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Original Article

Classification and comparison of the physical characteristics and functions of various age groups of community-dwelling elderly individuals participating in the Kayoi-no-ba program

Naritoshi Sato[1)], Kosuke Takano[1)], Isamu Konishi[1)], Ryosaku Kobayashi[1)], Kazuo Ishigami[1)], Naohiko Kinoshita[1)], Tomonori Nomura[1)], Toru Nagai[1)], Hiroyuki Masuda[1)], Daisuke Sato[1)], Wataru Uchiyama[1)], Masaru Kanda[1)*]

[1)] *Niigata University of Health and Welfare: 1398 Shimami-cho, Kita-ku, Niigata 950-3198, Japan*

Abstract. [Purpose] To classify and compare the physical characteristics and functions of community-dwelling elderly individuals of various age groups participating in the Kayoi-no-ba program. [Participants and Methods] A total of 176 community-dwelling elderly individuals living in six cities and towns in the Niigata Prefecture who participated in the Kayoi-no-ba program between 2018 and 2020 were recruited in this study. Physical characteristics, such as strength, balance, and mobility, were assessed. [Results] Among elderly females and males who participated in the Kayoi-no-ba program, those >80 years of age showed shorter height, lighter weight, and lower body muscle mass than the other age groups. Strength, balance, and mobility functions, including grip strength, sit-to-stand test, single-leg-stand test, and timed up-and-go test, were significantly decreased, especially in patients aged >80 years. [Conclusion] Among community-dwelling elderly individuals participating in the Kayoi-no-ba program, physical characteristics and functions were affected by aging, with significant decline particularly in those aged >80 years old. These findings suggest that early intervention is necessary to maintain muscle mass, strength, balance, and mobility in the elderly.

Key words: Community-dwelling elderly people participating in the Kayoi-no-ba program, Physical characteristics, Physical functions

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INTRODUCTION

The National Institute of Social Security and Human Affairs have reported that in 2015, individuals aged 65 years and older accounted for 26.6% of the Japanese population. However, considering the persistently low birth rates, this percentage is expected to increase to 33.4% by 2035 and to 41.2% by 2065. This implies that there would be one older adult for every 2.4 people[1)]. Japan has transitioned into a super-aging society, prompting the Ministry of Health, Labour and Welfare to initiate the "Kenkojumyo Enshin Plan (healthy lifespan extension plan)" in 2019, a program focused on three key areas, namely, the development of healthy lifestyle habits for all, including the younger generation; the prevention of epidemics and mitigating the severity of health conditions; and decreasing in the demand for long-term care and the implementation of measures to prevent frailty and dementia[2)]. Of these three areas, the third aspect calls for the "expansion of opportunities for social engagement (hereafter Kayoi-no-ba program)". A study by Tajika et al.[3)] reported that individuals participating

*Corresponding Author. Masaru Kanda (E-mail: kanda@nuhw.ac.jp)

in the Kayoi-no-ba program, which includes activities focused on frailty prevention, experienced reduced levels of frailty and worsening of the risk score for requiring long-term care compared with non-participants. Furthermore, this effect was significantly more pronounced among those who participated in the program for 3 years or longer[3]. Additionally, the study also reported a gradual improvement in the participants after 2 years of involvement, and significant improvement after 4 years of involvement in the Kayoi-no-ba program which was focused on exercise. Moreover, the Ministry of Health, Labour and Welfare reported gradual improvement in the participants after 3 years of involvement, and significant improvement after 6 years of involvement in the Kayoi-no-ba program which was focused on meeting covering hobbies or having meals[4]. As described, the Kayoi-no-ba program has shown a considerable degree of effectiveness in preventing the need for long-term care. However, it is anticipated that participants of the Kayoi-no-ba program will encompass a wide range of age groups. Therefore, we believe that the interventions should be tailored to specific areas and methods, while considering the distinct physical characteristics and functionalities of each age group. Therefore, this study aimed to classify and compare the physical characteristics and functions of the community-dwelling elderly people participating in the Kayoi-no-ba program, within various age groups.

PARTICIPANTS AND METHODS

This cross-sectional study targeted 204 community-dwelling elderly people living in six cities and towns in Niigata Prefecture (Niigata City, Shibata City, Tainai City, Itoigawa City, Tsunan Town), who participated in the Kayoi-no-ba program between 2018 and 2020. This study was approved by the Ethics Review Board of the Niigata University of Health and Welfare on September 19, 2018 (Approval No. 18066-180919). Prior to their participation in the study, all participants were provided with the study details, and their written consent were obtained. The Kayoi-no-ba program under investigation in this study was independently administered by local residents and was conducted in the form of a weekly exercise program. The participants were the community-dwelling elderly people included pre-frail older adults, older adults who required support, and healthy older adults who were mainly independent and were able to attend the Kayoi-no-ba program. Furthermore, the participants must have attended the long-term care prevention program of the Kayoi-no-ba at least once per week. Among the participants, completing two assessments (physical characteristics and strength, balance and mobility function) were considered eligible for this study. Accordingly, 132 were females (age group distribution: 30 in 60s, 61 in 70s, and 41 in over 80), whereas 44 were males (age group distribution: 37 in 70s, and 11 in over 80) (Table 1).

