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# The Descriptive Epidemiology of the Diurnal Profile of Bouts and Breaks in Sedentary Time in English Older Adults

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**Short title:** Diurnal profile of sedentary behaviour in older adults

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**Key words:** sedentary time, older adults, epidemiology.

## Key Messages

- Older adults spent significant amounts of time sedentary throughout the day, but particularly in the evenings. They also took fewer breaks in sedentary time in the evening. Marginally more sedentary time was accrued on weekend days compared to week days.
- Older adults, males, the retired, and those with a higher BMI spent more time sedentary and had fewer breaks
- These findings should inform the development and targeting of strategies to reduce sedentary time among older adults

## **ABSTRACT**

### **Background**

High sedentary time is associated with adverse metabolic health outcomes and mortality in older adults. It has been suggested that breaking up sedentary time may be beneficial for metabolic health; however population prevalence data are lacking on the patterns of sedentary behaviour which would identify opportunities for intervention.

### **Methods**

We used data of adults aged  $\geq 60$  years ( $n=3705$ ) from the population-based EPIC-Norfolk cohort to characterise the patterns of total sedentary time, breaks in sedentary time, and sedentary bouts across the day and assess their associations with participant characteristics using multi-level regression. Sedentary time was measured objectively by a hip-mounted accelerometer (Actigraph™ GT1M) worn for 7 days during awake time.

### **Results**

More than 50% of every waking hour was spent sedentary, increasing to a peak of 83% in the evening. On average fewer breaks were accrued in the evenings compared to earlier in the day. Marginally more sedentary time was accrued on weekend days compared to weekdays (difference 7.4 minutes, 95% CI 5.0-9.7). Large proportions of this sedentary time appear to be accrued in short bouts (bouts of  $<10$  minutes 32% of the time). Older age, being male, being retired, not being in paid employment and having a higher BMI were associated with greater sedentary time and fewer breaks.

### **Conclusion:**

Sedentary time is common throughout the day but peaks in the evenings with fewer breaks and longer bouts. We identified a number of characteristics associated with sedentary time and additionally inversely associated with sedentary breaks, which should inform the development and targeting of strategies to reduce sedentary time among older adults.

## BACKGROUND

There is emerging evidence that higher levels of sedentary time are associated with adverse health outcomes (1–4). Greater sedentary time has been associated with more adverse cardio-metabolic risk profiles, higher risk of type 2 diabetes (7) and cardiovascular disease, higher risk of cardiovascular and all-cause mortality (6,7) and reduction in physical capability. Increased understanding of the patterns and impact of sedentary time has important public health implications. There may be greater opportunities for health promotion interventions to target sedentary time in comparison to moderate-to-vigorous physical activity (MVPA) which only makes up a small portion of waking hours (8), even among highly active adults. A recent meta-analysis of more than a million individuals, which examined the joint associations of self-reported MVPA and self-reported sitting time with all-cause mortality, reported that high MVPA levels, of >60 minutes/day (achieved by 25% of the population), attenuated the association between sitting time and all-cause mortality (8). Berkemeyer et al. (9) report median daily MVPA time of <15min for over 60 year olds. Despite the known health benefits of MVPA, the majority of individuals have difficulty in maintaining such high levels (10–12), so targeting sedentary time may represent a complementary strategy.

Early work on the epidemiology of bouts and breaks in sedentary time in both the general adult population, and to a lesser extent older adults, suggests that prolonged sedentary bouts (13–21) and fewer breaks in sedentary time (22–26) may be deleterious to metabolic health, independent of total sedentary time and MVPA. The recent literature on descriptive epidemiology of sedentary time among older adults predominantly focuses on mean total sedentary time as measured by accelerometers. We currently know little about how sedentary time is accrued; in particular, there are few data concerning how sedentary time is distributed across the day and the week, the length of bouts typically accrued, and how it is broken up. Consequently, there is a need for research on this topic which will contribute to greater understanding of the determinants of sedentary time and inform development of interventions to reduce sedentary time.

This study is novel in utilising the data from a large population-based cohort of older adults (the European Prospective Investigation into Cancer in Norfolk, EPIC-Norfolk), to examine the descriptive

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3 epidemiology of objectively measured total sedentary time, breaks in sedentary time and sedentary  
4 bouts at the hourly level.  
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## 8 **METHODS**

### 9 **PARTICIPANTS**

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13 The European Prospective Investigation into Cancer (EPIC) Norfolk is a large prospective cohort of  
14 over 25,000 people living in Norfolk who were recruited at baseline between 1993-1997. The  
15 participating cohort at initial recruitment was similar to the national population sample studied in the  
16 Health Survey of England in terms of anthropometry, serum lipids and blood pressure (27).  
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24 Within EPIC-Norfolk, baseline characteristics were obtained through an initial health check (28).  
25 Between 2006-2011, 8623 individuals participated in a 3<sup>rd</sup> Health-check (27). The 3<sup>rd</sup> health check  
26 included accelerometry assessment of free-living behaviour in a subsample of 4137 (based on monitor  
27 availability). The present analysis was restricted to participants aged over 60 years (n=3705). The age  
28 of 60 was used in concordance with the United Nations agreed cut-off for older adults (29).  
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### 35 **DATA COLLECTION**

