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Associations of total amount and patterns of objectively measured sedentary behavior with performance-based physical function

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ABSTRACT

Although greater sedentary time has been found to be associated with negative health impacts, little is known whether the specific pattern of sedentary behavior (i.e. sedentary bouts, breaks and durations) are associated with physical function among older adults. The present study examined the associations between objectively measured sedentary behavior and physical function among older Japanese adults. A total of 174 male and 107 female community-dwelling older Japanese adults aged 65–84 years (mean age: 74.5 ± 5.2 years) were recruited. Sedentary behavior and physical activity were assessed using a triaxial accelerometer. Physical function was measured through hand grip strength, eye-open one leg standing, 5-m walking, and timed up and go tests. Forced-entry multiple linear regression models adjusted for potential confounders were performed. After adjustment, total daily sedentary time and duration of prolonged sedentary bouts (both ≥ 30 min) were positively associated with time spent on the 5-m walking stage and timed up and go tests in older women; however, no significant associations were observed in older men or the whole sample. This paper highlights the importance of developing sedentary behavior change strategies for interventions aiming to improve mobility in in older women. Further evidence from a prospective study is required to establish directions of causality between sedentary behavior and mobility.

1. Introduction

Japan is one of the rapid aging societies where 26.7% of its population was aged 65 or older in 2015. This proportion is predicted to be 38.8% by 2050 (Statistics Bureau, 2017). Older adults are at risk of declining physical function (Guralnik and Simonsick, 1993), which is related to higher risk of fall, functional limitations and disability, and mortality (Manton, 1988; Smee et al., 2012; Toraman and Yildirim, 2010; den Ouden et al., 2013). Declining physical function has also been considered a principal reason for losing physical independence (Fried et al., 2004; Wang et al., 2002). Therefore, identifying modifiable behavioral factors associated with physical function among older adults in rapid aging societies is necessary.

Sedentary behavior has emerged as a new behavioral risk factor for many non-communicable diseases (Sedentary Behaviour Research, 2012). More sedentary time is associated with increased risk of metabolic syndrome, obesity, impaired mental health, and mortality among older adults (Balboa-Castillo et al., 2011; Bankoski et al., 2011; Inoue et al., 2012; Pavey et al., 2015). In addition, the key health consideration for older adults is maintaining a sufficient level of physical function to safely and independently perform regular daily activities (Department of Health, 2010). Sedentary behavior could be particularly important for older adults' physical function because reduced energy expenditure, lack of skeletal muscular contractions and raised inflammatory markers through prolonged sedentary time could contribute to accelerated loss of muscle mass and strength (Gianoudis et al., 2015; Schaap et al., 2009). Therefore, to prevent or postpone declining physical function, a more in-depth understanding of the association

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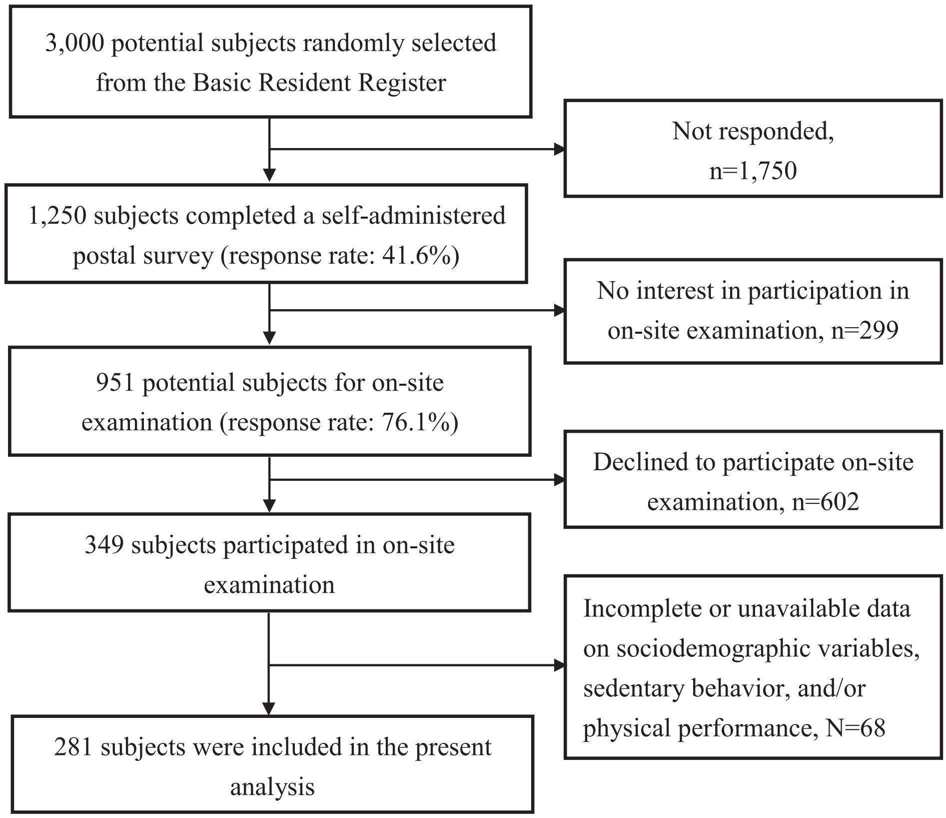

