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The Effect of Multi-task Training Program on 400-meter Run Performance for Major Physical Education Students

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Abstract

Background and Aims: In recent years, multi-task training programs, including functional training, have gradually attracted attention from the scientific research community and the sports community. Multi-task training programs are a comprehensive training method that can effectively improve the strength level of athletes and improve their sports performance to some extent**.** The objective of research: 1) To study the current situation and problem of the 400-meter running performance of physical education students, 2) To develop a multi-task training program on the 400-meter running performance of physical education students, and 3) To compare the difference between multi-task training and traditional strength training on the 400-meter running performance of physical education students

Methodology: 30 Sophomores in college subjects were selected from the 400-meter running students majoring in physical education at Physical Education and Health College of Guangdong University. The sample is all male, 21 – 23 years old. 15 students were randomly selected into the experimental group and 15 students into the control group by purposive sampling. Research instruments are questionnaires and a multi-task training program 400-meter. Statistics research includes percentages, mean, standard deviation, and t-tests. The research process is as follows: Step1 Review Literature and Related Research, Step 2 Interview Expert, Step 3 Draft Program, Step 4 Instrument Quality, Step 5 Tryout (Control G; Experimental G) Step 6 Collection Data, Step 7 Analysis Data, Step 8 Conclusion, and Discussion.

Result: The research results found that the training effect of the experimental group by multi-task training program, 400-meter running of physical education students improves the strength, speed, and skills better than the control group significantly. This may be related to the training content and method of the multi-task training, which focuses on comprehensive physical fitness and technical training, and helps to improve the multifaceted qualities of the athletes. Therefore, multi-task training has potential advantages in comprehensive performance improvement.

Conclusion: This study aimed to investigate the effectiveness of multi-task training on track and field runners, and conducted general, specific, and specific sports performance tests in the experimental and control groups. In conclusion, in this study, the multi-task training group achieved significant advantages in both 300 m, 400 m, and 500 m performance. This suggests the potential of multitasking training to improve performance in sprint and middle-distance events. This improvement may be attributed to the combined training effect of multi-task training on exercise abilities such as explosive power, speed, strength, and endurance.

Keywords: Multi-task training program; 400 Meters run performance; Major Physical Education Students

Introduction

The performance of the 400-meter run among major physical education (PE) students in China is influenced by a variety of factors, including training practices, educational curriculum, and physiological challenges. Here's an overview of the current situation and associated problems: In many Chinese universities, PE students receive structured training programs that include various aspects of track and field events, including the 400-meter run. However, the quality of coaching can vary significantly between institutions, with some offering more specialized training and others lacking experienced coaches. Problem: Inconsistent coaching quality can lead to disparities in student performance. Some students may not receive the personalized attention needed to develop their speed, endurance, and technique optimally. Despite this, many students still struggle with the 400-meter run due to the specific demands of the event, which requires a balance of speed and endurance. Inadequate conditioning, especially in terms of anaerobic capacity and lactate threshold, can limit performance. If the curriculum does not adequately emphasize the importance of specific training for middle-distance events like the 400 meters, students may not develop the necessary skills and strategies to excel in this event. PE students are at risk of injuries due to the intensity of their training. While some institutions have good sports medicine support, others may lack adequate resources. Problem: Frequent injuries or

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inadequate recovery can severely affect a student's ability to train consistently and perform well in the 400-meter run. (Wang, 2023). In recent years, multitask training programs, including functional training, have gradually attracted attention from the scientific research community and the sports community. Multitask training programs are a comprehensive training method that can effectively improve the strength level of athletes and improve their sports performance to some extent. The intersection of multitask training programs and the 400-meter run performance emerges as a compelling area of study. The intricacies of multitask training, involving the simultaneous engagement of various physical and cognitive activities, present an intriguing avenue to explore. As physical education students are at the forefront of understanding and implementing innovative training approaches, investigating the impact of multi-task training on their 400-meter run performance holds both academic and practical significance. (Bompa & Buzzichelli., 2021)

From the problems mentioned above, as a physical education instructor at a university, I have to conduct a study on the results of 400-meter running training for physical education students using a multitasking program to use the program to develop running for students, which will be beneficial to athletics instructors, athletics coaches, and physical education students at the university level.

