Article

Associations between the duration and frequency of sedentary bouts and adiposity in elderly community-dwelling women

Jana Pechová [1]*, Jana Pelclová [1], Aleš Gába [2], Izabela Zajac-Gawlak [3], Lenka Tlučáková [4], Jan Dygrýn [1], Zuzana Svozilová [1] and Hana Lepková [5,]

[1] Institute of Active Lifestyle, Faculty of Physical Culture, Palacký University, Olomouc, Czech Republic
[2] Department of Natural Sciences in Kinanthropology, Faculty of Physical Culture, Palacký University, Olomouc, Czech Republic
[3] Department of Physical Education, The Jerzy Kukuczka Academy of Physical Education, Katowice, Poland
[4] Department of Sport Educology and Humanistic, Faculty of Sports, University of Prešov, Prešov, Slovakia
[5] Centre of sports activities, Brno University of technology, Brno, Czech Republic
* Correspondence: jana.hodonska@upol.cz; Tel.: +420-585636739

Abstract: 1) Background: This study aimed to describe the frequency and duration of sedentary bouts and assess the bidirectional cross-sectional associations between these characteristics and adiposity in elderly women. 2) Methods: Data from 314 elderly community-dwelling women (mean age 66.6±6.5 years) from Czech Republic, Poland, and Slovakia were analyzed. Measures were collected in 2008–2017. Fat mass percentage (FM%) was used as an indicator of adiposity. The patterns of sedentary behaviour were monitored using an accelerometer, and ≥5, ≥10, ≥20, ≥30, ≥40, and ≥60 minute bouts were analyzed. The exponent alpha was also calculated to express the accumulation of sedentary time in bouts. We performed a multiple linear regression analysis to assess the bidirectional causal association between variables. 3) Results: There was a significant association of FM% with time spent in bouts with a duration ≥5, ≥10, ≥20min (β ranging 0.11–0.28, p≤0.01) and the frequency of bouts with a length ≥5, ≥10, ≥20, and ≥30min (β ranging 0.03–0.74, p≤0.05) in fully-adjusted models. In contrast, a strong negative association was observed between FM% and alpha (bout distribution) in both directions (p≤0.001). 4) Conclusions: Our results suggest that the sedentary characteristics such as bout duration, bout frequency, and distribution (alpha) are bidirectionally associated with adiposity and they should be considered in further research in older adults.

Keywords: Adipose tissue; Adiposity; Alpha sedentary; Elderly women; Sedentary bouts

1. Introduction

Sedentary behaviour (SB), defined as any waking activity performed in a sitting or reclining posture and requiring ≤1.5 metabolic equivalent of tasks [1], is highly prevalent worldwide [2,3]. It is associated with adverse health outcomes [4,5] and increased risk of mortality [6]. In older adults, who spend a majority of their waking time being sedentary [7], evidence indicating a potentially adverse impact of SB on health, irrespective of a person's physical activity (PA) levels, is emerging [8]. Hence, SB research including geriatric-relevant health outcomes is essential to develop health promotion strategies that are effective in the elderly [9].

SB can be assessed in different ways, including objective tool-based methods and self-reported events or domain-specific measures such as TV or screen viewing, leisure time sitting, or sitting in a car [10,11]. In addition to total sedentary time, the use of

accelerometers allows the identification of SB patterns. Subjective observation of sedentary accumulation patterns is challenging for older adults, because they may have difficulties recalling SB during specific timeframe [12]. On the other hand, assessing the total amount of sedentary time in association with adiposity can lead to different results [13] in comparison with studies assessing the different patterns of sedentary time in relation to adiposity [12,13]. Identifying of specific characteristics and sedentary accumulation patterns seems to be important to aging-related outcomes.

Accordingly, sedentary time can be described in terms of bouts of different duration (time in a day or week) and frequencies (times a day or week). Studies employing SB bout analysis in older adults have suggested that most sedentary time occurred in bouts of shorter duration: <30 min in men [14] and <20 min in women [15]. However, these studies studied only the minutes spent on various bouts of SB, but they did not refer to the actual number of bouts. Deeper investigation of dose-response associations is needed to understand if a different accumulation of SB composed of bouts may have different implications for health. Therefore, not only total sedentary time but also SB characteristics such as the duration or frequency of bouts should be considered.

