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Article

# The influence of aerobics core strength training on the quality of students' difficulty element

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**Abstract:** Aerobics is a comprehensive sport, which requires participants to have good muscle strength and coordination ability in the process of training. With the continuous development of aerobics, the completion quality of difficulty element has become an important index to evaluate students' Aerobics level. Among them, the strength training of core muscle group is particularly important for the completion quality of Aerobics difficulty element. The core muscle group includes abdominal muscle, back muscle, hip joint surrounding muscle, etc., which provide stability and strength for the trunk and support for the movement of upper and lower limbs. Core strength training can strengthen the body control ability of Aerobics Gymnastics athletes, maintain the posture of athletes, promote the coordination of athletes' limbs, and help athletes achieve good results. Therefore, this study aims to explore the influence of Aerobics core strength training on the quality of students' difficulty element.

**Keywords:** aerobics; core strength training; difficulty element

## 1. Introduction

Aerobics is a sport that integrates fitness, entertainment and competition. The quality of difficulty element is one of the important standards to measure the level of aerobics [1]. With the continuous development of aerobics, people have higher and higher requirements for their competitive level. In the Aerobics Gymnastics competition, the completion quality of difficulty element directly affects the score and ranking of athletes [2]. Therefore, how to improve the quality of students' Aerobics difficulty element has become an important topic in the current aerobics teaching and training. As a new training method, core strength training has been widely used in the field of competitive sports in recent years [3]. Core strength training can not only improve the core stability and body control ability of athletes, but also prevent sports injuries and improve sports performance [4]. From the existing research, core strength training is helpful to improve the body control ability of Aerobics Gymnastics athletes [5]. Core strength is a kind of strength ability that is classified by the anatomical part of the human body and juxtaposed with upper and lower limb strength, and its purpose of force generation is mainly to stabilize the core part of the human body, to control the center of gravity, to transmit upper and lower limb strength, and to optimize the generation, transmission, control, and utilization of strength [6].

From the perspective of sports anatomy, the core muscle group, as a hub connecting the upper and lower limbs, plays a key role in transmitting strength and stabilizing the body during exercise [7]. The core muscle group includes rectus abdominis, transversus abdominis, multifidus, erector spinae, gluteus maximus and so on. These muscles work together to maintain the core stability of the human body. However, at present, there is no in-depth research on the specific force mode of the

core muscles and the cooperation mechanism between them in the process of completing the difficult movements of Aerobics Gymnastics. In terms of exercise physiology, the mechanism of core strength training on neuromuscular system needs to be further explored. The existing research has not yet given a comprehensive and in-depth explanation of how core strength training can improve the control ability of nerve to muscle, improve the efficiency of muscle recruitment, and then improve the quality of difficult movements [8]. At the same time, the relationship and influence between core strength training and other physical quality training also need more research to clarify. From the point of view of the characteristics of the difficult movements of Aerobics Gymnastics, all movements are multi-joint, multi-muscle group, multi-dimensional whole-body movements under the control of the core strength, and the size of the core strength and the stability of the core parts directly affect the athlete's ability to control the body [9].

Modern Aerobics Gymnastics competition is the stability and quality of the completion of difficulty element. Good body core strength is the guarantee of maintaining body balance, stability and high success rate of difficulty element [10]. Core strength training is conducive to the exertion of Aerobics Gymnastics Athletes' special strength. In the whole set of movements of Aerobics Gymnastics, the relationship between Aerobics movements and difficulty element is more complex. The completion of the three groups of difficulty element requires strong and stable core muscle groups to provide support [11]. Therefore, the quality of completing the three kinds of difficulty element of Aerobics Gymnastics ABC element is closely related to the strength of core strength. Integrating core strength training into the daily training of Aerobics Gymnastics can provide teachers with the basis for scientifically selecting training methods and making plans, optimize teaching and improve students' competitive level; It can help students clarify the value of core strength training, reduce training blindness, tap potential and improve performance.