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37 Participants received questionnaires and were examined by nurses trained to adhere to the EPIC  
38 research protocol. Participants completed a Health & Lifestyle Questionnaire which addressed their  
39 personal and family history of disease, current medication, and lifestyle factors including physical  
40 activity, diet and smoking habits. The phrasing of the questions have been outlined in detail before  
41 (28). Trained nurses also took anthropometric measurements at the health assessment. Weight was  
42 measured on digital scales and height was measured using a free-standing stadiometer.  
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### 50 **ACCELEROMETRY**

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52 Participants were invited to wear a uniaxial accelerometer (Actigraph GT1M™, Actigraph, Pensacola,  
53 USA) on the right hip for 7 days during waking hours and to remove it while showering, bathing or  
54 swimming. Monitors were initialised to record activity and step frequency at 5 second epoch intervals,  
55 which was then integrated into 60 second epochs, to maximise comparability to the existing literature  
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3 (30,31). We defined sedentary behaviour as acceleration <100 counts per minute (cpm) (32,33), again  
4 to maximise comparability with the existing literature (34). This method is an established proxy for  
5 measurement of sedentary time (35–37) although there is potential for misclassification of time spent  
6 sitting or reclining from standing with the use of this method (34,38). We defined breaks in sedentary  
7 time as  $\geq 1$  minute spent in acceleration of  $\geq 100$  cpm (39,40). Non-wear was identified as continuous  
8 zero count strings of  $\geq 90$  minutes. Accelerometry summary data were generated for each consecutive  
9 hour of each record. In the present analysis, we only included hours if at least 30 minutes of the hour  
10 was wear time, and we further only included records with at least 600 minutes of wear time on at least  
11 one day between the hours of 06:00 and 00:00. Sensitivity analysis utilising records with at least five  
12 days of wear time greater than 600 minutes per day was done (individual accelerometer-wear time of  
13 5 days or more made up 96% of total accelerometer wear-data, individual accelerometer-wear time of  
14 7 days made up 79% of total accelerometer wear-data).

## 25 26 27 **STATISTICAL ANALYSIS**

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29 Hourly accelerometry data were indexed with hour of day and day of week, and other participant level  
30 data were merged onto this dataset. Multilevel mixed-effects linear regression models weighted for  
31 hourly wear-time were used to analyse associations, with random intercepts specified at participant  
32 level. Stratification by descriptive factors was built into models, with adjustment factors which have  
33 previously been shown to be related to sedentary time (age and sex). Descriptive factors that were  
34 examined included age (60-<65, 65-<70, 70-<75, 75-<80, 80-<85,  $\geq 85$ ), sex, smoking status (never,  
35 former, current), BMI (<18.5, 18.5-<25, 25-<30, 30-<35,  $\geq 35$  kg/m<sup>2</sup>), employment status (employed  
36 versus not employed), social class (I, II, IIIa, IIIb, IV, V), retirement status (retired versus not retired),  
37 education level (further education after age 16 years (yes versus no)), and marital status (single,  
38 married, other). The model was additionally tested to examine if there were differences after  
39 stratification for weekend versus weekday. Interactions were tested in the model and confidence  
40 intervals were examined for significance. All analyses were conducted using STATA 13.1 (StataCorp,  
41 TX, USA) and figures were produced in Microsoft Excel.

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## RESULTS

### PARTICIPANT CHARACTERISTICS

We included 3705 participants in this analysis (Table 1). Included individuals had similar characteristics to the excluded individuals, to those in the wider cohort of EPIC-Norfolk at the 3<sup>rd</sup> health check and as reported previously, those included in the Health Survey for England (27). Death registration data from the Office for National Statistics (41) suggests that the Norfolk area is slightly healthier than the general UK population, with a standardized mortality ratio of 0.92. Characteristics of the cohort at baseline have been described previously (27). As reported before, EPIC-Norfolk represents a healthier sample than the general UK population; in this sample only 3.4% were current smokers, and prevalence of co-morbid conditions were lower than would be expected in the general population (rates in this sample were diabetes 3.7%, stroke 2.3%, cancer 12.0%, myocardial infarction 4.0%).

Among the 3705 individuals (all aged over 60 years) there was a good spread across age groups between 60-80 years old (90% of all included individuals), with a further 10% over age 80. The median age of participants was 69.5 (IQR 64.5-75.1 years). 86% of the included individuals were retired, as would be expected in a cohort of older adults.

The mean daily sedentary time was 545 minutes (SD 81.3). The mean number of daily breaks in sedentary time was 78 (SD 14.3). Average break duration was 4.6 minutes (SD 5.9). Mean daily sedentary time was predominantly accumulated in bouts of >10 minutes (mean 367 minutes (SD 123)) spent in bouts of >10 minutes, 67% of total sedentary time). Bouts of >20 minutes accounted for 47% of total sedentary time (mean 257 minutes (SD 122)), whereas only 12% of total sedentary time was accumulated through bouts of >60 minutes (mean 63 minutes (SD 82)).

### DISTRIBUTION OF HOURLY SEDENTARY TIME & BREAKS ACROSS THE DAY

Older adults spent at least 30 minutes of each hour sedentary, with this gradually increasing across the day (Figure 1). There were two peaks in the day; a small peak around 13:00 and a much bigger peak around 20:00 to 22:00 when average sedentary time was almost 50 minutes of each hour.



