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Effect of Exercise Prescription on Physical Fitness Intervention for Older Adults with Mild Disability

Chenxu Qu[a], Deming Liu, Wenhui Wang, Jiajia Chen, Dongliang Liu, Mingming Zhao

School of Physical Education, Henan University, Kaifeng 475000, China

[a]753110054@qq.com

Abstract

In order to design an exercise prescription to improve the disability status of elderly people, 100 elderly people with mild disability were selected by questionnaire, experimental method and mathematical statistics, and the exercise prescription intervention was conducted twice a week for 60 min for 16 weeks. The results showed that the height, weight, BMI and body fat percentage of the elderly did not change significantly in terms of body shape; in terms of body function, the systolic and diastolic blood pressure of the elderly improved significantly, and the heart rate did not change significantly in quiet time. In terms of physical quality, the speed quality, flexibility quality and strength quality of the elderly were significantly improved, and the agility quality did not change significantly. CONCLUSION: Exercise prescription intervention can provide good help in physical function and physical quality and improve the daily living ability of the elderly. In the development of exercise prescription, attention should be paid to its scientific, comprehensive, dynamic and fun nature, with a view to improving the disabling status of the elderly.

Keywords

Exercise Prescription; Mildly Disabled Older Adults; Physical Fitness.

1. Introduction

According to the standard of the United Nations for aging society, China has entered the aging society in 2000 (H.Q. Zhang.etal, 2020). In addition, with the general decline in the physical quality of our citizens, the proportion of elderly people with disabilities is gradually increasing, and the National Office for the Aged made a prediction in October 2016 that the total number of disabled elderly people in China is likely to reach 42 million by 2020. Disabled elderly people will lose their ability to take care of themselves in different degrees, which will become a burden for other family members to a certain extent and reduce the family happiness index, and the physical health of disabled elderly people will also lead to the decline of the average health level of our citizens, so the current problem of elderly people's disability has been a problem that cannot be ignored in the process of social development in China.

The assessment about the physical disability status of the elderly is mainly from three aspects: physical form, physical function, and physical quality (Y.Q. Zhang, 2018). And the disability is a dynamic process, if not intervened to stop it, it is easy to gradually deteriorate thus making the elderly lose the ability to take care of themselves. Scientific and systematic physical fitness training and exercise prescription can play a good role in promoting the physical health of the elderly, intercepting the deterioration of the disabling state in time, stopping the irreversibility of the disabling state, and helping to delay the aging of the elderly body functions. Therefore, it is of high theoretical and practical significance to study the exercise prescriptions suitable for

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the elderly with mild disability, and to reduce the occurrence of related diseases caused by disability in the elderly with mild disability through a series of scientific physical training intervention methods, to improve the happy life of the elderly, and to provide the theoretical basis for the construction and promotion of the exercise rehabilitation service model system for the elderly with mild disability.

2. Experimental Subjects and Methods

2.1. Experimental Subjects

The object of this paper is the effect of exercise prescription intervention on the physical fitness of elderly people with disability. The experimental subjects were 100 mildly disabled elderly people in Kaifeng. After the selection of the experimental subjects, the three main indexes of physical disability level assessment were mainly based on physical form (height, weight, BMI, body fat percentage), physical function (systolic blood pressure, diastolic blood pressure, heart rate), and physical quality (10m maximum step speed, standing forward bending, standing walking time, and grip strength), and the experimental group and the control group were evaluated by The effect of the exercise prescription intervention was analyzed by evaluating the differences between the experimental and control groups.

