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Study On the Impact of Hand Exercise on The Cognitive Function of The Elderly Brain

Jintao Shen[1], Xiaowei Xu[2, *], Jing Yang[3]

[1] College of Management, Zhejiang Shuren University, Hangzhou, China
[2] College of Physical Educationt, Zhejiang Shuren University, Hangzhou, China
[3] Markist Academy, Zhejiang Shuren University, Hangzhou, China
[*] Corresponding author: Xu Xiaowei (Email: 357312970qq.com)

Abstract: This study aims to evaluate the impact of unarmed strength training on the cognitive function of middle-aged and elderly patients with mild cognitive impairment (MCI). The study subjects are 60 elderly male MCI patients from the Community Health Service Center in Hangzhou, with an age range of 66±5 years. The participants were randomly divided into two groups: the control group and the intervention group. The control group did not receive any intervention measures, while the intervention group underwent a 12-week unarmed strength training program. Before and after the study, the Montreal Cognitive Assessment Scale (MoCA) was used to assess the changes in cognitive function of the subjects. The data analysis was conducted using SPSS 23.0 software, and t-tests and chi-square tests were used for inter-group comparisons based on the distribution characteristics of the data. After 12 weeks of unarmed training, the MoCA score of the intervention group at T2 was significantly higher than that of the control group ($P<0.05$), indicating that the cognitive function of the intervention group had significantly improved. Unarmed strength training has a positive impact on the cognitive function of middle-aged and elderly MCI patients, and a 12-week training program can effectively improve the cognitive ability of this group.

Keywords: Free-hand strength training; middle-aged and elderly people; mild cognitive impairment.

1. Introduction

With the intensification of the global aging population trend, cognitive impairment has become an increasingly serious public health problem[1]. It is estimated that there are currently about 50 million dementia patients worldwide, and this number is expected to increase to 152 million by 2050. Mild cognitive impairment (MCI), as an early stage of cognitive decline, also increases the number of patients. Although MCI patients can still maintain basic self-care abilities in daily life, they have shown mild cognitive impairment in areas such as memory, attention, and executive function[2]. If effective intervention measures are not taken, MCI patients have a higher risk of progressing to more severe dementia, such as Alzheimer's disease (AD), which not only seriously affects the quality of life of patients, but also brings a heavy burden of care to families and society[3].

In the field of non pharmacological intervention, sports have received increasing attention due to their potential benefits for cognitive function. Numerous studies both domestically and internationally have shown that physical activities such as aerobic exercise and strength training can improve cognitive function in the elderly and slow down cognitive decline. For example, a systematic review found that aerobic exercise can improve executive function and memory in MCI patients; Another 6-month strength training study also showed that older adults who participated in the training performed better in cognitive tests[4]. However, existing research mostly focuses on the Western population and has a small sample size, making its applicability to the Eastern population, especially the elderly in China, unclear.

In China, unarmed strength training, as a simple and easy exercise activity without the need for equipment, has gradually become an important choice for the elderly to exercise. However, research on the impact of hand strength training on cognitive function in MCI patients is relatively scarce, and existing studies are mostly limited to short-term interventions and lack long-term tracking[5]. In addition, the standardization level of research methods is not high, and there are differences in the selection of evaluation tools, making it difficult to directly compare and promote research results.

In view of this, this study selected elderly male MCI patients from Hangzhou Community Health Service Center as the research subjects, aiming to explore the intervention effect of 12 weeks of barehanded strength training on cognitive function of MCI patients. This study used the Montreal Cognitive Assessment Scale (MoCA) as the main evaluation tool, aiming to provide more scientific and reliable evidence for the application of barehanded strength training in MCI interventions through rigorous experimental design and standardized evaluation processes[6]. At the same time, this study will also supplement and improve the shortcomings of existing research, providing reference for the health management and disease prevention of the elderly population.

2. Objects and Methods

2.1. Research subjects

This study selected 60 elderly patients with mild cognitive impairment (MCI) registered at the Hangzhou Community Health Service Center as the research subjects. Patients were randomly assigned to a control group and an intervention group, with 30 patients in each group. All participants voluntarily participated in this study and signed informed consent forms.

