Objectively measured sedentary time before and after transition to retirement: The Finnish Retirement and Aging Study (FIREA)

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ABSTRACT

Background: Retirement is associated with an increase in self-reported daily sedentary time, but no longitudinal evidence exists on how objectively measured sedentary time changes during retirement transition. The aim of this study was to compare objectively measured daily and hourly sedentary time before and after retirement and examine whether these changes differ by gender and occupational status.

Methods: The study population consisted of 478 participants (mean age 63.2 years, SD 1.7, 85% women) from the Finnish Retirement and Aging Study (FIREA). Sedentary time was measured using a wrist-worn triaxial ActiGraph accelerometer before and after transition to retirement with one year interval. Pre-retirement occupational status was categorized as manual and non-manual.

Results: Daily sedentary time was 8 hours 10 minutes in women and 9 hours 49 minutes in men before retirement. Considering all measurement days before and after retirement, daily sedentary time increased in women by 29 minutes (95% CI 20 to 38). Especially women retiring from manual occupations showed marked increase in sedentary time (63 min, 95% CI 50 to 77). When only non-working days before retirement were considered, increase in daily sedentary time among women was less marked (16 min, 95% CI 7 to 25). Among men, daily sedentary time did not change in retirement transition (-7 minutes, 95% CI -26 to 12).

Conclusions: Objectively measured sedentary time increases among women and remains at high level among men during the retirement transition. Attention should be paid to reduce daily sedentary time in retiring women and men.

Key words: sedentary time, accelerometer, retirement, occupational status, work

INTRODUCTION

Sedentary behavior, defined as waking behavior while sitting, reclining or lying down with low energy expenditure (1) has attracted increasing scientific interest as a result of the associations found between sedentary behavior and compromised cardiometabolic health (2) and physical functioning (3), higher risk of type 2 diabetes (4) as well as higher all-cause mortality (5,6). During the last decades, sedentary work, passive commuting and sitting during leisure time have become more common (7). Objectively measured total sedentary time is estimated to be highest among adults aged 60 years or older, 9.4 hours per day in Western countries (8).

Retirement is an important point in life that may involve changes in physical activity behavior (9). Restructuring of daily activities may also influence sedentary behavior. A recent longitudinal study suggests that self-reported daily non-occupational sedentary time increases after retirement (10). Increases have been observed especially in self-reported TV viewing time (10-14). However, reliance on self-reported data in assessing sedentary time (10-15) is subject to recall and information bias (16).

Modern technology enables objective measurements of sedentary time among large populations and allows detailed examination of sedentary time across the day. There are few previous cross-sectional studies that have compared objectively measured sedentary time between retired and non-retired persons. These studies report conflicting findings of sedentary time being lower (17) or higher among retirees (18) compared to non-retired people. To the best of our knowledge, there are no previous longitudinal studies on individual-level changes in objectively measured sedentary time and daily sedentary profiles during retirement transition (19). In addition, because gender and work characteristics have been shown to moderate changes in self-reported sedentary time during retirement transition

(10), it is of interest to examine whether the changes are different in women and men or between different occupational statuses.

Along these lines, we conducted repeated accelerometer measurements among aging workers transitioning from work to statutory retirement. Our aim was to compare daily sedentary time and daily sedentary profiles before and after retirement transition, and further to examine whether the changes in daily sedentary time and daily sedentary profiles during retirement transition differ by gender and occupational status.

METHODS

Study population

This study is based on the Finnish Retirement and Aging Study (FIREA) which is an ongoing longitudinal cohort study of older adults in Finland established in 2013 (10). The eligible population for the FIREA study cohort included all public sector employees whose individual retirement date was between years 2014 and 2019 and who were working in year 2012 in one of the 27 municipalities in Southwest Finland or in the 9 selected cities or 5 hospital districts around Finland. Information on individual retirement date was obtained from Keva, the pension insurance institute for the municipal sector in Finland. FIREA study cohort members were first contacted 18 months prior to their estimated retirement date by sending a questionnaire. Detailed description of the FIREA study protocol is reported elsewhere (10,20). The FIREA study is conducted in line with the Declaration of Helsinki, and has been approved by the Ethics Committee of Hospital District of Southwest Finland.

