

# Disuse syndrome in Japanese older adults due to instructions to stay at home during the COVID-19 pandemic

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## ABSTRACT

This study aimed to reveal the extent of the adverse effects caused by the restrictions on going out due to the COVID-19 pandemic on physical function. The participants were 129 healthy older adults, aged 65 years and older, who lived independently without the need for long-term care. The presence or absence of disuse syndrome was investigated using a partially modified "Disuse Syndrome Inventory." The address, age, and gender of the participants were also surveyed in a factor analysis of disuse syndrome. The effective response rate was 90.6% (n = 117). Disuse syndrome was observed in 38.5% (n = 45) of the participants, which was significantly higher in women compared to men, and in medium-sized to depopulated cities compared to large cities. It has become clear that a large number of older adults have disuse syndrome because of the travel and commute restrictions due to the COVID-19 pandemic. To return to normal life sooner, it is necessary to consider countermeasures as soon as possible.

**Keywords:** Coronavirus disease 2019, infection, physical function, restrictions on going out.

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## INTRODUCTION

The coronavirus disease of 2019 (COVID-19) is causing serious and adverse effects on people's health worldwide (CDC, 2021). The disease was declared a pandemic on March 11, 2020, by the World Health Organization (WHO), which urged countries to further strengthen their countermeasures. In response to the request, the Japanese government declared the first state of emergency on April 7, 2020. The spread of the infection was temporarily suppressed, and the emergency state was lifted on May 25, 2020. However, after this point, the number of infected people increased again, and the second state of emergency was declared on January 7, 2021, and lifted on February 7, 2021. However, as of March 19, 2021, when this paper was submitted, the emergency declaration has not yet been lifted in the Tokyo metropolitan area (Prime Minister's Office of Japan, 2021). Therefore, we should not feel relieved at this stage. Depending on future trends, a national state of emergency may be issued again. As such, the

restrictions associated with COVID-19, which deterred many people from going out, may continue to exist, causing an adverse effect on physical function. In older adults, especially, there is an already-existing decline in physical and cognitive functions that occurs with aging (CDC, 2021; Sepúlveda et al., 2020). Therefore, this group of individuals is expected to experience more adverse effects on physical function.

Several studies have investigated the effects caused by staying at home due to the COVID-19 pandemic on older adults' life and physical functions. Yamada et al. (2020) used online questionnaires that targeted Japanese older adults to investigate changes in their physical activity due to the initiation of the pandemic in April 2020. The results showed that the total activity time in April 2020 was significantly lower compared to that in January 2020. Shinohara et al. (2020) used a postal questionnaire that targeted Japanese older adults to investigate changes in living and physical or psychological conditions due to the

pandemic in April 2020. They reported that the subjective frequency of daily movement, muscle strength of the legs, and food intake have reduced. From the results of these studies, it can be concluded that even 1 to 3 months of refraining from going out due to the pandemic have adversely affected physical function. As of February 2021, when the paper was submitted, the COVID-19 pandemic had not ended in Japan, and the current period of refraining from going out is even longer than that of previous studies. Therefore, a more serious impact than that which had been reported in previous studies may occur. Now that restrictions on going out have been prolonged, it can be beneficial to re-investigate the impact and its factors as of November–December 2020 as a preliminary step to address serious effects.

It is known that refraining from going out due to COVID-19 can cause various secondary damage as well. Specific examples include anxiety disorders, depression (Xiao et al., 2020), lower-back pain (Stephan et al., 2021), social isolation, cognitive decline, and increased mortality (Gorenko et al., 2020). Similarly, clarifying the current state of disuse syndrome in Japan, caused by refraining from going out due to COVID-19, is meaningful as a cautionary study against such secondary damage.

Impact is expected to vary based on age, gender, and location (Castañeda et al., 2020; Rodríguez et al., 2020). Regarding location, considering that many stores tend to be crowded in large cities with high population densities and that more opportunities exist to avoid congestion, it is hypothesized that people living in large cities with high population densities are more likely to be adversely affected. Regarding age, it is hypothesized that people from older age groups are more likely to be adversely affected due to the decline in physical activities (Milanović et al., 2013). Regarding gender, it is hypothesized that, compared to men, women are more likely to be adversely affected, given that they are more likely to have sarcopenia (Ning et al., 2020).

