level was assessed using a modified version of the Active Australia questionnaire. Women reported the frequency and duration of time in the previous week spent walking briskly, in moderate-intensity leisure time physical activity (LTPA), and in vigorous-intensity LTPA. An activity score was calculated by multiplying minutes in each activity by an assigned metabolic equivalent (MET) (walking=3.0 METs, moderate intensity=4.0 METs, and vigorous intensity=7.5 METs) [17]. These products were summed to a total LTPA score in MET minutes per week. Subsequently, the LTPA score was categorized as none (0 to <40), very low (40 to <300), low (300 to <600), moderate (600 to <1,200), or high (1,200+). The Active Australia questions have acceptable reliability and validity [18].

Self-rated health was assessed using the following question from the Short Form 36 health questionnaire [19]: ‘In general, would you say your health is: excellent, very good, good, fair, poor?’

Marital status was categorized as ‘sole’ (i.e., single, separated, divorced, widowed) or ‘partnered’ (i.e., married and/or living with a partner).

Education level, based on highest qualification achieved, was categorized as ‘low’ (school certificate or less), ‘intermediate’ (higher school certificate), ‘technical’ (having a trade certificate or diploma), or ‘university’ (completed a university degree).

Occupation was defined using the Australian Standard Coding of Occupations [20], with the categories ‘no paid job’, ‘blue collar’ (e.g., in production, transport, cleaning, etc.), ‘skilled’ (e.g., in a trade or advanced clerical work), or ‘professional’ (e.g., manager, teacher, etc.).

Hours worked per week were categorized as ‘none’ (unemployed or not in the labor force), ‘part-time’ (1 to 34 h), or ‘full-time’ (35 h or more) using the time-use question as described below.

Country of birth was classified as ‘Australia’, ‘other English speaking’, or ‘other non-English speaking’.

Area of residence was derived from postal codes and classified as ‘urban’, ‘large rural town’, or ‘small rural town/remote area’.

Sitting Time

Sitting time was assessed using the following question: How many hours each day do you typically spend sitting down while doing things like visiting friends, driving, reading, watching television or working at a desk or

computer (a) on a usual week-day and (b) on a usual weekend-day? This question is similar to the sitting time question in the long form of the International Physical Activity Questionnaire (IPAQ), which, in women, has good test–retest reliability (Spearman correlations of 0.77 and 0.85 for week-day and weekend-day sitting time, respectively) and moderate criterion validity against accelerometers (<100 counts per minute, Spearman correlation=0.38 for overall sitting time) [14].

Time-Use

The women were asked to report time spent per week in the following activities: employment (*full time, part time, casual, work without pay*), home duties (*in their own or family home*), passive leisure (*for example TV, music, reading, relaxing*), active leisure (*for example walking, exercise, sport*), and studying. There were seven response categories for each question: ‘I don’t do this activity’, ‘1–15 hours’, ‘16–24 hours’, ‘25–34 hours’, ‘35–40 hours’, ‘41–48 hours’, and ‘more than 49 hours’.

Analysis

Prior to construction of the sitting-time variables, data on sitting time were missing for 2.0% (week-day) and 2.7% (weekend-day) of the younger women, and for 4.4% (week-day) and 5.4% (weekend-day) of the mid-aged women (see Appendix Table 2 for details). The sitting variables were constructed as reported previously [21]. Of the women who answered the sitting time questions, week-day sitting time exceeded 24 h per day for 3.3% of the younger women and 2.7% of the mid-age women. As more than 80% of these out-of-range values were divisible by five (for example 30, 45), and because the sitting questions were preceded by the Active Australia questions (which asked about physical activity in hours *per week*) [18], it was assumed that these women had reported sitting time over five week-days instead of one week-day. These values were therefore divided by five. Likewise, values for weekend-day sitting which exceeded 24 h and were divisible by two were divided by two. A ‘practical’ maximum value of 16 h per day was adopted and values exceeding 16 h were set to missing. The numbers of women included in the analysis were 8,717 (week-day sitting) and 8,698 (weekend-day sitting) in the younger cohort and 10,490 (week-day sitting) and 10,470 (weekend-day sitting) in the mid-aged cohort (Appendix Table 2).

