Chapter

Overarching Goal and Intervention for Healthy Aging in Older People during and after the COVID-19 Pandemic: Impact of Rehabilitation

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic has had a major impact on society and our lives. Many older people and those with underlying medical conditions have refrained from social activities and become housebound, increasing the risk of frailty. Therefore, we developed the Home Exercise Program for Older People, a multidisciplinary program that makes it easier for older people to exercise at home. We also provide outpatient rehabilitation for not only those affected by COVID-19, but also older people with frailty who have become confined under the COVID-19 pandemic. In this chapter, we overview the situations and lives of older people in Japan under the COVID-19 pandemic and discuss preventive strategies.

Keywords: COVID-19, SARS-CoV-2, rehabilitation, frailty, NCGG-HEPOP®

1. Introduction

1.1 Worldwide spread of COVID-19 and refraining from leaving the home among the aged

The spread of the coronavirus infection caused by the novel severe acute respiratory syndrome coronavirus 2 has had a major impact on people's lives [1, 2]. Within approximately 1 month after the global outbreak of coronavirus disease 2019 (COVID-19), when it was declared a pandemic by the World Health Organization, the average number of steps taken by 455,404 people in 187 countries was reported to have decreased by 27.3% [3]. In Japan, a state of emergency was declared, and many people were forced to refrain from going out and to restrict their social activities. They were also encouraged to stay indoors to avoid the "Three Cs" (closed spaces, crowded places, and close-contact settings). Because higher mortality rates were reported among older patients and those with underlying medical conditions [4], older individuals more strictly refrained from activities. In fact, in a survey of 1600 older persons aged 65 years and older, physical activity levels were approximately 30% lower than before the spread of COVID-19 [5, 6].

Although a trend toward less restraint with respect to engagement in activities has recently been seen, many older people remain at increased risk of frailty or deteriorating to a level requiring nursing care as the COVID-19 pandemic continues unabated. The risk of frailty or deterioration to the state of requiring long-term care is therefore increasing.

1.2 Definition of frailty

Frailty, a condition in which older people lose the ability to perform activities, is defined as "a state of multiple declines in physical functions with reserve capacity approaching or exceeding a clinically disabling threshold, assuming there is a threshold for clinical impairment" and falls between normal health and the need for nursing care [7, 8]. Frailty progresses because of not only the age-related deterioration of physical functions such as muscle strength, balance, and walking ability, but also psychological problems such as cognitive impairment and depression, and social problems such as living alone and economic deprivation, which can lead to outcomes such as functional disability, the need for nursing care, and even death [7, 9–11]. Both the prevention and remediation of frailty are important because decreased activity levels in older people increase the risk of developing frailty and, with respect to older people with underlying medical conditions, the risk of requiring long-term care [12, 13]. Frailty is characterized by vulnerability to functional decline even under mild stress and is notably reversible, allowing a return to a robust state, if appropriate measures are taken. Frailty encompasses not only physical, but also mental, cognitive, social, and other aspects (**Figure 1**). The physical aspect of frailty is based on the concept of the phenotype model proposed by Fried et al. [7]. Rockwood et al. have also proposed the deficit accumulation model [14]. The deficit accumulation model is useful for comprehensive assessment of functional impairment in the selection of clinical interventions and prediction of life expectancy and risk of institutionalization, including for those with disabilities or at end-of-life stages. Of the two models, the accumulation model is more complex to use in clinical practice, so the phenotypic

