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Article

# Empirical research on physical functional training of students majoring in sports dance in colleges and universities

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**Abstract:** Use the method of functional movement screening to find out their wrong movement patterns, investigate the root cause, combine the special technical characteristics, formulate a functional training plan, improve the body's functionality, and finally improve the special performance. A total of 40 students from Class 1 and Class 2 of the 2021 grade sports dance major of Shandong Normal University were selected as the experimental subjects; Class 1 was the experimental group, and Class 2 was the control group. There were 20 people in each of the experimental group and the control group (10 males and 10 females). The training time is 19:00–20:00; the training period is 8 weeks; the experimental group carries out functional training, and the control group carries out the original quality training. After 8 weeks of traditional training, the overall FMS score of the control group did not increase significantly after the experiment ($P < 0.05$), indicating that traditional physical training cannot effectively improve the ability of athletes to prevent sports injuries. The FMS scores of the experimental group were significantly improved after the experiment ($P > 0.05$). Therefore, it is believed that physical functional training is more scientific, safe and efficient than traditional physical training, and improves the sports level of college sports dance students.

**Keywords:** college physical education; dance major; physical function training

## 1. Research background

Sports dance, referred to as "ballroom dance", includes Latin dance and modern dance; especially, Latin dance is a kind of high-skill, high-intensity, high-difficulty sport [1]. There are ten types of Latin and modern dance, each of which has a different musical and dance style and therefore requires high performance and basic quality of the dancers [2]. In 1992, sports dance was listed as a sports event. The same year, sports dance was included in the competition by the International Olympic Committee. The opening ceremony of the 11th World Games, postponed for a year due to the pandemic, is held at the Protection of Life Stadium in Birmingham, Alabama, US, on 7 July 2022. Standard dance and Latin dance in dancesport are listed as official competitions [3]. It can be seen that the development trend of the sports dance profession is increasingly professional, which puts forward the guarantee requirements for delaying exercise fatigue, strength and physical energy reserve, and reducing injury. In addition, competition rules and judges also have quality requirements for completion level, movement difficulty, and artistic expression. Therefore, focusing on physical fitness and strength training while training professional skills is of great benefit to improving competition performance. Although the existing research covers the musical styles, dance characteristics and high requirements for the quality of dancers of ten types of Latin dance and modern dance, these descriptions are often

superficial and do not deeply explore the cultural connotations behind different dance types, the internal connection of technical systems and the profound influence on the physical and mental development of dancers. At the same time, for the challenges of delaying exercise fatigue, enhancing strength and physical energy reserve, and preventing sports injury brought by the development of sports dance careers, the existing research also mostly stayed in the description of phenomena, lacking in-depth analysis based on empirical data, and specific and scientific training methods and strategies proposed for these challenges [4].

In addition, although the competition rules and referee standards put forward clear requirements for completion level, difficulty of movements, and artistic expression, the existing research on how to balance professional skill training and physical training and how to improve the competitive level while maintaining artistic quality lacks systematic theoretical support and practical guidance. This not only limits the space for sports dance athletes to improve their competitive level but also affects the overall development level of sports dance as a sports project.

Therefore, this study aims to make up for the shortcomings of the existing research. By strengthening the theoretical support, this study deeply analyzes the technical system, cultural connotation of sports dance and its influence on the physical and mental development of dancers. At the same time, combining empirical research and scientific training theory, this study proposes a set of comprehensive training methods that can not only improve professional skills but also enhance physical ability and strength. On this basis, this study will also explore how to improve the competitive level of athletes while maintaining the artistic nature of dance sports, so as to contribute new ideas and strategies for promoting the healthy development and internationalization of dance sports.

## 2. Research object and method

### 2.1. Research object

This article takes the empirical study of physical functional training for students majoring in sports dance in universities as the research object. A total of 40 students from Class 1 and Class 2 of the 2021 sports dance major at Shandong Normal University were selected as experimental subjects, with Class 1 as the experimental group and Class 2 as the control group. The experimental group and the control group each consist of 20 people (10 males and 10 females). In principle, there is no significant difference in the dance level and training years of the selected experimental samples, and an 8-week physical functional training will be conducted. See **Table 1** for details.

