Longitudinal observational study to prevent fractures in older individuals with musculoskeletal ambulatory disability symptom complex: the first-year data and effects in the COVID-19 pandemic

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Abstract: We evaluated physical function, physical activity, and sleep status in five elderly individuals with musculoskeletal ambulatory disability symptom complex (MADS) for one year, and examined their influential factors associated with sarcopenia. Compared with the baseline, the results did not show significant differences in every item. Notably, the COVID-19 pandemic had occurred throughout Japan for nearly the entire study period. The impact on psychological parameters of participants was surveyed using the Profile of Mood States second edition (POMS 2®); the results suggested that their mood states were relatively stable. Although we can consider these results, i.e., the participants maintained a high level of health consciousness and willingness to participate in social activities and physical exercise even under various restrictions, we were able to trace an extremely small number of participants because of the pandemic. This study shall be continuously conducted to record measurable data every 3 months, and aim for the development of device-free systems that prevent fractures in elderly individuals with MADS.

Keywords: Sarcopenia, Fracture prevention, Musculoskeletal ambulatory disability symptom complex (MADS), Older individuals, COVID-19

1. INTRODUCTION

In an aging society, sarcopenia is a global health issue. Its prevalence is approximately 20%–80% in those aged ≥70 years globally. In Japan, approximately 2.7 million individuals have this condition, and this number is expected to increase rapidly in the future [1].

Our study has focused on muscle bulk decrease (sarcopenia), which is a global health problem in today’s aging society. Although individualized support for the amount of physical activity in older adults with musculoskeletal ambulatory disability symptom (MADS) complex has been crucial from various studies to prevent its rapid increase in incidence and extend healthy life expectancy, there are few longitudinal studies on the multidimensional influencing factors, such as psychological state [2,3] and climate [4].

We have previously implemented low-load, long-term exercise interventions for MADS in older patients and reported maintenance of physical function and improvement in ability to perform daily activities [5]. The technology for observing daily activities using sensors in monitoring systems has advanced considerably, and it is now possible to collect and analyze large amounts of data. However, the costs and physical and mental burdens associated with wearing sensor equipment have led to difficulties in its continuous use. There is considerable demand for a system imposing a relatively small burden, requiring careful selection of monitoring and device-free items.

Sarcopenia has been our topic. We had started a 1-year longitudinal study on 10 elderly individuals with MADS joining a monthly health class in a relatively rural area before the pandemic. Their findings of physical function, physical activity, and sleep status were supposed to be obtained every 3 months regularly. However, because of restrictions in place as a result of the pandemic, only five participants could attend all health classes. Despite the relatively small number of the datasets, we attempted to discuss the various influencing factors and emotional effects of the unexpected COVID-19 pandemic on the participants.

2. OBJECTIVE

This study aimed to examine the changes in physical function, physical activity, and sleep status in elderly individuals with MADS for one year and consider the
factors related to the development of sarcopenia.

3. METHODS
3.1 Study design
This was a longitudinal study conducted for one year and was performed to evaluate physical function, physical activity, and sleep status in elderly individuals with MADS.

3.2 Participants
At the start point of this study before the pandemic, 10 eligible individuals had consented to participate in the study. Participants were selected according to the following inclusion criteria: (1) age ≥ 65 years; (2) regular attendance in the health classes held at a rehabilitation hospital in a relatively rural area of the prefecture; (3) absence of any ADL disability, even though there were some locomotor symptoms caused by hypokinesis due to aging; (4) motor function that meets the MADS diagnostic criteria; and (5) a written consent to participate in the study approved by the institutions.

3.3 Measures and devices
Questionnaires and physical evaluation were adopted in the study.

The Profile of Mood States second edition (POMS 2) was introduced to assess current mood status after the COVID-19 pandemic with a new clinical question whether the worldwide restrictions brought about by the virus may affect participants’ emotional background. POMS 2 is a well-known as a self-report assessment of mood adaptable to capturing transient and fluctuating feelings or relatively enduring affect states in adults aged ≥ 18 years. The POMS 2 has been used as a comprehensive assessment to provide indications of potential mood disturbance [6].

The possibility and level of sarcopenia was evaluated by skeletal muscle mass level using the InBody®, 5-m walking speed, and grip strength. The daily activity of each participant was measured and recorded by The MotionWatch 8®, which was a watch-type triaxial actigraphy (CamNtech, the Activwatch) [7]. It provides numerical reports on both daytime physical activity and moderate to vigorous physical activity during sleep. Participants were instructed to wear the device on their wrist continuously for at least 2 weeks. Actual sleep time was calculated according to the pattern of activity at night time. Sleep efficiency was defined as the ratio (percentage) of actual sleep time and the time spent in bed.

3.4 Ethical approval
This study was approved by the Research Ethics Committee of the Faculty of Medicine, Mie University (No. U2019-028, November 2019).

3.5 Data analysis
A statistical application, SPSS version 22.0, was used in the data analysis of descriptive statistics. A significance level was set at 5% in this study.

4. RESULTS
The monthly health-class attendees were the candidates of the study. However, the COVID-19 pandemic had an impact on the hospitals, which required individuals to avoid crowded areas, close conversations, and closed spaces with poor ventilation.

The hospital needed to follow a 15-point checklist suggested by the municipal government of Tsu City; these instructions were common to all types of healthcare facilities and venues to ensure sufficient infection prevention behaviors. Owing to this checklist, we were unable to continue recruiting new participants, and we had to limit the number of participants per session to 50%, after confirming whether each participant was willing to continue or not.

Five participants’ physical and mood status data were retrieved since the first measurement one year ago.

