ABDOMINAL CORE STRENGTH TRAINING IN FEMALE VOLLEYBALL PLAYERS

TREINAMENTO DE FORÇA DO CENTRO ABDOMINAL EM JOGADORAS DE VOLEIBOL

ENTRENAMIENTO DE FUERZA DEL NÚCLEO ABDOMINAL EN JUGADORAS DE VOLEIBOL

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ABSTRACT

Introduction: The performance of female volleyball players depends heavily on the stability of the abdominal center. This stabilization system provides the players with a stable performance during exercises. Abdominal core strength training can also improve the efficiency and accuracy of body movements, although its studies in volleyball players lack evidence. Objective: Examine the effect of abdominal core strength training on physical fitness in female volleyball players. Methods: Eighteen female volleyball players were randomly selected and divided into two groups. The experimental group performed abdominal core strength exercises. The control group practiced regular physical exercises. The experiment lasted 12 weeks. The article addressed eight primary test items. Among them, the waist extension test and the adapted bridge test were the main indicators of the center of gravity stability. The experiment's results were analyzed by comparing the data before and after the intervention by mathematical and statistical methods. Results: The experimental group improved significantly in all aspects after 12 weeks of abdominal core strength training ($P<0.05$). The experimental group's results were significantly improved ($P<0.05$). Conclusion: Abdominal core strength training promotes the development of stability, coordination, and agility in young female volleyball players. The exercises explored to strengthen the abdominal center are indicated for women's volleyball teams. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Abdominal Core; Resistance Training; Physical Fitness; Volleyballw.

RESUMO

Introdução: O desempenho das jogadoras de voleibol feminino depende grandemente da estabilidade do centro abdominal. Esse sistema de estabilização fornece às jogadoras um desempenho estável durante os exercícios. O treinamento da força do centro abdominal também pode melhorar a eficiência e a precisão dos movimentos corporais, embora seus estudos em jogadoras de voleibol careçam de evidências. Objetivo: Analisar o efeito do treinamento de força do centro abdominal sobre a aptidão física em jogadoras de voleibol. Métodos: Foram selecionadas 18 jogadoras de voleibol por amostragem aleatória, divididas em dois grupos distintos. O grupo experimental executou exercícios de força do centro abdominal. O grupo de controle praticou exercícios físicos regulares. O experimento durou 12 semanas. O artigo abordou oito itens de testes primários. Entre eles, o teste de extensão da cintura e o teste de ponte adaptado foram os principais indicadores da estabilidade do centro de gravidade. Os resultados do experimento foram analisados comparando os dados antes e depois da intervenção por métodos matemáticos e estatísticos. Resultados: Após 12 semanas de treinamento da força do centro abdominal, o grupo experimental obteve melhora significativa em todos os aspectos ($P<0,05$). Os resultados do grupo experimental foram significativamente melhorados ($P<0,05$). Conclusão: O treinamento de força do centro abdominal promove o desenvolvimento da estabilidade, coordenação e agilidade nas jovens jogadoras de voleibol. Indica-se às equipes de voleibol feminino os exercícios explorados para fortalecer o centro abdominal. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

***Descritores*:** *Centro Abdominal; Treinamento de Força; Aptidão Física; Voleibol.*

RESUMEN

Introducción: El rendimiento de las jugadoras de voleibol depende en gran medida de la estabilidad del núcleo abdominal. Este sistema de estabilización proporciona a los jugadores un rendimiento estable durante los ejercicios. El entrenamiento de la fuerza del núcleo abdominal también puede mejorar la eficacia y la precisión de los movimientos corporales, aunque sus estudios en jugadores de voleibol carecen de pruebas. Objetivo: Este trabajo analiza el efecto del entrenamiento de la fuerza del núcleo abdominal en la aptitud física de las jugadoras de voleibol. Métodos: Se seleccionaron 18 jugadoras de voleibol por muestreo aleatorio, divididas en dos grupos distintos. El grupo experimental realizó ejercicios de fuerza del núcleo abdominal. El grupo de control practicó ejercicios físicos regulares. El experimento duró 12 semanas. El artículo abordaba ocho elementos principales de la prueba. Entre ellos, la prueba de extensión de la cintura y la prueba del puente adaptado fueron los principales indicadores de la