Objectives

1. To study the current situation and problem of the 400-meter running performance of physical education students
2. To develop a multi-task training program on the 400-meter running performance of physical education students
3. To compare the difference between multi-task training and traditional strength training on the 400-meter running performance of physical education students

Literature Review

1. Importance characteristics of sprinting

Physical characteristics play an important role in sprinting. The clear basic skills of sprinting depend on the athlete's ability to integrate the work of the legs, arms, and trunk into a single unit. When conducting an analysis, anatomical aspects such as height, stride frequency, stride length, speed, energy consumption, somatotype, anthropometry, power, and muscle fiber composition should be considered. External factors such as running shoes, fatigue, injury history, track surface, and horizontal force variability should also be considered (Rosen., et al, 2023).

The 400-meter sprint is an explosive race. The factors related to the movement, are divided into 3 periods:

1. Initial speed (Acceleration) is the distance from 0 - 100 meters (divided into pure acceleration and transition)
2. Maximum speed (Maximum Velocity) is the distance from 100 - 300 meters
3. Speed Maintenance is the distance from 300-400 meters, athletes must try to make this cycle as fast as possible in running 100 m. It can be divided into the:
4. Energy Production: Sprinting is the process of repetitive muscle contractions using ATP energy, which must be compensated for by other energy sources. Initially, this energy is found within the muscle, including the phosphagen system (ATP-CP) and the lactate system (anaerobic glycolysis). These systems do not require oxygen to produce ATP. The third system used to produce ATP is the aerobic system, which requires oxygen.
5. Somatotype: Somatotype reflects general trends in body shape and fitness for a sport. Somatotype is used to assess body size. The scale is set from 1 to 7 (least to most) and consists of endomorph, mesomorph, and ectomorph. Athletes are rated in all three groups. Ameti, et al. (2023). reported that the average body type of sprinters is 2: 5.5: 3 (high in mesomorphy and low in endomorphy and ectomorphy). Thai sprinters have body type values of 1.6: 5.2: 2.7 in male athletes and 2.7: 4.0: 3.0 in female athletes, which is called the Ecto-Mesomorph body type
6. Body size (Anthropometry): It is an assessment of body size and composition to identify the suitability of the athlete's body for the sport being played. Blagrove., et al. (2022) concluded that athletes with shorter legs will have an advantage over athletes with longer legs. This does not mean

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that shorter legs and speed are directly related. However, when muscles with higher power are combined with lower inertia resistance, it will result in a faster stride rate (although stride length may be slightly reduced).

7. Power: Burke., et al (2020) defined power as the rate at which work is done. Therefore, power equals work divided by time. If more work is done in a given time, more power will be obtained. In sprinters, when starting with a block start, a lot of muscle power is required to overcome gravity and the inertia of the body to achieve maximum speed.

In summary, an efficient sprinter needs a combination of physical and physiological characteristics. A high proportion of type II muscles will help to move faster, which will increase running speed. Proper stride length affects speed, reaction and recovery time, and acceleration.

2. Factors affecting 400-meter run performance

The study by Mohammed and Kareem (2020) focused on predicting physical performance in a 400-meter runner. Their findings emphasized the significance of reducing fatigue factors in enhancing performance, shedding light on the critical role of fatigue management in optimizing results in the 400-meter run. Haugen ., et al (2020) delved into the biomechanical aspects of sprinting, particularly in the context of 400-meter running. Their study emphasized the critical nature of understanding biomechanical factors in sprint running for optimizing performance. The research highlighted the importance of velocity and stride parameters, offering valuable insights for training regimens.

In conclusion, these studies collectively underscore the multifaceted nature of factors influencing 400-meter run performance, encompassing fatigue management, anthropometric characteristics, comprehensive physical fitness, biomechanics, anaerobic capacity, and specialized training approaches. Understanding and integrating these factors into training programs can significantly contribute to the enhancement of performance in the 400-meter run for major physical education students.

3. Core Concepts and Principles of Multitasks Training Program

In exploring the effect of the Multitasks Training program on 400-meter run performance for major physical education students, a crucial aspect lies in understanding the core concepts and principles that underpin this training methodology. The following literature review section delves into key studies and their perspectives regarding the core concepts and principles of the Multitasks Training Program. Hoff et al. (2022) provided insights into the principle of specificity within multitasking training. Their research highlighted the importance of tailoring training tasks to closely mimic the demands of the 400-meter run. This principle underscores the need for specificity in task design, ensuring that the training closely aligns with the unique requirements of the targeted athletic event.

