Effect of Otago Exercise on Indicators of Sarcopenia in the Elderly

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Abstracts: This study was conducted to determine the effect of Otago exercise intervention on muscle mass, muscle strength, and physical performance, which are diagnostic indicators of sarcopenia, in elderly individuals aged 65 or older. The final subjects included 6 individuals in the walking exercise group and 5 people in the Otago exercise group. Walking exercises were conducted 12 times a week for 22 minutes at a time and more than 80 steps per minute whereas the Otago exercise was conducted four times a week for 50 minutes, a total of 12 times under the supervision of a senior movement leader. After the intervention, a diagnostic evaluation of sarcopenia was performed, and before and after the intervention, the intergroup skeletal muscle mass (ASM), grip force (Hand Grip), and SPPB were compared. The three evaluation parameters are related to physical function and showed that after each exercise intervention, the Otago exercise group exhibited an increase in the limb skeletal muscle and the SMI. The walking exercise resulted in a decrease in muscle strength, but the Otago exercise group showed an increase in this metric. The SPPB score increased in the Otago movement group, but no statistically significant results were obtained. It was demonstrated that the Otago exercise positively affects the index of muscle loss in the elderly, and is potentially effective for preventing and managing sarcopenia.

Keywords: Elderly exercise, Sarcopenia, Otago exercise, Walking, Physical performance.

1. INTRODUCTION

Sarcopenia, initially defined as the loss of skeletal muscle mass [1] owing to a decrease in the number and cross-sectional area of muscle fibers [2], now encompasses not only a decrease in muscle mass but also a decline in muscle strength and function [3,4]. Sarcopenia can lead to a decrease in physical performance, difficulty in maintaining daily life functions [5], increased risk of falls and fractures [6], and an increase in long-term care admission and mortality [7]. In addition, a decrease in muscle mass [8] can lead to a decrease in maximum oxygen consumption [9] and metabolic rate [10], as well as a decrease in physical strength [11].

This concept has since evolved via extensive research, leading to the addition of sarcopenia disease code in the International Classification of Diseases, 11th Revision (ICD-11) by the World Health Organization (WHO) in 2017, following an initiative by the Centers for Disease Control and Prevention (CDC) in the United States in 2016. Additionally, in 2021, Korea also included sarcopenia (M62.5) as a diagnostic code in the Korean Standard Classification of Diseases and Causes of Death (KCD-8) during its eighth revision [12].

After the disease code of sarcopenia was introduced, the National Health Insurance Service was able to compensate patients with sarcopenia, and as of June 2022, the status of benefits for the 65-year-old elderly population is as follows. Among the 65–79-year-old age group, 289 men and 422 women; a total of 711 patients, 109 men and 142 women aged 80–89, a total of 251 patients, and 13 men and 20 women aged 90–100, a total of 33 patients, were charged for sarcopenia. This was an increase of 59% for a total of 583 people in 2021 when disease codes were first assigned. It is expected that this trend will continue, resulting in an increase in medical expenses given that the number of elderly people aged 65 or older is expected to increase from 8% in 2022 to 25.5% of the total population in 2030.

Ahn Chan-woo and Lee Won-mi [13] suggested in their study that among the positive effects of elderly participation in exercise, is the reduction of medical expenses. The findings of a study conducted in 2000 in the United States imply that a 10% reduction in sarcopenia is possible, potentially saving $1.1 billion in health-related costs [8].

As a specific alternative, Lee Sang-yoon [14] suggested the development of new medical technologies and new drugs to prevent, treat, and rehabilitate patients according to the clinical pattern and progression of sarcopenia, but recommended exercise and nutritional intervention as preventive and treatment methods in the current state. Although the importance of elderly exercise is being highlighted for the prevention and treatment of sarcopenia, the prolonged COVID-19 pandemic, which began in 2020, has limited the scope of physical activity of the elderly, resulting in a decrease in physical activity. According to a 2022 survey by the Ministry of Health and Welfare, the rate of increase and decrease in exercise non-practice for the elderly compared to the previous period was 51.8% aged 65 to 69, 51.8% aged 70 to 74, 35% aged 75 to 79, 47.3% aged 80 to 84, and 29.6% aged 85 or older. A decrease in regular exercise can cause excessive protein degradation as muscle mass decreases, which can directly or indirectly affect metabolic pathways [15]. The effect on the body mass index (BMI) was also reported to be significant [16]. In particular, a decrease in exercise can cause a decrease in the lower limb strength among the body muscles, leading to falls in the elderly.