Independent sample *t* tests were used to compare mean week-day and weekend-day sitting time for the younger and mid-age women, and paired *t* tests were used to compare mean week-day and weekend-day sitting time in each cohort. Mean week-day and weekend-day sitting

times were compared for each response category for each of the time-use questions on employment, active leisure, passive leisure, home duties, and study using analysis of variance (ANOVA). For most activities, the highest category was ‘41 hours or more’ (the categories ‘41–48 hours’ and ‘≥49 hours’ were merged), but for ‘studying’ and ‘active leisure’ the highest category was ‘25 hours or more’ as there were small numbers of responses in the highest categories for these activities. A conservative significance level of 0.005 was adopted for the analysis to account for the high numbers of participants. All analyses were conducted using SAS, version 9.1.3 (Copyright 2002–2003 by SAS Institute Inc.).

Results

Sitting time, physical activity, self-rated health, and socio-demographic characteristics of the younger and mid-age women are shown in Table 1. Women in both cohorts tended to report sitting longer on week-days than weekend-days [mean difference between week-day and weekend-day sitting (95% confidence interval)=1.02 (0.95–1.10) h/day in the younger women and 0.48 (0.42–0.54) h/day in the mid-aged women; $p<0.0001$ for both]. This difference was more marked in the younger women. Young women had higher mean sitting times than the mid-age women on both week-days [mean difference between cohorts (95% confidence interval)=0.92 (0.84–1.02) h/day for week-days; $p<0.0001$] and weekend-days [mean difference (95% confidence interval)=0.39 (0.31–0.47) h/day; $p<0.0001$].

Means and standard errors (SE) for week-day and weekend-day sitting time across the categories of time-use are shown in Fig. 1 [see Appendix Table 3 for mean values (SE)]. The most consistent and statistically significant positive associations were with time spent in passive leisure on week-days and weekend-days in both younger and mid-age women, but also with studying on week-days and, to a lesser extent, on weekend-days for the younger women.

The positive association between week-day sitting time and work was characterized by high sitting hours for young and mid-age women who reported working >35 h per week. There was no association between hours in employment and weekend-day sitting in the young women, and a very slight downward trend in weekend-day sitting time with increasing hours in employment in the mid-age women.

The most marked and consistent *inverse* relationship was for home duties in both cohorts. This association was less marked for weekend-day sitting. Younger women who did not do home duties had high sitting times on both week-days and weekends.

The relationships between sitting time and active leisure were less consistent. Although there were significant down-

Table 1 Sitting time, physical activity, self-rated health, and sociodemographic characteristics of women in the younger and mid-age cohorts^a

	Younger cohort 2003 data	Mid-age cohort 2001 data
Sitting time (h/day), mean (SD)		
Week-day sitting	6.55 (3.31)	5.63 (3.06)
Weekend-day sitting ^b	5.54 (2.83)	5.16 (2.74)
LTPA (MET minutes/ week), %		
None (0 to <40)	8.9	17.8
Very low (40 to <300)	18.5	19.2
Low (300 to <600)	17.4	18.0
Moderate (600 to <1,200)	23.2	20.3
High (>1,200)	32.0	24.7
Self-rated health, %		
Excellent	13.4	10.6
Very good	42.1	36.9
Good	34.9	38.8
Fair	8.2	12.2
Poor	1.3	1.5
Marital status, %		
Sole	77.2	18.3
Partnered	22.8	81.7
Education, %		
Low	10.2	47.8
Intermediate	19.4	16.9
Technical	25.5	20.3
University	45.0	15.0
Occupation, %		
No paid job	18.9	25.5
Blue collar	20.9	25.5
Skilled	15.6	13.1
Professional	44.6	35.9
Hours worked, %		
Unemployed/not in labor force	17.5	22.3
Part time (1–34 h/week)	26.3	35.8
Full time (35+h/week)	56.3	41.9
Country of birth, %		
Australia	93.0	77.3
Other English speaking	3.6	13.8
Other non-English speaking	3.5	8.9
Area of residence, %		
Urban	57.9	38.0
Large rural town	10.4	13.6
Small rural town/remote area	31.9	48.4

SD standard deviation, *LTPA* leisure time physical activity, *MET* metabolic equivalent, *n* number

^a For women with data on week-day sitting time ($n=8,717$ in young women and $n=10,490$ in mid-aged women); n varies slightly due to missing data