The study population for the FIREA activity sub-study included those Finnish speaking FIREA study members whose estimated statutory retirement date was in 2016–2019, who had responded to the first questionnaire and who were still working by the end of 2017 (n=2,643). These participants were contacted by mail to invite them to take part in the activity sub-study and of them 938 (36%) returned the written informed consent. Thereafter the participants have been followed up annually with questionnaires and accelerometer measurements. By the end of March 2019, 526 participants had successfully used accelerometer at least once before and once after transition to full-time statutory retirement, with one year in between the measurements (rest of the consented participants were not yet retired). To determine the timing of retirement, the actual retirement day (for full-time statutory retirement) was inquired during each phase of the data collection.

Accelerometer measurements

Sedentary time was measured with triaxial ActiGraph wActiSleep-BT and wGT3X-BT accelerometers (ActiGraph, Pensacola, Florida, US), which were mailed to participants. Participants were asked to wear the device on their non-dominant wrist for 7 consecutive days and nights at all times, including water-based activities. Participants were also provided a daily log, where they were asked to record date, bedtime, waking and working times. Data from the accelerometers were downloaded and converted into 60 seconds epochs in ActiLife software, version 6.13 (ActiGraph, Pensacola, Florida, US). We defined sleep by the algorithm available in the ActiLife software (21) and non-wear time by the Choi algorithm (22) and excluded sleep and non-wear time, leaving only data from waking wear time, i.e. wake time when accelerometer was worn, to the analyses. We defined sedentary time as less than 1853 vector magnitude (VM) counts per minute (CPM), which is validated for accelerometers worn on non-dominant wrists among older adults against thigh-worn triaxial activPAL accelerometer (23). Hours with less than 60 minutes of accelerometer recording (≈2.0% of the hours) were excluded from the analyses of daily sedentary profiles.

For the analyses, we excluded participants who had less than four valid days of ≥10 hours of waking wear time of accelerometer measurement in either or both of the measurement points and less than one valid working day and less than one valid non-working day before retirement (n=48), resulting in an analytic sample of 478 persons. Number of valid days (≥10 hours of waking wear time) were 3270 days including 2056 working days and 1201 non-working days before retirement and 3266 days after retirement.

Assessment of covariates

Gender, date of birth, and occupational status were obtained from the Keva register. Occupational status was categorized based on the International Standard Classification of

Occupations (ISCO) (24) into two groups according to the occupational titles by the last known occupation preceding retirement: manual workers (e.g. cleaners, maintenance workers; ISCO classes 5-9) and non-manual workers (e.g. teachers, physicians, registered nurses, technicians; ISCO classes 1-4). Other covariates were derived from the questionnaires and selected because they have been reported to associate with sedentary behavior (25). Smoking status was categorised into non-smokers (never and former) and current smokers. Body mass index (BMI) was calculated from self-reported weight and height and categorised into normal weight (<25.0 kg/m^2), overweight (25 to <30 kg/m^2) and obese (≥ 30 kg/m^2) (26). Number of chronic diseases was calculated and participants were categorized into having 0, 1 or ≥2 doctor diagnosed chronic diseases (angina pectoris, claudication, myocardial infarction, or cerebrovascular disease, diabetes, osteoarthritis, osteoporosis, sciatica, fibromyalgia, rheumatoid arthritis, asthma, chronic bronchitis). Physical functioning was evaluated with the validated RAND-36 Health Survey (identical with the Short Form SF-36) (27,28) and for the current study we used information on mobility limitation based on the question of difficulties walking 500 meters (no, somewhat and markedly).

Statistical analyses

The characteristics of the study population before retirement and eligible population are shown as percentages for categorical variables and means and standard deviations (SD) for continuous variables. We defined the eligible population as those survey participants who had retired by the end of 2017 (n=2,058).

To examine changes in daily sedentary time, we calculated the sum of the sedentary minutes for each day. Next, we averaged the sum of sedentary minutes across all days and separately for non-working days before retirement. Thereafter, we compared all days (comprising working days and non-working days) before retirement to all days after retirement. To examine more specifically the changes in sedentary behavior irrespective of work-related activity, we compared daily sedentary time on all non-working days before retirement to all days after retirement except for working days after retirement (one person reported temporary working days after retirement). The analyses were conducted using linear mixed models and the results are shown in mean estimates of daily sedentary time and their 95% confidence intervals (CI). The analyses were initially adjusted for age, gender, occupational status, and length of daily waking wear time. In the second set of analyses, we additionally adjusted for smoking, body mass index, number of chronic diseases and mobility limitation. We also conducted the analyses separately by gender and occupational status. We did not assess concomitant changes in physical activity, because our primary aim was to study changes in sedentary time. Physical activity is however at least indirectly reflected by changes in sedentary behavior during waking hours as reduced sedentary behavior means increased physical activity and vice versa.

