COMPARISON BETWEEN DIFFERENT EXERCISES ON THE HEALTH AND PHYSICAL CONDITIONING OF THE ELDERLY

COMPARAÇÃO ENTRE DIFERENTES EXERCÍCIOS SOBRE A SAÚDE E O CONDICIONAMENTO FÍSICO DOS IDOSOS

COMPARACIÓN ENTRE DIFERENTES EJERCICIOS SOBRE LA SALUD Y EL ACONDICIONAMIENTO FÍSICO DE LOS ANCIANOS

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ABSTRACT

Introduction: Research on scientific fitness exercises for the elderly has an important practical significance and can improve the physical fitness and health of the elderly. Chinese research on scientific conditioning exercises for the elderly is still lacking, especially when comparing results between different sports approaches in the elderly. Objective: To study the effects of different types of exercise on the physical performance and health of the elderly. Methods: 329 healthy elderly volunteers (161 men) with a mean age of 64.5 years from 6 different sports activities were selected. The following indicators of body shape and physical function were evaluated before and after training: height, weight, waist circumference, hip circumference, vital capacity, heart rate, systolic blood pressure, and diastolic blood pressure. All indicators were collected following the standardized methods of China's national fitness monitoring system. Exercise intensity was monitored with the subject's target heart rate. Physical exercises were performed for 30 to 40 minutes, 3 to 4 times a week. Results: The type of physical exercise has a significant association with human performance and health. Conclusion: Exercise and fitness programs positively correlate with human performance and health. ***Evidence level II; Therapeutic Studies - Investigating the results.***

Keywords: Sports; Frail Elderly; Exercise; Health Risk.

RESUMO

Introdução: A pesquisa sobre exercícios de aptidão científica para idosos tem um importante significado prático, podendo melhorar a aptidão física e a saúde dos idosos. Atualmente, a pesquisa chinesa sobre exercícios de condicionamento científico para idosos ainda é deficiente, principalmente ao comparar resultados entre diferentes abordagens esportivas nos idosos. Objetivo: Estudar os efeitos de diferentes tipos de exercícios no desempenho físico e na saúde dos idosos. Métodos: 329 idosos voluntários saudáveis (161 homens) com idade média de 64,5 anos, de 6 diferentes atividades esportivas foram selecionados. Os seguintes indicadores de forma corporal e função física foram avaliados antes e após os treinos: altura, peso, circunferência da cintura, circunferência do quadril, capacidade vital, frequência cardíaca, pressão arterial sistólica e pressão arterial diastólica. Todos os indicadores foram coletados seguindo os métodos padronizados do sistema nacional de monitoramento de condicionamento físico da China. A intensidade do exercício foi monitorada com a frequência cardíaca alvo do indivíduo. Os exercícios físicos foram executados entre 30 a 40 minutos, 3 a 4 vezes por semana. Resultados: O tipo de exercício físico tem uma associação significativa com o desempenho humano e a saúde. Conclusão: Os programas de exercícios e condicionamento físico têm uma correlação positiva com o desempenho humano e a saúde. ***Nível de evidência II; Estudos terapêuticos - Investigação de resultados.***

Descritores: *Esportes; Idoso Fragilizado; Exercício Físico; Risco à Saúde Humana.*

RESUMEN

Introducción: La investigación sobre ejercicios científicos de acondicionamiento físico para ancianos tiene un significado práctico importante y puede mejorar la condición física y la salud de las personas mayores. Actualmente, aún falta investigación china sobre ejercicios de acondicionamiento científico para personas mayores, especialmente cuando se comparan los resultados entre diferentes enfoques deportivos en ancianos. Objetivo: Estudiar los efectos de diferentes tipos de ejercicio sobre el rendimiento físico y la salud de los adultos mayores. Métodos: Se seleccionaron 329 voluntarios adultos mayores sanos (161 hombres) con una edad media de 64,5 años, de 6 actividades deportivas diferentes. Se evaluaron los siguientes indicadores de forma corporal y función física antes y después del entrenamiento: altura, peso, circunferencia de la cintura, circunferencia de la cadera, capacidad vital, frecuencia cardíaca, presión arterial sistólica y presión arterial diastólica. Todos los indicadores se recopilaron siguiendo los métodos estandarizados del sistema nacional de seguimiento del estado físico de China. La intensidad del ejercicio se controló con la frecuencia cardíaca objetivo del sujeto. Los ejercicios físicos se realizaron durante 30 a 40 minutos, 3 a 4 veces por semana. Resultados: El tipo de ejercicio físico tiene una asociación significativa con el rendimiento humano y la salud. Conclusión: Los programas de ejercicio y acondicionamiento físico tienen una correlación positiva con el rendimiento y la salud humana. ***Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.***

