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Original Article

Influences of a combined nutrition and exercise intervention on prevention and treatment of sarcopenia in the community-dwelling elderly

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Abstract: Objective: To investigate the influences of a combined nutrition and exercise intervention on prevention and treatment of sarcopenia in the community-dwelling elderly. Methods: A total of 116 elderly patients with sarcopenia admitted to the outpatient department of our community health service center from June 2019 to June 2020 were selected and randomly divided into observation group (n=60) and control group (n=56). During the experiment, the basic data and health indicators of the patients in the two groups were investigated, and medical interventions were carried out. The interventions lasted for 180 d. The experiments for multiple human functions were conducted in batches between the two groups, and the muscle percentage and body fat percentage (BFP) of the patients were measured and compared. Results: There was no statistically significant difference in the basic data, health assessments and living habits between the two groups. In the four phases after interventions, there were certain statistically significant differences in grip strength, pace and BFR in control group, and significant differences in pace, body fat index and the five-repetition sit-to-stand (STS) ability in observation group. Conclusion: The combination of nutrition and exercise intervention combined with the meals prepared using the nutritionally complete formula can effectively improve the conditions of elderly patients with sarcopenia, and a series of recovery treatment combined with exercise is conducive to the prevention and treatment of sarcopenia in the elderly.

Keywords: The elderly, sarcopenia, nutrition intervention, exercise

Introduction

Sarcopenia is an aging-associated condition, and it can further aggravate the related functions and quality of life of the patients, negatively affect their psychological states, and lead to the adverse events, which is specifically a progressive and generalized skeletal muscle disorder involving the loss of skeletal muscle mass and function due to the high-intensity exercise [1]. The muscle plays an integral role in supporting the motor system of the human body. In medicine, researchers often regard the muscle aging and atrophy as obvious signs of human aging, and muscle atrophy can lead to fracture and joint injuries. The elderly patients with sarcopenia often experience difficulty in walking and standing, and a slight collision will lead to their fractures. Additionally, sarcopenia may affect the related functions of some organs, induce cardiac and pulmonary failure of the elderly, and even lead to death in severe cases. This is called skeletal muscle aging or sarcopenia clinically [2]. Specifically, sarcopenia is characterized by the aged-related loss of skeletal muscle mass and muscle decline. In 1991, overseas scholars reported that the loss of skeletal muscle led to the loss of innervation-related functions of some skeletal muscle cells, resulting in mitochondrial dysfunction, multiple inflammations, decreased synthetic hormones, and declined muscle strength and muscle fatigue [3].

Sarcopenia is highly prevalent in the elderly. Our findings showed that the prevalence of skeletal muscle aging was elevated with the increase of age [4]. After consulting online information from Australian Bureau of Statistics, it was found that from 2002 to 2011, the incidence rates of sarcopenia in people aged less than 70 years and over 70 years were 20% and 30%, respectively. The incidence rate of sarcopenia was higher with the rise in age. The latest observation statistics in the medical circle revealed that people aged 40 years and onwards showed a sign of skeletal muscle aging, and experienced the loss of skeletal muscle with an annual loss rate of approximately 8%, while people aged over 70 years experienced a multiplied loss of skeletal muscle, thereby leading to sarcopenia. If people have a good physical literacy base and a good muscle base at the young age, their muscles age faster than those who exercise normally in old age [5, 6]. As the human body goes through the processes from maturity to aging, there is a significant decline in the related performance of neuromuscular system. Even the healthy elderly will experience a decline in skeletal muscle mass and muscle abilities. With the growth of age, the structures within the human body will undergo subtle changes, and some excessive activities will lead to the muscle loss of the elderly [7].

The aging of human body is inevitable. With the growth of age, the physiological system functions of the human body are decreased, which is manifested as the decline of exercise abilities [8]. In severe cases, it leads to a vicious cycle, the release of aging skeleton hormones, and the change of the dominant nervous system, including the changes in the composition of fiber types, and improves sarcopenia and the influences caused by skeletons and joints. Therefore, it is necessary to strengthen the daily muscle exercise, seek to increase the muscle content, strengthen nutrition, and avoid the vegan diet and the intake of a small amount of protein and vitamin [9, 10]. Meanwhile, it is necessary to formulate proper plans and adhere to the duration of and intensity of exercise, thereby exerting a good health care effect. Regarding the elderly, the senior resistance exercise (RE) can improve muscle strength, and walking for half an hour every day is the best way to conduct the resistance exercise [11, 12]. Moreover, medically high-intensive resistance exercise is not recommended for the elderly. The American College of Sports Medicine (ACSM) suggests that the high-intensity strength training must be completed 2 to 3 times a week to improve the muscle abilities and strength. This is the minimum requirement for middle-aged and elderly people to conduct the strength training, and each training should be repeated 10 to 15 times [13, 14].

