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Original Article

Age-associated changes in the level of physical activity in elderly adults

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Abstract. [Purpose] This study aimed to clarify how light-, moderate-, and vigorous-intensity physical activity in older adults changes with age, subdividing physical activity according to intensity levels, by using an accelerometer. [Subjects] Older adults living independently in the community were included (n = 106, age: 65–85 years). [Methods] A triaxial accelerometer was used to measure the amount of light-, moderate-, and vigorous-intensity physical activity (1–2.9, 3–5.9, and ≥6 metabolic equivalents, respectively) and inactive time over 7 days. Light- and moderate-intensity physical activity levels were further subdivided into 1–1.9, 2–2.9, 3–3.9, and 4–5.9 metabolic equivalents, respectively. [Results] The amount of moderate-intensity physical activity at both sub-levels showed significant inverse correlations with age (r = −0.34, −0.33, respectively), but this was not seen with other levels. Both levels of moderate-intensity physical activity were independently predicted by age using multiple regression analysis adjusted for gender and body mass index. [Conclusion] These results suggest that understanding the reduction in moderate-intensity physical activity with age in older adults, subdivided according to intensity level, could be a useful index to increase the amount of higher intensity physical activity in stages, considering individual health conditions.
Key words: Physical activity, Age, Older adults

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INTRODUCTION

Physical inactivity has been estimated to be the fourth leading risk factor for global mortality[1)]. Heart disease and stroke, the second and fourth leading causes of death in Japan, respectively, are also related to physical inactivity (such as increased sitting time)[2, 3)]. For adults aged ≥65 years, the Japanese official physical activity guidelines for health promotion published in 2013 recommended 40 min/day of physical activity (PA), irrespective of the level of intensity[4)]. It has been also reported that higher intensity aerobic exercise is more effective for reducing arterial stiffness, which is related to cardiovascular events[5, 6)]. Therefore, it is important to prevent the amount of total PA and higher intensity PA from decreasing in older adults, to preserve or promote health and to inhibit the development of diseases such as cardiovascular disease.

The total amount of PA undertaken decreases with age in people aged ≥52 years[7)], with moderate-vigorous-intensity PA decreasing and light-intensity PA (LIPA) increasing with age[8)]. It has also been reported that, in both males and females aged over 60 years, the number of steps taken daily decreases, and total PA, LIPA, and moderate-vigorous-intensity PA are lower than those in younger people[9, 10)]. Total daily activity decreases with age in older adults[11)]. The prevalence of chronic conditions (e.g., hypertension) is higher in older adults than in younger people[12)]. This suggests that it is important to understand how the relative amounts of LIPA, moderate-intensity PA (MIPA), and vigorous-intensity PA (VIPA) change with age in older adults, but this has so far not been well documented. Particularly, this has not been investigated with PA subdivided according to intensity level to examine the effects of increases in the amount of higher intensity PA, considering individual health conditions. Such an understanding could provide an additional index that may be useful in addressing lower levels of PA and greater levels of physical inactivity, to preserve and promote health, and ultimately to reduce diseases such as cardiovascular events. Therefore, the aim of this study was to clarify how PA undertaken by older adults varies with age, subdividing PA according to intensity level.

SUBJECTS AND METHODS

This cross-sectional study recruited 106 community-dwelling older adults (age range, 65–85) living independently in Shimada city, Shizuoka Prefecture, Japan. The data was collected during 2013–2014. Subjects were excluded if they were unable to measure their PA for 7 consecutive days (Sunday to Saturday) or if they had obvious neurological or

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Table 1. Characteristics of the study subjects (n = 106)

Characteristics	mean ± SD
Gender (male/female)	44/62
Age	72.8±5.4
Height (cm)	152.5±9.1
Weight (kg)	52.2±10.0
BMI (kg/m^2)	22.4±3.0
LIPA$_1$: 1.0–1.9 METs (min/day)	432.6±93.4
LIPA$_2$: 2.0–2.9 METs (min/day)	243.9±80.1
MIPA$_1$: 3.0–3.9 METs (min/day)	48.6±33.5
MIPA$_2$: 4.0–5.9 METs (min/day)	4.8±7.0
IT (min/day)	709.9±107.6
TPA (min/day)	730.1±107.6

BMI: Body mass index, LIPA: Light-intensity physical activity, MIPA: Moderate-intensity physical activity, IT: Inactive time, TPA: Total physical activity (LIPA + MIPA + VIPA)

Table 2. Correlation coefficient of age with physical activity (n = 106)

	r
LIPA$_1$: 1.0–1.9 METs (min/day)	−0.06
LIPA$_2$: 2.0–2.9 METs (min/day)	0.07
MIPA$_1$: 3.0–3.9 METs (min/day)	−0.34 *
MIPA$_2$: 4.0–5.9 METs (min/day)	−0.33 *
IT (min/day)	0.13

* p < 0.05
LIPA: Light-intensity physical activity, MIPA: Moderate-intensity physical activity, IT: Inactive time

orthopedic diseases that led to difficulty with walking. All subjects read and signed an informed consent form, and this study was approved by the Ethics Committee of Seirei Christopher University.

