

# FUNCTIONAL PHYSICAL TRAINING TO IMPROVE THE PHYSICAL HEALTH OF UNIVERSITY STUDENTS



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TREINAMENTO FÍSICO FUNCIONAL PARA A SAÚDE FÍSICA DE UNIVERSITÁRIOS

ENTRENAMIENTO FÍSICO FUNCIONAL PARA LA SALUD FÍSICA DE LOS ESTUDIANTES UNIVERSITARIOS

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## ABSTRACT

**Introduction:** Recently, the obesity rate in Chinese universities has increased substantially and the indicators of physical fitness have declined. The physical quality of college students is an alarming problem that cannot be ignored. The results of structured work could establish a basis for colleges and universities to formulate scientific functional physical training programs. **Objective:** Analyze the role of functional physical training in teaching physical education to male college students in colleges and universities. **Methods:** 116 male volunteer students from 4 colleges and universities were selected and divided into control and experimental groups. The groups received three physical education classes lasting 90 minutes for eight weeks. The experimental group received an additional 30 minutes of functional physical training. Both groups were tested for vital capacity, seated forward bending, standing long jump, 50-meter run, pull-up, and 1000-meter test. The tests were compared and statistically analyzed. **Results:** After 1000-meters of training, the experimental group was superior to the control group on all measures except sitting forward flexion. The results showed significant changes ( $P < 0.01$ ). The restorative effect of the experimental group was significantly enhanced. There was no significant difference in body weight, BMI, 50-meter run, jump, vital capacity, pull-up, and other indicators before and after control training ( $P > 0.05$ ). **Conclusion:** The 8 weeks of functional physical training promoted a significant effect on improving the physical health of college students. Functional physical training should be appropriately reinforced in university physical education classes to improve students' physical fitness. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

**Keywords:** Physical Education and Training; Physical Fitness; Student Health; Vital Capacity.

## RESUMO

**Introdução:** Recentemente, a taxa de obesidade nas universidades chinesas tem aumentado substancialmente e os indicadores de aptidão física têm diminuído. A qualidade física dos estudantes universitários é um problema alarmante que não pode ser ignorado. Os resultados de um trabalho estruturado poderiam estabelecer uma base para que faculdades e universidades possam formular programas científicos de treinamento físico funcional. **Objetivo:** Analisar o papel do treinamento físico funcional no ensino da educação física de estudantes universitários do sexo masculino em faculdades e universidades. **Métodos:** Foram selecionados 116 estudantes voluntários do sexo masculino em 4 faculdades e universidades, divididos em dois grupos: controle e experimental. Os grupos receberam três aulas de educação física com duração de 90 minutos durante oito semanas. O grupo experimental recebeu 30 minutos adicionais de treinamento físico funcional. Os dois grupos foram testados quanto à capacidade vital, flexão sentado para frente, salto em pé à distância, corrida de 50 metros, pull-up e teste de 1000 metros. Os testes foram comparados e analisados estatisticamente. **Resultados:** Após oito semanas de treinamento, o grupo experimental foi superior ao grupo de controle em todas as medidas, exceto a flexão sentado. Os resultados apresentaram alterações significativas ( $P < 0,01$ ). O efeito restaurador do grupo experimental foi significativamente aprimorado. Não houve diferença significativa no peso corporal, IMC, 50 metros de corrida, salto, capacidade vital, pull-up e outros indicadores antes e depois do treinamento controle ( $P > 0,05$ ). **Conclusão:** As 8 semanas de treinamento físico funcional promoveram um efeito significativo na melhoria da saúde física dos estudantes universitários. O treinamento físico funcional deve ser adequadamente reforçado nas aulas de educação física universitária para melhorar a aptidão física dos estudantes. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Educação e Treinamento Físico; Aptidão Física; Saúde do Estudante; Capacidade Vital.