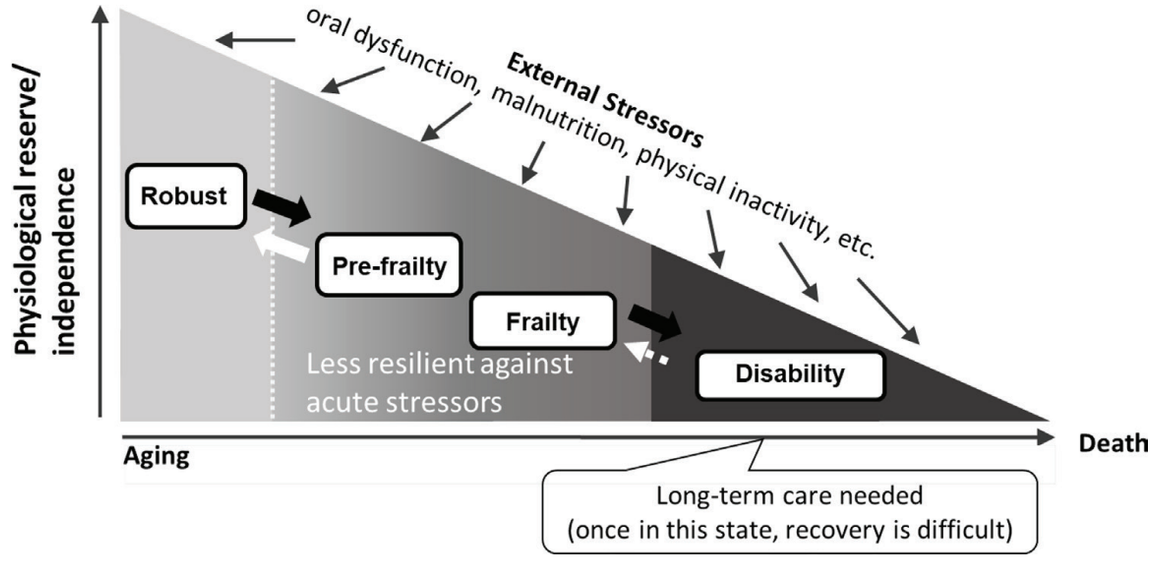

Figure 1.
Conceptual diagram of frailty for older people, there is concern about the progression of frailty, in which a small amount of stress can lead to major deteriorations in health. Prepared by the author with reference to Kuzuya M (2009) [13].

model definition is often used in studies of community-dwelling elderly, and the phenotypic model focusing on physical aspects will be used in this paper.

1.3 Assessment of frailty

The Cardiovascular Health Study (CHS) criteria proposed by Fried [7] are often used to consider disability prevention for older individuals living in the community. These criteria assess five items—fatigue, weight loss, decreased physical activity, decreased walking speed, and decreased muscle strength—with those meeting the criteria for three or more items being considered to be frail, and one or two items pre-frail. The revised Japanese version of the CHS criteria (J-CHS) [15] and the Frailty Screening Index [16] are commonly used in Japan. The former includes measures of walking speed and grip strength and focuses on the physical aspects of frailty, whereas the latter is a more general assessment, as all questions are binary choice and some focus on memory. The Kihon Checklist, which has been used to identify people eligible for secondary prevention projects and lifestyle support services, is also used. A total score of eight points or more is considered to indicate frailty, and a score of 4–7 points pre-frailty, suggesting an increased risk of requiring nursing care and even death [17].

1.4 Evidence of interventions for frailty

Intervention studies on older individuals with reduced mobility have reported the effectiveness of muscle strengthening exercises, stretching, aerobic exercises, and balance exercises on lower limb muscle strength, and many of these studies have reported that exercises combining two or more of these exercises are more effective [18]. However, evidence for interventions in older adults with frailty remains weak because the definition of "frailty" differs from country to country and study to study, and the target population is not sufficiently uniform. It is therefore desirable to establish the same definition of frailty, clarify the inclusion criteria, and accumulate larger samples.

2. Survey of the effects of COVID-19 on older people with underlying medical conditions

2.1 Survey on the influence of the spread of COVID-19 on living at home

The Asian Working Group on Sarcopenia (AWGS) recommends establishing a balance between the prevention of COVID-19 and maintenance of function [19], as well as providing continued physical activity and daily living instructions to sustain activity levels and exercise opportunities while working to prevent infection and avoid functional decline. A systematic review of the impact of the spread of infection on rehabilitation found that all patients with COVID-19, regardless of infection status, had limited rehabilitation services [20], and a follow-up study found that community-dwelling older adults who lived alone or were less socially active tended to remain less active [21]. Older individuals with frailty or underlying conditions who live alone and have little social interaction may be at a particularly increased risk of developing frailty and disability.

Our hospital provides rehabilitation services to older patients not only during inpatient care, but also on an outpatient and home-visit basis. Under this situation, with the aim of discussing future interventions to maintain activity levels and

function in older patients with underlying diseases, we conducted a survey on the impact of the spread of COVID-19 in older patients undergoing rehabilitation at our hospital [22].

2.2 Impact of the pandemic in the patients who received rehabilitation

We surveyed 175 patients aged 65 years or older receiving outpatient or in-home rehabilitation at our center regarding their activities before and during the spread of COVID-19. The results indicated that the frequency of going out for errands tended to decrease during the period of infection spread. On the other hand, the frequency of going out for health reasons tended to be divided into two groups: those who consciously went out and those who refrained from and reduced the frequency of going out. Regarding exercise, approximately half of the respondents reported engaging in some form of exercise during the COVID-19 pandemic, with the most common reference material being "nothing in particular" (**Figure 2**). The frailty group was classified into three groups based on scores on the Kihon Checklist and whether they required nursing care [17, 23]. Both the frailty and nursing care groups were significantly less likely to go out after the start of the infection spread (**Figure 3**).