This study was conducted to investigate the influences of the exercise combined with different nutritional interventions on the prevention of sarcopenia in the elderly and the dietary intervention and other interventions throughout the treatment process, thus providing a good template for the prevention of sarcopenia.

Materials and methods

General data

A total of 116 sarcopenia elderly patients admitted to the outpatient department of our community health service center from June 2019 to June 2020 were selected and randomly divided into observation group (n=60) and control group (n=56). This study has been approved by the Ethics Committee of Shangrao Normal University Sports institute. All study participants provided written informed consent prior to participating in the study.

Inclusion criteria: Patients who aged over 65 years, voluntarily participated in this investigation, complied with the relevant criteria for sarcopenia, with a measured body mass index (BMI) value of less than 24 kg/m^2, or those who lost weight unintentionally by 5% within one year.

Exclusion criteria: Patients who were unable to stand up from a chair or move independently, those with nervous system diseases or other diseases affecting human interaction, those with chronic cardiopulmonary functions affecting normal activities, those with renal insufficiency and requiring the protein intake, and those with impaired cognitive functions.

Intervention methods

The control group received a balanced diet and exercise intervention. The balanced diet was prepared according to the relevant indicators of Chinese Society of Nutrition. Based on the food types, the customized meal was prepared for each patient according to the hierarchical structure and recommendations from the *Die-*

tary Guidelines for Chinese Residents. Each patient ate 300-500 grams of vegetables, 200-300 grams of fruits, less than 200 grams of animal foods (e.g., fish meat), 300 grams of milk products, over 25 grams of beans and nuts, less than 30 grams of fats and oils, and less than 50 grams of salts per day. This was a dietary standard for food intake in the elderly patients. After dietary intervention, the patients received weekly telephone follow-up (TFU) calls, their dietary implementations were supervised, and their conditions were timely fed back, so as to formulate corresponding countermeasures for arising issues, and provide the effective information for subsequent follow-up studies. Additionally, the patients were instructed to conduct moderate-intensity aerobic exercise for 30 min and RE every day. The aerobic exercise was conducted five times a week with the intensity not too high, and the aerobic exercise must be conducted under the guidance of medical personnel. Meanwhile, muscle-related exercises, especially leg muscles, were conducted. Eight to ten sets of muscle exercises were repeated for 8-12 times each time. The resistance band was a common piece of exercise equipment. After exercise, the patients received weekly TFU calls and their activities were conducted, and the volume and intensity of aerobic exercise were timely adjusted. On the basis of the balanced diet and effective exercises, the observation group was additionally given the meals prepared using the nutritionally complete formula, added with the related indicators of the elderly. For convenience of use, we mixed the ingredients into the powder using the nutrition formula. However, such powder should not be replaced with the daily meals. After intervention, the periodic follow-ups were conducted to maintain a record.

Observation indices and assessment criteria

Comparison of BMI between the two groups before intervention and on day 30, 90, 120 and 180 after intervention: BMI is the international standard for obesity measurement and is a person's weight in kilograms divided by the square of height in meters. A BMI of 18.5 to 24.9 is considered as normal, a BMI of over 24 as overweight, and a BMI of over 28 as obese.

Comparison of grip strength between the two groups before intervention and on day 30, 90, 120 and 180 after intervention: Grip strength is an indicator of the muscular conditions of the upper limbs, and a measure of muscular strength or the maximum force/tension generated by one's forearm and hand muscles. In physical fitness tests, grip strength is often reflected in the form of grip strength normalized by BMI. With the advantages of scientific physical strength assessment, the grip strength is measured twice, with a higher score as the grip strength value. During the measurement, the attention should be given to avoid the contact of the arms with the body or prevent the arms from shaking too much.

Comparison of pace between the two groups before and after intervention: The measurement of the time for walking six meters at a normal pace is the most scientific method.

