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Duration and breaks in sedentary behaviour: Accelerometer data from 1566 community-dwelling older men (British Regional Heart Study)

Barbara J. Jefferis, PhD[a,b], **Claudio Sartini, MSc**[a], **Eric Shiroma, MSc**[c], **Peter H. Whincup, PhD**[d], **S. Goya Wannamethee, PhD**[a], and **I-Min Lee, ScD.**[c]

[a]Department of Primary Care & Population Health, University College London, London. UK

[b]University College London Physical Activity Research Group

[c]Brigham and Women's Hospital, Harvard Medical School, Boston, MA. USA

[d]Division of Population Health Sciences and Education, St George's University of London, London, UK

Abstract

Background—Sedentary behaviours are increasingly recognised as raising risk of CVD events, diabetes and mortality, independently of physical activity (PA) levels. However, little is known about patterns of SB in older adults.

Methods—Cross sectional study of 1566/3137 (50% response) men aged 71–91 years from a UK population-based cohort study. Men wore a GT3x accelerometer over the hip for one week in 2010–11. Mean daily minutes of SB, % of day in sedentary behaviours, sedentary bouts and breaks were calculated and summarized by health and demographic characteristics.

Results—1403 ambulatory men aged 78.4 years (SD 4.6 years) with ≥600 minutes of accelerometer wear on ≥3 days had complete data on covariables. Men spent on average 618 minutes (SD=83), or 72% of their day in sedentary behaviours (<100 counts/minute). On average men accumulated 72 spells of sedentary behaviours per day, with 7 breaks in each sedentary hour. Men had on average 5.1 sedentary bouts of ≥30 minutes, which accounted for 43% of sedentary time, and 1.4 bouts of ≥60 minutes, which accounted for 19% of daily sedentary time. Men who were over 80 years old, obese, depressed and had multiple chronic conditions accumulated more sedentary time and spent more time in longer sedentary bouts.

Conclusions—Older men spend nearly three quarters of their day in sedentary behaviours, mostly accumulated in short bouts, although bouts lasting ≥30 minutes accounted for nearly half

Corresponding author: Barbara. J. Jefferis, UCL Department of Primary Care & Population Health, UCL Medical School, Rowland Hill Street, London. NW3 2PF. UK. Tel +44 207 794 0500 ext 34751, Fax: +44 207 794 1224, b.jefferis@ucl.ac.uk.

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of the sedentary time each day. Men with medical risk factors were more likely to also display sedentary behaviour.

Sedentary behaviours are increasingly recognised as increasing risks of CVD events, diabetes and mortality, independently of physical activity (PA) levels [1,2], although the independence has been questioned [3]. Sedentary behaviours can be defined as activities with an energy expenditure under 1.5 METS (metabolic equivalents) and a sitting or reclining posture, whilst awake [4]. New UK guidelines [5] suggest that “long periods” of sedentary behaviours should be avoided, but do not provide clear guidance about how long such periods are, nor how often to break them up. Most research has focused on total time spent in sedentary behaviours each day or proxies including the number of hours per day spent watching television, yet television or screen time captures only a fraction of daily sedentary behaviours.

The recent availability of instruments to measure PA and sedentary behaviours objectively permits more detailed investigation of patterns of sedentary behaviours, including the duration of spells and frequency of breaks in sedentary time. Older adults (over 65 years) are also the most sedentary age group [6] and also the most rapidly growing group in UK and other developed countries. However, little is known about actual patterns of sedentary behaviour in older adults, such data could be important for targeting interventions if breaking up sedentary behaviour is demonstrated to reduce clinical disease and mortality, and bouts of particular duration are associated with negative outcomes. A recent study [7] reported on accelerometer measured sedentary behaviour patterns and associations with key lifestyle factors in older women. There are few comparable [8] data available in older men. We therefore investigated patterns of sedentary behaviour in relation to these variables, as well as physical and mental health status, known to be predictors of low PA levels in older men{Jefferis, 2014 1431 /id}.