Based on this, this study puts forward a comprehensive hypothesis: in Aerobics Gymnastics training, compared with traditional strength training, core strength training can significantly improve students' core strength and core stability, and then more effectively improve the quality of students' difficult movements, so that students can achieve higher scores in the completion of various difficult movements.

## 2. Research objects and methods

### 2.1. Research object

30 professional athletes of Capital University of Physical Education And Sports who passed the inclusion and exclusion criteria were selected as the research object. The 30 athletes in this study were divided into experimental group and control group. In the control group, there were 7 male athletes and 8 female athletes; The average age was 20.68 ± 1.69 years old, the average height was 176.32 ± 5.28 cm, and the average weight was 55.33 ± 2.56 kg. There were 7 male athletes and 8 female athletes in the experimental group; The average age was 21.19 ± 1.72 years old; The average height was 175.63 ± 5.67 cm and the average weight was 56.21 ± 3.28 kg. There was no significant difference between the two groups ($p > 0.05$).

## 2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Aerobics athletes; (2) The age range is 18–25 years old; (3) Voluntarily join the research project and sign the informed consent form; (4) Actively cooperate with the training arrangement throughout the whole process, ensure that the number of core strength training participation is not less than 3 times per week, and accept periodic movements on time to complete the quality assessment.

Exclusion criteria: (1) Individuals with unresolved sports injuries such as muscle strains, fractures, ligament tears, etc.; (2) People with chronic diseases such as diabetes, heart disease or extreme physical discomfort during physiological period; (3) Training conflict and interference, who are participating in other physical strengthening and strength training projects.

## 2.3. Training content

All participants received professional training for 8 weeks. The control group received traditional strength training based on the strengthening of difficulty element. The experimental group carried out core strength training on the basis of difficulty element training and traditional strength training. The training program adopted a step-by-step approach from foundation to improvement, and divided the training of athletes into two stages. The first stage is basic training, and the second stage is consolidation and improvement. The core strength training is as follows: in the first stage (1–3 weeks), the basic strength is enhanced through the training of body straight-line control and horizontal back muscle extension. In addition, the training effect will be comprehensively improved by means of lateral straight-line control, hip flexion and supine hip lifting, lateral opposite elbow and foot support, and leg arm cross from both ends. Each training is divided into 5 groups, and the training time and times are strictly controlled. In the second stage (4–8 weeks), the training program was adjusted to further consolidate and improve. Including dumbbell logging, lunge solid ball lifting and swinging, pushing and passing solid ball or forward lunge holding solid body turning, as well as hanging leg lifting, barbell body forward bending, etc. Each training is still divided into 5 groups, and the number of training has increased. Each group has 1 minute rest after training. Through gradual and targeted training programs, the core strength of athletes can be comprehensively improved.

## 2.4. Evaluation method

### 2.4.1. Strength test indicators of core parts

The strength evaluation indexes of core parts include: back muscle flexion, two head rise and side waist rise, involving strength burst and endurance test. When the training time is less than 30 s, there is no significant difference in the test results of athletes; After more than 30 s, the test results are significantly different, which can reflect the difference of athletes' core strength. In terms of endurance test, when the time is less than 45 s, the difference is small; The test time is more than 45 s, and the results are significantly different, which can reflect the difference of athletes' core endurance. In order to reserve a certain experimental error space, we set the core strength burst test time as 45 s and the core endurance test time as 60 s.

### 2.4.2. Core stability test indicators

The core stability test content is divided into two parts: static core stability test and dynamic core stability test. The core stability test under static state includes eight level pitching bridge test, six level pitching bridge test and five level side bridge test. The core stability test under dynamic state includes prone foot pad Swiss ball test, supine foot pad Swiss ball test and side lying foot clip Swiss ball test.

### 2.4.3. Completion quality test of difficulty element

The jury will score the students on the spot according to the specific requirements and evaluation standards of the quality test of the completion of difficulty element in Aerobics Gymnastics. The test includes three groups of ABC difficulty element used by high school students in their regular training, one for each type. Each action needs to be completed three times, and the referee will score the completion of the three times respectively. The total score of a single difficulty element test is 15 points, and the full score of each completion is 5 points. The test covers the completion of three groups of ABC element (**Table 1**).