2.3 Outcomes of older patients hospitalized with COVID-19

The number of infected patients in Japan increased dramatically around January 2022 as the Omicron variant, which is associated with a lower mortality rate but greater infectiousness compared with the Delta variant, became the dominant strain [24]. Older individuals with pre-hospitalization frailty were found to be more likely to experience disability during acute treatment and a reduced ability to perform activities of daily living, even in relatively mild cases of COVID-19, and to sometimes require continued rehabilitation even after treatment is completed [25, 26]. We conducted a study using the Clinical Frailty Scale (CFS) to determine whether patients admitted to our hospital with a positive COVID-19 test result could be discharged directly home from the COVID-19 ward after the completion of acute care, depending on the severity of their frailty. The cutoff value on the CFS for not being discharged home [14] was six points (moderate frailty) or higher, with a sensitivity of 77.8% and specificity of 81.8% [27].

3. Home exercise program for older people (NCGG-HEPOP®)

3.1 Development and Purpose of HEPOP®

To maintain the physical and mental functions of older individuals whose social activities were limited because of the prolonged spread of COVID-19 and other factors and to create materials that would allow nonprofessionals to provide appropriate advice regarding exercise and activity, the National Center for Geriatrics and Gerontology published a "Home Exercise Program for Older People" (NCGG-HEPOP®). This program was drafted mainly by therapists and completed by considering advice and opinions from specialist physicians from each department and multiple other professionals.

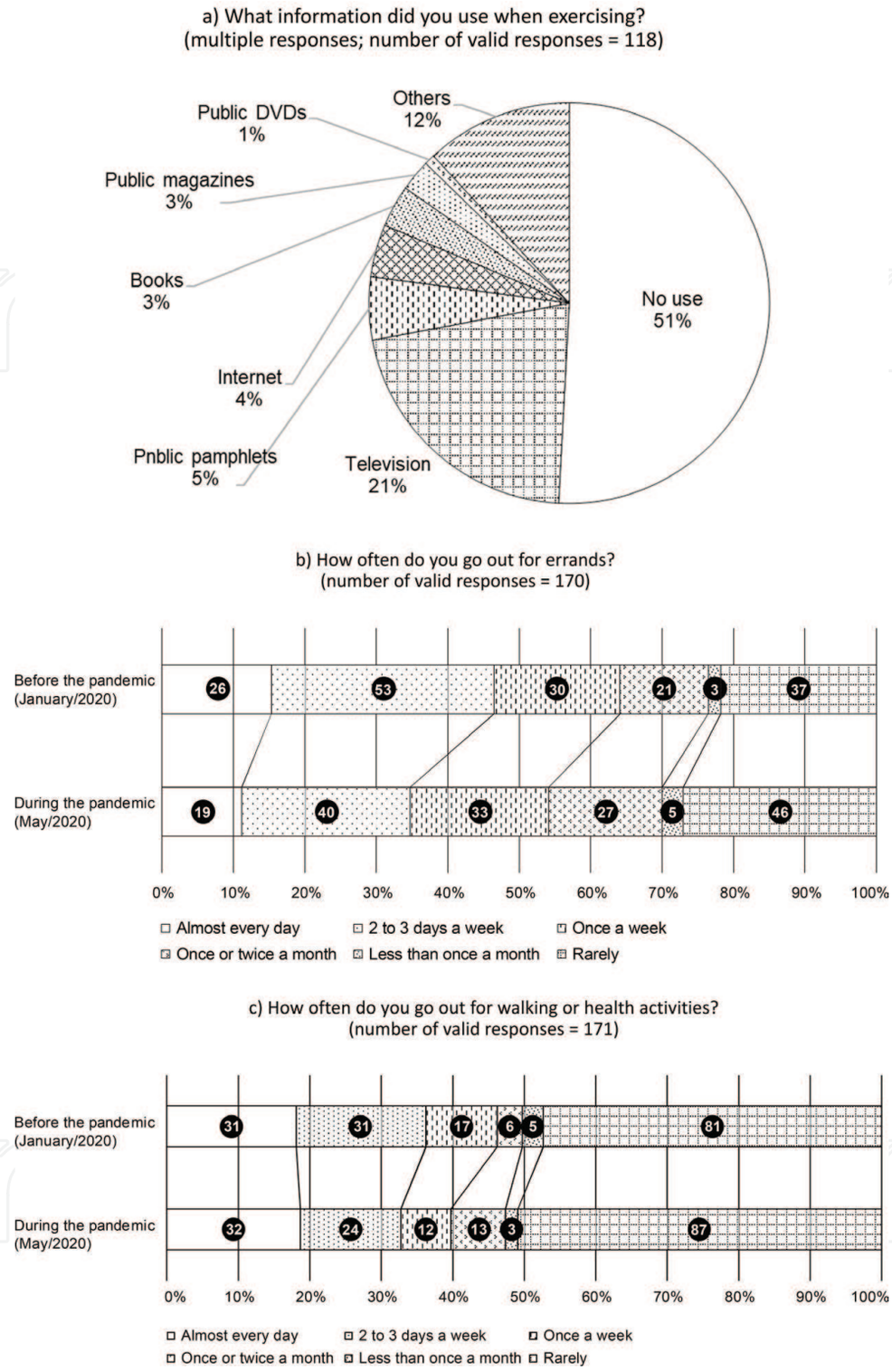

Figure 2.
Status of exercise and going out.

