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Theoretical Study of Effective Resistance Exercise for Sarcopenia

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Abstract

Sarcopenia is a phenomenon in which muscle function, including muscle strength, deteriorates as muscle mass decreases in the process of increasing age. The diagnosis of sarcopenia utilizes total muscle mass and limb muscle mass, and limb muscle mass is expressed as height squared, body weight, and BMI. Each divided value is used as an index, mainly less than 7.23 kg/m2 for men and less than 5.67 kg/m2 for women. Grip strength, standing up from a chair, and walking speed were mainly used as physical function factors, and grip strength less than 27 kg for men and less than 16 kg for women were used as indicators. The limb muscle mass showed a decreasing trend after peaking in the mid-20s in men, and maintaining a gradual peak in women from the mid-20s to the mid-40s, showing a more rapid decline in men. The rate of decrease in muscle mass and strength continues to increase after the age of 20, and muscle strength rapidly decreases after the age of 80. In Korean men, total muscle mass and limb muscle mass show a decreasing trend from the mid-30s, and a more markedly rapid decrease from the age of 60. For women, it remains constant from the age of 30 to the age of 50, then gradually decreases after the mid-50s, and shows a rather rapid decrease after the mid-70s, showing a more gradual decrease than that of men. Men show a sharp decrease from the mid-40s when limb muscle mass is divided by height squared, and women show a marked decrease after 70 years old when limb muscle mass is divided by height squared. Exercise for the prevention and treatment of sarcopenia results in an increase in protein assimilation hormone, an increase in antioxidant activity, a decrease in inflammation, an increase in muscle insulin sensitivity, and an increase in protein synthesis. Resistance exercise is basically used, and aerobic exercise and equilibrium A combination of exercises is effective. In addition, for a more efficient effect of sarcopenia through resistance exercise, it is necessary to supplement nutrition including protein.

Keywords: *Sarcopenia, Aging, Resistance exercise*

1. Introduction

Please refer to this document and follow the specifics outlined below when submitting your final draft. These guidelines include complete descriptions of the fonts, spacing, and related information for producing your manuscripts. Please follow them and if you have any questions, direct them to the person in charge of your journal, The decline in muscle function due to the decrease in muscle strength and muscle mass affects

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physical strength and causes abnormal physical activities. Maintaining strength and muscle mass is essential for a healthy quality of life as we age, as it increases the risk of falls and impairments in activities of daily living and causes metabolic diseases[1, 2] .

The decline in muscle function that affects motor performance is due to lifestyle patterns caused by environmental and social changes with aging, and changes in functional demands of muscles due to reduced physical activity[3], and changes in neuromuscular activity. Remodeling of the motor unit[4], reduction in maximum motor unit discharge rate[5], and increase in the proportion of slow contractile fibers have been suggested as causes[6]. As age increases, there is a difference in the expression of muscle strength through maximal voluntary contraction (MVC), and the decrease in muscle strength due to changes in the neuromuscular structure appears in the lower body than the upper body from the extensors rather than the flexor muscles. known to be remarkable[7]. These changes in muscle strength lead to changes in daily life functions, such as reduced ground reaction force and reduced walking speed[8, 9]

Resistance exercise has the effect of improving muscle strength, muscle mass, and muscle cross-sectional area, thereby preventing sarcopenia. This is because it causes increased hypertrophy in IIa and type IIx [10, 11]. In particular, resistance exercise is effective in increasing muscle mass and muscle strength, increasing hormones related to muscle protein synthesis, and reducing inflammatory factors, and increasing the transverse area of muscle fibers [12].

Studies to prove the effect of resistance exercise for the purpose of preventing muscle strength and muscle mass loss are continuously being reported. Another study found that strength and cross-sectional area of the quadriceps muscle increased after 12 weeks of resistance training at 80% of 1RM in men aged 60-72 years[13]. In a previous study in which resistance training was conducted for 12 weeks in the elderly, lean body mass and muscle strength were reported to increase[14].

Considering the growth rate of the elderly population in Korea, a more active policy review related to aging is required, and various studies are urgently required to provide an academic basis to support it. Therefore, this study will help prevent and treat aging-related diseases by presenting a theoretical basis for accurate diagnosis, prevention, and mitigation of muscle loss, and provide solutions to properly respond to the aging society.

2. Main Subject

2.1 Definition of sarcopenia

Sarcopenia is a phenomenon in which muscle function, including muscle strength, decreases as muscle mass decreases in the process of increasing age, and is considered a representative health-related risk factor in the aging process.

Skeletal muscle is the largest organ constituting the human body and accounts for 40-50% of the human body. However, after the age of 30, skeletal muscle tends to decrease by about 1% every year in our body, and then rapidly decreases after the age of 65. As aging progresses, the functional capacity (muscle strength, power) of muscles also gradually decreases. In this way, a decrease in muscle strength or performance as well as a decrease in muscle mass due to aging is called sarcopenia.

