

# EFFECTS OF SCHOOL SOCCER TRAINING ON THE HEALTH AND FITNESS OF OBESE CHILDREN



ORIGINAL ARTICLE  
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EFEITOS DO TREINAMENTO DE FUTEBOL ESCOLAR SOBRE A SAÚDE E A APTIDÃO FÍSICA DE CRIANÇAS OBRASAS

EFFECTOS DEL ENTRENAMIENTO DE FÚTBOL ESCOLAR EN LA SALUD Y LA APTITUD FÍSICA DE NIÑOS OBRASOS

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## ABSTRACT

**Introduction:** Based on the representative data reflecting the level of physical development and athletic quality, such as the “National Physical Health Test for Students”, it is shown that the physical health status of adolescents and children in China is decreasing annually, and the trend of obesity is gradually increasing. **Objective:** Analyze and study the effect of training on the physical fitness of obese children aged 12 to 14 through school soccer training. **Methods:** The effect of school soccer training on the health and physical fitness of obese children aged 12-14 years was studied, and conclusions were drawn by the literature method, experimental method, mathematical statistical method, and logical analysis method. Forty-eight screened obese children were randomly assigned to the experimental and control groups, 24 in each group. The experimental group underwent 12 weeks of soccer training, and the control group underwent 12 weeks of no training control. The subjects’ body composition and flexibility quality indices were measured post-intervention. **Results:** The visceral fat index, body fat rate, and muscle rate of boys and girls progressed expressively, with a significant difference ( $P < 0.05$ ). Muscle weight is also known as lean body weight, with an expressive increase in muscle tone. In comparison, the increase in fat weight and muscle ratio in boys was expressively higher than in girls. **Conclusion:** Regular long-term school soccer training can increase mobility in obese children, increase physical flexibility, and help promote physical health and prevent injury. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

**Keywords:** Child Obesity; Fitness; Soccer.

## RESUMO

**Introdução:** Com base nos dados representativos que refletem o nível de desenvolvimento físico e qualidade atlética, como o “Teste Nacional de Saúde Física para Estudantes”, é demonstrado que o estado de saúde física de adolescentes e crianças na China está diminuindo anualmente, e que a tendência de obesidade está aumentando gradualmente. **Objetivo:** Analisar e estudar o efeito do treinamento na aptidão física de crianças obesas entre 12 a 14 anos de idade através do treinamento de futebol escolar. **Métodos:** O efeito do treinamento de futebol escolar sobre a saúde e a aptidão física de crianças obesas de 12-14 anos de idade foi estudado, e as conclusões foram tiradas pelo método da bibliografia, método experimental, método estatístico matemático e método de análise lógica. Quarenta e oito crianças obesas submetidas a triagem foram designadas aleatoriamente aos grupos experimentais e de controle, 24 em cada grupo. O grupo experimental passou por 12 semanas de treinamento de futebol e o grupo de controle passou por 12 semanas sem controle de treinamento. A composição corporal e os índices de qualidade da flexibilidade dos sujeitos foram medidos antes e depois da intervenção. **Resultados:** O índice de gordura visceral, a taxa de gordura corporal e a taxa muscular de meninos e meninas progrediu expressivamente, com diferença significativa ( $P < 0,05$ ). O peso de musculatura também é conhecido como peso corporal magro, com um aumento expressivo do tônus muscular. Em comparação, o aumento do peso de gordura e da taxa muscular nos meninos foi expressivamente maior do que o encontrado nas meninas. **Conclusão:** O treinamento regular de futebol escolar de longo prazo pode aumentar a mobilidade das crianças obesas, aumentar a flexibilidade física e ajudar a promover a saúde física além de prevenir lesões. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Obesidade Infantil; Aptidão Física; Futebol.

## RESUMEN

**Introducción:** A partir de los datos representativos que reflejan el nivel de desarrollo físico y la calidad atlética, como la “Prueba Nacional de Salud Física para Estudiantes”, se demuestra que el estado de salud física de los adolescentes y niños en China disminuye anualmente, y la tendencia de la obesidad aumenta gradualmente. **Objetivo:** Analizar y estudiar el efecto del entrenamiento sobre la forma física de niños obesos de entre 12 y 14 años mediante el entrenamiento de fútbol escolar. **Métodos:** Se estudió el efecto del entrenamiento de fútbol escolar en la salud y la forma física de niños obesos de 12 a 14 años, y se extrajeron conclusiones mediante el método bibliográfico, el método experimental, el método estadístico matemático y el método de análisis lógico. Cuarenta y ocho niños obesos examinados fueron asignados aleatoriamente a los grupos experimental y de control, 24 en cada grupo. El grupo experimental se sometió a 12 semanas de entrenamiento futbolístico y el grupo de control, a 12 semanas sin entrenamiento. Se midieron la composición corporal y los índices de calidad de la flexibilidad de los sujetos antes