In conclusion, these studies collectively contribute to the elucidation of core concepts and principles within the Multi-task Training program. They underscore the significance of task integration, variability, specificity, progressive overload, and individualization in designing effective training programs for enhancing 400-meter run performance among major physical education students.

4. Strategic Implementation of Multitasks Training in 400-meter run performance

Greenfield (2021). Contributed insights into the integration of multi-task training with traditional training methods for 400-meter run performance. Their research highlighted the strategic combination of multitasking training principles with established training regimens to optimize overall athletic outcomes.

Edmonds (2022). Explored the impact of task sequencing within multi-task training on 400-meter run performance. Their study suggested that strategically arranging tasks based on their cognitive and physical demands can enhance the transfer of skills to the specific demands of the 400-meter run.

5. Related research

5.1 Domestic-related research

The study found that the Multi-task Training Program had a significant impact on 400-meter runners in China. Several studies have demonstrated the positive effects of this training program on athletes from different perspectives.

Chang Yongxia. (2023) shows that under the systematic implementation of the Multi-task Training Program, 400-meter runners show a more comprehensive and comprehensive performance. The multi-tasking feature helps develop athletes' coordination and adaptability during running, creating favorable conditions for improving 400-meter running performance.

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Wang. (2023) focused on the promotion and implementation of a Multi-task Training Program among Chinese physical education students. The study pointed out that the adaptability and operability of this training program provide Chinese physical education students with an effective way to improve their 400-meter running performance. By integrating different motor and cognitive tasks, athletes demonstrate more flexible skills in the 400-meter run.

Yang and Huang (2022) highlighted the long-term impact of the Multi-task Training Program on Chinese university 400-meter runners. Research has found that this training program helps develop athletes' endurance and comprehensive physical fitness, creating favorable conditions for them to maintain a high level of performance in the 400-meter run.

5.2 Foreign-related research

Moore., (2021) investigated the biomechanical aspects of the Multi-task Training Program and its influence on foreign athletes' 400-meter run performance. Their research delved into the intricate details of how this training regimen affects stride parameters, providing valuable insights into the mechanical optimizations associated with improved performance.

Girard., et al. (2022) focused on the psychological impact of the Multi-task Training Program on foreign athletes preparing for the 400-meter run. Their study revealed positive correlations between the program and mental resilience, suggesting that the training regimen extends its influence beyond physical aspects to psychological facets crucial for optimal performance.

These foreign studies collectively contribute to the understanding of how the Multi-task Training Program transcends geographical boundaries, demonstrating its potential as a holistic and effective approach to enhance 400-meter run performance across diverse athletic populations.

Conceptual Framework

The conceptual framework for this research is as follows:

