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Effects of Cross-Training Exercise Program to Improve Health-related Physical Fitness for University Students in Guangdong

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Abstract

Background and Aim: Health-related physical fitness test is beneficial to the health-related physical fitness of college students. According to the researcher's survey, most students do not have an awareness of daily physical exercise, which leads to a decline in physical function and health-related physical fitness scores. The purpose of this paper is to study the effect of cross-training programs on improving college students' health-related physical fitness, to improve college students' health-related physical fitness scores by constructing an 8-week cross-training program, and to encourage students to actively participate in extracurricular physical exercise to promote health-related physical fitness and to form the awareness of lifelong sports. The results of this study show that cross-training can improve students' health-related physical fitness performance and that even after only 4 weeks of cross-training, students' health-related physical fitness performance can still make significant progress.

Materials and Methods: The study involves Guangdong Province Foreign Language and Arts Vocational College of Catering and Tourism College 2022 students, the total number of grades 710 people, health-related physical fitness scores failed 66 people, using G-Power in 66 students to calculate the sample size of 28 students (14 male, 14 female) aged between 18-22 years old. The research procedure started with anthropometric measurements: height, weight, BMI, body fat percentage, etc. Subsequently, cross-training was performed. Tests included: cardiorespiratory endurance, muscular strength, muscular endurance, and flexibility. The experiment lasted for eight weeks, with five one-hour training sessions per week. Subjects underwent Health-related physical fitness tests in the first, fourth, and eighth weeks.

Results: The 8-week cross-training program reduced students' BMI and body fat percentage, and improved students' health-related physical fitness grades and physical fitness. The student's health-related physical fitness grades failed in the first week, improved significantly in the fourth week (67 points), and the average score in the eighth week (75 points) improved even more significantly.

Conclusion: Constructing a cross-training program had a significant effect on improving cardiorespiratory endurance, muscular strength, muscular endurance, and flexibility in college students. It also increased their BMI and body fat percentage. It was concluded that an 8-week cross-training program decreased students' BMI and body fat levels while increasing muscle mass and improving health-related physical fitness scores, and students showed significant improvement in fitness scores in week 4 and even more significant improvement in week eight. Considering the positive effects of training on physical function and fitness, it is recommended that extracurricular sports be promoted so that more people can exercise in their spare time.

Keywords: Cross-Training; Health Related Physical Fitness; College Students

Introduction

In China, physical education is listed as an elective course for college students. The health-related physical fitness test is a mandatory component for students every year. The purpose of health-related physical fitness tests for college students is to improve students' physical function and quality. The health-related physical fitness test is beneficial to students' health-related physical fitness. The five components of physical fitness include "cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, and body composition", which are closely related to their physical health (Yang, T.J., 2018).

In China according to the National Student Physical Fitness Standard, the health-related physical fitness test score of 50 points or more is qualified as a mandatory credit item for graduation issued by the school. Those whose health-related physical fitness test scores are assessed as failing shall be allowed to take a supplementary test once in the current school year, and if the supplementary test score still fails to meet the standard, the school year's health-related physical fitness score shall be assessed as failing. Upon graduation of students from general high schools, secondary vocational schools'

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colleges, and universities, some students fail to achieve 50 points or more in the health-related physical fitness test every year and are treated as graduates and cannot get a degree certificate. However, the school will open a health-related physical fitness test class for these students every year, and even students who have finished school can return to the school to apply for a remedial test, if the remedial test score meets the standard, the school will issue a degree certificate for them." Some students have a hard time meeting the standards and may be a little unsympathetic to the school. Such strength is, on the one hand, our responsibility and obligation to conduct fitness tests for students by state regulations; on the other hand, it is a way to accurately understand the physical condition of students through rigorous testing, to formulate plans and training to help students improve their fitness. In addition, strict physical fitness monitoring can, to a certain extent, make students increase their awareness of physical exercise" (Shi, Y.F., & Shen, L., 2013).

The researchers investigated the students of the class of 2022 in the Catering and Tourism College of Guangdong Province Foreign Language and Arts Vocational College and found that some college students did not have the habit of daily physical exercise, and stayed in the dormitory to play games or were sedentary after classes, which led to a decline in physical function and physical fitness. In the physical education class, bad symptoms such as dizziness and vomiting appeared when jogging. This is the main reason why the health and fitness scores are not up to standard. In the past health-related physical fitness tests, it was found that cardiorespiratory endurance and muscular strength were weak, with 35% of students failing the health-related physical fitness: 1000m (male)/800m (female) event test, 70% failing the health and fitness: pull-up event test and scores in other events were not promising. This has become a problem we have to focus on.

How to solve the problem of declining students' physical fitness? The researcher's design of extracurricular physical activity is based on the requirements of the national physical education syllabus and physical education policy to develop a cross-training program and lead students to exercise after school to improve their health-related physical fitness performance. Physical education teachers are advised to encourage students to adhere to physical activity before, during, and after school to develop a good habit of lifelong physical activity.