Therefore, by conducting a questionnaire targeting older adults, this study aims to identify the extent and cause of the adverse effects of refraining from going out due to the COVID-19 pandemic during November–December 2020.

## **MATERIALS AND METHODS**

### **Participants**

Participants were 129 healthy adults, aged 65 and older, who regularly utilized health and welfare services, including health prevention activities and purpose-of-life measures provided by O City Hall, with the goal of living without dependence on nursing care. These facilities' management and operation are under the responsibility of the older adults of the region. Participants were excluded if they received Japanese nursing-care insurance. City Hall staff regularly visited the facility to perform services that ensured that the older adults in the program do not require nursing care. The author accompanied the service staff a total of nine times (November 2020: 11, 16, 20, 25; December 2020: 8, 9, 15, 21, 22).

As an ethical consideration, participants were provided a written explanation of the study. It was stated that by answering the questionnaire, the participants agreed to the purpose of the study. It was also stated that the results of the study were to be published academically. A similar explanation was provided verbally as well. The study was approved by the Research Ethics Committee of the International University of Health and Welfare (authorization number: 20-10-201).

### **Study design**

The study was cross-sectional and used a face-to-face questionnaire to investigate the extent and factors of the impact of refraining from going out due to the COVID-19 pandemic on the lives of older adults during November–December 2020.

### **Method**

In this study, the presence of disuse syndrome was investigated by a questionnaire, in which the author partially modified the "Disuse Syndrome Inventory" (The Ministry of Health, Labour and Welfare of Japan, 2021) (Table 1). Disuse syndrome (The Ministry of Health, Labour and Welfare of Japan, 2021) is defined as the condition of reduced mental and physical function, along with difficulty in movement due to a prolonged state of inactiveness. This questionnaire was published with the aim of early detecting and subsequently alleviating the disuse syndrome caused by disasters. The survey period spanned two months, between November and December 2020, and the survey was conducted to determine changes in life function from before to after the above-mentioned period, as determined by the spread of COVID-19. Disuse syndrome was identified if participants indicated that their condition worsened after the onset of the COVID-19 pandemic in response to any of the first five questions, or if the answer to question 6 or 7 was "yes" on the "Disuse Syndrome Inventory." In this condition, it is highly possible that the overall "mental and physical function" has deteriorated, which renders "activity" difficult. This condition requires caution, and consulting with local governments and medical institutions are recommended if cases arise (The Ministry of Health, Labour and Welfare of Japan, 2021). In Japan, following the Great East Japan Earthquake (Murakawa et al., 2013) and Noto Peninsula Earthquake (Takahashi and Hattori, 2020), the Disuse Syndrome Inventory was used to understand the status-of-living functions as a guideline for recovery after a disaster. Although the ramifications of refraining from going out due to COVID-19 differ from those in the case of an earthquake, they are similar in the sense that life becomes inactive due to a disaster. Thus, in this study, using this checklist is considered effective.

Age (young older adults, 65–74 years old vs. old older adults, 75 years old and over), location (large cities vs. medium-sized or depopulated cities), and gender were also surveyed in a factor analysis of disuse syndrome.

A large city was defined as having a population density of 473.3 people/km<sup>2</sup> or more in areas of daily life, with reference to the Long-term Care Prevention Guide of the National Center for Geriatrics and Gerontology, which was created with the assistance of the Ministry of Health, Labor and Welfare of Japan (Arai, 2021). Artificial density was calculated by the population of older adults living in the daily life area, as stated by the Older Adult Welfare Plan and Long-term Care Insurance Business Plan of City Hall in March 2018 (Otawara City Hall, 2021). In addition, the area of daily life was measured by Google Earth (Google Earth, 2021). Daily life areas are defined by Japanese government law (Japanese Ministry of Health Labor and Welfare, 2021) and are determined by municipalities as areas where residents under their jurisdiction live their daily lives, based on a comprehensive review of geographical,