3.2 Contents of HEPOP®

In HEPOP®, a flowchart was created to enable the selection of an appropriate individual exercise and activity package and exercise and lifestyle guidance program (**Figures 4** and **5**) based on several questions [28]. For example, responses of "Yes"

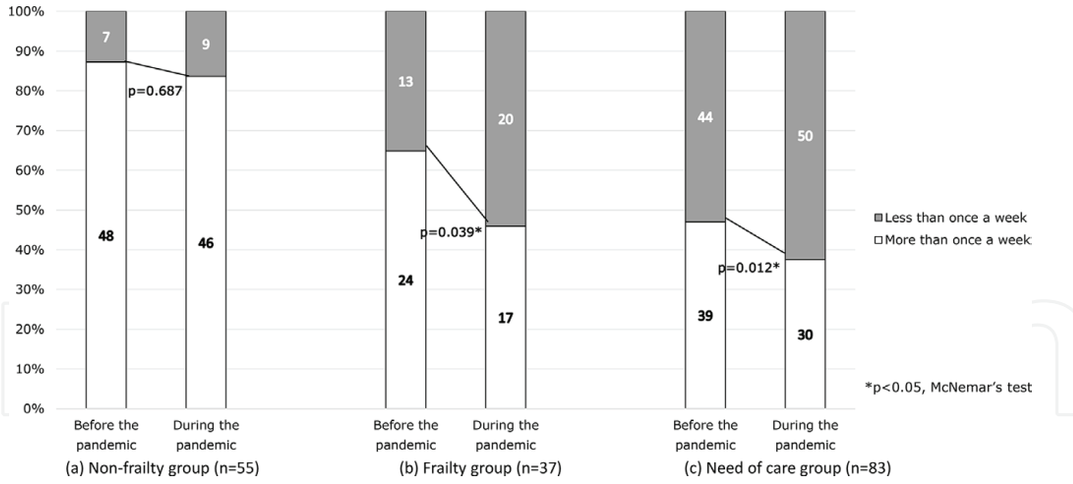

Figure 3.
Change in frequency of going out before and after the spread of infection. Before the pandemic = November/2019–January/2020. During the pandemic = March/2020–May/2020. (a) Kihon Checklist (KCL) score < 8, (b) KCL score ≥ 8, (c) Person in need of nursing care.