Fig. 1. Flow chart of participants selection process.

between sedentary behavior and physical function among older adults is needed.

Evidence has verified the negative relationships of self-reported and objectively measured sedentary behavior with aspects of physical performance such as muscle strength, mobility, and balance in older adults, independently of their moderate-to-vigorous physical activity (MVPA) (Hamer and Stamatakis, 2013; Manas et al., 2017; Seguin et al., 2012). However, most related studies have used self-reporting methods to assess sedentary behavior, which is a major limitation because older adults may have difficulty accurately recalling their total sedentary times or durations of specific sedentary behaviors (Van Cauwenberg et al., 2014). Although some studies have employed objective sedentary behavior measures, such studies are limited in several respects. First, most of these studies have been conducted in Western countries such as the United States, United Kingdom, Canada, and Portugal (Cooper et al., 2015; Fleig et al., 2016; Rosenberg et al., 2016; Santos et al., 2012). In comparison with Western countries, Japanese older adults may have different lifestyle patterns and gender role (Amagasa et al., 2017), which could possibly lead to different outcomes. Only one such study was conducted in Japan; however, this study was limited because of a small sample size of institutionalized older women ($N = 19$) (Ikezoe et al., 2013). Second, although older men and women were found to have different sedentary behavioral patterns and physical characteristics such as skeletal muscle mass (Bellettiere et al., 2015; Jankowski et al., 2008; Janssen et al., 2000; Matthews et al., 2008), few studies have examined the association between sedentary behavior and physical function separately by gender. Finally, although two studies have reported that breaks in sedentary behavior were positively associated with physical performance in older adults (Davis et al., 2014; Sardinha et al., 2015), little is known regarding whether total and specific patterns of objectively measured sedentary behavior are associated with physical function. Given that prolonged and unbroken sedentary time has negative impacts on health (Hamilton et al., 2007; Dunstan et al., 2012), specific patterns of sedentary time can also be considered in terms of the number and duration of sedentary bouts. For the public health prevention practices, it is of value to further explore these modifiable factors related to physical function, such as total sedentary time, sedentary bouts (i.e., periods of uninterrupted sedentary time), breaks (i.e., nonsedentary bout between two sedentary bouts), and duration (i.e., the length of continuous sedentary time). Therefore, the present study examined the associations of total amount and patterns of objectively measured sedentary behavior with performance-based physical function among older Japanese men and women.

2. Materials and methods

2.1. Participants

Data from a cross-sectional survey conducted in 2013 were used in this study. A total of 3000 older Japanese adults aged 65–84 years and living in Matsudo City, Chiba Prefecture, Japan, were randomly selected from the Basic Resident Register according to gender and age bracket (65–69, 70–74, 75–79, and 80–84 years). This study involved two stages of data collection: a self-administered postal survey and on-site examinations.

In first stage, each potential respondent was sent a written consent form and questionnaire on their background that included questions on age, level of education, marital status, family income, and behavioral factors through the postal service. A total of 1250 older adults responded to this questionnaire by regular postal mail (response rate: 41.6%) and asked whether or not they were interested in taking part in additional examination. Those who showed their interest in additional examination ($n = 951$; response rate: 76.1%) were formally sent a letter requesting participation in the on-site examination via postal mail. However, 602 of those declined to participate; thus, 349 older adults who agreed to participate were ultimately enrolled in the present study (participation rate: 36.7%). On-site examination was conducted in community centers by trained research staffs including well-trained nurse, exercise trainers, physical therapists, and research staffs. An incentive (a 1000-yen book voucher) was offered to each participant who completed the tests.