In groups with a low exercise participation rate of less than 3 times a week according to a study by Ahn Il-soon [17], physical strength including BMI, body fat rate, and muscle strength did not show any significant change. As such, it is necessary to implement an effective exercise program that can increase the exercise of the elderly while sustaining muscle mass, muscle strength, and physical performance, which are three indicators of sarcopenia diagnosis, resulting in the expression and deterioration of sarcopenia.

Since exercise intervention in the elderly should be applied in a safe manner that does not exacerbate musculoskeletal and other underlying diseases, walking exercise that can be easily performed is generally recommended. However, in many previous studies, it has been shown that walking alone may not be sufficient to increase muscle mass or reduce the risk of falls [18]. In addition, it is difficult for most people to continuously perform this activity over a long period. In 2017, Lee Hyang-beom [19] reported that complex exercises that mixed two types of exercises had a more significant effect on muscle strength rather compared to a single exercise. In addition, several previous studies have suggested that complex exercise that can stimulate the cardiopulmonary and muscular systems simultaneously is recommended [20,21].

The Otago Program consists of a complex variety of exercises including walking, muscle, and balance exercises. The Otago Exercise is an evidence-based program that was developed in New Zealand. In a study of the elderly involving various physical characteristics and ages, the research institute reported that this exercise regime is potentially a safe and effective method of low-cost management to prevent falls in the elderly [22]. Most of the previous studies based on the Otago Exercise are related to falls in the elderly, and the reported studies on sarcopenia, which has become an important issue, are insufficient.

Therefore, this study compared the effects of walking and Otago exercises on muscle mass, muscle strength, and physical performance, which are diagnostic indicators of sarcopenia. Specifically, the investigation was performed in the elderly population to identify effective exercises to improve the index of sarcopenia. The purpose of this is to investigate an effective exercise intervention program for the prevention and treatment of muscle loss in the elderly.

2. MATERIALS AND METHODS

2.1. Study Design

The participants of this study were at least 65 years old and resided in Seoul, Korea. The selection process involved diagnostic assessments for sarcopenia, including screening and pretesting based on AWGS 2019. After the test was performed, the participants were divided into a walking exercise group and an Otago exercise group. A total of 12 exercise interventions were conducted for 4 weeks, after which a post test was conducted to analyze the changes in muscle mass, muscle strength, and physical performance.

2.2. Study Population

The final subjects were selected based on the diagnosis screening test for sarcopenia by recruiting male and female seniors aged 65 or older living in Seoul. The purpose and methodology of the study were explained to the participants before the start of the study. Only subjects who understood the instructions and were willing to participate in the study were selected. In addition, individuals who previously participated in systematic exercise training, who were unable to walk independently without assistive tools, who complained of chest pain or cerebrovascular disease, who were prescribed drugs that affected their balance, or who experienced communication difficulties, were excluded from the selection.

A total of 33 subjects met the criteria for selection in the study. In addition, 12 elderly participants who were diagnosed with sarcopenia were selected, and exercise intervention was utilized by dividing them into walking exercise and Otago exercise groups via random assignment. There were six subjects in the former group and five participants in the latter group, excluding one individual who was eliminated. The general characteristics of the subject are shown in **Table 1**. There was no significant difference between the two groups based on a test of homogeneity before the exercise. Sequence selection was efficiently conducted using a two-step approach so that the pairwise sequence identities in the data set would be larger than a given threshold value. The sequence identities of all sequence pairs in the data set were calculated in advance.

Table 1. General characteristics of the subjects.

Categories		walking exercise group	Otago exercise group	p
Gender [a]	Male	1 (16.67%)	0 (0.00%)	0.338
	Female	5 (83.33%)	5 (100.00%)	
Age (y)		75.33±4.13	72.60±2.41	0.232
Height (cm)		152.72±5.78	152.70±6.48	0.854
Weight (kg)		52.87±5.31	53.70±10.74	0.647
Calf circumference (cm)	Right	32.73±1.06	32.66±4.24	0.852
	Left	32.90±1.56	33.24±3.72	0.714
Skeletal Muscle Mass (kg)		18.43±2.64	17.38±2.66	0.584
Body Fat Mass (kg)		18.00±3.19	20.48±6.39	0.273
Body Mass Index (kg/m^2)		22.58±1.21	22.94±3.76	0.855
Body Fat Percentage (%)		34.07±4.91	37.38±5.20	0.465
Trunk Muscle Mass (kg)		15.72±1.92	14.90±1.88	0.855