Comparison of five-repetition sit-to-stand test (5STS) between the two groups before and after intervention: The 5STS is a test of lower limb function that measures the time it takes to rise from a standard armchair into full standing and back to upright sitting as quickly as possible for five repetitions, mainly reflecting the balance ability of lower limb muscles of the body. Clinically, 5STS is generally used for major studies, and both methods are used for such studies. The first one is that the STS repetitions are specified and the duration is recorded, while the second one is that the STS repetitions are observed within a certain period of time. In this study, we adopted the first method, that is, the patients were instructed to conduct 5STS and the duration was recorded. Duration less than 10 s was considered normal.

Comparison of calf circumferences between the two groups before and after intervention: The circumferences of the thickest part of the calf were compared between the two groups.

Comparison of muscle percentages between the two groups before and after intervention: The muscle percentage refers to the proportion of muscle to the total body weight. A high muscle percentage does not mean a healthy body and perfect figure, as some lean people may have a higher muscle percentage because of the low weight, thin figure and poor muscle mass. Therefore, a standard range that can measure the health status of the body should be obtained.

Comparison of body fat percentage (BFP) between the two groups before and after inter-

Table 1. Comparison of General clinical data between the two groups

General clinical data		Observation group (*n*=60)	Control group (*n*=56)	*t*	*p*
Gender	M	38	36	0.011	0.915
	F	22	20		
Mean age (yo)		77.04±5.48	77.55±6.22	3.887	0.496
Self-health assessment	Excellent	9	8	0.035	0.983
	Fair	41	38		
	Poor	10	10		
Living habits	Excellent	38	34	0.543	0.762
	General	17	15		
	Poor	5	7		
Declining physical strength	Y	10	12	0.463	0.793
	General	15	14		
	N	35	30		

vention: BFP is an important indicator of human health and is often used to determine whether people are overweight or obese. However, the influences of other human factors may be ignored using BFP. Therefore, BFP and BMI reference value should be adopted to identify the factors leading to the obesity, so as to obtain an objective result.

Statistical methods

The same math formulas were digitized using SPSS20.0 for analysis, and detected using Student's t test. The actual effects were reflected using [n (%)], and the indicators were detected using the statistical variances and Student's t test. $P < 0.05$ indicated a statistically significant difference.

Results

Comparison of general clinical indices between the two groups

The comparison of data showed that there were no statistically significant differences in the general clinical indices (e.g., gender, mean age, self-health assessment, living habits, functional status) between the two groups ($P > 0.05$), which were comparable (**Table 1**).

Comparison of BMI between the two groups before and after intervention

The BMI differences were not remarkable ($P > 0.05$) between the two groups. However, the BMI in the two groups changed significantly on day 30, 90, 120 and 180 after intervention, and there were marked differences in the BMI between the two groups before and after intervention ($P < 0.05$). The BMIs of the patients in observation group were notably changed compared with those in control group ($P < 0.05$) (**Figure 1**).

Comparison of grip strength between the two groups before and after intervention

There was no statistically significant difference in the grip strength scores between the two groups before intervention ($P > 0.05$). After intervention, the grip strength in observation group was remarkably elevated than that in control group at the four time points ($P < 0.05$) (**Figure 2**).

Comparison of paces between the two groups before and after intervention

There was no significant difference in the pace between the two groups before intervention ($P > 0.05$). After intervention, the paces in the two groups were significantly increased compared with those before intervention ($P < 0.05$), and the pace in observation group was faster than that in control group ($P < 0.05$) (**Figure 3**).

Comparison of 5STS between the two groups before and after intervention

There was no statistically significant difference in 5STS between the two groups before inter-