**Table 1.** Details of disuse syndrome inventory.

| A Please circle one of the numbers before the COVID-19 pandemic and currently.  |  |   |
|---|--|---|
|   | Before the COVID-19 pandemic<br>(November 2019-December 2019)  | Currently<br>(questionnaire implementation date)  |
| 1 Walking outdoors  | 1. I was walking alone in the distance.<br>2. I walked alone if it was nearby.<br>3. I was walking with someone.<br>4. I hardly walked outside.<br>5. I was not walking outside.                       | 1. I am walking alone in the distance.<br>2. I walk alone if it is nearby.<br>3. I am walking with someone.<br>4. I hardly walk outside.<br>5 I am not walking outside.                             |
| 2 Walking in the home   | 1. I was walking without support.<br>2. I was walking with the support of the walls and furniture.<br>3. I was walking with someone's assistance.  | 1. I am walking without support.<br>2. I am walking with the support of the walls and furniture.<br>3. I am walking with someone's assistance.  |
| 3 Activities around the house<br>(Bath, washbasin, toilet, meal, etc.)  | 1. There was no inconvenience when going out.<br>2. There was no inconvenience at home.<br>3. There were some inconveniences, but I was able to manage them.<br>4. I sometimes spent time with others. | 1. There is no inconvenience when going out.<br>2. There is no inconvenience at home.<br>3. There are some inconveniences, but I was able to manage them.<br>4. I sometimes spend time with others. |
| 4 Number of outings   | 1. Almost every day<br>2. Three times a week or more<br>3. One time a week or more<br>4. I hardly went out.  | 1. Almost every day<br>2. Three times a week or more<br>3. One time a week or more<br>4. I hardly go out.   |
| 5 How much physical activity do you do during the day?  | 1. I was moving well outside.<br>2. I was moving well at home.<br>3. I was often sitting.<br>4. I was lying down sometimes.  | 1. I am moving well outside.<br>2. I am moving well at home.<br>3. I am often sitting.<br>4. I am lying down sometimes.   |
| B Please tell us about your current status. Please circle the applicable status.  |  |   |
| 6 Is it more difficult to walk than before the COVID-19 pandemic?   | Yes • No   |   |
| 7 Is there anything else that has become difficult?   | Yes • No   |   |
| 8 Please answer only those who answered "yes" in 7.<br>What kind of motion has become difficult? * Multiple answers allowed | 1. using a Japanese-style toilet<br>2. going up and down steps (high places)<br>3. getting up from the floor<br>4. other (Specific example: )  |   |

population-related, traffic, and social conditions, among others, as well as the status of public nursing care facilities. Therefore, daily life areas are an indicator that can be easily utilized by local governments to respond to pandemics such as COVID-19 in the future.

#### Data analysis

To identify the impact of refraining from going out, aggregated

results were expressed in terms of both the number of people and percentages. For factor analysis, a chi-square independence test was conducted on the number of people in the results of each item of the questionnaire, after dividing the respondents into groups for gender, location, and age. In addition, a logistic regression analysis (direct entry) was used to examine the onset factors of disuse syndrome. The explanatory variables were gender, location, and age. The Hosmer-Lemeshow test was used to determine the degree of conformity in the logistic regression analysis. IBM SPSS Statics ver26.0 (SPSS Inc) was used as the statistical software. A

p-value < 0.05 was considered statistically significant.

## RESULTS

### Overall results

The effective response rate was 90.6% (n = 117). Participants were 78.8 ± 7.4 years old and included 24 males and 93 females.

Disuse syndrome was identified in 38.5% (n = 45) of the participants (Table 2).

For question 7—“Have you experienced any other difficulties?”—two respondents selected the answer “using a Japanese-style toilet,” eight answered “going up and down steps (high places),” five answered “getting up

from the floor,” and five answered “other.” Specific examples of “other” were “forgetfulness,” “increased physical lassitude,” “tiredness,” and “difficulty in doing laundry.”

### Results of the factor analysis

As a result of the logistic regression analysis, gender (partial regression coefficient: 1.882, p: 0.005, odds ratio: 6.566, 95% confidence interval: 1.766-24.416) and location (partial regression coefficient: 0.647, p: 0.007, odds ratio: 1.909, 95% confidence interval: 1.190-3.065) were identified as significant explanatory variables. The Hosmer-Lemeshow test indicated that the model had a good fit (p = 0.749). The results of the factor analysis showed different trends by location, age, and gender.

