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Original Article

Changes in physical function in older females over a 5 year period

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Abstract. [Purpose] The quality of physical functions was evaluated prospectively in older females over a 5 year period to identify the physical functions that are more likely to consistently decline or be maintained in females aged 65–74 years and more than 75 years. [Participants and Methods] Physical functions, including grip strength, walking speed, and balance, were measured for older females aged 65–74 years group and more than 75 years group from 2015 to 2019. T-scores of the physical performances were calculated to analyze the changes in the physical functions over 5 years. [Results] Based on the T-scores, physical functions in terms of the 5-m walking speed, timed up-and-go test, and functional reach test, improved from 2015 to 2019 in the 65–74 group, whereas all physical functions consistently deteriorated in the older than 75 group. [Conclusion] There was no significant decline of the physical functions in both groups; however, the T-score variations for physical functions during the 5 year observation period differed in each group.

Key words: Aging, Older people, Physical function

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INTRODUCTION

The population of Japan comprises a high proportion of aging adults. In 2020, 28.4% of the Japanese population comprised older adults; this number is expected to increase in the future[1)]. In 2016, the average life expectancy of older adults in Japan was 80.98 years for males and 87.14 years for females[1)]. For many years, the average life expectancy of females in Japan has been the highest globally. The reasons for the high life expectancy include improvements in the living environment, diet and nutrition, advances in medical technology, and the introduction of long-term care insurance. Long-term care insurance is a system unique to Japan. It was implemented in 2000 as a way for society to support the care of older people. The system supports the independence of older individuals, selection of medical and welfare services, and implementation of measures to prevent the need for long-term care. In Otawara, Tochigi Prefecture, where this study was performed, a community-care prevention project offering regular physical function testing started in 2006. Physical function tests are conducted yearly to measure grip strength (GS), walking speed (WS), and balance. Females tend to be more likely to participate in community-care prevention projects[2)]. The social roles of older people are also changing in Japan due to increasing life expectancy and extended working age. In 2019, the difference between average life expectancy and healthy life expectancy for females was 12.06 years, which was longer than the 8.73 years for males. This implies that females are living longer than males with some form of disability. Therefore, it is necessary to study longitudinal changes in physical function in older females[3)]. Many older people still possess sufficient physical strength to contribute to society[4)]. In addition, physical functions, such as WS[5)], GS, independent activities of daily living[6)], balance[2)], and other physical functions are improving in older people in Japan.

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Previous studies[2, 5, 6] were large-scale studies with large sample sizes. However, it is difficult to collect a large sample size in our target area (i.e., Otawara City) because of its smaller population than that of target areas of these previous studies. We therefore thought that a longitudinal analysis of the same participants would enable us to understand the characteristics of physical function even with a small sample size. In this study, we sought to conduct a longitudinal study of physical function, including WS, GS, and balance, among older females aged 65–74 and more than 75 years who consistently participated in the physical function measurement project over 5 years to identify the functions that tend to decline and those that tend to be maintained in different age groups. We believe that the results of this study provide basic data for developing intervention strategies for different age groups when implementing long-term care prevention projects.

PARTICIPANTS AND METHODS

Participants of this study are older females (≥65 years old) living in the community who were not certified for requiring long-term care at baseline in 2015. They were recruited from each region in Otawara, Tochigi Prefecture from April 2015 to March 2019 and participated in the physical function measurement. The exclusion criteria were as follows:1) requiring long-term care insurance service; 2) male gender; and 3) participation in the program for less than 5 years. In 2015, there were 363 participants, with a mean age and standard deviation of 78.2 ± 6.2 years; 106 of these participants were aged 65–74 years, and 258 were aged 75–96 years.

We measured the 5-m WS (5mWS), GS, timed up-and-go (TUG) test, functional reach test (FRT), and one-leg standing time (OLST). These assessments were performed twice, and the best data were used for analysis.

To assess the 5mWS, the time (in seconds) required to walk a 5-m distance was measured. In the TUG test, we measured the time it took participants to stand up from a chair, walk a distance of 3 m at a maximum safe pace, change direction, walk back to the chair, and sit down again[7]. The FRT measured the maximum distance that the participants could reach by extending their arms forward while maintaining a standing position[8]. The participants were instructed to keep the heel of their foot in contact with the floor during the FRT. The OLST measured the time for which the participants could stand on one leg without support and with eyes open. The criterion for OLST termination was when the lifted lower limb contacted the ground or when the supported lower limb moved, or when the measurement time exceeded 60 s. GS was measured twice on each side in a standing posture using a Smedley-type handheld dynamometer (Takei Scientific Instruments Co. Ltd., Niigata, Japan), and the maximum value was used for analysis.