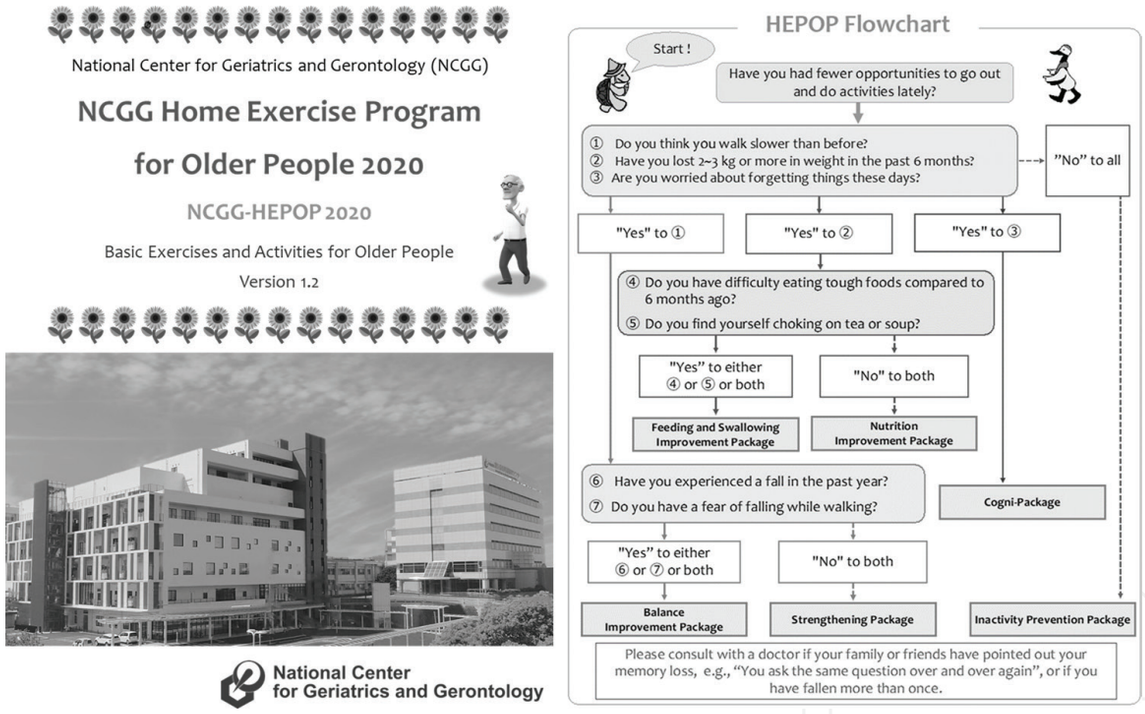

Figure 4.
Home exercise program for older people (HEPOP®).

to the items "Do you think you walk slower than before?" and "Have you experienced a fall in the past year?" recommends of balance improvement package. Five other packages were also created: Strengthening package, Inactivity prevention package, Cogni-package, Feeding and swallowing improvement package, and Nutrition improvement package [29, 30]. Each package includes more than 10 different programs and is classified into three levels according to the exercise difficulty and load, thereby allowing participants to select and combine exercises according to their abilities and condition on that particular day. Since the appropriate package may change depending on one's physical and mental condition, it was recommended to answer the flowchart questions once a month or after changes in one's physical or

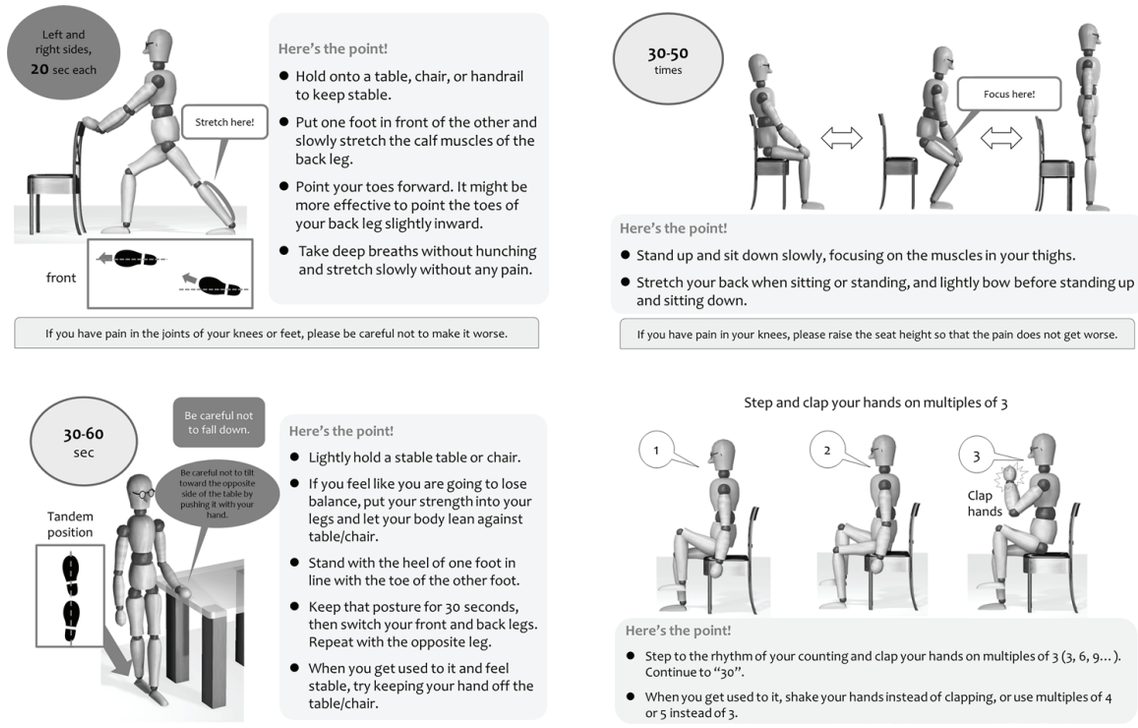

Figure 5.
HEPOP® exercises.

mental condition and to choose exercises and activities more appropriate for one's condition at that time.

3.3 Preparing and publishing shortened, video, and multi-language versions of HEPOP®

To disseminate HEPOP® widely around the world, we made it available for anyone to view and download free of charge from our website and also printed and distributed booklets. In addition, we produced a DVD that included some of the exercises with explanations [31] and distributed it to those who wanted to learn more, in addition to uploading the contents to YouTube. We also had the videos translated into English, Chinese, Thai, Russian, and other languages, with the aim of creating content that could be used by anyone around the world.