Older adults' SB might be considered in conjunction with age-related changes in body composition, because fat-free mass tends to decrease with advancing age, whereas body fat mass increases [16–19]. Extensive adiposity might be associated with increased SB or, conversely, might be a barrier to performing regular PA. Whether adiposity is a predictor of SB in the elderly or is a consequence remains unclear. In the older adult population, low PA levels [17,20] and sedentary time [21–26] have been shown to be associated with increase in adiposity. However, the majority of the previous studies used self-reported data. New evidence shows that objective measures show even stronger associations with adiposity [27].

To our knowledge, none of the previously conducted studies investigated the bidirectional causal association between specific patterns of SB (including both the duration and frequency of sedentary bouts) and adiposity in the elderly. Therefore, this study aimed to investigate whether sedentary time accumulated in prolonged bouts displays a linear association with body fatness. We also described the frequency and duration of sedentary bouts and assessed the bidirectional cross-sectional associations between these characteristics and adiposity in a cohort of elderly women from three Central European countries.

2. Materials and Methods

Participants and design

A total of 409 community-dwelling women from Czech Republic, Poland, and Slovakia were recruited from 2008 to 2017. These women attended local senior clubs or were students of the University of Third Age. Women were recruited during face-to-face meetings, at the same time the date of the measurement was arranged. Only volunteers participated in this cross-sectional study. Those who refused to participate are not accounted in the description. All participants had undergone an objective assessment of PA and SB by accelerometers and body composition analysis. All measurements took place during spring (late March to beginning of June) and autumn (October to beginning of December), avoiding extreme weather conditions and seasonal fluctuation in movement behaviours. Women who had undergone major hip or knee surgery in the previous 12 months or who had suffered from a physical handicap that might have interfered with

body composition and PA measurement (e.g., motor skills disorder, amputation, and paralysis) were excluded from the study. We also excluded women who had used diuretics during the last 12 months.

A written informed consent was obtained from the participants before taking part in the study. The study was approved by the Institutional research ethics committee of the Faculty of Physical Culture of Palacký University Olomouc (No. 20/2016). The ethical principles of the Declaration of Helsinki were adhered to throughout this research.

Adiposity assessment and anthropometric indices

The standing height was obtained using a portable anthropometer P-375 (Trystom, Olomouc, Czech Republic) with an accuracy of 0.1 cm, and body weight was measured using a bioelectrical impedance analyzer to the nearest 0.1 kg. Body adiposity was expressed as a fat mass percentage (FM%) and was measured by a multi-frequency bioelectrical impedance analysis method using the InBody 720 device (Biospace Co., Ltd., Seoul, Korea) with the manufacturer's equations. This method has been considered as sufficiently precise for the assessment of adiposity in the elderly women with different weight status and PA level [28]. To maintain the examination validity, the study participants were instructed to fast for at least 4 h and maintain proper hydration for at least 24 h before the examination. All measurements were performed in a standing position while the participants were barefooted and wearing light-weight clothing. The body mass index (BMI) was calculated by dividing body weight (in kilograms) by height (in meters squared). Overweight and obesity were defined as a BMI of ≥ 25 and ≥ 30 kg/m^2, respectively.

PA and SB assessment

All participants were asked to wear the ActiGraph GT1M accelerometer (Manufacturing Technology Inc., FL, USA) for at least 8 consecutive days during waking hours, except for water-based activities. The accelerometers were given to the participants immediately after completing the adiposity assessment. The participants were instructed to attach the accelerometer above the right hip on top of their clothing. The time sampling interval of the ActiGraph was set at 1-min epoch. Non-wear time was defined by an interval of 60 consecutive minutes of zero counts per minute (cpm), allowing for 2 min of non-zero interruptions. To be included in the analysis, ≥ 4 valid days of monitoring with 10 h of accelerometer wear per day were required [29].

