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Research Article

Comparison and Relationship of the Physical Characteristics and Functions of Older Females Participating in Community Salons (Kayoinoba in Japanese) -Classifying into Different Age Groups

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Abstract

The purpose of this study was to compare the physical characteristics and functions of 132 older women participating in community salons by classifying them into different age groups and comparing and examining the relationships among them. It has been suggested that they show a decline in "height," "weight," and "muscle mass" with age, especially from their 80s. In addition, it has also been suggested that physical functions such as "grip strength," and "sit-to-stand" decline in the 80s, and balance functions such as "one-leg stand (left and right)" and "TUG" decline, especially in the 70s. Furthermore, these functions have been associated with muscle mass. In particular, "grip strength" and "TUG" have been associated with "trunk muscle mass".

Background

The percentage of Japan's older (aged 65 and above) population was 26.6% in 2015, and according to the low variant projection, it will be 33.4% in 2035 and 41.2% in 2065 (this would be one out of every 2.4 persons) [1]. In this super-aging society, the Ministry of Health, Labor, and Welfare (MHLW) has launched the "Healthy Lifespan Extension Plan" [2], which focuses on three areas: (1)

the formation of healthy lifestyles for all people, including the next generation, (2) prevention of epidemics and serious illnesses, and (3) prevention of disability, measures against frailty, and prevention of dementia. The third area, "prevention of disability, measures against frailty, and prevention of dementia," calls for the "further expansion of community salons (kayoinoba)." According to a previous study, compared with non-participants, community salon participants showed reduced worsening of frailty and lower disability risk scores, and the effect was particularly significant among those who participated for three years or more [3]. In

addition, the study reported that the effect of a reduction in the incidence of disability was gradual among participants in exercise-centered community salons after 2 years and significant among participants after 4 years. In a study of community salons for lunch meetings, coffee breaks, and hobbies, a moderate difference in the reduction of the incidence of disability was observed after 3 years, and a significant difference was observed after 6 years among the participants [4]. As shown above, community salons have been effective in the prevention of disability to a certain level. However, the age of participants in community salons varies, as they include younger-olds and older-olds. In addition, it has been reported that approximately 80% of the participants of community salons are females [5], and that the difference between the average life expectancy and healthy life expectancy is larger for females than for males [6]. We believe that implementing interventions for older females who participate in community salons by understanding the physical characteristics and physical functions of different age groups and focusing on specific bodily sites and methods will lead to more effective disability prevention. Therefore, the purpose of this study was to compare the physical characteristics and functions of older females participating in community salons by classifying them into different age groups and comparing and examining the relationships among them.

Methods

Research design and subjects

This study was a cross-sectional study of 155 older females residing in five municipalities in Niigata Prefecture (Niigata City, Shibata City, Tainai City, Itoigawa City, and Tsunan Town) who participated in community salons from 2018 to 2020. This study was approved by the Ethics Review Committee of Niigata University of Health and Welfare (18066-180919). All subjects were informed of the content of the study and they provided their consent to participate in the study in writing. The selection criteria were that the participants were frail older adults, older adults requiring support, or healthy older adults who were independent and able to participate in kayoinoba. Only females who attended the care prevention program at a kayoinoba once a week and had completed two assessments (body composition assessment and physical function assessment) were considered eligible for inclusion in this study. Accordingly, 132 females (Group A: 30 participants in their 60s; Group B: 61 participants in their 70s; and Group C: 41 participants in their 80s) were included in the study (Table 1).

	A: 60's	B: 70's	C: over 80's	Total
Female	30	61	41	132

Table 1: Subjects.

Evaluation

Physical characteristics assessment; Basic attributes and body composition

Height, weight, and body mass index (BMI) were measured as basic attributes. Furthermore, body composition assessment (whole-body muscle, trunk muscle, upper limb muscle, and lower limb muscle tissue mass) excluding the fat mass and estimated bone mass using a BIA body composition analyzer (MC-780A, TANITA, Japan) was performed.

Physical and balance functional assessment

Physical function assessment included "grip strength," "sit-to-stand test (number of repetitions in 30 seconds [STS-30])," "sit-to-stand test (time to complete five repetitions) (STS-5)," "one-leg standing test," and "Timed Up & Go Test (TUG)."

