

Assessing the Impact of Crossfit Exercise - Based Fitness Activities to The Physical Fitness of Line Dancers

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Abstract: Experimental analysis and research were conducted on the practice and application effects of CrossFit training for line dance athletes at Chengdu University. The CrossFit training program lasted for six weeks, and the researcher collected data through observation and notes during the actual experiment. The specific experimental results showed that CrossFit training significantly improved the strength of the students. In terms of balance training, the pre-training group who did not undergo CrossFit training, had noticeably lower balance abilities compared to the post-training group. This indicated that CrossFit training is greatly beneficial for linedance athletes. Regarding flexibility, the post-training group, who underwent CrossFit training, exhibited noticeably higher flexibility compared to the pre-training group. In terms of speed, the post-training group's speed significantly increased after CrossFit training, suggesting that it greatly enhances the speed of linedance athletes. Based on these results, the paper specifically presented training plans and suggestions. The recommendations highlighted that each athlete's physical constitution and capabilities and responses. Therefore, the first step is to devise training plans. CrossFit training has proven to be highly effective in improving muscle strength, flexibility, and balance. Hence, the next step is the comprehensive application of CrossFit training, followed by focusing on flexibility and balance training, such as schedule at least one day of yoga or Pilates training per week; Strengthening speed and agility exercises, such as short-distance sprints and agility training at least twice a week. Pay attention to personalized training and establish a regular evaluation mechanism.

Keywords: Line Dancers; CrossFit training; Post-training group; Pre-training group.

1. Introduction

In recent years, line dance sports have seen significant growth, with competitions becoming increasingly competitive. The evolution of training methodologies for line dance teams has been a critical factor in this development. Competitions now demand athletes not only to exhibit high levels of technical skill and expressiveness but also to maintain superior physical fitness. This has placed a spotlight on the unique requirements of line dance athletes, who must blend artistic performance with athletic prowess, highlighting a distinctive aspect of this study's focus. Physical fitness serves as a fundamental prerequisite for athletes to execute high-quality technical and tactical maneuvers. The physical condition of line dance athletes directly impacts the progress of competitive line dancing within our nation.

In February 2020, the State General Administration of Sports underscored the importance of basic physical training through the issuance of the "Notice on Further Strengthening Basic Physical Training to Make Up for the Short Board of Physical Quality." This directive highlighted the necessity of integrating the comprehensive development of young people's physical quality with specialized training from the grassroots level of sports training. It aimed at significantly enhancing the physical quality and functions of young athletes through dedicated physical training programs.

Line dancing is a popular fitness exercise that combines music and artistic performance, in which participants form a certain formation under music accompaniment, and use organized dance steps that match the accompaniment music through changes in movement direction, dance step combinations, and upper limb movements (Wang, 2020). On

the one hand, the project has strong inclusiveness and can carry cultural diversity, specifically covering dance cultures from different countries, such as jazz, waltz, Irish dance, street dance, and other dance elements. Using multiculturalism as a carrier, it enables the public to subconsciously understand and learn about the cultural backgrounds and connotations of different countries when practicing choreography (Sun, Wang, 2021). Physical fitness, embodying essential athletic abilities such as strength, speed, endurance, coordination, flexibility, and agility, forms a crucial component of an athlete's competitive capabilities. Yet, the specific application of these principles to the nuanced requirements of line dance athletes represents an underexplored area, marking a significant research gap that this study addresses. Through tailored physical training, athletes can significantly improve their physical functions, training, and competitive techniques, while maintaining the stability of their physical condition during training and competitions.

The emphasis on "sports" and "health" was notably reiterated by Xi Jinping, the General Secretary of the CPC Central Committee, President of the State Council, and Chairman of the Central Military Commission, in his report to the 20th National Congress on October 16, 2022. Advocating for the comprehensive development of both mass and competitive sports, Xi Jinping's report underscored the acceleration towards building a strong sports nation as a pivotal goal in the modernization of a socialist country. This broader strategic context enriches the significance of our study, which seeks to contribute to these national objectives through the lens of line dance sports.

The introduction of line dance into China as an

international sport and fitness movement aligns with the "Healthy China Strategy," serving as a foundational project for sports development and a cornerstone in building a robust sports nation. Line dancing, characterized by its diverse dance forms and styles, requires athletes to possess not only physical fitness but also sophisticated dance step techniques and choreographic innovation. Despite the burgeoning popularity and clear alignment with national health and sports development goals, the domain of physical training specific to line dance remains conspicuously under-researched. Searches conducted on Google and CNKI, China's authoritative scientific network, using keywords such as "physical training of line dancers" and "line dance training methods," yield no relevant studies, highlighting a significant research gap.

This paper aims to address this gap by exploring the effects of CrossFit exercise-based activities on the physical fitness level of line dancers. CrossFit, a novel muscle strength training method, distinguishes itself by enabling significant improvements in muscle strength with minimal additional loads. This study will innovatively apply CrossFit within the context of line dance, exploring its possible impact on the overall performance of the line dancers. By leveraging advanced training concepts and techniques, this research seeks to enhance the physical conditioning and overall performance capabilities of line dancers, contributing to the advancement of competitive line dancing and supporting the transition of China from a major sports country to a sports powerhouse.