Descriptores: *Deportes; Anciano Frágil; Ejercicio Físico; Riesgo a la Salud.*

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INTRODUCTION

China is developing towards an aging society. The gradual decline of human physique level with age is the law of objective development. The practice has proved that scientific lifestyle and fitness exercise can significantly slow down the decline of human physiological functions. At the same time, exercise can also enhance the physical fitness and health of the elderly.[1] Therefore, the research on scientific fitness exercises for the elderly has important practical significance. At present, Chinese research on scientific fitness exercises for the elderly is still very weak. The research selects sports events that are easy to develop among the elderly in China. According to the individual situation of the elderly, they are grouped by sports within the specified time. We determine the intensity and time of exercise load to observe the effects of different exercises on the body shape and function of the elderly. This provides a theoretical basis for scientifically guiding the fitness exercise of the elderly.

METHOD

Research object

We selected 329 healthy seniors from 6 sports activity stations. Among them, there are 161 males and 168 females.[2] The average age is 64.5 years. The youngest age is 60 years old, and the oldest age is 69 years old.

Research methods

Test index

We choose body shape and physical function indicators. The content includes 8 items, including height, weight, waist circumference, hip circumference, vital capacity, heart rate, systolic blood pressure, and diastolic blood pressure.[3] All indicators are carried out following the standardized methods of China's national fitness monitoring system.

Experimental method

Before the experiment, we conduct systematic training for the testers. According to the principle that there is no significant difference in the test results, the subjects were divided into martial arts, aerobic exercise, fast walking, slow walking, and ball sports.[4] The exercise intensity refers to the target heart rate of the individual. Record your exercise status for each exercise and ensure that you do physical exercise 3-4 times a week. Each training time is 30min-40min. After the exercise, the subjects' body shape and function were tested in the same way as before the exercise.

The orientation determination of the human body model irrespective of the pose

We use SVM based on structural risk minimization as a classifier to determine the orientation of the human body. SVM can be seen as solving a secondary planning problem. We are given a training sample $\{(X_i, y_i) \mid i = 1, ..., N; X_i \in R^n, y_i \in \{-1, +1\}\}$. The discriminant function $f(X) = \mathrm{sgn}\{\sum_{i=1}^{N} \alpha_i y_i k(X_i, X) + b\}$ is obtained through training. Where $k(X_i, X)$ is the kernel function α_i is the Lagrange multiplier corresponding to each sample. b is the threshold. $\{\alpha_1, \cdots, \alpha_N\}$ can be obtained by solving the following functional

$$\begin{cases} \min\limits_{a} \dfrac{1}{2} \sum\limits_{i,j=1}^{N} \alpha_i \alpha_j y_i y_j k(X_i, X_j) - \sum\limits_{i=1}^{N} \alpha_i, \\ s.t. \sum\limits_{i=1}^{N} \alpha_i y_i = 0, \\ 0 \le \alpha_i, i = 1, \cdots, N \end{cases} \quad (1)$$

For the case of linear inseparability, we will assign a penalty factor c that controls the degree of punishment for the wrong sample and solve it with the following formula.

$$\begin{cases} \min\limits_{a} \dfrac{1}{2} \sum\limits_{i,j=1}^{N} \alpha_i \alpha_j y_i y_j k(X_i, X_j) + \dfrac{1}{2c} \sum\limits_{i=1}^{N} \alpha_i^2 - \sum\limits_{i=1}^{N} \alpha_i \\ s.t. \sum\limits_{i=1}^{N} \alpha_i y_i = 0, \\ 0 \le \alpha_i \le c, i = 1, \cdots, N \end{cases} \quad (2)$$

During training, each joint point is extracted for each human body model M_i as a sample. Then, the left and right hip joints are manually identified to calculate the vector that reflects the human body orientation. Then calculate the human body orientation feature vector X_i. The sample constructed in this way is regarded as a positive sample.[5] At the same time, construct a negative sample. Its feature vector is composed of the angle opposite the human body, so it can be obtained by subtracting the positive sample feature vector. The category of the sample is $y_i = -1$. Then, use the linear and Gaussian functions as the kernel functions to train the classifier to obtain the corresponding discriminant functions.