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3 Conversely,, individuals spent up to 30 minutes per hour in sedentary breaks with this falling to just  
4 over 10 minutes per hour by 20:00, i.e. showing decreasing time spent in at least light intensity activity  
5 as the day progressed. On average, older adults took 5-7 breaks in sedentary activity per hour, until  
6 around 18:00 when there was a noticeable decline to a low of less than 4 breaks per hour from 20:00  
7 until 23:00. The bottom quartile took 2 or less breaks per hour in these evening hours.  
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14 65.8% of total sedentary time was accumulated through short bouts of <30 minutes and 31.9% of total  
15 sedentary time was accumulated through bouts of <10 minutes duration. In line with results for hourly  
16 break patterns, sedentary time was accrued in varying bout durations at different times of the day.  
17 Longer bouts of sedentary time occurred more exclusively in the evening, whereas shorter bouts  
18 occurred throughout the day (Figure 2).  
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#### 24 25 **ASSOCIATIONS WITH PARTICIPANT CHARACTERISTICS**

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27 With increasing age we observed greater time spent sedentary, with this difference being greatest in  
28 the earlier hours of the day for the strata aged over 75 (Figure 3). The trend appeared to decrease  
29 gradually until the peak of sedentariness around 21:00, when all age groups spent similar time  
30 sedentary. Older participants broke up their sedentary time less frequently ( $p<0.001$ ); this was  
31 particularly the case after midday until the end of the day. There was very little difference in break  
32 patterns between age groups in the morning. Men spent more hourly time sedentary and took more  
33 hourly breaks than women throughout the day ( $p<0.001$ ) (Figure 3).  
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42 Retired participants accrued more sedentary time across the day than those not retired ( $p<0.001$ ) and  
43 had fewer breaks across every hour than those who were not retired ( $p<0.001$ ). This was particularly  
44 the case across the later hours of the day (13:00-20:00) (Supplementary Figure 1).  
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49 Those who had had further education accrued marginally more sedentary time in the morning (06:00-  
50 12:00) than those without, with a crossover point at midday after which time those with further  
51 education appeared to have marginally less sedentary time per hour until 21:00 when the difference  
52 disappeared again (Supplementary figure 1). Individuals who had had further education had fewer  
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3 breaks in the morning (06:00-10:00), then more breaks in the evening after 17:00 than those without  
4 further education.  
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8 From social class I to IV, there was a trend of increasing time spent sedentary in the morning, with all  
9 social classes converging to similar durations of sedentary time after lunch. However, after midday,  
10 those in social class V spent the most time sedentary (Supplementary Figure 2).  
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15 Individuals who never smoked accrued less sedentary time than current smokers between 08:00-  
16 10:00 and 14:00-18:00. Current smokers accrued marginally more sedentary time in particular in both  
17 the early hours (06:00-08:00) and late hours (21:00-23:00) (Supplementary figure 1). Current smokers  
18 had more breaks than former or never smokers, especially in the middle part of the day (12:00-16:00)  
19 (Supplementary Figure 1).  
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26 Finally, those with higher BMI spent more time sedentary per hour than their counterparts with lower  
27 BMI ( $p < 0.001$ ). These differences were greatest between 07:00 to 12:00, and 14:00 to 18:00, with  
28 little difference by the evening peak (Supplementary Figure 2). Participants with a higher BMI were  
29 less likely to break up their sedentary time, with the difference being greater after midday.  
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36 Sensitivity analysis utilising records with at least five valid days of wear time revealed no significant  
37 differences in the results (excluding  $n=141$ ).  
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#### 41 **WEEKEND VERSUS WEEKDAY**

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43 Participants were more sedentary on weekend days compared to weekdays ( $p < 0.0001$ ) (Figure 4).  
44 The difference was greatest in the afternoon hours between 14:00 and 18:00. On weekdays,  
45 sedentary time was broken up more frequently than on weekend days, particularly between 13:00 and  
46 17:00.  
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## DISCUSSION

### KEY FINDINGS

This is the first study to comprehensively examine sedentary time at the hourly level with simultaneous examination of the descriptive epidemiology of bouts and breaks in sedentary time in a large, population-based cohort of UK older adults. We have described patterns of sedentary time not previously reported in the literature. More sedentary time and fewer breaks occur in the evenings compared to earlier in the day. The majority of this sedentary time was accrued in reasonably short bouts. Further, marginally more sedentary time was accrued on weekend days compared to weekdays.

We also report associations with several descriptive characteristics, as well as replicating trends previously seen for age and sex. Having a higher BMI and being retired were associated with greater sedentary time and fewer breaks in sedentary time. Further, we found that sedentary time was socio-economically patterned. Those in higher social classes and with further education were more likely to accrue more sedentary time in the morning. Those with further education had fewer breaks in sedentary time in the morning. Altogether, this work meaningfully adds to the picture of the descriptive epidemiology of sedentary time, bouts and breaks, and gives new insights into the patterns of sedentary time and breaks throughout the day.