To illustrate daily sedentary profiles before and after transition to retirement, we calculated each participant's sums of sedentary minutes for each waking hour of each day and then averaged the sedentary minutes per hour across all days by using linear mixed models. We show the results as mean hourly sedentary minutes (95% CI) separately for working days and non-working days before retirement and all days after retirement by gender and occupational status. Since we were interested in daytime sedentary behavior, we illustrated mean sedentary minutes for each hour from 7:00 am to 9:59 pm. All statistical analyses were performed using SAS statistical software, version 9.4 (SAS Institute, Inc., Cary, North Carolina).

RESULTS

Our study population consisted of relatively well-functioning aging public sector workers. Before retirement the mean age of the participants was 63.2 years and the majority were women (85%) and in non-manual occupations (67% of women, 74% of men) (Table S1). Average length of daily waking wear time was 16.1 hours (95% CI 16.0–16.2) before and 15.7 hours (95% CI 15.6–15.8) after retirement and 95% had ≥6 valid wear days in both measurement points. There were no differences in self-reported daily sitting time between the final study population and the eligible study population, but in the final study population, there were smaller proportion of women and men who smoked (women: 4% vs. 8%, men: 4% vs. 10%) (Table S1).

Table 1 presents daily sedentary time before and after retirement by gender and occupational status. When all measurement days before retirement were considered, women had 8 hours 10 minutes daily sedentary time before retirement and they increased their daily sedentary time during retirement transition overall on average by 29 minutes (95% CI 20 to 38), and by 16 minutes (95% CI 7 to 25) when only non-working days before retirement were considered. Daily sedentary time on all days before retirement was lower among women in manual occupations compared to women in non-manual occupations. Women retiring from manual occupations showed marked increase in sedentary time after retirement (63 minutes, 95% CI 50 to 77) whereas women retiring from non-manual occupations increased their daily sedentary time only slightly (13 minutes, 95% CI 3 to 23). When only non-working days before retirement were considered in women, no difference in daily sedentary time between manual and non-manual occupations before retirement were observed, but women retiring from non-manual occupations increased their daily sedentary time by 19 minutes (95% CI 9 to 29) during retirement transition. However, women retiring from manual occupations also showed tendency to increase their daily sedentary time. Adjusting with smoking, BMI, number of chronic diseases and mobility limitation did not markedly change these results (Table S2).

Table 1 shows that compared to women, men's daily sedentary time was almost two hours more on all measurement days on average and one hour more on non-working days before retirement. When all measurement days before retirement were considered, men did not show changes in daily sedentary time during retirement transition. There was small difference between occupational groups so that men in manual occupations were less sedentary compared to men in non-manual occupations on all days but not on non-working days before retirement. When non-working days before retirement were compared to all days after retirement, no statistically significant changes in daily sedentary time during retirement transition were observed in men.

Figure 1 illustrates daily sedentary profiles by gender and occupational status. Profiles were different between working days before retirement and days after retirement during morning hours and the usual workhours (from 8 am to 4 pm), but not during the evenings. Among women in manual occupations, usual working hours were more sedentary after retirement compared to before retirement. In contrast, the usual working hours were less sedentary after retirement compared to before retirement among women in non-manual occupations and men in both occupational statuses. The shapes of the profiles on non-working days before and days after retirement were similar in all subgroups and sedentariness was especially prominent in the evening hours of the day.

DISCUSSION

To the best of our knowledge, the current study is the first longitudinal cohort study examining within-individual changes in objectively measured sedentary time during retirement transition. Daily sedentary time increased during retirement transition in women, especially among women retiring from manual occupations. No increase in daily sedentary time was observed among men, who maintained their higher level of daily sedentary time after retirement compared to women. The hourly sedentary data revealed that evenings were highly sedentary both before and after retirement in women and men.