The cross-training method is a modern training method that integrates strength training, aerobic training, and flexibility training. Studies have shown that "students' physical fitness indicators are significantly higher than before, with significant improvements in bounce strength, flexibility, upper body and waist and abdominal strength". (Chen, M.,2015).

The main purpose of this paper is to study the effect of "cross-training" exercise programs on improving the health and fitness of college students. The cross-training program was constructed on the example of the Catering and Tourism College of Guangdong Provincial College of Foreign Languages and Arts. The training process is to analyze the students' body composition and then conduct experiments, the experimental programs are 800m/1000m, standing long jump, pull-ups, sit-ups, seated forward bends, etc. The training method is to use cross-training to improve the student's health and fitness. The training method is to utilize cross-training to exercise the students' body functions and to develop the student's physical fitness comprehensively. The results of this study show that cross-training can improve college students' health-related physical fitness performance and promote physical health.

Objectives

1. To study the Effect of the Cross Training Exercise Program to improve Health-related Physical Fitness for Catering and Tourism College Students of Guangdong Vocational College of Foreign Languages and Arts.

2. Construct the Cross Training Exercise program to improve Health-related Physical Fitness for Catering and Tourism College Students of Guangdong Vocational College of Foreign Languages and Arts.

3. To Compare within group Effects of the training exercise Program between the pretest after the 4th week and after the 8th week for Catering and Tourism College Students of Guangdong Vocational College of Foreign Languages and Arts.

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Literature Review

In 2020, China's State General Administration of Sport and Ministry of Education implemented the important instructions of General Secretary Xi Jinping on the construction of a strong sports nation and the spirit of the National Education Conference. It is pointed out that "establish the concept of health-first education, for all students, open all full physical education classes, to help students enjoy the fun of physical exercise, enhance physical fitness, improve personality, and sharpen the will to achieve civilization of their spirit and savagery of their physical fitness. To carry out colorful after-school training"(State General Administration of Sports & Ministry of Education,2020). According to a document from the Ministry of Education stating that China attaches great importance to the health-related physical fitness of students and encourages students to actively participate in physical exercise to enhance their physical fitness.

Ministry of Education. (2014). China's Ministry of Education 2014 released the National Student Physical Fitness Standard (2014 Revision), the standard from the body form, physical function and physical quality and other aspects of the comprehensive assessment of students' physical fitness level, is China's student development core literacy system and academic quality standards of an important part of the student's physical fitness are the individual evaluation of health standards. The content of healthy physical fitness includes five aspects: "cardiorespiratory endurance, muscular endurance, muscular strength, flexibility, and body composition". In this study, students' physical fitness was scored according to the above National Physical Fitness Standards for Students.

This study was a cross-training through extracurricular sports. Zhang, G.M., in "Analysis of the Current Situation and Countermeasures of Extracurricular Physical Activity for College Students in Liaoning Province," suggested that the management of extracurricular physical activity in colleges and universities should try to meet the diversified needs of students for workout programs and workout time (Zhang, G.M.,2006). Eui, L. & Jooyoung, K. et al. (2021) investigated how a school-based physical activity program affects health-related fitness among adolescents in the Republic of Korea.2022 Scholar Yang Gen-yin elaborated that: science guides students to voluntarily participate in extracurricular physical exercise, continuously improves the physical fitness of contemporary college students, and cultivates their awareness and habit of lifelong exercise (Yang, G.Y., 2022). The researcher believes that cross-training is diversified training with alternating content that is not easily boring. Therefore, cross-training was chosen as the training method.

Cross-training as far as the origin and development are concerned, cross-training abroad is earlier than at home. Cross-training was founded by Greg Glassman in 2000. It originated from the fitness training system in the United States, and its main partner, Reebok, has a set of its own trainer training and certification system (Guo, L., 2016). Cross-training was introduced to China relatively late, so we need to do more research in the area of cross-training.

In 2013, Cross-training flowed into China, and it was Reebok that joined hands with Cross Fit, a strength training course, to land in Shanghai and open the first Reebok Cross Fit Me Wellness gym in China. Equipped with 30 Cross Fit professional coaches, 22 of them are foreign coaches. Currently, there are Cross Fit gyms in Shanghai, Beijing, Guangzhou, Ningbo, and Kunming. In recent years, the physical fitness part of the National Professional Fitness Trainer Skills Competition has also taken up most of the weight, which shows that with the gradual rise and development of fitness programs, more physical fitness competitions have been carried out in China, and the first to bear the brunt is the cross-training model-driven physical fitness competitions (Mu, Y.G., 2018). This shows that cross-training improves fitness, many fitness trainers, coaches, etc. utilize cross-training for their workouts.

As early as 1994, Tanaka H. pointed out in Effects of cross-training that cross-training is a widely used method to improve the competitiveness of a particular sport through training in various sports. It has a significant effect on physical fitness and functional improvement (Tanaka H, 1994). Therefore, in this paper, cross-training was chosen to exercise students' health-related physical fitness, and the results of the study showed that cross-training could improve students' health-related physical fitness performance.