Methods

The British Regional Heart Study is a prospective cohort study of 7735 men recruited from a single Primary care centre in 24 British towns in 1978–80 (age 40–59 years). Since 2010, survivors have been invited to participate in annual studies of objectively measured PA. Here we use cross-sectional data collected between 2010 and 2012, when 3137 survivors were invited to a clinic visit and asked to participate in a study of objectively measured PA. Local research ethics committees provided ethical approval and participants gave written informed consent. Participants wore a GT3X accelerometer (Actigraph, Pensacola, Florida) over the hip for 7 days, during waking hours, removing it for bathing. Data collected were processed using standard methods; raw data collected from movements registering on the vertical axis were integrated into 60 second increments, called epochs. Non-wear time was identified and excluded using a commonly used and freely available R package “Physical Activity”[10]. Periods of continuous zeros lasting more than 90 minutes were assigned as non-wear time; short spells of non-zero counts lasting up to 2 minutes during the 90 minute period were allowed as non-wear time if no activity counts were detected during both the 30 minutes before and after that interval, to reflect the possibility of the monitor accidentally

being moved when not being worn. This means that any non-zero counts except the allowed short interval of up to 2 minutes are considered as wear time.

The number of minutes per day spent in sedentary behaviour was categorised using standard count-based intensity threshold values of counts per minute: <100 for sedentary behaviour (<1.5 MET)[11]. Three further summary measures of sedentary behaviours were calculated per day and averaged over valid days (i) percentage of the wear-day spent in sedentary behaviour (ii) number of sedentary bouts (defined as a period of consecutive minutes where the accelerometer registers <100 counts per minute) (iii) number of sedentary breaks (defined as at least one minute where the accelerometer registers ≥100 counts per minute following a sedentary bout).

Nurses measured height and weight at a clinic visit. Men completed questionnaires including data on cigarette smoking (current, ex, never), presence of chronic diseases (0, 1–2, or ≥3 of the following: heart attack, heart failure, angina, other heart trouble, diabetes, stroke, osteoporosis, arthritis, and claudication) and depression (scoring ≥2 on the 4-item Geriatric Depression Scale) [12].

Summary measures of sedentary behaviours were calculated according to age, BMI, smoking status, chronic diseases and depression, using adjusted marginal means from mixed models (stata xtmixed) adjusted for age, BMI, smoking status, wear time (continuous variables) and day of week (weekdays, Saturday, Sunday), smoking status, depression and chronic diseases (categorical variables). Differences across each measure of sedentary behaviour compared to the baseline group were tested. Complete case analysis was used; ie with data available for the outcome (three or more days of data) and all covariates. Statistical analyses were conducted in R and Stata version 12[13,14].

Results

1566/3137 (50%) of survivors who were invited agreed to participate and provided accelerometer data. Of these, 1455/1566 (93%) were independently mobile community-dwelling men, had completed the questionnaire, and by convention, provided ≥600 minutes wear time on ≥3 days [11]. 1403/1455 men with a mean age of 78.4 years (SD=4.6) had data on BMI, smoking, depression and presence of chronic diseases. Men had a mean of 6.7 (SD=0.8) valid wear days and spent a mean of 618 minutes (SD=83), 72% of their wear-day in sedentary behaviours. The percentage wear time spent in sedentary behaviours was higher at older age, particularly in over 80s, at higher BMI, especially the obese, in men who were depressed and in men with higher number of chronic health conditions (Table 1).

There were on average 72 sedentary bouts per day (lasting median 3.2 minutes interquartile range 1.1–9.9), with on average 7 breaks per hour of sedentary behaviour. The number of bouts and breaks per hour decreased (indicating more time spent in longer sedentary bouts) in men with increasing age, BMI, chronic conditions and in men who were depressed. Smokers had more sedentary bouts per day than non-smokers. Men had on average 5.1 sedentary bouts lasting over 30 minutes, which accounted for 43% of sedentary time, and

1.4 sedentary bouts per day lasting ≥60 minutes, but they accounted for 19% of sedentary time per day (Table 2).

