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## Original Article

# Changes of Instrumental Activities of Daily Living, Body Composition, and Physical Functions of Older Women during the COVID-19 Pandemic: A Follow-Up Study

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## SUMMARY

**Background:** Although the restrictions on outings owing to the Coronavirus Disease 2019 (COVID-19) pandemic negatively affected older adults, only a few reports on observed changes in body composition and physical function owing to the pandemic. Therefore, this study examined the effects of behavioral restrictions associated with the state of emergency declaration owing to the COVID-19 pandemic on instrumental activities of daily living (IADL), body composition, and physical functions in community-dwelling older women.

**Methods:** The analyses included 17 women who completed IADL, body composition, and physical function measurements on each measurement day before the COVID-19 pandemic (pre-COVID-19, May 2019) and after lifting the emergency declaration (during-COVID-19, December 2020). The Japanese version of the Frenchay Activities Index (FAI) was used to assess the participants' IADL. Body composition was measured as body fat percentage and whole-body muscle mass. A battery of physical tests was completed to assess participants' physical functions. The Wilcoxon signed-rank test was used for the comparison of pre- and during-COVID-19 pandemic.

**Results:** The FAI decreased during-COVID-19 compared to pre-COVID-19 phase ( $p < 0.001$ ), especially for outdoor and hobby activities. Body fat percentage increased ( $p = 0.004$ ), and whole-body muscle mass decreased ( $p = 0.001$ ). The sit-and-reach test decreased ( $p = 0.041$ ), and the 10-meter normal walking time increased ( $p = 0.002$ ).

**Conclusions:** This study revealed that behavioral restrictions due to the COVID-19 pandemic adversely affected IADL, body composition, and physical functions of community-dwelling older women.

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## 1. Introduction

Coronavirus Disease 2019 (COVID-19) is highly contagious and lethal. The Japanese government declared a nationwide state of emergency on April 7, 2020. The government urged people to maintain social distancing, avoid large gatherings, and refrain from non-essential or non-urgent outings.<sup>1</sup>

Several studies have raised concerns that such behavioral restrictions, especially the voluntary restraint on outings, reduce physical activity<sup>2</sup> and promote inactivity,<sup>3</sup> which may adversely affect cardiopulmonary function, myofibrillogenesis, insulin sensitivity,<sup>4,5</sup> and mental health,<sup>6</sup> among others. Urgent issues include assessing the actual effects on older adults who are most vulnerable to such changes and implementing preventive measures against these changes.

Questionnaire surveys and studies using activity meters have been conducted on changes in physical activities during the COVID-19 pandemic in both young and older people.<sup>7–9</sup> Studies on older adults have reported decreases in physical activity<sup>7,9</sup> and walking distance.<sup>8</sup> These studies investigated the intensity, frequency, and duration of

physical activities, such as light exercise, sports, housework, working, and walking. Considering that the COVID-19 pandemic has forced people to change their lifestyles, changes in the categories of instrumental activities of daily living (IADL) should also be investigated; however, only few studies have observed these changes in detail.<sup>9,10</sup>

Previous studies in older adults have only reported subjective decreases in lower limb muscle strength<sup>11</sup> and significant decreases in trunk muscle mass after the first wave of the pandemic.<sup>12</sup>

Currently, older adults are recommended to engage in exercises and physical activities to prevent many adverse effects that are likely to occur during the COVID-19 pandemic.<sup>13</sup> Assessment and elucidation of changes in IADL, body composition, and physical functions may allow the implementation of more targeted exercise guidance for older adults affected by behavioral restrictions during the COVID-19 pandemic. Thus, we aimed to examine the effects of behavioral restrictions associated with the state of emergency declaration owing to the COVID-19 pandemic on IADL, body composition, and physical functions in community-dwelling older women.