In the on-site examination conducted on weekdays and weekends over three months (October to December 2013), firstly, each participant took a physical performance test and then received an accelerometer and was asked to wear the accelerometer on their right hip in a 7-consecutive-day period while awake except during bathing and water activities. Of the 349 participants, 281 were included and 68 were excluded because the data of their sociodemographic variables, sedentary behavior, and/or physical performance was either incomplete or unavailable. For data analysis, 281 participants were included on the basis of the inclusion and exclusion criteria (Fig. 1). Written informed consent was obtained from all participants by regular postal mail. The present study received prior approval from the Ethics Committee of the Faculty of Sports Sciences, Waseda University, Japan (2013–265).

2.2. Objectively measured sedentary behavior

Sedentary behavior was measured using a triaxial accelerometer (Active Style Pro HJA-350IT, Omron Healthcare, Kyoto, Japan). This device can ignore high-frequency vibrations and provides reliable and accurate metabolic equivalent values (METs), which have been reported to be closely correlated with METs calculated by the indirect calorimetry (Ohkawara et al., 2011). Data were recorded in 10-s intervals that were transformed into 60-s intervals for data analysis (Oshima et al., 2010). Nonwear time was defined as periods of at least 60 consecutive min of no activity (0.9 or fewer METs) with allowance of up to 2 min of observations of limited movement (≤ 1.0 METs). Data for participants with at least 4 valid wear days (including one weekend day, a valid day was defined as having at least 10 h of wear time per day) were included in the analysis, which is in line with previous studies to estimate daily sedentary behavior in older adults (Sardinha et al., 2015; Chen et al., 2015; Trost et al., 2005). Any waking behavior characterized by energy expenditure less than or equal to 1.5 METs was considered sedentary behavior (Tremblay et al., 2017).

From the accelerometer data, total sedentary time, number of ≥ 30 min sedentary bouts, duration of ≥ 30 min sedentary bouts, and number of sedentary breaks per sedentary hour were calculated. Following a previous study (Tremblay et al., 2017), the total amount of sedentary time was calculated by summing the time spent engaged in any sedentary behavior, sedentary bouts defined as periods of uninterrupted sedentary time, and a sedentary break was defined as a nonsedentary bout between two sedentary bouts.

2.3. Performance-based physical function

The physical function components included upper body strength, balance, and mobility. Upper body strength was measured by hand grip strength tests (kg). Balance was measured by eye-open one leg standing test (s). Mobility was measured by 5-m walking (s) and timed up and go (s) tests.

(a) *Hand grip strength test*: Each participant was asked to squeeze a handheld Jamar dynamometer with maximum force. Hand grip is easy and quick to measure and exhibited satisfactory validity and reliability for measuring physical function among older adults in the previous studies (Abizanda et al., 2012; Rijk et al., 2016; Jakobsen et al., 2010; Taekema et al., 2010). Two trials were conducted on the dominant arm and the greatest value was used for data analysis.
(b) *Eye-open one leg standing test*: Eye-opening one leg standing test has been a frequently used test for assessing balance in older adult population (Shimada et al., 2011; Izawa et al., 2015). Each participant was asked to stand on one comfortable leg with his or her eyes open. A timer was used to record for how long the participant could remain standing up to 60 s (Rikli and Busch, 1986). Additionally, the timer was stopped when the position of the standing leg was displaced or any body part except for the standing leg touched the ground. Two trials were performed and the greatest value was used for data analysis.
(c) *5-m walking test*: The 5-m walking test is a valid and reliable measurement of gait speed (Salbach et al., 2001; Wilson et al., 2013), which is an indicator of physical function in older adults (Lusardi et al., 2003). Each participant was asked to walk 11 m without assistance as quickly as possible ("walk as fast as you can"). The time taken to walk the middle 5 m was recorded to allow for the participant to accelerate and decelerate. Briefly, the timer was started when the leading foot crossed the 3-m line and stopped when the leading foot crossed the 8-m line. One trial was conducted and the time was used for data analysis.
(d) *Timed up and go test*: Each participant was asked to stand up from a standard-height chair, walk 3 m forward as quickly as possible, turn 180°, walk back to the chair, and sit down (Podsiadlo and Richardson, 1991). A timer was used to record the time taken for the participant to complete the test. Two trials of the test were conducted and the greatest performance (shortest time) was used for data analysis.