The inclusion criteria include: age between 60 and 75 years old. A population with a score of 15-24 on the Montreal Cognitive Assessment (MoCA) test, who did not meet the diagnostic criteria for dementia and did not suffer from any physical or mental disorders that could cause brain dysfunction. No serious heart disease, respiratory system disease, or other major diseases that may affect exercise ability.

No involvement in other cognitive interventions or exercise training programs. Ability to understand and follow research instructions.

Exclusion criteria include the presence of severe hearing or visual impairment. There are clinical manifestations of dementia. Has a history of mental illness or is currently receiving treatment for a mental illness. There have been fractures or other serious sports system injuries in the past 6 months.

2.2. Research Methods

2.2.1 Questionnaire survey to investigate the general personal information of the subjects. Mainly targeting the natural conditions and lifestyle habits of elderly MCI patients. We conducted a one-on-one inquiry between the researchers and the participants, and filled it out on the spot. All participants in this study were surveyed. Distribute 60 questionnaires, collect 60 questionnaires, with a response rate of 100% and a questionnaire effectiveness rate of 100%.

2.2.2. Experimental design

Using a randomized controlled trial design, eligible subjects were randomly divided into two groups: a control group and an intervention group. The control group will not receive any intervention, while the intervention group will receive 12 weeks of unarmed strength training.

2.3. Intervention plan

The intervention plan for this study was jointly developed by doctors and physical fitness coaches. The training plan for the intervention group is as follows: training frequency: 3 times a week, with an interval of at least 1 day between each session. Training duration: Each training session includes 5 minutes of warm-up, 30 minutes of strength training, and 5 minutes of relaxation. Training content: This includes hand strength training exercises such as squats, wall push ups, assisted pull-ups, and plank supports. Training intensity: Target RPE (subjective effort perception score) of 13-15 points (slightly challenging but able to persist in completing). Training guidance: Professional physical fitness coaches provide on-site guidance to ensure accurate movements and avoid sports injuries.

2.4. Indicator testing

All subjects were tested twice with different indicators before the experiment (T0) and at 12 weeks (T1), using the following specific methods. (1) Cognitive function indicators are measured using the MoCA scale. The MoCA scale is an internationally recognized rapid screening and assessment tool specifically designed for mild cognitive impairment. (2) Body shape indicators include height, weight, blood pressure, heart rate, and body fat percentage.

2.5. Statistical processing

After data collection is completed, use SPSS 23.0 software for data analysis. Descriptive statistical analysis is used to outline the distribution of data. Independent sample t-test was used for inter group comparison, while paired sample t-test was used for intra group comparison. Use P<0.05 as the standard for statistical significance.

3. Results

1. Basic information of the subjects

This study included 60 elderly male patients with mild cognitive impairment (MCI), aged 66±5 years. All participants were from the Hangzhou Community Health Service Center and were randomly assigned to a control group and an intervention group, with 30 cases in each group. Two groups were matched in terms of age, education level, lifestyle habits, etc. before the start of the study to ensure consistency of baseline data. The specific baseline data is detailed in Table 1.

Table 1. General data of the subjects (n=60, x^2± s)

Variable	Control group（n = 30）	Intervention group（n = 30）	P-value*
Age	66.5±4.8	65.8±5.1	0.322
Education level			
Primary school / junior high school	18(60%)	19(63.3%)	0.821
Technical secondary school / high school	9(30%)	7(23.3%)	
College / undergraduate	3(10%)	4(13.3%)	
Smoking			
Frequent	12(40%)	14(46.7%)	0.702
Occasional	11(36.7%)	9(30%)	
Seldom	7(23.3%)	7(23.3%)	
Alcohol drinking			
Frequent	10(33.3%)	11(36.7%)	0.811
Occasional	14(46.7%)	15(50%)	
Seldom	6(20%)	4(13.3%)	