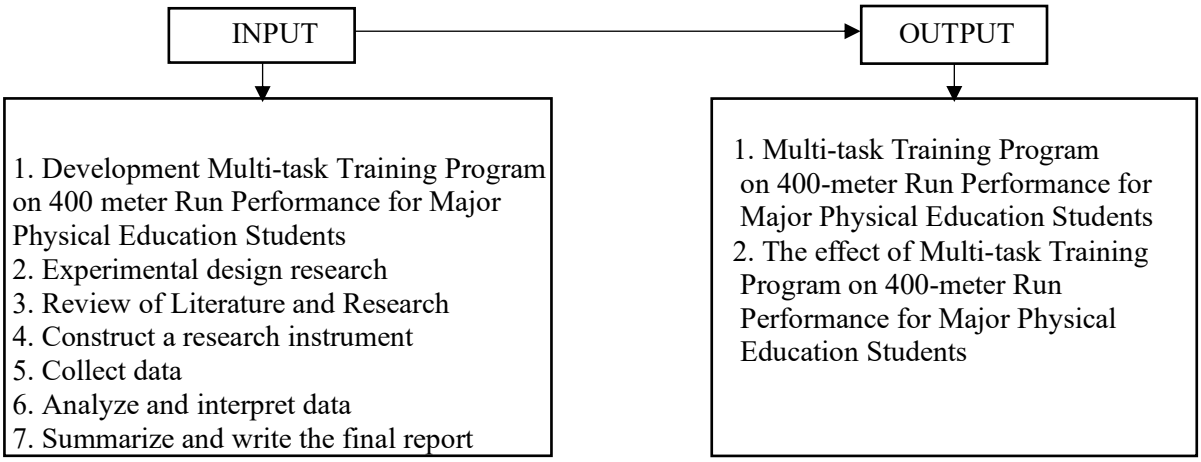

Figure 1 Conceptual Framework

Methodology

1. 30 Sophomores in college subjects were selected from the 400-meter running students majoring in physical education at Physical Education and Health College of Guangdong University. The sample is all male, 21 – 23 years old. 15 students were randomly selected into the experimental group and 15 students into the control group by purposive sampling. Research instruments are questionnaires and a multi-task training program of 400-meter, Index-items of objective congruence by 3 experts. Statistics research includes percentages, mean, standard deviation, and t-tests.

2. Research tools

Step 1 Review Literature and Related Research
Step 2 Interview Expert
Step 3 Draft Training Program
Step 4 Instrument Quality

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Step 5 Tryout (Control G ； Experimental G)
Step 6 Collection Data
Step 7 Analysis Data
Step 8 Conclusion and Discussion

Results

Part 1 The Current situation and problem of the performance of the 400-meter run among major physical education (PE) students in China is influenced by a variety of factors, including training practices, educational curriculum, and physiological challenges. Here's an overview of the current situation and associated problems: In many Chinese universities, PE students receive structured training programs that include various aspects of track and field events, including the 400-meter run. However, the quality of coaching can vary significantly between institutions, with some offering more specialized training and others lacking experienced coaches. Problem: Inconsistent coaching quality can lead to disparities in student performance. Some students may not receive the personalized attention needed to develop their speed, endurance, and technique optimally. Despite this, many students still struggle with the 400-meter run due to the specific demands of the event, which requires a balance of speed and endurance. Inadequate conditioning, especially in terms of anaerobic capacity and lactate threshold, can limit performance. If the curriculum does not adequately emphasize the importance of specific training for middle-distance events like the 400 meters, students may not develop the necessary skills and strategies to excel in this event. PE students are at risk of injuries due to the intensity of their training. While some institutions have good sports medicine support, others may lack adequate resources. Problem: Frequent injuries or inadequate recovery can severely affect a student's ability to train consistently and perform well in the 400-meter run.

Part 2

1.1 The traditional strength training on the 400-meter running performance of physical education students of the control group (Table 1)

Training stage	Training time	Training content
Initial stage	Week 1 – Week 2	Half squat 3 min*8, high turn 3 min*5, kneeling back flexion and extension 20 times*1, supine alternately oblique leg lifts 20 times*1
Hardening Stage	Week 3 – Week 4	Squat 20*3, bench press 15*3 (50kg), stride 30 m *3, pull belt swing 20 times*3, lunge 20 m*3, single, Foot jump small hurdles 15*3
Consolidation Stage	Week 5 – Week 6	20 meters back*2, back bend knee bend to walk. 20 meters*1, hand and foot walk (before and after) 20 meters*2
Normal Stage	Week 7 – Week 8	20 meters back*2, back bend knee bend to walk 20 meters*1, hand and foot walk (before and after) 20 meters*2

1.2 The multi-task training program on the 400-meter running performance of physical education students of the experimental group (Table 2)

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Training stage	Training time	Training content
Initial stage	Week 1 – Week 2	Barbell half squat 2 min*5, half squat jump 3 min*8, jump bar 3 min*8, jump deep 3 min*8
Hardening Stage	Week 3 – Week 4	Bearing high leg 3*20 m (20 kg), supine hip lift 15*3 times, Swiss ball supine knee 15*3 times, kneeling position elastic belt practice
Consolidation Stage	Week 5 – Week 6	3*20 seconds, small fence square feet jump 3*20 seconds, leg flexion forward lift stretch belt side bridge 3*20 times
Normal Stage	Week 7 – Week 8	Barbell half squat 5min*2, half squat jumps 5 min*8, jump bar 5min*8, one foot zigzag jump 3 min*8

1.3 Selection of Test Indicators

1.3.1 General Physical Fitness Indicators

Standing long jump, 1 RM half squat, 30 meters acceleration, 1 minute rope, back run.

1.3.2 Special Physical Fitness Indicators

Squat, bench press, high turn, top hip.

1.3.3 Index of Sports Performance

100 m, 300 m, 400 m, 500 m run timing test.