2.4. Covariates

Based on the previous studies (Sardinha et al., 2015; Carson et al., 2014), the covariates included self-reported sociodemographic variables (age, gender, marital status, living status, educational level (tertiary education: university or college degree or higher; not tertiary education: high school degree or lower), employment, and life circumstances (perception of economic circumstance), smoking (a current smoker; not a current smoker) and alcohol consumption habit (yes; no), self-reported medical history (hypertension, stroke, heart disease, diabetes mellitus, hyperlipidemia, gout, arteriosclerosis, osteoporosis, knee osteoarthritis, hip osteoarthritis, spinal osteoarthritis, spinal stenosis, rheumatoid arthritis, collagen disease, cancer, and dementia), objectively assessing body mass index, and MVPA. MVPA were also measured by a triaxial accelerometer (Active Style Pro HJA-350IT, Omron Healthcare, Kyoto, Japan). Any waking behavior equal to or > 3 METs was considered MVPA (Ainsworth et al., 2000; Owen et al., 2010).

2.5. Statistical analyses

Descriptive statistics were calculated for all outcome measures stratified by gender. An independent *t*-test and the chi-square test were used for continuous and proportional variables, respectively. Kolmogorov–Smirnov tests were used to assess if outcome variables were normally distributed. Correlation coefficients were computed to examine the relationship between wear time, total sedentary time, number of sedentary bouts, duration of sedentary bouts, number of sedentary breaks and MVPA. Accordingly, a minimum sample size of 85 participants was determined to detect an effect size of 0.15 in a model with four predictors at 80% power. Forced-entry multiple linear regression models adjusted for potential confounders and wear time of the accelerometer were conducted to examine the associations of total amount and patterns of objectively measured sedentary behavior (total sedentary time, number of ≥ 30 min sedentary bouts, duration of ≥ 30 min sedentary bouts, and number of sedentary breaks per sedentary hour) with performance-based physical function (upper body strength, balance, and mobility) for the whole sample and men and women. All statistical analyses were performed using IBM SPSS 22.0 (SPSS Inc., IBM, Chicago, IL, USA). The level of significance was set at $p < 0.05$.

Table 1
Characteristics and health status of the study participants.

	Total (n = 281)	Males (n = 174)	Females (n = 107)	P
	Mean (SD)			
Age (years)	74.5 (5.2)	75.2 (5.4)	73.3 (4.8)	0.003
BMI (kg/m^2)	23.5 (3.2)	23.7 (3.0)	23.1 (3.4)	0.114
Marital status (%)				0.007
Married	82.6	87.4	74.8	
Not married	17.4	12.6	25.2	
Living status (%)				0.250
Living with others	87.9	89.7	85.0	
Not living with others	12.1	10.3	15.0	
Educational level (%)				< 0.000
Tertiary education	38.8	47.7	24.3	
Not tertiary education	61.2	52.3	75.7	
Employment (%)				0.172
Yes	27.0	29.9	22.4	
No	73.0	70.1	77.6	
Life circumstance (%)				0.945
Excellent	6.8	7.5	5.6	
Good	54.1	53.4	55.1	
Poor	36.3	36.2	36.4	
Disappointing	2.8	2.9	2.8	
Smoking (%)				0.001
Yes	7.5	11.5	0.9	
No	92.5	88.5	99.1	
Alcohol drinking habit (%)				< 0.000
Yes	54.1	69.5	29.0	
No	45.9	30.5	71.0	
Medical history (n)	1.3 (1.2)	1.3 (1.2)	1.4 (1.1)	0.424

Abbreviations: n, number; SD, standard deviation; BMI, body mass index.
Tertiary education: university or college degree or higher; Alcohol drinking habit: current drinker.
$p < 0.05$.

