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Develop Program of Recreational Sport for Promoting Physical Fitness Among University Students in Fuzhou

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Abstract

Background and Aim: To improve the physical fitness of university students. This research is concerned with four main objectives as 1) To study the status of recreational sports participation among university students in Fuzhou; 2) To develop a FITT-VP program that can improve the physical fitness of university students in Fuzhou; 3) To evaluate the feasibility of the developed recreational sport program to promote physical fitness among university students in Fuzhou.

Materials and Methods: This article takes 18 universities in Fuzhou City as the research object. It adopts research methods such as questionnaires, interviews, and focus group discussions to survey 6 recreational sports and fitness experts, 6 physical education department directors, and 400 college students (simple sampling) in Fuzhou City. The questionnaire data obtained were analyzed by descriptive statistical analysis and t-test statistics using SPSS software. In addition, the research findings were also verified and evaluated through focus group discussions with 12 experts and stakeholders to verify the feasibility and appropriateness of the research.

Results: The research results show that University students in Fuzhou exercise 3-4 times per week (3.40 ± 1.11), with each session's intensity ranging from moderate to high (2.82 ± 1.14), and each session lasting 60-90 minutes or more (2.92 ± 1.24). The training types are highly diverse, including resistance training (bodyweight exercises and weightlifting) and aerobic training (yoga, basketball, jump rope, aerobics, etc.) (1.84 ± 1.00). This article presents a recreational sports program for college students in Fuzhou City, including 24 training programs in six dimensions: frequency, time, intensity, type, training volume, and progression. Through interviews and focus group discussions, the training programs were demonstrated and evaluated, and found to be feasible and appropriate by experts and relevant stakeholders. Before and after the experiment, there was a significant improvement in the students' physical fitness (56.33±7.23 VS 67.34±8.82), but the post-experiment physical fitness scores were like the average physical fitness level of Chinese university students.

Conclusion: It has been shown that the recreational sports program intended to increase university students' physical fitness is feasible. Cohort studies can be conducted with a larger number of participants in the future.

Keywords: Health-Related Physical Fitness (HRPF); Recreational Sports; University Students; FITT-VP Program; Experimental Intervention

Introduction

The physical fitness of students at universities has increasingly drawn interest from a wide range of people in recent years. University student populations' physical fitness is on the decline due to changes in modern lifestyle and increased academic pressure. Because of this, the People's Republic of China's Ministry of Education, as well as several local education departments, have progressively implemented several policies meant to improve students' university physical fitness and foster their overall development by bolstering physical education.

The National Physical Fitness Standards for Students were to be fully implemented, according to the 2014 Basic Standards for Physical Education Work in Higher Schools published by the People's Republic of China Ministry of Education. It states that, in the case of students unaffected by sports-related illnesses, those who do not receive a graduation certificate and do not receive a score of 50 on the physical fitness test will not be considered to have finished the program(Ministry of Education of the People's Republic of China, 2014). Furthermore, in 2012, the Shandong Provincial Department of Education stipulated that

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undergraduates in higher education institutions would not be permitted to graduate if they failed the physical fitness test. The results of the National Student Physical Fitness Standard Test will also be taken into account when managing students' academic records, comprehensive assessment, excellence evaluation, precedence evaluation, postgraduate exemption, and other evaluation contents. Failure on the test prevents a person from being "evaluated for precedence" or "evaluated for excellence," from being eligible for scholarships, from being exempted from postgraduate study, and from receiving a diploma or certificate of graduation.

Additionally, Nankai University encourages students to engage in a range of physical activities on their initiative, autonomy, and self-awareness. To this end, the university introduced the Regulations on Further Promoting the Physical Fitness and Health of Students as a systematic guarantee. To record the annual physical fitness test results for each academic year and keep track of them in the undergraduate student management files, the university issues "Nankai University Physical Fitness Test Report Cards." Undergraduates are required to apply for various scholarships and personal honors, for which they must have received a passing or higher physical fitness test result in the previous academic year. In addition, Nankai University established a scholarship program worth 2,000 yuan per individual annually, along with several policy supports, to encourage college students to engage in physical exercise on their own initiative and to improve their physical fitness through the "inside and outside the classroom integration" of physical education instruction.

Furthermore, as per the Ministry of Education's Opinions on Strengthening the Work of Physical Education in Higher Education Institutions, all students who do not have any special reasons for their physical fitness should be aware of and take part in the school-organized Physical Fitness Standard for Students test(Ministry of Education of the People’s Republic of China, 2014). At the 2013 National Symposium on Physical Education, Vice Minister of Education Hao Ping declared that a "one-vote veto" would be applied to the assessment of the school's quality if college students' physical fitness declined for three years.