**Table 1.** quality and price standards for completing difficulty element.

| Difficulty | Action requirements | Scoring criteria |
|---|---|---|
| Group A | HELICOPTER 1/1 TURN TO PUSH UP | Each difficulty element is worth 5 points, 5 points for completion, 3–4 points for minor mistakes, 1–2 points for medium mistakes, and 0 point for major mistakes |
| Group B | 1/2 TURN PIKE JUMP 1/2 TWIST TO PUSH UP | |
| Group C | DOUBLE ILLUSION | |

## 2.5. Statistical methods

SPSS 25.0 was used to process the experimental data. The data of each group were expressed by mean ± standard deviation ($x \pm s$). The significant differences between groups were compared by *t* test, and the significant differences within groups were compared by repeated analysis of variance ($p > 0.05$, no significant difference; $p < 0.05$, significant difference).

# 3. Research results

## 3.1. Core strength test results and analysis

From the statistical data in **Table 2**, it can be seen that the explosive force levels of the core parts of the two groups of students before the experiment are roughly the same. There is no difference in the test scores of the two groups of students in the 45 s supine two head up, 45 s prone dorsal muscle, 45 s side waist up right and 45 s side waist up left ($p > 0.05$). After 8 weeks of training, the scores of the two groups of students were improved, but the improvement effect of the experimental group was better than that of the control group, and the scores of the two groups were significantly different ($p < 0.05$). This shows that core strength training has a more obvious role in promoting the development of muscle explosiveness of Aerobics Gymnastics athletes than traditional strength training.

**Table 2.** comparison of explosive force test results for two core parts.

| Group | *n* | 45 s supine from both ends/piece | | 45 s prone dorsal muscle/piece | | 45 s side waist up (right)/piece | | 45 s side waist up (left) /piece | |
|---|---|---|---|---|---|---|---|---|---|
| | | Before | After | Before | After | Before | After | Before | After |
| Experimental group | 15 | 31.58 ± 7.36 | 40.66 ± 2.22 | 33.13 ± 2.85 | 39.84 ± 1.99 | 22.73 ± 1.55 | 25.98 ± 1.85 | 20.33 ± 1.77 | 24.49 ± 1.96 |
| Control group | 15 | 32.31 ± 5.17 | 34.12 ± 4.67* | 33.81 ± 2.66 | 35.23 ± 2.53* | 22.18 ± 2.41 | 23.56 ± 2.41* | 20.92 ± 2.13 | 21.71 ± 1.95* |

Note: * indicates significant difference between the two groups, $P < 0.05$.

From the statistical data in **Table 3**, it can be seen that the endurance levels of the two groups of students in the core parts before the experiment are roughly the same, and there is no difference between the two groups of students in the test results of 60 s supine from both ends, 60 s prone back muscle, 60 s side waist right and 60 s side waist left ($P > 0.05$). After 8 weeks of training, the endurance test scores of the experimental group and the control group were improved. After the experiment, there were significant differences between the experimental group and the control group in the test results of 60 s supine from both ends, 60 s prone dorsal muscle, 60 s lateral lumbar from right and 60 s lateral lumbar from left ($p < 0.05$). This shows that core strength training has more advantages over traditional strength training in the development of endurance of Aerobics Gymnastics athletes.

**Table 3.** comparison of endurance test results for two core parts.

| Group | *n* | 60 s supine from both ends/piece | | 60 s prone dorsal muscle/piece | | 60 s side waist up (right)/piece | | 60 s side waist up (left)/piece | |
|---|---|---|---|---|---|---|---|---|---|
| | | Before | After | Before | After | Before | After | Before | After |
| Experimental group | 15 | 56.22 ± 5.99 | 63.63 ± 5.84 | 51.32 ± 6.91 | 60.73 ± 3.09 | 41.64 ± 4.45 | 49.68 ± 2.22 | 36.63 ± 3.06 | 40.48 ± 3.13 |
| Control group | 15 | 55.47 ± 5.37 | 57.94 ± 5.93* | 52.24 ± 4.69 | 56.55 ± 3.14* | 43.92 ± 4.03 | 45.63 ± 3.09* | 35.77 ± 3.13 | 37.12 ± 2.96* |

Note: * indicates significant difference between the two groups, $P < 0.05$.

