

CORE MUSCLE STRENGTH TRAINING OF YOUNG SOCCER PLAYERS

TREINO DE FORÇA MUSCULAR NO CORE DE JOVENS JOGADORES DE FUTEBOL

ENTRENAMIENTO DE LA FUERZA MUSCULAR EN EL CORE DE JÓVENES JUGADORES DE FÚTBOL



ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

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ABSTRACT

Introduction: Core strength training is a modern method of approach that matches the current demand for a more resilient physique on young players. Although it was initially conceived as complementary training to contribute to strength and agility, other benefits have been observed for soccer athletes nowadays. Among the under-explored benefits is the effect on the athletes' stability. **Objective:** This article explores core training results on stability in young soccer players. **Methods:** The theoretical applicability of basic stability training for young soccer players with core muscle strength training is discussed using mathematical statistics. The theoretical result is confronted with the practice of the controlled experiment on 18 young soccer players in 32 weeks with stabilization protocols. **Results:** The fitness and soccer skills of the young men improved significantly ($P < 0.05$). **Conclusion:** Core strength training can promote the overall fitness of young soccer players. This training protocol for core strengthening achieves the primary goal of improving athletes' competitive ability and fitness. **Evidence Level II; Therapeutic Studies – Investigating the results.**

Keywords: Strength training; Soccer; Physical fitness testing; Athletes.

RESUMO

Introdução: O treino de força do core é um método moderno de abordagem que condiz com a atual exigência por um físico mais resistente sobre os jovens jogadores. Embora seja inicialmente concebido como um treino complementar para contribuir com a força e agilidade, atualmente tem se observado outros benefícios para os atletas de futebol. **Dentre os benefícios pouco explorados está o efeito na estabilidade dos atletas.** **Objetivo:** Este artigo explora os resultados do treino básico do core na estabilidade sobre jovens jogadores de futebol. **Métodos:** Discute-se por meio de estatísticas matemáticas a aplicabilidade teórica do treino básico de estabilidade aos jovens jogadores de futebol com o treino de força muscular do core. O resultado teórico é confrontado com a prática do experimento controlado em 18 jovens jogadores de futebol no período de 32 semanas com protocolos de estabilização. **Resultados:** O preparo físico e as habilidades futebolísticas dos jovens melhoraram significativamente ($P < 0,05$). **Conclusão:** O treino de força central pode promover a aptidão geral dos jovens jogadores de futebol. Este protocolo de treino para fortalecimento do core atinge a meta principal de melhorar a capacidade competitiva e a aptidão física dos atletas. **Nível de evidência II; Estudos Terapêuticos - Investigação de Resultados.**

Descritores: Treinamento de Força; Futebol; Teste de Aptidão; Atletas.

RESUMEN

Introducción: El entrenamiento de la fuerza del core es un método de enfoque moderno que se ajusta a la demanda actual de un físico más resistente en los jóvenes jugadores. Aunque inicialmente se concibió como un entrenamiento complementario para contribuir con la fuerza y la agilidad, hoy en día se han observado otros beneficios para los atletas de fútbol. **Entre los beneficios poco explorados está el efecto sobre la estabilidad de los atletas.** **Objetivo:** Este artículo explora los resultados del entrenamiento del core en la estabilidad de los jóvenes futbolistas. **Métodos:** Se discute la aplicabilidad teórica del entrenamiento de la estabilidad básica para jóvenes futbolistas con el entrenamiento de la fuerza de los músculos centrales por medio de la estadística matemática. El resultado teórico se confronta con la práctica del experimento controlado en 18 jóvenes futbolistas en el período de 32 semanas con protocolos de estabilización. **Resultados:** La forma física y las habilidades futbolísticas de los jóvenes mejoraron significativamente ($P < 0,05$). **Conclusión:** El entrenamiento de la fuerza del núcleo puede promover el estado físico general de los jóvenes futbolistas. Este protocolo de entrenamiento para el fortalecimiento del núcleo logra el objetivo principal de mejorar la capacidad competitiva y la forma física de los atletas. **Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.**

Descriptor: Entrenamiento de Fuerza; Fútbol; Pruebas de Aptitud Física; Atletas.



INTRODUCTION

Core strength training is also called core area exercises. The content includes stability power and specialized power. It is a scientific modern physical fitness training method. Football has a large field, fast speed, and fierce confrontation. It has high requirements for physical fitness and skills.¹ Athletes must have better physical fitness. In the game, various technical actions such as acceleration, emergency stop, start, change of direction, breakthrough with the ball, likely collision, passing, fighting, shooting, etc., require good coordination and body posture control in the completion process. The core part plays the role of linking up and down. Football is particularly important for the completion of the action. The article combines the characteristics and competitive requirements of football. It aims to improve middle school students' amazing physical stamina and skills in football training as the starting point. We design a set of methods for students' core strength training to strengthen the core area to establish conditioning.² At the same time, the article studies the impact of core strength training on middle school students' football training skills and physical fitness.