In this study, SB bout was defined as all minutes showing 0–99 cpm [30]. Based on previous studies [31–34], the Central European women are considered as more physically active; therefore, PA was defined according to the cut-off point for adult population – light intensity PA was defined as all minutes in threshold 100–1951 cpm and moderate-to-vigorous PA (MVPA) as all minutes with values ≥ 1952 cpm [30]. Behaviour was considered as sedentary, if the intensity corresponded to the sedentary range and was performed continuously for a certain time interval. We defined six time intervals (bouts) for data analysis: ≥ 5, ≥ 10, ≥ 20, ≥ 30, ≥ 40, and ≥ 60 min. In all cases, a bout was defined as

consecutive minutes within the SB cpm threshold (0–99 cpm). Bouts with bottom limitation were exported from accelerometer software in the following order: ≥5, ≥10, ≥20, ≥30, ≥40, and ≥60 minutes, i.e. each bout category is presented as a bout of at least this length or longer [15,35]. Total sedentary time was calculated as the sum of all 1-min sedentary intervals. Bout duration (a certain period of continuous sedentary time) and bout frequency (a certain number of times) were calculated and standardized for one week [1]. Moreover, we calculated for the exponent alpha [36,37], which characterizes the frequency distribution of sedentary bouts. Alpha is a unitless measure that indicates if the sedentary time was accumulated rather in relatively longer bouts or relatively shorter bouts with more breaks.

Covariates

Several variables were used in the analyses to control for variation of these covariates. The analysis was controlled for an accelerometer-based wear time due to high variability in this variable among the study sample. Additionally, we controlled the analysis for several confounding factors that have been identified as strong predictors of SB [10]. This includes demographic (age and employment status), socio-economic (education), health (self-reported health), behavioural (LIPA, MVPA, and smoking status), and environmental factors (living in an apartment). Current employment status was revealed by means of the question "Do you currently have a job?", living arrangements with the question "Do you live in an apartment?", and level of education with the question "Do you have higher education?". Self-reported health was assessed using a single question on the respondents' current health and was classified as "excellent", "very good", "good", "fair", or "poor". This variable was dichotomized, with the first three answers being considered as "good health status". Furthermore, we identified dog owners and participants living in large cities (≥ 100,000 inhabitants) as these factors were strongly associated with SB and PA in older Central European adults (38,39). PA status was assessed objectively, and other covariates were obtained by self-report from participants.

Statistical data analysis

All analyses were done using the SPSS software, version 22 (SPSS for Windows; SPSS, Chicago, IL). The descriptive statistics were calculated for accelerometry-measured PA and SB, and factors used as covariates; they are presented as the mean, standard deviation, and 95% confidence interval unless stated otherwise. For current analysis, we excluded the data from those women who did not provide a valid accelerometry data (n = 71). Those missing self-reported information used as confounder in the models were also excluded (n = 24). The final sample comprised 314 women.

80% of the participants had seven days of valid accelerometer data. Thus, all the SB and PA variables that were used were adjusted for the time spent wearing the device and for the device being worn for seven days. We analyzed the associations of the duration and frequencies of several sedentary bouts with adiposity using a multiple linear regression analysis that was adjusted for potential confounding variables. We conducted modeled

analyses to assess the bidirectional causal association between variables. The factors established as predictors of SB were included as covariates in the multivariable model [10]. In the first analysis, FM% was used as an independent (exposure) variable. Model 1 represents a model adjusted for age and wear time. It is important to determine whether PA influences SB; thus, model 2 was adjusted for model 1 and MVPA. Light intensity PA was removed from the model as a confounder due to collinearity. The correlation coefficient between light intensity PA and sedentary time was lower than –0.7. Model 3 was adjusted for model 2 and other confounders. We recalculated these confounders for binary variables. In the second linear regression analysis, bout duration and bout frequency were considered as exposure variables. The regression models were adjusted for the same confounding variables. Finally, in the last analysis, the exponent alpha was assessed.