estabilidad del centro de gravedad. Los resultados del experimento se analizaron comparando los datos antes y después de la intervención mediante métodos matemáticos y estadísticos. Resultados: Después de 12 semanas de entrenamiento de fuerza en el núcleo abdominal, el grupo experimental logró una mejora significativa en todos los aspectos (P<0,05). Los resultados del grupo experimental mejoraron significativamente (P<0,05). Conclusión: El entrenamiento de la fuerza del núcleo abdominal promueve el desarrollo de la estabilidad, la coordinación y la agilidad en las jóvenes jugadoras de voleibol. Está indicado para los equipos de voleibol femenino los ejercicios explorados para fortalecer el núcleo abdominal.
Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.

Descriptores: *Núcleo Abdominal; Entrenamiento de Fuerza; Aptitud Física; Voleibol.*

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INTRODUCTION

The development of core strength is a very critical link in sports competition. It can help athletes maintain their core muscles and ensure their balance. Volleyball is a highly competitive sport, and its technical skills often require players to use it in unstable situations. Accelerating the physical stability of athletes and the improvement of sports levels has become a primary way to promote the development of Chinese volleyball team. Based on the college girls' volleyball team, its core strength can effectively improve its sports level.[1] Strengthening the training of the core strength of volleyball players has become an essential direction for Chinese competitive sports development. This article adopts the theory and method of core strength to train the core strength of our women's volleyball team. This article discusses and summarizes women's volleyball teaching ideas and methods. The findings of this paper extend the theory of core strength training for women's volleyball players.

METHOD

Research objects

This paper takes 18 female volleyball players as a research sample. Before the start of the experiment, 18 contestants were tested for physical fitness and fundamental quality. According to the current physical condition of 18 players, this article will divide them into two equal groups.[2] The primary conditions of the members of the experimental group and the control group are shown in Table 1.

Test scheme

The experimental group used core strength exercises. Athletes train in light-load, high-rep, easy-to-difficult steps. The first step is to maintain the coordination of the core muscles. The second step is for the player to remain stationary under non-stationary conditions.[3] The third step is for the athlete to perform erratic dynamic resistance movements. The control group used regular physical exercise. Athletes perform strength exercises using freehand, single, or combined strength equipment.

The article selected eight physical indicators, including 36-meter movement, double shake, three-level leapfrog, approach run, long jump, two-head start, 30-second 20-kg clean and jerk, and 30-second inclined board sit-ups. This article selects four main items in the McGill test: lumbar flexion, extension, right bridge, and left bridge.[4] This paper examines athletes' core strength test results before and after the test.

Judgment model of volleyball landing point rotation angle

When determining the rotation angle judgment mode after the volleyball landed, this paper first determines the camera's internal and external parameters. Then this paper converts the pixel coordinates of the image into real volleyball court coordinates. This gets the volleyball's landing position.[5] This paper constructs the rotation angle judgment mode of the volleyball after landing according to the characteristics of its landing position.

Assume that T represents the sampling cycle. θ represents the volleyball trajectory state. $M^{'},M$ represents the model of the two cameras. In this paper, the formula (1) is used to convert the pixel coordinates of the graphics into the actual coordinates of the volleyball stadium.

$$Q = K_W \cdot \frac{\sqrt{(QM + o)(M^{*}\ M)}}{T\theta} \tag{1}$$

K_W represents the pixel space coordinate point of the image. QM represents the connection between different images. o represents the tracking of a set of pixel points. This paper uses the formula (2) to find the three-dimensional coordinates of the volleyball landing

$$F^{*}(\alpha,\beta,\gamma) = \frac{\delta q(\cdot)}{NQ}\left(\frac{a_v - a_v^{(i)}}{a_v + a_v^{(i)}}\right) \tag{2}$$

Table 1. Overview of the members of the experimental and control groups.