## 2. Materials and methods

This longitudinal study examined how IADL, body composition,

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and physical functions changed in community-dwelling older adults who experienced through the COVID-19 pandemic. Fifty-two older adults living in Sennan-gun, Osaka, Japan, participated in the Physical Fitness and Rejuvenation Program (PFRP) at Osaka University of Health and Sport Sciences in May 2019, before the COVID-19 pandemic (pre-COVID-19). Of these, 27 people who participated in the Physical Function Measurement Event held on October 30, November 2, and December 7, 2020 (during-COVID-19), following the declaration of a state of emergency issued for 49 days from April 7 to May 25, 2020, were selected. We excluded eight men to include women exclusively and two women with missing data. Therefore, 17 women completed the measurements of IADL, body composition, and physical function.

This study was approved by the Research Ethics Committee of Osaka University of Health and Sport Sciences (Approval No. 20-30). We explained participants the objectives and contents of the study, our intention to use the obtained data for study purposes alone, and our efforts to maintain confidentiality. We explained orally and in writing that participation in the study was voluntary and that there would be no disadvantages for non-participation. We obtained declarations of understanding and written informed consent to participate in this study. This study conformed to the provisions of the Declaration of Helsinki.

### 2.1. Measurements

The survey and measurement items included basic characteristics of the participants (i.e., age, height, weight, and living conditions; Table 1), IADL, body composition, and physical functions. Trained examiners completed all measurements.

The Japanese version of the Frenchay Activities Index (FAI) was used to evaluate IADL. This scale is a lifestyle index that measures activities reflecting the complexity of community life.<sup>14</sup> The FAI comprises 15 items related to applied activities in daily and social life, as proposed by Holbrook et al.<sup>15</sup> Each of the items is rated from 0 to 3 points according to its performance frequency over the previous three months, with the total score lying within 0 to 45 points. The items were classified into five closely related domains, and the scores for each domain and total scores were calculated. Higher scores indicated a greater ability to perform and independence in IADL.<sup>14,16</sup> Its reliability and validity as an evaluation method have been proven.<sup>17,18</sup>

Body composition was measured as body fat percentage and whole-body muscle mass using a bioelectrical impedance analysis<sup>19</sup> (DC-320; separate type, TANITA, Akita, Japan).

Physical function was measured using nine tests. These were performed according to the measurement methods of previous studies.<sup>20</sup>

The one-leg stand with eyes open, and the functional reach test evaluated participants' balance of their lower limbs and postural balance, respectively. The functional reach test was measured using a functional reach meter (TKK 5802; Takei Scientific Instruments Co., Ltd., Niigata, Japan).

Grip strength was measured using a Smedley digital grip dynamometer (Grip-D; TKK 5401, Takei Scientific Instruments Co., Ltd.).

Leg strength was measured with a one-leg dynamometer (TKK 5715, Tension Meter D, KK 5710e, Takei Scientific Instruments Co, Ltd). For both grip and leg strength, the mean values of the left and right measurements were used as indicators of muscle strength.

A 30-second chair stand was used to evaluate the muscle strength and endurance of the lower limbs.

A digital sit-and-reach test measurement system (TKK 5112,

Takei Scientific Instruments Co, Ltd) was used to assess flexibility and stepping was used to evaluate agility.

A digital vertical jump instrument (Jump-MD, TKK 5406, Takei Scientific Instruments Co, Ltd), which evaluates jumping power, was used to measure the vertical jump. Furthermore, the 10-meter normal walking time was used to measure walking capability.

### 2.2. Statistical analysis

The Shapiro-Wilk test was performed to test the normality of data distribution. Thus, the median values (i.e., range, minimum–maximum) of each of the five FAI domains, total FAI scores, body fat percentage, whole-body muscle mass, and physical functions were evaluated for both pre- and during-COVID-19 conditions, and the Wilcoxon signed-rank test was used for inter-year comparisons of median values. The statistical significance level was set at  $p < 0.05$ , and SPSS Statistics (IBM Japan, version 21, Japan) was used for the statistical analyses.