METHOD

Research objects

This article selects 18 school team players who are 19-21 years old and have a certain foundation in football as the research objects of this article. The experimental subjects were divided into a control group of 9 people and an experimental group of 9 people.³ The control group taught following the school's normal teaching schedule and plan. In contrast, the experimental group increased the core strength training of students in the preparation activities and tidying up and relaxing parts of each class. The experimental and control groups kept the same in terms of teaching hours, number of teachers, teachers, special teaching content, and venue equipment. The significance test of the experimental results was carried out before and after the experiment.

Research methods

We check books, periodicals, master and doctoral papers on football training, and core strength training through libraries, reference rooms, and CNKI. At the same time, learn about the progress of research on core strength training at home and abroad.⁴ This is to accumulate information for research and find the basis.

The study period is from the beginning of September 2020 to the end of August 2021. The duration is 32 weeks in total, with 4 lessons per week. We conducted experiments on the experimental and control groups through the special teaching training of football elective classes.⁵ The control group used traditional teaching methods, preparation part (warm-up preparation activity) → basic part (special quality technical exercises) → end part (organization and relaxation). The experimental group added core strength training to the classroom and practiced throughout the entire classroom. The core strength exercise content is added during the preparation activities. The core strength is practiced in the special quality exercises. The relaxation part is organized to make targeted exercises and relaxation for the core parts. The experiment mainly uses non-equipment exercises and combines the actual situation and training level of the students.

Mathematical Statistics

We use sports statistics to collect data. SPSS14.0 software was used to process the data to analyze and evaluate the experimental and control groups' learning effect.

Real-time extraction and simulation of football arc trajectory

$(x_c, y_c)^T$ represents the position of the footsteps. θ_c represents the angle between the forward direction of the step and the x axis.

v, ω represents the linear velocity and angular velocity of footsteps.⁶ Then use formula (1) to establish a foot movement model first

$$Q'_{jjer} = \frac{\{v, \omega\} + \theta_c}{(x_c, y_c)^T} \times \frac{p_c \pm p_e}{p_r} \{x_e, y_e\} \quad (1)$$

p_c represents the footstep movement equation. $\{x_e, y_e\}$ represents when the footstep moves from the current pose p_e to the target pose p_r . The resulting new coordinate system.⁷ s_{df} represents the pose error of footstep movement. u_{sf} represents any initial error. (s'_{fg}) represents the angle between the new coordinate system $\{x_e, y_e\}$ and the original coordinate system $\{x, y\}$. E'_{ert} represents the differential equation of the posture error of the foot movement. Use formula (2) to get the coordinates of the point where the ball passes by the footsteps of the moving arc trajectory center point

$$E'_{ilp} = \frac{E'_{ert} + \{x, y\}}{\{x_e, y_e\} \mp s'_{df}} \pm u'_{sf} \times (s'_{fg}) \quad (2)$$

$(x_{\omega}, y_{\omega}, z_{\omega})$ represents the coordinates of the moving point of the footstep in the world coordinate system. γ_{lko} represents the unit orthogonal matrix.⁸ Then use equation (3) to give the internal parameters of the camera

$$R'_{sdp} = \frac{\gamma'_{lko} + (x_{\omega}, y_{\omega}, z_{\omega})}{M_{in} \mp (x_c, y_c, z_c)} \times j'' + \mu'_{po} \quad (3)$$

(x_c, y_c, z_c) represents the coordinates of the footsteps in the camera coordinate system. μ_{po} represents the number of pixels whose gray value is j'' . M_{in} represents the total number of pixels in the entire footstep movement arc trajectory graph.⁹ μ_{rt} represents the calibration threshold of the camera. $(u, \mu)_T$ represents the image coordinates of the spatial point p in the camera C_1 . Use equation (4) to give the external parameters of the camera

$$E'_{ier} = \frac{C_1 \mp p}{(u, \mu)_T} + \mu'_{rt} + \{k'_{lp}\} \quad (4)$$

k_{lp} represents the actual footstep movement output pose. ζ_{yu} represents the horizontal projection of the arc trajectory of the footsteps. ∂_{lm} represents the maximum width of the arc trajectory point of continuous footsteps.¹⁰ Then use formula (5) to determine the desired tracking arc trajectory of the ball passing by the footsteps

$$r'_{lpk} = \frac{\partial'_{lm} + \zeta'_{yu}}{u'_{tu} \mp b'_{plk}} + \frac{d'_{km} \mp R'_{sdp}}{E'_{ier} \times Q'_{jjer}} \mp E'_{ilp} \quad (5)$$

u_{tu} represents the between-class variance of the arc trajectory of the footsteps. b_{plk} represents the geometric center coordinates of the arc trajectory of the footsteps.