3.4 Application of HEPOP® and problems experienced during the COVID-19 pandemic

Study participants with various diseases, as described in the previous section (2.1), were given exercise instructions using HEPOP® and encouraged to exercise independently at home. Several weeks later, those who were non-frail, frail, or in need of care at the time of the intervention were surveyed to determine whether they had implemented the exercises [22]. Approximately 50% of those in the non-frail group and those in need of care were able to implement exercises at least once a week, whereas the frail group had a lower frequency, in the 30% range. The non-frail group was more likely to exercise because they already had a higher rate of exercise, whereas those in need of nursing care used some kind of nursing care service and required more involvement from a third party. On the other hand, the individuals with frailty were

less likely to participate in social activities because of limitations in their communities, such as a lack of social gatherings and senior citizen clubs, which are the main hubs for social participation activities, as well as having fewer friends and neighbors, which may have resulted in less social participation and consequently fewer exercise opportunities [32, 33]. As the spread of COVID-19 is expected to be prolonged, and the associated limitations on social participation are presumed to further increase the risk of functional decline [34], we would like to build on these results and expand the use of tools such as HEPOP® for frail older adults and their family and medical caregivers to complement the opportunities for and quality of exercise.

4. Outpatient clinic for locomotive and frailty syndrome

4.1 What is a locomotive-frailty outpatient clinic?

To properly assess and improve the holistic health of older individuals with or at risk of frailty, our hospital has been providing a comprehensive medical service since 2016, when we established the world's first locomotive-frailty outpatient clinic. In this clinic, a multidisciplinary team of geriatricians, orthopedic surgeons, and rehabilitation physicians, as well as physical therapists, dietitians, pharmacists, and social workers, conduct evaluations to determine an appropriate treatment plan for patients and propose and implement intervention methods. For example, dietitians provide dietary and nutritional guidance to patients with malnutrition and obesity problems, and physical therapists provide exercise guidance to patients with decreased muscle strength and balance. The prevalence of frailty among the patients seen in our clinic was found to be 30.9%, which is higher than the 6.1% and 11.3% [8] reported in a survey of older adults living in the community.

4.2 Early detection of high-risk patients in need of care

One of the main roles of our locomotive-frailty outpatient clinic is the easy and early detection of patients at particularly high risk of worsening to the need for care and the provision of appropriate preventive caregiving measures. In our previous study of risk factors for worsening to the need for long-term care in 233 patients (mean age 78 ± 6 years) who had visited our locomotive-frailty outpatient clinic [35], we found an association between scores on the Short Physical Performance Battery (SPPB), which is used in AWGS 2019 [36], and whether a person was certified as requiring long-term care 1 year later. Specifically, an SPPB cutoff score of nine points or less was associated with an increased risk of new or worsened long-term care need certification after 1 year (area under the receiver operating characteristic curve 0.74, sensitivity 65%, specificity 75%) (**Table 1**).

5. Rehabilitation for older patients with frailty

5.1 Voluntary exercise efforts and behavior modification

Behavior modification is one of the most important perspectives in implementing rehabilitation for patients with frailty and those at risk of needing care. Even if high-quality exercise regimens are provided by professionals such as physical therapists or HEPOP®, simply providing it to the individual does not prevent caregiving.

	Usual walking speed (m/s)	SPPB (score)
Cutoff value	0.92	9
P	<0.001	<0.001
Sensitivity	62.2%	64.9%
Specificity	77.0%	75.0%
Maximum youden's index	0.392	0.399
AUC [95%CI]	0.740 [0.656–0.825]	0.737 [0.647–0.827]

SPPB, Short Physical Performance Battery; AUC, area under the curve; CI, confidence interval.

Table 1.
Cutoff values for usual walking speed and the SPPB.