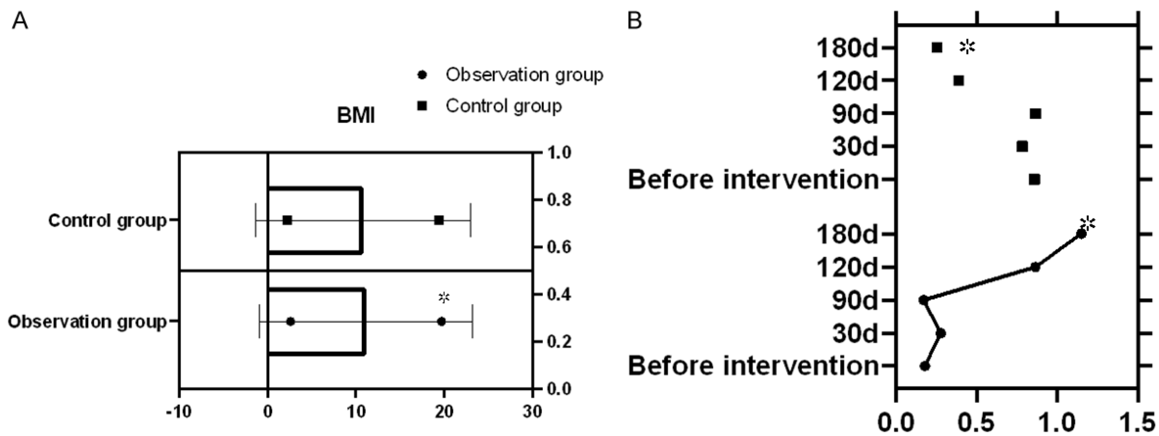

Figure 1. Comparison of BMI between the two groups before and after intervention. There was no significant difference in BMI between the two groups before intervention ($P > 0.05$). The BMI in observation group (20.23±2.52) and control group (19.64±2.13) changes significantly on day 30, 90, 120 and 180 after intervention compared with that before intervention, and the differences were remarkable before and after intervention ($P < 0.05$). The patients in observation group change remarkably compared with those in control group ($P < 0.05$).

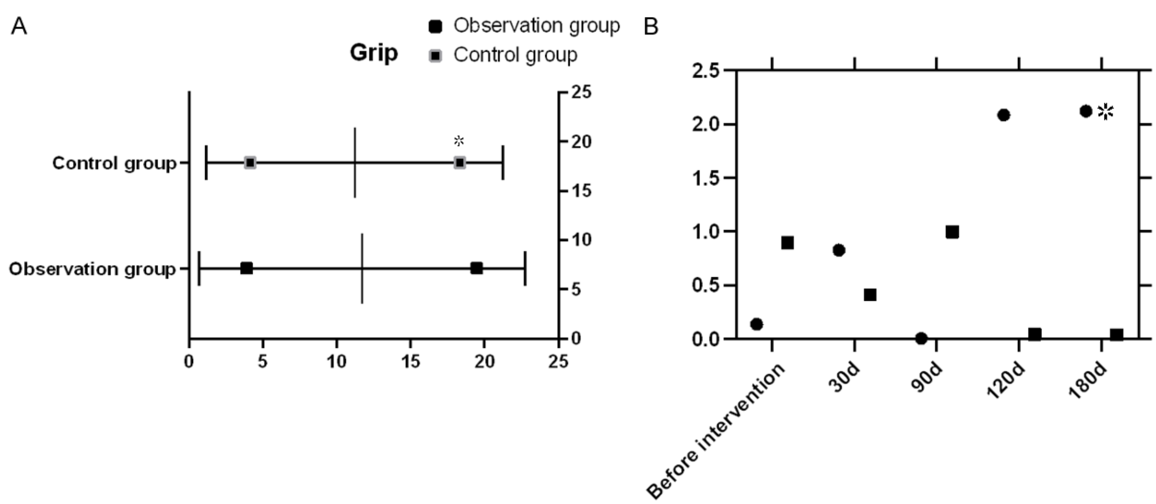

Figure 2. Comparison of grip strength between the two groups before and after intervention. There was no statistically significant difference in the grip strength scores between the two groups before intervention ($P > 0.05$), and the grip strength in observation group (2.25±3.71) was markedly higher than that in control group (18.34±4.15) at the four time points after intervention ($P < 0.05$).

vention ($P > 0.05$), while 5STS in observation group showed significant changes compared with that in control group ($P < 0.05$) (**Figure 4**).

Comparison of calf circumferences between the two groups after intervention

There was no statistically significant difference in the calf circumference between the two groups before intervention ($P < 0.05$), but the calf circumference in observation group changed remarkably compared with that in control group after intervention ($P < 0.05$) (**Figure 5**).

Comparison of muscle percentages between the two groups before and after intervention

There was no statistically significant difference in the muscle percentage between the two groups before intervention ($P < 0.05$), but the muscle percentage in observation group changed significantly compared with that in control group after intervention ($P < 0.05$) (**Figure 6**).