## RESUMEN

**Introducción:** Recientemente, la tasa de obesidad en las universidades chinas ha aumentado considerablemente y los indicadores de aptitud física han disminuido. La calidad física de los estudiantes universitarios es un problema alarmante que no se puede ignorar. Los resultados de un trabajo estructurado podrían sentar las bases para que los colegios y universidades formulen programas científicos de entrenamiento físico funcional. **Objetivo:** Analizar el papel del entrenamiento físico funcional en la enseñanza de la educación física de los estudiantes universitarios varones en los colegios y universidades. **Métodos:** Se seleccionaron 116 estudiantes voluntarios varones de 4 colegios y universidades, divididos en dos grupos: control y experimental. Los grupos recibieron tres clases de educación física de 90 minutos durante ocho semanas. El grupo experimental recibió 30 minutos adicionales de entrenamiento físico funcional. Ambos grupos



fueron sometidos a pruebas de capacidad vital, flexión hacia delante sentada, salto de longitud de pie, carrera de 50 metros, dominadas y prueba de 1000 metros. Las pruebas se compararon y se analizaron estadísticamente. Resultados: Tras ocho semanas de entrenamiento, el grupo experimental fue superior al grupo de control en todas las medidas, excepto en la flexión hacia delante en posición sentada. Los resultados mostraron cambios significativos ( $P < 0,01$ ). El efecto restaurador del grupo experimental fue significativamente mayor. No hubo diferencias significativas en el peso corporal, el IMC, la carrera de 50 metros, el salto, la capacidad vital, la dominada y otros indicadores antes y después del entrenamiento de control ( $P > 0,05$ ). Conclusión: Las 8 semanas de entrenamiento físico funcional promovieron un efecto significativo en la mejora de la salud física de los estudiantes universitarios. El entrenamiento físico funcional debe reforzarse adecuadamente en las clases de educación física de la universidad para mejorar la aptitud física de los estudiantes. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

**Descriptor:** Educación y Entrenamiento Físico; Aptitud Física; Salud del Estudiante; Capacidad Vital.

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## INTRODUCTION

In recent years, the physical fitness index of Chinese college students has shown a downward trend. Two national health surveys in 2020 and 2021 show that the essential physical fitness of college students in China is declining year by year, the obesity rate is rising, and their health status is not optimistic. Where should we put sports technology and physical fitness in recent years in physical education? Are there any unique training methods for students' basic physical abilities such as strength, speed, agility, and flexibility? These two issues have caused widespread controversy in academia. Functional physical training refers to the completion of multi-joint, multi-dimensional sports under the conditions of various sports loads and speeds. It focuses on the movement's shape, not the muscles' activity. The training emphasizes no trajectory and disorder.<sup>1</sup> Although functional physical training in China started relatively late, it has developed rapidly.

First, there are more and more opportunities to use functional physical training in competitive sports. During the 2011 London Olympic Games preparatory stage, Chinese Olympic athletes sent a professional to conduct collaborative teaching at the Athletes Performance Fitness Training Center in the United States when they participated in foreign competitions.<sup>2</sup> The Chinese women's volleyball team won the 2015 Women's Volleyball Championship. These achievements, in some sense, illustrate the role of functional physical training in competitive sports. Secondly, the current research on functional physical training in China has become a hot spot. Some researchers took the Hebei youth basketball team as a research sample and formulated an operational physical training plan for Chinese youth men's basketball game. Athletes experienced strength, endurance, agility, and flexibility improvements over 11 months and three training cycles. And the athlete's heart rate will be significantly accelerated after training. Some scholars take 20 male college students participating in summer basketball training as a research sample.<sup>3</sup> At the same time, the study conducted research employing comparative experiments. The results showed that the FMS functional motor test scores in the experimental group were improved. Young athletes showed significant improvements in both speed and strength after functional fitness training. It can be seen from the above that functional physical training has been widely used in China. This article asked college students to perform functional physical training for eight weeks. Through the research to analyze the effect of functional physical training on the physical quality of college students. The research results of this paper can promote the improvement of college students' physical quality.

## METHOD

The study is Purely observational studies which no need to registry ID of ICMJE, and all the participants were reviewed and approved by Ethics Committee of Jiangsu Vocational Institute of Commerce, China (NO. 20210047)

## Objects

This paper selects 116 male undergraduates from 4 schools as the research object. At the same time, the subjects were randomly divided into two groups: one was the control group, and the other was the experimental group.<sup>4</sup> There are 58 students in each group.

## Research methods

### Test method

The trial period is from October 2021 to January 2022. The control group was based on exercise textbooks in the exercise curriculum. Students work out in 90-minute increments. Students have physical education and exercise on a two-week basis.<sup>5</sup> The experimental class carried out regular physical education courses 45 minutes before each physical education class and functional physical training after 45 minutes to replace traditional physical education courses.