In 2016, Zhang, F. pointed out in "Research on the effect of using the cross-training method in after-school basketball training in secondary schools", the results of experimental research on the

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basketball team show that cross-training can improve the student's physical fitness and athletic ability Zhang, F., 2016).

Through a 4-week experimental study of Probe into Plateau and Half-plateau Cross-training for Juvenile Middle and Long Races, XiLiang, K. found that cross-training can gradually promote the improvement of training levels, cross-training can regulate the psychological and physiological fatigue of athletes and can mobilize athletes' motivation to train (XiLiang, K.,2000). The studies of the above scholars have shown that cross-training improves students' physical fitness and health-related physical fitness performance. It is consistent with the findings of this paper.

Summary : According to studies by Chinese scholars. cross-training is a multi-functional training, there are a variety of training methods, that can improve the physical skills and physical quality of the training method, in soccer, basketball, badminton, track and field, swimming and other sports training has been widely used, and has a significant effect. Sufficient supporting evidence is provided for the study of this paper.

Domestic and foreign scholars agree that cross-training is a modern training method that integrates strength training, aerobic training, and body flexibility training. It can be low-intensity or high-intensity, covering a wide range of aerobic, strength, flexibility, agility, and balance training.

Literature references from Chinese and foreign scholars suggest that cross-training can improve students' "cardiorespiratory endurance, muscular strength, muscular endurance, and flexibility," which is consistent with the findings of this paper.

Conceptual Framework

The paper title “Effects of Cross-Training Exercise Program to Improve Health-related Physical Fitness for University Students in Guangdong” was designed as follows

Figure 1 Conceptual Framework

Methodology

1. Research Paradigm: The scope of this study is the class of 2022 in the Department of Catering and Tourism of Guangdong Province Vocational and Technical College of Foreign Languages and Arts, with a total of 710 students and 14 classes.

2. Research strategy: Develop an 8-week cross-training program to improve student health and fitness performance.

3. Population and sample including random sampling: This study involves 28 people, aged between 18-22 years old, all of whom are students of the class of 2022 in the College of Catering and Tourism, Guangdong Province College of Foreign Language and Arts. Purposive sampling was used to calculate the sample size using G*Power, 3 repeated measurements from 66 students with unsatisfactory health fitness scores, resulting in 28 people as the sample of the experimental study.

4. Research and development tools/data collection tools. Cross Training Program: 1–8-week training program. And Lab Record Sheet.

5. Data Collection Method: Research Design: One group repeated Measurement. And Research tool: Cross Training Exercise Program/duration = 8 weeks, 5 days/week

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6. Data analysis, both quantitative and qualitative data: Statistic /mean standard deviation, One-way ANOVA Repeated Measurement, and Significant difference level.05

7. Data reliability and Validity check: Researchers piloted the cross-training program with 3, 9, and 30 students to test the reliability and implementation process of the cross-training program. The students were tested and were able to achieve more than 65% in all the large-group experiments with 30 students. In this way, it was proved that the cross-training program was reliable and that the testing process went very smoothly. According to the IOC calculation formula, all the values of the experimental data obtained were within the range of 0.915±0.055. It indicates that the cross-training program in this study is effective and can be included in the research experiment.

Experiment:

First, BMI and body fat percentage measurements were taken. Then, subjects participated in a cross-training program. Subjects participating in the experiment underwent an 8-week cross-training program in cardiorespiratory endurance, muscular strength, muscular endurance, and flexibility. At the end of cycle 4 of the training, a second health fitness repeated measure was taken, and at the end of cycle 8 of the training, a third health fitness repeated measure was taken to assess changes in body composition and health fitness performance of the study subjects.

The health fitness testing study began with anthropometric measurements. The measurements were as follows: height, weight, BMI, and body fat percentage of the subjects were measured using the Heng Kang Jia HK6800-ST. Subjects were informed of the measurement methods. The study used the direct observation method - the Health Fitness Test. The following components and measurement tools were selected from the National Student Physical Fitness Standards: 800m/1000m test (Stopwatch), standing long jump test (Heng Kang Jia Ye HK6800-TY), pull-up test (Single bar: holding the bar with both hands and bending the elbows at a 90-degree angle), sit-up test (Stopwatch: number of sit-ups in 1 minute), and seated forward bend (Heng Kang Jia Ye HK6800-TQ). Before performing each test, subjects were informed of the test content and measurement method, and after the test, subjects were informed of their performance.