### FINDINGS IN THE CONTEXT OF THE LITERATURE

A considerable amount of sedentary time was accumulated through short bouts of <30 minutes (65.8% of total sedentary time) and <10 minutes (31.9% of total sedentary time). This is in agreement with Jefferis et al. (42) and Shiroma et al. (43) who both reported that large proportions of sedentary time are accumulated in bouts of <30 minutes. Only 11.1% of total sedentary time was accumulated through bouts of >60 minutes. Longer bouts of sedentary time occurred predominantly in the evening, whereas shorter bouts occurred throughout the day. Longer bouts occurring in the evening may present an easier target for a planned intervention than shorter bouts occurring at other times of the day.

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5 Older adults on average spent at least 30 minutes of each waking hour in sedentary activity, with this  
6 gradually increasing across the day peaking around 21:00 when sedentary time represented almost 50  
7 minutes of the hour. Two other studies have reported on patterns across the day measured by  
8 accelerometry. Martin et al. (44) found similar results but suggested that the peak of hourly sedentary  
9 time was lower at 40 minutes in a population of 60-69 year olds living in the USA. The predominant  
10 prevalence of sedentary time in evenings may be because older adults have a diurnal pattern of  
11 activity that peaks in volume in the late morning related to activities that take the individual out of the  
12 house (e.g. shopping) with the evening being a time for rest (e.g while eating dinner, watching  
13 television).

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23 Older participants accumulated more sedentary time in prolonged sedentary bouts than younger ones,  
24 particularly in the morning. Davis et al. (45) and Belletiere et al.(46) looked at patterns of hourly  
25 sedentary time across age groups, and had similar findings. We also found that older individuals took  
26 fewer hourly breaks; reinforcing findings from two earlier studies (42,43). However, this difference was  
27 predominantly seen in the afternoon and evening.

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34 Men accumulated more sedentary time in prolonged bouts than women as Belletiere et al.(46) have  
35 also reported, and we are the first to report that older men had fewer hourly breaks in sedentary time  
36 than older women. Though Jefferis et al. (42) report a mean of 7.2 breaks per hour for men, and  
37 Shiroma et al.(43) report a mean of 9.0 breaks per hour in a study of women, there are no other  
38 studies in the literature which examine the diurnal pattern of breaks. The overall pattern of hourly  
39 breaks in sedentary time shows that there is a noticeable decline in breaks from early evening, with  
40 the fewest breaks occurring at 20:00 (5-7 breaks per hour during the day and 3-4 during the evening).  
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47 This highlights that an intervention relating to increasing breaks might target the evening hours.

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51 In a recent review of existing experimental studies examining the relationship between frequency of  
52 interruption of sedentary time and markers of adiposity and cardiometabolic health (40), the studies  
53 that were selected almost exclusively compared an intervention with 2 or 3 breaks per hour versus no  
54 breaks. Our results, and other observational studies (39,47) suggest the 'average' older adults  
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3 achieve this but about 25% of the population do not, particularly during evening hours. This is  
4 important because a dose-response relationship between breaks and health outcomes now needs to  
5 be elucidated before we know how to approach designing interventions targeting breaking up  
6 sedentary time.  
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12 In addition to number of breaks in sedentary time, it is likely that duration, posture, and intensity of  
13 breaks are important aspects of what makes them beneficial (48). A break in sedentary time might  
14 constitute simply standing or other light activity, or higher intensity activity. It has been suggested that  
15 certain types of breaks (for example, standing still) are inadequate to represent a metabolic benefit  
16 (48–51), that instead a break with at least light activity might be more beneficial (48). Though we did  
17 not examine these specific break characteristics in this work, due in part to the limitation of the  
18 employed accelerometer to not be able to distinguish postures, understanding what types of breaks  
19 are most beneficial will be useful in intervention design.  
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29 Our analysis is the first to suggest distinct associations between sedentary time and several  
30 socioeconomic factors with patterns of sedentary time and breaks in sedentary time across the day.  
31 These findings contribute to our understanding of the determinants of sedentary time and highlight  
32 potential targets for interventions such as the evening time or the ‘older’ elderly strata, the retired and  
33 those with higher BMI.  
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40 Mean hourly sedentary time on weekend days was on average longer than weekdays. Participants  
41 took fewer hourly breaks on weekdays compared to weekend days. However, the differences found  
42 here for both sedentary time and breaks were small and may not be clinically significant.  
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#### 49 **INTERPRETATION OF STUDY FINDINGS**