2.2. Research Methodology

2.2.1. Questionnaire Method

In this study, mildly disabled older adults in Kaifeng city were surveyed. The measurement instrument was the barthel index scale (Juliane Eichhorn-Kissel. etal, 2011) with high reliability and validity, and the level of disability was assessed according to the score status. 445 questionnaires were distributed in Kaifeng city, and 433 were returned, with a return rate of 97.3%. 100 physically mildly disabled elderly people with scores of 71-99 were finally selected. Among them, 60 were male and 40 were female. In the process of sample selection, in order to improve the representativeness of the sample: 1) ensure that all individuals in the selected sample have a disability status caused by physical function aging, while physical disability caused by pathology or congenital disability does not meet the requirements of this study; 2) ensure that all elderly with mild disability are consciously participating in this exercise prescription intervention experiment; 3) there is no significant difference in height, weight and age between the control group and the experimental group of elderly with mild disability; 4) all subjects are free of psychological and mental problems; 5) all subjects are in good health and have normal cardiopulmonary function.

2.2.2. Experimental Method

One hundred elderly people with mild disability were divided into a control group of 30 men and an experimental group of 20 women. The experimental group underwent a 16-week exercise prescription program, while the control group continued to follow a regular daily routine. At the end of the experiment, the differences in physical form, physical function and physical fitness between the two groups were compared, and the effect of the exercise prescription on the physical fitness of the elderly with mild disability was analyzed.

2.2.3. Mathematical and Statistical Methods

In this study, SPSS 26.0 statistical software was used for data analysis, and the physical form, physical function and physical quality of the elderly with mild disability were statistically analyzed, and the measurement data were expressed as Mean±SD, and the differences between the two groups were analyzed by t-test.

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3. Experimental Design

3.1. Notes on the Experiment

Because there are many unstable factors during exercise for this special group of elderly people due to their physical functions, the whole experimental process should be strictly monitored: 1) carefully observe the subjective feelings of the elderly during exercise, and stop exercise in time once shortness of breath and pallor appear; 2) stop exercise in time when the blood pressure of the elderly exceeds 100/180 mmHg; 3) inform the exercisers in advance to exercise within their ability; 4) pay attention to remind the elderly of their diet and clothing before exercise.

3.2. Test Phase

The whole experimental process of this study was 16 weeks, with 2-3 exercise sessions per week, each exercise at about 60 min, divided into a preparation part of 15 min, a basic part of 35 min, and an ending part of 10 min, with an interval rest of about 2-3 min between groups. The specific exercise prescription intervention program is shown in Table 1.

(1)Preparation section

The main purpose of the preparatory part is to awaken the body's motor capacity and is the warm-up phase before performing sports, increasing the range of motion of the joints and reducing muscle viscosity, especially important in the elderly before performing sports activities, which can reduce the risk of sports injuries (Garber Carol Ewing.etal, 2011). The preparation component focuses on 5-15 minutes of low-intensity (<60% HRmax) to moderate-intensity (60-<70% HRmax) aerobic exercise, with freehand exercises as the main activity modality, trying to move all joints of the body.

(2)Basic section

The basic part mainly includes aerobic exercises and resistance exercises. The main contents of aerobic training are in-situ leg lift and hip strike, in-situ longitudinal jump and front and back strike, in-situ trunk lateral extension and in-situ stepping C word around the shoulder; the main contents of resistance exercises are upright double arm bend, upright double arm forward push, small half squat and left and right translation, standing rear leg tuck, TRX overhead arm flexion and extension. In addition, the American College of Sports Medicine recommends aerobic exercise for older adults 3-5 times a week for a cumulative 30-60 min each time, and the German Rehabilitation Center for the Elderly recommends aerobic training activities of low intensity (55-<65% HRmax) to moderate intensity (65-<75 HRmax) for older adults with poor physical fitness. However, considering that the subjects of this study are elderly people with mild disability, their physical fitness level is already different from that of normal elderly people, and in order to avoid sports injuries and accidents, the training frequency of the aerobic training part of this exercise prescription was selected to be three times a week, with 20 min of aerobic training activities and 15 min of resistance exercises each time, and the training intensity was selected from low intensity (55-<65% HRmax) to medium intensity (65-<75 HRmax), and the whole experimental process was closely monitored and adjusted in a timely and appropriate manner.