The height, weight, and body mass index (BMI) were measured as basic attributes. A body composition analyzer (MC-780A, TANITA, Tokyo, Japan) based on the bioelectrical impedance analysis was used to assess body composition (whole body muscle mass, trunk muscle mass, upper extremity muscle mass, and lower extremity muscle mass), excluding fat mass and estimated bone mass.

Assessments for physical strength, balance and mobility function included “grip strength”, “chair-stand test (CS-30, measured as the number of repetitions within 30 s)”, “sit-to-stand test (SS-5, measured as the time to complete five repetitions)”, “single-leg-stand test”, and “timed up and go test (TUG)”.

A digital grip dynamometer (Takei Kiki Kogyo, Niigata, Japan) was used to measure grip strength. Following the method of Nakatani et al., CS-30 was conducted using a chair, 40 cm in height with no armrests[5]. Similarly, the SS-5 was measured by the time taken to complete five repetitions of a sit-to-stand action, following the method of Bohannon et al[6].

The single-leg-stand test was measured using a digital stopwatch, and two trials were conducted for each leg, with a maximum duration of 60 s for each trial. The recorded result was the longer of the two measured times.

The TUG test was performed according to the method of Podsiadlo and Richardson[7]. The chair used for the test was 40 cm height. A mat switch and a time-measuring device (Takei Kiki Kogyo) were used to automatically and precisely measure the time for this process.

In the statistical analysis, we initially performed a preliminary examination using the Shapiro–Wilk test. If there was a normal distribution, we confirmed the homogeneity of variance through Levene’s test. Thereafter, we performed one-way analysis of variance. Subsequently, post-hoc testing using the multiple comparison method was performed and corrected using the Bonferroni technique. The significance level for correction using the Bonferroni method was set at 0.017 (0.05/3). If a normal distribution was not observed, the Kruskal–Wallis test was performed. Post-hoc testing was performed using the multiple comparison method, and correction was performed using the Bonferroni method. SPSS version 27.0 (IBM Japan, Tokyo, Japan) was used for statistical processing, and the significance level for all tests was set at 5%.

Table 1. The number of participants

	60s	70s	Over 80	N
Female	30	61	41	132
Male	–	34	11	44
N	31	102	57	176

RESULTS

The height of female participants in over 80 was significantly shorter than those of 60s and 70s, and that of male participants in over 80 was significantly shorter than those of 70s. The weight of female participants in over 80 was significantly lighter than those of 60s and 70s, and that of male participants in over 80 was significantly lighter than those of 70s. Furthermore, there were no significant differences in BMI of both female and male participants across the different age groups (Table 2).

The muscle mass of the whole body, trunk, upper extremity, and lower extremity in female participants in over 80 was significantly lower values than those of 60s and 70s, and that in male participants in over 80s was significantly lower values than those of 70s (Table 2).

The grip strength of female participants in over 80 was significantly lower values than those of 60s and 70s, and that of male participants in over 80 was significantly lower values than those of 70s. The number of CS-30 of female participants in over 80 was significantly lesser than those of 60s and 70s; however, there was no significant difference in male participants. The time of SS-5 of female participants in over 80 was significantly slower than those of 60s and 70s; however, there was no significant difference in male participants. The time of right single-leg-stand test of female participants in over 80 was significantly shorter than those of 60s and 70s and those in 70s was significantly shorter than 60s; however, there was no significant difference in male participants. The time of left single-leg-stand test of female participants in over 80 was significantly shorter than those of 60s and 70s and those in 70s was significantly shorter than 60s, and that of male participants in over 80 was significantly shorter than those of 70s. The time of TUG of female participants in over 80 was significantly slower than those of 60s and 70s; however, there was no significant difference in male participants (Table 3).

DISCUSSION

The results of this study revealed that the height and weight of female participants in over 80 was significantly shorter and lighter than those of 60s and 70s, and that of male participants in over 80 was significantly shorter and lighter than those of 70s. Comparing the results from our study with the statistics compiled by the National Statistics Center, Statistics Bureau of Japan, Ministry of Internal Affairs and Communications[8], no major differences were found in females. Although males revealed slightly shorter height and lighter weight, there was no significant difference in BMI. Similarly with above results, the muscle mass of the whole body, trunk, and upper and lower extremity in female participants in over 80 was significantly lower values than those of 60s and 70s, and that in male participants in over 80 was significantly lower values than those of 70s. Tanimoto et al.[9] reported that muscle mass decreases with age in both male and female. Furthermore, based on each body part, it has been reported that both male and female lose upper extremity muscle mass after their 60s, lower extremity muscle mass after their 20s, and trunk muscle mass after their 50s. These results suggested that interventions need to be implemented to maintain muscle mass before 80 when a significant decrease is observed from 70s at the latest.