Discussion

These are the first detailed data on patterns of sedentary behaviours (number and duration of bouts, breaks and total amount of sedentary behaviours) in older men, complementing published data on the same measures of sedentary behaviours in older women in USA [7] and data on total amount of sedentary behaviours in men and women in Iceland [8].

In this large community-based sample of older men, nearly three quarters of the day when the monitor was being worn was spent in sedentary behaviours. On average, sedentary behaviour was broken up frequently with around seven breaks per sedentary hour. However, a very small proportion (2.4%) of the total number of sedentary bouts per day which lasted one hour or more filled large portions of the day, accounting for one fifth of total sedentary time.

Older men who were depressed, smokers, obese or suffered more chronic health conditions spent more of the day in prolonged sedentary spells, hence they, who already have characteristics which increase risks of CVD and diabetes, may also bear a heavier health burden from their sedentary behaviours.

The percentage of daily sedentary behaviours reported here was similar but very slightly higher than men of a similar age [8], and somewhat higher than among women; both of younger and of similar age in studies using the same brand of accelerometer worn over the hip [7][8]. In our sample of men we found that the number of breaks was lower and the duration of bouts was longer than reported in women [7]. Hence although older men are reported to have higher levels of MVPA than women{Arnardottir, 2013 1661 /id; Jefferis, 2014 1431 /id}, it may be that they also have higher total sedentary time and longer sedentary periods.

The study benefits from including a large sample of community-dwelling, ambulatory older men rather than a high risk clinical population (eg nursing home residents), which should improve generalizability of the results. However, it is possible that study responders were more active and less sedentary than non-responders. If so, the levels of sedentary behaviours reported here may be conservative estimates. Nevertheless, the 50% response rate to the postal accelerometer study compares favourably with prior population-based studies of older adults: 21% [15], 43% [16] and in the over 75 year olds in the Health Survey for England 37% women and 48% men had ≥4 days with valid data [17]. However compared to the men who declined to participate, the participants were younger and reported being more active ten years previously and had lower BMI. Whilst our sample reflects patterns of sedentary behaviours in the UK, it may not reflect patterns in other countries. Finally, as we present cross-sectional data, we cannot infer causality

If breaking up sedentary behaviour is demonstrated to reduce clinical disease and mortality, and bouts of particular duration are associated with negative outcomes, these data will help to target interventions. Other data indicate that older adults do benefit from higher levels of

activity; both in terms of healthier ageing and also reduced levels of CVD and mortality{Almeida, 2014 1689 /id}{Hamer, 2014 1693 /id}. Our data suggest that the elderly suffering from multi-morbidity, the obese, depressed and smokers will require extra focus to reduce long sedentary bouts.