Our results give more precise estimates of within-individual changes in sedentary time across retirement transition and confirm previous findings based on self-reported data. In addition, although several studies have examined self-reported sedentary time before and after retirement, these studies have mostly compared two groups (aging workers and retirees) and have not examined within-individual changes during retirement transition (11-14). In line with earlier studies using self-reported sedentary time of mainly leisure time activities or only TV viewing (10-14), our objective measurements also indicated an increase, but to a lesser extent, in leisure sedentary time in the retirement transition. Hence, a major advantage of our study is that due to the 7-day accelerometer measurement, we were able to examine sedentary time during working days and non-working days separately and compare them to sedentary time after retirement. Our results indicate, in accordance with previous findings (29), that working hours indeed are a major contributor to overall daily sedentary time. Removal of working hours in the retirement transition resulted in no change in daily sedentary time in men and increase of daily sedentary time in women. Interestingly, daily sedentary time did not decrease among non-manual workers who had more sedentary time during working days.

In addition, although we did not have context specific information on leisure-time activities, previous studies have reported that watching TV is the most common leisure sedentary activity in this age group (10,15). Moreover, TV watching is shown to increase in the retirement transition, in the FIREA study population (10) as well as in other retiring study populations (11-15). This is concerning, because watching TV has been found to associate with obesity, various cardiometabolic diseases and with higher risk for mortality (6).

We can compare the clinical relevance of the observed change of daily sedentary time in women to a recent cross-sectional study among large study population of older women, which reported that each 1-hour increase in objectively measured daily sedentary time is associated with increased odds for prevalent type 2 diabetes (4). In our study, daily sedentary time increased by 63 minutes in women retiring from manual occupations suggesting clinically relevant increase in daily sedentary time and need for preventive actions among women retiring from manual occupations. However, longitudinal evidence on associations between changes in objectively measured sedentary time and health outcomes is currently few and far between. It should also be noted that although women in non-manual occupations increased their daily sedentary time only slightly, they were more sedentary compared to women in manual occupations before retirement. In addition, men were markedly more sedentary compared to women, especially on working days before retirement but also after retirement and therefore attention should be paid to reduce daily sedentary time also in retiring men.

A unique feature of the present study is that we were able to compare daily profiles of sedentary time before and after retirement transition and to shed light on how hours spent in work before retirement are spent after retirement transition. We observed that the largest differences in daily sedentary profiles before retirement and days after retirement occurred during the usual working hours. These differences were particularly seen in non-manual workers who had high amount of hourly sedentary time during working hours. The opposite phenomenon was seen among women retiring from manual occupations: usual working hours were replaced with sedentary activities after retirement. On the other hand, shapes of the daily sedentary profiles between non-working days before retirement and days after retirement were very similar across the day. Interestingly, similar evening patterns in sedentariness were observed in all of the groups both before and after retirement. High amount of sedentary time during evenings has also been reported in cross-sectional studies among working adults (30) and retirees (17). In earlier studies, a more prominent drop in physical activity in the evenings has been observed among older adults compared to younger adults (31) which may be associated with increased fatigability (32) and lower physical function (33). However, increased fatigability or functional limitations do not likely explain our results, because our study population consisted of relatively well-functioning people in their early 60's. In addition, adjusting with number of chronic diseases and mobility limitation did not markedly change the results. Based on the results of the current study and those of others (17,30), interventions to decrease sedentariness among aging people should likely be targeted especially to the evening hours.

Our findings indicate that changes in daily sedentary time during retirement transition differed markedly by gender. Women were less sedentary before and after retirement compared to men, which is also supported by other studies among persons aged 60 years or older (8). Gender differences within non-manual and manual occupational groups on working days may be explained by a gender-based segregation of occupations in the public sector in Finland (34). Women work in occupations which may be less sedentary compared to men's occupations, for instance, in the non-manual group as teachers vs. technicians, and in the manual occupational group as nurses vs. drivers. In addition, another possible reason for gender differences on working days may be that active commuting is more common in women compared to men in Finnish people aged 60–64 years (35). However, we observed gender differences also on non-working days before retirement and on retirement days. The differences in sedentary time during leisure time may partly be explained by domestic physical activity because women are reported to do household chores more often compared to men, especially in this age group (36). Moreover, wrist-worn accelerometers may be more sensitive for capturing light physical activity performed in household chores compared to subjective and other accelerometer attachment positions (e.g. waist or thigh).