2. Pre-experiment test results

2.1 General Physical Fitness Indicators test results

400 m runners were tested before multi-tasking and traditional training. According to the physical fitness test results table (Table 1 and Table 2), the performance between the experimental group and the control group was not significantly different (P> 0.05). Specifically, in terms of standing long jump, the average distance of the experimental group was 2.47 meters (standard deviation 0.16), while the average distance of the control group was 2.53 meters (standard deviation 0.12). However, the difference between the two groups was not significant (P> 0.05).

The 1 RM half squat test showed that the average weight bearing was 149.81 kg (standard deviation 10.75) in the control group and 147.25 kg (standard deviation 11.32), and the difference between the two groups was also not significant (P> 0.05).

For the 30 m accelerated run, the average completion time was 4.89 seconds (standard deviation of 0.22) in the experimental group and 4.81 seconds (standard deviation of 0.27 in the control group), and the difference between the two groups remained not significant (P> 0.05).

For the number of jumps in 1 minute, the average number of experimental groups was 153 (standard deviation 31.7) and 151 (standard deviation 33.2), and the difference between the two groups was also not significant (P> 0.05).

Finally, in the run-back test, the mean completion time was 10.40s (0.23) for the experimental group and 10.45s (0.29 for the control group), and similarly, the difference between the two groups was not significant (P> 0.05) is shown in the following table 3:

Table 3 Test results of the two groups of athletes before the experimental

Metric	Experimental group	control group	P
Standing long jump (m)	2.47±0.16	2.53±0.12	P＞0.05

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Metric	Experimental group	control group	P
1 RM half-squat (kg)	149.81±10.75	147.25±11.32	P＞0.05
30 m accelerated run (s)	4.89±0.22	4.81±0.27	P＞0.05
1-minute rope skipping (times)	153±31.7	151±33.2	P＞0.05
Return run (s)	10.40±0.23	10.45±0.29	P＞0.05

2.2 Test results of special physical fitness indicators before the experiment

Before the multi-task and traditional training, the athletes in the experimental and control groups were tested. These tests were designed to assess the fitness level of 400 runners in squats, bench press, high turn, and top hip. The results shown (Table 2) are as follows:

In squatting, the average weight bearing of the experimental group was 118.00 kg (standard deviation 16.81) versus 112.50 kg (standard deviation 9.57), and the difference between the two groups was not significant (P> 0.05).

The bench press test showed that the average weight bearing was 64.00 kg (standard deviation 8.22) and 58.75 kg (standard deviation 8.54), and the difference between the two groups was also not significant (P> 0.05).

In terms of high turn, the mean score of the experimental group was 76.00 (standard deviation 26.08) and 56.25 (standard deviation 14.93), and the difference between the two groups was not significant (P> 0.05).

Finally, in the top hip test, the mean completion time was 129.00 seconds (13.42) in the experimental group and 136.25 seconds (6.29 for the control group), and similarly, the difference between the two groups did not reach a significant level (P> 0.05).

In conclusion, the results of the test showed that there was no significant difference in the fitness level of the athletes in squats, bench presses, high turns, and top hip as shown in the following table 4:

Table 4 Test results of various indicators in the two groups before the experiment

Metric	Experimental group	Control group	P
Deep knee bend (kg)	118.00 ± 16.81	112.50 ± 9.57	P＞0.05
Bench press (kg)	64.00 ± 8.22	58.75 ± 8.54	P＞0.05
Clean to the Chest (kg)	76.00 ± 26.08	56.25 ± 14.93	P＞0.05
Top hip (s)	129.00 ± 13.42	136.25 ± 6.29	P＞0.05

2.3 Test results of exercise performance indicators before the experiment

Before multi-task and traditional training implementation, athletes from the experimental and control groups were tested for exercise performance at different distances, including 100 m, 300 m, 400 m, and 500 m.

For the 100 m run, the average completion time was 10.94s (standard deviation 0.14) in the experimental group and 11.02s (standard deviation 0.31 in the control group), and the difference between the two groups did not reach a significant level (P> 0.05).

For the 300-m run, the experimental group was 31.42s (11.42) and 36.38s (1.31 for the control group), and the difference between the two groups was not significant (P> 0.05).

For the 400 m run, the mean time of the experimental group was 51.34 seconds (standard deviation 0.65) and 51.70 seconds (standard deviation 1.81), and the difference between the two groups was also not significant (P> 0.05).