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Reference List

1. Ford ES, Caspersen CJ. Sedentary behaviour and cardiovascular disease: a review of prospective studies. Int J Epidemiol. 2012; 41:1338–53. [PubMed: 22634869]
2. Gennuso KP, Gangnon RE, Matthews CE, et al. Sedentary Behavior, Physical Activity, and Markers of Health in Older Adults. Med Sci Sports Exerc. 2013
3. Maher C, Olds T, Mire E, et al. Reconsidering the Sedentary Behaviour Paradigm. PLoS One. 2014:9.
4. Sedentary Behaviour RN. Letter to the editor: standardized use of the terms “sedentary” and “sedentary behaviours”. Appl Physiol Nutr Metab. 2012; 37:540–2. [PubMed: 22540258]
5. Chief Medical Officers of England SWaNI. A report on physical activity for health from the four home countries’ Chief Medical Officers. London: Crown; 2011. Start Active, Stay Active.
6. Matthews CE, Chen KY, Freedson PS, et al. Amount of Time Spent in Sedentary Behaviors in the United States, 2003–2004. Am J Epidemiol. 2008; 167:875–81. [PubMed: 18303006]
7. Shiroma EJ, Freedson PS, Trost SG, et al. Patterns of accelerometer-assessed sedentary behavior in older women. JAMA. 2013; 310:2562–3. [PubMed: 24346993]
8. Arnardottir NY, Koster A, Van Domelen DR, et al. Objective measurements of daily physical activity patterns and sedentary behaviour in older adults: Age, Gene/Environment Susceptibility-Reykjavik Study. Age Ageing. 2013; 42:222–9. [PubMed: 23117467]
9. Jefferis, BJ.; Sartini, C.; Lee, IM., et al. Adherence to physical activity guidelines in older adults using objectively measured physical activity in a population study. 2013. Submitted for publication
10. Physical Activity: Process Physical Activity Accelerometer Data [computer program]. Version 0.1–1. Nashville, TN: Leena Choi; 2011.
11. Tudor-Locke C, Camhi SM, Troiano RP. A catalog of rules, variables, and definitions applied to accelerometer data in the National Health and Nutrition Examination Survey, 2003–2006. Prev Chronic Dis. 2012; 9:E113. [PubMed: 22698174]
12. van Marwijk HW, Wallace P, de Bock GH, et al. Evaluation of the feasibility, reliability and diagnostic value of shortened versions of the geriatric depression scale. Br J Gen Pract. 1995; 45:195–9. [PubMed: 7612321]
13. R: A Language and Environment for Statistical Computing [computer program]. Vienna, Austria: R Foundation for Statistical Computing; 2013.
14. Stata Statistical Software: Release 13 [computer program]. College Station, TX: StataCorp LP; 2013.
15. Davis MG, Fox KR, Hillsdon M, et al. Objectively measured physical activity in a diverse sample of older urban UK adults. Med Sci Sports Exerc. 2011; 43:647–54. [PubMed: 20689449]

16. Harris TJ, Owen CG, Victor CR, et al. What factors are associated with physical activity in older people, assessed objectively by accelerometry? Br J Sports Med. 2009; 43:442–50. [PubMed: 18487253]

17. Craig, R.; Mindell, J.; Hirani, V. Summary of Key findings. London: The Health and Social Care Information Centre; 2009. Health Survey for England 2008. Physical Activity and Fitness.

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Table 1

Characteristics of sedentary behaviour in 1403 men in British Regional Heart Study.