For this longitudinal study, we used data from the physical function assessments from Otawara City conducted from 2015 to 2019 and the study was conducted in cooperation with the International University Health and Welfare and Otawara City. This study was conducted in accordance with the Declaration of Helsinki and privacy protection guidelines of Otawara City and was approved by the Ethics Review Committee of the International University of Health and Welfare (18-Io-158-2). After explaining the assessments to the participants, the investigators acquired written informed consent from all participants.

Participants were assigned to the following two groups according to their age in 2015: those aged 65–74 years formed the 65–74 group, whereas those aged more than 75 years formed the ≥75 group.

For characteristics (height and weight) and each physical function, a two-way analysis of variance (ANOVA) was used to compare time factors (i.e., 5 years from 2015 to 2019) and age factors (i.e., 65–74 group and ≥75 group). For age factors showing the main effect, the Dunnett method was used as a post hoc test, with 2015 as the reference year. All statistical analyses were performed using SPSS Statistics version 25.0 (IBM Inc., Armonk, NY, USA), with the significance level set at 5%.

T-scores were used to visually compare age-related changes in each physical function between the 65–74 group and ≥75 group. Positive T-score values indicated values greater than the 2015 values, and negative T-score values indicated values less than the 2015 values. T-scores were calculated using the following equation: (individual value − mean of both time coefficients and both age group coefficients for each year) / standard deviation[9]. The reference values for 2015 were used as a reference for the T-scores. The signs of positive and negative T-score values were reversed because a greater value in the TUG indicates a decline in physical functioning.

RESULTS

Figure 1 shows the flow chart for participant recruitment. There were 70 participants in the study; 25 were aged 65–74 years, and 45 were aged 75–90 years.

Table 1 presents the mean ± standard deviation for each physical function over 5 years in both age groups. The two-way ANOVA showed that the year factor had no significant effect on any parameter (5mWS: F=0.22; GS: F=0.95; TUG: F=0.62; FRT: F=2.24; OLST: F=0.72) and that there was no correlation of age and year factors (5mWS: F=0.77; GS: F=0.11; TUG: F=0.40; FRT: F=1.15; OLST: F=0.08). On the other hand, the age factor had a significant effect on all physical function items (5mWS: F=32.97; GS: F=10.31; TUG: F=50.78; FRT: F=22.33; OLST: F=65.96).

Figures 2 and 3 show the T-scores of the relative changes in physical function for each parameter, by year, from 2015 to 2019 in both the 65–74 group and ≥75 group. In the 65–74 group, physical function in terms of the 5mWS, TUG, and FRT increased from 2015 to 2019. In the ≥75 group, all physical function parameters decreased over time.

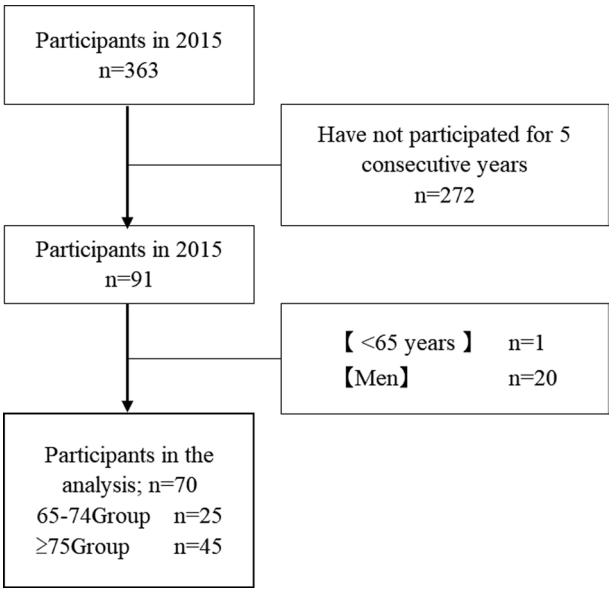

Fig. 1. Participant recruitment.