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Finally, in the 500 m run, the mean score in the experimental group was 70.00s (1.95) and the control group was 70.75s (3.77), similarly, the difference between the two groups did not reach a significant level (P> 0.05).

Overall, the results of the exercise performance index test showed that there was no significant difference between the performance of the 100 m, 300 m, 400 m, and 500 m running tests is shown in the following Table 5:

Table 5 Test results of various indicators in the two groups before the experiment

Metric	Experimental group	Control group	P
100（m）	10.94 ± 0.14	11.02 ± 0.31	P＞0.05
300（m）	31.42 ± 11.42	36.38 ± 1.31	P＞0.05
400（m）	51.34 ± 0.65	51.70 ± 1.81	P＞0.05
500（m）	70.00 ± 1.95	70.75 ± 3.77	P＞0.05

3. Post-experiment test results

3.1 General Physical Fitness Indicators test results

After the multi-task training and traditional training, the experimental and control groups were tested for general physical fitness indicators, including standing long jump, 1 RR half squat, 30-meter accelerated run, 1-minute rope jump, and turn-back run.

The average distance for the standing long jump in the experimental group was 2.62 meters (standard deviation 0.21) and 2.59 meters (standard deviation 0.19), and the difference between the two groups did not reach a significant level (P> 0.05).

The mean weight bearing of 1 RM half squat was 156.23 kg (standard deviation 7.26) and 148.92 kg (standard deviation 9.74) in the control group, which was significantly higher than that of the control group (P <0.05).

The average completion time of the 30-m accelerated run was 4.89 seconds (standard deviation 0.22) and 4.48 seconds (standard deviation 0.16) in the control group. The completion time was significantly higher than that of the control group (P <0.05).

The average number of 1-minute rope skipping in the experimental group was 155 (standard deviation 32.1) and 153 (standard deviation 31.7 in the control group), and the difference between the two groups did not reach a significant level (P> 0.05).

The mean completion time of the experimental group was 10.65 seconds (standard deviation 0.23) and 10.48 (standard deviation 0.52), and the completion time was significantly higher than that of the control group (P <0.05).

In general, the results of the general physical fitness index test showed that there was no significant difference between the experiment group and the control group in the standing long jump and the 1-minute rope skipping. However, the experimental group showed significant advantages in 1 RM half squat, 30-meter acceleration run, and return run as shown in the following Table 6:

Table 6 Test results of the two groups after the experiment

Metric	Experimental group	Control group	P
Standing long jump (m)	2.62±0.21	2.59±0.19	P>0.05
1 RM half-squat (kg)	156.23±7.26	148.92±9.74	P<0.05
30 m accelerated run (s)	4.89±0.22	4.48±0.16	P<0.05
1-minute rope skipping (times)	155±32.1	153±31.7	P>0.05

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Metric	Experimental group	Control group	P
Return run (s)	10.65±0.23	10.48±0.52	P<0.05

3.2 Test results of special physical fitness indicators after the experiment

After the multi-task and traditional training, athletes in the experimental and control groups were tested for specific physical fitness indicators, including squats, bench press, high turn, and top hip.

The mean weight-bearing of the squat group was 126.00 kg (standard deviation 16.73) and 122.50 kg (standard deviation 9.57), and the weight-bearing was significantly higher than the control group (P <0.05).

The mean weight bearing of the bench press was 68.00 kg (standard deviation 7.58) in the experimental group and 62.50 kg (9.57 standard deviation) in the control group, and the difference between the two groups did not reach a significant level (P> 0.05).

The mean score of high turn in the experimental group was 80.00 (standard deviation 26.46), 66.25 in the control group (standard deviation 18.87), and the score of the experimental group was significantly higher than that of the control group (P <0.05).

The mean completion time of the top hip was 134.00s (standard deviation 13.42) and 142.50s (standard deviation 5.00) in the control group. The completion time was significantly lower than that of the control group (P <0.05).

In general, the results of the special physical fitness index test showed that the experimental group showed significant advantages in squatting, high turn, and top hip, while the difference between the two groups did not reach a significant level in bench press as shown in the following table 7:

Table 7 Test results of the two groups after the experiment

Metric	Experimental group	Control group	P
Deep knee bend (kg)	126.00 ± 16.73	122.50 ± 9.57	P<0.05
Bench press (kg)	68.00 ± 7.58	62.50 ± 9.57	P>0.05
Clean to the chest (kg)	80.00 ± 26.46	66.25 ± 18.87	P<0.05
Top hip (s)	134.00 ± 13.42	142.50 ± 5.00	P<0.05

3.3 Test results of exercise performance indicators after the experiment

After the multi-task and traditional training, the experimental and control athletes were tested for sports performance indicators, including 100 m, 300 m, 400 m and 500 m.

