An analysis study of sarcopenia and locomotive syndrome in the old people using evaluation tool

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This study was conducted to analyze the relationship between locomotive syndrome and sarcopenia in the old people using a functional evaluation tool. In this study, 237 Korean old people selected from the Miraeseum Seongnam Senior Complex and the Misa Riverside Welfare Center were diagnosed with the two diseases and the Berg balance scale was performed to confirm the deterioration of dynamic balance sensory. Through the diagnostic evaluation of the two diseases, the locomotive group (n=180) and the sarcopenia group (n=34) were classified and statistically analyzed. As a result of the study, a significant difference in dynamic balance sensory between the two diseases was confirmed, and a significant negative correlation was confirmed with 25-question geriatric locomotive function scale and grip strength among the diagnostic evaluation items of the two diseases. These results suggest that gradual deterioration of locomotive syndrome and sarcopenia occurs in the deterioration of physical performance in the old people, suggesting that the evaluation of locomotive syndrome can be used as a screening test for sarcopenia.

Keywords: Sarcopenia, Locomotive syndrome, Old people, Evaluation tool, Berg balance scale, Correlation analysis

INTRODUCTION

Tools for assessing the functioning of the old people are broadly divided into age-specific assessment tools and evaluation tools for each body function, such as the musculoskeletal system and nervous system, and the evaluation tools used here require additional validation work to reduce errors that appear due to linguistic and cultural differences, mainly due to the large number of tools developed in foreign countries. Therefore, in order to reduce this unnecessary work, it is necessary to develop evaluation tools that can be studied and applied in Korea.

In the old people, physical activity decreases significantly due to the decline in physical functions with age, and the resulting cardiovascular disease, an increase in body fat mass, and a decrease in muscle function are prominently displayed. This decrease in function causes muscle weakness or decreased ability to balance that causes falls in older people (Smee et al., 2012). Thus, the deterioration of the sense of dynamic balance due to the decrease in physical activity has constrained the old people to independent activities due to the fear of falling.

In addition, since the quality of life of the old people is affected not only by the internal factors of the body, but also by external factors such as environmental and social activities, healthy physical activity is an important factor in the quality of life of the old people (McPhee et al., 2016). Therefore, for healthy physical activity, it is important to maintain a normal muscular state, and the factors that hinder this are the changes in the body that come with the aging process (Distefano and Goodpaster, 2018). In particular, sarcopenia, which can appear as a mixed pathological mechanism such as chronic degenerative diseases, nutritional deficiencies, and deterioration of cognitive or mental state, is considered a representative disease (Wiedmer et al., 2021).

Sarcopenia refers to a decrease in muscle mass in skeletal muscle due to a decrease in the number of muscle fibers and cross-sectional area as we age, rather than on purpose (Rosenberg, 1997). It is known that muscle mass decreases by about 1 to 2% every year according to aging and rapidly decreases by 2 to 3% after the age of 60 (Wilkinson et al., 2018). More than 50 million people worldwide have the disease, and it is estimated that there will be more than 200 million sarcopenia patients after 2040 (Park et al., 2019). Recently, however, sarcopenia has been interpreted in a comprehensive sense, not only for a decrease in muscle mass, but also for the weakening of muscle strength and a decrease in the speed of walking or the ability to perform physical activity (Delmonico and Beck, 2016).

Japanese Orthopedic Association has defined a new concept of locomotive syndrome while continuously conducting research on the decline in motor function in the old people (Nakamura, 2011). Locomotive syndrome refers to a decrease in motor function caused by the debilitation of motor organs such as bones, joints, muscles, tendons, ligaments, and nerves that are essential to move the body (Ishibashi, 2018). Locomotive syndrome mainly occurs with the old people or sarcopenia disease (Yoshimura et al., 2019), mainly causes limitation of joint range of motion, imbalance of body alignment, balance and gait disturbance (Ikemoto and Arai, 2018), and restriction of activities such as sports activities, walking, moving, and self-care (Iwaya et al., 2017). In addition, it has the result of limiting the independence of the old people in performing daily life, and it is reported that most of the old people experience locomotive syndrome in a super-aging society (Yoshimura et al., 2019).