In this study we used occupational status as an indicator of work-related activities, but it also reflects participants' socioeconomic status (SES) (37). It can be argued that people with higher SES might become less sedentary after retirement, because they make conscious efforts to be active compared to those with lower SES. Because we did not have information on other SES indicators, such as participants' income, we cannot be sure about the role of SES in the results.

Our study focused on the short-term changes in sedentary time in the retirement transition. It has been observed that self-reported non-occupational sedentary time continues to increase several years after the retirement transition (10) and self-reported leisure-time physical activity increases in the retirement transition but begins to decrease as time passes after retirement (9). Therefore future studies on long-term changes in objectively measured sedentary time during the retirement transition are needed.

The major strength of our study is repeated objective measurement of sedentary time before and after retirement, which enabled us to track within-individual changes in sedentary time during an important life transition. Furthermore, we took into account several individual characteristics which are associated with sedentary behavior (25) and these confounding factors did not markedly affect our conclusions. Our study population consisted of public sector employees with high diversity of occupations, which allowed us to make comparisons between the non-manual and manual occupational statuses. A large proportion of the participants provided sufficient amount of accelerometer data to study working and non-working days separately before retirement. Bias associated with the seasonal variation was minimized as the measurements were conducted at the same time of the year for each individual (on average 360 days between the measurements). Regarding selection bias, no differences were found in self-reported sitting time between the final study population and the eligible study population for this study.

There are naturally also limitations and challenges that should be considered when interpreting our findings. The wrist-worn accelerometers may underestimate daily sedentary time compared to the posture sensitive thigh-worn accelerometers (23). Further, handling accelerometer data requires making several choices which can lead to information bias. We decided to set the epoch length at 60 s, which is commonly used in the literature (23,38). There are also challenges associated with distinguishing sedentary time from in-bed and non-wear time because they are all comprised of low intensity or no movement (21). We used the Choi algorithm, which is a commonly used method in defining non-wear time (38). The sleep algorithm available in the ActiLife software corresponds well to sleep times reported in the log in our population (21). Additionally, breaks or average duration of each uninterrupted sedentary time session were not assessed in the present study. Furthermore, we included only full hours (60 min) of wear and wake time in our analysis which led to exclusion of approximately 2.0% of all hours. Excluded hours took place during early mornings and late evenings. These hours belong to normal sleep-wake cycle and are not that important in examining daily sedentary behavior nor a relevant intervention target for reducing sedentary time (39).

We aimed at examining differences between occupational status groups, but the sample size only allowed comparison between non-manual and manual workers. Because there may be heterogeneity within non-manual and manual workers in terms of sedentary behavior, future studies with larger sample size are needed to examine changes in sedentary time during retirement transition with more detailed occupational categorization.

Finally, our study population consisted of relatively healthy Finnish public sector employees, of which majority were women, leaving the number of men in both occupational groups rather small. There were no marked differences between the final study population and the eligible study population. Therefore, our results can be generalized to public sector employees in Finland or in countries with similar statutory retirement age and pension system. Future research should be conducted in other populations to confirm the findings of the current study.

CONCLUSIONS

This is the first longitudinal cohort study to show that objectively measured sedentary time increases among women and remains at high level among men during the retirement transition. Therefore public health interventions should be targeted to retiring women and men to reduce daily sedentary time.

Competing Interests None declared

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Contributors SS designed this study and the data collection. KS, AP and JP analyzed the data. KS drafted the manuscript. All authors contributed to data interpretation, revised article critically, and approved the final version of manuscript.