The development status of line dance program and the importance of physical fitness training

The "14th Five-Year Plan" period is an important stage for China to enter a new journey of building a socialist modernized country in an all-round way. The "Proposal of the Central Committee of the Communist Party of China on the Formulation of the Fourteenth Five-Year Plan for National Economic and Social Development and the Visionary Goals for the 23rd Five-Year Plan" explicitly puts forward the need to further inherit and carry forward the excellent traditional Chinese culture, and to enhance the influence of Chinese culture on the world stage. As an international fitness sport, line dance has been participated by enthusiasts from all over the world in recent years, gradually setting off an international line dance fitness boom. At present, line dance organizations of various countries are taking the competition works as the form of cultural output, gradually integrating the cultural elements of their own countries, and showing the world the unique charm of their culture and the elegance of the times. In order to further meet the growing spiritual and cultural needs of the people, according to the realistic changes in the international line dance competition environment and the development goal of China's line dance, in April 2013, the Gymnastics Management Center of General Administration of Sport of China and the National Center for Promoting Line Dance and Square Dance (renamed as China Trampoline and Skills Association Line Dance Branch in 2021) expert group comprehensively initiated the project of "Excavating and Inheriting Chinese Traditional Sports Culture". The expert group of the National Center for the Promotion of Line Dance and Square Dance (renamed as China Trampoline and Skill Association Line Dance Branch in 2021) launched the "Excavation and Inheritance of China's Traditional Sports Culture" Line Dance Piloting Activity, initially taking the national style of line dance as the entry point, digging into the

traditional sports culture of China's nationalities, and exploring the fit point of integrating and innovating the elements of the Line Dance and China's excellent traditional sports culture. Based on the attributes of the international platform of volleyball dance, it will effectively broaden the way of Chinese volleyball dance to inherit China's national traditional culture, consolidate the cultural characteristics of China's volleyball dance, enhance the cultural self-awareness and cultural self-confidence of the people, push forward the in-depth implementation of China's strategic objectives of cultural construction in the period of the 14th Five-Year Plan, and help China's volleyball dance gradually move towards the center of the world stage. In April-May 2021, this study interviewed domestic experts in the field of line dance and learned that since the introduction of line dance to China in 2004, it has been gradually popularized to all provinces and cities in the country with its popular fitness form and diversified sports style, and has been widely loved by the people.

Steps are an important element of the line dance program, which contains a total of 64 basic steps and 12 transition steps, and the choreography of the line dance set consists of basic steps and multiple transition steps, and the strength of the completed movements and the overall level changes reflect the diverse characteristics and spirit of the line dance. By analyzing the international volleyball dance competition rules and the video of the National Volleyball Dance Championship in 2019-2022, it is found that focusing on the quality of the completion of all the movements in the set, the degree of excellence of the choreography of the set, and the athletes' expressive power. So for the athletes themselves, the perception and control of the limbs is an important factor for the athletes to achieve excellent results. Steps are irreplaceable elements in line dance programs, and accurately completing the standard movement techniques of basic steps is an important factor in achieving good results. In order to enable athletes to better complete the standard basic dance steps, it is necessary to ensure the basic physical quality of athletes, and constantly improve the athletes' ability to complete the basic dance steps, so that the overall strength of the sports team can be improved. How to improve the athletes to complete the basic step movement technical ability, has become a line dance coaches have been concerned about the problem.

The physical quality training of line dance athletes includes general body training and specialized body training. The general body training includes strength training, speed training, flexibility training, endurance training, coordination training of limbs and so on. For coaches and teachers, how to correctly teach and guide students to master the basic step movement technology, how to improve the students' special basic ability in the fastest speed, has become the most core problem of line dance coaches and teachers. Line dance steps require clear and accurate steps, stable body coordination and correct style when completing the movements. In China Line Dance Championship, different teams showed the phenomenon of uneven quality of basic steps. The appearance of this phenomenon is caused by the unscientific training method of coaches on the characteristics of basic steps and basic steps of line dance. Improving the training efficiency of line dance step movement technology, enriching the training methods of line dance, attracting more athletes to enter the family of line dance, and improving the technical level of line dance are important ways to better promote and develop line

dance. The future innovative development path of row dance aims to deeply explore the cultural elements of ethnic sports, based on their material connotations in human social life, guided by the new expectations of the people for a better sports life, and aimed at serving the comprehensive development of the economy and society as well as human beings (Bao,2019).

2. Statement of the Problem

The purpose of this study is to determine the impact of CrossFit Training on the physical fitness attributes of line dancers. This study aimed to dissect the multifaceted nature of physical fitness enhancements attributed to CrossFit interventions, thereby providing a comprehensive evaluation of its impact to the physical fitness of the line dancers. To achieve this aim, the research is meticulously designed to address the following pivotal questions:

Specifically, it sought to answer the following questions:

What is the level of the physical fitness of the line dancers before and after the implementation of the CrossFit Training in terms of the 4 fitness tests below?

1.1. Strength: to be assessed through the line dancers' performance in the Standing Long Jump test, which serves as a proxy for lower body strength and explosive power.

1.2. Balance: to be assessed through the Single-leg Closed-eye Timing Test, offering insights into the line dancers' equilibrium and postural control capabilities.

1.3. Flexibility: to be assessed through the Sit-and-reach test, providing a measure of the line dancers' lower back and hamstring flexibility.

1.4 Speed: to be assessed through the 50 Meter Dash, reflecting the line dancers' sprint speed and acceleration prowess.

2. Is there a significant difference between the pretest scores of the line dancers before the intervention and the post test score after the intervention?

3. Based from the result of the study, what enhanced training plan can be proposed?

3. Hypotheses

Ho1: There is no significant difference between the pretest score of the line dancers before the intervention and the post test score after the intervention.

4. Methodology

4.1. Research Design

The researcher utilized the quantitative method particularly the quasi-experimental research design.

One group of respondents underwent the Crossfit training program for six weeks. The researcher employed the experiment from March 2024-April 2024. The training schedule was scheduled 3-4 times a week, with each session lasting one and a half hours at Chengdu University Physical Fitness Gym as well as the indoor basketball court.

1 Training Instruments

(1) Load bearing sandbag vest (adjustable weight)

A sandbag vest is a common fitness equipment that many people buy to wear for exercise. The sandbag vest has the characteristics of safety and hygiene, comfortable wearing, convenient use, and not limited by the venue, quickly improving explosive power, bouncing power and sensitivity, and enhancing endurance.