Because this study included those who participated in the 2019 PFRP and agreed to cooperate in the 2020 measurement, a power analysis of the data was conducted after the completion of the measurement. Using G\*Power 3.1.9.6 (Kiel University, Germany), effect size was calculated for each measurement item,  $\alpha$  was set to 0.05, and the sample size was 17.

## 3. Results

When the total FAI scores and scores for each of the five domains were compared between pre- and during-COVID-19, the total ( $p < 0.001$ ), outdoor activity domain ( $p < 0.001$ ), and hobby domain ( $p = 0.031$ ) scores were lower for during- than for pre-COVID-19. No significant changes were observed in other domain scores (Table 2).

During-COVID-19, body fat percentage was significantly greater than in pre-COVID-19 ( $p = 0.004$ ). Whole-body muscle mass significantly decreased during-COVID-19 compared to pre-COVID-19 ( $p = 0.001$ ).

The sit-and-reach test ( $p = 0.041$ ) significantly decreased, and the 10-meter normal walking time ( $p = 0.002$ ) significantly increased during-COVID-19. Stepping capability ( $p = 0.011$ ) was the only item that significantly improved during-COVID-19. No significant changes were observed in the other items (Table 3).

## 4. Discussion

Decreases in physical activity have been reported in older adults during the COVID-19 pandemic.<sup>7–9</sup> In this study, which focused on IADL, we found that the total activity in older adults decreased during the COVID-19 pandemic. Outdoor activities, including social and hobby outings (e.g., going to the cinema, theaters, dining, drinking,

**Table 1**  
Basic characteristics of the participants.

	Pre-COVID-19 Mean (SD)	During-COVID-19 Mean (SD)
Age (years)	64.6 (4.6)	65.9 (4.6)
Height (cm)	155.5 (4.5)	155.2 (4.6)
Weight (kg)	52.8 (12.0)	52.4 (11.4)
Living conditions		
Total, n	17	
Alone, n	3	
With a spouse, n	9	
With other family members, n	5	

SD, standard deviation; cm, centimeter.

**Table 2**  
Comparison of pre-COVID-19 and during-COVID-19 in FAI scores.

	Pre-COVID-19 Median (range)	During-COVID-19 Median (range)	<i>p</i> -value <sup>b</sup>
Household affair <sup>a</sup> (0–15)	15 (11–15)	15 (12–15)	0.854
Outdoor household affair <sup>a</sup> (0–9)	6 (4–9)	5 (3–8)	0.130
Outdoor activity <sup>a</sup> (0–12)	11 (8–12)	8 (3–11)	< 0.001***
Hobby <sup>a</sup> (0–6)	6 (4–6)	5 (0–6)	0.031*
Work (Gainful work) <sup>a</sup> (0–3)	1 (0–3)	0 (0–3)	0.129
Total score (0–45)	37 (32–42)	34 (25–38)	< 0.001***

<sup>a</sup> The 15 items of the FAI were classified into 5 closely related domains.

<sup>b</sup> *p*-value for comparison of FAI scores between pre-COVID-19 and during-COVID-19 by Wilcoxon signed rank test. FAI, Frenchay Activities Index.

\* *p* < 0.05, \*\* *p* < 0.005, \*\*\* *p* < 0.001.

**Table 3**  
Comparison of pre-COVID-19 and during-COVID-19 in body composition and physical functions.

	Pre-COVID-19 Median (range)	During-COVID-19 Median (range)	<i>p</i> -value <sup>a</sup>
Body fat (%)	27.0 (17.1–43.3)	28.3 (20.1–43.2)	0.004**
Whole-body muscle mass (kg)	33.6 (30.5–45.2)	33.3 (29.6–43.9)	0.001**
One-leg stand with eyes open (s)	100.0 (13.0–120.0)	95.2 (12.5–180.0)	0.192
Grip strength (kg)	25.9 (18.5–34.9)	27.0 (21.3–34.5)	0.058
Leg strength (kg)	31.6 (20.6–49.1)	35.8 (21.2–49.9)	0.332
CS-30 (count)	30.0 (20.0–37.0)	28.0 (18.0–41.0)	0.100
Sit-and-reach test (cm)	41.5 (32.5–57.0)	37.5 (26.0–57.5)	0.041*
Stepping (count)	30.0 (16.0–49.0)	36.0 (28.0–47.0)	0.011*
Vertical jump (cm)	30.0 (22.0–42.0)	27.0 (19.0–39.0)	0.105
FRT (cm)	39.5 (13.0–56.0)	38.0 (27.5–48.0)	0.266
10-meter normal walking time (s)	5.4 (4.6–7.2)	6.8 (5.3–7.8)	0.002**