**Table 2.** Results of the disuse syndrome inventory.

|   | n  | %    |
|---|----|------|
| Disuse syndrome (decrease at least one of each item)                | 45 | 38.5 |
| 1 Walking outdoors  | 19 | 16.2 |
| 2 Walking in the home   | 6  | 5.1  |
| 3 Activities around the house (Bath, washbasin, toilet, meal, etc.) | 6  | 5.1  |
| 4 Number of outings   | 14 | 12.0 |
| 5 How much physical activity do you do during the day?              | 11 | 9.4  |
| 6 Is it more difficult to walk than before the COVID-19 pandemic?   | 25 | 21.4 |
| 7 Is there anything else that has become difficult?                 | 14 | 12.0 |

n = number of people, % = ratio.

### Gender

The results of the analysis on gender are listed in Table 3. More women were identified as having disuse syndrome compared to men (women, 42 of 93 [45.2%]; men, 3 of 24 [12.5%] p < 0.05). The results for each item

are shown below. The items that garnered significantly more responses, indicating deterioration among older adults, were—“(1) Walking outdoors” (women, 19 of 93 [20.4%]; men, 0 of 24 [0.0%]) and “(7) Is there anything else that has become difficult?” (women, 14 out of 93 [15.1%]; men, 0 out of 24 [0.0%]) (p < 0.05).

**Table 3.** Relationship between gender and disuse syndrome.

|   | Women (n=93) |      | Men (n=24) |      | P     |
|---|--------------|------|------------|------|-------|
|   | n            | %    | n          | %    |       |
| Disuse syndrome (decrease at least one of each item)                | 42           | 45.2 | 3          | 12.5 | <0.05 |
| 1 Walking outdoors  | 19           | 20.4 | 0          | 0.0  | <0.05 |
| 2 Walking in the home   | 5            | 5.4  | 1          | 4.2  |       |
| 3 Activities around the house (Bath, washbasin, toilet, meal, etc.) | 6            | 6.5  | 0          | 0.0  |       |
| 4 Number of outings   | 13           | 14.0 | 1          | 4.2  |       |
| 5 How much physical activity do you do during the day?              | 11           | 11.8 | 0          | 0.0  |       |
| 6 Is it more difficult to walk than before the COVID-19 pandemic?   | 23           | 24.7 | 2          | 8.3  |       |
| 7 Is there anything else that has become difficult?                 | 14           | 15.1 | 0          | 0.0  | <0.05 |

n = number of people, % = ratio.

## Location

The results of the analysis on location are listed in Table 4. The number of people identified with having disuse syndrome was significantly higher in medium-sized to depopulated cities compared to that in large cities (medium-sized to depopulated cities, 33 of 71 [46.5%]; large cities, 12 of 46 [26.1%],  $p < 0.05$ ). The results for each item are shown below. The items that garnered significantly more responses, thus indicating deterioration, were—“(1) Walking outdoors” (large cities; 17 of 71 [23.9%], medium-sized cities or depopulated cities; 2 of 46 [4.3%]); “(3) Activities around the house” (large cities; 6 of 71 [8.5%], medium-sized cities or depopulated cities; 0 of 46 [0.0%]); “(5) How frequently

do you engage in physical activity during the day?” (large cities; 11 of 71 [8.5%]; medium-sized cities or depopulated cities; 0 of 46 [0.0%]); and “(7) Have you experienced any other difficulties?” (large cities; 12 of 71 [16.9%], medium-sized cities or depopulated cities; 2 of 46 [4.3%])” ( $p < 0.05$ ).