**Table 1.** Statistical table of basic physical conditions and training years of experimental and control groups ($M \pm SD$).

| Group | Gender | Number of people | Age | Height | weight | Training years | Sports injury history (%) | *T* | *P* |
|---|---|---|---|---|---|---|---|---|---|
| experimental group | male | 10 | 20.0 ± 0.7 | 175.8 + 7.5 | 71.8±5.2 | 7.1 ± 0.8 | 0..00 | −0.24 | 0.874 |
| | female | 10 | 19.8 ± 1.4 | 162.2 ± 6.6 | 53.4±5.8 | 8.6 ± 1.7 | 0.00 | −0.49 | 0.664 |
| control group | male | 10 | 19.7 ± 2.0 | 176.4 + 7.4 | 71.2 ± 5.1 | 7.2 ± 0.9 | 0.00 | −1.62 | 0.168 |
| | female | 10 | 20.1 ± 1.2 | 163.5 + 6.8 | 53.5 ± 5.1 | 8.6 ± 1.3 | | −1.31 | 0.278 |

## 2.2. Research methods

### 2.2.1. Literature review method

This article explores and reads relevant papers on functional training, sports dance, Latin dance, functional movement screening, and other keywords by browsing RISS, KISS, and Nurimedia Korean academic journal databases, as well as using domestic platforms such as CNKI, Baidu Wenku, and Wanfang Database. The aim is to understand the existing research results on academic controversies and doubts between movement screening and physical functional movement training and to seek solutions to the contradictions presented in sports dance training practice. This provides rigorous research ideas, scientific theories, and a methodological basis, as well as experimental design for functional movement training to intervene in the sports performance of college students as the main subject of sports dance.

### 2.2.2. Questionnaire survey method

In this study, the "Expert Questionnaire on Sports Dance Special Testing Indicators" was developed based on the specific characteristics of sports dance and the scoring rules of various competitions. After summarizing and collecting the results of the questionnaire survey, it was concluded that "pirouettes" (turning) and "large jumps" were selected as the special testing indicators. Furthermore, six senior national-level sports dance judges were invited to objectively and standardize the evaluation of four physical performance indicators—vertical perception, center of gravity transfer ability, body balance, and muscle coordination ability—before and after the functional movement training intervention for both the experimental and control groups of sports dance college students [5]. Each evaluation criterion was scored on a scale of 0 to 10 points.

### 2.2.3. Experimental method

*Experimental plan*

Control Group: The control group underwent traditional physical fitness training [6]. The training program consisted of three stages:

- Warm-up phase: 10 min of slow jogging.
- Strength training phase: 50 sit-ups and 3 sets of 15 squats.
- Flexibility training phase: 100 front, side, and back leg kicks, and 10 min of leg stretching on each side.
- The training lasted for 8 weeks, with 5 sessions per week, each lasting 60 min.

Experimental Group: The experimental group replaced traditional fitness training with functional training, with the training period remaining unchanged (8 weeks, 5 sessions per week, 60 min per session). The functional training intervention for the sports dance college students was divided into three phases [7]:

- Phase 1: Adaptation Stage (Weeks 1–2): This phase focused on proprioception training, aiming to enhance the neuro-muscular system's specialized connections, improve core strength, and increase body balance. In both basic steps and choreographed dance movements, the core muscles were engaged to maintain stability before the limbs performed the corresponding dance movements.
- Phase 2: Consolidation Stage (Weeks 3–5): The intensity of training gradually increased, focusing on endurance, muscle volume, and strength training. Through

effective muscle stimulation, the neural-muscular response was enhanced, improving muscle contraction capacity to maintain postural stability and balance, thus improving dynamic balance. Many specialized dance movements involve rotations, which require a certain level of balance and stability.