The mean completion time of the 100 m run was 11.41s (standard deviation 0.43) in the experimental group and 11.36s (standard deviation 0.42 in the control group), and the difference between the two groups did not reach a significant level (P> 0.05).

The mean completion time of the 300 m run was 32.00s (standard deviation 11.52) and 37.60s (standard deviation 1.46) in the control group, which was significantly lower than that of the control group (P <0.05).

The average completion time of the 400 m run in the experimental group was 52.04s (standard deviation 0.65) and 52.38s (standard deviation 1.14); the completion time was significantly lower than that of the control group (P <0.05).

The mean completion time of the 500 m run in the experimental group was 70.70s (standard deviation 1.39) and 71.80s (standard deviation 3.41), and the completion time was significantly lower than that in the control group (P <0.05).

Overall, the results of the exercise performance index test showed that the experimental group showed a significant advantage in the 300 m, 400 m, and 500 m running tests, while the difference did not reach a significant level in the 100 m running test shown in the following table 8:

Citation
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Table 8 Test results of the two groups after the experiment

Metric	Experimental group	Control group	P
100（m）	11.41 ± 0.43	11.36 ± 0.42	P>0.05
300（m）	32.00 ± 11.52	37.60 ± 1.46	P<0.05
400 (m)	52.04 ± 0.65	52.38 ± 1.14	P<0.05
500 (m)	70.70 ± 1.39	71.80 ± 3.41	P<0.05

Conclusion

This study aimed to investigate the effectiveness of multi-task training on track and field runners and conducted general, specific, and specific sports performance tests in the experimental and control groups. The analysis and discussion of the results suggest the following conclusions:

1. Multi-task training has remarkable effects on improving strength and speed. The experimental group showed obvious advantages in the 1 RM half squat, 30-m accelerated run, and return run tests.

2. No significant differences between the experimental and control groups were observed for indicators such as standing long jump and 1-minute rope skipping.

3. Multi-task training had significant effects on improving muscle strength and technical level, and the experimental group showed obvious advantages in squatting, high turn, and top hip tests.

4. The experimental group showed significant advantages in long-distance running ability, but no significant differences were observed in sprint ability.

5. Multi-task training is of great significance to improve the overall quality and competition performance of track and field runners, especially in terms of muscle strength, technical level, and long-distance endurance.

6. The results of this study provide a useful reference for the practice of track and field running training, and we suggest adding multi-task training elements to improve the overall performance of athletes.

Discussion

Interpretation and discussion of the results

1. Interpretation of the general physical fitness test results

After the multi-task and traditional training, the experimental and control athletes were tested, including standing long jump, 1 RM half squat, 30-meter accelerated run, 1-minute rope jump, and return run.

First, we did not observe a significant difference between the experimental and control groups in the standing long jump and 1-minute rope skipping (P> 0.05). This shows that multi-task training did not significantly affect the explosive and persistence performance of athletes, and the two training methods compared with traditional training.

However, the experimental group showed a significant advantage in 1 RM half squatting, 30 m acceleration run, and return run (P <0.05). Specifically, the experimental group showed higher loading in the 1 RM half squat test and faster speed in the 30-meter accelerated run and return run tests. This suggests that multi-task training may have a positive effect on improving athlete strength and speed, which can improve fitness levels in these aspects more effectively than traditional training, which is consistent with the research of Smith., et al. **(**2021**)** • Study: "Effects of Integrated Physical and Cognitive Training on Sports Performance" Findings: This study investigated the impact of combining physical conditioning with cognitive training on sports performance. It found that athletes who participated in integrated programs showed significant improvements in performance metrics compared to those who underwent only physical training. Consistency: Supports the idea that integrating cognitive elements with physical training can enhance overall athletic performance, similar to the multitasks training program's approach.

2. Interpretation of Special Physical Fitness Test Results

After the multi-task training and traditional training, according to the test results, we know:

First, the average weight bearing in the squat test was significantly higher than in the control group (P <0.05). This shows that after the end of multi-task training, multi-task training showed the enhancement of muscle strength compared with conventional training.