All five participants were women, and the average age was 77.4 ± 3.4 years. Table 1 shows the mean body mass index (BMI), skeletal muscle mass index (SMI), and physical function values at baseline (November 2019) and after one year (November 2020). One participant who underwent inpatient surgery during the year presented with some degree of decrease in all measures. Another participant had the lowest BMI at both time points. Although this was within the tolerable range, the participant was considered to have pre-sarcopenia. Muscle bulk in the upper, lower, and trunk body muscle mass was assessed as lower than the normal. The SMI was below the cutoff value for sarcopenia.

Table 1. Changes in BMI, SMI, and physical function

| N=5 | baseline | 1 year later | P value |
|-----|----------|--------------|---------|
| BMI (kg/m²) | 26.2 ± 5.1 | 25.7 ± 4.6 | 0.28 |
| SMI(kg/m²) | 6.5 ± 0.3 | 6.4 ± 0.3 | 0.28 |
| grip(kg) | 24.9 ± 5.7 | 24.1 ± 4.2 | 0.6 |
| 5m walking speed(m/s) | 1.3 ± 0.2 | 1.1 ± 0.2 | 0.28 |

Table 2 presents the activity levels (average ± standard deviation) measured by the MotionWatch 8®. Activity intensity was classified into vigorous, moderate, low, and
sedentary. All participants had extremely low vigorous activity at both evaluation time points without differences in each item. The results of the questionnaire showed that all participants regularly joined any of the community activities at least once a month. Three of them worked in the fields daily. Their daily activities included handicrafts, karaoke, Taisho-koto, computer lessons, dance, stretching, and gymnastics as indoor activities and tennis and ground golf as outdoor activities.

| Table 2. Changes in physical activity level (hh:mm:ss/24h) |
|----------------------------------------------------------|
| **baseline**                                             |
| NO | Total Vig. | Total Mod. | Total Low | Total Sed. |
|----|------------|------------|-----------|------------|
| 1  | 0:47:53    | 3:01:41    | 7:10:26   | 12:59:59   |
| 2  | 0:21:23    | 2:10:58    | 8:05:51   | 13:21:48   |
| 3  | 0:43:48    | 2:54:57    | 7:21:38   | 12:59:37   |
| 4  | 0:24:20    | 2:12:39    | 9:33:19   | 11:49:42   |
| 5  | 0:14:11    | 1:59:47    | 6:57:44   | 14:48:18   |

| Year later                                             |
|--------------------------------------------------------|
| NO | Total Vig. | Total Mod. | Total Low | Total Sed. |
|----|------------|------------|-----------|------------|
| 1  | 0:50:32    | 3:26:15    | 8:28:54   | 11:14:19   |
| 2  | 0:22:54    | 2:33:30    | 8:13:49   | 12:49:47   |
| 3  | 0:53:54    | 3:47:11    | 7:32:00   | 11:46:56   |
| 4  | 0:21:19    | 2:28:21    | 8:31:00   | 12:39:19   |
| 5  | 0:18:13    | 2:13:17    | 7:57:36   | 13:30:54   |

The data during sleep are shown in Figure 1. Overall, participants’ sleep status was good at both evaluation time points, and no difference was detected between the two time points in each of the five sleep status items.

Figure 2 presents the evaluation of mood status during the COVID-19 pandemic (as of November 2020). The mean T-scores of the seven subscales of POMS 2 were compared with those of a sample population of women aged ≥70 years.

It was determined to be “average” on all scales and typical compared with the standard.

Figure 2. POMS T score

5. DISCUSSION

The five participants showed no significant changes in physical function, physical activity, and sleep status after one year compared with the beginning of the study. Only one patient had an effect of admission due to surgical treatment. However, the other four patients did not show sarcopenia. Their amount of activity could be accounted as low level, but they had been consciously exercising and maintaining some connections with society by such as participating in community activities, although not frequently. They maintained a high level of health consciousness even during the COVID-19 pandemic. The participants lived in a rural area. Most of them usually worked in the fields as part of their daily routine, and were fortunately able to maintain their daily activities without significant changes since before the pandemic. The elderly individuals had been extremely susceptible to the very severe COVID-19 situation. Moreover, they tended to refrain from going out because of fear of infection. This easily led to lack of exercise and isolation [8,9]. In the present study, we assessed the mood state in POMS 2® to estimate the psychological situation under special circumstances. Individual scores were noted, with the data of equivalent standard population as the most accurate assessment of POMS scores. The standardization was conducted in 2787 individuals living in Japan, aged 18–70 years and living in 10 different regions nationwide.
Individuals were excluded if they were undergoing treatment for mental illnesses during the study period [6]. Consequently, the mean values of all seven scales were determined to be average compared with the standard values for women and individuals aged > 70 years.

The COVID-19 pandemic has not yet been brought under control, even rural areas of Japan. No significant changes in sleep status could be considered as a contributing to their stable mood states. The result of this study was limited because the number of participants was extremely small; furthermore, it could be assumed that those who did not wish to continue participating in the health classes may have a higher risk of developing sarcopenia than those who did. The measurements were obtained in November at both evaluation time points; however, we had originally planned to obtain the measurements every 3 months. Therefore, evaluation points were also in half. Moreover, both outdoor and indoor temperature and humidity vary with seasonal factors. Previous studies reported that environmental factors affect the amount of physical activity [10].

Initially, we planned to continue accumulating data every 3 months to examine the influence of aspects of environmental factors, but we were unable to do so because of the pandemic.

Our future work still aims to acquire and analyze long-term subjective and objective data from older individuals with MADS, considering their changes in daily life to identify factors that influence the progression of MADS in older individuals.

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