（3）Closing section

After completing the basic part of the exercise prescription, the elderly with mild disability should perform some finishing activities to restore their heart rate to normal level, and also to eliminate the metabolites produced by the body of the elderly after the training, eliminate fatigue and speed up the recovery process. In this experiment, we arranged the elderly to perform relaxation activities within 10 min, mainly static stretching, and the intensity was controlled at a low intensity of less than 65% HRmax.

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Table 1. Exercise intervention programs

Purpose	Movement style	Exercise time	Movement frequency	Exercise intensity
Warm-up section	Hand Exercises	<15min	Three times a week	<70%HRmax
Aerobic Training	In-situ leg lift and hip slap, in-situ vertical jump and front and back slap, in-situ torso lateral extension, in-situ stepping C around shoulder	20min	Three times a week	<75%HRmax
Resistance training	Upright double arm curl, upright double arm push forward small half squat left and right translation, standing back leg collection, TRX overhead arm flexion	15min	Three times a week	<75%HRmax
Resistance training	Static stretching mainly, patting and kneading, etc.	10min	Three times a week	<65%HRmax

4. Experimental Results

4.1. Comparison of the Mean Values of Body Morphology between the Experimental and Control Groups of Elderly People with Mild Disability Before and After the Experiment

In this study, BMI and body fat percentage were mainly used to reflect the changes of body shape in the control and experimental groups before and after the experiment. As shown in Tables 2 and 3, there was no significant difference in height, weight and body fat percentage in the elderly with mild disability before and after the experiment in the experimental group ($P > 0.05$), but there was a difference in BMI index before and after the experiment ($t = -1.739$. $P < 0.5$), indicating that exercise prescription played a significant role in the BMI index. In addition, there were no significant differences in height, weight, BMI and body fat percentage among the mildly disabled elderly in the control group at the end of the experiment.

Table 2. Comparison of the mean values of body morphology in the experimental group of elderly people with mild disability before and after the experiment

		Pre-experiment	After the experiment	t	p
	N	$\bar{x}\pm s$	$\bar{x}\pm s$		
Height(cm)	50	163.5±6	163.8±6	1.225	0.135
Weight(kg)	50	64.94±6.6	63.1±7.7	-0.554	0.525
BMI(kg/m2)	50	23.22±1.33	22.64±1.28	-1.739	0.023*
Body fat percentage(%)	50	34.51±4.67	35.12±4.56	-1.332	0.216

Note: *p<0.05, **p<0.01, same below

Table 3. Comparison of the mean values of body morphology in the control group of elderly people with mild disability before and after the experiment

		Pre-experiment	After the experiment	t	p
	N	$\bar{x}\pm s$	$\bar{x}\pm s$		
Height(cm)	50	164.3±4	164.4±6	2.332	0.625
Weight(kg)	50	65.2±6.6	65.7±6.8	-0.868	0.775
BMI(kg/m2)	50	23.58±1.25	23.62±1.33	-1.326	0.640
Body fat percentage(%)	50	33.72±4.32	34.56±3.88	-0.656	0.361

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4.2. Comparison of the Mean Values of Physical Functions between the Experimental and Control Groups of Elderly People with Mild Disability Before and After the Experiment

Systolic and diastolic blood pressure and heart rate are important indicators of the human cardiovascular system and are also important factors affecting human health, which are influenced by a combination of factors. Normal systolic and diastolic blood pressure and heart rate ensure the proper functioning of the circulatory system and promote internal stability, especially in this group of elderly people. But too high or too low blood pressure can seriously affect the health of the elderly or even life-threatening, and the elderly are a group with a high prevalence of hypertension and coronary heart disease, so the stability of blood pressure and heart rate is of extra importance to the elderly.