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51 The accelerometry method used in our study is a widely implemented proxy method for measuring  
52 sedentary time (35–37). There are, however, a number of decisions in the accelerometry data  
53 collection and processing protocol which could lead to information biases. We set our analysis epoch  
54 length at 60 seconds, the commonest length used in the literature. Changes in epoch length can  
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3 influence accelerometer-determined sedentary time but the most appropriate length has yet to be  
4 established (30,31). We used a cut-point of <100 cpm, however other cut-points have been  
5 suggested (37) but given that the overwhelming majority of existing studies use the <100 cpm  
6 threshold and 60 second epoch, using these settings facilitates comparisons of our data with the  
7 majority of existing literature.  
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14 Another aspect of the analysis protocol relates to the identification of non-wear. We used a time  
15 threshold of  $\geq 90$  minutes of consecutive zero counts to define non-wear, which means that shorter  
16 true episodes of non-wear would be wrongly included as sedentary time. However, the opposite is  
17 also true as too low a threshold would significantly underestimate sedentary time and evidence  
18 supports the 90-minute threshold as this yields a realistic number of 3-4 non-wear bouts per day  
19 (8,52,53). In order to account for confounding by wear-time, we only included hours with wear-time for  
20 at least 30 minutes of the hour and also weighted for wear-time. The sample sizes were large for each  
21 hour from 09:00 to 22:00 ( $n > 21000$  hours) and there were smaller sample sizes as would be expected  
22 around morning rising and going to bed (06:00  $n = 1635$  hours, 07:00  $n = 5812$  hours, 08:00  $n = 13653$ ,  
23 22:00  $n = 14692$ , 23:00  $n = 4705$ ).  
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33 The use of three-day wear-time threshold was appropriate, given our sensitivity analysis utilising  
34 records with at least five days of wear time greater than 600 minutes/day showed no significant  
35 difference in results.  
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39 Given that age and sex have repeatedly been found to be associated with sedentary time, these  
40 factors were potential confounders and were included in regression models. Adjusted and unadjusted  
41 models were compared, and only age, sex and wear-time remained in the models as covariates.  
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44 However, we cannot exclude the possibility of residual confounding.  
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48 The EPIC-Norfolk cohort has several strengths. It is a well-characterised, large population-based  
49 cohort that is similar to a nationally representative sample for anthropometric indices, blood pressure  
50 and serum lipids, albeit with a lower prevalence of cigarette smoking (54). The sample is less  
51 representative of the frailer elderly and the oldest elderly and in common with all cohorts is susceptible  
52 to healthy volunteer bias and attrition. This study and analyses were designed to minimise possible  
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3 sources of bias and confounding, although there are several unavoidable sources which are  
4 recognised here.  
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## 8 **CONCLUSIONS**

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10 High sedentary time in older adults is a large and neglected public health problem. Total sedentary  
11 time and prolonged bouts are highly prevalent and particularly common in this age group hence  
12 significant potential health gain could arise from targeting this emerging risk factor. Although some  
13 national recommendations concerning sedentary time among older adults exist (55–58), they are brief  
14 and vague, as little is known about this topic. As the health risks associated with spending too much  
15 time sedentary (5–7,59) and not breaking this time up are being recognised (22–26,60,61), the need to  
16 map the determinants of sedentary time and identify population subgroups who are most likely to  
17 benefit from interventions remains an important area for future research. We have highlighted the  
18 burden of sedentary time and described how this time is accrued through bouts and breaks in  
19 sedentary time. This, coupled with emerging evidence that excess sedentary time is associated with  
20 adverse health outcomes and sedentary breaks are inversely associated with adverse health  
21 outcomes, underlines the need for prospective studies of the determinants of sedentary time and what  
22 future interventions might look like.  
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44  
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**TABLE 1: Baseline Characteristics**

Included Participants n=3705. Statistical testing for differences was done with either Student's unpaired T-Test, Chi-squared test, or Mann-Whitney U test. Chi-squared test for trend was used for age groups and BMI groups. The 'Other' category of marital status includes those who were widowed, separated or divorced.

Characteristic	Included Participants		All EPIC-Norfolk 3rd Health-check Participants Aged over 60 years		P Value For Difference between Included & all EPIC-Norfolk Participants At 3 <sup>rd</sup> Health-check Aged over 60 years		
	Frequency	Percent (%)	Frequency	Percent (%)			
Sex	Female	1683	45.4	3463	45.8	0.15	
	Male	2022	54.6	4096	54.2		
	TOTAL	3705	100	7559	100		
Age	60-<65	1030	27.8	2,136	28.3	0.29 (P for trend)	
	65-<70	913	24.6	1,784	23.6		
	70-<75	821	22.2	1,594	21.1		
	75-<80	563	15.2	1,208	16.0		
	80-<85	294	7.94	643	8.51		
	≥85	84	2.27	194	2.56		
	TOTAL	3705	100	7559	100		
Marital Status	Single	111	3.16	251	3.41	0.25	
	Married	2845	78.6	5,692	77.3		
	Other	663	18.3	1425	19.4		
	TOTAL	3619	100	7,368	100		
Social Class	I	325	8.84	641	8.56	0.42(P for trend)	
	II	1519	41.3	3067	41.0		
	IIIa	588	16.0	1215	16.2		
	IIIb	759	20.6	1543	20.6		
	IV	414	11.3	843	11.2		
	V	73	1.98	178	2.38		
	TOTAL	3678	100	7487	100		
Paid Employment	Yes	719	19.8	1480	20.0	0.83	
	No	2,911	80.2	5928	80.0		
	TOTAL	3,630	100	7408	100		
Retired	Yes	3,074	86.2	6196	85.2	0.16	
	No	491	13.8	1074	14.8		
	TOTAL	3,565	100	7270	100		
Further Education after Left School	Yes	1,603	43.7	3246	43.4	0.77	
	No	2,067	56.3	4235	56.6		
	TOTAL	3,670	100	7481	100		
Smoking Status	Current	124	3.40	287	3.85	0.37	
	Former	1,697	46.6	3524	47.3		
	Never	1,824	50.0	3634	48.8		
	TOTAL	3,645	100	7445	100		
Complying To	Male	Yes	1,454	90.3	2981	89.7	0.32