According to the results of this study, the grip strength of female participants in over 80 was significantly lower values than those of 60s and 70s, and that of male participants in over 80 was significantly lower values than those of 70s. Comparing the values from the National Center for Geriatrics and Gerontology[10] with the average values for the participants of this

Table 2. Comparison of physical characteristics between 60s, 70s, and over 80 in female and male

		60s	70s	Over 80	
Height	Female	151.7 ± 5.2	151.5 ± 5.7	145.4 ± 5.6	*$
	Male	—	161.5 ± 4.5	152.9 ± 6.5	$
Weight	Female	52.2 ± 6.0	51.6 ± 7.2	47.3 ± 7.0	*$
	Male	—	61.7 ± 8.6	51.8 ± 5.8	$
BMI	Female	22.7 ± 2.5	22.5 ± 3.2	22.4 ± 2.8	
	Male	—	23.7 ± 3.0	22.2 ± 2.3	
Whole body MM (kg)	Female	33.5 ± 2.2	33.1 ± 2.6	30.5 ± 3.3	*$
	Male	—	45.7 ± 3.7	37.3 ± 4.3	$
Trunk MM (kg)	Female	19.4 ± 1.4	19.6 ± 1.6	18.3 ± 1.8	*$
	Male	—	25.7 ± 1.8	21.7 ± 2.4	$
UE MM (kg)	Female	3.1 ± 0.4	3.0 ± 0.4	2.8 ± 0.5	*$
	Male	—	4.6 ± 0.4	3.8 ± 0.4	$
LE MM (kg)	Female	11.0 ± 0.9	10.5 ± 1.1	9.5 ± 1.6	*$
	Male	—	15.3 ± 2.1	11.7 ± 1.7	$

*: 60s vs. over 80 ($p<0.05$), $: 70s vs. over 80 ($p<0.05$).
BMI: body mass index; MM: muscle mass; UE: upper extremity; LE: lower extremity.

Table 3. Comparison of physical strength, balance and mobility function scores between 60s, 70s, and over 80 in female and male participants

		60s	70s	Over 80	
Grip strength (kg)	Female	23.2 ± 3.3	22.5 ± 4.0	19.5 ± 4.3	*$
	Male	—	33.1 ± 4.9	25.2 ± 4.2	$
CS-30 (times)	Female	22.2 ± 6.3	21.8 ± 6.9	17.0 ± 4.9	*$
	Male	—	21.6 ± 5.3	21.6 ± 9.6	
SS-5 (seconds)	Female	7.2 ± 2.1	7.3 ± 2.1	9.2 ± 2.1	§γ
	Male	—	7.0 ± 2.0	8.4 ± 2.9	
RSL (seconds)	Female	42.6 ± 19.4	30.5 ± 23.1	13.9 ± 13.8	*$#
	Male	—	31.1 ± 21.1	17.4 ± 18.3	
LSL (seconds)	Female	42.2 ± 19.9	29.6 ± 22.1	11.9 ± 12.4	*$#
	Male	—	28.3 ± 22.8	8.5 ± 5.8	$
TUG (seconds)	Female	5.2 ± 0.8	5.8 ± 0.9	7.4 ± 1.2	§γ
	Male	—	5.5 ± 1.0	6.2 ± 1.2	

*: 60s vs. over 80 ($p<0.05$), $: 70s vs. over 80 ($p<0.05$), #: 60s vs. 70's ($p<0.05$), §: 60s vs. over 80 ($p<0.05$), γ: 70s vs. over 80 ($p<0.05$).
CS: chair stand; SS: sit-to-stand; SLS: single leg stand; RSL: right single leg stand; LSLS: left single leg stand; TUG: timed up and go.

study, no major differences were found. Furthermore, there were no age groups that corresponded the diagnostic criteria of Chen et al.[11] for Asian sarcopenia (18 kg or less). On the other hand, comparing the values for male with the average value for the male participants in this study, we found that values were lower by more than 5 kg in both age groups. Furthermore, the diagnostic criteria for Asian sarcopenia[11], of 28 kg or less, was found to be applicable for participants in over 80. Ikeda et al.[12] reported that grip strength reflects the overall physical strength of community-dwelling female older adults, which includes lower extremity muscle strength, standing balance, and gait function. Additionally, according to Miyahara[13], a person may require long-term care if their grip strength falls below 20 kg. These results suggested that it is necessary to initiate interventions to maintain grip strength before over 80 when a significant decline is observed from 70s at latest, even if a person does not meet the diagnostic criteria for Asian sarcopenia.