During the training period, the experimental and control group trainees were monitored for heart rate using a cardiac rhythm meter. The teaching content of the experimental and control groups is precisely the same as the teaching content of the control group.<sup>6</sup> Before and after the experiment, according to the provisions of the 2014 "National Student Physical Health Standards," the lung capacity, sitting forward flexion, standing long jump, 50-meter running, pull-up, and 1000-meter indicators were tested.

## The formulation of the 8-week exercise capacity training program

The 8-week functional physical training consists of three links: 1) The first stage is mainly warm-up activation. Students use movement to activate and enhance physical flexibility. Exercise training not only promotes muscle stretching but also improves body control. Warm-up exercises can increase the ability of muscles to work together. 2) The second stage is functional training.<sup>7</sup> The coaches carry out physical and strength training according to the student's physical condition. 3) The third stage mainly focuses on restoration. Athletes carried out exercise training mainly on running and supplemented by static stretching. Resting stretches include chest stretches, shoulder stretches, neck stretches, back stretches, trunk stretches, hamstring stretches, and stretches around the hip joint.

## Improve the physical fitness evaluation model of K-means

This paper proposes a new clustering method based on K-means. K-means is a segmentation clustering method. The algorithm is simple, and the operation speed is fast. First, this paper selects K groups of objects as initial points in a data set. Then, by locating other objects, the position corresponding to the starting position of K is obtained to form the original cluster.<sup>8</sup> After completing the

assignment, this paper turns the average of each category into a new center. It is classified according to the principle of recency until its center of mass does not change. Because the initial group is generated based on arbitrarily chosen centers of mass, there is no guarantee that the resulting K classes are all “natural subclasses.” K-means must be done iteratively. In this paper, K-means cluster analysis was performed to obtain two data: total  $\zeta$  value and total  $\sigma$  value. The overall  $\zeta$  value represents the sum of the squares of the deviations for each cohort. Its expression is:

$$\zeta = \sum_{i=1}^g \sum_{\alpha \in e_i} dist(e_i, \alpha)^2 \quad (1)$$

$e_i$  is the  $i$  cluster.  $\alpha$  is a small circle in  $e_i$ ,  $e_i$  is the mean of the  $i$  cluster.  $dist$  is the distance between objects.  $\sigma$  is the sum of the cluster variable squared deviations between the individual categories. Its expression is:

$$\sigma = \sum_{i=1}^g q_i dist(e_i, e)^2 \quad (2)$$

$q_i$  is the dimension of the cluster.  $e_i$  is the mean of the  $i$  cluster.  $e$  is the grand mean.  $dist$  is the distance between objects. K-mean clusters expect a lower overall  $\zeta$  value and a more considerable overall E value for a given number of clusters  $G$ . This moment indicates that the total  $\sigma$ /total  $\zeta$  value is more considerable. In this paper, Equation (3) is used to modify the total  $\sigma$ /total  $\zeta$ . The purpose is to exclude the influence of clusters K and the number of samples n on the calculation.

$$\frac{total \sigma / n - G}{total \zeta / G - 1} \quad (3)$$

Where  $(n - g) / (n - 1)$  represents complexity. (3) the Calinski-Harabasz equation, the larger the ratio, the better. The Calinski-Harabasz equation has the characteristics of simple calculation and rapid operation, and it can be selected with appropriate values. Since there is no criterion for clustering, the intrinsic method is used for evaluation, and the evaluation adopts the following parameter indicators:

1. The Calinski-Harabasz criterion is shown in formula (3). The meaning of its equations has already been explained above, so it will not be repeated.
2. The mathematical expression of the contour coefficient is:

$$P(i) = \frac{v(i) - u(i)}{\max\{u(i), v(i)\}} \quad (4)$$

$u(i)$  represents the average distance of other objects of the class to which object  $i$  belongs. The lower the number, the tighter it will be.  $v(i)$  represents the shortest distance from  $i$  to the non-membership class. The larger this number, the more separated from the other clusters.<sup>9</sup> The selection interval of the silhouette coefficient is [-1, 1]. The larger the value, the better the clustering effect.