The comparison of the mean physical function values of the experimental and control groups before and after the experiment in Tables 4 and 5 shows that after the experimental training with exercise prescription, the maximum heart rate at quiet time did not change significantly in the experimental group before and after the experiment ($t=1.22$, $P>0.05$), but the diastolic blood pressure and systolic blood pressure of the disabled elderly in the experimental group improved significantly after the training ($P<0.05$) , and the improvement of diastolic blood pressure was very significant ($P < 0.01$), while no significant changes in diastolic blood pressure, systolic blood pressure and heart rate indexes were observed in the disabled elderly in the control group.

Table 4. Comparison of the mean values of physical functions of the elderly with mild disability in the experimental group before and after the experiment

		Pre-experiment	After the experiment	t	p
	N	x±s	x±s		
Diastolic blood pressure(mmHg)	50	74.44±3.43	72.57±5.97	-3.31	0.002**
Systolic pressure(mmHg)	50	129.41±6.89	119.0±11.66	-2.44	0.031*
Heart rate	50	69±6.44	69±5.66	1.22	0.27

Table 5. Comparison of the mean values of physical function in the control group of elderly people with mild disability before and after the experiment

		Pre-experiment	After the experiment	t	p
	N	$\bar{x}$±s	$\bar{x}$±s		
Diastolic blood pressure(mmHg)	50	70.45±2.97	70.22±4.22	-1.221	0.353
Systolic pressure(mmHg)	50	127.23±7.66	128.41±9.77	-1.387	0.686
Heart rate	50	67.00±7.13	68±581	-1.22	0.327

4.3. Comparison of the Mean Values of Physical Fitness Before and After the Experiment between the Experimental Group and the Control Group of Elderly People with Mild Disability

Physical quality is the most direct external factor of elderly people's disability level, and it is also the most important and basic ability of elderly people to complete their daily life. In this experiment, four indexes were selected to evaluate the physical quality of elderly people with disabilities, namely, starting walking time, 10m maximum step speed, standing forward bending and grip strength.

The data in Tables 6 and 7 show that after 16 weeks of experimentation with exercise prescription, the physical quality level of the elderly with disabilities changed significantly, among which the changes in 10m maximum step speed and standing forward bending were the

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most obvious and highly significant in the analysis of differences before and after the experiment (t=-9.131, P<0.001 t=-3.223, P<0.001), indicating that the exercise In addition, grip strength also improved (t=3.218, P<0.05), indicating that the exercise prescription can also improve the strength quality of the disabled elderly, while on the contrary, no significant changes occurred in the control group, indicating that the exercise prescription can play a better role in promoting the physical quality of the disabled elderly.

Table 6. Comparison of the mean values of physical fitness of the elderly with mild disability in the experimental group before and after the experiment

		Pre-experiment	After the experiment	t	p
	N	$\bar{x}\pm s$	$\bar{x}\pm s$		
Stand up and walk timing(s)	50	9.72±2.67	9.15±1.55	1.444	0.131
10 meters maximum step speed(s)	50	1.66±0.44	2.20±0.33	-9.131	0.000***
Standing forward bend(cm)	50	25.44±7.11	32.77±4.13	-3.223	0.000***
Grip strength(kg)	50	27.33±2.18	31.34±1.66	-3.218	0.003**

Table 7. Comparison of mean values of physical fitness of elderly people with mild disability in the control group before and after the experiment

		Pre-experiment	After the experiment	t	p
	N	$\bar{x}\pm s$	$\bar{x}\pm s$		
Stand up and walk timing(s)	50	9.81±2.87	9.62±1.55	0.254	0.531
10 meters maximum step speed(s)	50	1.61±0.35	2.02±0.35	-5.131	0.613
Standing forward bend(cm)	50	27.14±6.21	27.77±5.13	-1.223	0.514
Grip strength(kg)	50	28.52±2.01	31.34±1.66	-3.218	0.615

