

SCIENTIFIC INVESTIGATION OF A TRAINING MODEL ON ATHLETE'S CORE STRENGTH



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INVESTIGAÇÃO CIENTÍFICA DE MODELO DE TREINO SOBRE A FORÇA NO CORE DO ATLETA

INVESTIGACIÓN CIENTÍFICA DE UN MODELO DE ENTRENAMIENTO SOBRE LA FUERZA EN EL CORE DEL ATLETA

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ABSTRACT

Introduction: The muscular structure that makes up the core is responsible for the central stabilization of the human body and controlling the movement of the body's center of gravity. Core training is indispensable for improving physical performance in competitive sports. **Objective:** To analyze the concepts, methods, and results of core strengthening in athletes. **Methods:** Controlled research among several athletes for three months. The experimental group was approached with a training model for core strengthening of 30 minutes four times a week. The relationship between core strength and traditional strength training was confronted with the literature, logical analysis, and comparative analysis methods. **Results:** After the core strength training, the athletes' sports quality was improved, especially the abdominal strength and the strength of the dorsal muscle groups. The stability of deep core muscles, motor coordination, and core balance capacity was improved ($P < 0.05$). **Conclusion:** The presented model for strengthening running in athletes showed a high value of applicability and dissemination. **Evidence Level II; Therapeutic Studies – Investigating the results.**

Keywords: Resistance training; Gymnastics; Sports; Athlete.

RESUMO

Introdução: A estrutura muscular que compõe o core é responsável pela estabilização central do corpo humano e o controle no movimento do centro de gravidade corpóreo. O treino do core é indispensável para o aprimoramento do desempenho físico nos esportes competitivos. **Objetivo:** Analisar os conceitos, métodos e resultados do fortalecimento do core em atletas. **Métodos:** Pesquisa controlada entre vários atletas por três meses. O grupo experimental foi abordado com um modelo de treino para fortalecimento de core de 30 minutos, quatro vezes por semana. A relação entre a força do core e o treino de força tradicional foi confrontada com a literatura, método da análise lógica e o método da análise comparativa. **Resultados:** Após o treino de fortalecimento do core, a qualidade esportiva dos atletas foi aprimorada, especialmente a força abdominal e a força dos grupos musculares dorsais. A estabilidade da musculatura profunda do core, a coordenação motora, e a capacidade equilíbrio do core foi aprimorada ($P < 0,05$). **Conclusão:** O modelo apresentado para fortalecimento do core em atletas demonstrou alto valor de aplicabilidade e divulgação. **Nível de evidência II; Estudos Terapêuticos - Investigação de Resultados.**

Descritores: Treinamento de Força; Ginástica; Esportes; Atletas.

RESUMEN

Introducción: La estructura muscular que compone el core es responsable de la estabilización central del cuerpo humano y del control del movimiento del centro de gravedad. El entrenamiento del core es indispensable para mejorar el rendimiento físico en los deportes de competición. **Objetivo:** Analizar los conceptos, métodos y resultados del fortalecimiento del core en los atletas. **Métodos:** Investigación controlada entre varios atletas durante tres meses. Al grupo experimental se le planteó un modelo de entrenamiento para el fortalecimiento del core de 30 minutos, cuatro veces por semana. La relación entre la fuerza del core y el entrenamiento de fuerza tradicional se confrontó con la literatura, el método de análisis lógico y el método de análisis comparativo. **Resultados:** Tras el entrenamiento de la fuerza del core, la calidad deportiva de los atletas mejoró, especialmente la fuerza abdominal y la fuerza de los grupos musculares dorsales. La estabilidad de los músculos profundos del core, la coordinación motora y la capacidad de equilibrio del core mejoraron ($P < 0,05$). **Conclusión:** El modelo presentado para el fortalecimiento del core en los atletas demostró un alto valor de aplicabilidad y difusión. **Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.**

Descriptores: Entrenamiento de Fuerza; Gimnasia; Deportes; Atletas.



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INTRODUCTION

At present, core muscle training continues to appear in various special sports. As a new training method, it has a significant effect on improving sports performance. Core muscle training is mainly for the strength and stability training of the large core muscles and the deep small

muscles of the body.¹ Core muscle training is an indispensable factor in the physical training of competitive sports. Core strength training is not simply to develop the stability and strength of the core but to develop the coordination ability of the neuromuscular system. The formation of the coordination ability between the two is a gradual training process.