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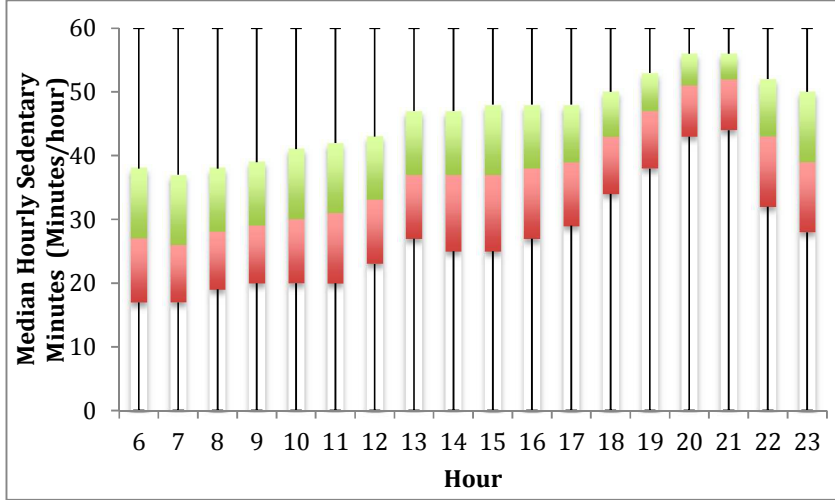
Characteristic			Included Participants		All EPIC-Norfolk 3rd Health-check Participants Aged over 60 years		P Value For Difference between Included & all EPIC-Norfolk Participants At 3 <sup>rd</sup> Health-check Aged over 60 years
			Frequency	Percent (%)	Frequency	Percent (%)	
Recommended Alcohol Limit (Males: <21units/week, Females: <14 Units/week)	No		156	9.69	343	10.3	0.55
	Yes		1778	92.0	3624	92.4	
Personal History of Stroke	No		3,619	97.7	7364	97.5	0.41
	Yes		85	2.29	193	2.55	
Personal History of MI	No		3,555	96.0	7247	95.9	0.84
	Yes		149	4.02	310	4.1	
BMI (kg/m <sup>2</sup> )	TOTAL		3,704	100	7557	100	0.48
	<18.5		24	0.65	53	0.7	
	18.5-<25		1,253	33.9	2564	34.0	
	25-<30		1,722	46.6	3477	46.1	
	30-<35		551	14.9	1124	14.9	
	≥35		149	3.19	272	3.27	
	TOTAL		3,699	100	7540	100	

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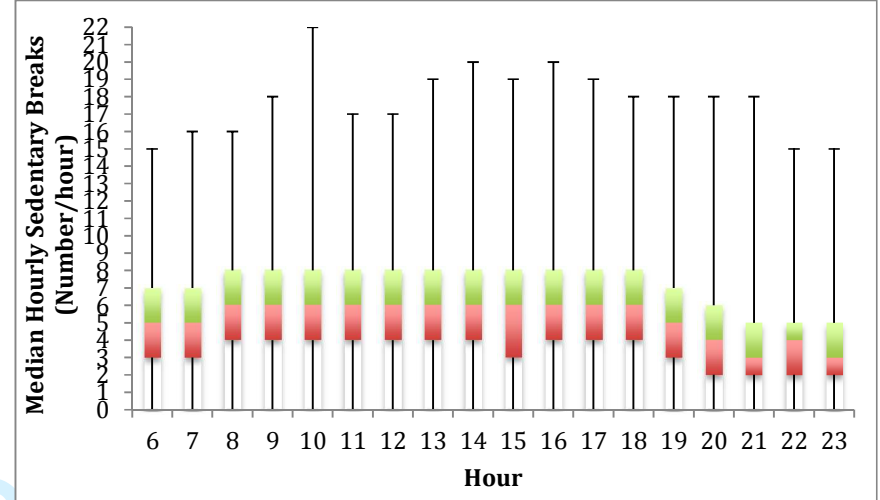


Figure 1: Boxplots of Distributions of Hourly Sedentary Time and Breaks in Sedentary Time. Red segments are 25<sup>th</sup> to 50<sup>th</sup> centiles. Green segments are 50<sup>th</sup> to 75<sup>th</sup> centiles. Tails are minimum and maximum values.

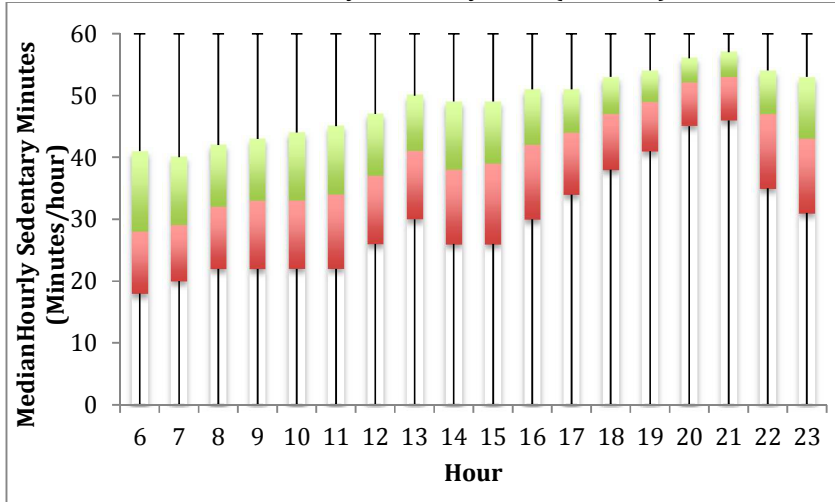
Panel 1: Distribution of Hourly Sedentary Time (Males)