The purpose of the experiment was to enhance students' health and fitness performance through a cross-training program. The cross-training program provided by the researcher allowed the subjects to train in cardiorespiratory endurance, muscular strength, muscular endurance, and flexibility; in the first phase of the experiment, the subjects were informed about the main components of the training and the time and technique of the workout; in the second phase of the experiment, anthropometric (BMI, body fat percentage) analyses and a health fitness test were conducted to determine the level of physical fitness; and in the third phase of the experiment, a cross-training program was conducted for the subjects in cardiorespiratory endurance, muscular strength, muscular endurance and flexibility in a planned exercise program. Subjects received the following training:

1. Muscle strength training: upper limbs (pull-ups, push-ups, dumbbell swing arms), waist and abdominal strength (supine leg lifts, "V" sit-ups), lower limb muscle strength (semi-squat jumps, deep squats, feeler jumps, standing long jump training).

Hand strength pull-up will focus on strengthening, aiming to enhance the whole-body strength, and improve the pull-up and standing long jump performance.

2. Cardiorespiratory endurance training: fun cross-country running, scavenger hunts, AI positioning to find a partner game, middle and long-distance running. The aim is to improve students' 800m/1000m aerobic endurance.

3. Muscular endurance training: Plate support, step test, resistance training, etc. It aims to enhance the endurance of abdominal muscles and improve the performance of sit-ups.

4. Flexibility training: dynamic stretching (leg stretching, hand stretching, trunk stretching), static stretching (positive leg press, lateral leg press, standing forward bending, etc.). Designed to enhance flexibility and improve sitting forward bending performance.

5. AI Physical Training: Students are trained in muscular strength, muscular endurance, cardiorespiratory endurance, and flexibility. Programs: seated forward bending, standing long jump, sit-ups, push-ups, 800m/1000m, various aerobic exercises (e.g., jumping rope, IA fitness, sports games,

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etc.). There is no repetition of what is assigned each week. The main focus is to improve physical fitness, enhance body mass, and strengthen muscles. Students exercise on the campus sports smart cloud platform [APP], which contains videos to follow along, and the system will prompt students to exercise correctly and provide feedback on the quality of training movements for scoring at the end of the workout.

Each training program was supervised by the researcher. Subjects were cross-trained after class. The training program lasted for 8 weeks. Subjects exercised for more than 1 hour per day, Monday through Friday, and each training module consisted of a warm-up (10 minutes), a main component (40-50 minutes), and a relaxation exercise (5 minutes). Exercise load: 50%-60% at the beginning of the second week, with weekly increments of 5%-10%, not to exceed 10%. Intervals were organized according to the different components. The cross-training program is shown in Table 1.

Table 1 8-week cross-training program

Day / Week	Mon	Tue	Wed	Thu	Fri
Week 1	Muscle strength Muscle endurance	Cardio Endurance Flexibility	Muscle strength Muscle endurance	Cardio Endurance Flexibility	AI physical training
Week 2	Muscle strength Flexibility	Muscle endurance Cardio Endurance	Muscle strength Flexibility	Muscle endurance Cardio Endurance	AI physical training
Week 3	Muscle strength Muscle endurance	Cardio Endurance Flexibility	Muscle strength Muscle endurance	Cardio Endurance Flexibility	AI physical training
Week 4	Muscle strength Flexibility	Muscle endurance Cardio Endurance	Muscle strength Flexibility	Muscle endurance Cardio Endurance	AI physical training
Week 5	Muscle strength Muscle endurance	Cardio Endurance Flexibility	Muscle strength Muscle endurance	Cardio Endurance Flexibility	AI physical training
Week 6	Muscle strength Flexibility	Muscle endurance Cardio Endurance	Muscle strength Flexibility	Muscle endurance Cardio Endurance	AI physical training
Week 7	Muscle strength Muscle endurance	Cardio Endurance Flexibility	Muscle strength Muscle endurance	Cardio Endurance Flexibility	AI physical training
Week 8	Muscle strength Flexibility	Muscle endurance Cardio Endurance	Muscle strength Flexibility	Muscle endurance Cardio Endurance	AI physical training

Cross-training content schedule:

Single-week training program (Week1, 3, 5, 7)

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Mon & Wed: muscular strength training (upper body: pull-ups, push-ups, dumbbell swing; lumbar and abdominal strength: supine leg raises, "V" sit-ups), muscular endurance training (plank support, step test)

Tue & Thu: Cardiorespiratory endurance training (fun cross-country running, scavenger hunt) Flexibility training (static stretching: positive leg press, lateral leg press, standing forward bend, seated forward bend)

Bi-weekly training program (Week2, 4, 6, 8)

Mon & Wed: muscular strength training (lower limbs: semi-squat jump, deep squat, touch jump, standing long jump training), flexibility training (dynamic stretching: leg stretching, hand stretching, torso stretching, marching positive kicking, positive/side leg press,)

Tue & Thu: Muscular endurance training (resistance training: reverse curls, sit-ups, kneeling push-ups), cardiorespiratory endurance training (AI locating partner game, 800m/1000, m, and other aerobic exercises)

Every Friday: AI physical training (seated forward bending, standing long jump, sit-ups, push-ups, 800m/1000m, and various aerobic exercises such as jumping rope, IA fitness, sports games, etc.).

