# PHYSICAL CONDITIONING AND CORE STRENGTH TRAINING IN FEMALE COLLEGE AEROBICS GYMNASTICS ATHLETES

*TREINO DE CONDICIONAMENTO FÍSICO E FORÇA DO CORE NAS ATLETAS UNIVERSITÁRIAS DE GINÁSTICA AERÓBICA*

*ENTRENAMIENTO DE ACONDICIONAMIENTO FÍSICO Y DEL CORE EN ATLETAS UNIVERSITARIAS DE GIMNASTICA AERÓBICA*

**Original Article**
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## ABSTRACT

Introduction: Competitive aerobics is a high-level sport that has the achievement of the championship and the pursuit of excellence as its primary objective. Strengthening the core is an integral part of sports training. Personalized core strength training for athletes in aerobics gymnastics is critical for sports success. Objective: To study the core strength training of university aerobics gymnastics athletes exploring its effects on physical conditioning and skills. Methods: After the literature survey, mathematical statistics discuss core strength training methods focused on female aerobics college athletes. Results: Women's aerobics athletes' static squats, full squats with weights, and load intensity directly interfere with the difficulty and performance of aerobic movements. This experiment's organizing hip supine, push-up, and abdominal control are very significant. Conclusion: Core strength training helps improve the physical conditioning of female college aerobics athletes. **Evidence Level II; Therapeutic Studies – Investigating the results.**

**Keywords:** Gymnastics; Physical fitness testing; Resistance Training; Athletes.

## *RESUMO*

*Introdução: A aeróbica competitiva é um esporte de alto nível que tem como objetivo principal a superação do campeonato e a busca da excelência. O fortalecimento do core é parte importante do treino esportivo. Um treino de força do core personalizado para atletas em aeróbica é fundamental para o êxito esportivo. Objetivo: Estudar o treino de fortalecimento no core das atletas universitárias de ginástica aeróbica explorando seus efeitos sobre o condicionamento físico e habilidades. Métodos: Após o levantamento bibliográfico, utiliza-se de estatísticas matemáticas para discutir os métodos de treino de força do core focado em atletas universitárias de aeróbica. Resultados: Os agachamentos estáticos das atletas de aeróbica feminina, agachamentos completos com pesos e intensidade de carga interferem diretamente no nível de dificuldade e desempenho dos movimentos aeróbicos. Nesse experimento, organizar o apoio supino do quadril, flexão de braço, e controle abdominal são muito significativos. Conclusão: O treino da força do core ajuda a melhorar o condicionamento físico das atletas universitárias de aeróbica.* **Nível de evidência II; Estudos Terapêuticos - Investigação de Resultados.**

***Descritores*:** *Ginástica; Testes de Aptidão Física; Treinamento de Força; Atletas.*

## *RESUMEN*

*Introducción: El aerobismo competitivo es un deporte de alto nivel que tiene como principal objetivo la superación del campeonato y la búsqueda de la excelencia. El fortalecimiento del core es una parte importante del entrenamiento deportivo. Un entrenamiento de fuerza del core personalizado para atletas en aerobismo es de fundamental importancia para el éxito deportivo. Objetivo: Estudiar el entrenamiento del core de las atletas universitarias de gimnastica aeróbica explorando sus efectos en la condición física y las habilidades. Métodos: Tras el estudio de la literatura, se utiliza la estadística matemática para discutir los métodos de entrenamiento del core centrados en las atletas universitarias de aerobismo. Resultados: Las sentadillas estáticas de las atletas de aerobismo, las sentadillas completas con pesas y la intensidad de la carga interfieren directamente en el nivel de dificultad y el rendimiento de los movimientos aeróbicos. En este experimento, para organizar el apoyo de la cadera en posición supina, la flexión del brazo y el control abdominal son muy significativos. Conclusión: El entrenamiento del core ayuda a mejorar la condición física de las atletas de aerobismo universitario.* ***Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.***

***Descriptores:*** *Gimnasia; Pruebas de Aptitud Física; Entrenamiento de Fuerza; Atletas.*



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## INTRODUCTION

Core strength training is an important part of sports training. However, today's core strength training is still extensive in terms of methodology, load control, and special adaptability. Starting from a scientific point of view and using the advantages of interdisciplinary to promote performance improvement is a key issue. Competitive aerobics is a high-level sport with the direct purpose of winning the championship and striving for excellence. It is based on anaerobic metabolism exercise.[1] The exercise intensity is high, the time is short, the speed is fast, the movement is difficult, the changes are many, and the technique is complicated. The completion of the four types of difficult movements stipulated in the rules of the game, the smoothness and amplitude of the movements, and the coordination and stability in the body center changes are directly related to the strength of the core strength. Therefore, this article only does a preliminary theoretical study on the core strength training of female competitive aerobics athletes from 18-20 years old. This helps athletes complete various difficult movements and achieve excellent results.