- Phase 3: Improvement Stage (Weeks 6–8): This stage focused on explosive power training and maximum force generation. By training proprioception and the nervous system, deep muscles were activated to improve muscle coordination and enhance the power output of movements. The specific characteristics of Latin dance, such as speed and crisp movements, require a certain level of explosive power. Following a systematic and progressive training approach, the experimental subjects followed the training sequence of each stage, completing the assigned tasks and ultimately improving the quality of specialized technical movements and overall performance.
- See **Table 2** for details

**Table 2.** Division of functional training phases for sports dance students.

| Phase Division | Adaptation Stage | Consolidation Stage | Improvement Stage |
|---|---|---|---|
| Training Duration | Weeks 1–2 | Weeks 3–5 | Weeks 6–8 |
| Training objectives | To reduce the risk of exercise injuries caused by neglecting warm-up, enhance joint stability and trunk strength, improve proprioception, and correct incorrect movement patterns and body posture. | To strengthen weak muscle groups, continue to reinforce the correction of incorrect body movements, provide effective stimulation to muscle groups, enhance neuromuscular response, increase the contraction capacity of relevant muscles, and thereby improve dynamic body balance. | Through training of proprioception and the nervous system, activate deep muscles, enhance muscle coordination, and increase the power output of movements. |
| Training methods | 1 Bending Bridge 30 s X3<br>2 Side tablets (on each side) 60 s X3<br>3 crunch 10 order X3<br>4 Kneeling and stretching the hip 10 order X3<br>5 Reverse leg bending and abdominal curling 10 order X3<br>6 Kneeling and alternating opposite side lifts 10 order X4<br>7 Carry it up 10 order X3<br>8 Abdominal training 15 order X4<br>9 Side bridge hip rise and fall 10 order X3<br>10 Support and lift buttocks alternately, touch feet 30 s X3 | 1 Side tablets (on each side) 60 s X4<br>2 Standing posture elastic band push forward 15 order X4<br>3 Standing posture elastic band pulled back 15 order X4<br>4 Kneeling and stretching the hip 10 order X4<br>5 Single leg elastic band hard pull 10 order X4<br>6 Side bridge hip rise and fall 10 order X4<br>7 Elastic band turns hip to side arch step 10 order X6 | 1 Standing posture elastic band push forward 15 order X4<br>2 Standing posture elastic band pulled back 15 order X4<br>3 Barbell Hard Pull 10 order X4<br>4 No reverse rotation 90° exchange jump 6 order X8<br>5 There is a reverse rotation 90° exchange jump 6 order X8 |
| Training feature | With the goal of standardizing the quality of movements, the training load intensity is relatively low. | Increase in the difficulty of movements and load intensity; resistance training using equipment such as resistance bands and Swiss balls. | Gradually increase the number of training sets and load intensity; adjust the ratio of basic movement training to specialized movement training by decreasing the focus on basic movements and increasing the emphasis on specialized movements. |

*Functional movement screening (FMS)*

Functional Movement Screening (FMS) was created by Gray Cook, an American expert in the fields of strength training, fitness, injury prevention, and rehabilitation, who has achieved world-leading results. FMS is a body function evaluation method

and, in China, is considered an innovative movement pattern assessment system with the characteristic of being simple and easy to implement. It consists of seven movements: the step-over, deep squat, straight-line lunge, shoulder flexibility, trunk stability push-up, straight-leg raise, and trunk rotation stability, along with three exclusionary tests [8], as shown in **Figure 1**.

The FMS scoring system ranges from 0 to 3, with 0 being the lowest score and 3 being the highest, and is divided into four levels. FMS has been widely understood and recognized, and it is extensively applied in evaluating sports risks across various disciplines, such as taekwondo, tennis, and swimming, gradually forming a more systematic self-screening and movement correction model. However, literature reviews indicate that current debates regarding FMS center on the accuracy of repeat measurements and its effectiveness in sports interventions [9].


**Figure 1.** Functional movement screening (FMS).

*Experimental evaluation methods*

(1) Functional Movement Screening (FMS) Evaluation [10].

The FMS scale was used to assess the functional movement scores of the participants. During the test, a score of 0 was given if any part of the body experienced pain, a score of 1 was given if the participant could not complete the entire movement or maintain the starting position, a score of 2 was given if the participant completed the movement but with poor quality, and a score of 3 was given if the participant performed the movement with high quality. The FMS assessment was conducted both before and after the experimental intervention.