(2) flexi-bar

The flexi-bar is a new type of portable training device, which is a kind of intelligent training that can maximize the ability of the body including balance, strength and coordination. The Flexi-bar can be used to train the arm and rotator cuff muscles and improve the stability of the rotator cuff joint, as well as to train the stability of the core muscles, the coordination and control of the body's muscles, and to improve the overall level of the athlete's basic skills. This kind of reaction can improve the athlete's body coordination and stability, and can effectively exercise the control ability of basic hand position movement techniques.

(3) Leather tape measure and tape measure

The tape measure is mainly used to test the physiological form of the subject, and the tape measure is used to measure the jumping ability performance.

(4) Barbell (40 kilos and below)

Barbells were mainly used in this experiment for maximal strength testing and to provide weights for the subjects' training, thus applying exercise loads and influencing the training effects.

(5) Seated Forward Bend Tester

The Seated Forward Bend Tester (JH2010-TQ) will be used in this study to test the range of motion of the trunk and hip joints at rest, which accurately responds to the quality of body flexibility.

(6) Single-leg closed-eye tester

In this study, the closed-eye single-foot standing tester (JH2010-ZL), which can automatically test the time of closed-eye single-foot standing, and accurately respond to the balance of the human body, with a range of 0-999.9 seconds, and a measurement accuracy of ± 0.1 seconds.

4.2. Research Locale

The study was conducted among the Physical Education Major students at Chengdu University in Sichuan Province.

Founded in 1978, Chengdu University is one of the first batch of full-time general undergraduate institutions sponsored by local cities after the reform and opening up.

In the 2022 Times Higher Education World University Rankings, the school entered the top 100 universities in China for the first time, ranking 77th domestically, ranking 1001-1200 among global universities; in the 2022 Times Higher Education Asian University Rankings, it ranked No. 1 among universities in mainland China 86-92, 351-400 in Asia.

Disciplines and majors: There are now 10 disciplines and 69 undergraduate majors in art, literature, management, education, economics, law, engineering, medicine, science, and agriculture. There are 9 first-level disciplines authorized for master's degree, 16 categories of professional master's degree authorized, and a post-doctoral innovation practice base. 27 majors have entered the Ministry of Education's "Double Ten Thousand Plan" first-class undergraduate major construction sites, including 15 national-level first-class professional construction sites and 12 provincial-level first-class professional construction sites. In the 2022 Times Higher Education World University Subject Rankings, clinical and health disciplines rank 601+ globally, and engineering disciplines rank 801-1000 globally; in the 2022 Times Higher Education Third Edition China Subject Ratings, 7 Discipline on the list.

4.3. Population

This study selected 42 Physical Education major students

of Chengdu University as the research subjects.

They must be in good health, without any major diseases, Familial hereditary disease or physical defects; They have at least one year of experience in gymnastics, dance training, or other specialized training, and are students with certain athletic abilities and the same level of athletic ability. Understanding informed consent forms and they are all voluntary participants; they were able to avoid taking part in hazardous activities or taking stimulant-type beverages or food during the experimental period; they were able to guarantee that they would take the training and testing seriously during the experimental period, and would obey the experimental arrangements.

4.4. Technique

Throughout the experimental process, the researcher was accompanied by instructors specializing in human science and coaches specializing in line dance to guide and cooperate with each other, in order to guarantee the smooth implementation of the experimental work to ensure that the experimental results are more effective.

4.5. Research instrument(Validation)

The researcher utilized the following instruments:

1 Line Dancer Level Test Standard. It is an instrument certified by the International Line Dance Federation to measure the level of a line dancer and represent the overall line dance level of a line dancer. The individual skill level of this experiment was mainly based on the physical fitness tests evaluation, this was analyzed and evaluated by obtaining the level of physical fitness of the line dancers.

2 Physical fitness test standards for college students. This experimental study is based on the evaluation standards of college students' physical fitness test, and selected some evaluation standards of body shape and physical fitness indexes, and statistically analyzes the changes before and after the experiment. It tested physical fitness tests such as strength, balance, flexibility and speed.

4.6. Data gathering procedure

The following procedures were conducted by the researcher in order to obtain the data required for the investigation.

1.Pre -Data Gathering Procedure

The researcher obtained permission from the Adamson University Ethics Review Board to ensure the ethical reliability of the study. The researcher requested permission from the president of the institution for her to conduct the study.

Prior to data collection, the validity of the research instrument were checked by experts in the field of physical education and the participants will be identified. The researcher sought data collection support from the dissertation thesis adviser and the Dean of the Graduate School.

Informed consent from the line dancers were sought to ensure that the study complied with the ethical norms of research. There was no more consent needed because the respondents were no longer minors.

After approval from the supervisor, the researcher consulted with the head of department on the details of data collection.

2.Actual Data Gathering Procedure

The researcher conducted the experiment for six weeks and

recorded the training results.

3.Post Data Gathering Procedure

The researcher gathered quantitative data through excel spreadsheets and these data were processed using appropriate SPSS tools. The researcher ensured that data privacy would be strictly observed by protecting the anonymity and confidentiality of the data, regulating data access, data security and data processing.

The data was properly organized and analyzed utilizing these statistical tools:

Mean. This was used to determine the line dancers' level of physical fitness prior and after the administration of the CrossFit Training. The physical fitness level of the line dancers in terms of strength, speed, balance and flexibility was assessed.

t-test. This was used to test for significant differences in line dancers' levels of physical fitness prior and after the intervention-CrossFit Training.

