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A Clinical Study of Scientific Exercise Prescription Intervention for Patients with Grade 1 Essential Hypertension

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Abstract

Objective: To explore the clinical effect of scientific exercise prescription intervention on patients with Grade 1 Essential Hypertension (EHT). Methods：136 patients with grade 1 EHT who met the inclusion criteria and attended the physical examination centers of three hospitals, namely, the Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine, the Second Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine, and the First People's Hospital of Xianyang City, from April 2022 to December 2022, were selected for this study using a multicenter case registry study, and the included patients were given a 4-week scientific exercise prescription intervention, and at the end of the trial cycle Patients were divided into low and moderate exercise groups according to the absolute amount of exercise intervention they received. Changes in systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate, body mass index (BMI), and the short form-36 health survey(SF-36) were observed in both groups. Results: SBP, DBP, heart rate, BMI and SF-36 improved after exercise, but the changes of SBP, DBP, heart rate and SF-36 in the moderate exercise group were significantly better than those in the low exercise group, and the difference was statistically significant (P<0.05), and the BMI in the moderate exercise group was not significantly different from that in the low exercise group after the intervention (P>0.05). Conclusion：Scientific exercise intervention can significantly improve the blood pressure level of EHT patients and improve the survival quality of patients, and moderate exercise group can better improve the clinical effect than low exercise group, which is worth further promotion.

Keywords

Scientific fitness; Essential hypertension; Exercise prescription; Aerobic exercise; Resistance exercise.

1. INTRODUCTION

With the intensification of population aging in China, hypertension has become a serious public health problem facing China. According to the latest data from the China Cardiovascular Health and Disease Report 2021, the number of people with hypertension in China has reached 245 million, and the number of people with normal high blood pressure has reached 435 million [1]. Compared with previous surveys [2], the prevalence is clearly on the increase. Because blood pressure levels are closely related to cardiovascular risk factors, they often lead to serious events such as stroke, coronary heart disease, myocardial infarction, and heart failure, and remain an important cause of death from cardiovascular disease to date. The ESC/ESH Guidelines for the Management of Hypertension 2018 states that for every 10 mmHg (1 mmHg = 0.133 kPa) reduction in SBP, or 5 mmHg reduction in DBP, the risk of cardiovascular disease

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in patients can be reduced by 20% to 40%, and the risk of death can be reduced by approximately 10% to 15% [3]. However, for a long time, people do not know enough about hypertension disease, and according to the latest sample survey of hypertension among Chinese residents [4], the "awareness rate", "treatment rate", and "control rate" of hypertension among Chinese adults " are 41.0%, 34.9% and 11.0%, respectively, which are still at a low level. Therefore, effective prevention and treatment of hypertension has become one of the major strategies to curb the epidemic of cardiovascular and cerebrovascular diseases in China.

Global hypertension practice guidelines suggest that healthy lifestyle interventions can prevent or delay the onset of hypertension, and for patients with diagnosed hypertension, lifestyle changes are the first line of antihypertensive treatment [5],And exercise therapy, as one of the six components of a healthy lifestyle, has been well established by numerous studies that it can ideally control blood pressure and reduce the risk of cardiovascular disease through scientific and effective health management. Studies have pointed out [6，7,8] that patients can lower blood norepinephrine and renin activity levels during exercise to lower blood pressure, while reducing sympathetic activity in the kidneys and some muscles, reducing the intensity of vascular inner wall contraction and reducing peripheral resistance levels to lower blood pressure. However, there are certain differences in the physical condition and health condition of each person. The level of physical function varies from patient to patient. Therefore, in exercise training, individual differences need to be fully considered and personalized scientific exercise interventions should be made to bring out the antihypertensive effect of exercise, especially for people with hypertensive diseases, the best type, time, frequency and intensity of exercise should be selected as much as possible [9]. Therefore, in this study, personalized scientific exercise interventions were implemented for patients with grade 1 EHT, aiming to provide reference for the development of effective scientific health interventions in the future and to provide new ideas and methods for the prevention and treatment of hypertension.