These sarcopenia are also closely related to frailty and osteoporosis. Sarcopenia caused by aging is reported to increase the risk of falls, fractures, weakness, metabolic diseases, and death due to restrictions on physical performance of the elderly[15, 16].

2.2 Diagnosis of sarcopenia

In the past, the concept of sarcopenia was introduced as being caused by a decrease in muscle mass due to aging, but recently, for clinical reasons, deterioration of muscle function has been included as a cause[17].

For example, the European Working Group on Sarcopenia in Elder People (EWGSOP) includes decreased muscle mass, decreased muscle strength, and decreased physical performance[18]. In particular, EWGSOP classified sarcopenia into three stages: presarcopenia, sarcopenia, and severe sarcopenia.

In addition, EWGSOP is a procedure for clinically determining sarcopenia, first measuring gait speed as a physical performance of the elderly, measures grip strength (representative muscle strength) if it is faster than 0.8 m/s, and determines that it is not sarcopenia if the grip force is determined. However, if the walking speed is slower than 0.8 m/s or if the grip force is low, the muscle mass is measured, and if the muscle mass is low, it is judged to be sarcopenia.

In Korea, self-established diagnostic standards have not yet been established, and foreign diagnostic standards are being used.

The specific diagnostic criteria for sarcopenia used worldwide is the value obtained by dividing the appendicular skeletal muscle mass (ASM) by the square of the height (ASM/height2), which is 7.0-7.23kg/m2 for men and 5.4-5.67 for women. kg/m2 is the diagnostic criterion. Muscle strength is usually measured by grip strength, and the diagnosis criterion is 26-30 kg for men and 16-20 kg for women. The diagnostic criterion for physical performance is 0.8 m/s, which is the walking speed.

2.3 Muscular Strength Criteria

Aging, dwarf physique, inadequate nutritional intake, socioeconomic disadvantage, and multiple chronic diseases are considered determinants of the decrease in grip strength, which is a representative item of sarcopenia[19].

In particular, an increase in age is the most important factor in reducing grip strength, and it appears more remarkably in men, and somewhat unexpected factors such as a decrease in body fat are sometimes added as a cause. It has been reported that the decrease in grip strength in the aging process has a high correlation with diseases of the cardiovascular system, respiratory system, and endocrine system.

Past studies have said that 27 kg for males and 16 kg for females as a result of analyzing the standard index of grip strength related to sarcopenia in British subjects, and 26 kg for males suggested by the FNIH project, almost the same level as the female 16 kg[20, 21].

In a recent study, the average grip strength of a 30-year-old male in the UK was 51.6 kg, the average grip strength of a 30-year-old male in developed countries was 52.8 kg, and the average grip strength of a developing country was 43.4 kg [22]. There are some differences between countries or races, and such differences are considered to have a significant impact on differences in body size, including BMI.

Results for British subjects showed that the number of subjects who did not meet the criteria for myopenia grip strength at the age of 80 increased to about 60%[22].

2.4 standard of muscle mass

According to the results of the analysis of Koreans from 2008 to 2010[23], the total muscle mass and limb

muscle mass of men began to decrease in their mid-30s and showed a significantly faster decline from age 60.

Women tend to maintain a certain tendency from 30 to 50 years old, then gradually decrease after the mid-50s, and show a somewhat rapid decline after the mid-70s, showing a more gradual decline than men.

For men, the muscle mass of the limbs shows a rapid decrease from the mid-20s when divided by BMI, and shows a gradual decrease from the mid-20s when divided by weight, and a rapid decrease from the mid-40s when divided by the square of height.

For women, if the muscle mass of the extremities is divided by BMI, it shows a decreasing trend from the age of 30 onwards, whereas if divided by the square of the height, it shows a significant decreasing trend from the age of 70. After that, it has been reported to remain constant[23].

2.5 Sarcopenia and resistance exercise

For the elderly, physical activity or exercise is an improvement measure to improve body composition and muscle function, and the effects of muscle mass, muscle strength increase, life improvement, and fall reduction have been reported even in the elderly suffering from sarcopenia[24, 25], among which resistance exercise is an effective way to increase muscle mass and strength[26, 27]. Compared to aerobic exercise, it is known to be an appropriate method for maintaining independent daily life for a long period of time for improving muscle mass, strength, and physical performance of middle-aged and elderly people suffering from sarcopenia. Resistance exercise has been suggested as a treatment[29, 30].

Resistance exercise is exercise using equipment such as barbells and dumbbells, with the goal of improving muscle function such as muscle strength, muscle hypertrophy, and muscular endurance, and accordingly, weight load, frequency, rest time, number of repetitions, number of sets, etc. It has the characteristics of being able to construct an efficient exercise program by configuring training variables differently[31].

Past studies recommended that patients with sarcopenia should do resistance exercise involving large muscles twice a week[32], starting with 40-60% of exercise intensity and gradually increasing it to 70-85%, 6-12 times, 6 ~10 sets, recommended to be performed[33].