The research process was as follows:

Step 1 Relevant research concepts and theories were checked and summarized into a concept paper.

Step 2 Perspectives and reference data were collected, conceptual frameworks were developed, and research instruments were constructed.

Step 3 Data reliability and Validity check

Step 4 Conduct an 8-week cross-training program, testing students' body composition and cardiorespiratory endurance, muscular endurance, muscular strength, and flexibility in the first, fourth, and eighth weeks, and collecting data.

Step 5 Statistical Analysis: SPSS version 23 was used to Statistic /mean standard deviation and One way ANOVA Repeated Measurement

Step 6 Summarize the results of the study.

Results

The first part of the study was BMI and body fat percentage analysis. All data are shown in Table 2. There was a slight decrease in BMI (1.04%) and a decrease in body fat percentage (1.96%). These changes were statistically significant.

1. The results of the 7 test indicators were analyzed in the first week of the experiment

2. Using normality test, descriptive analysis, F-test ANOVA, and repeated test method, the 7 test indicators were tested in the fourth and eighth weeks of the experiment and the differences were analyzed.

Hagan, S. (2023) In the 1990s, the World Health Organization adopted the BMI indicator as the official screening indicator for obesity, and since then, the BMI indicator has gained notoriety among clinicians. Studies have consistently shown that population-level BMI is strongly associated with percent body fat and risk of serious health problems. Therefore, in this paper, BMI and percent body fat are used as indicators to analyze students' physical fitness.

Table2 BMI & body fat (%) Repeated Measures ANOVA （n=28）

Parameter	**Week 1 (`X± SD)**	**Week 4 (`X ± SD)**	**Week 8 (`X ± SD)**	**F**	**p**
BMI	23.81±4.44	23.40±4.19	22.77±4.02	67.82	0.001***
Body fat (%)	22.82±9.51	22.07±9.19	20.86±8.26	28.04	0.000***
*Comments: significant differences: *p<0.05.*					

As can be seen in Table 2, after 8 weeks of cross-training intervention, a comparison of the mean and single group repeated test ANOVA results for the first, fourth, and eighth weeks for the 28 students showed that. the BMI value decreased by 0.41 in the first week compared to the fourth week, 0.63 in

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the fourth week compared to the eighth week, and 1.04 in the first week compared to the eighth week. the mean value of body fat percentage decreased by 0.75 in the first week compared to the fourth week, week four compared to week eight decreased by 1.22, and week one compared to week eight decreased by 1.97. The data shows that there is a decrease in student BMI and body fat percentage through cross-training and that cross-training can adjust student BMI and body fat percentage to a healthier state. The experimental results show that $p<0.05$, differs significantly.

Table 3 Health-related Physical Fitness items Mean and Standard deviation

Parameter	Week 1 (ˆX± SD)	Week 4 (ˆX± SD)	Week 8 (ˆX± SD)
800M	4.99±0.46	4.69±0.38	4.31±0.34
1000M	5.05±0.42	4.68±0.28	4.24±0.18
Standing Long Jump	174.32±31.14	182.93±28.78	190.61±29.08
Sit-ups	24.50±10.68	30.14±7.72	34.00±7.04
Pull-ups	1.86±1.83	7.21±2.08	11.79±2.61
Sitting forward bend	10.25±6.35	10.96±5.86	12.46±5.25

As can be seen in Table 3, there was a significant improvement in all health fitness scores of the 28 students after 8 weeks of cross-training intervention when compared to the mean and standard deviation results of the pre-intervention test, week 4 and week 8. The specific analyses are shown in Tables 4-9.

Table 4 800M Repeated Measures ANOVA

800M	Multiple Means Comparison			F-test	
	Mean	Std. Error	Mean Difference (I-J)	F	p
week 1	4.99	0.46	0.29		
week 4	4.69	0.38	0.38	92.32	0.000***
week 8	4.31	0.34	0.67		
*Comments: significant differences: *p<0.05.*					

As can be seen in Table 4, after eight weeks of cross-training intervention, a comparison of the ANOVA results of the single group repeated tests of the 14 girls in the 800m at week one, week four, and week eight shows. The average performance improved by 0.38 seconds between week 1 and week 4, 0.38 between week 4 and week 8, and 0.67 seconds between week 1 and week 8 comparisons. It proves that through cross-training girls 800m is improved. f value is 92.32, $p<0.05$; three training results show that all stages of 800m performance improved, the eighth-week difference is the most significant, which shows that cross-training can improve students' 800m performance.