As such, sarcopenia or locomotive syndrome, which can occur during the aging process, has become recognized as an important disease that inhibits daily activities in the old people. However, it is very rare to study the correlation between the two diseases by applying the evaluation tool for locomotive syndrome and sarcopenia to the old people in Korea. In particular, the basic data on the old people in Korea is very lacking as previous studies on the locomotive syndrome consisted of only the old people in Japan. In addition, studies are needed because there are very few studies that analyzed the effects of locomotive syndrome and sarcopenia on dynamic balance sensory using physical therapy evaluation tools.

Therefore, in this study, the prevalence of the two diseases was confirmed by applying the locomotive syndrome and sarcopenia evaluation tools to the old people in Korea, and the correlation between the evaluation tools for the two diseases was analyzed. In addition, this study was conducted to confirm the effect of these two diseases on the dynamic balance sensory the old people through physical therapy evaluation. Ultimately, this analysis aims to identify factors that hinder physical activity in the old people and suggest lifestyles necessary to lead a healthy quality of life.

MATERIALS AND METHODS

Study subjects

The study was conducted on 237 old people over the age of 65 in Gyeonggi-do from August 2021 to September 2021 with the cooperation of Miraeseum Seongnam Senior Complex and Misa Riverside Welfare Center, Hanam City. All study subjects were selected as those who could understand and communicate the content and purpose of the study, read and answer the questionnaire on their own, and could walk without an orthosis and those who agreed to participate in the study after recognizing that there were no ethical issues in the contents of this study. All subjects participated in the study after reading the instructions approved by the institutional review board of Eulji University and signing the consent form.

Subjects were divided into groups by evaluating locomotive syndrome and sarcopenia. The "2020 locomotive syndrome evaluation protocol" presented by the Japanese Society of Orthopedic Surgeons was used for the evaluation of locomotive syndrome. If any one of the stand-up test, two-step test, and 25-question geriatric locomotive function scale (GLFS-25) evaluation meets the criteria, it is judged as locomotive syndrome. For the evaluation of sarcopenia, "Diagnosis of sarcopenia" presented by the Asian Working Group for Sarcopenia 2019 was used. If muscle mass, muscle strength and/or physical performance is lower than the standard, it is judged as sarcopenia.

As a result of these diagnostic evaluations, 180 people in the locomotive syndrome group and 34 people in the sarcopenia group were divided. All subjects in the sarcopenia group were evaluated as having locomotive syndrome, and 23 people were normal. The general characteristics of each group among all subjects are as follows (Table 1).

Study design

This study was conducted with the approval of the Institutional Review Board of Eulji University in June 2021(EU21-037). In accordance with the criteria for the selection of subjects in this study, a total of 237 people who voluntarily participated fully explained the purpose and content of the study before participating in the study, and received a letter of consent to participate in the study. After recruiting subjects, all subjects were divided into

Table 1. General characteristics of subjects by group

Characteristic	LSG (n=180)	SG (n=34)	NG (n=23)
Age (yr)	71.1±6.2	73.2±5.6	70.5±7.3
Height (cm)	159.1±7.8	158.3±8.4	158.7±7.1
Weight (kg)	63.3±8.5	54.1±7.6	60.2±7.4
Waist circumference (cm)	87.7±8.7	81.2±8.7	83.2±7.8
Skeletal muscle mass (kg)	23.0±4.2	20.1±3.3	22.6±3.5

Values are presented as mean±standard deviation.
LSG, locomotive syndrome group; SG, sarcopenia group; NG, normal group.

Table 2. Diagnosis of locomotive syndrome

Locomotive syndrome stage 1	1. Stand-up test: cannot stand on one leg from a 40-cm chair 2. Two-step test: 1.1 m or more and less than 1.3 m 3. GLF-25: 7 points or more and less than 16 points
Locomotive syndrome stage 2	1. Stand-up test: you can stand up with both legs from a 40-cm and 30-cm chair, but you cannot stand up with both legs from a 20-cm chair 2. Two-step test: 0.9 m or more and less than 1.1 m 3. GLF-25: 16 points or more and less than 24 points
Locomotive syndrome stage 3	1. Stand-up test: you can stand up with both legs from a 40-cm chair, but you cannot stand up with both legs from a 30-cm chair 2. Two-step test: less than 0.9 m 3. GLF-25: 24 points or more

GLFS-25, 25-question geriatric locomotive function scale.

groups after the evaluation of locomotive syndrome and sarcopenia, and Berg balance scale (BBS) was evaluated to measure the difference in dynamic balance sensory.