5. Results and Discussion

Table 1. Summary results: Strength Test Results Before and After Training

Result	(F)Frequency		Result	(M)Frequency	
	Before	After		Before	After
Below180cm	2	0	200-250cm	10	2
181-190cm	2	3	251-260cm	10	9
Over191cm	8	9	Over261cm	8	17
Total	14	14	Total	28	28

From the table1, it can be seen that the test results of standing long jump have changed overall before and after training. The average before training is 238.9 centimeters, and the average after training is 252.8 centimeters. Among them, the passing level below 180cm of female students after training is 0, all concentrated in the two levels of good and excellent; Among them, 9 people exceeded the excellent level of 191cm, an increase of 1 person compared to before. After training, boys were concentrated at two levels: good and excellent, with 17 people exceeding 261cm, an increase of 9 people compared to before. Human strength and quality are the foundation of all sports. When engaging in sports activities, people mainly use the muscles of various parts of the body to achieve different exercise loads and contraction rates, thereby enabling passive and organ bones to move. After 8 weeks of routine training, the students (control group) of the aerobics team at Xuchang University showed a significant improvement in the performance indicators of strength (60 second two head start, standing long jump) in general physical fitness (Ma, 2022). The focus of CrossFit training is on high-intensity, short-term interval training, and even uninterrupted training, which can increase the trainer's muscle circumference, increase muscle fibers, enhance their ability to overcome internal forces, and thus enhance their strength and fitness. The above all indicate that after a period of physical training, leg strength can be better consolidated and exercised, especially in improving the lower limbs in specialized physical fitness. CrossFit training on improving strength quality will be very significant. CrossFit training can make the strength of line dancers effectively strengthened, in the training of CrossFit training mode, with barbell front squat, weighted banana swing, freehand deep squat, freehand squat jump, over head squat and other movements of the line dancers training, CrossFit training of the line dancers after the

physical fitness qualities are improved, the quality of the strength of the quality of the obvious impact of the competition. The metabolism of line dancers in the competition is mainly anaerobic metabolism supplemented by aerobic metabolism, at the same time, good upper and lower limb strength is the basis of victory in the competition, and better strength and endurance is the guarantee of continuous performance of technical movements on the field of play, it is concluded from the above study that CrossFit training has a significant effect on the strength of physical fitness of the line dancers, and there are both static and dynamic training methods in the whole training process. In the whole training process, there are static training means and

power training means, the combination of the two actions, for the core part of the muscle to play a deep level of stimulation, can strengthen the control of the core muscles, the enhancement of the core strength, which makes the athletes in the competition to play the line dance technique can achieve the desired control effect as well as play the technical and tactical to maintain the balance of the body. Compared with other physical training, CrossFit training can significantly improve the trainer's technique and tactics, and this is also true in line dancing, where stable core strength and long-lasting strength and endurance play an important role in the process of competition for sparring athletes.

Table 2. Summary: Balance Ability Test Results Before and After Training

	before training -Left Balance	before training-right balance	after training -Left Balance	after training-right balance
Mean	33.419	29.40	104.81	110.26
median	29.000	20.00	95.50	98.00
mode	12.0a	11	88	77a
Min value	4.0	6	39	61
Mac value	163.0	225	191	214

There are multiple modes present. The minimum value is displayed.

From the table, it can be seen that the results of the single leg closed eye timing test have changed before and after training. The average left balance before training was 33.4 seconds, and the average left balance after training was 104 seconds; The average right balance after training is 29 seconds, and the average right balance after training is 110 seconds. From the data, it can be seen that the average left balance test result after training has increased by 71.391 seconds compared to the pre training left balance test result, and the average right balance test result after training has increased by 80.86 seconds compared to the pre training right balance test result. The growth rates of left and right are significant and close. In line dance, sometimes there are some difficult balance movements that require athletes to maintain a state of balance, and there are not many balance exercises in CrossFit physical training, but in the experiments, the balance cycle exercises can promote athletes to maintain a static balance, and help athletes to improve the sense of balance, because the body will be regulated through the brain nerves when standing on one leg. In line dance, athletes sometimes need to complete the vertical movement with short T-hand position, and the way of holding dumbbells with both hands adds a certain degree of difficulty on the basis of one-legged balance, which is helpful for athletes to carry out the balance in the vertical movement to a certain extent. In addition, the weight lifting in the CrossFit theory includes jerk, deep squat, and hard pull, etc. These movements need to be completed by athletes in a balanced state, and through continuous repetition, it can improve athletes' strength, movement speed, and accuracy, and also promote the development of athletes' body balance. According to the problem of poor balance among athletes, the experimental group mainly controls their body to maintain balance through single leg dumbbell balance exercises. Many weight-bearing exercises in CrossFit physical fitness training have already provided assistance for athletes' body balance training (Wu, 2021). Chen Yuexia found that CrossFit fitness training has a significant impact on the body shape and balance ability of members by applying it to fitness classes in fitness clubs

(Chen, 2019). The results show that different samples significantly improve their balance level after training compared to before, indicating that after a certain period of training, the improvement of balance is effective.

(4) Flexibility Test Results Before and After Training

Table 3. Summary: Flexibility Test Results Before and After Training

Result	(F)Frequency		(M)Frequency	
	Before	After	Before	After
Below5.2cm	4	0	6	0
6-17.9cm	6	3	16	13
18-20.9cm	1	2	3	12
21-25.8cm	2	8	3	3
Over25.8cm	1	1	0	0
Total	14	14	28	28

From the table, it can be seen that there have been changes in the sitting and stretching test results after training compared to before. The average value before training is 11, and the average value after training is 17. Both men and women showed significant improvement in data results after training compared to before. Before and after training, the flexibility of girls is better than that of boys. After training, girls concentrate on good and excellent levels, while boys concentrate on passing and good levels.