Table5 1000M Repeated Measures ANOVA

1000M	Multiple Means Comparison			F-test	
	Mean	Std. Error	Mean Difference (I-J)	F	p
week 1	5.05	0.42	0.37		
week 4	4.67	0.28	0.43	71.57	0.000***
week 8	4.24	0.18	0.80		
*Comments: significant differences: *p<0.05.*					

As can be seen in Table 5, after eight weeks of cross-training intervention, a comparison of the ANOVA results of the single group repeated tests of the first, fourth, and eighth weeks of the 1000m for the 14 boys showed. The average performance of the first week improved by 0.38 seconds with the

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fourth week, the average performance of the fourth week improved by 0.43 seconds with the eighth week, and the comparison of the first week and the eighth week improved by 0.81 seconds. The experiment proved that by cross-training boys 1000m is improved. f-value is 71.57, $p<0.05$; three training results showed that all stages of 1000m performance improved, the difference of the eighth week is the most significant, cross-training can improve the performance of boys 1000m.

Table6 Standing Long Jump Repeated Measures ANOVA

Standing Long Jump	Multiple Means Comparison			F-test	
	Mean	Std. Error	Mean Difference (I-J)	F	p
week 1	174.32	31.14	7.67		
week 4	182.93	28.78	8.60	76.02	0.000***
week 8	190.61	29.08	16.29		
*Comments: significant differences: *p<0.05.*					

As can be seen from Table 6, after 8 weeks of cross-training intervention, a comparison of the results of single group repeated test ANOVA for standing long jump of 28 students in the first, fourth, and eighth weeks showed. The mean value of standing long jump performance increased by 8.61cm in the first week compared with the fourth week, 7.68cm in the fourth week compared with the eighth week, and 16.29cm in the first week compared with the eighth week. The F-value was 76.02, $P<0.05$; the experiment proved that the students' standing long jump performance improved significantly through cross-training, and the boys' lower limb strength was better, so their standing long jump performance improved more significantly than that of the girls. The results of the three training sessions of the standing long jump are shown in the following table. From the analysis of the results of the three training sessions of the standing long jump, the results of all stages were improved, and cross-training could improve the student's performance in the standing long jump.

Table7 Sit-ups Repeated Measures ANOVA

Sit-ups	Multiple Means Comparison			F-test	
	Mean	Std. Error	Mean Difference (I-J)	F	p
week 1	24.50	10.68	3.85		
week 4	30.14	7.72	5.64	32.02	0.000***
week 8	34.00	7.04	9.50		
*Comments: significant differences: *p<0.05.*					

As can be seen in Table 7, after 8 weeks of cross-training intervention, a comparison of the results of one-group repeated test ANOVA of sit-ups of 14 girls in the first, fourth, and eighth weeks showed. Mean: 24.50 in the first week, 30.14 in the fourth week, and 34.00 in the eighth week. Std. Error: 10.68 in the first week, 7.72 in the fourth week, and 7.04 in the eighth week. Mean Difference (I-J): 3.85 in week 1, 5.64 in week 4, and 9.50 in week 8. According to the data, the average performance of week 1 improved by 4.57 with week 4, the average performance of week 4 improved by 5.64 with week 8, and the comparison between week 1 and week 8 improved by 10.21. The experiment proved that the sit-up performance of girls was improved by cross-training. f-value was 32.02, $p<0.05$; the results of the three training sessions showed that the sit-up performance was improved at all stages, and cross-training improved the students' sit-up performance.

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Table8 Pull-ups Repeated Measures ANOVA

Pull-ups	Multiple Means Comparison			F-test	
	Mean	Std. Error	Mean Difference (I-J)	F	p
week 1	1.86	1.83	4.57		
week 4	7.21	2.08	5.35	522.91	0.000***
week 8	11.79	2.61	9.92		
*Comments: significant differences: *p<0.05.*					

As can be seen in Table 8, after 8 weeks of cross-training intervention, a comparison of the ANOVA results of single-group repeated tests of pull-ups of 14 male students in the first, fourth, and eighth weeks showed. Mean: 1.86 in the first week, 7.21 in the fourth week, and 11.79 in the eighth week. Std. Error: 1.83 in the first week, 2.08 in the fourth week, and 2.61 in the eighth week. Mean Difference (I-J): 4.57 in week 1, 5.35 in week 4, and 9.92 in week 8. According to the data, the average improvement between week 1 and week 4 was 5.35, the average improvement between week 4 and week 8 was 4.58, and the improvement between week 1 and week 8 compared was 9.92. It proves that the boys' pull-up scores are improved by cross-training. The F-value is 522.91, $p<0.05$; the results show that cross-training improves the students' pull-up scores at all stages.

Table 9 Sitting forward bend Repeated Measures ANOVA

Sitting forward bend	Multiple Means Comparison			F-test	
	Mean	Std. Error	Mean Difference (I-J)	F	p
week 1	10.25	6.35	0.71		
week 4	10.96	5.86	1.50	44.76	0.000***
week 8	12.46	5.25	2.21		
*Comments: significant differences: *p<0.05.*					

As can be seen in Table 9, after 8 weeks of cross-training intervention, a comparison of the results of one-group repeated-test ANOVA of 28 students in seated forward bending at week 1, week 4, and week 8 shows. Mean: 10.25 at week 1, 10.96 at week 4, and 12.46 at week 8. Std. Error: 6.35 at week 1, 5.86 at week 4, and 5.25 at week 8. Mean Difference (I-J): 0.71 at week 1, 1.50 in the fourth week, and 2.21 in the eighth week. The data showed that the mean performance of the first week improved by 0.71 cm with the fourth week, the mean performance of the fourth week improved by 1.5 cm with the eighth week, and the comparison between the first week and the eighth week improved by 2.21 cm. The F-value was 44.76, $P<0.05$; the experiment demonstrated that through the cross-training sitting forward bending performance is improved.