## 3.2. Core stability test results and analysis

It can be seen from **Table 4** that the static core stability level of the two groups of students before the experiment is roughly the same. Before the experiment, there is no difference between the two groups of students in the four data comparison test results of grade eight pitching bridge, grade six overhead bridge, grade five side bridge right and grade five side bridge left ($P > 0.05$). After 8 weeks of training, the static core stability test scores have improved. After the experiment, there was a significant difference between the two groups in the test results of grade eight pitching bridge, grade six pitching bridge, grade five side bridge right and grade five side bridge left ($p < 0.05$). This shows that the core strength training is more effective than the traditional strength training in the development of the static core stability of Aerobics Gymnastics Athletes' bodies.

**Table 4.** comparison of two sets of static core stability test results.

| Group | *n* | Eight level bridge/s | | Six stage overhead bridge/s | | Class V side bridge (right)/s | | Fifth stage side bridge (left)/s | |
|---|---|---|---|---|---|---|---|---|---|
| | | Before | After | Before | After | Before | After | Before | After |
| Experimental group | 15 | 44.58 ± 15.36 | 82.52 ± 18.45 | 22.33 ± 4.83 | 40.25 ± 8.16 | 16.82 ± 6.14 | 24.21 ± 3.16 | 14.83 ± 4.37 | 24.32 ± 3.16 |
| Control group | 15 | 45.81 ± 13.92 | 58.57 ± 19.15* | 22.72 ± 4.21 | 31.76 ± 7.75* | 16.44 ± 4.91 | 19.51 ± 5.16* | 14.23 ± 4.73 | 17.87 ± 6.61* |

Note: * indicates significant difference between the two groups, $P < 0.05$.

From the data in **Table 5**, it can be seen that the dynamic core stability level of the two groups of students before the experiment is roughly the same. Before the experiment, there is no significant difference between the two groups of students in the four test results of prone mat, supine mat, lateral pinch right and lateral pinch left ($P > 0.05$). After 8 weeks of training, the dynamic core stability test scores have improved. After the experiment, there was a significant difference between the experimental group and the control group in the test results of prone foot pad ball, supine foot pad ball, lateral foot Clip Ball right and lateral foot Clip Ball left ($p < 0.05$). This shows that core strength training has a more obvious role in promoting the development of dynamic core stability of Aerobics Gymnastics Athletes' side lying face than traditional strength training.

**Table 5.** comparison of two sets of dynamic core stability test results.

| Group | n | Prone foot mat ball/s | | Supine foot mat ball/s | | Side lying foot clamping ball (right)/s | | Side lying foot clamping ball (left)/s | |
|---|---|---|---|---|---|---|---|---|---|
| | | Before | After | Before | After | Before | After | Before | After |
| Experimental group | 15 | 50.71 ± 6.93 | 58.23 ± 3.98 | 33.72 ± 4.99 | 41.76 ± 7.13 | 25.64 ± 3.16 | 29.25 ± 2.82 | 25.72 ± 3.37 | 29.38 ± 2.67 |
| Control group | 15 | 50.95 ± 8.07 | 51.25 ± 7.85* | 34.23 ± 4.98 | 34.47 ± 4.37* | 24.82 ± 3.32 | 25.93 ± 3.09* | 24.71 ± 3.26 | 25.43 ± 3.27* |

Note: * indicates significant difference between the two groups, $P < 0.05$.

## 3.3. Quality results and analysis of difficulty element

It can be seen from the data in **Table 6** that there is little difference between the two groups before the experiment in the quality of difficulty element. There was no significant difference in the test scores of Group A, Group B and Group C difficulty element between the two groups ($P > 0.05$). After 8 weeks of training, the two groups of students' performance in the completion quality of difficulty element after the experiment improved, and there were significant differences between the two groups in the completion quality test of Group A, Group B and Group C difficulty element after the experiment ($P < 0.05$). This shows that core strength training is superior to traditional strength training in improving the quality of Aerobics Gymnastics Athletes' difficulty element.