Table 1. Characteristics and physical function over a five-year period in the two groups

		2015	2016	2017	2018	2019	p-value		
							Year factor	Age factor	Interaction
Height (cm)	65–74 group	150.8 ± 5.7	150.6 ± 5.8	150.5 ± 5.9	150.3 ± 6.0	150.0 ± 5.7	0.88	*	1.00
	≥75 group	146.6 ± 6.2	146.6 ± 6.3	146.2 ± 6.3	145.7 ± 6.0	145.5 ± 6.4			
Weight (kg)	65–74 group	55.9 ± 7.4	56.2 ± 7.4	55.6 ± 7.4	55.8 ± 8.0	55.5 ± 7.5	0.93	*	0.99
	≥75 group	49.7 ± 6.8	49.5 ± 6.9	49.1 ± 6.4	48.4 ± 6.9	48.3 ± 7.1			
5mWS (m/s)	65–74 group	1.4 ± 0.2	1.4 ± 0.2	1.4 ± 0.2	1.5 ± 0.3	1.5 ± 0.2	0.93	*	0.55
	≥75 group	1.3 ± 0.3	1.3 ± 0.3	1.2 ± 0.3	1.3 ± 0.4	1.2 ± 0.3			
GS (kg)	65–74 group	22.7 ± 4.4	23.4 ± 4.3	22.3 ± 4.2	22.8 ± 3.0	21.6 ± 4.3	0.44	*	0.98
	≥75 group	21.3 ± 4.9	21.5 ± 4.1	20.9 ± 4.9	20.7 ± 4.2	20.4 ± 4.9			
TUG (s)	65–74 group	6.3 ± 0.8	6.0 ± 0.8	6.3 ± 0.9	6.2 ± 0.8	5.9 ± 0.9	0.65	*	0.81
	≥75 group	7.3 ± 1.6	7.0 ± 1.4	7.4 ± 1.9	7.5 ± 1.9	7.5 ± 1.9			
FRT (cm)	65–74 group	34.6 ± 7.9	37.64 ± 6.5	38.8 ± 5.1	38.0 ± 5.8	37.3 ± 4.6	0.06	*	0.33
	≥75 group	33.5 ± 6.7	34.9 ± 7.4	34.8 ± 6.2	34.2 ± 7.0	31.5 ± 6.5			
OLST (s)	65–74 group	50.7 ± 17.4	47.9 ± 18.3	44.7 ± 21.2	47.0 ± 18.0	43.8 ± 21.6	0.58	*	0.99
	≥75 group	29.9 ± 24.1	26.9 ± 20.9	27.6 ± 21.9	27.5 ± 21.7	24.2 ± 22.5			

Values are presented as mean ± standard deviation. 65–74 group: participants aged 65–74 years; more than 75 group: participants aged ≥75 years. 65–74 group: n=25. ≥75 group: n=45. *p<0.05. 5mWS: 5-m walking speed; GS: grip strength; TUG: timed up-and-go; FRT: functional reach test; OLST: one-leg standing time.

DISCUSSION

We conducted a five-year longitudinal study of the changes in physical function of two groups of older females, namely, the 65–74 group and ≥75 group. There were no significant declines in either group from 2015 to 2019 in all physical functions tested. In other words, both groups maintained their physical function over the five-year period. However, the T-score results showed that the two groups showed different trends in physical function.

In the 65–74 group, T-scores for 5mWS, TUG, and FRT were higher in 2019 than in 2015. In the same group, GS and OLST were lower in 2019 than in 2015. On the other hand, in the ≥75 group, T-scores were lower in all categories in 2019 than in 2015. It is common for physical functions to decline with age. However, recent reports[3, 5] have shown rejuvenation of physical functions in older individuals in Japan, which has attracted attention.