## Age

The results of the analysis on age are listed in Table 5. There was no significant difference between the number of young and old older adults that were identified as having disuse syndrome. The results for each item are shown below. The items that garnered significantly more

**Table 4.** Relationship between address and disuse syndrome.

|   | Medium to depopulated cities (n=71) |      | Large cities (n=46) |      | P     |
|---|-------------------------------------|------|---------------------|------|-------|
|   | n                                   | %    | n                   | %    |       |
| Disuse syndrome (decrease at least one of each item)                      | 33                                  | 46.5 | 12                  | 26.1 | <0.05 |
| 1 Walking outdoors  | 17                                  | 23.9 | 2                   | 4.3  | <0.05 |
| 2 Walking in the home   | 5                                   | 7.0  | 1                   | 2.2  |       |
| 3 Activities around the house (Bath, washbasin, toilet, meal, etc.)       | 6                                   | 8.5  | 0                   | 0.0  | <0.05 |
| Number of people (%) whose condition deteriorated for each checklist item | 4                                   | 15.5 | 3                   | 6.5  |       |
| 5 How much physical activity do you do during the day?                    | 11                                  | 15.5 | 0                   | 0.0  | <0.05 |
| 6 Is it more difficult to walk than before the COVID-19 pandemic?         | 19                                  | 26.8 | 6                   | 13.0 |       |
| 7 Is there anything else that has become difficult?                       | 12                                  | 16.9 | 2                   | 4.3  | <0.05 |

n = number of people, % = ratio.

**Table 5.** Relationship between age and disuse syndrome.

|   | Old older adults (n = 82) |      | Young older adults (n = 35) |      | P     |
|---|---------------------------|------|-----------------------------|------|-------|
|   | n                         | %    | n                           | %    |       |
| Disuse syndrome (decrease at least one of each item)                          | 36                        | 43.9 | 9                           | 25.7 |       |
| 1 Walking outdoors  | 16                        | 19.5 | 3                           | 8.6  |       |
| 2 Walking in the home   | 6                         | 7.3  | 0                           | 0.0  |       |
| 3 Activities around the house (Bath, washbasin, toilet, meal, etc.)           | 4                         | 4.9  | 2                           | 5.7  |       |
| Number of people (%) whose condition has deteriorated for each checklist item | 4                         | 13.4 | 3                           | 8.6  |       |
| 5 How much physical activity do you do during the day?                        | 6                         | 7.3  | 5                           | 14.3 |       |
| 6 Is it more difficult to walk than before the COVID-19 pandemic?             | 23                        | 28.0 | 2                           | 5.7  | <0.05 |
| 7 Is there anything else that has become difficult?                           | 14                        | 17.1 | 0                           | 0.0  | <0.05 |

n = number of people, % = ratio.

responses, indicating deterioration among old older adults, were—“(6) Is it more difficult to walk than it was before the COVID-19 pandemic?” (old older adults, 23 of 82 [28.0%]; young older adults, 2 of 35 [5.7%])” and “(7) Is there anything else that has become difficult?” (old older adults, 14 of 82 [17.1%]; young older adults, 0 of 35 [0.0%]) ( $p < 0.05$ ).

## DISCUSSION

In this study, we used questionnaires that targeted older adults from November to December 2020 to reveal the extent of the adverse effects caused by refraining from going out due to the COVID-19 pandemic. The results demonstrate that disuse syndrome was identified in 38.5% ( $n = 45$ ) of the participants. The results of the factor analysis showed different trends based on age, location, and gender. The trends for the age and gender variables were consistent with the hypothesis, but the hypothesis of large cities being more susceptible than smaller ones was not supported. The results are discussed below.

First, 38.5% ( $n=45$ ) were identified to have disuse syndrome. Disuse syndrome is an important cause of deterioration of living function, and its prevention and improvement are said to be essential for long-term care prevention (Japanese Ministry of Health Labor and Welfare, 2021). This means that so many people may be in the reserve group in need of care. The survey was conducted in one area of Japan, but such a situation may have occurred all over the country. Given the burden on caregivers and the financial burden on the country, relief measures are urgently needed. The item that garnered the most responses, indicating deterioration, was “(6) Is it more difficult to walk than before the COVID-19 pandemic?”; subsequently, it was followed by “(1) Walking outdoors.” This can be due to the restricted movement during the pandemic. It has been reported that the decrease in walking ability is closely related to various adverse effects on older adults. Previous studies have reported that older adults with faster walking speeds are more likely to both maintain their living functions and exhibit longer life expectancies (Shinkai et al., 2000; Studenski et al., 2011) and that mild dementia and dementia are closely related to decreased walking ability (Hajizadeh et al., 2018; Doi et al., 2015; Doi et al., 2018). Therefore, it can be said that preventing the deterioration of the walking ability is an important matter in Japan during the COVID-19 pandemic.