With so many schools and institutions and so many university students in Fuzhou City, the capital of Fujian Province, it is impossible to overlook the physical health of the student body. Even though Fuzhou City's universities have made great efforts in the area of physical education, issues like heavy workloads, inadequate sports facilities, and a lack of exercise habits among students have resulted in an overall low level of physical fitness among college students. This study examines college students' participation in recreational sports in Fuzhou and how it affects their physical health through questionnaire surveys and field data collection. Its goal is to offer workable ideas to help college students in Fuzhou become more physically fit.

Objectives

1. To study the physical fitness of college students in 18 undergraduate schools in Fuzhou City.
2. To develop the FITT-VP program that can improve the physical fitness of college students in Fuzhou City.
3. To test the effectiveness of the FITT-VP program through an 8-week experiment.

Literature review

Recreational sport plays an important role in maintaining physical health and preventing disease. Recreational sports play an essential role in the prevention and treatment of lifestyle-related diseases such as high blood pressure, type 2 diabetes, and osteoporosis (Bangsbo et al., 2015; Milanovic et al., 2015). Abundant research has unequivocally demonstrated that recreational sport has a positive impact on preventing adverse health outcomes and all-cause mortality (Bull et al., 2020). Furthermore, from a disease mechanism perspective, recreational sports can effectively reduce the risk of both premenopausal and postmenopausal breast cancer (Rezende et al., 2018). According to the 2019 American College of Sports Medicine (ACSM) guidelines, there is substantial evidence that recreational sports have a significant

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positive impact on improving several cancer-related health outcomes, including depression, fatigue, and anxiety (Campbell et al., 2019; Schmitz et al., 2019).

However, today, most college students continue to lead sedentary lifestyles. This may be due to concerns about the security of information available on the internet, and sometimes because they fail to promptly follow their doctor's advice, leading to a disconnect from the latest guidelines. Some common barriers reported by patients include exercise-induced pain, concerns about getting injured, fear of negative effects from physical activity, discomfort with medical advice, and lack of time. An evident consequence of this situation is the high prevalence of obesity (Olivotto et al., 2013; Sweeting et al., 2016). From this perspective, for students with poor physical fitness, we can consider changing the format of physical activities by organizing them more recreationally and creating plans to improve their physical fitness.

Although the importance of exercise programs and recreational sports receives relatively little attention, current guidelines consistently emphasize the need for exercise programs and recreational sports in patients with HCM (hypertrophic cardiomyopathy) (Ommen et al., 2020). It has received support and recognition from some experts in the field (Geske et al., 2018; Weissler-Snir, 2021). This highlights the crucial importance of recreational sport for the physical fitness of university students. Even students majoring in physical education face the challenge of sitting for long periods due to excessive screen time.

Recreational sports play an essential role in maintaining health and preventing disease. Research has shown that it plays an important role in the prevention and treatment of lifestyle-related diseases. Despite this, many students lead sedentary lives, possibly due to concerns about internet safety, failure to follow medical advice, or other barriers. This exacerbates the problem of obesity. It's therefore necessary to encourage students to engage in more recreational physical activity to improve their physical fitness. Despite the relative lack of attention given to recreational sport programs, they are of paramount importance to the physical well-being of university students and are supported and endorsed by guidelines and experts.