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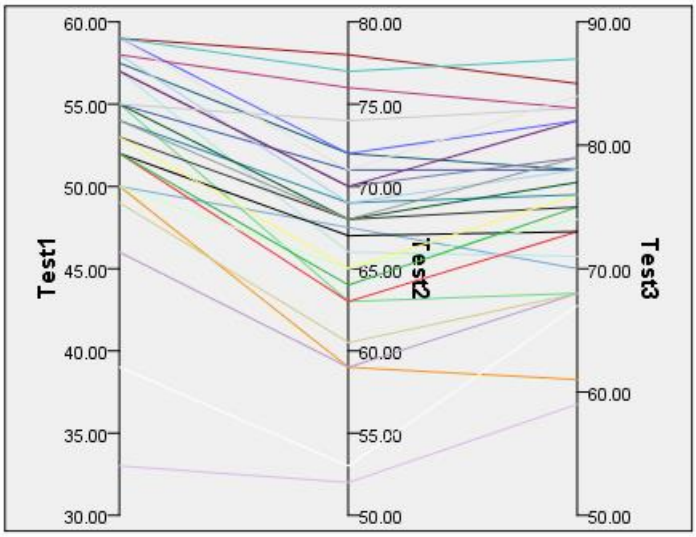
Table10 Cross training performance analysis



Test1=week1 Test2=week4 Test3=week8

Table 10 shows the 7 scores (BMI, sit-ups/pull-ups, 800/1000m, and seated forward bends) are converted to the total score average based on the National Health Fitness Scale. The upper graph of each score shows that the cross-training program was able to improve the physical fitness scores of the students in the School of Catering and Tourism, Guangdong Provincial College of Foreign Languages and Arts. The results of the grade conversion are: the test results of the first week are all failing, the fourth week is 67 points, and the average score of the eighth week is more than 75 points. This shows that the students' health and fitness scores have improved significantly.

Discussion

The cross-training program has a positive impact on improving the physical fitness of students in the School of Catering and Tourism, Guangdong College of Foreign Languages and Arts. The researcher concluded that targeted training of students' cardiorespiratory endurance, muscular endurance, muscular strength, and flexibility through an 8-week cross-training program improves students' health fitness performance and fitness. Cross-training plays a key role in promoting student health and fitness. The results of this study show that cross-training can reduce BMI and body fat percentage and bring students' BMI and body fat percentage up to standard; it helps to improve students' cardiorespiratory endurance, muscular endurance, muscular strength, and flexibility.

It is feasible to construct a health and fitness cross-training program for students of Guangdong College of Foreign Languages and Arts Vocational College of Catering and Tourism. It was proved in both IOC expert interviews and pretest experiments that the cross-training program is reliable and valid. The researcher concluded that improving student fitness while reducing athletic injuries because cross-training, which alternates training of multiple muscle groups, prevents athletic injuries while improving student health fitness performance. This is consistent with the findings of Baker, B. D. et al that diversifying the overall training regimen through cross-training may be an important strategy to reduce athlete-specific sports injuries. (Baker, B. D et al, 2019)

The researchers concluded that constructing a new cross-training program could improve college students' health-related physical fitness while eliminating aversion and burnout to running and maintaining good daily exercise habits. By introducing variety into an exercise program, cross-training can eliminate boredom and burnout and increase the likelihood of staying physically active during your lifetime. It also allows for more flexibility in your workouts (Brody, E.J..1996).

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This study concluded that cross-training enhances the fun of exercise and increases students' interest in exercise. It also allows students to exercise safely. This is consistent with the findings of White, M. L., et al. scholars who suggested that cross-training in a school setting may be a safe and enjoyable alternative to participation in physical activity. (White, M. L et al. 2018)

The researcher compared the within-group effects of a pre-test with a cross-training exercise program for students of the Guangdong College of Foreign Language and Arts Vocational College of Catering and Tourism after week 4 and after week 8. It was found that students from Guangdong Province Foreign Language and Arts Vocational College of Catering and Tourism improved cardiorespiratory endurance, muscular strength, muscular endurance, and flexibility, and were able to improve health-related physical fitness through an 8-week cross-training program. The main areas of improvement were trunk muscles, lower body explosive strength, waist and abdominal endurance, flexibility, and cardiorespiratory endurance. There was a significant improvement in the student's health fitness scores compared to week one versus week four, and the student's scores improved even more dramatically in week four versus week eight. In particular, lower limb muscle strength: standing long jump improved (16.29 cm), upper limb muscle strength: pull-ups improved (9.9), waist and abdominal muscle endurance: sit-ups improved (9.5), cardiorespiratory endurance: 800m for girls (0.67 seconds) and 1000m for boys (0.80 seconds), and flexibility: improved (2.21 cm). Repeated tests by F-test showed that these changes were statistically significant ($P<0.05$) and the experimental results were significantly different. The results of this experiment show that cross-training improves students' health and fitness performance. The results of this study coincide with the research of scholars Xia, Q.D., & Zheng, Z. on the effect of a 16-week physical fitness intervention program on college students' physical fitness level in the context of great health. (Xia, Q.D., & Zheng, Z., 2021)