Mathematical Statistics

We used the Excel software package to perform routine descriptive statistics on the original data obtained in the experiment. We test the significance of the differences before and after the exercise.

RESULTS

Analysis of the effect of different sports on physical fitness

The experimental results showed that the subjects' BMI was in the normal range. There was no significant difference in BMI index before and after exercise. (Table 1) However, the BMI after exercise tends to be higher for both men and women than before exercise. Many studies have shown that the increase or decrease of BMI after the end of human growth and development is mainly affected by body fat and muscle.[6] Because exercise can increase the body's energy consumption and reduce the accumulation of fat, the increase in BMI index after exercise is that exercise may have a certain effect on muscle strengthening of the elderly.

The experimental results show that the waist-to-hip ratio index after exercise is significantly lower than before. (Table 2) Among them, martial arts exercises have a significant difference in reducing abdominal fat among the elderly. The waist-to-hip ratio index of women's fast

Table 1. BMI index test results of the elderly before and after exercise ($\bar{x} \pm s$).

Project	Male			Female		
	Before exercise	After exercise	P	Before exercise	After exercise	P
Martial arts	24.8±2.74	25.2±2.65	0.54	24.4±2.70	24.7±2.56	0.68
Aerobic exercise	24.9±3.3	25.4±3.13	0.56	24.7±4.10	24.9±3.85	0.83
Go slow	24.0±2.98	24.7±2.91	0.31	24.3±2.83	24.7±2.57	0.5
Ball games	24.5±2.89	24.8±3.03	72	24.8±3.06	24.9±2.96	0.81

Table 2. Test results of waist-to-hip ratio index of the elderly before and after exercise.

Project	Male			Female		
	Before exercise	After exercise	P	Before exercise	After exercise	P
Martial arts	0.93±0.06	0.90±0.06	0.02	0.86±0.06	0.82±0.05	0.003
Aerobic exercise	0.94±0.06	0.91±0.06	0.2	0.87±0.06	0.84±0.05	0.057
Go slow	0.92±0.06	0.91±0.08	0.67	0.88±0.06	0.84±0.05	0.02
Ball games	0.91±0.06	0.90±0.06	0.6	0.87±0.06	0.84±0.06	0.05

walking, slow walking, and ball sports groups decreased after exercise than before exercise, and the test results have significant differences. Combined with the test results of the BMI index, it further confirms that the elderly can achieve the goal of losing weight by insisting on scientific fitness exercises.[7] At the same time, exercise can slow down skeletal muscle decline, increase muscle anabolism, and increase muscle mass. The experiment also suggests that martial arts exercises are better for the elderly to choose fitness exercises. Older women can also choose brisk walking, slow walking, and ball sports.

The effect of different sports on the human respiratory system

The respiratory function of the elderly gradually declines with age. This experiment shows that there is no significant difference in the vital capacity index before and after exercise for the elderly after different exercises. (Table 3) However, the vital capacity index increased to varying degrees after the experiment.[8] This suggests that scientific fitness exercises for the elderly can slow down the decline of respiratory function. As the age grows, only long-term scientific fitness exercises can effectively improve respiratory function.

The effect of different sports on the circulatory function of the human body

The fitness exercise results of different events showed a significant difference in heart rate before and after the experiment in the fast walking and slow walking group of older women. There was no significant difference in heart rate among the groups of other sports. It can be seen from Table 4 that the average heart rate of men before exercise is between 70.5 beats/min-74.5 beats/min. The average heart rate after exercise is 68.9 beats/min-74.8 beats/min. Before women's exercise, it was 70.2 beats/min-76.2 beats/min. After exercise, it is 71.4 times/min-73.7 times/min. The decrease in heart rate at rest can be considered an increase in cardiac reserve and myocardial contractility from the analysis of physiological mechanisms.[9] This increases the heart's stroke volume, and the lower heart rate at rest can also meet the needs of human blood circulation. The experimental results indirectly show that the fitness exercises selected in the study have a certain effect on preventing the decline of heart function in the elderly.