2. MATERIALS AND METHODS

2.1. General information and grouping method

The study population was obtained from 136 patients with Grade 1 EHT who attended the physical examination centers of three hospitals, namely, the Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine, the Second Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine, and the First People's Hospital of Xianyang City, from April 2022 to December 2022. All included patients were given a 4-week scientific fitness intervention, and patients were grouped according to the absolute amount of exercise they received at the end of the exercise cycle. The exercise volume was calculated as exercise volume = MET x 0.0175 x exercise time (min) x body weight (kg). The selection of total exercise grouping was based on the optimal amount of exercise for hypertensive patients in relation to cardiovascular risk and improvement of cardiovascular disease [10, 11] . According to the results, the amount of exercise was divided into two groups: low exercise group: <1200kcal/wk; moderate exercise group: 1200kcal/wk<2000kcal/wk. After the 4-week exercise intervention, 10 patients were unable to complete the exercise cycle and dropped out, 3 patients were excluded due to other diseases during the exercise period and did not meet the inclusion requirements. , 6 were lost to disassociation after the intervention, and 2 patients dropped out due to participation in other exercise studies, resulting in 115 patients completing the study. After calculating the average weekly exercise, 65 patients were in the low exercise group and 50 patients in the moderate exercise group.

Gender was counted data, and the χ^2 test was used. There were 35 males and 30 females in the low-exercise group, accounting for 53.8% and 46.2% of the low-exercise group, respectively; 27 males and 23 females in the moderate exercise group, accounting for 54.0% and 46.0% of

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the moderate exercise group, respectively. The mean age of the low-exercise group was (48.04 ±13.64) years; the mean age of the moderate exercise group was (47.08±12.01) years. The differences in general data between the two groups were not statistically significant (P>0.05) and were comparable.

2.2. Inclusion and exclusion criteria

2.2.1 Inclusion criteria

(1) Meeting the diagnostic criteria for EHT with a hypertension classification of grade 1;

(2) Age 18-60 years old, regardless of gender;

(3) Those who are not taking antihypertensive drugs or are taking oral antihypertensive drugs but have poor blood pressure control;

(4) Ability to complete research questionnaires independently;

(5) Voluntary signing of the informed consent form.

2.2.2 Exclusion criteria

(1) Cardiovascular risk level stratification with target organ damage or concomitant clinical disease;

(2) The presence of contraindications to exercise intervention, such as febrile disease, bleeding disorders, severe cardiac, hepatic, or renal insufficiency, acute exacerbation of chronic disease, malignancy, etc;

(3) Suffering from mental illness or cognitive impairment;

(4) Those who have unfavorable physical activity and cannot complete all sports independently;

(5) Pregnant or lactating women.

2.3. Methods

2.3.1 Pre-intervention patient information registration

①General information, disease history and exercise experience of all included patients were registered. General information included basic demographics such as name, age, and gender.

②Patients were included to fill in the health status questionnaire (SF-36). the SF-36 scale was designed to assess the subjects' quality of survival in two main modules: physiological function and psychological status, which were divided into eight areas, including physiological function, physical function, somatic pain, general health status, energy, social function, emotional function, and mental health, providing a comprehensive overview of the subjects' quality of survival.

③Physical examination: SBP and DBP, heart rate and BMI were recorded in the resting state of the subjects.

2.3.2 Intervention program

Included patients received 4 weeks of general treatment and exercise prescription intervention.

General treatment: Subjects were given health education on hypertension disease, including dietary guidance, cardiovascular disease risk factor management, and medical guidance.

Exercise program: Based on the general treatment, a 4-week exercise prescription was recommended for the subjects, and patients chose the level of exercise intervention they would receive based on their health needs and exercise capacity.

Exercise prescription development: refer to the American College of Sports Medicine's ACSM Guidelines for Exercise Testing and Exercise Prescription [12] the FITT principles on exercise

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prescription for hypertension, an exercise prescription containing the type, duration, intensity, and frequency of exercise was recommended for patients (Table 1).