y después de la intervención. Resultados: El índice de grasa visceral, el índice de grasa corporal y el índice muscular de niños y niñas progresaron expresivamente con diferencias significativas ( $P < 0,05$ ). El peso muscular también se conoce como peso corporal magro, con un aumento expresivo del tono muscular. En comparación, el aumento del peso graso y de la tasa muscular en los chicos fue expresivamente superior al observado en las chicas. Conclusión: El entrenamiento regular de fútbol escolar a largo plazo puede aumentar la movilidad en niños obesos, incrementar la flexibilidad física y ayudar a promover la salud física, además de prevenir lesiones. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

**Descriptor:** Obesidad Pediátrica; Aptitud Física; Fútbol.

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## INTRODUCTION

Soccer has a wide social influence in China, and the Party Central Committee and the State Council attach great importance to the development of soccer because it enables children and youth to get effective physical exercise, and also hones the quality of will, cultivates the spirit of solidarity and cooperation, etc., which is beneficial to the life and study of youth. The State General Administration of Sports and the Ministry of Education issued a notice on the development of national youth school soccer activities to promote "sunshine" sports for hundreds of millions of students, to improve the overall physical health of the majority of students, it is recommended that primary and secondary schools around the soccer included in the content of physical education. The National Fitness Plan (2021-2025) states that fitness activities should be widely carried out for all people to improve their physical health.<sup>1</sup> The development of soccer among school-age children population can both improve the quality of physical education in schools and motivate students to participate in physical exercise. Therefore, soccer will play an important role in the process of building a healthy China.<sup>2</sup>

Child and adult obesity is increasingly prevalent worldwide, and obesity has become one of the public health challenges in several countries,<sup>3</sup> and the number of obese children in China will reach more than 40 million in 2025.<sup>4</sup> Surveys show that the current trend of physical fitness of students in China is declining, with a greater decline in endurance and flexibility qualities.<sup>5</sup> The prevalence of overweight and obesity in school-age children is high, and overweight and obesity have short- and long-term effects on children and adolescents,<sup>6</sup> causing effects that can continue into adulthood and may increase the risk of non-communicable diseases such as diabetes and cardiovascular disease in young adulthood.<sup>7</sup> This not only damages the physical and mental health of obese adolescent children but also creates many potential problems in society. Studies have shown<sup>8</sup> that lack of physical activity has become a major cause of obesity and overweight in adolescent children, that exercise is an effective way to improve overweight obesity and its functional status in children and adolescents,<sup>9</sup> and that the use of safe and effective exercise interventions can improve health status and reduce the probability of obesity and related diseases.<sup>10</sup> In this study, the effect of 12 weeks of soccer training on body composition and physical fitness indexes of obese children was observed to explore its role in childhood obesity intervention and to provide a more scientific basis for the development of soccer sports in schools.

## Research object and research method

### Subjects of study

In this study, 48 obese children (24 males and 24 females) from a middle school in Wuhan were used as the study subjects. Based on body mass index (BMI), obese children were classified according to the Classification Standards for Overweight and Obesity Screening Body Mass Index Values for Chinese School-Age Children and Adolescents, excluding

children with the following conditions, secondary and pharmacological obesity, suffering from cardiovascular and other diseases, being regular exercise or using weight-loss drugs. Forty-eight children who met the criteria of simple obesity were randomly divided into experimental and control groups. There was no significant difference between the indexes of the experimental and control groups before the experiment.

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 Beijing Sport University, China

### Methods of study

In the whole process of the experiment, the health and safety of the subjects were first ensured. And the intervention program of training was designed according to the physical characteristics of obese children to stimulate the subjects' interest in soccer training so that the training program could be implemented smoothly and the subjects could complete the experiment throughout. The intervention program was: (1) Experimental period: the experimental intervention period was 12 weeks, 4 times/week. (2) Training time: 60-90 min. (3) Training intensity: 50-70% of the maximum heart rate during training. 2 weeks of acclimatization training is required before the start of formal training. (4) Training content: game warm-up, with ball technology (kicking, stopping, dribbling), without the ball technology (starting, various running methods, emergency stop), competition, and post-game pulling. Test indicators are body composition indicators and athletic quality indicators.