(2) Specialized Performance Evaluation

Test Movements: Pirouette [11,12], large jump [13,14]

Testing Method: Before and after the training, the performance of the 40 students participating in the experiment was recorded in video format. A double-blind method was used to ensure that the experts did not know which group was the control group and which was the experimental group, nor the pre- and post-test data of either group. Three experts scored the videos, and the average score for each evaluation criterion was used as the final score.

### 2.2.4. Statistical analysis method

SPSS 22.0 and Excel software were used to organize and analyze the data collected from the experiment. Independent samples *t*-tests were performed to

compare the pre- and post-test data between the two groups to assess the effectiveness of the experiment. Paired samples *t*-tests were used to compare the results within each group. The *p*-value was calculated, and significant differences between the experimental and control groups before and after the intervention were analyzed. A *p*-value greater than 0.05 indicated no significant difference between the two groups, a *p*-value less than 0.05 indicated a significant difference, and a *p*-value less than 0.01 indicated a highly significant difference.

## 3. Results and analysis

### 3.1. Analysis of pre-experiment FMS data and specialized performance scores for experimental and control groups

**Table 3.** Analysis of FMS test and special results before experiment.

| Test project | Experimental group | Control group | *P* |
|---|---|---|---|
| stride | 1.81 ± 0.17 | 1.86 ± 0.12 | 0.271 |
| squat | 1.87 ± 0.21 | 1.81 ± 0.10 | 0.313 |
| Straight line lunge squat | 1.80 ± 0.13 | 1.86 ± 0.36 | 0.278 |
| Shoulder joint flexibility | 2.10 ± 0.17 | 1.99 ± 0.24 | 0.156 |
| Trunk stability push up | 1.60 ± 0.31 | 1.70 ± 0.18 | 0.241 |
| Lift straight legs up actively | 1.70 ± 0.26 | 1.60 ± 0.29 | 0.577 |
| Stable rotation of torso | 1.50 ± 0.34 | 1.60 ± 0.16 | 0.253 |
| flat turn | 6.17 ± 0.86 | 5.90 ± 0.85 | 0.400 |
| big jump | 6.53 ± 0.48 | 6.67 ± 0.59 | 0.502 |

Note: $P > 0.05$ indicates no significant difference; $P < 0.05$ indicates a significant difference; $P < 0.01$ indicates a highly significant difference.

From **Table 3**, it can be seen that there were no significant differences ($P > 0.05$) in the standard deviation and mean total scores of the 7 FMS movements and specialized performance actions between the experimental and control groups before the experiment. This indicates that there were no significant differences between the two groups in all the indicators, which meets the basic requirements of the experiment. This allows for a better observation of the impact of functional training interventions on the FMS scores compared to traditional fitness training, ensuring the validity of the experiment.

The characteristics of sports dance require athletes to possess good flexibility, body mobility, explosive power, and core stability [15]. The shoulder flexibility test in FMS primarily assesses the flexibility of the shoulder joint and its ability to extend, internally rotate, and adduct [16]. Given that flexibility is a requirement for sports dance exams, the experimental and control groups had relatively high scores on this movement before the experiment.

The step-over, deep squat, and straight-line lunge in FMS are complex movements designed to test the flexibility and stability of the hip, knee, and ankle joints. Due to the specificity of the sports dance discipline, female athletes are required to wear high heels during training and performances, with heels no lower than 7 cm, and male athletes are required to wear heels no lower than 3 cm. As a result, athletes

commonly have weaker ankle and knee joint strength. Therefore, both the experimental and control groups had relatively lower scores in these three movements, indicating the need to strengthen training on the stability of the knee, ankle, and hip joints.

The trunk stability push-up, straight-leg raise, and trunk rotation stability tests in FMS primarily assess body flexibility, stability, pelvic stability, the ability of the contralateral leg to extend actively, and the nervous system's ability to regulate muscles. Both the experimental and control groups had lower scores on these three tests before the experiment, indicating poor core stability, which needs improvement.