3. Results

A total of 281 participants aged 65–84 years (74.5 ± 5.2 years) comprising 174 men and 107 women were included in the present study. Table 1 summarizes the demographic and health variables for the entire sample stratified by gender. The chi-square test determined that men were more likely to be married, be educated to a higher level, be current smokers, and have alcohol-drinking habits than were women. The Kolmogorov–Smirnov tests showed that outcome variables were normally distributed ($p < 0.05$).

Table 2 provides the descriptive data of total amount and patterns of objectively measured sedentary behavior, MVPA, and physical function. Of all participants, the average wear time of the accelerometer was 900.9 (standard deviation = 86.4) min per day. The independent *t*-test results revealed that men had a significantly shorter average accelerometer wear time and fewer sedentary breaks per sedentary hour, a longer average total daily sedentary time, more prolonged sedentary bouts (≥30 min), and a longer average sedentary bout duration (≥30 min) than women. No significant differences were observed in daily sedentary breaks or MVPA between men and women. Additionally, except for the eye-open one leg standing test, men exhibited superior performance to women in all tests.

Table 3 shows the associations between sedentary behavior and physical function in the whole sample. After adjusting for the potential confounders and MVPA, no significant associations were observed between total amount and patterns of objectively measured sedentary behavior and each test of physical function in the whole sample. Table 4 shows the associations between sedentary behavior and physical

Table 3
Associations of total amount and patterns of objective-measured sedentary behavior with performance-based physical function in total participants (*N* = 281).

Variables	β	95%CI	P
Handgrip strength test			
Total sedentary time	−0.083	(−0.199, 0.034)	0.165
Number of ≥30 min sedentary bouts	0.053	(−0.132, 0.237)	0.575
≥30 min sedentary bout duration	−0.060	(−0.159, 0.039)	0.237
Sedentary breaks	0.004	(−0.115, 0.124)	0.944
Eye-open one leg standing test			
Total sedentary time	−0.061	(−0.207, 0.085)	0.411
Number of ≥30 min sedentary bouts	−0.171	(−0.400, 0.059)	0.145
≥30 min sedentary bout duration	−0.094	(−0.217, 0.030)	0.136
Sedentary breaks	0.077	(−0.072, 0.227)	0.308
5-m walking test			
Total sedentary time	0.081	(−0.062, 0.225)	0.265
Number of ≥30 min sedentary bouts	0.055	(−0.172, 0.282)	0.633
≥30 min sedentary bout duration	0.108	(−0.013, 0.229)	0.080
Sedentary breaks	−0.049	(−0.196, 0.098)	0.512
Timed up & go test			
Total sedentary time	0.054	(−0.085, 0.193)	0.446
Number of ≥30 min sedentary bouts	0.075	(−0.145, 0.296)	0.502
≥30 min sedentary bout duration	0.080	(−0.038, 0.198)	0.183
Sedentary breaks	−0.001	(−0.144, 0.142)	0.991

Abbreviations: β (95%CI), standardized regression coefficients and 95% confidence intervals. Adjusted by age, gender, BMI, marital status, living status, educational level, employment, life circumstance, smoking, alcohol drinking habit, medical history, wearing time, and MVPA. Number of ≥30 min sedentary bouts and sedentary breaks are also adjusted for total sedentary time.
$P < 0.05$.

Table 2
Total amount and patterns of objective-measured sedentary behavior, MVPA and performance-based physical function of study participants.

Variables	Total (n = 281)	Males (n = 174)	Females (n = 107)	P
	Mean (SD)			
Accelerometer variables				
Wear time (min/day)	900.9 (86.4)	888.4 (97.0)	921.2 (60.9)	0.001
Total sedentary time (min/day)	524.9 (111.7)	548.9 (115.4)	485.9 (93.5)	< 0.000
≥30 min sedentary bouts (times/day)	4.4 (1.9)	4.9 (1.9)	3.8 (1.7)	< 0.000
≥30 min sedentary bout duration (min)	233.0 (118.5)	256.9 (120.5)	194.6 (104.9)	< 0.000
Sedentary breaks (times/sedentary hour)	7.6 (2.9)	7.1 (2.9)	8.5 (2.6)	< 0.000
MVPA (min/day)	49.4 (32.5)	50.0 (35.5)	48.5 (27.2)	0.692
Performance-based physical function				
Hand grip strength test (kg)	27.4 (8.4)	31.6 (7.1)	20.6 (5.1)	< 0.000
Eye-open one leg standing test (s)	42.9 (21.6)	41.8 (21.5)	44.6 (21.8)	0.290
5-m walking test (s)	2.9 (0.5)	2.8 (0.5)	3.1 (0.6)	0.001
Timed up & go test (s)	6.2 (1.2)	6.1 (1.2)	6.4 (1.3)	0.023

Abbreviations: n, number; SD, standard deviation; MVPA, moderate to vigorous physical activity.
$p < 0.05$.