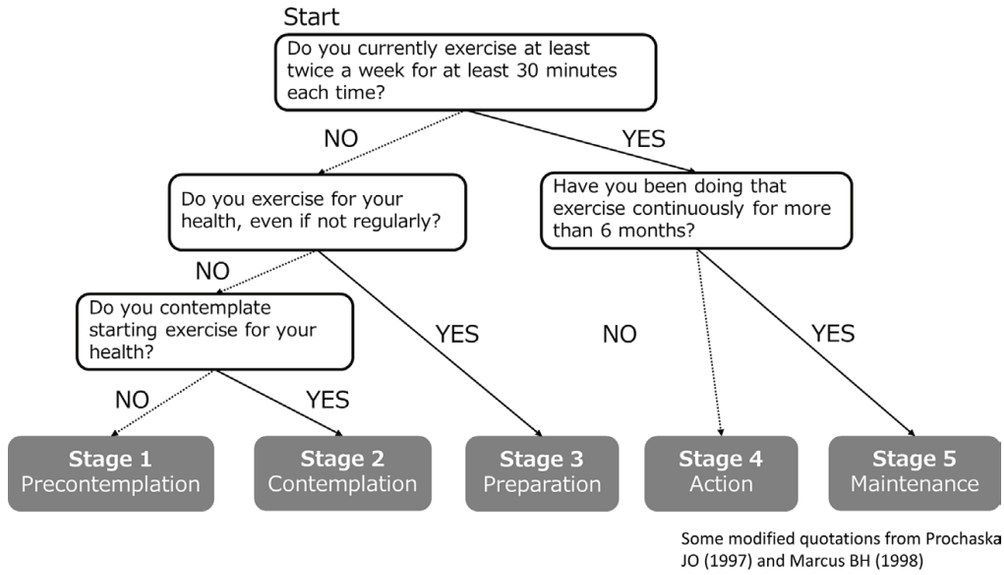

Figure 6.
Transtheoretical model flowchart some modified quotations from Prochaska JO (1997) and Marcus BH (1998) [37, 38].

In our clinic, we use the transtheoretical model of health behavior change (TTM) [37, 38], a stage classification based on behavioral modification, preparation for exercise, and duration of practice, to assess exercise awareness and provide stage-appropriate interventions when conducting rehabilitation and exercise interventions for people with frailty (**Figure 6**). Some people have always been regular exercisers, whereas others have always wanted to exercise, but have not been able to do so regularly. The method of involvement varies depending on the stage, and one of the goals is to get patients to progress to further stages. A meta-analysis of practice reports for people with diabetes found that introducing practices, setting up step-by-step exercise, working toward habituation, and providing feedback on assessment results significantly improved HbA1c levels in people with diabetes after the intervention [39].

Further study is needed to determine the effectiveness of this model for older patients with frailty. However, those in stages 2 and 3 may share a schedule and specific targets to make it easier for them to continue exercising. In stages 4 and 5, we instruct patients on the appropriate amount of exercise, the selection of an exercise program, and the correct posture so that they do not exercise incorrectly or overuse

the exercise program. In stage 1, which involves the initial explanation of the benefits of exercise, followed by family participation, an immediate effect may be seen.

5.2 Changes in motor function and behavior modification stage after exercise

This section presents the findings of our clinical study on outpatient rehabilitation for older individuals who were referred from the locomotive-frailty outpatient clinic at our hospital because of declines in muscle strength and balance. Rehabilitation consisted mainly of exercise instruction at home by a physical therapist using HEPOP®. The following points were tried and tested: (1) regular evaluations were conducted to provide feedback to the patients, (2) the amount and frequency of exercise were gradually increased based on the evaluation results, (3) the importance of voluntary exercise at home was explained and the patients were asked to record their daily exercise status, (4) low-intensity, high-frequency strength exercises were performed at home, whereas high-intensity, high-difficulty balance exercises were performed at the hospital under the supervision of a physical therapist, and (5) the frequency of visits to the hospital was reduced from once a week to once a week or longer as the exercise habits became more firmly established. After 3 months of outpatient rehabilitation among 36 older individuals aged 65 years and over, we found significant improvements in walking time, on the Timed Up and Go test (TUG), and on the five times sit-to-stand test (paired *t* test, $p < 0.05$). In addition, 75% of the participants improved their TTM stage by one stage or more (McNemar's test, $p < 0.05$). Based on these findings, we believe that home exercise instruction using HEPOP® may be effective for improving physical function and promoting behavioral modification in older individuals.

5.3 A Case in which frailty improved with appropriate exercise guidance despite the COVID-19 pandemic

We present a case in which physical function was improved by exercise instruction in a homebound older adult who had originally established an exercise habit, but whose activity was restricted during the COVID-19 pandemic. An older man in his 70s with a history of a classic lumbar vertebral compression fracture had subjective symptoms of stumbling when walking after refraining from activity due to the ongoing pandemic. Prior to visiting our institution, he was attending a gym for training five to six times a week. He mainly performed aerobic exercises using an ergometer and treadmill, and his behavioral modification stage was 5. However, he was not performing muscle strengthening exercises or balance training. When COVID-19 began to spread, it limited his access to the training gym and thus reduced his activity levels. Therefore, exercise instruction from a physical therapist was started once a week at an outpatient rehabilitation center. At the time of his initial examination, he had a J-CHS score of 1 (Pre-frailty), a walking speed of 1.1 m/s, a TUG time of 7.7 s, knee extension muscle strength of 42.3 kgf on the right and 36.9 kgf on the left, and a one-leg standing time of 8.7 s. Outpatient rehabilitation included exercise instruction using HEPOP®, routine home exercise checks using a notebook, standing balance exercises, and resistance training instruction for 3 months (**Figure 7**). After the intervention, he started to perform machine training in addition to aerobic exercise at the gym, which he resumed, and was also able to perform HEPOP exercises daily at home. As a result, 3 months after the intervention, his complaint of stumbling when walking disappeared and his physical functions improved (walking speed 1.3 m/s, TUG time 6.2 s, and one-leg standing time 17.1 s). His knee extension muscle strength improved to 43.3 kgf on the right and 40.8 kgf on the left. Although this patient was in behavioral modification