Physical and balance functional measurement method

A digital hand dynamometer (manufactured by Takei Scientific Instruments Co., Ltd.) was used to measure the grip strength. The maximum grip strength was measured twice with the left and right upper limbs positioned on the sides of the body, and the maximum value was considered the grip strength. According to the method of Nakatani, et al. [7], STS-30 was performed with both the upper limbs crossed in front of the chest while sitting on a 40-cm chair without armrests. At the signal of the examiner, the participants stood up from the chair with their knees fully extended and then sat down again. This was considered as one repetition and the total number of repetitions in 30 seconds was measured. STS-5 was performed in the same way as STS-30, following the method of Bohannon et al. [8], and the time required to complete five repetitions was measured. The maximum time during SLS, which the participant was standing on one leg with the eyes open was measured twice using a digital stopwatch with an upper limit of 60 seconds. The longest time measured was used in the analysis. During this test, both the upper limbs should be on the hips of the participant and the lower limb being lifted should not be in contact with the supporting lower limb. The test was discontinued when there was a change in the support base and when the upper limbs left the side of the hips. The TUG test was conducted according to the method of Podsiadlo and Richardson [9], with the distance between the chair and the target (a mini-cone with a height of 22 cm) set to 3 m (from the tip of the seat to the other side of the mini-cone). The chair was an office chair with a height of about 40 cm and without armrests. At the start, the participants were asked to put the tips of both feet together, spread them about shoulder-width apart, and place both hands on the front of the thighs. The time taken by the participant to stand up at their own will, walk as fast as possible, walk around a target placed 3 m ahead, and then sit down again was measured. Measurements were taken using a

mat switch and time measuring device (Takei Scientific Instruments Co., Ltd.). The time from when the participant's buttocks left the mat switch fixed to the seat surface with double-sided tape to when the participant sat down again was automatically measured in units of 1/100th of a second (TUG time).

Statistical analysis

For the statistical analysis step, a Shapiro-Wilk test was performed in advance. For comparisons between groups, if a normal distribution was observed, Levene's test was used to confirm the equality of variances, followed by a one-way analysis of variance. Post hoc tests were performed using the multiple comparison procedure and corrected using the Bonferroni correction. The significance level after the Bonferroni correction was 0.017 (0.05/3). If a normal distribution was not found, a Kruskal-Wallis test was performed. Post hoc tests were performed using the multiple comparison procedure and corrected using the Bonferroni correction. Pearson's correlation coefficient was used for the association between each functional endpoint and muscle mass when a normal distribution was observed, and Spearman's rank correlation coefficient was used when no normal distribution was observed. SPSS version 27.0 (IBM Japan) was used for statistical processing, and the significance level for all tests was 5%.

Results

Comparisons of participants' height, weight, and BMI

There were no differences in height and weight between female participants in their 60s and 70s. However, significantly lower values were observed among participants in their 80s or older. There were no significant differences in BMI among different age groups (Table 2).

	A: 60's	B: 70's	C: over 80's	p-value
Height(cm)	151.7±5.2	151.5±5.8	149.6±6.3	**<0.01[ab]**
Weight(kg)	52.2±6.0	51.6±7.2	47.3±7.0	**<0.01[ab]**
BMI	22.7±2.5	22.5±3.2	22.5±2.9	0.90
[a]significantly decreased between 60's-80's (p<0.05); Bold value: p<0.05; [b]significantly decreased between 70'S-80'S (p<0.05).				

Table 2: Comparisons of Height, Weight, BMI.

Comparisons of participants' muscle mass

There was no difference in "whole body muscle mass," "trunk muscle mass," "upper limb muscle mass," and "lower limb muscle mass" between female participants in their 60s and 70s in all categories. However, significantly lower values were observed among participants in their 80s or older (Table 3).

	A: 60's	B: 70's	C: over 80's	p-value
Muscle mass(kg)	33.5±2.2	33.1±2.6	30.5±3.3	**<0.01[ab]**
Trunk muscle mass(kg)	19.4±1.4	19.6±1.6	18.3±1.8	**<0.01[ab]**
UE muscle mass(kg)	3.1±0.4	3.0±0.4	2.8±0.5	**<0.01[ab]**
LE muscle mass(kg)	11.0±0.9	10.5±1.1	9.5±1.6	**<0.01[ab]**
UE: Upper Extremity, LE: Lower Extremity; [a]significantly decreased between 60'S-80'S (p<0.05); Bold value: p<0.05; [b]significantly decreased between 70's-80'S (p<0.05)				

Table 3: Comparison of Muscle mass, Trunk muscle mass, UE muscle mass, LE muscle mass.

Comparisons of participants' physical and balance functions

There was no difference between female participants in their 60s and 70s in grip strength and sit-to-stand (STS-30/ STS-5). However, significantly lower values were observed among participants in their 80s or older. The "SLS (right and left)" values were significantly lower among participants in their 70s than among those in their 60s. Similarly, participants in their 80s or older scored significantly lower than those in their 70s. In TUG, the values were significantly higher among those in their 70s than among those in their 60s. Similarly, participants in their 70s scored higher than those in their 80s or older (Table 4).