Table 4
Associations of total amount and patterns of objective-measured sedentary behavior with performance-based physical function by gender.

Variables	Males (n = 174)			Females (n = 107)		
	β	95%CI	P	β	95%CI	P
Handgrip strength test						
Total sedentary time	−0.082	(−0.225, 0.091)	0.404	−0.117	(−0.268, 0.096)	0.350
Number of ≥30 min sedentary bouts	0.069	(−0.188, 0.305)	0.639	0.037	(−0.257, 0.307)	0.860
≥30 min sedentary bout duration	−0.027	(−0.158, 0.114)	0.749	−0.167	(−0.260, 0.028)	0.114
Sedentary breaks	−0.013	(−0.160, 0.138)	0.886	0.100	(−0.158, 0.296)	0.546
Eye-open one leg standing test						
Total sedentary time	−0.073	(−0.252, 0.111)	0.445	0.001	(−0.285, 0.288)	0.992
Number of ≥30 min sedentary bouts	−0.099	(−0.382, 0.183)	0.488	−0.293	(−0.763, 0.115)	0.146
≥30 min sedentary bout duration	−0.103	(−0.256, 0.055)	0.203	−0.052	(−0.288, 0.169)	0.609
Sedentary breaks	0.075	(−0.098, 0.244)	0.399	0.066	(−0.283, 0.432)	0.680
5-m walking test						
Total sedentary time	−0.081	(−0.239, 0.098)	0.408	0.247	(0.041, 0.607)	0.025
Number of ≥30 min sedentary bouts	0.096	(−0.175, 0.349)	0.513	−0.064	(−0.515, 0.361)	0.728
≥30 min sedentary bout duration	−0.016	(−0.159, 0.130)	0.844	0.249	(0.087, 0.534)	0.007
Sedentary breaks	−0.022	(−0.178, 0.139)	0.811	−0.078	(−0.450, 0.256)	0.587
Timed up & go test						
Total sedentary time	−0.065	(−0.239, 0.116)	0.495	0.210	(0.003, 0.511)	0.048
Number of ≥30 min sedentary bouts	0.153	(−0.126, 0.426)	0.286	−0.141	(−0.551, 0.235)	0.427
≥30 min sedentary bout duration	0.001	(−0.152, 0.154)	0.986	0.178	(0.003, 0.409)	0.047
Sedentary breaks	0.032	(−0.137, 0.198)	0.718	−0.020	(−0.341, 0.295)	0.884

Abbreviations: β (95%CI), standardized regression coefficients and 95% confidence intervals. Adjusted by age, BMI, marital status, living status, educational level, employment, life circumstance, smoking, alcohol drinking habit, medical history, wearing time, and MVPA. Number of ≥30 min sedentary bouts and sedentary breaks are also adjusted for total sedentary time. $P < 0.05$.

function stratified by sex, adjusting for the potential confounders and MVPA. Similar to the results for the whole sample, total amount and patterns of objectively measured sedentary behavior were not significantly associated with each physical function test in men. In women, total daily sedentary time was positively associated with time spent on the 5-m walking test (β: 0.247, 95% CI: 0.041, 0.607) and timed up and go test (β: 0.210, 95% CI: 0.003, 0.511). Furthermore, duration of prolonged sedentary bouts (≥30 min) was determined to be positively associated with time spent on the 5-m walking test (β: 0.249; 95% CI: 0.087, 0.534) and timed up and go test (β: 0.178; 95% CI: 0.003, 0.409).

