EFFECTS OF STRENGTH TRAINING ON THE FEMALE ATHLETE'S LOWER EXTREMITY

EFEITOS DO TREINAMENTO DE FORÇA NAS EXTREMIDADES INFERIORES DAS ATLETAS

EFECTOS DEL ENTRENAMIENTO DE FUERZA EN LAS EXTREMIDADES INFERIORES DE LAS ATLETAS

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ABSTRACT

Introduction: The innovation and development of complex movements in aerobic gymnastics present higher demands for the athletes' overall qualifications. Objective: Analyze the effect of special lower limb strength training on the performance of female gymnasts. Methods: Four female gymnasts from sports colleges were selected as research targets. The method is discussed using literature materials, expert interviews, experimental methods, and mathematical statistics. Results: There was a significant difference in the athletes' body composition index before and after training (P<0.05). The exceptional quality of female aerobic gymnastics athletes after the special lower limb strength training was significantly elevated compared with that before the training. Conclusion: The strength training method used in this paper significantly improves the individual strength of the lower limbs of female gymnasts. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Gymnastics; Athletes; Strength Training.

RESUMO

Introdução: A inovação e o desenvolvimento de movimentos complexos na ginástica aeróbica apresentam maiores exigências para a qualificação geral das atletas. Objetivo: Analisar o efeito do treinamento de força especial de membro inferior no desempenho das ginastas femininas. Métodos: Foram selecionadas quatro ginastas femininas de faculdades de esportes como alvos de pesquisa. O método é discutido utilizando materiais de literatura, entrevistas com especialistas, métodos experimentais e estatísticas matemáticas. Resultados: Houve uma diferença significativa no índice de composição corporal das atletas antes e depois do treinamento (P<0,05). A excepcional qualidade das atletas de ginástica aeróbica feminina após o treinamento especial de força dos membros inferiores foi significativamente elevada em comparação com aquela antes do treinamento. Conclusão: O método de treinamento de força utilizado neste trabalho tem um efeito significativo na melhoria da força individual dos membros inferiores das ginastas femininas. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

***Descritores*:** *Ginástica; Atletas; Treinamento de força.*

RESUMEN

Introducción: La innovación y el desarrollo de movimientos complejos en la gimnasia aeróbica presentan mayores exigencias para la cualificación general de los atletas. Objetivo: Analizar el efecto del entrenamiento especial de la fuerza de los miembros inferiores en el rendimiento de las gimnastas. Métodos: Se seleccionaron cuatro gimnastas de escuelas deportivas como objetivos de la investigación. El método se discute utilizando material bibliográfico, entrevistas a expertos, métodos experimentales y estadísticas matemáticas. Resultados: Hubo una diferencia significativa en el índice de composición corporal de los atletas antes y después del entrenamiento (P<0,05). La calidad excepcional de las atletas de gimnasia aeróbica tras el entrenamiento especial de fuerza de las extremidades inferiores fue significativamente mayor que antes del entrenamiento. Conclusión: El método de entrenamiento de fuerza utilizado en este trabajo tiene un efecto significativo en la mejora de la fuerza individual de las extremidades inferiores de las gimnastas. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

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

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INTRODUCTION

The most prominent feature of competitive gymnastics is pursuing the technology's difficulty and novelty. This sport is mainly manifested by the arrangement and innovation of complicated movements, high standard movement specifications, and good stability. Competitive gymnastics has higher and higher requirements for athletes' exceptional physical fitness.[1] This study investigated the lower body-specific strength training of female gymnasts. At the same time, we evaluate the effect of improving the exceptional quality of athletes.

METHOD

Research objects

This paper selects four female gymnasts from sports colleges as the research objects. The basic situation is shown in Table 1. This paper tests the indicators reflecting the exceptional strength quality of the lower limbs of gymnasts.

Research methods

The author conducted field tests on one core stability quality and ten special physical fitness test items of 4 female gymnasts from

Table 1. Basic information on research objects.

NO.	Date of birth	height/m	Weight/kg	Level 3 all-around score/ point	Grade
Athlete A	2001-01	1.67	52	32.38	Sophomore
Athlete B	2001-11	1.63	52	35.30	Sophomore
Athlete C	2001-07	1.61	51	34.35	Sophomore
Athlete D	2001-01	1.56	50	36.00	Sophomore

March to July 2021. In this paper, the random error, systematic error, conditional error, and other factors are controlled to a minimum.[2] This paper strictly controls the primary test, test items, sequence, time, instruments, and conditions in the whole test process.