## Experimental result and analysis

### Comparison of body composition indexes and flexibility indexes between the control group and the experimental group

According to Table 1, the BMI was 27.58 kg/m<sup>2</sup> and 25.18 kg/m<sup>2</sup> ( $P < 0.05$ ) for boys and 27.60 kg/m<sup>2</sup> and 25.23 kg/m<sup>2</sup> ( $P < 0.05$ ) for girls in the control and experimental groups, respectively. The body fat percentage was 36% and 31.22% ( $P < 0.05$ ) for boys and 38.96% and 35.14% ( $P < 0.05$ ) for girls in the control and experimental groups, respectively. The visceral adiposity index was 11.24 and 8.21 ( $P < 0.05$ ) in boys and 10.79 and 9.24 ( $P < 0.05$ ) in girls in the control and experimental groups, respectively. Sitting forward flexion was -5.70 cm and 2.58 cm ( $P < 0.05$ ) in boys and 3.46 cm and 10.96 cm ( $P < 0.05$ ) in girls in the control and experimental groups, respectively. The transverse fork height was 32.89 cm and 24.32 cm for boys in the control group and the experimental group, respectively ( $P < 0.05$ ), and 36.89 cm and 22.19 cm for girls ( $P < 0.05$ ). The above indexes were significantly different from each other. In addition, there was a significant difference between the control group and the experimental group of girls in the comparison of subcutaneous fat, muscle rate, and protein rate.

### Comparison of body composition indexes and flexibility indexes of the experimental group before and after the experiment

Table 2 shows the change data of the experimental group before and after the experiment. The BMI was 27.50 kg/m<sup>2</sup> and 25.18 kg/m<sup>2</sup>

**Table 1.** Changes in body composition and flexibility indexes in the control and experimental groups after the experiment ( ).

Indicators	Control group		Experimental group	
	Male (n=12)	Female (n=12)	Male (n=12)	Female (n=12)
Height (cm)	164.23±7.14	155.22±3.02	166.11±2.37	157.02±4.20
Body weight (kg)	75.02±3.18	66.18±6.24	71.04±3.78	62.34±3.10
BMI (kg/m <sup>2</sup> )	27.58±3.11	27.60±1.89	25.18±2.89*	25.23±2.71*
De-fatted weight (kg)	47.68±3.01	41.04±2.43	52.37±3.99	44.21±5.31
Body fat percentage %	36.00±8.96	38.96±6.18	31.22±3.25*	35.14±3.57*
Visceral fat index	11.24±2.18	10.79±3.17	8.21±1.39*	9.24±1.89*
Subcutaneous fat %	19.79±3.02	24.78±1.78	17.03±3.17	22.19±2.47*
Amount of fat (kg)	21.70±5.53	25.97±1.06	18.14±2.19	22.78±4.33
Muscle rate %	37.35±2.01	30.19±4.19	42.03±1.51	32.79±2.26*
Protein rate %	14.74±1.27	13.42±1.90	16.77±0.79	14.65±3.87*
Muscle mass (kg)	27.19±3.14	21.81±1.68	28.06±2.21	22.96±1.95
Amount of protein (kg)	9.27±1.21	8.11±2.33	10.52±1.15	8.91±1.06
Sitting forward bend (cm)	-5.70±1.36	3.46±1.09	2.58±1.82*	10.96±2.03*
Cross-fork height (cm)	32.89±0.65	36.89±1.54	24.32±1.29*	22.19±3.89*
Left front longitudinal fork height (cm)	37.67±1.10	38.03±3.41	29.89±1.37*	20.15±3.26*
Right front longitudinal fork height (cm)	35.26±2.05	38.19±4.29	30.17±2.84*	22.03±1.81*

Note: \* p<0.05; \*\* p<0.01.