It is an important prerequisite for improving athletes' specific abilities. Gymnastics is a sports event that performs continuous, complex, and high-intensity complete sets of movements under the accompaniment of music. Gymnastics movements are mostly full-body movements involving multiple joints and multiple muscle groups. Suppose the gymnast lacks effective core muscle stability and coordination training. This may cause asymmetry in body posture.² The technical movements of gymnastics have very high requirements for the exertion of upper and lower limbs. The stability of the core is the key to the success or failure of gymnastics. We selected 16 students majoring in gymnastics as experimental subjects. We conducted a 3-month comparative test on whether core muscle training can improve gymnastic core stability. Discuss the role of core muscle group training in gymnastics. The article provides references for the scientific training of gymnastics.

METHOD

Research objects

The research objects are 16 college students majoring in gymnastics in class 2020. The gymnastics practice time is one year, with 8 boys and 8 students each.³ There is no obvious difference in gymnastics skills. The study subjects are in good health.

Research methods

Literature data method

We searched related papers through three retrieval tools: Wanfang, VIP Journal, and CNKI. A large amount of information about core muscle group strength training has been collected by consulting the library.

Experimental method

We randomly selected 8 students as the experimental group and 8 as the control group.⁴ The subject was in good health before the experiment.

The tools needed in the experiment include the star balance test, meter ruler, and weight scale.

The subject stood at the center of the test site and kept his left foot supported. Extend your right foot in different directions.⁵ Test three times in each direction. Record it and take the average value. The 1-8 directions represent 8 directions in the star pattern: front right, front right, front right, rear right, front-rear, rear left, front left, and front left.

The experimental group performed core strength training 4 times a week. Each time is 30 minutes. The control group received regular gymnastics training. The special training items and content arrangements are the same. The entire trial lasted 3 months. Test and analyze records before the experiment. After the experiment, the experimental and control groups were compared and analyzed using the comparative statistical methods according to the same test method.

The core muscle group training is mainly the strength and stability training of the large core muscle groups and the deep small muscle groups of the body. The training is divided into three stages.⁶ The first two weeks of the first stage are the preparatory training stage. Athletes master technical skills and lay a solid foundation. The second stage is 3-7 weeks. In this stage, basic core muscles training is carried out to overcome one's body weight. The third stage is 8-12 weeks. This period is the improvement phase. Athletes combine special features and use certain equipment to perform more difficult core muscle group exercises.

Model establishment

The athlete assumes that the upper limbs are perpendicular to the ground during the completion of the action. So, the moment of the big arm and forearm to the coordinate origin is. We do not need to calculate its mass and centroid location, nor do we need to model it. The experiment only needs to calculate and model the mass, center

of mass, and moment of the head, upper torso, lower torso, thighs, calves, feet, and hands.⁷ Concerning "National Standard of the People's Republic of China GB/T17245-2004", the formula for calculating body mass is expressed as follows

$$Y = B_0 + B_1X_1 + B_2X_2 \quad (1)$$

B_0, B_1, B_2 is the regression coefficient of the constant term, body mass, and height of the regression equation. X_2 is the height, mm. The calculation formula for the position of the centroid of the body segment is expressed as follows:

$$Y = B_0 + B_1X_1 + B_2X_2 \quad (2)$$

B_0, B_1, B_2 is the regression coefficient of the constant term, body mass, and height of the regression equation. The formula for calculating the moment of gravity of the body segment is expressed as follows:

$$M = YX_i \quad (3)$$

The abscissas of the center of mass of the body segments such as the head, upper torso, lower torso, hands, thighs, calves, and feet are shown in the following formula:

$$X_3 = (Y_3' \times L_{cs3} / L_{cs3}) \cos 65^\circ \quad (4)$$

$$X_4 = -Y_4' \cos \theta \quad (5)$$

$$X_5 = -Y_4' \times 100 / L_{cs4} - Y_5' \cos 65^\circ \quad (6)$$

$$X_6 = Y_6' \times L_{cs6} / L_{cs6} \quad (7)$$

$$X_7 = \frac{Y_7' \times L_{cs7}}{L_{cs7}} - \left(\frac{Y_4' \times 100}{L_{cs4}} + \frac{Y_5' \times 100}{L_{cs5}} \right) \cos \theta \quad (8)$$

$$X_8 = \frac{Y_8' \times 100}{L_{cs7}} + \frac{Y_8' \times L_{cs8}}{L_{cs8}} - \left(\frac{Y_4' \times 100}{L_{cs4}} + \frac{Y_5' \times 100}{L_{cs5}} \right) \cos \theta \quad (9)$$

Mathematical Statistics

We use excel software to count the test results of 16 athletes. And use spss11.0 to analyze the data.