		Minutes in SB		Percent wear time in SB[a]		N bouts SB/day[b]		N breaks per Sedentary hour[c]	
	N Men (%)	Mean (95% CI)[d]	p-value[e]	Mean (95% CI)[d]	p-value[e]	Mean (95% CI)[d]	p-value[e]	Mean (95% CI)[d]	p-value[e]
All men[d,f]	1403	618 (614,621)		72.4 (72.0,72.8)		71.9 (71.2,72.6)		7.2 (7.1,7.3)	
Age group			<0.001		<0.001		<0.001		<0.001
70 to <75 years	389 (27.7)	602 (595,609)		69.7 (68.9,70.5)		73.4 (72.2,74.6)		7.6 (7.4,7.8)	
75 to <80 years	544 (38.8)	610 (603,616)		71.2 (70.5,72.0)*		72.7 (71.6,73.8)		7.4 (7.2,7.6)	
>=80 years	470 (33.5)	641 (635,647)*		76.0 (75.3,76.7)*		69.6 (68.3,70.9)*		6.7 (6.5,6.9)*	
BMI (kg/m^2)			0.002		<0.001		<0.001		<0.001
<25	406 (28.9)	614 (606,621)		71.5 (70.6,72.3)		74.5 (73.2,75.8)		7.5 (7.3,7.7)	
25 to <30	722 (51.5)	613 (608,618)		71.7 (71.1,72.3)		72.7 (71.7,73.7)		7.4 (7.2,7.5)	
>=30	275 (19.6)	637 (629,644)*		75.7 (74.8,76.5)*		65.7 (64.1,67.3)*		6.4 (6.2,6.6)*	
Smoking status			0.012		0.073		0.008		0.297
Non smoker	1356 (96.7)	617 (613,620)		72.3 (71.9,72.7)		71.7 (71.0,72.4)		7.2 (7.1,7.3)	
Smoker	47 (3.3)	649 (627,671)*		74.9 (72.4,77.4)		77.6 (73.3,82.0)*		7.5 (6.9,8.2)	
Depression			<0.001		<0.001		<0.001		<0.001
Not depressed	1094 (78.0)	613 (609,617)		71.3 (70.8,71.8)		73.1 (72.3,73.9)		7.4 (7.3,7.5)	
Depressed	309 (22.0)	634 (626,642)*		76.4 (75.4,77.3)*		67.4 (65.8,68.9)*		6.6 (6.4,6.8)*	
Chronic conditions			<0.001		<0.001		<0.001		<0.001
None	657 (46.8)	621 (615,627)		73.0 (72.3,73.7)		71.3 (70.1,72.5)		7.1 (6.9,7.3)	
1–2	644 (45.9)	630 (619,640)*		74.4 (73.1,75.6)*		69.4 (67.4,71.4)*		6.9 (6.6,7.2)*	
≥3	102 (7.3)	652 (637,667)*		78.3 (76.5,80.1)*		66.6 (63.3,70.0)*		6.3 (5.9,6.8)*	

[a] percentage sedentary= 100*sedentary (<100 cpm) minutes/total wear time (minutes)

[b] a bout of SB is a period of consecutive minutes where the accelerometer registers <100cpm.

[c] a break in SB is at least one minute where the accelerometer registers >100cpm following a sedentary bout

[d] marginal means are adjusted for age, BMI, smoking status, wear time, day order, number of chronic diseases and depression

[e] p-value tests for equal means across all levels of subgroup.

[f] ambulatory men, not in a care home, no missing covariate data

[*] pairwise mean difference p<0.05 when compared to age <75, BMI <25, non-smoker, not depressed, 0 chronic conditions

Table 2

Number of sedentary bouts /day, percent of sedentary bouts, and percent of sedentary time of various bout durations, (n=1403)

Bout duration (minutes)	Number of sedentary bouts per day, mean (SD)[a]	% of sedentary bouts, (mean, SD)[b]	% of sedentary time, mean (SD)[c]
1+	71.6(15.7)	100	100
5+	27.5(4.6)	39.6(7.6)	86.5(5.0)
10+	16.5(2.7)	24.3(7.2)	74.5(8.4)
20+	8.5(1.9)	12.9(5.8)	56.5(11.8)
30+	5.1(1.6)	8(4.7)	43.2(13.2)
40+	3.3(1.3)	5.2(3.8)	33.1(13.2)
50+	2.1(1.1)	3.5(3.1)	25.1(12.7)
60+	1.4(0.9)	2.4(2.6)	18.8(11.7)
70+	0.9(0.7)	1.6(2.2)	14.1(10.7)
80+	0.6(0.6)	1.1(1.9)	10.5(9.6)
90+	0.4(0.4)	0.8(1.7)	7.7(8.5)
100+	0.3(0.4)	0.6(1.5)	5.8(7.5)
110+	0.2(0.3)	0.4(1.4)	4.4(6.6)
120+	0.1(0.2)	0.3(1.3)	3.3(6.1)

[a] a bout of SB is a period of consecutive minutes where the accelerometer registers <100cpm.

[b] % of sedentary bouts, number of sedentary bouts of n minutes/number of sedentary bouts of 1 minute

[c] % of sedentary time, length of sedentary bouts of n minutes/length of sedentary bouts of 1 minute