	A: 60's	B: 70's	C: over 80's	p-value
Grip strength (kg)	23.2±3.3	22.5±4.0	19.5±4.3	**<0.01[ab]**
STS-30 (times)	22.2±6.3	21.8±6.9	17.0±4.9	**<0.01[ab]**
STS-5 (s)	7.2±2.1	7.3±2.1	9.2±2.1	**<0.01[de]**
R SLS (s)	42.6±19.4	30.5±23.1	13.9±13.8	**<0.01[abc]**
L SLS (s)	42.2±19.9	29.6±22.1	11.9±12.4	**<0.01[abc]**
TUG (s)	5.2±0.8	5.8±0.9	7.4±1.2	**<0.01[def]**

SLS: Single Leg Stand; [a]significantly decreased between 60's-80's (p<0.05); Bold value: p<0.05; [b]significantly decreased between 70's-80's (p<0.05); [c]significantly decreased between 60's-70's (p<0.05); [d]significantly increased between 60's-80's (p<0.05); [e]significantly increased between 70's-80's (p<0.05); [f]significantly increased between 60's-70's (p<0.05).

Table 4: Comparison of grip strength, STS-30, STS-5, SLS, TUG.

Relationship between physical and balance functions and muscle mass

In terms of the relationship between physical and balance functions and muscle mass among female participants, "grip strength" had significant positive correlations with "whole body muscle mass," "trunk muscle mass," "upper limb muscle mass," and "lower limb muscle mass." In addition, "sit-to-stand" had a significant correlation (STS-30: positive correlation, STS-5: negative correlation) with "lower limb muscle mass." Furthermore, "SLS" had a significant positive correlation with "lower limb muscle mass." Finally, "TUG" had significant negative correlations with "lower limb muscle mass" "upper limb muscle mass," "whole body muscle mass," and "trunk muscle mass (Table 5)."

	Grip Strength	**STS-30**	**STS-5**	**R SLS**	**L SLS**	**TUG**
MM	**.490**	.169	-.167	**.217[b]**	.150	**-.363**
Trunk MM	**.454**	.027	-.056	.162	.131	**-.233**
UEMM	**.432**	.100	-.106	.071	.058	**-.247**
LEMM	**.376**	**.292**	**-.261**	**.279**	**.203[b]**	**-.426**

MM: Muscle Mass; [a]significant correlation (p<0.01); Bold value: p<0.05; [b]significant correlation (p<0.05)

Table 5: Relationship between physical function and muscle mass.

Discussion

Comparisons of participants' height, weight, and BMI

The results of this study showed that there was no difference between female participants in their 60s and 70s in terms of "height" and "weight," but significantly lower values were observed among participants in their 80s or older. No significant differences in BMI were found among different age groups. According to a study, aging causes a decrease in anterior disc height due to disc degeneration and rotation deformity, resulting in a forward inclination of the trunk, or posterior scoliosis deformity [10]. In other words, an increase in curvature due to age-related deformity may lead to a decrease in height. In addition, another study has reported that a decrease in

the trunk and limb skeletal muscle mass, which constitutes pelvis-lumbar spine support mechanisms, is involved in the progression of spinal column deformity [11]. Furthermore, it has been reported that age-related decline in physical function may reduce appetite, resulting in weight loss [12]. These findings suggest that the "height" and "weight" of community-dwelling older females who participate in community salons decline with age, especially from their 80s.

Comparison of participants' muscle mass

No differences were observed between female participants in their 60s and 70s in "whole body muscle mass," "trunk muscle mass," "upper limb muscle mass," and "lower limb muscle mass." However, significantly lower values were observed among participants in their 80s or older. A study has reported that skeletal muscle mass declines after the age of 20; this decline is approximately 5-10% by the age of 50, and 30-40% between the ages of 50 and 80 [13]. Another study has reported that with aging, mitochondrial dysfunction and intramuscular fat accumulation also occur in skeletal muscle mass, inducing insulin resistance and causing a decrease in skeletal muscle mass [14]. Furthermore, it has been reported that females aged 75 or older (average 79.2 years old) have lower muscle mass in their whole body and lower limbs than do females aged between 65 and 74 (average 70 years old) [15]. In other words, the muscle mass of the whole body, including the upper and lower limbs and trunk, may decrease with age. These findings suggest that the "muscle mass" of community-dwelling older females who participate in community salons declines with age, especially from their 80s.