Assessment of locomotive syndrome

Locomotive syndrome is a syndrome in which mobility functions such as walking decrease, and the restriction of daily life movements and the deterioration of independent movement occur as it progresses (Nakamura and Ogata, 2016). In this study, the 3-stage test for locomotive syndrome presented by the Japanese Society of Orthopedic Surgery was used to evaluate the locomotive syndrome. A total of three tests, stand-up test, two-step test, and the GLFS-25, were performed to classify the severity into three levels according to the classification criteria for each test (Table 2). However, this three-stage classification criterion has not been verified for the old people in Korea, so in this study, stages 1 to 3 were not distinguished.

The first test was stand-up test. The stand-up test is a test performed on a chair with a step-by-step height with both legs or one leg. Chairs were evaluated in heights of 40 cm, 30 cm, 20 cm, and 10 cm. The subject sat on a chair with their arms crossed and stood up with both legs from a 40 cm high chair with their shins on the floor at about 70 degrees and held the posture for 3 sec. If this motion is possible, it was evaluated whether it is possible to stand up on one leg from a chair of the same height and maintain the posture. If the subject performed the movement well, the chair height was gradually lowered to perform the movement.

The second test was a two-step test, an evaluation of walking ability. The subject walked two steps as far as possible, gathers both feet together, and measures the length from the starting point to the toe of the landing point. If the subject was out of balance, it was invalidated, and a better record was used by performing a total of two repetitions. The final value was then calculated by dividing the two-step stride length by the subject's height.

The third test was GLFS-25, an evaluation questionnaire devel-

oped in Japan. GLFS-25 consists of a total of 25 evaluation items. Pain-related questions 1 through 4 are scored with 0 points for "no pain," 1 for "mild pain," 2 for "moderate pain," 3 points for "significant pain," and 4 points for "severe pain," while 5 to 25 for daily life questions are scored as "no difficulty" 0, 1 for "slightly difficult," 2 for "usually difficult," 3 for "quite difficult," and 4 for "very difficult," with a total score ranging from a minimum of 0 points to a maximum of 100 points (Seichi et al., 2012).

Sarcopenia diagnostic assessment

Sarcopenia refers to loss of muscle mass due to aging, low muscle strength, and low physical performance. To diagnose sarcopenia in this study, three areas including muscle mass, muscle strength, and physical ability were measured and evaluated using the sarcopenia criteria presented by the Asian Sarcopenia for sarcopenia 2019. Among the subjects with decreased muscle mass, if any one of muscle strength or physical performance was below the standard value, it was evaluated as sarcopenia. The muscle mass was measured using the bioelectrical resistance method (Inbody570, InBody, Seoul, Korea). And the muscle index was calculated by dividing the limbs skeletal muscle mass by the square of the subject's height, and when the weight was less than 7.0 kg/m for men and 5.7 kg/m for women, it was judged as decreased muscle mass. The muscle strength was measured using a dynamometer. The grip strength of the subject's both hands was measured twice, and the highest value was used. If it was less than 28 kg for men and less than 18 kg for women, it was judged as a decrease in muscle strength.

The physical performance was measured using the 6-m walking time test, the 5 times sit to stand test, the short physical performance battery (SPPB). The 6-m walking test measured the time

it takes to walk a distance of 6 m at the usual speed and converted it into speed. If the speed was less than 1.0 m/sec, it was determined that physical performance deteriorated. The 5 times sit to stand test measured the time it takes to stand up from a chair with arms crossed and sit 5 times. If the measurement time was 12 sec or more, it was determined that physical performance deteriorated. The SPPB is an evaluation that measures the score by evaluating three items related to balance. If the total score was 9 or less, it was judged that the physical performance was deteriorated. If any one of these three evaluation tools were below the reference value, it was determined that the physical performance was lowered.

Berg balance scale

The BBS was used to measure the subject's dynamic balance sensory. It consists of 14 movements, such as standing in a sitting position and looking back, standing without external support, sitting alone with feet on the floor, sitting and standing, standing with eyes closed, standing with feet together, standing with arms outstretched, standing with arms outstretched, picking up objects from the floor etc. Each item was scored on a 5-point scale ranging from 0 for 'cannot perform without assistance' to 4 for 'independent movement,' giving a total score between 0 and 56. This assessment tool can also assess a subject's risk of falling. A total score of 0 to 20 corresponds to a "high fall risk," a score of 21 to 40 corresponds to a "moderate fall risk," and a total score of 41 to 56 corresponds to a "low fall risk" (Blum and Korner-Bitensky, 2008).