3. Results

Descriptive analysis

A total of 314 community-dwelling women aged 66.6 ± 6.5 years were included in the analysis (Table 1). Almost two-thirds were classified as overweight (42%) or obese (23%) based on their body mass index. Women wore the accelerometer on average 13.9 ± 1.2 h per day. On average, the women spent 7.8 ± 1.5, 5.4 ± 1.4, and 0.6 ± 0.4 hours per day in SB, light intensity PA, and MVPA, respectively. Amount of SB is expressed as sedentary bouts of different length (≥5, ≥10, ≥20, ≥30, ≥40, ≥60 minutes/bout). Women accumulated more sedentary bouts lasting ≥5, ≥10, ≥20, ≥30 min than longer sedentary bouts.

Table 1. Descriptive characteristics of the participants (n = 314)

	Mean	SD	95% CI
Age and anthropometrics			
Age (years)	66.6	6.5	65.9, 67.3
Body height (cm)	160.9	6.5	160.2, 161.7
Body weight (kg)	70.2	12.0	68.8, 71.5
Body mass index (kg/m^2)	27.1	4.4	26.6, 27.6
Fat mass percentage (%)	36.1	7.1	35.3, 36.9
Physical activity			
Light intensity physical activity (h/day)	5.4	1.4	5.3, 5.6
Moderate-to-vigorous physical activity (h/day)	0.6	0.4	0.6, 0.7
Monitor wear time (h/day)	13.9	1.2	13.7, 14.0
Sedentary behaviour			
Sedentary time (h/day)	7.8	1.5	7.6, 7.9
Alpha	1.6	0.1	1.59, 1.61

Duration of sedentary bouts (h/week)

≥5 min	42.1	11.3	40.8, 43.4
≥10 min	32.3	11.0	31.1, 33.5
≥20 min	20.6	9.7	19.5, 21.7
≥30 min	13.8	8.2	12.9, 14.7
≥40 min	9.4	6.8	8.7, 10.2
≥60 min	1.5	2.3	1.2, 1.7

Frequency of sedentary bouts (times/week)

≥5 min	177.2	34.2	173.4, 181.0
≥10 min	87.1	22.3	84.6, 89.6
≥20 min	34.9	13.9	33.3, 36.4
≥30 min	17.6	9.2	16.6, 18.7
≥40 min	9.9	6.4	9.1, 10.6
≥60 min	1.2	1.8	1.0, 1.4

Weight status, n (% of n)

Underweight	2 (0.6)
Normal weight	108 (34.4)
Overweight	133 (42.4)
Obesity	71 (22.6)

Self-reported data, n (% of n)

Higher education (>13 years)	153 (49)
Employed	56 (18)
Living in a flat (not in a house)	199 (63)
Location with ≥100, 000 citizens	173 (55)
Having a pet	60 (19)
Current smoker	14 (4.5)

Abbreviation: n, number of participants; *SD*, standard deviation; *CI*, confidence interval

Sedentary time was mainly accumulated in bouts of shorter duration (Figure 1). Women in the last quartile with the highest %FM collected, on average, more sedentary bouts and they accumulated more minutes in all bout categories.
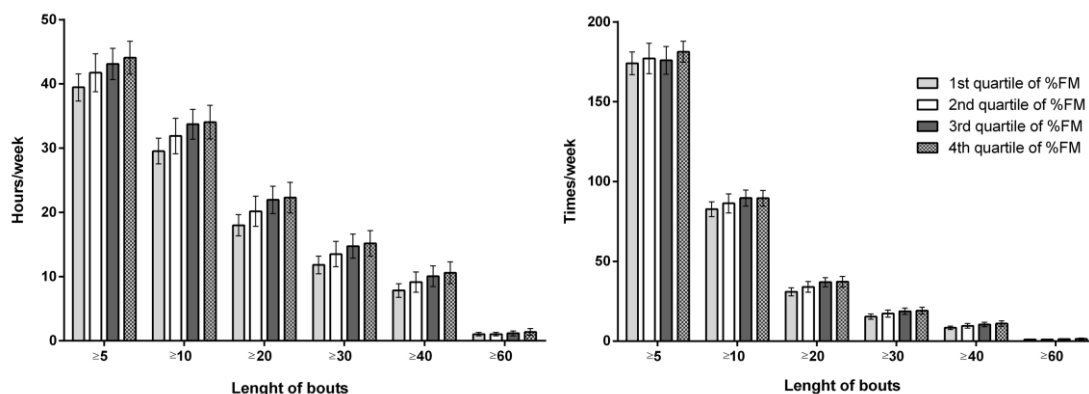
Figure 1. The duration (h/week) and frequency (times/week) bout distribution across quartiles of %FM.