^b $n=8,698$ in young women and $n=10,470$ in mid-aged women

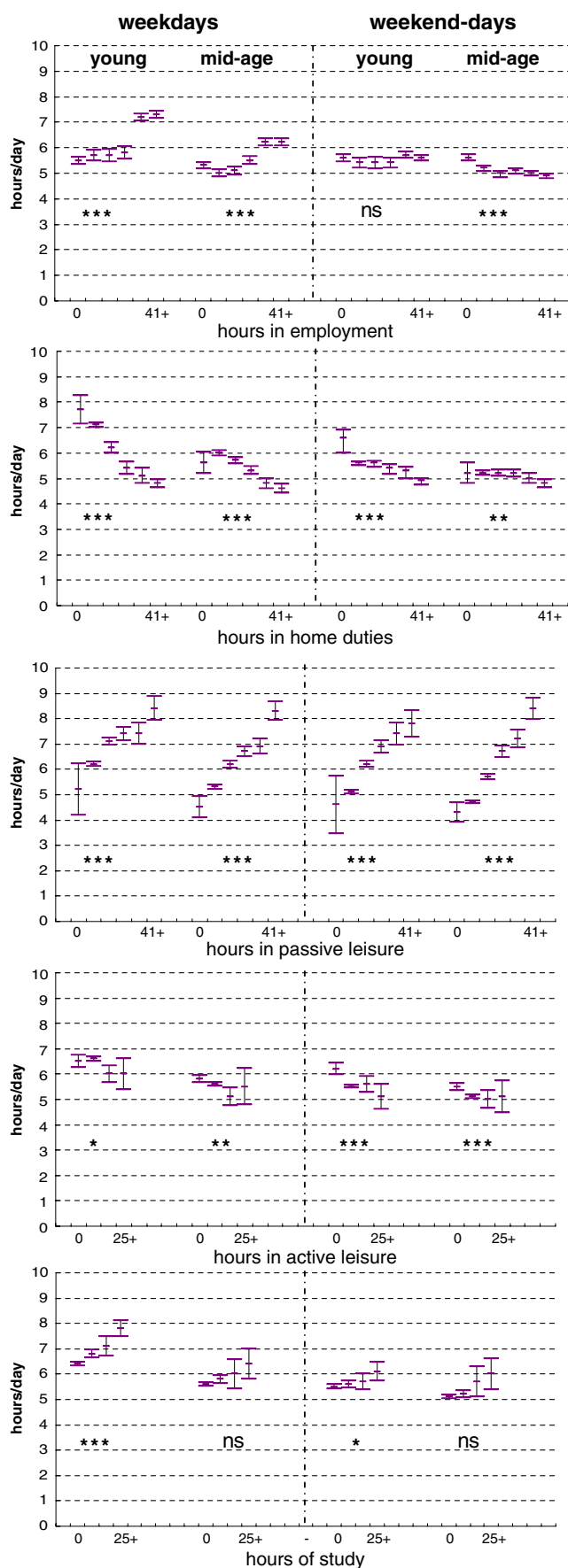
ward trends, especially on weekend-days, there was high variability in sitting time among the most active women.

Discussion

We found strong associations between sitting time and reported weekly time spent in a range of activities in both

younger and mid-age women. For example, sitting time increased when women reported more hours in passive leisure, studying, or at work, but decreased with increased time spent in home duties and, to a lesser extent, active leisure.

The patterns of week-day and weekend-day sitting time across categories of increasing time spent in other activities were largely similar. However, we found that week-day sitting time was higher for women who spent more time at work,



◀ **Fig. 1** Mean (± 2 * standard error) week-day and weekend-day sitting time by time-use categories for women in the younger and mid-age cohorts [$n=8,717$ (week-day sitting) and $n=8,698$ (weekend-day sitting) in young women, and $n=10,490$ (week-day sitting) and $n=10,470$ (weekend-day sitting) in mid-aged women]. * $p < 0.005$; ** $p = 0.0001-0.0005$; *** $p < 0.0001$. ns=not significant

whereas this was not the case for weekend-day sitting time. It is likely that the increased week-day sitting time predominantly reflects occupational sitting, because more women work on week-days than on weekend-days. However, time spent at work is not necessarily associated with increased sitting time, especially in women whose jobs require them to be ‘on their feet’. It is possible that those in more sedentary jobs, such as clerical and administrative work, work mostly on week-days, while women in ‘on their feet’ jobs, such as nurses, hairdressers, and waitresses, may have variable work schedules that also include work during weekend-days. This could explain the significant decrease in weekend-day sitting time across categories of increased hours in employment in the mid-age women. It has been suggested that estimates of week-day sitting time may provide a better reflection of the transition to a sedentary lifestyle in developing countries than measures of weekend-day sitting [22]. While week-day and weekend-day sitting times were similar for women spending much time in passive leisure, our results confirm that high hours of sitting in paid work are more likely to be recorded for week-day sitting time. Thus, if space in surveys is limited, asking only about week-day sitting, as in the short-form IPAQ [12], may be sufficient to capture high sitting times in work and leisure.