Group	Test group	Control group
Height (cm)	178.35±6.7	178.35±6.39
Weight (kg)	63.71±5.98	63.3±4.74
Age	20.93±1.24	20.72±1.34
Training years	7.32±1.34	7.32±1.24
Sport class	Secondary	Secondary

$\delta(\cdot)$ stands for important functional function. δ represents a continuous image frame. N represents the number of samples. Q represents an independent and identically distributed random sample. a_v, $a_v^{(i)}$ represents the movement of the volleyball at each time point, respectively. According to formula (3), this paper extracts the landing trajectory characteristics of volleyball

$$\omega_v^{(i)}(\alpha_{o:k}) = \frac{p(\alpha_{o:k} \mid z_{1:k})}{q(\alpha_{o:k} \mid z_{1:k})} Q \times F^*(\alpha, \beta, \gamma) \quad (3)$$

$\alpha_{o:k}$ represents the previous rotational position. $z_{1:k}$ represents the current volleyball rotation. According to the characteristics of the landing trajectory of the volleyball obtained in the above (3), this paper establishes the rotation angle judgment mode of the volleyball on the ground.

Data Analysis

In this paper, the relevant data is input through Excel, and each indicator's average analysis is carried out. All data are presented as mean and standard deviation. This paper uses SPSS17.0 to analyze the data and conduct a t-test. It can be seen that the difference between the control group and the experimental group is not statistically significant.[6]

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Xi'an Physical Education University following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

Test results of all athletes before training

Athletes performed eight physical fitness items and four central stability measures before the experiment. Statistical methods are used in this paper to measure.[7] The results of these studies are listed in Tables 2 and 3. The mean values of each measure in the experimental and control groups were higher than 0.05 in the t-test. There was no significant difference in initial physical and physical fitness between the two groups of athletes.

Index test results of students in experimental group and control group before and after different training

Good physical exercise can put the athlete at a better level in the game. Athletes can use core strength training more proficiently and achieve better athletic performance. There was a significant difference between the experimental and control groups before and after the test (P<0.01). There were significant differences between the experimental and control groups (P<0.01). Before and after the experiment, there were very significant differences in two indicators, such as double--shake rope skipping and 20kg clean and jerk in 30 seconds (P<0.01). 36m movement showed a significant difference (P<0.05). After the experiment, the three indicators of the athletes in the experimental group and the control group also showed significant differences.[8] Core strength training can allow athletes to control their center of gravity better and improve the functions of a solid connection, integration, and transmission. In this way, the athlete can improve the stability of his body. It can be seen from Table 4 that the control group's clean and jerk performance of 20 kg within 30 seconds was significantly improved (P < 0.01) after the regular 12 weeks of regular strength training. Athletes in the control group showed no improvement in the short distance and 30-second incline (P>0.01).

Comparative study of the stability test results before and after the experiment between the experimental group and the control group

The control group had different improvements in test scores on the right and left bridges before and during the test (P<0.05). Although there were some differences in the results of the lumbar flexion and extension tests, there was no statistical difference.[9] This suggests that regular strength training doesn't do much for it. However, the experimental group's four test results of lumbar flexion, lumbar extension, right bridge, and left bridge were significantly improved (P<0.01). After the test, the performance of the experimental group in terms of core stability was significantly improved compared with the control group (P<0.05), which indicated that the core stability level of the experimental group was significantly higher than that of the control group after 12 weeks of core strength training. (Table 5)

Table 2. The particular physical fitness test of the two groups of players before and after the test.

Index	Test group	Control group	t
36m move(s)	12.75±1.09	12.74±1.09	0.015
Double jump rope (n)	37.44±2.48	37.4±2.7	0.026
Level 3 leapfrog (m)	6.24±0.49	6.29±0.51	0.170
Approach height (m)	2.84±0.12	2.85±0.24	0.090
Approach throw (m)	7.47±1.19	7.35±1.36	0.159
From both ends (n)	33.34±5.98	33.24±5.78	0.029
20kg clean and jerk in 30 seconds	21.1±2.27	20.16±2.47	0.650
30-Second Incline Plank Crunches	20.25±4.38	19.71±4.9	0.190

Table 3. Comparison of core stability between experimental and control groups before and after the test.