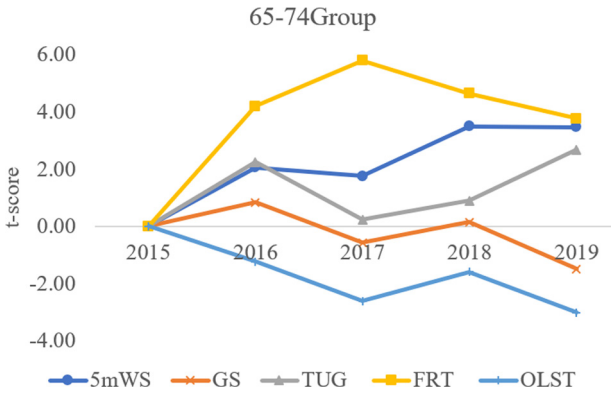

Fig. 2. T-score in the aged 65–74 years group.
T-score: (individual value − mean of both time coefficients and both age group coefficients for each year) / standard deviation. 5mWS: 5-m walking speed; FRT: functional reach test; GS: grip strength; OLST: one-leg standing time; TUG: timed up-and-go.

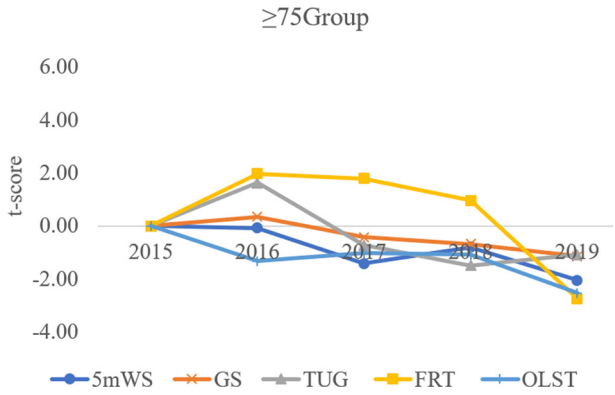

Fig. 3. T-score in the aged more than 75 years group.
T-score: (individual value − mean of both time coefficients and both age group coefficients for each year) / standard deviation. 5mWS: 5-m walking speed; FRT: functional reach test; GS: grip strength; OLST: one-leg standing time; TUG: timed up-and-go.

T-score results showed that, compared to 2015, WS was higher in the 65–74 group and lower in the ≥75 group in 2019. A previous study[10] showed that WS decreases with age and influences the occurrence of disability. The present results suggest that the ≥75 group may be at higher risk of falls and disability in the future than the 65–74 group, since the ≥75 group had lower WS T-scores in 2019 than in 2015.

The GS T-score changed by a similar degree in both groups, with a gradual decline from 2015 to 2019. GS is an indicator of health status[11] and has been adopted as a diagnostic criterion for sarcopenia[7]. The diagnostic criterion for sarcopenia is <18 kg GS for females. In 2019, the mean GS values were 21.6 ± 4.3 and 20.4 ± 4.9 kg for the 65–74 group and the ≥75 group, respectively. Both values in our study were higher than the standard value. The GS of older people with chronic diseases is lower than that of healthy older people[12]. Therefore, it is important to continuously assess GS using physical function measurements.

TUG and FRT results showed similar changes in the 65–74 group, as both values were higher in 2019 than in 2015; however, TUG and FRT values in the ≥75 group had declined moderately by 2019. A previous study on the TUG test[13] set its cut-off value at 9 s. In our study, both groups had TUG values below this cut-off value, indicating a low fall risk. The FRT was >30 cm in both groups, which is higher than that reported for older people in a previous study[14]. However, for the ≥75 group, the TUG and FRT T-scores were lower in 2019 than in 2015. The extent of change in these figures requires continued investigation.

The changes in the OLST were similar in both groups. A previous study[15] reported that patients with falls in the past year had a shorter OLST than those without falls. Although the decline in T-scores was similar between the two groups in our study, the OLST at baseline was approximately 20 s shorter in the ≥75 group, suggesting a higher fall risk in this group compared to the 65–74 group. Additionally, decreased visual acuity increases the likelihood of balance disorders[16]. Moreover, based on the findings of a preliminary study in Otawara, 15.5% of the older complain of "eye diseases". This could be one of the reasons why OLST in 2019 was shorter in both groups than in 2015.

Our study had some limitations. First, only females were included in the study. Second, the sample size was small. Finally, discerning the chronic diseases affecting individual patients was difficult. However, we believe that our findings provide valuable information about the longitudinal changes in measurements of physical function over the five years.

This is the first study to provide longitudinal data on the physical function of older Japanese individuals. Both age groups (65–74 group and ≥75 group) showed no significant changes between 2015 and 2019 in all physical function tests. In other words, both groups maintained their physical function over the five-year period. Our results provide valuable data for the future.

Funding

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Conflict of interest

None.

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