**Table 6.** comparison of quality test results for completing two difficult actions.

| Group | *n* | A/score | | B/score | | C/score | |
|---|---|---|---|---|---|---|---|
| | | Before | After | Before | After | Before | After |
| Experimental group | 15 | 6.99 ± 0.62 | 9.96 ± 0.79 | 4.76 ± 1.13 | 7.66 ± 0.73 | 7.13 ± 0.59 | 9.81 ± 0.88 |
| Control group | 15 | 7.49 ± 1.07 | 9.96 ± 1.01* | 4.68 ± 0.96 | 4.97 ± 0.97* | 6.98 ± 0.52 | 7.19 ± 0.74* |

Note: * indicates significant difference between the two groups, $P < 0.05$.

## 4. Discussion

Aerobics Gymnastics is a high-level sport. Participants not only need to complete complex and difficulty element, but also need to ensure excellent movement quality [12]. Excellent physical quality is the key to ensure the perfect completion of the movement, so in the Aerobics Gymnastics training, physical quality training is very important. Athletes need to adopt more scientific and effective training methods to improve their physical quality. Aerobics Gymnastics requires athletes to continuously complete Aerobics movements, difficulty element and various skill connecting movements under the rhythm of competitive music [13]. The trainer needs to carry out core strength training to improve the control ability of the core area, solve the problems of unstable trunk and uncoordinated limb movements caused by the shift of center of gravity and spatial changes in the process of movement, and improve the quality of difficulty element [14]. At present, traditional strength training methods are often used in Aerobics Gymnastics training [15]. However, with the continuous innovation and expansion of sports events and the change of rules, new requirements are put forward for athletes, and more targeted, scientific and reasonable training methods are needed. Therefore, this study intends to explore whether core strength training is more conducive to improving the difficulty element quality of athletes' Aerobics Gymnastics trainers than traditional strength training through experimental comparison.

Compared with the existing literature, the results of this study are consistent with most relevant research conclusions. Ozmen T and other scholars found that core strength training can effectively improve the athletes' related sports ability when studying the impact of core strength training on the dynamic balance and agility of adolescent badminton athletes [16]. In this study, the experimental group improved the core strength of Aerobics Gymnastics athletes more significantly than the control group, $P < 0.05$; The experimental group has a good effect on improving the dynamic core stability of athletes, $P < 0.05$; The experimental group has a good role in promoting the completion quality of athletes' Group A, Group B and Group C difficulty element, $P < 0.05$. This further confirmed the positive role of core strength training in improving athletes' performance. However, the research of Nambi G and others on football players shows that under certain circumstances, traditional training methods may have unique advantages in relieving pain and improving sports performance [17]. This suggests that in Aerobics Gymnastics training, we should not completely abandon the traditional strength training, but should explore the reasonable combination of the two.

The reason why the core strength training can achieve better results may be that the core muscle group, as a hub connecting the upper and lower limbs, plays a key role

in maintaining physical stability and transmitting strength in the difficult movements of aerobics. Core strength training strengthens the strength and coordination of core muscle groups through targeted movements, so that athletes can more accurately control the body center of gravity and reduce shaking and errors when completing movements. Therefore, it is suggested to increase the proportion of core strength training in the Aerobics Gymnastics training system. Coaches can make personalized core strength training programs according to students' individual differences. For students with weak core strength foundation, they can focus on basic movement training at the initial stage, such as four-point support, flat support, etc., and gradually enhance the strength of core muscle groups; For students with a certain foundation, it can increase the difficulty, introduce unstable equipment training, and further improve the core stability and strength control ability. The sample size of this study is relatively small, which may affect the universality and representativeness of the research results. Future research can expand the sample scope to cover athletes of different regions and levels, and further verify the conclusion of this study.

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**Conflict of interest:** The author declares no conflict of interest.

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