[a] n(%), Values for all variables, except for the 'a' variable, are the mean ± standard deviations

2.3. Evaluation

The reference values for the definition of sarcopenia were first presented by the European Working Group on Sarcopenia in Older People (EWGSOP) in 2010, and by the International Working Group on Sarcopenia in 2011, and the Asian Worker's Body Decreasing Algorithm (AGSA) in 2014. Since then, the European Commission for the Evaluation of Elderly Muscle Reduction (EWGSOP) has published updated indicators in 2018, and the Asian Muscle Reduction Assessment Committee (AWGS) has also published an updated algorithm in 2019 [3]. Accordingly, in this study, muscle mass, muscle strength, and physical performance were evaluated according to the diagnostic criteria of AWGS 2019. The evaluation methods for the three diagnostic indicators are as follows.

Muscle Mass

Muscle mass, one of the diagnostic indicators of sarcopenia, was determined based only the muscle index, which is the value divided by the square of the subject's height (m), after measuring the limb muscle mass according to the protocol recommended by AWGS 2019. In this study, the limb muscle mass of the limbs was measured using a multi-frequency impedance body fat meter (InBody S10 Biospace, Seoul, Korea). BIA involves the flow of current by placing electrodes in contact with the human body considering that 73.3% of the components of the human body is water [23]. Given the widespread use of BIA, the NIH (National Institutes of Health) held discussions on the reliability, problems, and standardization of this technique via academic meetings, and transitioned from single-frequency to multi-frequency methods to solve problems. Direct Segmental Multi-Frequency Bioelectrical Impedance Analysis (DSM-BIA) can accurately analyze body composition based on impedance measurements of the arms, legs, and torso. This approach is used to accurately measure both intracellular and extracellular moisture [24]. Moreover, it can be used to quantify FFM and FM to identify sarcopenia, cachexia, and sarcopenic obesity [25].

In this study, before measuring the limb skeletal muscle mass, the subjects did not consume food containing water within 2 hours before the test, minimal clothing was worn, and exercise was not permitted within 24 hours of the test. After going to the bathroom, measurements were performed after resting for 5 minutes with both arms and legs spread out in a lying position. The reference value for muscle mass evaluation was obtained as a decrease in muscle mass in the case of <7.0 kg/m2 for men and <5.7 kg/m2 for women, according to the definition of AWGS 2019.

Hand Grip

In this study, grip strength was measured using a digital grip strength meter (my-5401, TAKEI, Japan), a spring grip strength meter, and the measurement method outlined in the AWGS 2019 grip strength measurement guidelines was used. The subjects were allowed to stretched their arms down from the upright position and hold eld the grip gauge with their elbows fully extended. Their arms were spread approximately 15 degrees, and the grip force was measured by applying the maximum force for 5 seconds according to the evaluator's instructions. Each of the dominant hands was measured twice at intervals of 1-minute rest, and the largest of band was used [26]. The standard value was <28 kg for men and <18 kg for women.

Physical Performance

In the diagnostic evaluation of sarcopenia in the elderly, physical performance evaluation other than muscle mass and muscle strength measurements were considered [27], and in this study, all 3 tools that were recommended by the Asian sarcopenia evaluation committee 2019 (AWGS 2019) for physical performance evaluation were evaluated used.

The Short Physical Performance Battery (SPPB) consists of the following three items. The standing balance test involved standing side-by-side feet side by side, a semi-tandem stand with the hallux of one foot on the inside of the heel of the other, and a full stand with the toes of one foot on the heel of the other for more than 10 seconds. A maximum of 4 points were awarded. Walking speed measures the time to walk 4 meters at walking speed. 0 points if the walk, 1 point if the walking time exceeded 8.7 seconds, 2 points if it exceeds 6.21 seconds but less than 8.7 seconds, 3 points if it exceeded 4.82 seconds but less than 6.20 seconds, and 4 points if it was less than 4.82 seconds. The repeated chair-stand prosecutor sat in the chair with his arms folded in front of his chest. It measures the time required to stand five times. A total of 0 points was awarded for more than 60 seconds, 1 point for more than 16.7 seconds, 2 points for more than 13.7 seconds and less than 13.69 seconds, 3 points for more than 11.2 seconds, and 4 points for less than 11.19 seconds. If the sum was less than 9 points after these three evaluations, this was determined to be a decrease in physical performance.

The 6 m forward walk test is a method that involves measuring the time taken to walk a straight distance of 6 m at a normal walking speed after the starting signal is heard by the. If the walking speed is less than 1.0, this is interpreted as a decrease in physical performance.