Flexibility is the ability to reflect the range of movement of soft tissues such as muscles and ligaments around the joints, which is determined by the length of soft tissues and the ability to stretch, and is one of the basic qualities of the organism to carry out sports. Suitable for good flexibility is one of the basic conditions for athletes to have good physical condition, but also in a variety of sports can complete a variety of actions in the basic place, daily learning and life, no matter it is sitting posture, gait or other basic activities, all to flexibility as a basic premise. Regularly participate in physical exercise than the infrequent activity of the quality of flexibility is better, this is because a long time to sit still or fixed other posture will make certain muscle groups and

ligament tissue become stiff, the result is that the corresponding muscle groups or ligament tissue become more normal circumstances to short and win, the ductility of the reduction. Therefore, maintaining normal or good flexibility is essential for a healthy daily life and helps to improve the athlete's ability to perform and cope with activities of daily living. The quality of elasticity is an important physical quality of the human body. It refers to the range of motion of the body's joints, as well as the elasticity and extensibility of ligaments, muscles, tendons, skin and other tissues. Developing the quality of elasticity increases both the range of motion and the strength of the movement, reducing the chance of injury. The quality of elasticity can affect the movement technology during the game, so it is important to use a reasonable method of training in the development of the quality of flexibility, which is of great significance for the improvement of the level of sports technology. According to the anatomical structure of the human body, flexibility includes the flexibility of the upper limbs, trunk and lower limbs. Developing flexibility means training the flexibility of joints. In all kinds of sports, flexibility training should be carried out according to different project characteristics. For line dance sports, the training of flexibility is not only to show the collective performance ability of the athletes, but also the inevitable requirements of the rules of line dance on the technical movements, the quality of flexibility has an important position and role in the teaching of line dance courses. Generally speaking, the flexibility quality of girls is better than that of boys, which is determined by the structure and function of girls' motor organs. Girls' muscle fibres are thinner and longer, with a smaller cross-sectional area, their stretch is better, and there are fewer restrictions on joint activities, thus girls' flexibility is higher than boys; secondly, girls' peri-articular tissues are smaller in size, the joint capsule is looser, and ligaments and tendons and so on contain a large amount of water, so the elasticity and stretch are better. The better quality of flexibility of those who exercise in life than those who do not is due to the fact that those who do not exercise.

In Cai's (2019) experiment, 10 members were used as experimental samples and a 12 week Crossfit training intervention was conducted, which tested sitting forward bending, clean and jerk strength, squat strength, and 2400 meter running. The results show that Crossfit training can effectively improve the flexibility and other exercise elements of fitness enthusiasts. Bat conducted a 9-week experiment to analyze the effects of CrossFit training and cycle training on the anaerobic endurance, aerobic endurance, and flexibility of trainers. It was found that both CrossFit and cycle training have a positive impact on the physical function and fitness of athletes, but the former has a much greater impact on the physical function and flexibility of athletes. The results show that the overall sample has significantly improved flexibility after training compared to before, indicating that after a certain period of training, it is effective for improving flexibility.

(5) Speed test results before and after training

From the table, it can be seen that the results of the speed test have changed before and after training. The average before training is 8.13s, and the average after training is 7.6s. After training, the speed and quality of both girls and boys have improved. Among them, after training, girls have increased their excellent level by 3 people compared to before training, and boys have increased their excellent level by 2

people compared to before training. One male failed before training, and the number of male failures after training is 0. From this, it can be seen that the speed improvement effect after training is significant. After training, both boys and girls are mostly at a good level. The quality of speed refers to the ability of the human body or a part of the human body to move quickly, that is, the ability of the human body or a part of the human body to react quickly to movement, to complete movement quickly and to move quickly.

Table 4. Summary: Speed test results before and after training

Result	(F)Frequency		Result	(M)Frequency	
	Before	After		Before	After
7.5-7.9S	4	7	6.7-6.9S	0	2
8.0-8.4S	4	3	7.0-7.9S	22	25
8.5-10.3S	6	4	8.1-9.1S	5	1
			Over9.1S	1	0
Total	14	14	Total	28	28

The original German Schmolinsky put forward the relationship between the nervous system and speed: "Speed is the ability to complete all kinds of movements regulated by the nervous system of the organism and based on the muscular system". Canada's Bompá will give the definition of speed is concise and generalised speed is the body's "ability to carry out displacement per unit of time". Professor Guo Jiaxing of China divided the quality of speed into two parts, one is the reaction time, i.e. reaction speed, and the other is the ability of the organism or a part of the organism to complete the movement quickly, i.e. movement speed. So in summary, although the concept of speed quality is different in each research and analysis in the verbal summary, the connotation expressed is the same: speed quality includes three aspects, namely, the ability of the organism or a part of the organism to respond quickly to various signal stimuli, the ability to complete the movement quickly, and the ability to carry out the displacement quickly during the movement.

This is consistent with the results of Feng (2022) in the experiment. Feng Lili explored the training effect of Crossfit training on sprint specific students, mainly using experimental methods. 20 sprint specific students were selected as experimental samples, and Crossfit training was conducted 3 times a week for 40 minutes each time. The experiment lasted for 8 weeks of training intervention. The results showed that the sample showed significant improvement in track and field specific tests such as 30 meter sprint, 60 meter sprint, 300 meter run, and solid ball. The results showed that the overall sample showed a significant improvement in speed after training compared to before, indicating that after a certain period of training, the speed improvement was effective.