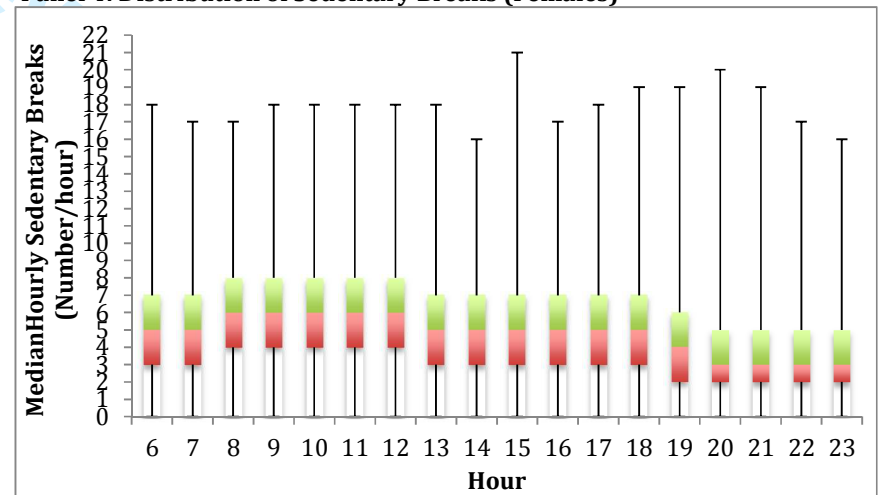
Panel 3: Distribution of Sedentary Breaks (Males)



Panel 2: Distribution of Hourly Sedentary Time (Females)



Panel 4: Distribution of Sedentary Breaks (Females)



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FIGURE 2: Accrual of Hourly Sedentary Time through Different Lengths of Bouts. All models were adjusted for age and sex.