Conclusion

1. The results of the study show that an 8-week cross-training program improves the health fitness of college students in the College of Catering and Tourism, Guangdong Province College of Foreign Language and Arts, in terms of cardiorespiratory endurance, muscular strength, muscular endurance, and flexibility. The cross-training program was constructed to improve the health fitness of college students as well as to improve the body parameters, which resulted in the standardization of the BMI of the college students, as well as the reduction of the body fat content and the increase of the muscle mass and the physical fitness. Stanford, B. (1996) Cross-training enhances cardiovascular fitness, builds muscle, reduces body fat, and improves flexibility.

2. The results of the study showed that 28 students from the Catering College of Guangdong Province Foreign Language and Arts Vocational College showed a significant improvement in all 7 health and fitness scores when comparing the pre-test group with the post-test group after the 4th and 8th week of the cross-training program. In terms of body composition: male students improved more significantly than female students. Because male students had longer endurance running distances and greater physical exertion, their BMI and body fat percentage decreased more. In terms of cardiorespiratory endurance: boys improved more significantly than girls. Because boys run longer endurance distances and have better stamina, they improve faster than girls. In strength: boys had weaker arm muscle strength and muscular endurance, while girls had better abdominal muscle strength and muscular endurance. The lower extremity explosive force of boys is better than girls. Flexibility: Girls' flexibility was originally better than boys', but the amount of training did not increase, resulting in less improvement in flexibility than boys. Among the seven data items, 800m/1000m, standing long jump, and sit-ups showed the most significant improvement. Pull-ups and seated forward bends still need to be strengthened. $p<0.05$. The improvement in week 8 was particularly significant, indicating that the longer the period of the cross-training program, the more significant the improvement in health and fitness performance.

3. The results of the study showed that health-related fitness after week 8 of the cross-training program was better than the pre-test, being aerobic fitness a key factor in improving students' health-related fitness performance. Durkalec-Michalski Krzysztof& Zawieja, E. E. et al. (2021) showed that

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cross-training performance was correlated with aerobic fitness, which gives a better understanding of the test's physiology to a deeper understanding.

4. Research results show that proper cross-training is not only suitable for athletes but also for ordinary people to exercise, it can prevent sports injuries and reduce overtraining of the same muscle group. Donohue, P. (1995) Alternating exercises can reduce the chance of injuries due to the overuse of a particular muscle group. Li Wen (2008) Cross-training can help athletes to reduce the stress on the lower limbs and reduce the risk of injuries due to over-training and other injuries and also strengthens those areas that have been neglected, thus reducing the chance of injury.

In conclusion, there was a significant improvement in the health-related physical fitness performance of the students through the cross-training program. The average of the total health-related physical fitness scores in the first week was failing, and the total scores in the fourth week improved to 67, and in the eighth week improved to 75. The experimental results show that cross-training can effectively improve students' health-related physical fitness scores, and promote physical health. The subjects of this study were freshmen, and the students quickly adapted to the exercise under the influence of the 8-week cross-training program. Therefore, it can be conducted in various types of colleges and universities and implemented for longer training periods than 8 weeks with better results.

Recommendation

1. Aerobic endurance and muscular strength are the keys to improving physical fitness, so it is recommended to adhere to the endurance exercise; to appropriately increase the amount of resistance strength training, muscular endurance is recommended that each muscle group rotation training, to avoid sports injuries; flexibility exercises are recommended to maintain the daily stretching, increase the amount of practice.

2. China's policy, "The Outline for the Construction of a Strong Sporting Nation" and the "Opinions on Deepening the Integration of Physical Education and Sports for the Healthy Growth of Young People" jointly issued by the Ministry of Education and the State General Administration of Sports suggest that we should better promote the improvement of physical education literacy and the development of a healthy lifestyle among young people. I believe that to improve students' health-related physical fitness, we must insist on exercising. It is recommended that students exercise 4-5 times a week for no less than one hour each time.

3. It is recommended that the content and movements of cross-training be designed according to the growth and development characteristics of students. The content of the exercises should follow the rules of physical development, and the difficulty or complexity of the movements should be gradual, from low to high, to meet individual differences and ensure the safety of the exercises. Finally, it is recommended that cross-training be applied to physical education classes so that students can increase their interest and reduce the boringness of physical exercise.

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