2.1 Results of strength training

As can be seen from the table, the paired t-test was utilized to study the variability of the experimental data, a total of 1 group of paired data, and showed variability ($p < 0.05$). Specific analysis shows that: between the pre-training group-strength and the post-training group-strength presents a significance at the level of 0.01 ($t = -9.914$, $p = 0.000$), as well as specific comparison of the differences shows that the mean value of the pre-training strength (238.90), will be significantly lower than the mean value of the post-training group-strength (252.83), indicating a significant experimental result. The average strength value of the pre-training was 238.90 centimeters while the average value of the post-

training was 252.83 centimeters. This significant improvement indicates that the CrossFit-trained athletes outperformed the non-trained athletes in terms of strength. Overall, CrossFit training has a positive effect on improving strength quality (Yang Qinghua, 2019), which shows that CrossFit training has a significant effect on general physical fitness, and the physical fitness training of line dance speciality has higher requirements on general physical fitness, so it should be actively explored in the application of the speciality of line dance. CrossFit training has a good adaptability to the project, and for the speciality of line dance, adjusting the training means and training mode according to the characteristics of the project makes the experimental

intervention positively improve the physical fitness of college students (Qu Jiaojiao, 2021). CrossFit training has a good adaptability to the project, for the speciality of line dance, according to the characteristics of the project to adjust the training means and training mode, so that after the experimental intervention of the college students in the speciality of physical fitness has a positive enhancement (Qu Jiaojiao, 2021), the line dancers want to achieve better results, can dance more coordinated, explosive line dance movement effect and ideal visual effect, then the athlete's cardiorespiratory fitness and strength quality have great requirements.

Table 5. Paired t-tests for Strength Before and After Training

Item	Mean	Standard	<i>t</i>	<i>p</i>	Decision on No	Interpretation
Pre -training	238.90	26.36	-9.914	0.000**	Rejected	Significant
Post -training	252.83	24.34				

Legend. Sig<0.05, level of significance

After 5 weeks of experimental intervention of CrossFit training, it was found that the training method could effectively enhance the students' upper limb strength and cardiorespiratory fitness, and at the same time, it also had a great improvement on the students' explosive power, which laid a solid foundation for the line dancers to achieve a good performance in the competitions. Compared with traditional physical training, CrossFit training is more conducive to improving the quality of balance, and the improvement of strength is also more significant for the desired training effect, CrossFit training can be tailored to the needs of various physical qualities, and compared with traditional physical training, it has a significant change in the improvement of the quality of speed and strength (Song Weiye, 2021), and the improvement of power and endurance as one of the qualities of power. Endurance, as one of the strength qualities, is also an indispensable physical quality in the speciality of line dance.

CrossFit training is committed to the development of the human body's top ten capabilities, regardless of whether the training action is aerobic or gymnastics or weightlifting, will have a certain impact on the quality of strength in the action exercise, especially weightlifting training action, almost all of them are weighted barbells or weighted medicine balls or kettlebells, because in the lifting of weights not only need to

be strong upper body strength, but also need to be certain that the core power to To keep the torso stable, the quality of strength will slowly improve over time, which in turn will play a role in the enhancement of the combination of strength movements. In terms of the training programme and the mode of training, CrossFit training focuses more on upper body strength, lower body strength and core strength.

This finding is consistent with the findings of Xiajixiang (2019), after Crossfit training, the cardiorespiratory function and muscle function of the sample were evaluated. Xie Chengliang conducted a 12 week comparative experimental intervention on the physical fitness of 107 physical education students, and found that there was a significant difference in strength quality between the two groups after the experiment(Xie,2022).CrossFit training emphasizes the use of high-intensity, short intervals, and even no breaks to train trainers, in order to increase their muscle circumference, thicken muscle fibers, and improve their ability to overcome internal and external forces. Crossfit training focuses more on improving the muscle recruitment ability of athletes, in order to enhance their strength performance. Therefore, the effect of CrossFit training on improving strength quality will be very significant.

2.2 Results of balance before and after training

Table 6. Validation of the Effect of Paired t-tests on Balance Before and After Training

item	Mean	Standard deviation	<i>t</i>	<i>p</i>	Decision on No	Interpretation
pre-training Left Balance	33.42	27.52	-11.40	0.000**	Rejected	Significant
post-training Left Balance	104.57	35.31				
pre-training-Right Balance	29.40	39.25	-12.10	0.000**	Rejected	Significant
post-training-right balance	110.26	36.95				

Legend. Sig<0.05, level of significance

As can be seen from the table, the paired t-test was utilized to study the variability of the experimental data, as can be seen from the above table: a total of 2 groups of paired data, both of which will show variability (p<0.05). Specific analysis can be seen: The pre-training - left balance and the post-training - left balance show a significance at the level of 0.01 (t=-11.403, p=0.000), as well as a specific comparison of the differences can be seen that the mean value of the pre-training left balance (33.42), will be significantly lower than the mean value of the post-training - left balance (104.57).The difference between the pre-training right balance and the post-training-right balance showed a

significance at the 0.01 level (t=-12.095, p=0.000), as well as the difference in the specific comparisons showed that the mean value of the pre-training right balance (29.40), would be significantly lower than the mean value of the post-training-right balance (110.26).In total, all of the 2 sets of paired data will show variability. Balance is crucial in line dance movement, not only in relation to performance elegance and technical accuracy, but also as a key factor in the prevention of athletic injuries. These significant improvements may be due to the effects of specific balance training or an overall physical training program. Fang Yu also found through experimental research that students' balance

quality has been effectively improved after undergoing CrossFit physical training. He believes that this is related to the improvement of deep small muscle groups through this training. Therefore, he suggests making certain improvements to CrossFit physical training and incorporating it into campus physical training (Fang, 2018). These results may indicate that specific training methods targeting balance are effective in enhancing the performance of line dancers. This is consistent with Sun(2021) study that there has been a significant improvement in muscle strength, flexibility, agility, and body composition after Crossfit. This may include balance board training, core stability training, and coordination training.