## METHOD

### Research object

This article takes 10 young female competitive aerobics athletes as the research objects.[2] Volunteers are all second-level athletes. Age is 18-20 years old. The training period is 3-4 years.

### Research methods

Before training, we test the core strength of 20 players. Finally, 10 athletes were selected as the research objects. After fully ensuring that there is no significant difference between the experimental and control groups in the core strength level before training, they are divided into the experimental and control groups, each with 5 people. The content of the experiment is that the experimental group conducts specialized core strength training with optimized training methods.[3] The control group was trained with other non-preferred training methods. Train 3-4 times a week (the training program will be carried out every other day). Each training time is 1.5 hours. The experimental design is shown in Table 1.

The experiment determined 5 test indicators to conduct comparative tests to verify the practicability of this paper. The content includes two-foot single-arm push-ups, acute angle, leg support, hanging legs, split-leg jumps, standing high body forward bending.

### Aerobics simulation human body design

This article uses a homogeneous transformation matrix to describe the movement of human limbs.[4] The advantage of this technology is that it can uniformly describe the position and posture to flexibly transform and map the movement of the limbs in different coordinate systems. The specific steps are:

**Table 1.** The core strength training program of the experimental group.

| | Training content | Practice method | Load/kg | Time/ frequency | Intermittent/s |
|---|---|---|---|---|---|
| Lower limb strength | Static squat | - | The 30s | 20 | 1×2 |
| | Full squat | 50-80 | 30s | 180(6-2) | ×2 |
| | Weight-bearing squat | 70-10 | 30s | 180(6-2) | ×2 |
| Waist and abdomen strength | Lie on your back with hips | - | 30s | 30-45 | 1×4 |
| | One-arm push | - | 30s | 30 | 1×4 |
| | Control abdomen | - | 30s | 45 | 1×4 |
| Flat bench press | push-ups | - | 10 | 45 | 15×4 |
| | Upper body strength | 30-50 | 10 | 180 | 10×6 |

The first step is to construct a limb $B$ around a joint $A$. The coordinate in space coordinate system $(x, y, z)$ is $(x_B, y_B, z_B)$. If the rotation angle of the joint around the center point $A$ in the space coordinates is $\alpha, \beta, \gamma$ respectively. Thus, the homogeneous square matrix transformed by limb $B$ in the coordinate system $A$ is obtained by changing the rotation matrix.

$$ {}^{A}_{B}T = \begin{bmatrix} {}^{A}_{B}R & {}^{A}_{B}P \\ 0 & 1 \end{bmatrix} \begin{bmatrix} r_{11} & r_{12} & r_{13} & 0 \\ r_{21} & r_{22} & r_{23} & 0 \\ r_{31} & r_{32} & r_{33} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (1) $$

Therefore, by reusing formula (1), the homogeneous transformation matrix of the joint $B$ in the world coordinate system can be obtained as:

$$ {}^{W}_{B}T = \left( \prod_{i=-1}^{n-1} {}^{i}_{i+1}T \right) * {}^{n}_{B}T \quad (2) $$

The joint's angular velocity and linear velocity in the world coordinate system can be obtained by formulas (1) and (2) combined with the Jacobian matrix. At the same time, we get the trajectory and direction of the limbs.

### Mathematical Statistics

We use SPSS software and Excel to analyze all data and information. Use the difference t-test method to test.

## RESULTS

### Comparison and analysis of the two sets of data before and after the experiment

The results in Table 2 show that there are significant differences before and after the experiment. The P values were lower than 0.05, and all five indicators were significantly improved.[5] This shows that this experimental method effectively improves the core competence of the research objects and is worthy of promotion.

Core strength training improves the body's control ability by improving strength, coordination ability, balance ability, and the movement's effectiveness in an unstable state. This training trains the balance and control ability of the nerve-muscle system and proprioception by adjusting the unstable body state by oneself.[6] Usually, an important principle of the core strength training program is to coordinate the work of many muscle groups during exercise, rather than to isolate a joint to do work when completing movements like gravity lifting. The purpose of stability training is to mobilize the small deep muscles of the trunk to participate in sports. Special attention is that core strength training is different from traditional strength training. It enables the muscles of the lower back and abdomen to do work simultaneously during training. To a certain extent, all sports must work together with the core parts to complete, and only a very small number of muscle groups are isolated.