Attitude analysis model of competitive aerobics athletes

Assuming that (u, v) is the coordinate of the joint point of the human body on the image. The corresponding (X, Y, Z) is the joint point coordinate in the three-dimensional space of the human body, and then the formula (1) can be obtained:

$$\begin{cases} u = f * X_c / Z_c \approx f * X_c / \overline{Z} \\ \upsilon = f * Y_c / Z_c \approx f * Y_c / \overline{Z} \end{cases} \quad (1)$$

Set $s = f / \overline{Z}$ as the scale factor. We can use formula (1) to derive the following formula (2):

$$\begin{bmatrix} u \\ \upsilon \end{bmatrix} = s \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} X_c \\ Y_c \\ Z_c \end{bmatrix} \quad (2)$$

If the focal length of the camera can conform to $f \to \infty$, then equation (3) holds:

$$f / Z_c \to 1 \quad (3)$$

Formula (4) is obtained by combining formula (1) and formula (3):

$$\begin{cases} u = X_c \\ \upsilon = Y_c \end{cases} \quad (4)$$

$dZ = Z_1 - Z_2$. The joint points in any two spaces have a line segment distance of length 1. (X_1, Y_1, Z_1) and (X_2, Y_2, Z_2) represent two joint points. Its corresponding (u_1, v_1) and (u_2, v_2) are the joint point coordinates of the plane.[3] There will be a certain relative depth between nodes. We denote dZ and R satisfies dZ.

Mathematical Statistics

This paper uses SPSS15.0 software to perform routine statistical processing on the test data.

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

RESULTS

After the special strength training of the lower limbs, the athletes leaned against the wall for handstand 45°, and the test values of controlled handstand increased the most. Leaning against a wall for a 45° handstand increases the time by 40s. Inversion control time also increased by 30 to 40s. This article adopts the particular strength training method for lower limbs to improve the athletes' exceptional quality and sports level.[4] The athletes coached by the author finally successfully passed the qualification test for the second-level gymnasts. This paper uses the all-around performance as the dependent variable y. We used standardized particular quality data and standardized 8-point star test data as independent variables. At the same time, the original data of the regression equation was input into SPSS17.0 software to test the regression equation. The model summary shows the correlation coefficient r=0.977. The coefficient of determination was 0.977. The adjustment coefficient of determination is 0.926. The standard error of the estimate is 0.20137. This shows that the regression equation holds.[5] Analysis of variance results showed that the mean square of regression was 1.306, the mean square of residuals was 0.041, F=119.342, P=0.009<0.07. This shows that the linear regression equation is significant. The partial regression coefficient analysis shows that the constant item is 26.493, and the coefficient of the exceptional quality item is 0.096. The coefficient of the 8-point star test item is 0.007. From this, the regression equation is obtained as the core comprehensive index= 26.493 + 0.096 × standardized exceptional quality data + 0.007 × standardized 8 - point star test data. We standardize the pre-training special quality data and the 8-point star test data and first calculate the mean and standard deviation of the pre-training special quality. We then normalized the data for each specific quality. Next, calculate the mean and standard deviation of the 8-point star test before training. We standardize the data of each special quality of the 8-point star test before training. Compare the difference in the core composite index before and after training.[6] We substitute the standardized data of the special quality before and after training and the 8-point star test into the core comprehensive index formula to obtain the comprehensive core index before and after training. (Table 2)

Table 2 shows the paired sample t-test on the core composite index of gymnasts before and after training results: the mean is -1.185. The standard deviation is 0.17683, t=-16.415, P=0.000<0.05. This shows a significant difference in the core composite index of athletes before and after training. After special strength training for lower limbs, the special qualities of gymnasts were significantly improved compared with those before training.[7] This shows that special strength training methods for lower limbs have a pronounced effect on improving the special quality of female gymnasts.

DISCUSSION

The author believes that the effect of lower limb special strength training on improving the exceptional quality of female gymnasts is based on the following reasons.