Balance is the ability of the organism to maintain a stable posture and state in a stable or unstable state. Balance in a stable state is necessary for the organism in its daily life, while balance in an unstable state is the ability of the neuromuscular tissues to spontaneously regulate and maintain the organism's ability to maintain a normal posture when it is in an unstable working state, which generally requires an appropriate amount of training to be performed well. The body's ability to maintain a normal posture requires an appropriate amount of training to perform well. In the body, strength, speed and endurance and other hard qualities usually rely on the surface of the large muscle groups to control and co-ordinate, and balance is to mobilise all parts of the body, especially the deep small muscle groups to participate in the regulation, so from the body's balance ability we can easily see the development of its deep muscle groups, the development of the deep

muscle groups is conducive to the body to better control itself, improve the efficiency of movement, save the use of force, and improve the efficiency of movement, and save the use of force, and improve the efficiency of movement. The development of deep muscle groups is conducive to better control of the body, improve the efficiency of movement, save the use of force, and improve the body's ability to deal with emergencies. For college students, the living environment is changing and full of challenges, good physiological balance and mental balance is the necessary basis for social development. Through the experimental data, it can be seen that Crossfit training can effectively promote the development of its ability in the training of balance quality. Crossfit is a kind of comprehensive and strong sport, especially focusing on the core strength training which has been widely discussed in recent years, and the core strength exercises in its training can effectively overcome the limitations of traditional physical training, which only trains the surface but not the deep layer, and only trains the big muscles but not the small ones, so as to improve the strength from the inside to the outside. The core strength exercises can effectively overcome the limitations of traditional physical training which only train the surface but not the depth, and only train the big muscles but not the small muscles, and strengthen our body functions from the inside out, so that our body can have the ability to deal with all the complexities in life, which is also the core idea of Crossfit training.

2.3 Results of flexibility before and after training

Table 7. Paired t-validation of Flexibility Before and After Training

group	item	Mean	Standard Deviation	<i>t</i>	<i>p</i>	Decision on No	Interpretation
group 1	pre-training-flexibility	11.04	7.40	-8.620	0.000**	Rejected	Significant
	post-training-flexibility	17.38	4.50				

Legend. Sig<0.05, level of significance

As can be seen from the table, the paired t-test was utilized to investigate the variability of the experimental data, as can be seen from the above table: a total of 1 group of paired data, all of which will show variability ($p < 0.05$). Specific analysis shows that: between the pre-training flexibility and the post-training - flexibility shows significance at the 0.01 level ($t = -8.620$, $p = 0.000$), as well as specific comparison of the differences shows that the mean value of flexibility in the post-training (17.38 cm) is significantly higher than that of the pre-training (11.04 cm), this significant difference ($t = -8.620$, $p = 0.000$) suggests that the athletes in the post-training experienced a significant enhancement in flexibility. This enhancement could be due to the fact that the post-training received specific flexibility training, such as static or dynamic stretching, or that an integrated training approach was utilized, which included multiple types of training, including flexibility exercises. Flexibility is one of the important physical qualities of line dancers, which is not only related to the quality of execution of movement skills, but also closely related to sports injury prevention. (Smith, 2018). Qin(2021) concluded through 12 weeks of training on the physical fitness of 47 aerobics athletes in Shanxi Province that training is beneficial for improving strength, endurance, and flexibility. Ligaments related to flexibility have the function of connecting, reinforcing joints, and limiting excessive joint movement. Line dancers have good flexibility and good ligament extension, which can demonstrate a large range of

movement in difficult movements. The rapid changes in movements during CrossFit physical training allow muscles and ligaments to continuously contract and stretch, enhancing the elasticity of ligaments. The process of clean and jerk involves extending the knees, hips, and shoulders to increase the range of joint movement, which can effectively assist in the development of flexibility. In summary, CrossFit training has a significant effect on improving flexibility.

In line dance training, jumping movements can bring visual impact to the audience, but there are certain requirements for athletes to jump, jumping movements need to have enough height, athletes in the air movement amplitude should be large, so in addition to the lower limb strength has a high demand for bouncing sex also has high requirements. CrossFit physical training commonly used jumping equipment - jumping box, jumping box height, athletes can carry out continuous obstacle jumping, single-leg jumping, double-legged jumping, through continuous obstacle jumping can effectively improve the coordination of muscle fibres "to promote the development of body coordination, all kinds of jumping exercises are conducive to the development of the athlete's lower limb explosive force. At the same time, athletes in training need to hold dumbbells upward longitudinal jump, in the process of swinging the upper limb weight to drive the whole body, not only to train the athletes' lower limb explosive force, but also to train the explosive force of the upper limb, which will help the development of

some of the difficult skills of the line dance, such as flexion split-legged jumps, the athletes need to drive the whole body longitudinal jumps of the upper limb, the explosive force of the upper limb has a certain demand. Although there are deep jump exercises in regular training, the training process focuses more on lower limb training, and the training method

is relatively single. Therefore, in the case of the whole body strength and other qualities have been comprehensively improved, the experimental group in the completion of the elastic movement quality is higher.

2.4 Training effect of speed before and after training

Table 8. Paired t-test Results of Training Effect of Speed Before and After Training

group	Item	Mean	Standard Deviation	Mean Difference	t	p	Decision on No	Interpretation
group1	pre-training-speed (sec)	8.14	0.88	0.54	8.021	0.000**	Rejected	Significant
	post-training-speed (sec)	7.60	0.61					