In repetitive sit-to-stand test (CS-30 and SS-5), the scores of female participants in over 80 were significantly lower than those of 60s and 70s. On the other hand, no differences were found among the male participants. Comparing the CS-30 values reported by Nakatani et al.[5] with the average values for the female participants of this study, similar results were obtained in 60s and the results in 70s and over 80 were higher. On the other hand, the average value for the male participants of this study were higher across both age groups. Compared with the values reported by Bohannon et al.[6] and by Sakamoto et al.[14], the average values of our study participants were higher. Repetitive sit-to-stand test is also used to evaluate the relationship between lower extremity muscle strength[5] and dynamic balance[15]. The relationship between lower extremity muscle strength and physical function has also been reported[6]. Considering the results of this study, the values were higher than those of the previous studies mentioned above. However, we believe there is a need to conduct interventions to maintain lower extremity muscle mass before the age of 80 years, the age of 70 years at the latest.

The time of right single-leg-stand test of female participants in over 80 was significantly shorter than those of 60s and 70s and those in 70s was significantly shorter than 60s; however, there was no significant difference in male participants. The time of left single-leg-stand test of female participants in over 80 was significantly shorter than those of 60s and 70s and those in 70s was significantly shorter than 60s, and that of male participants in over 80 was significantly shorter than those of 70s. A summary by the Ministry of Health, Labour and Welfare[16] reports that there is an increased risk of requiring long-term care if the single-leg-stand test time is less than 10 seconds for females and less than 20 seconds for males. This was not the case for the female participants in this study. On the other hand, this was the case for male participants in over 80. Furthermore, according to the Japanese Orthopaedic Association[17] report, "Musculoskeletal Ambulation Disability Symptom Complex" is considered to occur if the single-leg-stand test time is 15 seconds or less. This result applies to both female and male participants in over 80. Based on the findings from this study, the ability to stand on one leg declined as elderly females and males who participated in the Kayoi-no-ba program reached in 70s and people in over 80 may be at increased risk of Musculoskeletal Ambulation Disability Symptom Complex. These results suggested the need for early intervention to maintain balance before the age of 70 years at the latest, the age of 60 years if possible.

Regarding TUG, the time of female participants in over 80 was significantly slower than those of 60s and 70s; however, there was no significant difference in male participants. Comparing the average values for both female and male from a different study with those for both female and male participants of this study, a slight decrease was seen across all age groups[18]. Furthermore, according to the Japanese Orthopaedic Association[17] report "Musculoskeletal Ambulation Disability Symptom

Complex" occurs if the TUG duration is 11 seconds or more; however, this was not applicable to both female and male participants of this study. Considering the results of this study, elderly females and males who participated in the Kayoi-no-ba program have decreased mobility upon reaching their 80s. This suggests that it is necessary to implement interventions to maintain mobility, starting from 70s at the latest, and even earlier if possible.

As the limitation of this study, the target of participants was community-dwelling elderly participating in the Kayoi-no-ba program. According to the report by the Ministry of Health, Labour and Welfare, the ratio of elderly people who participate in the the Kayoi-no-ba program weekly is less than 2%[19]. The Kayoi-no-ba program involved in this study was only from six cities and towns in Niigata Prefecture; thus, the participants and area targeted by the study were limited. Additionally, the characteristics of each Kayoi-no-ba program are yet to be clarified. There is a need to compare and verify participants who have been confirmed to have an underlying disease at a medical institution or participants with low ADL function in future research. Moreover, this study did not include male participants in 60s due to not enough participants. In the future, it will be necessary to compare and verify the results with a greater number of elderly male participants. Furthermore, this study compared and verified physical characteristics and function in each age group among elderly people. However, the study did not verify how physical characteristics and function influence each other; in the future, there is a need to compare and verify this.

In conclusion, within the community-dwelling elderly people participating in the Kayoi-no-ba program, it was found that factors such as height, weight, and muscle mass, both in female and male participants, were affected by aging, with significant declines particularly in over 80. Additionally, it was found that grip strength, repetitive sit-to-stand test in female participants were affected by aging, with significant declines particularly in over 80. Moreover, grip strength and single-leg-stand test in male participants were affected by aging, with significant declines particularly in over 80. Furthermore, single leg stand test in female participants was affected by aging, with significant declines particularly from 70s. These findings suggested that early intervention is necessary in maintaining muscle mass, strength, balance, and mobility function, especially static balance function in elderly female participants and muscle mass for elderly male participants.

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Conflict of interest

None.

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