Table 1. Exercise prescription

Phase	Type	Intensity	Frequency	Time
Initial Phase (for those without exercise habits)	Walking,jogging, biking, and Play badminton, billiards, yoga, tai chi, eight-duanjin	RPE 9-11 (very easy to still easy); Talking test is mild: can talk and sing	3 times/week	1. 30min each time in the first week, every 1-2 weeks to extend the length of training 5-10min, a single time no more than 60min; 2. 150-300 minutes per week
Advanced Phase	Aerobic exercise: walking, jogging, swimming, tai chi, yoga, aerobic dance, etc. Resistance exercises: self-weight squats, squats against the wall, push-ups, elastic bands, etc.	RPE 12-14 (still easy to a little strained); speaking test is moderate: can speak but cannot sing	Aerobic exercise 3-5 times/week. Resistance exercise 2 times/week. 48h interval between 2 resistance exercises	Aerobic exercise for 30-40 min each; Resistance exercise selected 1-3 movements, each movement 2 groups; each group repeated 6-8 times, rest 2min between groups
Enhancement Phase	Aerobic exercise: fast walking, hiking, swimming, tai chi, cycling, various ball games, etc. Resistance exercise: pull-ups, dumbbells, push-ups, elastic bands, etc.	RPE15-16 (straining to very straining) Speaking test for high intensity: even speaking is difficult	Aerobic exercise 5-7 times/week. Resistance exercise 2 times/week. 48h interval between 2 resistance exercises	Aerobic for 40-60min at a time; Resistance exercise selected 3-5 movements, each movement 3 sets; each group Repeat 8-12 times, rest 2min between groups

Note: RPE: Rating scale of self exertion, a valid method for estimating the intensity of exercise load using subjective perception.

2.3.3 Intervention management

(1) Subjects kept a detailed record of the date, intensity, duration and type of exercise for each exercise session through an exercise diary.

(2) If discomfort occurs during exercise, record the intensity and duration of discomfort at any time. The investigator needs to make a timely judgment of the patient's exercise discomfort and make appropriate treatment.

(3) Those who take antihypertensive drugs during exercise need to record in detail the time of taking medication, the name of the drug and the dosage.

(4) Online exercise instruction was given once a week, and subjects exercised according to the exercise prescription the rest of the time.

2.3.4 Observed indicators and determination criteria

The resting SBP, DBP, resting heart rate, BMI and SF-36 scores of the two groups were compared. Efficacy assessment criteria: change of SBP and DBP relative to baseline after treatment; change of resting heart rate and BMI relative to baseline after treatment; change of SF-36 relative to baseline after treatment in patients at rest.

2.3.5 Statistical methods

All data and information from this study were statistically analyzed by SPSS 25.0 software. The general profile of the subjects was statistically described. The measurement data were first tested for normality, and those conforming to a normal distribution were described as mean± standard deviation, and the independent samples t-test was used for comparison between groups, and the paired samples t-test was used for comparison within groups; those not conforming to a normal distribution were described as median and upper and lower quartiles M (P25, P75), and the Mann-Whiney U test was used for comparison between groups. Count data were described using percentile, and the chi-square test was used for comparison between groups.

3. RESULTS

3.1. Changes in blood pressure in the two groups after 4 weeks of exercise intervention

SBP and DBP were significantly lower in the moderate exercise group than in the low exercise group after the intervention ($P<0.05$); patients in the moderate exercise group had significantly improved SBP and DBP after the exercise intervention compared with those before the intervention ($P<0.05$), whereas patients in the low exercise group had improved SBP after the intervention compared with those before the intervention ($P<0.05$), whereas there was no significant change in DBP index ($P>0.05$) (Table 2).

Table 2. Changes in blood pressure in the two groups after the intervention

Projects	low exercise group		moderate exercise group	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
SBP (mmHg)	144.09±8.52	141.02±7.96*	142.90±7.96	138.02±7.94*#
DBP (mmHg)	91.02±7.79	89.54±5.84	90.42±7.67	87.12±6.11*#

* indicates $P<0.05$ after the intervention compared with the pre-intervention within the group, and # indicates $P<0.05$ after the intervention in the moderate exercise group compared with the low exercise group.

3.2. Heart rate changes in the two groups after 4 weeks of exercise intervention

The heart rate in the moderate exercise group was significantly lower than that in the low exercise group after the intervention ($P<0.05$); the heart rate in both groups improved significantly after the exercise intervention compared with that before the intervention ($P<0.05$) (Table 3).

Table 3. Heart rate changes in the two groups after the intervention

Projects	low exercise group		moderate exercise group	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Heart rate (times/minute)	78.95±8.27	75.95±7.08*	79.18±7.22	73.06±6.17*#

* indicates $P<0.05$ after the intervention compared with the pre-intervention within the group, and # indicates $P<0.05$ after the intervention in the moderate exercise group compared with the low exercise group.