<sup>a</sup> *p*-value for comparison of median body composition and physical functions between pre-COVID-19 and during-COVID-19 by Wilcoxon signed rank test.

CS-30, 30-second chair stand; cm, centimeter; FRT, functional reach test.

\* *p* < 0.05, \*\* *p* < 0.005.

meetings) and travel by car, bus, train, or airplane outside of work,<sup>16</sup> decreased. However, there was no change in activities related to indoor housework, outdoor walking, and work, which may reflect the Japanese government's request to refrain from going out with other people.<sup>1</sup> Physical activity has decreased among people who were previously more active during the COVID-19 pandemic.<sup>9</sup> The participants in this study were older adults who had always been physically active, including in the PFRP. The decrease in time spent on hobbies, including sports, leads to a decline in physical activity as well as a decrease in opportunities for social interaction, leading to social isolation. Consequently, a negative spiral occurs, wherein greater social isolation is related to diminished physical activity and greater sedentary time.<sup>21</sup> Such conditions would have an adverse effect on physical composition and function.

In previous studies, few reports have measured the body composition of older adults before and during the COVID-19 pandemic. Previous reports have shown that the pandemic is associated with an increased body mass index in older adults over 50 years of age in the US<sup>22</sup> and increased body fat mass in female athletes in Japan.<sup>23</sup> Regarding muscle mass, decreased trunk muscle mass was observed in community-dwelling older women in Japan.<sup>12</sup> Additionally, physical functions, such as muscle strength and walking ability, were estimated to have decreased.<sup>24</sup> However, the actual decline in function and its extent were unclear; one study that found that grip strength did not change before and after the first wave of COVID-19 in community-dwelling older Japanese women.<sup>12</sup>

This study found an increase in body fat percentage and a decrease in whole-body muscle mass. The extent of this decline in total muscle mass was examined using data on age and mean whole-body muscle mass in Japanese women.<sup>25</sup> First, we calculated the mean total muscle mass of Japanese women in relation to the mean age of

the study participants before and during the COVID-19 pandemic (64.6 and 65.9 years, respectively; Table 1).<sup>25</sup> The results showed that the mean whole-body muscle masses at ages of 64.6 and 65.9 years were 34.8 kg and 34.7 kg, respectively, indicating a decrease of 0.1 kg in whole-body muscle mass for an increase in age by 1.3 years. However, the mean whole-body muscle mass of the participants measured at each mean age was 35.1 kg and 34.2 kg, respectively, indicating a decrease of 0.9 kg in whole-body muscle mass for an increase of 1.3 years of age; more whole-body muscle mass was lost during the pandemic than the expected amount that occurs with aging (Table 3). In healthy older adults, lean lower limb fat-free mass decreased by approximately 4% after daily steps were reduced for 14 days.<sup>26</sup> A previous study that compared total muscle mass before and after the first wave of COVID-19 also reported a decrease of approximately 0.7 kg, although this was not statistically significant.<sup>12</sup> These findings suggest that behavioral restriction and the consequent decrease in physical activity significantly affects muscle mass loss in older Japanese women. These effects may increase or accelerate the incidence of sarcopenia,<sup>27</sup> and our results emphasize the importance of immediate preventive efforts.