2. Changes in MoCA scores

During the 12 week study period, the intervention group received unarmed strength training, while the control group did not receive any intervention measures. Cognitive function assessment was conducted on two groups of participants using the MoCA scale before the study (T0) and after the study (T1). The results showed that the MoCA score of the intervention group was significantly higher than T0 at T1 (P<0.05), while the MoCA score of the control group showed no significant change between T0 and T1. There was a significant difference in MoCA scores between the two groups at T1, with the intervention group receiving significantly higher scores than the control group (P<0.05), indicating that hand strength training has a positive effect on improving cognitive function in MCI patients. The specific scoring changes are detailed in Table 2.

Table 2. Changes in MoCA score (n=60, , x^2± s)

Time point	Control group	Intervention group	P-value*
T0	19.2±2	18.8±2	0.511
T1	19.1±2	22.1±3	<0.05

3. Comparison of height, body mass, and changes in circumference

In addition to evaluating cognitive function, we also measured the body shape indicators of the subjects, including height, body mass, waist circumference, hip circumference, and chest circumference. During the study period, there were no significant changes in the height, body mass, and circumference of the control group. In contrast, after 12 weeks of barehanded strength training, the intervention group showed a slight decrease in body fat, as well as a decrease in waist and hip circumference, but these changes did not reach statistical significance. There was no significant change in height between the two groups. This may indicate that barehanded strength training has limited impact on improving the body shape of MCI patients. The specific changes in body shape are detailed in Table 3.

Table 3. Comparison of height, body mass, and changes in circumference (n=60, , x^2± s)

Variables	Time point	Control group	Intervention group	P-value*
Height (cm)	T1	174.5 ± 5	175.0 ± 4	0.645
Body mass (kg)	T1	67.5 ± 8	66.3 ± 7	0.157
Waist circumference (cm)	T1	85.2 ± 6	83.5 ± 5	0.074
Hip circumference (cm)	T1	96.3 ± 7	94.8 ± 6	0.092
Chest circumference (cm)	T1	92.1 ± 9	91.3 ± 8	0.428

4. Discussion

The sample selection process of this study ensured the balance between the two groups of subjects on key baseline characteristics, including age, educational background, and lifestyle habits, which provided a solid foundation for the reliability of the research results. Through a rigorous matching process, we aim to eliminate potential confounding factors and more accurately evaluate the impact of barehanded strength training on cognitive function in MCI patients[7].

The research results indicate that hand strength training has a significant positive effect on cognitive function in MCI patients. This discovery is consistent with existing research literature, emphasizing the importance of sports activities in maintaining and improving cognitive health in the elderly[8] . In addition, the results of this study further support the potential application value of hand strength training as a non pharmacological intervention for early intervention and long-term disease management in MCI patients.

Although the impact of hand strength training on the body shape indicators of the subjects, such as body mass, waist circumference, and hip circumference, did not reach statistical significance, the observed downward trend is still worth noting[9]. This may indicate that improvements in body shape may require longer training interventions or adjustments to diet and lifestyle. In addition, the stability of height meets expectations, as height changes in later adulthood are usually more closely related to genetic factors[10].

The limitations of this study suggest potential directions for future research. Firstly, expanding the sample size will help enhance the universality and extrapolation of research results. Secondly, extending the intervention time may help to gain a more comprehensive understanding of the long-term effects of hand strength training on body shape and cognitive function. In addition, future research should consider stricter control over the diet and lifestyle habits of participants to reduce the potential confounding effects of these factors on intervention outcomes[11]. Exploring the differences in the impact of different types and intensities of exercise on cognitive function in MCI patients is also an important direction for future research.

5. Conclusion

The results of this study support the positive impact of hand strength training on cognitive function in MCI patients. Although the improvement effect on body shape is not yet significant, this study provides valuable insights for non pharmacological interventions in MCI and new ideas for future clinical practice and research directions. Through further research and practice, we can better understand the role of hand strength training in cognitive health of the elderly, and provide more effective and personalized intervention plans for MCI patients.

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