Duration of sedentary bouts

When the duration of a sedentary bout was modelled as the exposure, a positive independent association with FM% was observed (Table 2). After adjustment for all confounders (Figure 2), the sedentary bouts ≥20 min were considered as independent predictors of adiposity (β = 0.11, p ≤ 0.01), and there were no significant associations for longer sedentary bouts. In the third model, one additional hour/week spent in bouts with a duration ≥20min was associated with 0.11 higher %FM. From this point of view, fat mass seems a better predictor of SB than the other way around.

Similar results were observed for bout duration, which was considered as an outcome variable (Table 3). In a minimally adjusted model, the associations were significant in all sedentary bouts except for ≥60 min bouts. This association weakened after adjustment for MVPA. After adjustment for all confounders (Figure 2), there were significant associations with bouts with a duration ≥5, ≥10, and ≥20 min (β ranging from 0.21 to 0.28, p ≤ 0.01). Based on Model 3, shown in Table 3, (adjusted for age, wear time, MVPA, socio-demographic, and health confounders), each additional 5% of fat mass was associated with a 1.05 hour/week increase in the time spent on SB bouts with a duration ≥20 min (p ≤ 0.01).

Table 2. Associations between FM% (outcome) and sedentary bouts (exposure)

	Model 1			Model 2			Model 3		
	FM%			FM%			FM%		
	β	R^2	95% CI	β	R^2	95% CI	β	R^2	95% CI
Duration of sedentary bout (hours/week)									
≥5	0.15‡	0.15	0.08, 0.23	0.10†	0.26	0.03, 0.17	0.11†	0.31	0.04, 0.18
≥10	0.14‡	0.15	0.07, 0.22	0.10†	0.26	0.03, 0.17	0.11†	0.30	0.03, 0.18
≥20	0.15‡	0.14	0.07, 0.24	0.10*	0.26	0.02, 0.18	0.11†	0.30	0.03, 0.19
≥30	0.15†	0.13	0.05, 0.24	0.09	0.25	–0.01, 0.18	0.09	0.29	–0.001, 0.18
≥40	0.16†	0.13	0.04, 0.28	0.09	0.25	–0.02, 0.20	0.09	0.29	-0.02, 0.20
≥60	0.14	0.11	–0.19, 0.48	0.12	0.25	-0.19, 0.42	0.07	0.28	-0.23, 0.38
Frequency of sedentary bout (number/week)									

≥5	0.04‡	0.14	0.01, 0.06	0.02*	0.26	0.003, 0.05	0.03*	0.30	0.01, 0.05	
≥10	0.06‡	0.14	0.03, 0.10	0.05†	0.26	0.01, 0.08	0.05†	0.30	0.02, 0.08	
≥20	0.12‡	0.15	0.06, 0.18	0.08†	0.27	0.03, 0.14	0.09†	0.31	0.03, 0.14	
≥30	0.13†	0.13	0.04, 0.22	0.08	0.25	–0.001, 0.17	0.09*	0.29	0.003, 0.17	
≥40	0.17†	0.13	0.04, 0.30	0.10	0.25	–0.02, 0.22	0.10	0.29	–0.02, 0.22	
≥60	0.18	0.11	–0.26, 0.62	0.15	0.25	–0.26, 0.56	0.09	0.28	–0.32, 0.49	

Abbreviation: FM%, fat mass percentage; *β*, regression coefficient; *R²*, coefficient of determination; *CI*, confidence interval

Model 1 was adjusted for age and wear time.

Model 2 was adjusted for Model 1 and moderate-to-vigorous physical activity.

Model 3 was adjusted for Model 2 and socio-demographic and health confounders (education, housing, location, health status, smoking status, and employ).