3. The mathematical formula of the Dunn Validity Index is:

$$L = \frac{\min_{0 < q \neq n < G} \left\{ \min_{\substack{\forall \alpha_i \in R_q \\ \forall \alpha_j \in R_q}} \{\alpha_i - \alpha_j\} \right\}}{\max_{0 < q \leq G} \max_{\substack{\forall \alpha_i \in R_q \\ \forall \alpha_j \in R_q}} \{\alpha_i - \alpha_j\}} \quad (5)$$

Dunn’s metric first finds the minimum separation between two classes, then divides by the maximum separation of objects in any class. The higher the Dunn index, the higher the cluster efficiency.

## Data Analysis

This study used SPSS 18.0 for data analysis. This paper uses paired t-tests and individual sampling t-tests for group comparison. This paper used the standard of  $\alpha = 0.05$  for the different analyses.

There is no need for a code of ethics for this study.

## RESULTS

### Comparative study of each quality index before and after the test and the control group

Before the test, there was no significant difference between the experimental group and the control group in different body mass indexes such as lung capacity, sitting forward flexion, standing long jump, 50-meter running, pull-up, and 1000-meter running ( $P > 0.05$ ).

### Comparative analysis of the qualities of the experimental group and the control group before and after the test

After eight weeks of physical education, there were no significant changes in the control group’s four items of weight, BMI, 50-meter running, and standing extended group ( $P > 0.05$ ). Pulmonary function and pull-up scores were somewhat improved but not significantly ( $P > 0.05$ ). The forward flexor strength of 1000m and the sitting body were improved ( $P < 0.05$ ).

After eight weeks of functional physical training, the weight and BMI of the students in the experimental group were significantly reduced. Compared with the control group, there was a significant difference ( $P < 0.05$ ). The vital capacity, 50-meter running, standing long jump, 1000-meter running, pull-up, and other five items were significantly improved, and there were significant differences ( $P < 0.01$ ).

After the test, the BMI of the experimental group was significantly higher than that of the control group ( $t = 3.108, P < 0.05$ ). Except for sitting forward flexion, all other measures of physical fitness were significantly improved. The results were significantly different ( $P < 0.01$ ). Please refer to Table 1 for specific data.

**Table 1.** Comparative analysis of data before and after the experiment between the experimental group and the control group.

Test items	Test Group			
	Before experiment	After the experiment	t	P
Weight/kg	75.25±11.85	73.5±9.44	-2.821	>0.05
Vital capacity/mL	24.2±3.59	23.65±2.84	-3.334	>0.05
50m run/s	3683.5±500.97	4477.06±547.5	12.558	<0.001
50m run/s	7.88±0.4	7.31±0.38	-8.385	<0.001
Standing long jump/cm	234.77±18.73	249.13±16.92	8.818	<0.001
Sitting forward flexion/cm	13.73±5.05	13.92±4.83	0.942	>0.05
1000m run/s	268.98±25.04	231.53±23.6	-18.822	<0.001
Pull-ups/ reps	5.11±1.6	11.85±2.47	20.713	<0.001
Test items	Control group			
	Before experiment	After the experiment	t	P
Weight/kg	73.61±11.09	73.6±11.02	0.192	>0.05
Vital capacity/mL	24.34±3.82	24.34±3.75	0.116	>0.05
50m run/s	3970.25±826.55	3980.38±823.86	0.567	>0.05
50m run/s	7.67±0.48	7.68±0.54	0.216	>0.05
Standing long jump/cm	239.47±22.82	239.81±20.95	0.384	>0.05
Sitting forward flexion/cm	13.94±5.93	14.39±3.73	2.303	<0.05
1000m run/s	267.96±30.28	265.25±29.79	-3.351	<0.05
Pull-ups/ reps	5.4±3.56	5.55±3.56	1.633	>0.05

## DISCUSSION

The concept of functional physical training originated in the United States. It is a training in which a physical therapist instructs the patient through partial movements. It has been widely used in fitness, medicine, and so on. It plays a pivotal role in improving human physical fitness.<sup>10</sup> Under the attention of relevant experts and scholars at home and abroad, functional physical training has gradually developed into sports and health. Physical education is carried out in a comprehensive physiological state. It has the advantages of stability, integrity, and non-interruption. Functional fitness training is comprehensive training. It can effectively exercise various parts of the human body from multiple angles rather than simply exercising a particular part. Human muscle activity depends on its environment. Functional physical exercise mainly refers to the relationship between the various muscle groups of the human body and the movements of the human body. The primary purpose of functional fitness training is to enhance the athlete's stability, integrity and balance. Functional physical training can significantly improve the overall quality of the human body. This training can improve the athlete's physical fitness through group exercises to improve the athlete's muscle and explosiveness.