ACSM recommends low-intensity exercise of 40-50% 1RM for beginners and medium-intensity resistance exercise of 60-70% 1RM for experienced users twice a week to strengthen the muscles of the elderly[34]

In presenting resistance exercise for the elderly, priority should be given to preventing muscle weakness in the lower limbs, which can interfere with activities of daily living and increase the risk of injury due to falls [15, 35], upper extremity muscle strength to perform specific movements such as pushing, pulling, grabbing, lifting, trunk flexion and rotation is also important[36].

Squat exercise can be effective as a resistance exercise to prevent lower extremity muscle strength loss[37, 38], but squat performed on a smith machine due to the possibility of injury during exercise Leg extension, leg curl, and calf raise performed on a machine and can be alternatives[36], and resistance exercise to prevent upper extremity muscle strength loss is Suitable alternatives to bench presses and let pull downs are machine chest presses and seated rows.

As such, it was reported that resistance exercise has a great effect on the increase in muscle mass and strength and reduces the progression of sarcopenia, and that even performing resistance exercise once a week

can improve muscle strength[39].

It can stimulate nerve roots, resulting in health promotion such as improvement in muscle strength and muscle hypertrophy, and increase in physical activity and tissue[40], and it can increase total energy consumption by increasing basal metabolism, improving fat breakdown ability and It has a positive effect on composition and blood lipids[41, 42]

On the other hand, aging not only interferes with ATP production in muscle mitochondria, but also reduces mitochondria in aging muscle by 40%, and metabolic disturbances in aging-related proteins reduce muscle mass. It leads to obesity[43].

Resistance exercise has the characteristics of being able to compose an efficient exercise program by setting clear goals by configuring training variables differently into three types of muscle strength, hypertrophy, and muscular endurance depending on the purpose[44], and configuring an individualized program. Weight load, frequency, rest time, number of repetitions, and number of sets can be determined [31].

According to past studies, weight intensity, number of repetitions, sets, and rest time in resistance exercise affect the amount of exercise, and the most widely used method to set resistance exercise load is determined by the maximum number of repetitions[12, 31].

In resistance training, exercise volume is the sum of all weights lifted in one training session, calculated as the product of repetitions, sets, and weights lifted. Therefore, a high volume of exercise means a high number of repetitions or sets or a high weight load, so it also means the overall intensity of the training.

However, since a high exercise amount at too low an intensity (less than 60% of 1RM) has no effect on improving muscle strength, it is effective to increase the weight load rather than the exercise amount for athletes who require high muscle strength[45]

As the rest time between sets, which is one of the factors influencing the one-time response and long-term adaptation of resistance exercise, increases, the amount of exercise increases. The rest period between sets of 3-5 minutes indicated that more repetitions were performed even if the number of sets increased. suggested that there should be a rest period between sets of less than 1 minute.

In addition, past studies have shown that applying a break between sets of 20 to 60 seconds in endurance resistance exercise is effective in increasing repetition recovery and exerting maximum force[46].

3. conclusion

To summarize the theoretical basis for the diagnosis and prevention method of sarcopenia, total muscle mass and limb muscle mass are used as diagnostic items, and values obtained by dividing limb muscle mass by height square, body weight, and BMI, respectively, are used. Grip strength and standing up from a chair were used as muscle strength factors, and walking speed was mainly used as a physical function factor.

The rate of decrease in muscle mass and strength continues to increase after the age of 20, and muscle strength rapidly decreases after the age of 80. In Korean men, total muscle mass and limb muscle mass show a decreasing trend from the mid-30s, and a more remarkably rapid decrease from the age of 60.

For women, it remains constant from the age of 30 to the age of 50, then gradually decreases after the mid-50s, and shows a rather rapid decrease after the mid-70s, showing a more gradual decrease than that of

men. In men, when the muscle mass of the limbs is divided by the square of the height, a sharp decrease occurs from the mid-40s, and in women, when the muscle mass of the limbs is divided by the square of the height, the decrease is markedly after the age of 70.

Sarcopenia acts as a risk factor for multiple diseases, including cardiovascular disease and diabetes, and also has an important effect on osteoporosis, fractures, falls, mental health decline, and cognitive dysfunction. Exercise for the prevention and treatment of sarcopenia results in an increase in protein assimilation hormone, an increase in antioxidant activity, a decrease in inflammation, an increase in muscle insulin sensitivity, and an increase in protein synthesis. Resistance exercise is basically used, and aerobic exercise and balance A combination of exercises is effective. In addition, for a more efficient effect of sarcopenia through resistance exercise, it is necessary to supplement nutrition including protein.

4. Recommendation

This study recommends resistance exercise and balanced nutrition including protein to improve and prevent sarcopenia. In addition, it is recommended that the exercise intensity of resistance exercise be at least 60% of the 1RM level, the rest time between sets is 1-3 minutes, and eccentric muscle contraction training is included in the training session.

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