As expected, associations between sitting time and time spent in active leisure on week-days and weekend-days were less consistent. Although there were slight downward trends in sitting for the low and moderately active women, some of the high active women also reported high sitting times. This confirms previous findings which suggest that sitting time and physical activity are not necessarily inversely related [13, 14]. A potential explanation could be a difference in patterns of occupational and leisure time sitting and physical activity. For example, people in more active jobs have been found to be more sedentary in their leisure time than people with jobs that require less activity [23]. Likewise, women in sedentary jobs could be very active in their leisure time to ‘make up’ for the lack of activity during time spent at work. For this reason, it is recommended that measures of both sitting time and physical activity are included in epidemiological studies [13, 14].

Although at least 50 studies have now reported self-reported sitting time data, few have explained the procedures used for data cleaning and management. As is the case for most of the commonly used physical activity questionnaires (Active Australia, IPAQ, Behavioral Risk Factor Surveillance System), there is a need to develop standardized protocols for

data cleaning of sitting time data, so that data from different studies that use the same measures can be compared. In this paper, we describe our protocol for recoding high sitting time values, on the assumption that the women reported weekly sitting time, presumably because they had been asked to report *weekly* activity time in the previous question. This protocol may only be applicable to other surveys which also do this. Notwithstanding, the findings highlight the need to be careful about the ordering of questions in self-report surveys, and the emphasis placed on the recall period in the question header. We cannot be certain that women who reported 5, 10, or 15 h of sitting time on week-days were not reporting 5-day data of 1, 2, or 3 h sitting per day, respectively. This should be examined in future validity studies with objective measures of sitting time. We also recommend that future validity papers separately report the validity of week-day sitting and weekend-day sitting time as these data are currently lacking. We also assumed that the maximum time spent sitting was 16 h per day. Asking about time spent sleeping in large epidemiological studies, or using 24-h accelerometer data in smaller studies, may confirm the length of the 'waking' day and help with decisions about how to manage seemingly high sitting time data.

The major limitation of this study is that both sitting time and time-use were self-reported. The limitations of self-report measures, which are widely used in population studies, have been addressed elsewhere [24]. Ideally, the reliability and the validity of the sitting time measures should be reported in studies which rely on self-report. However, while most cohort studies examining associations between sitting and health outcomes have relied on self-reported measures, the

reliability and validity of those measures is often not reported [25]. More objective measures, such as those from accelerometers, would provide improved estimates of time spent sitting, but because of logistic and financial constraints, it is not yet common practice to include objective measures in large prospective cohort studies. While we acknowledge the limitations of self-report measures, they are pragmatic for use in studies that include large numbers of participants and are considered appropriate for population monitoring [26]. The main strength of this study is that the data were drawn from a large sample of women who were recruited randomly from a national population database. Another strength is that we reported and compared both week-day and weekend-day sitting time with weekly time spent in other activities. This is important because few other studies have separately reported week-day and weekend-day sitting time.

In conclusion, young women reported higher sitting time than mid-aged women. Although mean week-day sitting time was higher than weekend-day sitting time in young and mid-aged Australian women, the patterns of the relationships between week-day and weekend-day sitting and time-use were largely similar, except for time spent in employment.

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Appendix

Table 2 Overview of the numbers and proportions of sitting time data which were recoded or excluded, and the final numbers of women included in the analysis

	Younger cohort		Mid-age cohort	
	Week-day	Weekend-day	Week-day	Weekend-day
a. Surveys, <i>n</i>	9,081	9,081	11,200	11,200
b. Missing sitting data, <i>n</i>	181	246	491	607
(% of 'a')	(2.0%)	(2.7%)	(4.4%)	(5.4%)
c. Women answering sitting questions, <i>n</i>	8,900	8,835	10,709	10,593
d. Sitting time >24 h/day, <i>n</i>	300	38	286	49
(% of 'c')	(3.3%)	(0.4%)	(2.7%)	(0.5%)
e. Data in 'c' recoded ^a	250	13	238	14
f. Excluded: >24 h/day after recoding, <i>n</i>	50	25	48	35
g. Excluded: >16 and ≤24 h/day, <i>n</i>	133	112	171	88
(% of 'c')	(1.5%)	(1.3%)	(1.6%)	(0.8%)
h. Total missing or excluded, <i>n</i> (b, f, g)	364	383	710	730
i. Number included in analyses, <i>n</i>	8,717	8,698	10,490	10,470
(% of 'a')	(96%)	(95.8%)	(93.7%)	(93.5%)