Pirouettes and large jumps are high-difficulty performance techniques that are performed on the balls of the feet. These movements require coordination between the head, shoulders, hips, and feet, requiring the entire body to tighten and maintain vertical alignment of the spine and the central axis. The transfer of the center of gravity must be clear, and the coordination of the entire body is crucial. Therefore, these movements place high demands on coordination and body stability [17].

## 3.2. Analysis of FMS data and specialized scores before and after the control group experiment

**Table 4.** Analysis of FMS test and special score results before and after the control group experiment.

| Test project | experimental group | Control group | *P* |
|---|---|---|---|
| stride | 1.86 ± 0.12 | 1.92 ± 0.11 | 0.203 |
| squat | 1.81 ± 0.10 | 2.07 ± 0.46 | 0.161 |
| Straight line lunge squat | 1.86 ± 0.36 | 1.97 ± 0.44 | 0.318 |
| Shoulder joint flexibility | 1.99 ± 0.24 | 2.17 ± 0.22 | 0.326 |
| Trunk stability push up | 1.70 ± 0.18 | 1.95 ± 0.54 | 0.121 |
| Lift straight legs up actively | 1.60 ± 0.29 | 1.78 ± 0.24 | 0.367 |
| Stable rotation of torso | 1.60 ± 0.16 | 1.73 ± 0.23 | 0.283 |
| flat turn | 5.90 ± 0.85 | 6.45 ± 0.21 | 0.323 |
| big jump | 6.67 ± 0.59 | 7.10 ± 0.51 | 0.242 |

Note: $P > 0.05$ indicates no significant difference; $P < 0.05$ indicates a significant difference; $P < 0.01$ indicates a highly significant difference.

As shown in **Table 4**, a comparison of the average FMS scores before and after the experiment in the control group reveals that the mean scores for all FMS items improved. Specifically, there were significant improvements in the deep squat and trunk stability push-up, with the deep squat score increasing from 1.81 before the experiment to 2.07 after, and the trunk stability push-up score increasing from 1.70 to 1.95. This indicates that traditional fitness training, which primarily involves exercises like sit-ups and squats, has a positive effect on these FMS items, leading to improvements in core strength and body stability.

The average scores for the step-over, straight-line lunge, shoulder flexibility, straight-leg raise, and trunk rotation stability also showed improvement. Independent samples *t*-tests were performed on the pre- and post-test results for the control group, but the *p*-values were all greater than 0.05, indicating no significant differences

between the pre- and post-test data. This suggests that traditional fitness training does not lead to significant improvements in these FMS items.

Comparing the specialized tests of pirouettes and large jumps, the average scores for both improved after the intervention. The pirouette score increased from 5.90 before the experiment to 6.45, and the large jump score increased from 6.67 to 7.10. Independent samples *t*-tests were conducted on the pre- and post-test data for these two specialized tests, but the *p*-values were both greater than 0.05, indicating no significant differences between the pre- and post-test scores. This suggests that traditional training interventions have minimal impact on specialized sports dance performance for university students.

## 3.3. Analysis of FMS data and special scores before and after the experiment in the experimental group

**Table 5.** Analysis of FMS test and special score results before and after the experimental group experiment.

| Test project | Experimental group | Control group | P |
|---|---|---|---|
| stride | 1.81 ± 0.17 | 2.56 ± 0.44 | 0.003 |
| squat | 1.87 ± 0.21 | 2.87 ± 0.46 | 0.000 |
| Straight line lunge squat | 1.80 ± 0.13 | 2.08 ± 0.49 | 0.118 |
| Shoulder joint flexibility | 2.10 ± 0.17 | 2.34 ± 0.34 | 0.086 |
| Trunk stability push up | 1.60 ± 0.31 | 2.19 ± 0.54 | 0.037 |
| Lift straight legs up actively | 1.70 ± 0.26 | 2.30 ± 0.24 | 0.006 |
| Stable rotation of torso | 1.50 ± 0.34 | 2.04 ± 0.14 | 0.004 |
| flat turn | 6.17 ± 0.86 | 8.45 ± 0.51 | 0.015 |
| big jump | 6.53 ± 0.48 | 8.79 ± 0.39 | 0.032 |

Note: $P > 0.05$ indicates no significant difference; $P < 0.05$ indicates a significant difference; $P < 0.01$ indicates a highly significant difference.