**Table 2.** Comparison of various indicators before and after the experiment.

| Index | Forward | Rear | t | p |
|---|---|---|---|---|
| Push-ups with two feet and one arm | 14.96±1.35 | 10.867±1.843 | 5.467 | <0.05 |
| Acute angle and leg support | 3.76±0.83 | 2.099±0.67 | 6 | <0.05 |
| Hanging leg lift | 13.53±0.703 | 10.067±1.58 | 6.045 | <0.05 |
| Split-leg jump | 13.06±0.89 | 10.199±1.638 | 6.703 | <0.05 |
| Standing high body forward bending | 31.06±2.282 | 28.799±3.52 | 1.108 | <0.05 |

Although static half squats, full weight-bearing squats, and weight--bearing half-squat mainly mobilize the strength of the lower limbs, the whole body and coordinated effort of the entire body mobilize small deep muscle groups to participate in sports.[7] In this experiment, the effect of arranging supine hip support, single-arm push-up, and abdominal control are very significant. Because this exercise method is a functional power chain exercise, it requires the subject to move the end of the lower limbs and hip joints while moving the end of the upper limbs and shoulder joints and maintain the straight posture of the abdomen. This coincides with core strength training usually requires at least a static fulcrum for static exercises. In particular, control of the abdomen is described as a training method to increase strength while considering the compression and shear forces of the shoulder joint. This exercise helps to control the transmission of strength within a tolerable range and strengthen the strength of the shoulders.

In addition, the core stability strength is very different from the traditional waist and abdomen strength training. Core stability training involves the entire trunk and pelvis muscles, especially focusing on the training of small muscle groups located in the deep layers.[8] In the practice method, the centripetal contraction fixed at one end is used, but the static contraction fixed at both ends is emphasized. One-dimensional movement is carried out in the direction of movement, and two-dimensional and three-dimensional movements are emphasized. Regarding training methods and means, the core stabilization strength is lighter, and many exercises are even exercised to overcome self-weight with bare hands. At the same time, one of the main functions of the core stabilizing force is to control the body's center of gravity. Therefore, the force is trained under unstable conditions in many cases. This enables more small muscle groups to participate in the exercise. This sport cultivates athletes' ability to stabilize joints and control their center of gravity during exercise.

## DISCUSSION

### Core strength and its training

There have been many inconsistencies in people's understanding of "core power." One of the most important disputes is the understanding and definition of "core" and "core area." The "core power" mentioned by people now usually refers to the power in the core area of the human body.[9] But the term "core power" does not have this specific function. Because human movement depends on the project, its core parts will be different. Core strength is a broader concept. Different sports have different pertinence. There are many types of core strength training methods. A more comprehensive classification divides core strength training into stable and unstable types and one-dimensional, two-dimensional, and three-dimensional types of unarmed and weight-bearing.

### The dynamic characteristics of modern competitive aerobics

According to the event group theory, competitive aerobics belongs to the "skills category of difficult and beautiful events." It is the same as the competitive events of the same group, such as gymnastics, figure skating, and diving. In the competition, the athlete's skill level is judged by the difficulty, novelty, stability, and grace of the movements completed.[10] Modern competitive aerobics is moving toward more graceful movements, avoiding repetition and symmetry of movements, diversified movements, and greater difficulty. This puts forward higher requirements for athletes' body control ability, maintaining movement range, and high-quality completion of movements when completing various difficulties. Difficulty moves in Group C are used the most, so to a large extent. The completion quality of group C exercises directly affects the completion quality of the whole exercises and whether they can achieve excellent sports performance. Analyzing the movement characteristics of difficulty of the C group, it has higher requirements for athletes' core ability. The main function of core strength training is to strengthen the stability of the spine and pelvis during exercise.[11] At the same time, this exercise can improve the stability of the core and the endurance of the core muscles. Enhance the ability of nerves to control muscles, and increase the energy output from the core to the limbs and other muscle groups during exercise. Improve coordination efficiency between the upper and lower limbs and the entire movement to reduce energy consumption and improve energy utilization. This makes technical actions more economical and effective.

## CONCLUSION

After the experiment, the five indicators are all significantly different and statistically significant. This shows that this experimental method is effective in improving the core competence of the research object. Youth competitive aerobics core strength training involves the muscles of the entire torso and pelvis. Therefore, in the practice method, the centripetal contraction with one end fixed and the static contraction with the two ends fixed are emphasized. In the direction of movement, not only one-dimensional movement but also two-dimensional and three-dimensional movement are emphasized.

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