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3.3. Changes in BMI of the two groups after 4 weeks of exercise intervention

There was no significant difference between the BMI of the moderate exercise group and the low exercise group after the intervention (P>0.05); the BMI of patients in the moderate exercise group improved significantly after the exercise intervention compared with that before the intervention (P<0.05), whereas there was no significant improvement in the low exercise group (P>0.05) (Table 4).

Table 4. Changes in BMI in the two groups after the intervention

Projects	low exercise group		moderate exercise group	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
BMI (Kg/M^2)	24.18±3.25	24.19±3.15	24.81±3.09	24.46±2.89*

* indicates P<0.05 after intervention compared with pre-intervention in the group

3.4. Changes in SF-36 in the two groups after exercise intervention

The results showed that the SF-36 scores of patients in both groups improved significantly after the intervention compared with those before the intervention (P<0.05), and the scores of patients in the moderate exercise group improved significantly after the intervention compared with those in the low exercise group (P < 0.05). (Table 5).

Table 5. Changes in SF-36 in the two groups after the intervention

Projects	low exercise group		moderate exercise group	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
SF-36	538.32±62.21	565.06±75.20*	558.40±59.59	590.20±55.30*#

* indicates P<0.05 after the intervention compared with the pre-intervention within the group, and # indicates P<0.05 after the intervention in the moderate exercise group compared with the low exercise group.

4. DISCUSSION

Before treating patients with hypertension, it is necessary to first stratify the risk level of hypertension[13] , and then hypertension treatment strategies are developed based on the risk level after stratification. Scientific fitness interventions are mainly applied to patients with low to moderate risk of hypertension, and patients with low to moderate risk of hypertension can be treated without drugs if their blood pressure reaches the standard after 1 to 3 months of lifestyle interventions. Scientific fitness interventions can reduce sympathetic excitability by [14] , adjusting the secretion level of human hormones, and increasing insulin sensitivity [15] , protecting and enhancing vascular function [16], inhibits the over-activated renin-angiotensin-aldosterone system [17] etc. to lower blood pressure and enhance oxygen uptake by the heart [18,19] to control body weight, improve energy metabolism, shape the body, and improve the quality of life of patients[20,21,22,23]. Meanwhile, a large number of epidemiological surveys have shown that different levels of physical activity are negatively correlated with the severity of hypertension, but the degree of improvement is positively correlated with physical activity, exercise intensity, and exercise duration. Tang H [24] et al randomly divided 180 patients with EHT into 3 groups with different exercise interventions and found that for patients with grade 1 EHT, appropriate mild to moderate exercise therapy in addition to diet therapy was effective in reducing arterial blood pressure, lipids and preventing arterial hypoelasticity to varying degrees. Hao Yuanyuan et al [25] The 120 patients with EHT were randomly grouped into aerobic exercise moderate intensity group, low intensity group and control group, and the

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moderate intensity group and low intensity group were given aerobic exercise of corresponding intensity for 12 weeks, while the control group was kept in daily life without any exercise intervention. The results demonstrated that aerobic exercise improved blood pressure, glucose and lipid metabolism, anxiety, and quality of life in EHT patients, and that moderate-intensity compared with low intensity aerobic exercise resulted in better intervention effects. Japanese scholar Takada[11] In hypertensive patients who received different exercise duration interventions, 30-60 minutes of exercise per week while receiving regular low to moderate intensity exercise interventions resulted in a significant decrease in blood pressure, with the greatest decrease in SBP and DBP especially with 60-90 minutes of exercise intervention per week. All of these are consistent with the results of the present study.

However, due to the short exercise period of this study and the small sample size included, some indicators failed to fully reflect the efficacy of the exercise intervention. Moreover, the exercise was recorded in the exercise diary by the subjects themselves, which was highly subjective and could not be effectively monitored during the exercise implementation, so the data might have a tendency to be biased. It is hoped that more subjects will be included in future studies and that the intervention period will be extended. Also, communication links with patients should be strengthened and a more complete exercise supervision mechanism should be established in order to provide more evidence-based evidence for scientific fitness interventions to lower blood pressure.

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