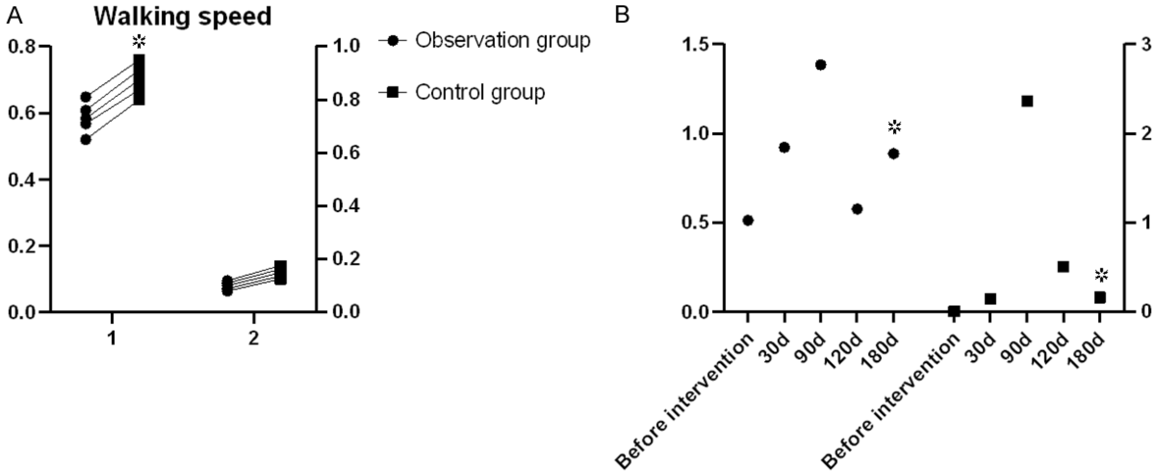

Figure 3. Comparison of paces between the two groups before and after intervention. There was no significant difference in the paces between the two groups before intervention (*P* > 0.05). After intervention, the paces (0.81±0.12) in the two groups were significantly faster than those (0.65±0.08) before intervention (*P* < 0.05), and the pace in observation group was faster than that in control group (*P* < 0.05).

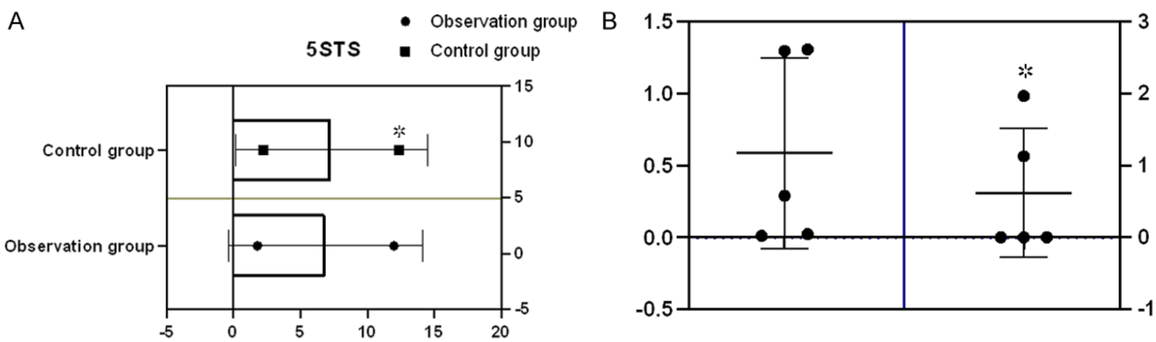

Figure 4. Comparison of 5STS between the two groups before and after intervention. There was no statistically significant difference in 5STS between the two groups before intervention (*P* > 0.05). After intervention, 5STS (11.35±1.47) in observation group showed significant changes compared with that (12.36±2.11) in control group (*P* < 0.05).