* $p<0.05$

† $p<0.01$

‡ $p<0.001$

Table 3. Associations between sedentary bouts (outcome) and FM% (exposure)

	Model 1 FM%			Model 2 FM%			Model 3 FM%		
	β	R²	95% CI	β	R²	95% CI	β	R²	95% CI
Duration of sedentary bout (hours/week)									
≥5	0.34‡	0.27	0.18, 0.50	0.26†	0.28	0.09, 0.44	0.28†	0.32	0.11, 0.46
≥10	0.30‡	0.25	0.14, 0.46	0.24†	0.26	0.06, 0.41	0.26†	0.28	0.08, 0.43
≥20	0.26‡	0.22	0.11, 0.40	0.20*	0.23	0.04, 0.35	0.21†	0.24	0.06, 0.37
≥30	0.18†	0.19	0.06, 0.30	0.13	0.20	–0.01, 0.26	0.14	0.21	–0.001, 0.27
≥40	0.14†	0.17	0.03, 0.24	0.09	0.18	–0.02, 0.20	0.10	0.19	–0.02, 0.21
≥60	0.02	0.01	–0.02, 0.05	0.02	0.01	–0.03, 0.06	0.01	0.02	–0.03, 0.05
Frequency of sedentary bout (number/week)									
≥5	0.88‡	0.18	0.34, 1.42	0.67*	0.19	0.09, 1.25	0.74*	0.26	0.16, 1.32
≥10	0.60‡	0.23	0.26, 0.94	0.49†	0.23	0.12, 0.85	0.54†	0.27	0.16, 0.91
≥20	0.41‡	0.22	0.21, 0.61	0.33†	0.23	0.11, 0.55	0.36†	0.24	0.14, 0.59

	β	R^2	CI	β	R^2	CI	β	R^2	CI
≥30	0.21†	0.19	0.07, 0.34	0.15	0.20	−0.003, 0.30	0.16*	0.21	0.01, 0.31
≥40	0.13†	0.17	0.03, 0.23	0.09	0.18	−0.02, 0.19	0.09	0.19	−0.02, 0.20
≥60	0.01	0.01	−0.02, 0.04	0.01	0.01	−0.02, 0.04	0.01	0.02	−0.25, 0.04

Abbreviation: FM%, fat mass percentage; *β*, regression coefficient; *R^2*, coefficient of determination; *CI*, confidence interval

Model 1 was adjusted for age and wear time.

Model 2 was adjusted for Model 1 and moderate-to-vigorous physical activity.

Model 3 was adjusted for Model 2 and socio-demographic and health confounders (education, housing, location, health status, smoking status, and employ).

* $p<0.05$

† $p<0.01$

‡ $p<0.001$

Frequencies of sedentary bouts

The frequencies of sedentary bouts, which were considered as exposure variables, were independently associated with FM%. A significant association was observed in periods ≥5, ≥10, ≥20, and ≥30 min (β ranging from 0.03 to 0.09, $p \le 0.05$). In the third model, and 10 additional bouts/week ≥30 min long predicted an increase in %FM of 0.9.