4. Discussion

The present study was the first to examine the association of total amount and patterns of sedentary behavior with physical function in community-dwelling older Japanese adults by using objective measures including triaxial accelerometers and standardized physical fitness tests. These findings revealed that sedentary behavior is related to the performance of mobility (5-m walking and timed up and go tests) only in older women. Independent of potential confounders and MVPA, more total daily sedentary time and longer duration of prolonged sedentary bouts (≥30 min) were associated with lower levels of mobility performance only in older women. This could serve as a reference for policy makers and intervention designers when developing behavioral change strategies for mobility decline prevention.

This study demonstrated that total amount and patterns of sedentary behavior may exhibit stronger associations with the performance of mobility in older women than that in older men, which is inconsistent with the findings of a previous study conducted in the United States (Gennuso et al., 2016). This inconsistency could be explained by cultural differences between Western and Asian countries. It is possible that different lifestyle patterns and gender role between United States and Japan may lead to these reverse findings. Traditionally, Japanese women are responsible for most of the housework, and thus women are more likely to have lifestyle patterns involving less time engaged in sedentary behavior, resulting in longer periods of light-intensity physical activity and short-bout MVPA than men (Amagasa et al., 2017). Thus, longer total daily sedentary time and duration of prolonged sedentary bouts (≥30 min) might be more negatively related to mobility among older women than among older men in Japan. Furthermore, regarding the inverse association between sedentary behavior and mobility only observed in older women, the possible reason is that longer total daily sedentary time and duration of prolonged sedentary bouts (≥30 min) are related to a lack of skeletal muscular contractions and raised inflammatory markers, which could contribute to accelerated loss of muscle mass and strength (Gianoudis et al., 2015; Schaap et al., 2009). Lower muscle mass was determined to be associated with reduced functionality of the lower limbs (Falsarella et al., 2014; Reid et al., 2008). Older women have lower amounts of skeletal muscle mass and muscle density than do age-matched men (Jankowski et al., 2008; Janssen et al., 2000; Bouchard et al., 2011; Goodpaster et al., 2001). Thus, the associations between sedentary behavior and mobility could be more profound in older women than in older men. However, the underlying mechanisms remain unclear. Future studies should focus on gender-specific associations between various patterns of sedentary behavior and physical function.

Several inconsistencies between previous findings and our results were noted. In contrast to the previous studies (Davis et al., 2014; Sardinha et al., 2015), the present study determined that breaking up sedentary time was not associated with superior physical performance in older adults. Moreover, although several studies have reported an inverse association between sedentary behavior and the performance of balance and muscular strength (Rosenberg et al., 2016; Ikezoe et al., 2013; Gennuso et al., 2016), no such significant associations were observed in the present study. Several possible reasons may explain these inconsistencies. First, participant characteristics may contribute to these inconsistencies; the older adults in the present study were younger than those in previous studies (Rosenberg et al., 2016), and also generally healthier, with superior performance in physical function (Ikezoe et al., 2013). Second, these inconsistencies may be attributable to the different objective measures of sedentary behavior; for example, in contrast to most related studies, which have used uniaxial accelerometers (Santos et al., 2012; Davis et al., 2014; Sardinha et al., 2015), the present study used a triaxial accelerometer to assess sedentary behavior, which may have yielded more accurate results among the older population than those obtained using an uniaxial accelerometer (Yamada et al., 2009).

Although this study adjusted for a comprehensive range of potential confounders based on community-dwelling older Japanese adults by using objective measurements, several limitations of the present study should be noted. First, the accelerometer data are limited by that they cannot capture postural information (i.e., sitting vs. standing still), which is possibly to overestimate sedentary time. Second, this study adopted a cross-sectional design, and thus could not provide a direction of causality. Finally, convenient sampling, exclusion criteria of accelerometer data, self-selection bias (older adults who were relatively healthy could be more willing to participate in the present study) and the low response rate may compromises generalizability; therefore, the study sample may not likely represent the population of older Japanese adults.

In summary, the present study extended the knowledge that associations of total amount and patterns of objectively measured sedentary behavior with performance-based physical function were observed only in older women, which were drawn from the convenience sample. These findings highlight that more total daily sedentary time and longer duration of prolonged sedentary bouts (≥30 min) were associated with lower levels of mobility performance only in older women. This paper provides vital information for further studies to design sedentary behavior intervention strategies for older adults with similar lifestyles. Further studies using prospective design to confirm our results are still warranted.

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Disclosure statement

The authors declare no conflicts of interest.

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