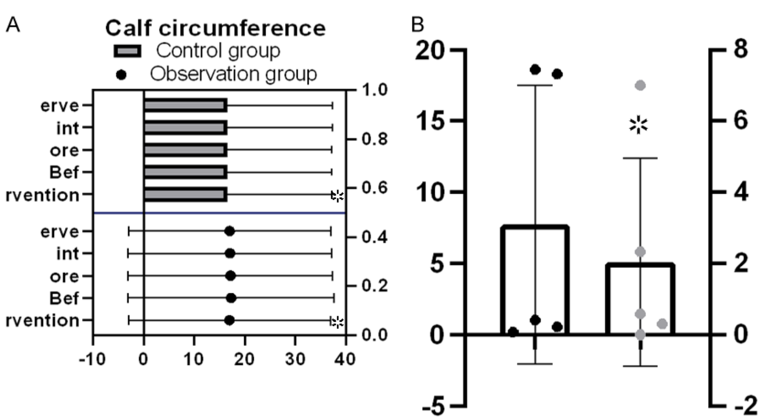

Figure 5. Comparison of calf circumferences between the two groups after intervention. There was no statistically significant difference in the calf circumference between the two groups before intervention (*P* < 0.05). After intervention, the calf circumference (31.17±2.87) in observation group changed significantly compared with that (31.26±1.89) in control group (*P* < 0.05).

Comparison of BFP between the two groups before and after intervention

There was no statistically significant difference in BFP between the two groups before intervention (*P* < 0.05), but the BFP in observation group changed remarkably compared with that in control group after intervention (*P* < 0.05) (**Figure 7**).

Discussion

In this study, we investigated and analyzed the intake of meat, eggs, fish, milk prod-

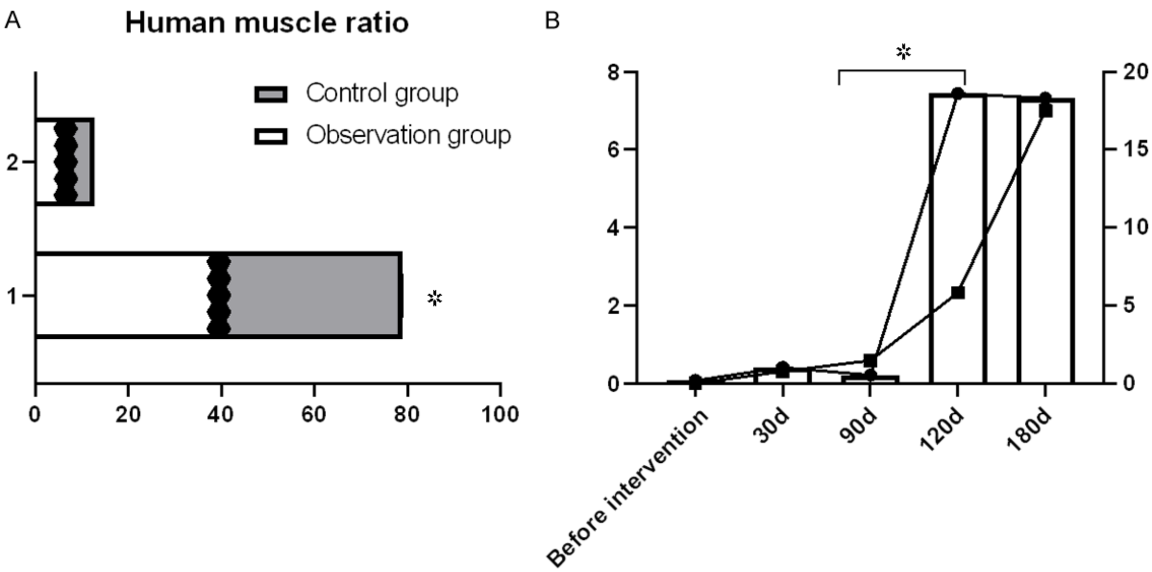

Figure 6. Comparison of muscle percentages between the two groups before and after intervention. There was no statistically significant difference in the muscle percentage between the two groups before intervention (P < 0.05), but the muscle percentage (39.46±6.66) in observation group changed significantly compared with that (39.29±6.23) in control group after intervention (P < 0.05).