In a fully adjusted model (Figure 2), the frequency of bouts ≥5, ≥10, ≥20, and ≥30 min as the outcome variable was significantly associated with FM% (β ranging from 0.16 to 0.74, $p \le 0.05$). Each additional 10% of fat mass was associated with 1.6 more bouts per week with a duration of ≥30min ($p \le 0.05$) and with 3.6 bouts/week with a duration of ≥20min. The association weakened in longer bouts.
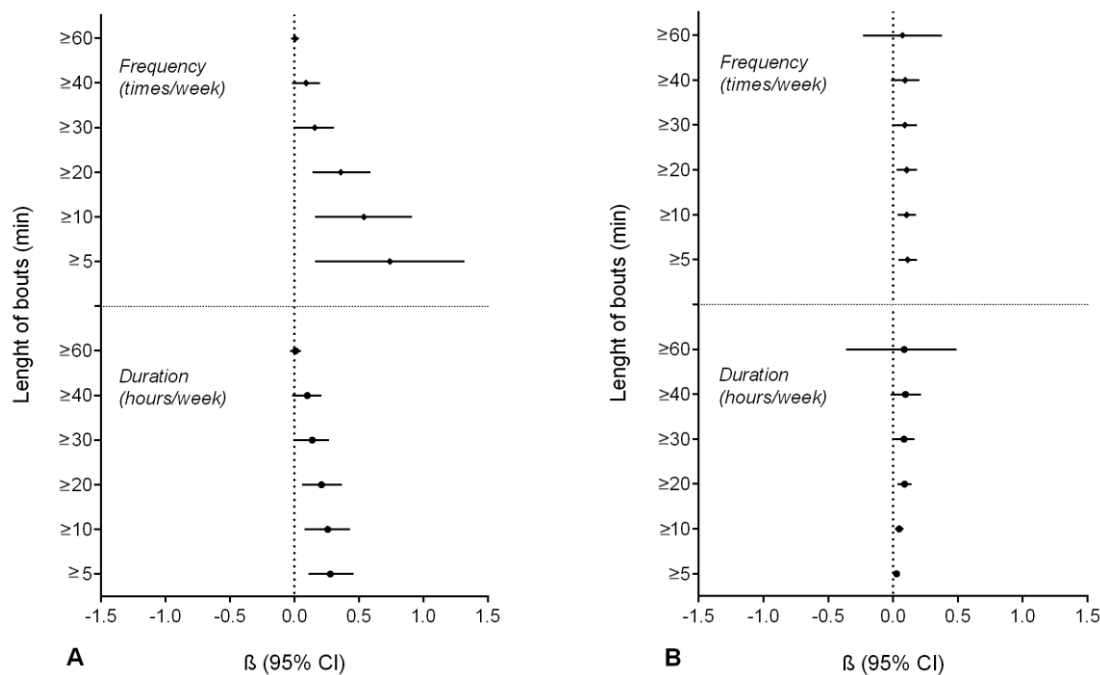
Figure 2. Associations between FM% (A – exposure; B – outcome) and patterns of sedentary bouts (duration and frequency).

Alpha

FM% (exposure) was negatively associated with exponent alpha in the fully adjusted model (β = –0.003; p ≤ 0.001). In contrast, we found a strong negative association in reverse causality (β = –14.37; p ≤ 0.001). Therefore, not only body fatness influences sedentary patterns, but how SB is accumulated and distributed also influences body fatness.

4. Discussion

In this cross-sectional study of elderly women, we found the bidirectional associations between objectively measured adiposity and sedentary bout characteristics. The regression analysis revealed a positive association between adiposity with frequency and duration of sedentary bout measures. The associations weakened, but lasted in bouts within ≥5 to ≥20 min after additional adjustment for covariates, suggesting that the bidirectional causal associations between adiposity and sedentary bout characteristics were independent of age, PA, demographic, socio-economic, and health factors. Our findings extend evidence of accelerometry-measured patterns of SB among community-dwelling older adults in Central European region.

On average, the women in our sample spent sitting less than 8 hours a day. These findings look promising for Central European elderly women because other evidence reported sedentary time accounting for 8.5 hours/day [40] or even 9.4 hours/day [7] in elderly population. The results of the Women's Health Study [15] showed that the mean sedentary time of 9.7 hours/day was accumulated in 86 bouts. Looking at patterns of SB, women accumulated majority of sedentary time in bouts of less than 30 min, which is similar to our study. Japanese elderly women spent also more time in bouts <30 min, while they have been sitting for more than 8 hours a day [41]. All these findings confirm that older adults spend almost two thirds of their waking time being sedentary [2].

Since menopause, elderly women are at higher risk of adiposity. Metabolic transformation in later years can substantially affect women's daily lives, physical condition and it can be a limitation to performing regular PA [42]. Therefore, identification of the relations of SB patterns with adiposity in the elderly is critical to chronic disease prevention.