The 5-timed chair stand test (5TCST) subject sat in front of the chest with arms folded in front of the chest using a standard chair without an armrest and approximately 43 cm, according to the method reliability assessment based on the works of [28] Harvey, Willy Wallmann et al [29], and Mirjana Kocic et al [30] In this approach, the time taken to stand up five times repeatedly was measured.

If any of the a forementioned three evaluation tools were applicable, it was determined that physical performance deteriorated, and the SPPB, 6M walking test, and 5 TCST were used for data analysis.

2.4. Interventions

Walking Exercise

Walking exercise is defined by the WHO as an aerobic physical activity performed by maintaining an appropriate intensity, frequency, and period. Walking is a form of exercise that affects the inhibition of the functional and oxidative stress of the mitochondria in cells, which are potential mechanisms of aging sarcopenia [31]. Appropriate walking exercises maintain physical strength and prevent diseases [32]. In addition, in a previous study, the maintenance of homeostasis and improvement of aerobic capacity is explained. The walking exercise group of this study walked faster than 80 steps per minute for 22 minutes on an 11 m × 15 m basketball court with urethane flooring for a total of 12 times a week. Exercise practice was confirmed using a mobile Application called "Walk on".

Otago Exercise Program

The Otago Exercise Program is a program developed by the University of Otago in New Zealand and the Institute for Fall Prevention. It was designed to prevent falls in the elderly living in a community by treating reduced balance and muscle weakness as fall risk factors [28-30]. The results of many studies have shown that the elderly living in a community exercise individually based on their families, and group-based exercise intervention has been conducted in some areas [33].

According to a study by Maria Tsekour [34], it was shown that it was more effective to place an exercise center under the supervision of a leader as opposed to an individual at home, considering the exercise methods, The study was conducted as a group exercise under the guidance of an elderly exercise expert.

The exercise program consisted of five warm-up exercises, five muscular exercises, 21 balance and mobility exercises, and three finishing exercises. For the warm-up exercises, the subjects were asked to lift their legs a short distance for approximately five to seven minutes, rotate their neck and body, and to flex their ankle joints. Subsequently, the main exercise commenced for approximately 30 to 35 minutes, and during the main exercise, lifting the knees forward and backward during the muscle exercise. This procedure included leg-side lifting, heel lifting, toe lifting, and balance exercises such as walking on tiptoe, heel walking, standing on one leg, walking sideways, walking backward, walking in eight, and sitting in a chair. There is a standing lamp. Finally, as a cool-down exercise to return the body to its pre-exercise state, the final procedure involved calf, back, and hamstring stretching.

In the first week of the experiment, support such as standing on a chair or wall was used, but from the second week onward, there was no support. From the third week, 500 g of weight was added to each ankle without support [33,35]. The Otago exercise group conducted the exercise three times a week for 50 minutes, 12 times for a total of four weeks, and the details of the program are shown in **Table 2.**

Table 2. Otago Exercise Program.

Warm-up Details Movement	Marching, neck movements, back extension, trunk movements, ankle movements.
Strength Exercise Detail Movement	Front knee strengthener, back knee strengthener, side hip strengthener, calf raises, toe raises.
Balance Exercise Detail Movement level 1	Knee bends supported, toe walking supported, heel-toe stand supported, heel-toe walking supported, one leg stand supported, sideways walking supported, heel walking supported, sit to stand using hands, backward walking supported, heel-toe walking backward, walk and turn.
Balance Exercise Detail Movement level 2	Knee bends without support, toe walking without support, heel-toe stand without support, heel-toe walking without support, one leg stand without support, sideways walking without support, heel walking without support, sit to stand without hands, backward walking without support stair walking.
cool down Details Movement	Calf stretch, back of thigh stretch, walking.

2.5. Data Analysis

The data measured in this study were analyzed using SPSS 25.0, and the statistical significance level was set as 0.05. Shapiro-Wilk tests were conducted to verify the normal distribution of all the variables. For variables including SMI, SPEED, and 5TCST, the parametric method was used because it satisfied the normal distribution. However, ASM, GRIP, and SPPB did not satisfy the normal distribution, so a non-parametric method was used. The changes in exercise before and after were analyzed using Paired t-test and the Wilcoxon Signed-Rank test. Furthermore, the difference in the measurement results between the two groups was analyzed using an independent sample t-test and the Mann-Whitney test.