Data analysis

IBM SPSS Statistical Version 25.0 (IBM Corp, Armonk, NY, USA) was used for analysis of the collected data and a descriptive statistical analysis was performed to determine the general characteristics of the study subjects. In addition, the Mann–Whitney U-test was conducted to analyze the difference in dynamic balance sensory between the locomotive syndrome group and the sarcopenia group, and Spearman correlation analysis was performed to confirm the correlation between the diagnostic evaluation items of locomotive syndrome and sarcopenia. In the study, the statistical significance level was specified as 0.05 to determine whether it was significant.

RESULTS

Comparison of dynamic balance assessment scores

Normality test was performed prior to confirming whether there was a difference in dynamic balance sensory between the locomotive syndrome group and the sarcopenia group, and as a result of the analysis, the total score of BBS showed no normal distribution (Table 3). To determine whether there is a difference in the sense of dynamic balance between groups, a nonparametric test method, the Mann–Whitney U-test, was performed. As a result, a statistically significant difference was confirmed with 51.14 points in the locomotive syndrome group and 48.47 points in the sarcopenia group ($P < 0.05$) (Table 4).

Correlation between locomotive syndrome and sarcopenia diagnostic evaluation items

Normality test was performed before confirming the correlation between diagnostic evaluation items of locomotive syndrome and sarcopenia. As a result of the analysis, it was found that all items did not show a normal distribution (Table 5). Spearman correla-

Table 3. Result of Shapiro–Wilk normality test of Berg balance scale total score

Berg balance scale total score	Shapiro–Wilk normality test		P-value
	Statistic	df	
LSG	0.694	180	0.000*
SG	0.672	34	0.000*
Total	0.682	214	0.000*

LSG, locomotive syndrome group; SG, sarcopenia group; df, degrees of freedom.
*$P < 0.05$.

Table 4. Comparison of dynamic balance sensory between the locomotive syndrome group and the sarcopenia group

Item	LSG	SG	U	P-value
Berg balances scale total score	51.14±6.677	48.47±9.909	2,401.500	0.045*

Values are presented as mean±standard deviation.
LSG, locomotive syndrome group; SG, sarcopenia group.
*$P < 0.05$.

Table 5. Result of Shapiro–Wilk normality test of diagnostic evaluation items

Variable	Shapiro–Wilk normality test		
	Statistic	df	P-value
GLFS-25 total score	0.754	214	0.000*
Grip strength	0.948	214	0.000*
Limbs skeletal muscle mass	0.957	214	0.000*
6-meter walking time	0.239	214	0.000*
5 times sit to stand test	0.382	214	0.000*
SPPB total score	0.881	214	0.000*

GLFS-25, 25-question geriatric locomotive function scale; SPPB, short physical performance battery; df, degrees of freedom.
*$P < 0.05$.

Table 6. Correlation analysis between diagnostic evaluation items

Item	GLFS-25 total score	Grip strength	Limbs skeletal muscle mass	6-m walking test	5 Times sit to stand test	SPPB total score
GLFS-25 total score	1					
Grip strength	-0.392* (0.000)	1				
Limbs skeletal muscle mass	-0.032 (0.647)	0.105 (0.126)	1			
6-m walking time	0.037 (0.594)	-0.031 (0.650)	-0.139* (0.042)	1		
5 Times sit to stand test	0.029 (0.671)	-0.047 (0.494)	-0.103 (0.133)	0.386* (0.000)	1	
SPPB total score	-0.027 (0.696)	0.039 (0.566)	0.096 (0.162)	-0.568* (0.000)	-0.822* (0.000)	1

GLFS-25, 25-question geriatric locomotive function scale; SPPB, short physical performance battery; BBS, Berg balance scale.
*$P < 0.05$.

tion analysis, a nonparametric test method, was performed to check the correlation between diagnostic evaluation items. There was a statistically significant negative correlation between the total score of GLFS-25, which is an evaluation index for locomotive syndrome, and the grip strength value, one of the diagnostic evaluation indexes for sarcopenia ($r = -0.392$, $P = 0.000$). However, there was no statistically significant correlation between the limbs skeletal muscle mass ($r = -0.032$, $P = 0.647$), 6-m walking test ($r = 0.037$, $P = 0.594$), 5 times sit to stand test ($r = 0.029$, $P = 0.671$), SPPB total score ($r = -0.027$, $P = 0.696$), which are the evaluation items for sarcopenia, and the GLFS-25 total score (Table 6).