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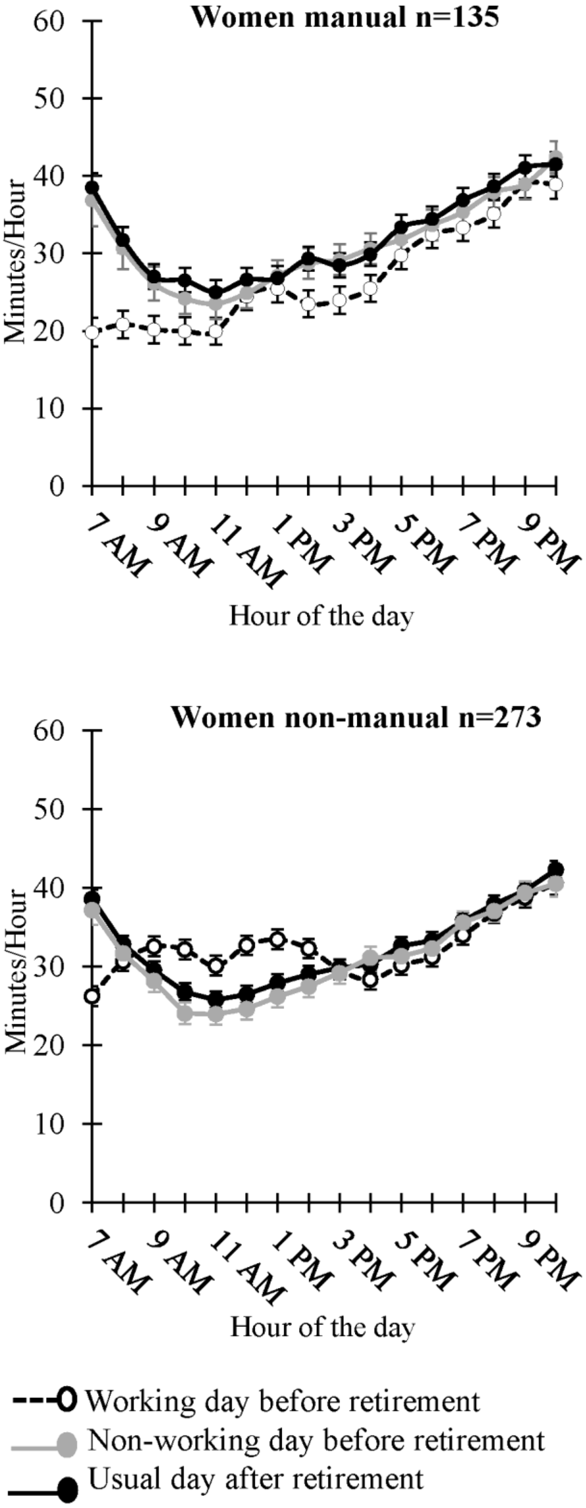
Table 1. Daily sedentary time before and after retirement by gender and occupational status (n=478).