RESULTS

The difference between the data before and after the experiment in the control group

It can be seen from Table 1 that the 6 indicators tested in the control group after 8 weeks of basic training have improved to a certain extent.¹¹

But only the in-situ vertical jump and the Llinions test scores before and after the two experiments have significant differences. Analyze the reasons for the significant differences: (1) Students usually practice less in bounce and various direction changes, so it is easy to improve their grades after 8 weeks of basic practice. (2) It can be seen from the data that the initial test scores of these two items are relatively low. It is normal for the performance to improve after training with a low base. In addition, the Illinois test is the first test project for students, so it also has a lot of room for improvement. There were no significant differences before and after the other performance experiments.

The difference between the data before and after the experiment in the experimental group

It can be seen from Table 2 that after 8 weeks of basic training and core strength training, there are significant differences in the 6 items before and after the experiment.¹² The reasons are as follows: (1) The experimental and control groups' training content is the same. Still, the experimental group is subjected to a specific load of core strength training after each training. The strengthening of core strength can improve the body's stability, and it has a certain effect on the connection, transmission, and integration of the strength of different parts and links of the body. This is the main reason for the significant differences in the experimental group's results in the 20m start-up run, cross-run, one-step approach kick, and in-place throw-in. (2) In addition to the core strength training factors, the in-situ vertical jump and Llinions test will also have the factors mentioned above.

Table 1. Comparative analysis of the results before and after the experiment in the control group.

Experiment content	Before the experiment	After the experiment	t	p
20m starting run (S)	3.49	3.47	1	> 0.05
Cross running (S)	13.99	13.99	1.265	> 0.05
In-situ vertical jump touch height (m)	62	64	2.294	< 0.05
Llinions test (S)	17.2	17	2.294	< 0.05
One-step approach and kick far (m)	39	40	1.941	> 0.05
Throw-in throw-in (m)	26	27	2.135	> 0.05

Table 2. Comparative analysis of the results of the experimental group before and after the experiment.

Experiment content	Before the experiment	After the experiment	t	p
20m starting run (S)	3.51	3.46	15.324	< 0.05
Cross running (S)	13.9	13.78	6.198	< 0.05
In-situ vertical jump touch height (m)	64	67	10.392	< 0.05
Llinions test (S)	16.9	16.5	6.158	< 0.05
One-step approach and kick far (m)	39	44	18.812	< 0.05
Throw-in < 0 (m)	26	29	18	< 0.05

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. GZ: writing and performing surgeries; CH: data analysis and performing surgeries; LY: intellectual concept of the article and provide football training theory and guidance; MZ: article review, performing surgeries and intellectual concept of the article.

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DISCUSSION

Comparing the experimental results with core strength training can significantly improve physical fitness and football skills. Core strength exercises are part of physical fitness exercises.¹³ It only focuses on the strengthening of the core area. The core area is the center of the limbs, and it is also the transmission belt through which the lower limbs transmit the force. This has the effect of stabilizing support and coordinating the exertion of the limbs. Static support exercises in practice can strengthen the stability of strength. Supporting walking exercises have a positive effect on the coordination of core strength and limbs. The powerful core muscles can enable athletes to control the body better. It can also stably support the athlete's technical movements and motor skills.

Football is determined by its characteristics. It requires athletes to make a variety of comprehensive technical movements. Although the muscles of the hip joint and pelvis of the human body are different from the muscles of the limbs, they are not directly involved in human movement.¹⁴ However, the contraction and stability of these parts can ensure the contraction of the limbs and provide a reliable fulcrum. Core strength training can comprehensively enhance the muscle contractility of the limbs and ensure more precise technical movements. Football players are in the process of rapid movement and sports, such as kicking far, circling the pole, bumping the ball, and shooting. In these technical exercises, athletes can maintain a certain degree of balance in their bodies. In this range, the body's floating range is large, and the muscle groups in the core area can coordinate and fix the limbs and trunks. When the athlete's limbs exert force, all the strength is transmitted to the limbs through the trunk. Which is the core strength, and the completion of the action is guaranteed.

CONCLUSION

Fast power includes starting power, explosive power, and braking power. Experiments have proved that the core strength exercises are more effective in improving the explosive power and braking force in the fast power of the football players than in the starting power in the short power. Core strength training is formed based on traditional strength training. It supplements the lack of core muscle training in traditional strength training, and it has a complementary relationship with traditional strength. The influence of core strength on competitive sports is multifaceted. This article is only an experimental study from the perspective of the fast power of football players. It is suggested that future researchers can conduct in-depth research from more angles.

ACKNOWLEDGMENT

The work was supported by Teacher Science Research Project of Yunnan Education Department - Career Resilience Takes the Initiative to Change the Behavior of Physical Education Teachers in Applied Universities in Yunnan Province.

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

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