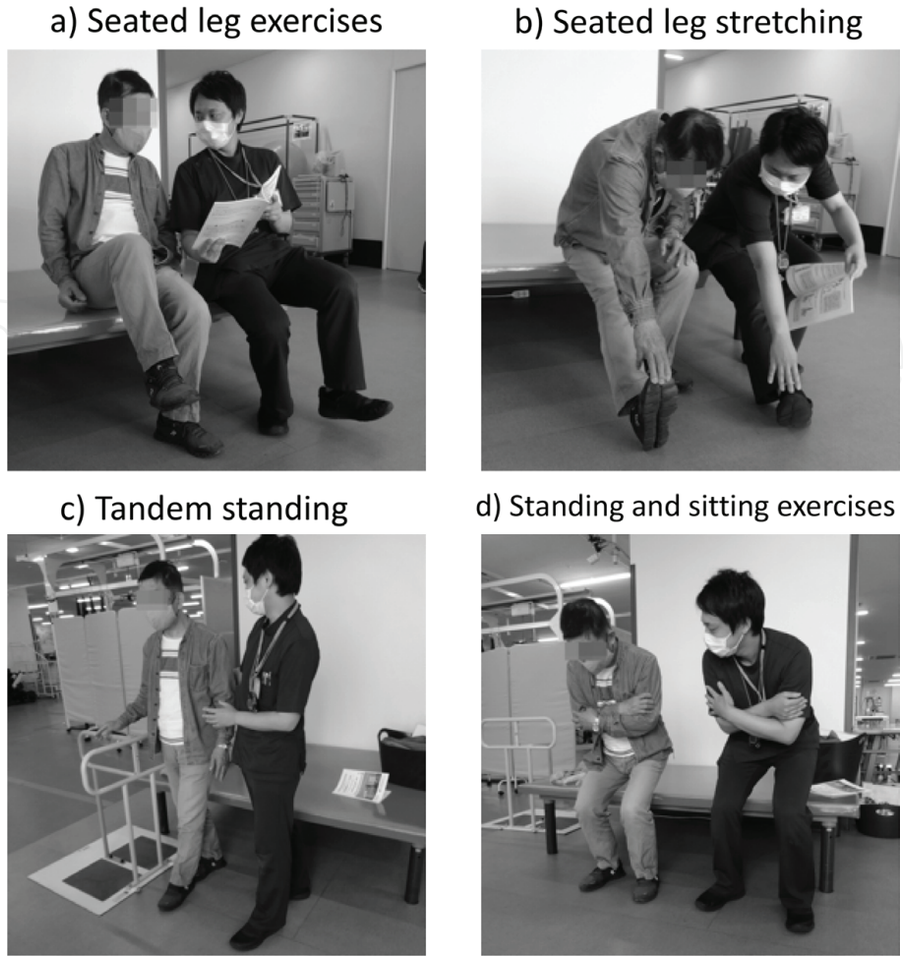

Figure 7.
Actual exercise instruction for older people using HEPOP®.

stage 5, we found that his exercise content was skewed, his balance ability had declined, and he had no exercise routine other than those performed at the gym. Therefore, even in patients with apparently good exercise habits and motivation, a specialized evaluation may reveal decreased or declining function, and a review of exercise content and improvement of function may be achieved by taking a more targeted approach. It is assumed that many older people are at risk for such functional decline as a result of the COVID-19 pandemic, so assessment and intervention in outpatient frailty clinics may play an important social role during this prolonged situation.

6. Conclusion

This chapter introduced the risk of frailty due to COVID-19 and key points regarding exercise guidance in the community and medical institutions. There is some concern that the prolonged COVID-19 pandemic has reduced the frequency of outings and opportunities for exercise and activity among many older adults, thereby increasing their risk of deteriorated physical and mental functions. In addition, in this situation, rehabilitation and other medical services are difficult to provide, and older adults with frailty are at a higher risk of decreased physical function and the need for increased caregiving. We hope that the use of guides for activities that can be performed at home according to each individual function, the provision of comprehensive support mainly

through community collaboration, and ongoing assessments and support by medical professionals can help older adults living at home continue to live healthy lives.

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Conflict of interest

The authors declare no conflict of interest.

Ethical considerations

All study protocols complied with the principles laid out in the Declaration of Helsinki, and written informed consent was obtained from each participant. The ethics review board of the National Center for Geriatric and Gerontology approved this study [Approval No. 881-9, 1413-2, 1582].

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