Comparison of participants' physical and balance functions

There was no difference between female participants in their 60s and 70s in "grip strength" and "sit-to-stand" (STS-30/ STS-5). However, significantly lower values were observed among participants in their 80s or older. A study has reported that grip strength reflects the overall physical fitness of community-dwelling older females, which includes not only lower limb and trunk muscle strength, but also standing balance and applied walking ability [16]. It has been reported that the sit-to-stand test is effective for evaluating lower limb muscle strength in older Japanese persons [7], and it is useful for evaluating lower limb muscle strength and dynamic balance in community-dwelling older females [17]. Grip strength and sit-to-stand tests are even used as diagnostic criteria for sarcopenia, which refers to age-related loss of muscle mass and strength [18,19]. This means that muscle strength and mass and these functions are interrelated and affect each other. These findings suggest that the "grip strength" and "sit-to-stand" ability of community-dwelling older females who participate in community salons decline with age, especially from their 80s. It has also been suggested that these functions may be a potential source of loss of body muscle mass and sarcopenia

incidence.

On the other hand, in the "SLS (left and right)" test, participants in their 70s scored significantly lower than those in their 60s, as did those in their 80s or older, when compared with those in their 70s. A study has reported that the functions of hip muscle groups affect dynamic and static balance in a narrow base support plane [20]. It has also been reported that the one-leg stand test can be a predictor of vulnerability in community-dwelling older adults [21] and that hip adductor muscle function is associated with balance and mobility in older adults [22,23]. According to a study on TUG among community-dwelling older females, those with decreased walking speed in the TUG task showed a decrease in muscle strength [24]. Other studies have also reported associations between TUG and skeletal muscle indices [25], mortality rate [26], and the possibility of future fractures due to falls [27]. This means that muscle function and balance or mobility affect each other, which may result in increased vulnerability and mortality. These results suggest that the "one-leg stand" and "TUG" ability of community-dwelling older females who participate in community salons declines with age, especially from their 70s. It has also been suggested that these functions are indicators of an increased risk of vulnerability and mortality in the subject population.

Relationship between physical and balance functions and muscle mass

In terms of the relationship between physical and balance functions and muscle mass in female participants, significant positive correlations were found between "grip strength" and "whole body muscle mass," "trunk muscle mass," "upper limb muscle mass," and "lower limb muscle mass." In addition, "sit-to-stand" showed a significant correlation (STS-30: positive correlation, STS-5: negative correlation) with "lower limb muscle mass." Furthermore, "SLS" showed a significant positive correlation with "lower limb muscle mass." In addition, "TUG" showed significant negative correlations with "lower limb muscle mass" and "trunk muscle mass." "Grip strength" has been reported to reflect the overall physical fitness of community-dwelling older females, which includes not only their lower limb and trunk muscle strength, but also standing balance and applied walking ability [16]. Musculoskeletal mass has been found to be highly associated with grip strength and physical function [28]. The "sit-to-stand" test has been reported useful for evaluating lower limb muscle strength and dynamic balance in older Japanese subjects [7,17]. In terms of the "SLS" test, studies have found associations between hip adductor muscle function and balance and mobility in older adults [22,23]. In the case of "TUG," it has been associated with skeletal muscle indices [25]. In addition, an association between lumbar back muscle thickness and TUG has also been found [29]. These findings suggest that the physical and balance functions of community-dwelling older females who participate

in community salons have been associated with muscle mass. In particular, "grip strength" and "TUG" have been associated with "trunk muscle mass" as well.

Limitations, Challenges, and Prospects of this Study

Although this study was conducted on community-dwelling older females who participate in community salons, it may be limited to older community residents with relatively high physical ability and ADL function, which allowed them to participate in community salons. Future studies should examine the present results and compare them with the results obtained from males, those with or without underlying medical conditions confirmed by medical institutions, and those with low ADL function. This study was conducted during COVID-19, which may have affected the frequency of participation of subjects in community salons. It is necessary to conduct further studies to compare and verify how the frequency of participation under normal and COVID-19 conditions affects the physical characteristics and physical and balance functions of elderly females.

Conclusion

It has been suggested that community-dwelling older females who participate in community salons show a decline in "height," "weight," and "muscle mass" with age, especially from their 80s. In addition, it has also been suggested that physical function such as "grip strength," and "sit-to-stand" decline, especially in the 80s, and balance function such as "one-leg stand (left and right)" and "TUG" decline, especially in the 70s. Furthermore, these functions have been associated with muscle mass. In particular, "grip strength" and "TUG" have been associated with "trunk muscle mass."

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