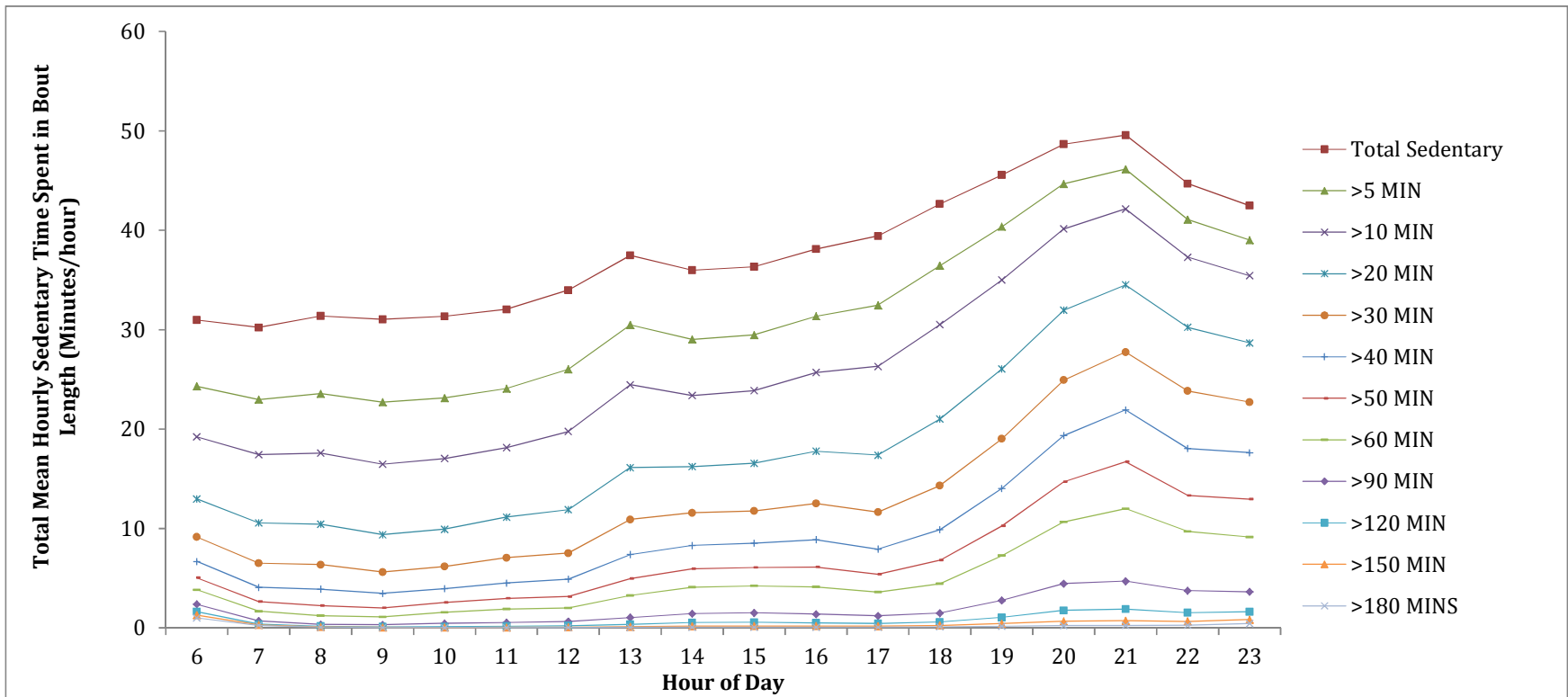
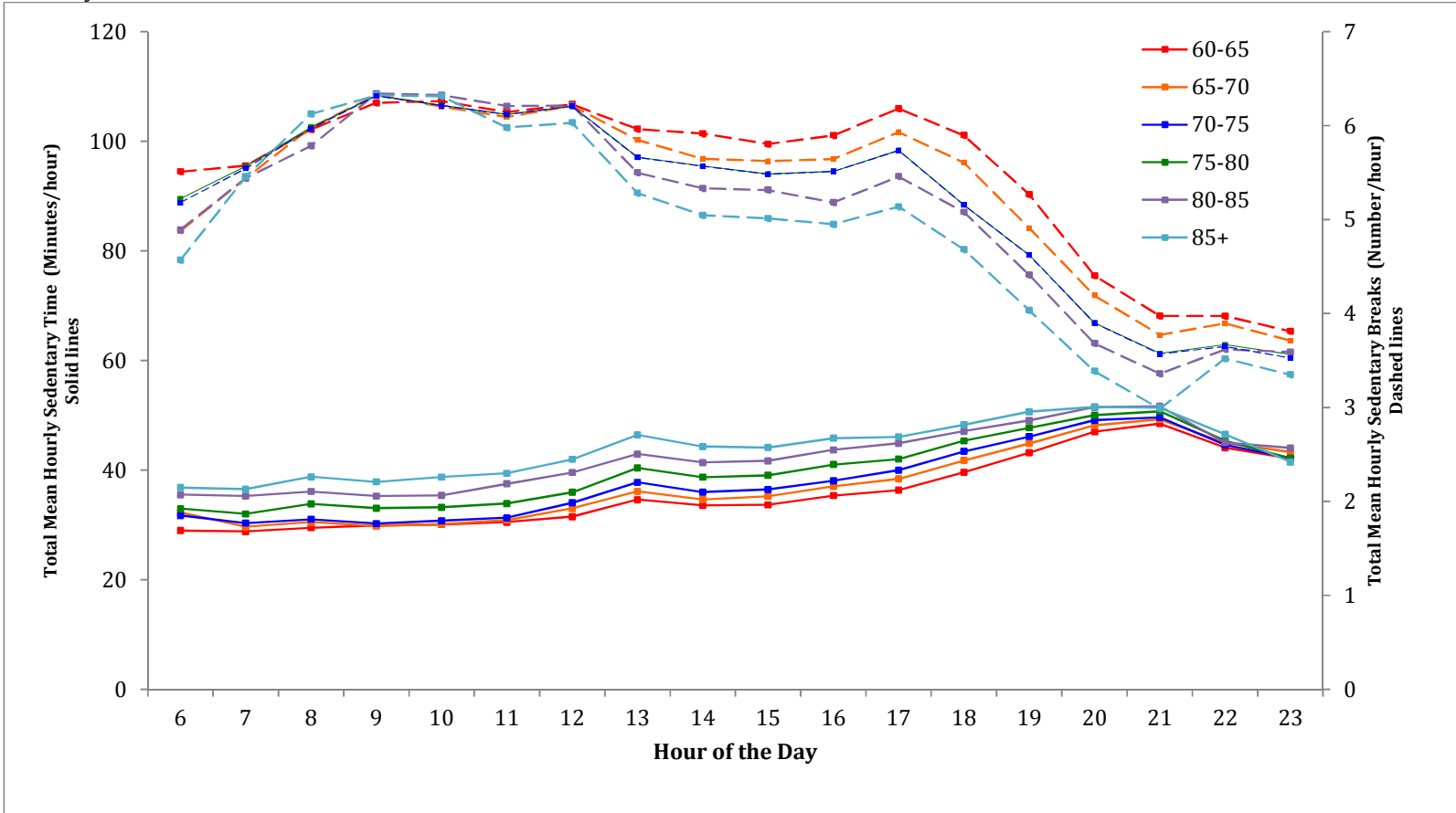


FIGURE 3: Mean Total Hourly Sedentary Time & Mean Total Hourly Breaks after Stratification for Age Group. All models were adjusted for sex. P for trend<0.001 for association of age with hourly sedentary time & p value for trend<0.001 for associations of age with hourly breaks in sedentary time. Trends in hourly sedentary time are in dotted lines and trends in sedentary breaks are in solid lines.



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*FIGURE 4: Mean Total Hourly Sedentary Time & Mean Total Hourly Breaks after Stratification for Weekend Versus Weekday. All models were adjusted for age and sex. P<0.001 for difference between hourly sedentary time for weekday compared to weekend day & p<0.001 for difference between hourly breaks in sedentary time for weekday compared to weekend day. Trends in breaks are in dashed lines, trends in sedentary time are in solid lines (Sample sizes: weekday=250698 person- hours, weekend day=97193 person- hours).*