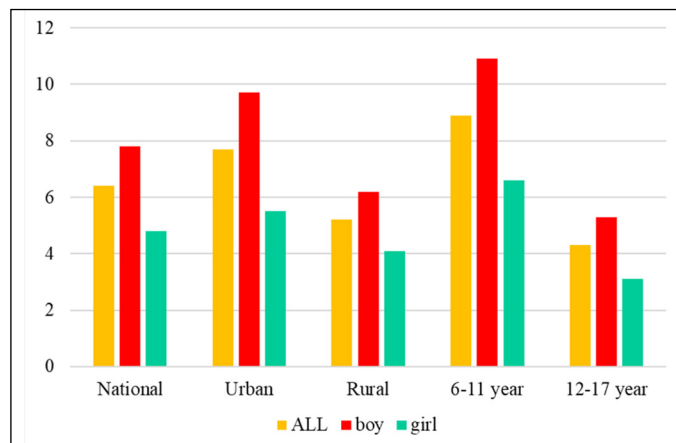
( $P < 0.05$ ) for boys and 26.98 kg/m<sup>2</sup> and 25.23 kg/m<sup>2</sup> ( $P < 0.05$ ) for girls before and after the experiment, respectively. Body fat percentage was 35.72% and 31.22% ( $P < 0.05$ ) in boys and 38.15% and 35.14% ( $P < 0.05$ ) in girls before and after the experiment, respectively. The visceral adiposity index was 10.27 and 8.21 ( $P < 0.05$ ) in boys and 10.94 and 9.24 ( $P < 0.05$ ) in girls before and after the experiment, respectively. Subcutaneous fat was 19.42% and 17.03% ( $P < 0.05$ ) in boys and 24.03% and 22.19% ( $P < 0.05$ ) in girls before and after the experiment, respectively. The fat mass was 21.08 kg and 18.14 kg ( $P < 0.05$ ) in boys and 25.28 kg and 22.78 kg ( $P < 0.05$ ) in girls before and after the experiment, respectively. Muscle percentage was 37.56% and 42.03% ( $P < 0.05$ ) in boys and 30.92% and 32.79% ( $P < 0.05$ ) in girls before and after the experiment, respectively. The left anterior longitudinal fork heights were 36.79 cm and 29.89 cm ( $P < 0.05$ ) in boys and 39.34 cm and 20.15 cm ( $P < 0.05$ ) in girls before and after the experiment, respectively. The right anterior longitudinal fork heights were 39.24 cm and 30.17 cm ( $P < 0.05$ ) for boys and 38.76 cm and 22.03 cm ( $P < 0.05$ ) for girls, respectively, before and after the experiment. The above indexes were significantly different in comparison. In addition, there was a significant difference in the comparison of pre-experimental and post-experimental boys in the index of defatted weight and girls in the index of protein rate.

2021 obesity rates among children of different environments and ages in China are shown in Figure 1. This study showed that obese children underwent significant changes in body composition through soccer training. In terms of BMI, this index decreased in both boys and girls before and after the experiment, and there was a significant difference ( $P < 0.05$ ). Also, there were changes in all indicators of body fat percentage, visceral adiposity index, subcutaneous fat, adiposity, muscle rate, and flexibility quality, compared to boys and girls who had different changes in different indicators.

**Table 2.** Changes in body composition and flexibility indexes in the experimental group before and after the experiment ( ).

Indicators	Pre-experiment		After the experiment	
	Male (n=12)	Female (n=12)	Male (n=12)	Female (n=12)
Height (cm)	164.72±3.82	155.57±5.85	166.11±2.37	157.02±4.20
Body weight (kg)	74.09±4.56	65.30±6.25	71.04±3.78	62.34±3.10
BMI (kg/m <sup>2</sup> )	27.50±4.20	26.98±2.29	25.18±2.89*	25.23±2.71*
De-fatted weight (kg)	47.65±1.23	41.09±3.06	52.37±3.99*	44.21±5.31
Body fat percentage %	35.72±10.92	38.15±7.29	31.22±3.25*	35.14±3.57*
Visceral fat index	10.27±2.03	10.94±4.01	8.21±1.39*	9.24±1.89*
Subcutaneous fat %	19.42±7.21	24.03±4.24	17.03±3.17*	22.19±2.47*
Amount of fat (kg)	21.08±3.28	25.28±5.37	18.14±2.19*	22.78±4.33*
Muscle rate %	37.56±1.78	30.92±2.13	42.03±1.51*	32.79±2.26*
Protein rate %	15.24±0.87	13.27±0.73	16.77±0.79	14.65±3.87*
Muscle mass (kg)	25.62±1.94	21.88±1.79	28.06±2.21	22.96±1.95
Amount of protein (kg)	10.21±2.45	8.77±1.99	10.52±1.15	8.91±1.06
Sitting forward bend (cm)	-5.29±1.26	2.89±0.65	2.58±1.82*	10.96±2.03*
Cross-fork height (cm)	31.72±0.23	38.02±0.72	24.32±1.29*	22.19±3.89*
Left front longitudinal fork height (cm)	36.79±0.72	39.34±0.68	29.89±1.37*	20.15±3.26*
Right front longitudinal fork height (cm)	39.24±0.84	38.76±0.87	30.17±2.84*	22.03±1.81*

Note: \* is p<0.05; \*\* is p<0.01.



**Figure 1.** Child obesity rate in China in 2021.

## CONCLUSIONS

Through the experimental results, three months of soccer training had a positive effect on the bodies of obese children aged 12- 14 years old, and the conclusions are as follows: Regular soccer training had a significant effect on the decrease of weight, BMI, body fat percentage, visceral fat, and subcutaneous fat of obese children and adolescents, and largely improved the flexibility level of obese children and adolescents, increased the physical flexibility of obese children, and helped to promote physical health and injury prevention. Soccer can be one of the interventions to prevent the occurrence of childhood obesity diseases. It is recommended that further research on youth soccer training intervention programs and intervention tools be conducted in the future to optimize the improvement effect on health-related indicators of obese children.

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

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