Legend. Sig<0.05, level of significance

As can be seen from the table, the paired t-test was utilized to study the variability of the experimental data, as can be seen from the above table: a total of 1 group of paired data, all of which will show variability ($p < 0.05$). Specific analysis can be seen: The pre-training - speed (sec) and the post-training - speed (sec) show a significance at the level of 0.01 ($t = 8.021$, $p = 0.000$), as well as a specific comparison of the differences can be seen that the mean value of the pre-training - speed (sec) (8.14), will be significantly higher than the mean value of the post-training - speed (sec) (7.60). This difference ($t = 8.021$, $p = 0.000$) could be due to the fact that the post-training received specific speed training or other forms of training interventions. Speed is one of the key abilities of line dancers, and it not only affects the performance of the athlete, but may also affect competition results (Johnson, 2020). Li Muxuan (2020) mentioned that CrossFit physical training can better improve the specialized physical fitness of football players compared to traditional physical training, and is more functional. This training method can achieve comprehensive development of athletes' physical fitness. Ma (2022) mentioned in his paper that the training modes advocated by CrossFit include time first mode and task first mode, which significantly improve the speed of participants. And the experimental data shows that CrossFit training focuses more on the development of upper limb, trunk, and lower limb strength, and the improvement of these strengths will also promote the improvement of speed to a certain extent. It suggests that the training methods experienced by the athletes in the post-training were particularly effective in improving speed.

Speed quality refers to the body's ability to move at high speed, while the body's ability to move quickly is a reflection of the body's acceleration and top speed". Speed qualities usually consist of three components: reaction speed, movement speed and displacement speed. These three are both related and distinct. Reaction speed focuses on neural activity, and movement speed and displacement speed focus on muscular activity. The development of all kinds of physical qualities as well as motor abilities contributes more or less to changes in other qualities. Therefore, the development of speed qualities should be handled in good relationship with other qualities. Generally speaking, the development of speed qualities is carried out when the trainer is at his best and in the most energetic state of mind, because when the body is in a state of exhaustion, the brain's reaction becomes sluggish and does not produce excitement or depression, which affects

the development of physical qualities. The two factors that play an important role in the production of speed qualities are fast power and flexibility. For fast power, you can use high intensity, high repetitions of weight-bearing exercises to promote muscle cross-sectional area and muscle strength, and improve muscle flexibility, precisely CrossFit training can achieve this purpose; secondly, you can use other methods to improve the body's flexibility, not only to increase the strength of the strength, but also to enhance the muscle's internal co-ordination, reduce muscle resistance, increase strength, and thus improve speed. Increase the strength and thus the speed. For the line dance, if you want to make the whole set of manipulation movement perfect show, need to have a lot of qualities of mutual support. Line dance is in the music accompaniment, unarmed or take the light equipment to carry on the movement of a kind of project, need to strength endurance, flexibility and speed of mutual cooperation. In view of the characteristics of line dance and the requirements of speed quality, the author believes that the most important thing is to develop speed endurance. In a set of manipulation movement, if the speed endurance is not up to the standard, it will make the whole set of manipulation movement lose the visual effect, so it is difficult to win the ranking in the competition.

6. Summary of Findings

CrossFit training has proven to be highly effective in improving muscle strength, flexibility, balance and speed. Hence, the next step is the comprehensive application of CrossFit training, followed by focusing on flexibility and balance training, such as schedule at least one day of yoga or Pilates training per week; Strengthening speed and agility exercises, such as short-distance sprints and agility training at least twice a week. Pay attention to personalized training and establish a regular evaluation mechanism.

7. Conclusion

From the experimental results, CrossFit training method has significantly improved the strength training of athletes compared to conventional physical fitness training. CrossFit training greatly improves students' cardiovascular function and explosive power, and is beneficial for enhancing their strength and fitness.

The CrossFit training method significantly improves the average balance of athletes compared to conventional physical training. The use of CrossFit training method in balance training has been shown to have a certain helpful

effect on improving balance.

The CrossFit training method has a significant effect on improving the flexibility of athletes compared to conventional physical training. CrossFit training follows the laws of physical and mental development of students, which can improve their flexibility in a short period of time.

The CrossFit training method has a significant effect on improving the speed quality of athletes compared to conventional physical training. CrossFit training passes the project cross training can comprehensively improve the speed of trainers and enable them to quickly respond to sudden changes.

8. Recommendations

1. Integration of the CrossFit training system into the specialized physical training process of line dancers. This will accurately monitor the training load during the training process, and require faster completion of training movements. Strict control of interval time is more conducive to improving training efficiency. Due to the high training intensity of CrossFit, attention should be paid to safety protection during training to prevent sports injuries caused by training. After training, corresponding recovery measures should be actively taken to promote fatigue recovery and prevent fatigue accumulation.

2. Personalized training plan. The physical structure and abilities of each athlete are different, and factors such as gender, age, height, and weight can all affect their training needs and responses. For male athletes, attention should be paid to strengthening their flexibility, while for female athletes, attention should be paid to improving their strength and anaerobic endurance. Establish a regular evaluation mechanism to monitor athlete progress and adjust training plans. For example, conducting a monthly physical fitness test to ensure that the training plan aligns with the athlete's current needs and goals.

3. Pay attention to flexibility and balance training. Flexibility and balance are crucial for dancers as they not only affect technical execution but also help prevent injuries. Enhancing these abilities can be achieved through yoga, Pilates, and specialized balance training. Suggest scheduling a dedicated flexibility and balance training day. For example, schedule at least one day of yoga or Pilates training per week.

4. Strengthen speed and agility training. Speed and agility are key to the performance of line dancers. Targeted training such as short distance sprints, agility ladder exercises, and directional changes can significantly enhance these abilities. Especially for athletes who may have natural disadvantages in these areas (such as taller athletes), strengthening training in this area is particularly important. For example, short distance sprints and agility training at least twice a week. You can use obstacles, games, and other methods to increase the fun of training.

CrossFit can improve the physical fitness of the human body in a short period of time, but to achieve better results, it is necessary to have a certain scientific time arrangement and design training programs tailored to individual differences. CrossFit needs to be improved in many aspects, so it can be used as an auxiliary training method, rather than solely relying on it as the primary training method. There is still a long way to go in the research of CrossFit on line dancers.

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