DISCUSSION

Sarcopenia is a phenomenon of decreased skeletal muscle that occurs with physiological changes in the body with age, which is a field that is being studied with great importance in modern society by causing the loss of the ability of the old people to live independently of their lives, that is, to live their daily lives. And locomotive syndrome is a state in which the motor organs necessary to move the body are weakened (Ishibashi, 2018), and is often seen in the old people with sarcopenia and weakness (Yoshimura et al., 2019), which leads to problems that limit independence in daily life.

In the field of physical therapy, the development and use of outcome measures whose reliability and validity have been verified for patient evaluation has been ongoing for a long time (Newman et al., 2003). It has been used to establish treatment plans and evaluate treatment outcomes. The evaluation tool for locomotive syndrome uses the locomotive syndrome stage 3 test method proposed by the Japanese Society of Orthopaedic Surgeons, and in a study conducted by Yoshimura et al. (2019) on community residents in Japan, the prevalence of locomotive syndrome was reported to be 81.0%. Yamada et al. (2020) also proved that the

stage 3 test method for locomotive syndrome suggested by the Japanese Society of Orthopaedic Surgery is applicable to many people, and Seichi et al. (2012) have stated that GLFS-25 and the like can be used in the test method for locomotive syndrome. Therefore, in this study, the three-step test for locomotive syndrome suggested by the Japanese Society of Orthopedic Surgery was applied to the evaluation of locomotive syndrome, and the prevalence rate was 78.0%, which was similar to the previous study. This can have important significance in that it is a good result that can secure the reliability of the domestic application of the locomotive syndrome evaluation tool developed in Japan.

Sarcopenia was evaluated by applying the evaluation criteria presented by the Asian Sarcopenia Evaluation Committee 2019, and as a result of the experiment, 34 patients in the sarcopenia group and 203 patients in the normal group were classified, and the prevalence of sarcopenia was 14.3%. According to a meta-analysis of 2,922 Korean old people patients over 65 years of age, the prevalence of sarcopenia was reported to be 13.1 to 14.9% in men and 11.4% in women (Choo and Chang, 2021). The prevalence of sarcopenia in the old people in Korea differs by diagnostic criteria. According to the 2018 diagnostic criteria for sarcopenia presented by the European Working Group on Sarcopenia in Older People 2 (EWGSOP 2), the prevalence of sarcopenia among the old people in Korea was reported to be 9.3%. And, according to the diagnostic criteria for sarcopenia presented by the Asian Working Group for Sarcopenia 2019, the prevalence was reported to be 9.1%. As such, the prevalence of sarcopenia varies depending on which of the diagnostic criteria for sarcopenia is used (Kim and Won, 2019). The difference in the prevalence of sarcopenia confirmed in this study from previous studies is thought to be due to the difference in the applied diagnostic criteria. Through continuous research, the most appropriate diagnostic criteria for sarcopenia to be applied to the old people in Korea should be reviewed.

The prevalence of locomotive syndrome among the old people in Korea surveyed in this study was 75.9%, and in a previous study of 963 Japanese old people in 2019, the prevalence was found to be 81.0%, which is similar to the current situation in this study (Yoshimura et al., 2019). This study is significant in that it introduced the concept of locomotive syndrome and confirmed the prevalence by conducting face-to-face evaluations in the old people in Korea. However, as there is a limit to the fact that it was limited to only the old people living in Gyeonggi-do, it will be necessary to investigate the old people in various regions in future studies.

As a result of the diagnostic evaluation of sarcopenia and the evaluation of locomotive syndrome, it was confirmed that all subjects in the sarcopenia group had locomotive syndrome. This can be said to be a result that can provide a theoretical basis similar to the result that locomotive syndrome can implicate patients with sarcopenia, as revealed in previous studies by Yoshimura et al. (2019) and Tanaka et al. (2019). In other words, the results of this study suggest a relationship in which sarcopenia is included in the subcategory of locomotive syndrome (Matsumoto et al., 2016), which can be utilized for a more in-depth study of the relationship between the two. In addition, this suggests that functional decline in the old people can occur in the stages of locomotive syndrome and sarcopenia, and the evaluation of locomotive syndrome can be used as a tool for diagnosing and preventing sarcopenia.