First of all, female gymnasts must keep the body balanced on the rotation axis during the rotation of one-leg rotation, ring jumping, and inversion rotation on the equipment.[8] Through the special strength training of the lower body, the strength of the erector spinae muscles of the athletes has been strengthened. This allows the athlete to complete the movement by rotating around the longitudinal axis to ensure accuracy. The core stability of the body is enhanced during the special strength training of the lower limbs to promote the momentum transfer of the

Table 2. Comparison of standardized results of the core composite index before and after training for female gymnasts.

Name		Athlete A	Athlete B	Athlete C	Athlete D
Exceptional quality data standardization results	Before training	-17.1019	-9.0092	-12.9997	-7.0791
	After training	-7.0667	9.3762	2.9629	10.4609
8-point star test data normalization results	Before training	6.3779	0.3749	9.7309	-6.1777
	After training	-4.7667	-7.0201	1.767	-11.6133
Core Composite Index	Before training	27.06	27.9	27.43	26
	After training	26.01	27.17	26.74	27.3
Paired sample t test		t=-16.417	df=7	Sig.(2tailed)=0.000	

upper and lower limbs. The reaction force of the ground is effectively transmitted to the upper and lower limbs. And the force of the muscles of the lower limbs on the ground is adjusted. This improves coordination between technical movements of the lower body. The special strength training of lower limbs has improved the transfer efficiency of the force. This allows for the coordinated combination and control of muscle capacity.[9] At the same time, this can also enable athletes to mobilize the muscles of the whole body while effectively improving the quality of movements and their specific physical fitness.

Secondly, female gymnasts must rely on solid core strength to complete various high-altitude somersaults and rotations in the air. Lower body special strength training enables athletes to have a good sense of control of the muscles in the core area. This ensures that it can perform various aerial maneuvers with high quality. Core stability training involves mobilizing a variety of muscles.[10] At the same time, it needs to participate in the action. This requires the efficient work of individual muscles and the cooperation of different muscles. Core stability training improves the body's neural stability. This enables the body to precisely coordinate the relevant muscles during exercise.[11] This enhances the core stability of the body and reduces the need for energy expenditure. The method prolongs the time of the body's stable movements, thereby improving the exceptional physical quality of the gymnast.

Finally, the female gymnast's body is compressed and twisted when the movement is completed. The compression load of the athlete's body is equivalent to about ten times its body weight. A small center of gravity instability will make the athlete's entire movement fall short.[12] The exceptional strength training for the lower body emphasizes the training of the gymnast's body balance and stability. This increases the area of the athlete's core area. This training improves the gymnast's landing stability and strengthens the psychological suggestion of the gymnast's safe landing.[13] This has laid a solid physical and psychological foundation for improving its exceptional quality. At the same time, the exceptional strength training of the lower limbs consolidated the stable center of gravity of the body's core muscles. It promoted the effective transmission of force.[14] This training enhances the synergistic strength and stability of the upper and lower limbs to improve the exceptional quality of gymnasts.

We suggest that a long-term lower body-specific strength training program should be developed for the strength training of gymnasts. We need to consider the characteristics of gymnastics fully. The coaches develop the core strength of gymnasts in a purposeful and targeted manner by combining the movement form and strength conduction mode of specific movements.[15] In gymnast strength training, coaches need to include lower body-specific strength training as part of strength training. We combine traditional strength training to develop core strength and coordination in gymnasts better. At the same time, coaches should further optimize the evaluation index of lower limbs' special strength training effect for gymnasts.

CONCLUSION

The comparison of the particular physical fitness of female gymnasts before and after training proves that the core training of the system can effectively improve the exceptional physical fitness of female gymnasts. Special strength training for the lower body strengthens the muscle group strength of the erector spinae of the athlete. This allows the athlete to always complete the movement by rotating around the longitudinal axis. This ensures the accuracy of the action. Lower body-specific strength training enables athletes to have a good sense of muscle control in the core area. This can help athletes complete various body twists, flips, and strenuous movements. The special strength training for the lower body emphasizes the training of the gymnast's body balance and stability. This can expand the core area of the athlete. This sport improves the stability of gymnasts' landing and strengthens the psychological suggestion of a safe landing. This has laid a solid physical and psychological foundation for improving extraordinary quality. The systematic lower limb exceptional strength training to improve the remarkable physical quality of female gymnasts is only the beginning. Lower body strength training can improve the stability of a single movement and then improve the quality and stability of a set of movements.

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