After the experiment, the systolic blood pressure and diastolic blood pressure of men and women with abnormal blood pressure decreased compared with those before exercise. The test results are significantly different.[10] The systolic blood pressure dropped from 170.8mmHg-173mmHg to 158mmHg-159mmHg before exercise. The diastolic blood pressure of men and women dropped from 92.8mmHg-94.4mmHg to 89mmHg-88.7mmHg. The indicators all fell below the prescribed standards for hypertension. (Table 5) The different sports selected in this experiment can improve the functional state of the circulatory system after being implemented in the elderly.

Table 3. Vital capacity index test results of older adults and women before and after exercise.

Project	Male			Female		
	Before exercise	After exercise	P	Before exercise	After exercise	P
Martial arts	16.8±3.6	18.1±4.5	0.22	13.1±3.6	14.2±4.3	24
Aerobic exercise	16.5±4.4	17.5±4.4	0.45	11.2±3.3	11.8±3.6	0.46
Go slow	15.5±4.3	15.0±4.2	0.61	11.7±3.3	10.9±3.7	0.41
Ball games	16.3±3.3	17.0±4.0	0.78	11.97±4.3	12.4±4.2	0.65

Table 4. Heart rate test results of older men and women before and after exercise.

Project	Male			Female		
	Before exercise	After exercise	P	Before exercise	After exercise	P
Martial arts	71.2±10.6	70.7±9.3	0.84	73.0±9.89	73.7±8.7	0.72
Aerobic exercise	74.5±14.6	74.8±12.3	0.92	70.2±8.3	72.8±11.4	0.29
Go slow	73.7±11.7	73.5±8.8	0.95	76.2±10.9	71.4±8.9	0.05
Ball games	70.5±7.35	68.9±7.9	0.38	72.8±7.99	72.4±9.5	0.84

Table 5. Blood pressure test results of patients with hypertension before and after exercise.

	Systolic blood pressure			Diastolic blood pressure		
	Before exercise	After exercise	*P*	Before exercise	After exercise	*P*
Male	170.8±8.5	158±19.7	0.05	92.8±4.6	89±10.5	0.03
Female	173±13.1	159±15.2	0.007	94.4±6.9	88.7±9.7	0.01

DISCUSSION

The BMI index is an index used by countries to assess human nutritional status and obesity. The normal range is between 20-25. When BMI25 is overweight, BMI>30 is obese. Scientific research shows that the accumulation of body fat is mainly in the waist and abdomen.[11] The waist-to-hip ratio index is an important morphological index for judging obesity at home and abroad. When it is greater than 1, it can be regarded as obesity. Swedish medical experts conducted a 12-year follow-up survey of 855 men and 1462 women. They concluded that whether the waist circumference of men or women is significantly larger than the hip circumference will seriously affect human health.

Vital capacity index (vital capacity/height) is an effective indicator of human respiratory function. Appropriate physical exercise can significantly improve lung elastic retraction and small airway patency. Exercise can improve muscle strength and endurance of the respiratory muscles.

Hypertension is one of the main diseases affecting the health of the elderly in China. The experimental results show that the systolic blood pressure and diastolic blood pressure of the older men and women before and after exercise show no significant difference in the test results of different sports events. We believe that exercise requires a large amount of blood to be transported to the muscles involved in the work of the whole body. Exercise promotes more opening of peripheral capillaries. It improves peripheral blood circulation, reduces peripheral resistance, and achieves the effect of lowering blood pressure. Therefore, older adults with uncomplicated hypertension who are not serious can achieve the purpose of treatment and prevention by performing scientific fitness exercises under the supervision of doctors.

CONCLUSION

There was no significant difference in BMI between the elderly men and women groups after different fitness exercises. The significant decrease in the waist-to-hip ratio index indicates that fitness exercise can enhance the muscle strength of the elderly. This has a certain effect on preventing obesity. Experimental results show no significant difference in the vital capacity index and heart rate before and after exercise. Vital capacity after exercise tends to be generally higher than before exercise, and the heart rate appears to decrease. This reflects that scientific fitness exercise can improve the respiratory and cardiac function of the elderly. The systolic and diastolic blood pressure of the male and female groups returned to the normal range after the elderly hypertensive patients performed fitness exercises. This shows that scientific fitness exercise has a certain effect on improving blood circulation.

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