Second, disuse syndrome was found to be significantly more prevalent in women than in men. The items that garnered significantly more responses, indicating deterioration among old older adults, were “(1) Walking outdoors” and “(7) Is there anything else that has become difficult?” This supports our hypothesis, and the reason may be that men and women engage in different ways of

forming social communities. Previous studies have reported that, compared to men, women are more likely to engage in regular physical activity, as they are motivated by spending time with others (Ohama et al., 2020). Therefore, it is probable that women are more likely to be affected by the COVID-19 pandemic when instructed to maintain social distancing. Measures should be devised regardless of gender, but it may be necessary to carefully look into this trend and the impact of such measures on women.

Third, disuse syndrome was more prevalent in medium-sized to depopulated cities compared to large cities. In the former, the items identified as indicating deterioration were—“(1) Walking outdoors,” “(3) Activities around the house,” “(5) How often do you engage in physical activity during the day?” and “(7) Is there anything else that has become difficult?” These results did not support the hypothesis that people living in densely populated large cities are more likely to be adversely affected. There could be multiple explanations for this. First, the characteristics of each city are determined in terms of connections between people and social participation. Previous studies have reported that depopulated cities are characterized by strong connections among residents, who often “talk frequently with neighbors” (Ohama et al., 2020), whereas larger cities have lower community participation and fewer social ties (Adjaye et al., 2019). Due to these facts, people living in medium-sized to depopulated cities are vulnerable to adverse effects. Secondly, compared to large cities, medium-sized to depopulated cities have their primary avenues of communal gathering spaced out (shops, friends’ homes in the neighborhood, etc.), with more travel required. Therefore, it is probable that items related to the outdoors (Questions 1, 3, 5) were more likely to indicate people that are affected by the disuse syndrome. Thus, special attention should be paid to those living in medium-sized to depopulated cities.

Finally, there was no significant difference between the number of young and old older adults that have disuse syndrome. However, the items that garnered significantly more responses, indicating deterioration for old older adults, were—“(6) Is it more difficult to walk than before the COVID-19 pandemic?” and “(7) Is there anything else that has become difficult?” These results partly support our hypothesis, as old older adults were potentially more susceptible to lower baselines due to age-related declines in physical function, compared to young older adults. Previous studies have reported that an age-related reduction in sex hormones, as associated with muscle gain, causes apoptosis (death of the cells needed to work the muscles) (Walston, 2012). In addition, gait is one of the items that are particularly susceptible to hindrance with aging. This can be seen from the fact that the Asian Sarcopenia Working Group’s Sarcopenia Criteria (Chen et al., 2020) uses reduced walking speed as an identifier. Therefore, the items related to walking

indicate deterioration.

The limitations of this study and its prospects are as follows:

- 1) The sample size was small. Due to the measures implemented for infection control, it is difficult to generalize the results of this study. Therefore, it is necessary to increase the number of participants in future studies.
- 2) Participants in this study regularly attended the facility and had physical functions that allowed transportation to that location. Those in need of long-term care with difficulties in moving may be more affected. It is also necessary to focus not only on older adults but also on children and adults. Previous studies show that the frequency of activity in university students (Romero et al., 2020; Rodríguez et al., 2021) and children (Mitra et al., 2020) decreased due to the COVID-19 pandemic. Therefore, in the future, it will be necessary to expand the range of research participants.
- 3) The study did not consider cognitive or mental function. This was a questionnaire focusing on physical function and activity. Some previous studies (Lee et al., 2020; Pérez et al., 2021) have reported that COVID-19 had adverse effects on mental health as well. Therefore, it is necessary to conduct additional verification on the cognitive function and mental aspects.
- 4) Longitudinal research was not conducted. Based on the situation's outlook, it is possible that refraining from going out will continue for a longer period. Therefore, in the future, it will be necessary to examine changes over time.

## Conclusion

The findings of this study indicate that a large number of older adults have disuse syndrome due to refraining from going out during the COVID-19 pandemic. To return to normal life sooner, it is necessary to consider and adopt countermeasures as soon as possible.

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