Index	Test group	Control group	t
Lumbar Flexion Test(s)	97.22±20.74	98.57±20.79	0.107
Waist Extension Test(s)	75.6±18.78	76.58±19.97	0.083
Right Bridge Test(s)	25.09±6.64	25.35±6.16	0.066
Left Bridge Test(s)	21.82±6.11	23.05±5.1	0.358

Table 4. Physical fitness test between the experimental group and the control group before and after the test.

Index	Test group		
	Before experiment	After the experiment	t
36m move(s)	12.75±1.09	11.37±1.04	2.13
Double jump rope (n)	37.44±2.48	41.81±1.91	3.247
Level 3 leapfrog (m)	6.24±0.49	6.65±0.24	1.749
Approach height (m)	2.84±0.12	2.89±0.15	0.606
Approach throw (m)	7.47±1.19	9.13±1.29	2.206
From both ends (n)	33.34±5.98	40.47±4.52	2.215
20kg clean and jerk in 30 seconds (n)	21.1±2.27	27.57±2.68	4.284
30 Second Incline Plank Crunches (n)	20.25±4.38	25.92±4.32	2.144
Index	**Control group**		
	Before experiment	**After the experiment**	**t**
36m move(s)	12.74±1.09	12.76±1.11	0.031
Double jump rope (n)	37.4±2.7	39.47±1.59	1.539
Level 3 leapfrog (m)	6.29±0.51	6.51±0.35	0.648
Approach height (m)	2.85±0.24	2.86±0.19	0.08
Approach throw (m)	7.35±1.36	8.88±1.2	2.136
From both ends (n)	33.24±5.78	36.28±4.46	0.985
20kg clean and jerk in 30 seconds (n)	20.16±2.47	24.39±2.13	3.01
30 Second Incline Plank Crunches (n)	19.71±4.9	25.75±4.47	2.119

Table 5. The core stability index test between the experimental group and the control group after the test.

Index		Lumbar Flexion Test(s)	Waist Extension Test(s)	Right Bridge Test(s)	Left Bridge Test(s)
Test group	Before experiment	97.22±20.74	75.6±18.78	25.09±6.64	21.82±6.11
	After the experiment	136.3±13.64	120.51±16.78	42.26±6.67	39.41±5.44
	t	3.663	4.149	4.244	4.414
Control group	Before experiment	98.57±20.79	76.58±19.97	25.35±6.16	23.05±5.1
	After the experiment	118.08±13.29	97.98±16.3	34.22±5.37	31.81±5.66
	t	1.84	1.929	2.523	2.676

DISCUSSION

Core strength exercises focus on developing the stability and balance of the body's core muscle groups. This exercise aims to balance the musculature of a volleyball player's entire body. In this way, the volleyball players can obtain sufficient sports vitality during the game, which is beneficial to the physical stability of the players. In volleyball, the physical quality of players is an important guarantee to ensure the technical and technical level of various sports. Improving the physical fitness of volleyball players is an essential condition for volleyball competitions. The use of core strength training plays an essential role in improving the overall strength of the volleyball team.[10] The core muscles are the source of strength. It helps with body coordination and movement. In training volleyball skills, volleyball players need to master their strengths. This can lay a solid foundation for the application of volleyball technology. In volleyball, special techniques such as back row serve, back row spike, and long pass has special requirements on athletes' physical fitness. Core strength can maximize the core muscles of athletes in volleyball training. In this way, the energy transfer of its various parts can be adjusted to the greatest extent. Core strength training can promote athletes' energy transfer and improve the volleyball team's overall strength.

CONCLUSION

After 12 weeks of core stabilization exercises, the experimental group showed significant improvements in all physical qualities. The physical fitness of the experimental group was significantly improved than that of the control group. Enhancing the core strength of female volleyball players is beneficial to improving their speed, agility, and physical fitness.

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