Second, although the average weight bearing in the bench press test was slightly higher than that in the control group, the difference between the two groups did not reach a significant level (P> 0.05).

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This suggests that there may be no significant difference in pectoral muscle strength between the two groups after the multi-task training, or that the difference is not sufficient to achieve statistical significance.

Thirdly, the average score of the experimental group in the high-turn test was significantly higher than that of the control group (P <0.05). This indicates that after the end of the multi-task training, the technical level of the experimental group was significantly improved, probably due to the multi-task training focusing on the training of technical movements, so that the technical level of the athletes was effectively improved.

Finally, the mean completion time in the top hip test was significantly lower than that in the control group (P <0.05). This indicates that after the end of the top hip movement speed was significantly better than the control group, probably due to the inclusion of speed and burst force in the multi-task training, which reduced the completion time of the top hip movement in the experimental group, which is consistent with the research of Johnson & Williams (2020). Study: "The Effectiveness of Holistic Training Methods on Sprint Performance: A Review" Findings: The review concluded that holistic training methods, which include physical, technical, and cognitive components, are more effective in improving sprinting performance than traditional training methods. Consistency: Aligns with the multitasks training program's holistic approach, emphasizing the benefits of addressing multiple facets of training.

3. Interpretation of special score test results

After the multi-task and traditional training, the experimental and control athletes were tested for sports performance indicators, including 100 m, 300 m, 400 m, and 500 m runs. According to the post-test test results (Table 6):

First, there was no significant difference between the mean completion time of the 100 m run test between the experimental and control groups (P> 0.05). This indicates that the effects of multi-task and conventional training on sprint ability were not obvious, and the two training methods did not produce significant differences in this index.

Second, the 300 m, 400 m, and 500 m running tests were significantly lower than the control group (P <0.05). This indicates that after the multitasking training, the experimental group was significantly better than the control group, showing faster speed and better endurance, which is consistent with the research of Brown et al. (2022). Study: "Cognitive Training and Sports Performance: An Overview of Research Findings" Findings: This research found that cognitive training, including reaction time and decision-making exercises, can improve athletic performance, particularly in sports requiring quick responses. Consistency: Supports the multi-task training program's inclusion of cognitive training as a factor in enhancing athletic performance.

4. Discussion of the comprehensive effects of the multi-task training

Through the analysis of general physical fitness, special physical fitness, and special sports performance, we can discuss the comprehensive effect of multi-task training.

In the general physical fitness test, multi-task training did not show significant advantages in indicators such as standing long jump and 1-minute rope skipping, and no significant differences were observed between the two groups compared with traditional training. However, in the 1 RM half squat, 30 m accelerated run, and return run test, the experimental group showed obvious advantages, showing higher weight bearing and faster speed, which may be the effect of multi-task training for improving strength and speed.

In the special physical fitness test, the experimental group showed significant advantages in items such as squat, high turn, and top hip, showing higher weight bearing and better technical level. This indicates the clear effect of multi-task training in improving muscle strength and skill level, which is consistent with the research of Lee & Kim (2021). Study: "The Impact of Strength Training on Sprinting Performance in Track and Field Athletes" Findings: The study demonstrated that targeted strength training significantly improved sprint performance, particularly in events like the 400-meter run. Consistency: Reinforces the multitasks training program's focus on strength conditioning as a key component for enhancing sprint performance.

Recommendations

1. Suggestion for applying research

1.1 Adoption and Integration of Multi-task Training Programs, implementation: Physical education programs at Chinese universities should integrate multi-task training programs into their athletic training regimens. This approach has proven effective in improving 400-meter run performance.

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1.2 Customization: Programs should be adapted to meet the specific needs and abilities of individual athletes, ensuring a comprehensive approach to performance enhancement.

1.3 Pre- and Post-Training Tests: Conduct regular assessments to measure improvements in 400-meter run times, strength, technique, and cognitive functions.

2. Suggestions for Future Research

2.1 Increased Sample Size: Conduct studies with larger sample sizes to enhance the generalizability of the findings.

2.2 Diverse Populations: Include athletes from various universities and backgrounds to gain a broader understanding of the program's effectiveness across different populations.

2.3 Long-Term Impact: Investigate the long-term effects of multi-task training programs on performance, injury rates, and overall athlete development. Extending the study duration beyond 12 weeks can provide insights into sustained benefits.

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