The amount of PA undertaken by each subject per day was assessed using a triaxial accelerometer (Active Style Pro HJA-350IT, OMRON Healthcare, Kyoto, Japan) continuously worn on the waist from the time the subject woke up until they went to bed, except when bathing or swimming. The accelerometer could accurately obtain not only step counts but also the amount of LIPA, MIPA, and VIPA the subject undertook during the day[13, 14]. These intensities were defined as follows: LIPA, 1.0–2.9 metabolic equivalents (METs); MIPA, 3–5.9 METs; and VIPA, ≥6 METs. For the analysis, LIPA and MIPA were further subdivided into LIPA$_1$ (1.0–1.9 METs), LIPA$_2$ (2.0–2.9 METs), MIPA$_1$ (3.0–3.9 METs), and MIPA$_2$ (4.0–5.9 METs). The time intervals for measuring PA were set at 60 s. The remainder of the day was considered to be inactive time (IT), calculated as 1440 min − (LIPA + MIPA + VIPA). We used 7 days' worth of data for each subject[15]. The subjects wore the accelerometer for 14–21 consecutive days. If data for a day were not obtained appropriately, for example, due to a subject forgetting to wear the accelerometer, or wearing it during sleep, we used the data from the same day of the following week.

Statistical analysis was performed using JMP 11 software (SAS Institute Inc., Cary, NC, USA). The results were expressed as the mean ± standard deviation (SD) and statistical significance was set at $p < 0.05$. Data were included for analysis if the wear time on the accelerometer was ≥8 h/day. The association between PA and age was evaluated by calculating Pearson's correlation coefficients. Multiple regression analysis was used to estimate the relationships between PA and age if significant as response variables; PA, predictor variables; gender and body mass index (BMI).

RESULTS

Table 1 shows the characteristics of subjects in this study. Most subjects undertook little or no VIPA over a week (1 min, n = 6; 2 min, n = 2; 3 min, n = 2; 4 min, n = 3; 5 min, n = 1; 6 min, n =2; 8 min, n = 1; and 9 min, n = 1). No correlation was observed between the amount of LIPA$_1$ or LIPA$_2$ undertaken and age (r = −0.06 and 0.07, respectively; p > 0.05, Table 2). IT was also not associated with age (r = 0.13, p > 0.05, Table 2). However, MIPA$_1$ and MIPA$_2$ were both inversely related to age (r = −0.34 and r = −0.33, respectively; p < 0.05, Table 2). Moreover, MIPA$_1$ and MIPA$_2$ were both independently predicted by age with multiple regression analysis adjusted for gender and BMI (β = −0.36 and −0.34; p < 0.05). In the present study, the mean amounts of LIPA$_1$ and LIPA$_2$ undertaken per day by subjects aged < 75 years (n = 64) were 433.1 ± 98.6 and 238.4 ± 82.1 min/day, and by subjects aged ≥75 years (n = 42) were 431.7 ± 86.0 and 252.2 ± 77.2 min/day.

DISCUSSION

In older adults in the community, negative correlations were observed between age and amount of MIPA$_1$ and MIPA$_2$ but not between age and amount of LIPA$_1$, LIPA$_2$, or IT. Neither LIPA nor IT was correlated with age in this study. The ability of dynamic balance in subjects aged ≥60 years is lower than that in subjects aged 20–39 years[16]. Healthy older adults are mostly occupied with LIPA throughout the day[17]. It has also been reported that total daily activity declines with age in older adults[11]. In the present study, the subjects on average undertook approximately 7 h of LIPA$_1$ and 4 h of LIPA$_2$ each day, with this being predominantly the same irrespective of whether the subjects were younger or older than 75 years. This may be because we recruited more active subjects aged ≥75 years, or because many subjects could have maintained LIPA levels, even those aged ≥75 years. Future studies are needed to further explore the factors that maintain LIPA in adults aged ≥75 years. Moreover, LIPA is undertaken the most (almost 14 hour/day) per day in healthy older adults[17], and the elderly spend 66% of their time being sedentary during the waking day[18]. Thus, LIPA and IT might not be related to age because of reduced individual differences. IT was calculated as the part of the day without LIPA, MIPA, or VIPA. A significant inverse correlation was observed between LIPA$_1$ and LIPA$_2$ and IT (Pearson's, r = −0.94 and −0.95, respectively; p < 0.05). The relationship between IT and age might not show because of being affected by LIPA.

The mean amounts of $MIPA_1$ and $MIPA_2$ undertaken were inversely related to age in this study. $MIPA_2$ was reduced compared with $MIPA_1$ at older ages, and VIPA (≥6 METs) was not observed in most subjects over the course of a week. This is in accordance with a previous report showing that physical activity levels decrease with age in adults ≥52 years[7]. It has been reported that elderly people spend only 3% of their day in moderate-vigorous-intensity PA[18]. After retirement, total PA decreases, and household or recreational PA increases[19]. It has been reported that leisure-related PA increases after retirement[20]. For example, home activities, such as kitchen activity and playing with a child (moderate effort), have been classified as 3–3.9 METs ($MIPA_1$); doing laundry (moderate effort) and organizing a room are classified as 4–5.9 METs ($MIPA_2$); special activities, such as gardening (moderate effort) and water calisthenics, have been classified as 3–3.9 METs ($MIPA_1$) and 4–5.9 METs ($MIPA_2$), respectively; while hiking, swimming leisurely, and climbing hills, are classified as ≥6 METs (VIPA)[21, 22]. Thus, encouraging older adults to continue or expand their home roles and leisure time activities may help prevent a reduction in PA. On the other hand, self-efficacy, and stages of change in attitude towards exercise behavior, farm work, employment, and household income are related to PA[23, 24]. These factors should be taken into consideration when promoting PA in older adults.

There are some limitations to this study. First, the number of subjects was small. Second, the criteria for selecting subjects (such as active or inactive) may not have been sufficient. Third, the cross-sectional design of the study meant that it could not indicate cause and effect. Future studies should recruit more selected participants to investigate how PA is affected by age in a prospective cohort of adults aged ≥65 years.

In conclusion, our results suggest that medium intensity activity declines with age in older adults. Understanding reductions in both $MIPA_1$ and $MIPA_2$ may lead to a useful approach for preventing the decrease of PA with age and preserving or promoting health.

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