Although evidence showed that a longer time spent in prolonged sedentary bouts represents a higher risk of adverse metabolic health outcomes [43], bout duration and frequency of sedentary bouts of ≥40 and ≥60 min were not significantly related to body fatness, as reported in the present study. Prolonged sitting was related to adiposity, but despite of the ascending character, this association was not significant. This is in contrast to the conclusions of a cross-sectional study conducted by Jeffferis et al. [14], which involved older men from the United Kingdom. After adjustment for MVPA, short bouts of SB 1–15 min were associated with lower BMI and waist circumference. In unadjusted model, a higher adiposity risk was significantly associated only with sedentary bouts longer than 30 min. Similarly, Honda et al. [43] proved the analogous association in a sample of middle-aged Japanese workers of both genders. In a prospective study, prolonged bouts were associated independently of MVPA with an increased risk of metabolic syndrome over 3 years. They did not found any association with bouts of length less than 20 min or total sedentary time. Moreover, the presented findings confirmed that sedentary bouts of shorter duration are related to adiposity among elderly community-dwelling women, which is probably due to the distribution of sedentary bouts during their day. As shown in Table 1, these women accumulated only a few sedentary bouts of longer duration and the rest of the sedentary time was accumulated in shorter sedentary bouts. Such a rare long period of sitting does not have to play a significant role in the association to adiposity. The most important fact might be a total amount of sedentary time, even when it is accumulated in short periods.

Our results showed that associations between sedentary bouts and FM% are bidirectional. It corresponds with the conclusions of the prospective study of Golubic et al. [44] conducted in middle-aged individuals. Conversely, other prospective studies in adult sample supported only a one-way association, that BMI or weight gain (exposure) was associated with sitting time and physical inactivity [26,45–49]. The results were somewhat inconsistent and differed in methodology. Three of these studies [47–49] have applied self-report methods, suggesting that the data obtained objectively could prevent measurement biases [27].

This study extends previous findings about sedentary bout characteristics in the elderly and the associations of sedentary time composition with adiposity. In this study, we calculated the exponent alpha, which is a recommended approach if the patterns of SB are of interest [36,37,50], as it indicates the distribution of SB patterns. In the study of Chastin and Granat [37], the exponent alpha ranged from 1.76 to 2.27 in groups with different occupation, age and health status, while total sedentary time did not differ significantly. Different patterns for accumulating sedentary time seem to be affected by overall physical status. Alpha in ethnically diverse cohort of elderly women from the United States (n=6166) ranged from 1.37 to 2.85 with an average value of 1.87 [51]. As reported in our study, the values of exponent alpha ranged from 1.40 to 2.05 in the Central European elderly women. Hence, the lower values of alpha indicated the accumulation of sedentary time in prolonged bouts with less interruptions. We confirmed the significant negative bidirectional association with adiposity; i.e. body fatness is associated with less fragmented SB. Therefore, the distribution of SB might be an important factor influencing adiposity in elderly women, which should be considered in further research.

Strength and limitations

A strength of the study is that SB and MVPA were objectively measured using accelerometry. Most importantly, we considered the sedentary characteristics as duration and frequency of sedentary bouts and distribution of sedentary bouts during a day expressed by an exponent alpha. A

large proportion of recently conducted studies used a self-reported total sitting or TV-viewing time [7,40]. To our knowledge, this is the first study investigating the bidirectional associations between adiposity and sedentary bout characteristics in elderly women. Additionally, this is the first detailed investigation of accelerometry-measured SB related to adiposity in the elderly population from the Central European region.

The study has also some limitations. Our sample is smaller than those of larger representative studies. Only healthy elderly community-dwelling women from senior clubs and University of the Third Age classes were included into our study. These women might be more socially and physically active. The average MVPA was 38 min per day, which implies that most of the women were physically active and met the physical recommendations. We used a uniaxial accelerometer, which is widely used for measuring PA and SB, but it may not be sufficiently sensitive to differentiate between physical behaviours such sitting and standing. We were also unable to obtain data on activities such cycling and swimming.

5. Conclusions

Our results suggest that the associations between adiposity and sedentary characteristics expressed as bout duration, bout frequency, and distribution of sitting time are bidirectional and independent of age, PA, demographic, socio-economic, and health factors. Shorter bouts were strongly associated with adiposity in elderly women, and the distribution of sedentary time played an important role. Our findings emphasize the benefits of adiposity prevention and treatment with the reduction of long sitting, which can lead to more active and healthy aging. A longitudinal study is needed to verify these associations.

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