3. RESULTS

3.1. Comparison of sarcopenia indices before and after exercise

Although there was no statistically significant change ($p > 0.05$), the pre-and post-intervention differences for both groups are presented in **Table 3**. In each group before and after the intervention, the limb skeletal muscle mass (ASM) increased in both groups, and the muscle index (SMI) also increased for both groups. The grip strength decreased in the walking exercise group but increased in the Otago exercise group. The SPPB scores increased in both groups, but for 6 m of walking, the required time increased in the walking exercise group but decreased in the Otago exercise group. The 5TCST time decreased in the walking exercise group, but the decrease was less in the Otago exercise group. There was no statistically significant change for each indicator in the group.

Table 3. Comparison of sarcopenia indices before and after exercise.

Categories	Group	Pre	Post	T or Z	P
ASM (kg)	walking exercise	13.48±2.51	13.64±2.48	-1.483	0.138
	Otago exercise	13.12±2.55	13.38±2.71	-1.355	0.176
SMI(kg/m2)	walking exercise	5.72±0.60	5.79±0.61	-1.861	0.136
	Otago exercise	5.59±0.75	5.7±0.80	-1.780	0.150
GRIP (kg)	walking exercise	23.25±2.56	22.77±2.50	-1.069	0.285
	Otago exercise	20.12±3.97	20.68±4.24	-1.342	0.180
SPPB (score)	walking exercise	9.17±0.98	9.50±0.84	-1.000	0.317
	Otago exercise	9.60±0.89	10.00±0.00	-1.000	0.317
SPEED (m/s)	walking exercise	1.44±0.29	1.48±0.32	-0.608	0.570
	Otago exercise	1.33±0.20	1.26±0.13	1.011	0.369
5TCST (sec)	walking exercise	10.58±2.49	9.12±1.63	1.937	0.111
	Otago exercise	8.59±1.14	8.66±0.52	-0.135	0.899

3.2. Comparison between the two groups of changes after exercise

After each exercise intervention, the limb skeletal muscle for the Otago exercise group (0.26 ± 0.3) increased more than that of the walking exercise group (0.2 6± 0.31) and the SMI also increased in the Otago exercise group. For muscle strength, the walking exercise group (-0.48 ± 1.03) decreased, but the Otago exercise group (0.56 ± 0.77) increased. This is likely related to the content of the Otago exercise program. The SPPB score increased in the Otago exercise group compared to the walking exercise group. The walking time for 6 m increased in the walking exercise group but decreased in the Otago exercise group. The 5TCST time decreased in the walking exercise group and increased in the Otago exercise group. There was no statistically significant difference between the two groups. The differences between each group are shown in **Table 4**.

Table 4. Comparison between the two groups of changes after exercise.

Categories	walking exercise group	Otago exercise group	T or Z	P
ASM (kg)	0.26±0.31	0.26±0.31	-0.548	0.584
SMI(kg/m2)	0.07±0.09	0.11±0.13	-0.550	0.596
GRIP (kg)	-0.48±1.03	0.56±0.77	-1.493	0.135
SPPB (score)	0.33±0.82	0.40±0.89	-0.503	0.615
SPEED (m/s)	0.04±0.17	-0.07±0.16	1.134	0.286
5TCST (sec)	-1.46±1.84	0.08±1.26	-1.574	0.150

4. DISCUSSIONS

This study confirmed the effect on muscle mass, muscle strength, and physical performance, which are indicators of sarcopenia. This was done by asking the elderly with sarcopenia to perform walking and Otago exercises, and the effects of the two interventions were compared. Screening and pre-testing were conducted to diagnose sarcopenia using the reference values presented by AWGS 19 for 33 individuals who met the study selection criteria. Six walking and five Otago exercise groups were randomly assigned. All exercises were conducted a total of 12 times in accordance with the Korea Health Promotion Foundation's manual for physical activity classes for the elderly, aimed at preventing diseases and improving health [36].

The exercise program in the manual consisted of equilibrium exercises, muscle strength exercises, and organization exercises consistent with the Otago exercise program. This demonstrates that the Otago exercise can also be used in the elderly population in Korea.

The frequency of exercise in the Otago movement group was examined three times a week as suggested by Susie Thomas [37]. It has been shown that this has a significant effect on reducing the frequency of falls and fall-related injuries when practiced more than twice a week. The exercise intensity was sequentially increased from low to high weight loads according to the guidelines of a study on Otago exercise intervention in older adults and patients living in a community [30].