As shown in **Table 5**, a comparison of the average FMS scores before and after the experiment in the experimental group reveals that the mean scores for all FMS items improved. Specifically, the step-over, deep squat, trunk stability push-up, straight-leg raise, and trunk rotation stability all showed significant improvements. The step-over increased from 1.81 before the experiment to 2.56; the deep squat increased from 1.87 to 2.87; the trunk stability push-up increased from 1.60 to 2.19; the straight-leg raise increased from 1.70 to 2.30; and the trunk rotation stability increased from 1.50 to 2.04. Independent samples *t*-tests were conducted on the pre- and post-test results, and all *p*-values were less than 0.05, indicating significant differences between the pre- and post-test data. Notably, the *p*-values for the deep squat, step-over, straight-leg raise, and trunk rotation stability were less than 0.01, indicating highly significant differences.

The reason for these improvements is that the movements in the first phase of functional training were closely related to the test movements, such as side bridge hip lifts, alternating hip raises with support, and back lifts. These exercises focused on strengthening the gluteus maximus and back muscles, improving the flexibility and stability of the hip joint. As a result, no pain was reported during post-test evaluations,

leading to improved performance in the deep squat and step-over tests. Exercises like the standing resistance band front push, standing resistance band rear pull, side bridge hip lifts, and resistance band hip rotation to side lunges effectively target the shoulder and core areas, enhancing the strength of the abdominal and back muscles, as well as spinal stability and overall body coordination. By relying on the abdominal, back, and core muscles to execute movements, these exercises prevent compensation due to insufficient strength in the back and abdominal muscles, thus reducing the risk of injury. Consequently, significant changes in test scores were observed.

Comparing the specialized tests of pirouettes and large jumps, the average scores for both showed significant improvement after the intervention. The pirouette score increased from 6.17 before the experiment to 8.45, and the large jump score increased from 6.53 to 8.79. Independent samples *t*-tests were performed on the pre- and post-test data for these two specialized tests, and both *p*-values were less than 0.05, indicating significant differences.

The reason for these improvements is that both pirouettes and large jumps are performed on the balls of the feet, which require coordination between the head, shoulders, hips, and feet. These movements demand full-body engagement to maintain vertical alignment of the spine and the central axis, as well as clear center of gravity transfer and overall body coordination. Thus, these movements place high demands on coordination and body stability. Functional training can better strengthen the deep small muscles in the torso, and it has a positive effect on the vestibular system and proprioception. This enhances the stability and balance of the torso and improves coordination between the upper and lower limbs. Strengthening the transmission and control of power throughout the body, strong core stability creates the necessary conditions for the limb muscles to generate force, ultimately improving dance performance [18].

## 4. Conclusions and suggestions

### 4.1. Conclusions

Based on the above data analysis, the Functional Movement Screen (FMS) scores of dance sports students in Shandong Normal University were generally low, which was mainly attributed to their daily training mode and intensity. Due to the high intensity of training and focus on the improvement of dance professional skills and neglect of comprehensive physical training, their muscles are relatively tense, which in turn affects the overall FMS score.

In this experiment, 40 dancesport students were randomly divided into an experimental group and a control group. The experimental group adopted the functional physical training method, while the control group continued to use the traditional fitness training method. The experimental results showed that functional physical training had a significant impact on improving FMS scores and professional dance performance, whereas the traditional training intervention had a limited effect on improving FMS scores and professional dance skills. Specifically, functional physical training not only effectively improved the FMS scores of danceshop students but also significantly enhanced their professional dance performance.