RESULTS

Before the experiment

The comparative analysis of the star balance test results of the experimental and control groups before the experiment is shown in Table 1. We tested the elongation value of the right leg on the experimental group and the control group before the experiment.⁸ The article found that the experimental and control groups had slight differences in the elongation value of the right leg in the 1 to 8 directions before the experiment. Still, there was no significant difference in general. This ensures the feasibility of experiment selection.

After the experiment

The comparative analysis of the star balance test results of the experimental and control groups after the experiment is shown in Table 2. Both the experimental and control groups were arranged with a professional coach for supervision and guidance during the experiment. This ensures the normal progress of the experiment.⁹ The athletes have undergone 3 months of training. The result showed that the right leg elongation value of the experimental group in the 1 direction was 89 cm before the experiment. After the experiment, the elongation value of the right leg was 97 cm. The length increased by 8 cm, and the elongation value of the right leg in the control group was 88 cm before the experiment. After the experiment, the elongation value of the right leg was 91 cm. The length has increased by 3 cm. The comparative analysis of data between the experimental and control groups showed that the right leg elongation value of the experimental group and control groups increased before and after the experiment.¹⁰ However, the increase in the elongation value of the right leg in the experimental group was more obvious. And there was a significant difference between the experimental and control groups ($P < 0.05$). This shows that the training of core muscles helps to improve the core stability of gymnastics practitioners in the first direction and is more obvious.

In the same way, we analyze the data in directions 2, 3, 4, 5, 6, 7, and 8. The results showed that both the experimental and control groups

Table 1. Before the experiment, the test results of the experimental and control group gymnast's right leg elongation.

Direction	Experimental group M±SD	Control group M±SD
1	89±2.9	88±2.2
2	82±4.2	79±2.2
3	88±2.2	85±2.5
4	92±5.6	95±4.7
5	99±7.2	97±5.8
6	98±6.6	104±5.7
7	97±4.2	104±5.2
8	82±2.5	87±2.2

Table 2. After the experiment, the test results of the experimental and control group gymnast's right leg elongation.

Direction	Experimental group M±SD	Control group M±SD
1	97±2.9	91±3.9
2	89±4.1	82±3.3
3	99±3.9	90±3.2
4	101±3.2	97±4.5
5	103±5.8	99±6.5
6	105±4.1	107±4.8
7	103±4.6	102±3.3
8	93±3.2	88±3.4

improved the elongation value of the right leg in the star balance test after three months of training.¹¹ The experimental and control groups had different performances in the star balance test. Significant differences appeared in the test of the elongation value of the right leg in the 1, 2, 3, 4, 5, 6, 7, and 8 directions ($P < 0.05$). This shows that core muscle training has a significant effect in the 1, 2, 3, 4, 5, 6, 7, and 8 directions for gymnastics practitioners' core stability. The training of core muscles helps improve the core stability of gymnastic practitioners.

DISCUSSION

The core muscle group anatomy focuses on the center of the body. The core muscle group is composed of the muscle groups on the front, back, and sides of the body and the muscles that wrap the body.¹² These include erector spinae, iliopsoas muscles, psoas major, gluteal muscles, rectus abdominis, transversus abdominis, serratus anterior, etc. Core stability strengthens the local and overall stability and coordination of the body by adjusting the nerve-muscle control system. The core muscles can perform the energy conversion and transfer of the body while exercising its sound and balanced effect. When the body is performing unsteady movement training, the core muscles can more fully mobilize the nerves to control the muscles. Therefore, in the core strength scientific training, coach training must formulate an effective and specialized training plan and stick to it for a long time because the effect of short-term training is not obvious.¹³ In gymnastics training, the core strength training theory should be studied in depth based on the characteristics of the project. It is suggested that core strength training should be promoted and used in combination with the characteristics of various special pieces of training in college sports training. Only in this way can the quality of sports training be improved. In gymnastics teaching, coaches can take core muscle group training as a means and method of gymnastics training teaching. The coach integrates this method scientifically and reasonably into the regular gymnastics' courses of middle school gymnastics practitioners.

CONCLUSION

The core stability of the students who participated in the system core muscle group training gymnastics exercises was significantly higher than that of the students who did not perform the core muscle group training. The training of core muscles has a significant effect on the stability of the gymnastics core. Gymnastics practitioners who have passed the core muscles training have significantly improved their performance in the star balance test. This shows that core muscle groups' training helps gymnastic practitioners balance their bodies. At the same time, the training can improve the core stability of gymnastic practitioners.

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