The walking exercise group confirmed their participation in exercise practice using a mobile application, and the exercises of the Otago group were conducted at the exercise center under the supervision of a senior exercise leader. A post-evaluation was conducted the day after a total of 12 exercise interventions were completed. As a result, the Otago exercise group showed an effective value for increasing ASM (limb muscle mass), and SMI showed an insufficient increase. Since this was corrected based on weight, it is believed to have had an effect. For muscle strength, the decrease of the walking exercise group was -0.48 ± 1.03, but the Otago exercise group increased by 0.56 ± 0.77. These results confirm that of a previous study by Park So-yeon and Shin In-soo [38], in which exercise consisting of a combination of full-body muscle exercise and balance exercise was shown to be significantly effective in improving muscle strength. The decrease in muscle strength in the walking exercise group was not irrelevant in the study of Joo Ji-yong [32], who showed significantly lower results in the late elderly (over 75) compared to the early elderly (under 75). Several previous studies that examined the effectiveness of walking exercise showed a reduction in blood pressure in the elderly [39,40], and significant changes in physiological indicators other than blood pressure, such as body mass index, and waist circumference. However, aerobic exercise including walking was not used as an intervention to prevent muscle weakness [32].

Xia Qin et al [41] showed that Otago exercise improved muscle fiber function and muscle strength in hypertensive elderly with pre-frailty, which is a pre-weak stage. In addition, Kim Eun-jung [42] investigated the use of a community fall prevention exercise program developed by the Korea Society of Muscle and Joint Health. The results revealed that it can reduce muscle strength.

The 6 m walking time increased in the walking exercise group and decreased in the Otago exercise group, but the reason for the statistically significant results is that elderly people with a high risk of falling often walk briskly, so it may not be related to Otago exercise. In addition, unlike a previous study [43] which showed a significant difference in gait ability as a result of a total of 24 Otago exercises in the elderly with fall experience, this study was based on only 12 sessions.

In the 5TCST, the number of walking groups decreased, but the number of Otago groups decreased less. In this study, for the exercise frequency standard of at least three times a week, an insufficient effect on muscle strength was observed [44].

However, Lim Jae-young [45] highlighted the importance of the exercise period, and Ahn Chan-woo and Lee Won-mi [13] note that regular exercise participation in the elderly had a positive effect on physical fitness according to a study on health and physical strength. Examining the change in the muscle strength of the upper and lower extremity by age group in the Kim Chang-gyu[46] study, there was no significant difference in the group before the age of 75 years, but there was a decrease in muscle strength beginning at 75 years. Considering that muscle strength changes are related to falls, a study by O'Loughlin et al [47] and Tineti et al [48] revealed that more than two-thirds of older people aged 80 or older experience falls every year. According to a survey by the Ministry of Health and Welfare of Korea, the fall rate of the elderly aged 65 to 60 was 4.5% as of 2020, 16.4% of the elderly aged 70 to 79, and 21.3% of the elderly aged 80 to 85 or older. Among them, the average number of falls in one year in 2020 was 1.95, which was slightly higher, with 1.5 for subjects in their 60s, 1.5 times for subjects in their 70s, and 2.3 times for subjects in their 80s [49].

Thus, it can be predicted that the older an individual, the weaker the muscle strength and the higher the risk of falling. The elderly men and women who participated in the study were 70 to 79 years old. This study, in which individuals aged 75 or older participated, suggests that the Otago exercise is potentially a safe and effective complex exercise program that can improve the muscle strength of the elderly, based on the results obtained for the change in muscle strength compared to the walking exercise group.

The main limitation of this study is that there were no statistically significant figures and the number of samples was small. In addition, we acknowledge that it is difficult to observe the effect of exercise owing to the short intervention period. Therefore, it is suggested that additional studies should be performed in the future. However, this study is meaningful as the first investigation to examine walking and Otago movements in the elderly with sarcopenia. Walking exercises help to increase muscle strength, but Otago exercises are more suitable for group exercises compared to walking exercises and help to motivate patients to exercise and increase their interest in continuous exercise. In addition, it is believed that it can help to improve the index of sarcopenia more than walking exercise. It was possible to confirm the effect of Otago exercise on the index of sarcopenia in this study, and this form of activity is expected to be widely used as an exercise intervention program.

5. CONCLUSION

It was confirmed that exercise events, exercise intensity, frequency, duration, and content affected the index of sarcopenia in the elderly. In addition, this study is meaningful as an investigation of the indicators of extramarital sarcopenia involving falls of the elderly when the Otago exercise is used as a form of intervention.

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