There are still many defects in the research and practice of physical education in China. The physical education system still needs continuous improvement. Promoting physical fitness training programs in China can provide some reference and guidance for reforming physical education in colleges and universities in China. The role of functional fitness training is to improve the athlete's stability effectively, flexibility and balance. Functional physical training can fundamentally improve college students' physical exercise effectiveness and pertinence.

Physical education in colleges and universities aims to improve the physique of current college students. Coaches must formulate a physical exercise plan according to the student's physical condition. Coaches deepen their fitness knowledge by thoroughly testing each individual's fitness. All movements of the human body are premised on a good physique. If students want to maintain a good physique, they must persist in exercising for a long time. The focus of functional physical training in Chinese universities is physical training. The method of assessment is usually an examination. Physical education teachers comprehensively evaluate each student's physique through examinations. This way, the optimal control of students' physical fitness can be achieved. Functional physical training has positively improved college students' heart, lung function, muscle strength, and endurance. While functional physical training has positive effects, there are bound to be some drawbacks. In response to this problem, coaches must treat and measure scientifically, rationally, and dialectically in their usual teaching and practice. Physical education teachers need to adopt effective ways and methods to improve students' physical condition. There has been a dialectical and interrelated relationship between physical fitness and functional fitness training. The two have different characteristics, but there is a close internal connection. Some specialized training can transform the previous physical exercise into a more complete, systematic functional fitness training.

The functional physical training teaching in physical education in colleges and universities regards human movement as a complete whole. In physical

education, coaches can strengthen the relationship between various parts of the student's body. The ways and means of exercising multiple athletic abilities are dynamic and tend to change over time. There are four main categories of functional fitness training: suspension, balance, core strength, and vibration training. The basic training in these training mainly includes deep muscle group training, body balance training, systematic training, and simple training. Specifically, to reduce college students' weight, students can use unstable training methods to perform deep muscle group exercises. The content includes a high elastic jump, balance beam, etc. When performing limb balance training, students mainly use functional physical training exercises to enhance the balance and stability of limbs. Routine exercise is a particular exercise for students' control ability. This improves the student's physical flexibility, coordination, and coordination. A simple practice is one of the more commonly used in colleges. The content includes abdominal jumping, sit-ups, 100-meter turnaround, etc. Coaches can allow athletes to add some physical and practical training on the usual basis to improve their physical fitness. College physical education teachers should fully play the role of physical education teachers in physical training. Teachers should choose appropriate training methods according to the specific problems of physical training and differences in goals to improve students' physical quality.

After eight weeks of functional physical training, the weight of the experimental group decreased, and the body mass index increased significantly. The vital capacity, 50-meter running, standing long jump, pull-up, 1000-meter running, and other indicators were significantly improved. Functional physical exercise mainly focuses on comprehensive exercise in terms of strength, speed, and endurance. In this way, the strength, speed, endurance, explosive power, cardiac function, and other qualities of college students have been significantly improved. Functional fitness training did not include human flexibility exercises in the trials. Sitting forward bends were not significantly improved. The improvement of athletic ability is related to the comprehensive ability of other aspects. Functional physical training does not have any effect on students' flexibility.

## CONCLUSION

After eight weeks of training, the experimental group was higher than the control group in all measures except the sitting flexor. The results were significantly different. The curative effect of the experimental group was significantly improved before and after the test. There was no significant difference in the control group's body weight, BMI, 50-meter running, standing long jump, vital capacity, pull-up, and other indicators before and after training. Eight weeks of functional physical training has played a particular role in improving the comprehensive physical fitness of male college students. Functional fitness training is an effective way to improve their physical fitness. Coaches need to enhance the initiative of students' physical training. In future physical education, coaches can reform and innovate the content of traditional physical education.

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All authors declare no potential conflict of interest related to this article

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