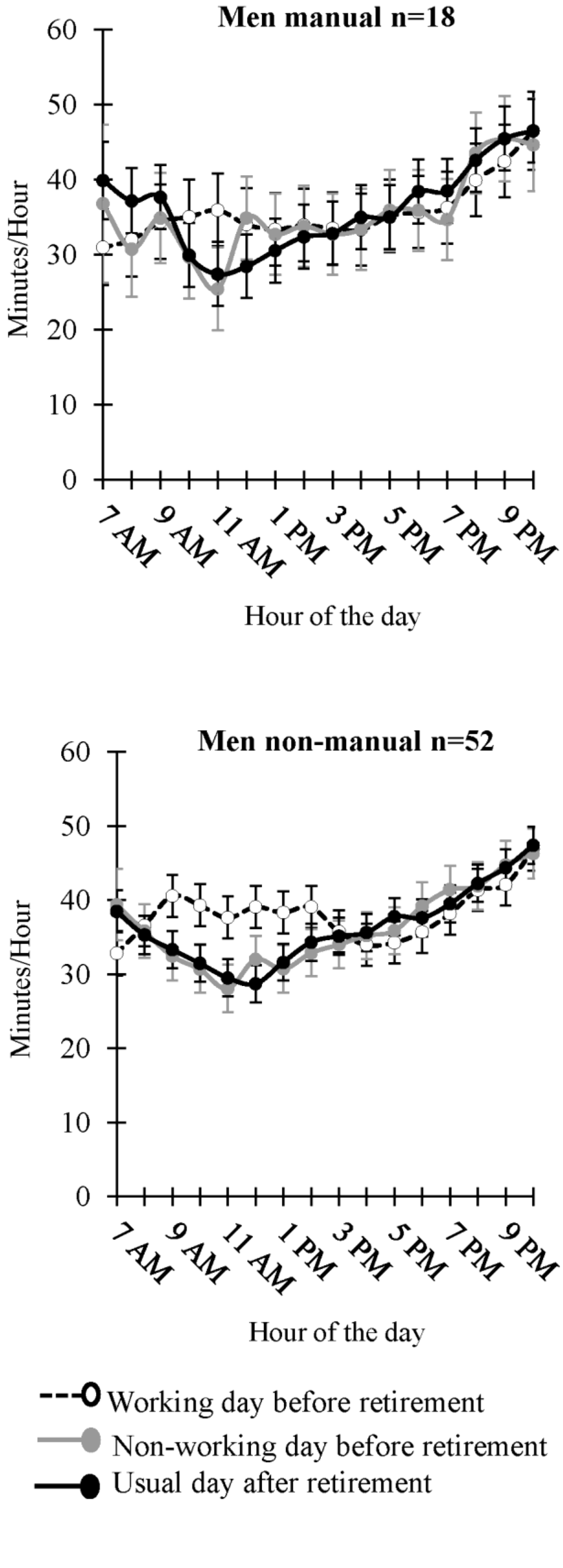
	n	All days before retirement Mean (h) (95% CI)	All days after retirement Mean (h) (95% CI)	Change Mean (min) (95% CI)	Non-working days before retirement Mean (h) (95% CI)	All days after retirement Mean (h) (95% CI)	Change Mean (min) (95 % CI)
Total[a]	478	8.4 (8.3 to 8.5)	8.8 (8.7 to 8.9)	24 (15 to 33)***	8.2 (8.0 to 8.3)	8.4 (8.3 to 8.6)	15 (6 to 23)**
Gender[b]							
Women	408	8.2 (8.0 to 8.3)	8.6 (8.5 to 8.8)	29 (20 to 38)***	8.0 (7.9 to 8.2)	8.3 (8.1 to 8.4)	16 (7 to 25)**
Men	70	9.8 (9.5 to 10.2)	9.7 (9.4 to 10.1)	-7 (-26 to 12)	9.2 (8.9 to 9.6)	9.4 (9.0 to 9.7)	7 (-12 to 25)
Occupational status[c]							
Women, manual	135	7.5 (7.3 to 7.8)	8.6 (8.3 to 8.8)	63 (50 to 77)***	8.0 (7.8 to 8.3)	8.2 (8.0 to 8.5)	12 (-2 to 25)
Women, non-manual	273	8.5 (8.3 to 8.6)	8.7 (8.5 to 8.9)	13 (3 to 23)*	8.0 (7.8 to 8.2)	8.3 (8.1 to 8.5)	19 (9 to 29)**
Men, manual	18	9.3 (8.7 to 10.0)	9.6 (8.9 to 10.2)	13 (-22 to 48)	9.0 (8.3 to 9.7)	9.2 (8.5 to 9.9)	13 (-22 to 48)
Men, non-manual	52	10.0 (9.6 to 10.4)	9.8 (9.4 to 10.2)	-13 (-34 to 8)	9.3 (8.9 to 9.8)	9.4 (9.0 to 9.8)	4 (-16 to 25)

Note: [a]Adjusted for gender, age, occupational status and daily waking wear time. [b]Adjusted for age, occupational status and daily waking wear time. [c]Adjusted for age and daily waking wear time. h=hours, min=minutes, CI = confidence interval. *p<.05, **p<.001, ***p<.0001

Figure captions

Figure 1. Distribution of hourly sedentary minutes among women and men by occupational statuses on working days and non-working days before retirement and all measurement days after retirement (n=478).


Women manual n=135
Minutes/Hour
Hour of the day
7 AM
9 AM
11 AM
1 PM
3 PM
5 PM
7 PM
9 PM
Women non-manual n=273
Working day before retirement
Non-working day before retirement
Usual day after retirement


Men manual n=18
Minutes/Hour
0
10
20
30
40
50
60
7 AM
9 AM
11 AM
1 PM
3 PM
5 PM
7 PM
9 PM
Hour of the day
Men non-manual n=52
Minutes/Hour
0
10
20
30
40
50
60
7 AM
9 AM
11 AM
1 PM
3 PM
5 PM
7 PM
9 PM
Hour of the day
Working day before retirement
Non-working day before retirement
Usual day after retirement