5. Analysis of Experimental Results

Scientific exercise prescription can more significantly improve the daily behavioral ability and physical health level of the elderly with mild disability, and other scholars have argued and analyzed the positive effects of tai chi, fitness exercises and some traditional ethnic exercise programs on the cardiorespiratory function and physical fitness of the elderly (G. Yang,Y.Y. Shen.etal, 2019). In addition the annual meeting of the American Medical Association also pointed out that moderate physical activity twice a week is very helpful for the physical fitness level of the elderly (Y. Li,etal. 2016). Scientific and systematic physical exercises of certain intensity and in various ways based on individual differences and specificities can greatly contribute to the recovery of physical fitness in elderly people with mild disability, and at the same time, its physical conditions required for exercise are low and not easily restricted by venues and environments, so it has the basic conditions for popularization.

(1) From the experimental results, it can be seen that there was no significant change in height, weight, BMI and body fat percentage in the mildly disabled elderly after the exercise prescription experiment (P > 0.05), and other scholars have also reached more consistent conclusions when conducting related experiments. Cris A conducted an experiment with obese people aged 18 to 70 years old, and divided the subjects into two groups, one group performed resistance exercises, and the other group performed aerobic exercises with the same frequency of 2 times per week. The other group performed aerobic exercises with the same frequency of 2 times per week for 10 weeks, and at the end of the experiment it was found that neither exercise had a significant effect on subcutaneous fat content. However, this does not mean that the exercise prescription experiment has no effect on the above four indicators. Due to the

irreversible trend of natural decline of the body's functional conditions, the body fat content of the elderly will generally tend to increase, but after the intervention of the exercise prescription experiment, the body fat content did not increase, but some improvement, indicating that the exercise prescription has played some slight effect, probably due to the bias in the content of the prescription and the limitation of the experimental period, resulting in a less significant effect, which needs to be adjusted in future experiments.

(2) After a 16-week intervention experiment with exercise prescription, significant improvements in diastolic blood pressure ($P < 0.01$) and systolic blood pressure ($P < 0.05$) occurred in the elderly with mild disability in the experimental group, and resistance training exercises for elderly women in Cunha RM's experiment revealed significant changes in both systolic and diastolic blood pressure in the subjects 60 minutes after the end of the exercises (Cunha R M.etal,2012), which is more consistent with the results of the current experiment. In addition, after 16 weeks of experimental intervention with exercise prescription, no significant ($p > 0.05$) changes in quiet heart rate were observed in the mildly disabled elderly, while significant changes in quiet heart rate were found in the 12 normal elderly after 10 weeks of experimental intervention with resistance training by Fleur Polknes. Since the subject was a mildly disabled elderly person, the training intensity was relatively low, so there was no significant stimulation of the autonomic nerves of the elderly, resulting in no significant change in the quiet heart rate of the elderly at the end of the test.

(3) At the end of the test, the get-up-and-walk timing index may require a good functional state of the cerebral cortex due to the sensitive quality of its test, which requires rapid motor commands according to environmental changes, and the elderly are subject to life cycle reasons so it is difficult to build (A.L. Hu, 2012). In addition, 10m maximum step speed ($P < 0.001$), standing forward flexion ($P < 0.001$) and grip strength ($P < 0.01$) were statistically significant, indicating that the intervention experiment of exercise prescription has positive effects on speed quality, flexibility quality and strength quality of the elderly with mild disability, which can improve the daily living ability of the elderly and avoid the occurrence of life accidents, Yang Guang in modern exercise rehabilitation The same view was reached by Yang Guang on the improvement of daily living ability of the elderly by modern exercise rehabilitation methods.

6. Concluding Remarks

The experiment concluded that 60 minutes of moderate intensity training activities three times a week can improve the physical form, physical function and physical quality of the elderly with mild disability to a certain extent, and more attention should be paid to the combined application of various training contents, especially the systematic, comprehensive, dynamic and interesting training contents are more effective, which can achieve the preset purpose of maintaining the physical health level of the elderly and improving their disability status.

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