^a Week-days: >24 h/day and divisible by 5, ≤16 h/day after dividing by 5; weekend-days: >24 h/day and divisible by 2, ≤16 h/day after dividing by 2; *n*=number of women

Table 3 Mean week-day and weekend-day sitting time (SE) by time-use categories for women in the younger and mid-age cohorts^a

	I don't do this	1–15 hours	16–24 hours	25–34 hours ^b	35–40 hours	41+hours	ANOVA ^c
Younger cohort							
Week-day sitting (h/day)							
Employment	5.5 (0.07)	5.7 (0.10)	5.7 (0.12)	5.8 (0.12)	7.2 (0.07)	7.3 (0.07)	<i>p</i><0.0001
Home duties	7.7 (0.28)	7.1 (0.04)	6.2 (0.10)	5.4 (0.13)	5.1 (0.15)	4.8 (0.08)	<i>p</i><0.0001
Passive leisure	5.2 (0.51)	6.2(0.04)	7.1 (0.07)	7.4 (0.13)	7.4 (0.21)	8.4 (0.24)	<i>p</i><0.0001
Active leisure	6.5 (0.12)	6.6 (0.04)	6.0 (0.17)	6.0 (0.30)			<i>p</i>=0.0013
Study	6.4 (0.04)	6.8 (0.08)	7.1 (0.19)	7.8 (0.16)			<i>p</i><0.0001
Weekend-day sitting (h/day)							
Employment	5.6 (0.07)	5.4 (0.09)	5.4 (0.11)	5.4 (0.10)	5.7 (0.06)	5.6 (0.05)	<i>p</i> =0.0090
Home duties	6.6 (0.30)	5.6 (0.04)	5.6 (0.09)	5.4 (0.13)	5.3 (0.15)	4.9 (0.08)	<i>p</i><0.0001
Passive leisure	4.6 (0.57)	5.1 (0.04)	6.2 (0.06)	6.9 (0.12)	7.4 (0.22)	7.8 (0.26)	<i>p</i><0.0001
Active leisure	6.2 (0.11)	5.5 (0.03)	5.6 (0.16)	5.1 (0.25)			<i>p</i><0.0001
Study	5.5 (0.04)	5.6 (0.07)	5.7 (0.16)	6.1 (0.19)			<i>p</i>=0.0021
Mid-age cohort							
Week-day sitting (h/day)							
Employment	5.3 (0.06)	5.0 (0.07)	5.1 (0.08)	5.5 (0.08)	6.2 (0.07)	6.2 (0.07)	<i>p</i><0.0001
Home duties	5.6 (0.21)	6.0 (0.05)	5.7 (0.06)	5.3 (0.08)	4.8 (0.10)	4.6 (0.08)	<i>p</i><0.0001
Passive leisure	4.5 (0.21)	5.3 (0.04)	6.2 (0.07)	6.7 (0.10)	6.9 (0.15)	8.3 (0.19)	<i>p</i><0.0001
Active leisure	5.8 (0.07)	5.6 (0.03)	5.1 (0.17)	5.5 (0.36)			<i>p</i>=0.0005
Study	5.6 (0.03)	5.8 (0.08)	6.0 (0.29)	6.4 (0.30)			<i>p</i> =0.0259
Weekend-day sitting (h/day)							
Employment	5.6 (0.06)	5.2 (0.07)	5.0 (0.08)	5.1 (0.07)	5.0 (0.06)	4.9 (0.06)	<i>p</i><0.0001
Home duties	5.2 (0.20)	5.2 (0.04)	5.2 (0.06)	5.2 (0.07)	5.0 (0.10)	4.8 (0.08)	<i>p</i>=0.0003
Passive leisure	4.3 (0.20)	4.7 (0.03)	5.7 (0.06)	6.7 (0.11)	7.2 (0.18)	8.4 (0.21)	<i>p</i><0.0001
Active leisure	5.5 (0.07)	5.1 (0.03)	5.0 (0.17)	5.1 (0.31)			<i>p</i><0.0001
Study	5.1 (0.03)	5.2 (0.07)	5.7 (0.29)	6.0 (0.31)			<i>p</i> =0.0055

^a *n*=8,717 (week-day sitting) and *n*=8,698 (weekend-day sitting) in young women, and *n*=10,490 (week-day sitting) and *n*=10,470 (weekend-day sitting) in mid-aged women

^b This category is '>25 hours' for active leisure and study

^c Boldface indicates statistical significance

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