Balance is the ability to maintain the center of gravity in line with the movement of the body within the base. It is an indicator of the stability and independence of the body and is closely related to human activities of daily living (Cohen et al., 1993). Therefore, based on the rationale for the decrease in balance ability due to aging (Lajoie and Gallagher, 2004), a group-to-group comparison of dynamic balance sensory assessments was conducted to determine the effect of locomotive syndrome (Imagama et al., 2020) and sarcopenia (Rosenberg, 1997) on the ability to balance. As a result of comparing the dynamic balance sensory between the two groups using the BBS, the locomotive syndrome group scored 51.14 points and the sarcopenia group scored 48.47 points, showing a statistically significant difference ($P < 0.05$). Through these results, it can be confirmed that sarcopenia not only affects the decrease in muscle mass, but also the decrease in physical performance, and supports the claim that the deterioration of physical performance due to aging can occur in the stage of locomotive syndrome and sarcopenia.

However, since this study measured the dynamic balance abili-ty using the BBS in relatively active old people using the welfare center, it is judged that there is a limitation of this study in the result that the BBS is not appropriate as a balance ability measurement tool for subjects with high activity levels, as suggested by Rose et al. (2006). It can be divided into physical factors and psychological factors as factors for balance. This is an interpretation based on a theoretical basis, physical factors include lower extremity strength, walking ability, balance ability, and grip strength (Baker et al., 2005; Lajoie and Gallagher, 2004), and psychological factors include including fear of falling and poor subjective health status. Therefore, in future research, in order to evaluate overall walking ability, fall risk and fear of falls, it is suggested that future studies include the 6-min walking test, the 10-m walking test, and the Korean-type old people fall efficacy scale used in the muscle reduction old people fall risk study. In addition to the BBS, which will help prevent fall accidents at an early stage if appropriate prevention and management is done by assessing the fall risk of old people with sarcopenia and locomotive syndrome.

Correlation analysis of the diagnostic evaluation items for locomotive syndrome and sarcopenia was performed. Among several items, a significant negative correlation was confirmed between the GLFS-25 total score, an item for the evaluation of locomotive syndrome, and grip strength, an item for the diagnostic evaluation of sarcopenia ($r = -0.392$, $P < 0.005$). Grip strength is a very important measure of motor dysfunction and muscle weakness. Previous studies have shown that grip strength plays an important role in indicators of age-related sarcopenia (Syddall et al., 2018). Therefore, this study is considered to be an important indicator of the relationship between the two groups because grip strength, a diagnostic index for sarcopenia, also showed a significant correlation with locomotive syndrome. Therefore, the decrease in grip strength can lead to restriction and deterioration of the performance of the activity, and it is likely to negatively affect physical function and pain, so it should be strengthened (Sayer et al., 2006).

Another indicator of diagnosing sarcopenia, the correlation of limb skeletal muscle mass and GLFS-25, a tool for measuring locomotive syndrome, showed no significant correlation. However, the decrease in skeletal muscle mass in the limbs is interpreted as a relatively high percentage of body fat in the human body, which leads to a decrease in physical activity and is clearly shown as a decrease in the functions in age. Therefore, limb skeletal muscle mass is one of the most important physical fitness factors for the old people, and it is thought that if various exercise programs are organized and implemented, it is possible to improve basic physical strength and prevent risk factors such as falls and fractures.

This study was conducted based on the hypothesis that locomotive syndrome, sarcopenia, and the deterioration of physical function in the old people, especially the deterioration of dynamic balance, will show a gradual deterioration, and the hypothesis that there will be a correlation between the diagnostic evaluation items of the two diseases. As a result, it was confirmed that all sarcopenia group had locomotive syndrome, and it was confirmed that sarcopenia group had lowered dynamic balance sensory than locomotive syndrome group. Also, a significant negative correlation between the GLFS-25 total score and grip strength was confirmed through correlation analysis of diagnostic evaluation items for two diseases.

These results suggest that locomotive syndrome may appear as one of the precursors to sarcopenia, through which the functional evaluation of locomotive syndrome can be used as one of the sarcopenia screening tests. Based on these studies in the future, more in-depth research is required, such as analyzing the correlation between factors of locomotive syndrome and sarcopenia through a large-scale cohort experiment.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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