The results of this study have important guiding significance for different types

of sports dance training, especially in terms of improving competitiveness and artistry and adapting to different application scenarios:

Improvement of competitiveness: For sports dancers who pursue high levels of competitive performance, functional physical training provides a more scientific and comprehensive training method. It can not only enhance the physical quality of athletes and improve the stability and efficiency of movements, but also prevent sports injuries to a certain extent, so as to prolong the careers of athletes and enhance their competitiveness in international competitions.

Enhanced artistry: Functional physical training emphasizes the control and coordination of movements, which helps sports dancers to better show the artistry of dance in their performances. By improving body posture and strengthening muscle strength and flexibility, athletes can complete dance movements more smoothly and expressively and improve the overall aesthetics and artistry of the dance.

Diversified application scenarios: Different types of sports dance have differences in application scenarios. For example, Latin dance emphasizes the combination of strength and speed, while modern dance focuses more on flexibility and coordination of the body. Functional physical training can provide personalized training programs for athletes according to the characteristics of different dance types and help them better adapt to the needs of different application scenarios.

## 4.2. Suggestions

For dancesport students, high-intensity training is an indispensable part of improving their skills, but it is also crucial to choose a training mode suitable for the characteristics of the discipline. The present study found that traditional training models that rely solely on repetitive exercises may lead to stiffness in some parts of the body and affect overall flexibility. Therefore, it is recommended that athletes adopt multi-dimensional movement patterns combined with functional training to comprehensively improve their physical fitness and dance skills. At the same time, the warm-up exercise before high-intensity training is essential to ensure that the muscles are fully activated, but the warm-up intensity should be moderate to avoid athletes feeling tired before the start of the main training.

The schedule of daily sessions integrated into functional training was as follows:

Primary level: In the basic training phase, at least two functional training sessions per week are scheduled, focusing on improving basic body strength, flexibility, and coordination.

Intermediate level: With the improvement of skill level, functional training should pay more attention to movement accuracy and efficiency. More challenging exercises, such as one-leg balance, functional strength training (e.g., kettlebell swing, medicine ball throwing), etc., could be introduced to enhance the core stability and explosive power of students.

Advanced Level: At the advanced level, functional training should be closely integrated with dance movements, simulating the high intensity and fast pace of competition. Through the simulation of specific movements in dance, combined with functional training elements, such as jumping, rotation, and rapid change of direction, students' movement performance and artistic expression are improved.

Case in point: For example, at the primary level, a simple functional training program could be designed, consisting of 30 s of standing on one leg (on each side), 1 min of planks, and two sets of 10 squat jumps. These exercises are designed to improve balance, core strength, and lower limb explosive power.

When developing a functional training program, the individual differences of students should be fully considered, including sports injury history, physical fitness differences (such as flexibility and endurance), etc. For example, for students with a history of sports injury, excessive use of the injured site should be avoided, and rehabilitation training should be increased. For students with poor flexibility, the proportion of stretching and flexibility training should be increased.

Case citation: Suppose a student has a history of knee pain; then excessive squat and jump exercises should be avoided when developing a functional training program, and instead, balance and stability training of leg muscles should be added, such as one-leg balance, static and dynamic leg stretching, etc.

The importance of warm-up and recovery

Emphasize the importance of warm-up exercises and ensure adequate warm-up before each training session to activate muscles, improve joint flexibility, and prevent sports injuries. Warm-up exercises should include dynamic stretching, low-intensity aerobic exercise, etc.

After training, appropriate recovery activities such as static stretching, foam shaft rolling, etc., are performed to help the muscles relax, reduce lactic acid accumulation, and promote recovery.

In this study, the sample was dance sports students from Shandong Normal University, but the key information about the history of sports injuries and basic differences in physical fitness (such as differences in individual flexibility and endurance) of the students was not recorded in detail. To more accurately assess the effects of functional training, future studies should collect more comprehensive student information, including but not limited to:

Students' sports injury history, including injury type, injury site, recovery, etc.

Students were assessed for physical fitness, including flexibility tests (such as sit-to-reach), endurance tests (such as 800-m running), and strength tests (such as squats and push-ups).

This information will help to develop a more personalized functional training program and ensure the effectiveness and safety of the training.

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