Physical function assessments in this study revealed a decrease in flexibility and walking ability. By referring to the mean values of each physical function by age group as described in the 2019 Report of the Physical Fitness and Exercise Capacity Survey of Japan,<sup>28</sup> we calculated the mean sit-and-reach test scores of specific age groups before and during the COVID-19 pandemic (60–64 years and 65–69 years, respectively) according to the mean age (Table 1) of the participants. The mean distances were 41.72 and 41.04 cm, respectively, with a decrease of 0.68 cm upon increasing age group by one level. However, the actual measured mean sit-and-reach test scores were 42.6 cm and 40.4 cm, respectively, indicating a significant re-

duction of 2.2 cm. Similarly, using a report<sup>29</sup> on age and 10-meter walking time in Japanese women, we calculated the mean 10-meter walking time of the participants at the mean ages before and during the COVID-19 pandemic (Table 1) to be 6 and 6.1 seconds, respectively. The mean 10-meter walking time increased by 0.1 seconds for each 1.3-year increase in age. However, our measured walking time was 5.7 seconds before the COVID-19 pandemic and 6.8 seconds during the pandemic, a significant increase of 1.1 seconds. The activity restrictions imposed by the emergency declaration had a more detrimental effect on older adults' flexibility and walking ability than the aging process did, with a decrease in IADL and lifestyle changes. Contrastingly, stepping improved during the COVID-19 pandemic. The stepping test is a method that counts the number of times a participant can open and close the lower extremities in a seated position. This method does not involve trunk movement and is performed to reduce the risk of injury to the lower extremities during the examination. Using this method, it was found that the function of repetitive lower limb opening and closing movements in the sitting position was preserved in elderly participants who could maintain their activities related to daily living at home, as shown in the FAI results.

Physical activity was recommended for older adults during the COVID-19 pandemic<sup>13</sup> and suggestions made regarding the specific type, frequency, and intensity of physical activity. However, these were not based on actual measurements because the aim was to prevent the immediate effects of a possible pandemic on the bodies of older adults. For the first time, this study comprehensively evaluated IADL, body composition, and physical function in community-dwelling older women, quantifying the deterioration with actual measurements and confirming the findings of previous studies. Additionally, the results showed a decrease in flexibility, which has not been described in previous studies, and revealed that greater physical function deterioration occurred in older adults. The results of this study provide evidence for more appropriate and effective exercise interventions for older adults living during the COVID-19 pandemic.

Previous studies have shown that short-term exercise restriction results in undesirable changes in body composition and physical function in older adults,<sup>26,30</sup> indicating that persistent COVID-19-related disasters continue to negatively affect many older adults. A six-month home-based whole-body resistance training program will only improve some functions.<sup>31</sup> Additionally, it is expected that recovery from reduced physical function will take longer. Notably, grip strength has been reported to increase in older women with increased levels of social participation — before and after the first wave of COVID-19,<sup>12</sup> which suggests that communication through social participation is important for maintaining and improving physical functions in middle-aged and older adults. Additionally, it is important to provide an effective exercise program that can be implemented at home during the pandemic. It is necessary to include collaboration among other professions, industries, government, and academia to provide a broad and effective exercise program for all older adults and support them in continuing to implement this exercise program.

This study has several limitations. We had to follow thorough measures to avoid COVID-19 infection — by measuring body temperature, maintaining interpersonal distance, and disinfecting the instruments. This made it difficult to measure numerous participants. Additionally, because body composition and physical function differ by sex, only women who participated in the PFRP more frequently were included in the analysis. However, because sex differences are reported in the decrease in physical activity due to the COVID-19 pandemic,<sup>9</sup> it is necessary to conduct a study with male

participants to better understand the generalizability of our findings.

This study revealed that behavioral restrictions due to the COVID-19 pandemic adversely affected the IADL, body composition, and physical functions of community-dwelling older women. These results are useful in providing exercise guidance for older women during the COVID-19 pandemic.

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## Conflicts of interest

The authors have no potential conflicts of interest to disclose.

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