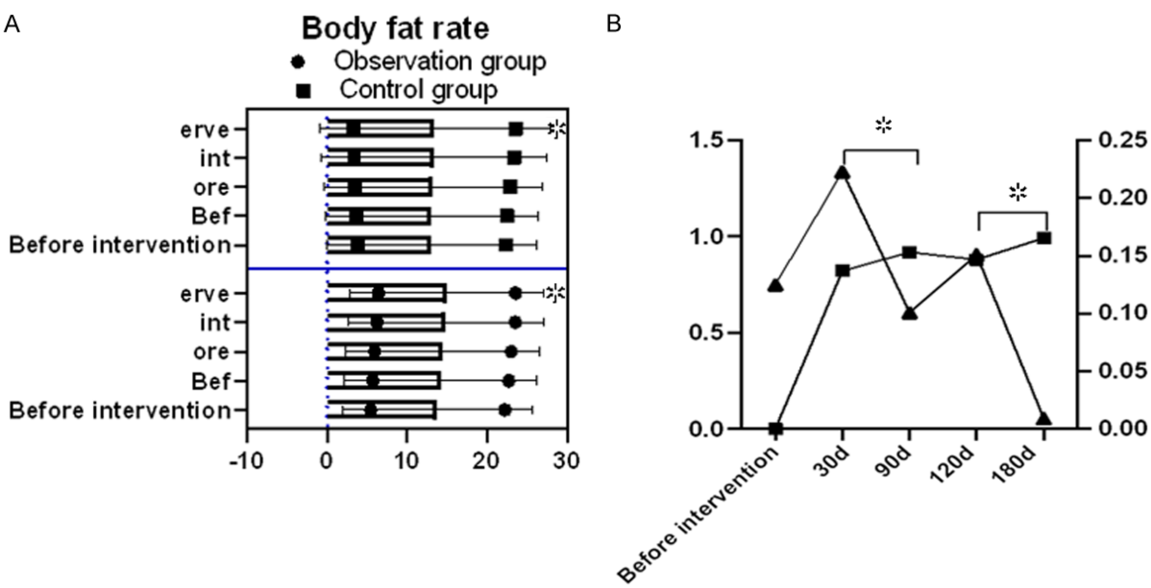

Figure 7. Comparison of BFP between the two groups before and after intervention. There was no statistically significant difference in BFP between the two groups before intervention (P < 0.05), but the BFP (23.53±6.38) in observation group changed remarkably compared with that (23.53±3.24) in control group after intervention (P < 0.05).

ucts and bean products in elderly patients with sarcopenia. It was found that the investigated situation was different from our hypothesis [15, 16]. The intake of above-mentioned nutritious foods was much lower than that recommended for Chinese residents, and could not meet the dietary requirements for the population. According to relevant reports, the elderly aged over 60 years did not consume over 75% protein content in their food every day [17]. This may lead to sarcopenia in the elderly to a certain extent, and the insufficient intake of protein plays a dominant role in causing sarcopenia as an influencing factor. Sarcopenia is related to the intake of foods rich in high-quality protein and the lower nutritional intake will lead to a higher prevalence of sarcopenia in the elderly. Therefore, the nutritional intake should be focused on to prevent sarcopenia [18]. The life lies in sports. Therefore, the enrolled 116 sarcopenia elderly patients were investigated, and it was found that these patients lacked regular aerobic exercise and RE. Our findings showed that the regular aerobic exercise combined with RE was conducive to the muscle growth. Undoubtedly, elderly patients with sarcopenia will benefit from the regular aerobic exercise combined with RE, because RE can help to maintain their muscle strength [19, 20], and regular aerobic exercise can improve the activity of mitochondrial enzymes in the muscles, increase the density of blood capillary, promote blood circulation, and help repair neuromotor cells, thus enhancing the skeletal muscle strength and the exercise ability [21].

In this study, we strengthened the nutritional intervention for the elderly using complete nutritional preparation and protein supplementation for nutritional intervention. The purpose of this study was to compare the effects of the two methods for nutritional intervention on the prevention and treatment of sarcopenia in the elderly. Our findings showed that the balanced diet and aerobic RE combined with the meals prepared using the nutritionally complete formula can effectively relieve the symptoms of elderly patients with sarcopenia [2, 22], and achieve remarkable effects on improving the physical indices of sarcopenia elderly patients with severe symptoms. This has significant effects on the prevention and treatment of sarcopenia, which has been proved by similar studies overseas. The combined nutrition and exercise interventions are effective in preventing and treating sarcopenia [23]. Such intervention can ensure the sufficient calories supply and quality protein intake, and maximize the prevention and treatment of sarcopenia. RE is the most effective option in the prevention and treatment of sarcopenia [24].

In this study, nutrition and kinematics are combined, which is of great clinical significance to the elderly patients with sarcopenia. However, we only investigated community-dwelling sarcopenia patients. Therefore, there was a small sample size and a short duration of investigation. The future in-depth studies should be conducted to obtain more reliable results.

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Disclosure of conflict of interest

None.

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