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Conceptual Framework

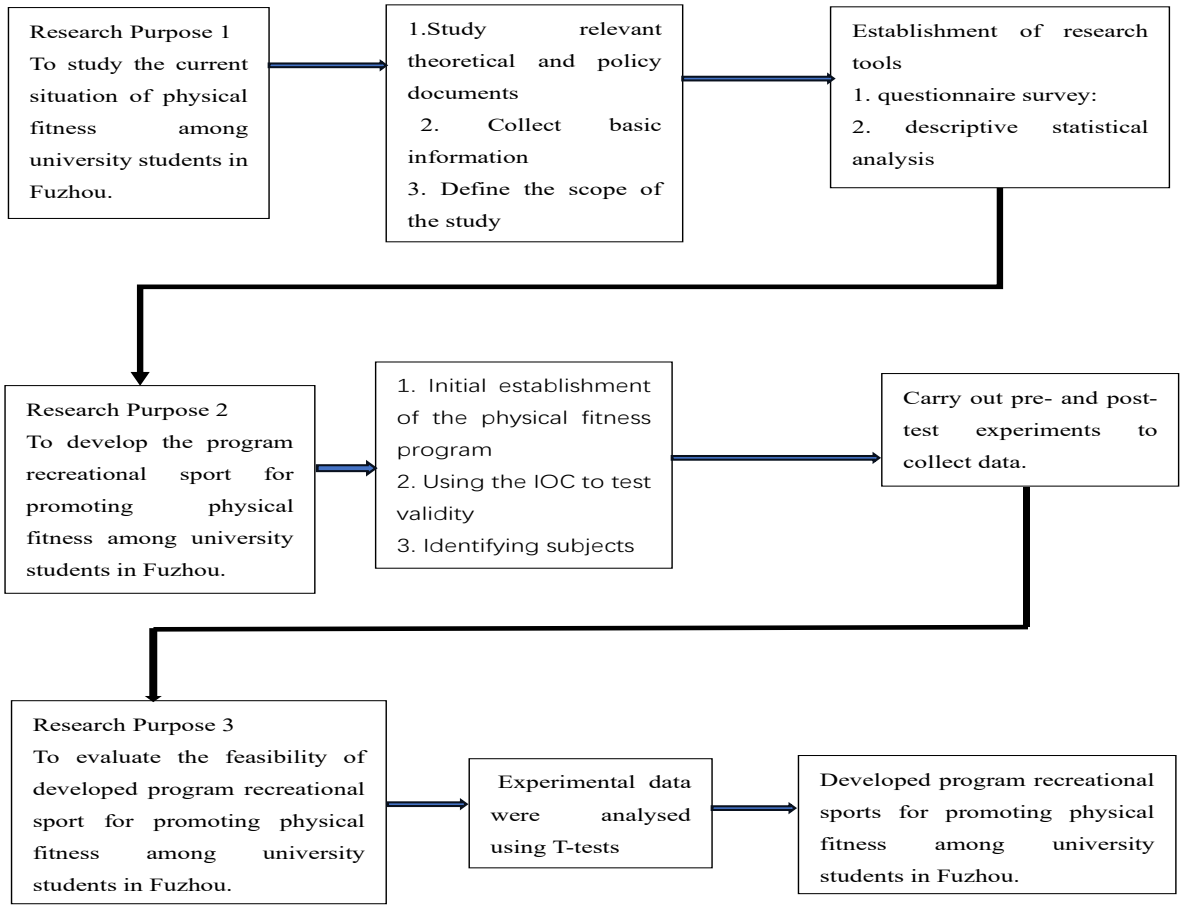

Figure 1 Conceptual Framework

The theoretical framework of the research includes three key theories: recreational sports theories, health-related physical fitness theories, and the impact of recreational sports on physical fitness. This framework aims to develop a recreational sports program to improve the physical fitness of university students in Fuzhou. The objective is to enhance students' physical fitness, increase participation in recreational sports, and facilitate their better integration into university life.

Methodology

1. Population and Sample

1.1 Population

Questionnaire population: In 2022, the number of university students in school in Fuzhou City was a total of 413,386 people. (The National Bureau of Statistics of China, 2022)

1.2 Sample

Survey sample: Questionnaire sample: According to the Krejcie and Morgan Table, 384 university students in Fuzhou by using simple random sampling. (Krejcie & Morgan, 1970)

Experimental sample: 30 freshmen at Fuzhou Institute of Technology by purposive sampling.

2. Tool

This study used research tools such as questionnaires, interviews, and focus group discussions to investigate the current physical fitness among university students in Fuzhou.

3. Data collection

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The data collection was carried out using questionnaires, interviews, and focus group discussions as follows:

3.1 Questionnaire

A questionnaire survey was conducted among 83 employees, 379 adults, and 379 children in 7 large sports parks in Fuzhou City, focusing on the evaluation and satisfaction with the management of sports parks.

3.2 Interviews

Face-to-face in-depth interviews were conducted with 6 sports administrators, 6 experts in leisure sports or physical fitness, and 18 college students from 6 undergraduate schools in Fuzhou City. The main goal was to understand the views and needs of stakeholders regarding the FITT-VP program.

3.3 Focus Group Discussion

The researchers invited one academic leader in physical education and seven senior professors from 18 undergraduate schools in Fuzhou City, as well as five college students who have been actively engaged in leisure sports exercises for a long time, to have a focus group discussion. The purpose was to deeply assess the feasibility of the FITT-VP program for the physical fitness of college students in Fuzhou City.

4. Data analysis

Descriptive statistical analysis was conducted using SPSS on the information obtained from the questionnaire survey, including frequency count, percentage, mean, and standard deviation, and paired sample T-tests, to obtain the basic evaluation and satisfaction of sports managers, sports experts, and college students towards the FITT-VP program from the data. The contents of the interviews and focus group discussion records were analyzed, classified, and coded to extract key information, themes, and recommendations.

Results

The findings of this study are divided into 3 parts and summarized below:

Section 1: Study the current situation of physical fitness among university students in Fuzhou.

Section 2: Develop the program recreational sports program for promoting physical fitness among university students in Fuzhou

Section 3: Evaluate the feasibility of developed program recreational sport for promoting physical fitness among university students in Fuzhou.

The details are as follows:

1. Study the current situation of physical fitness among university students in Fuzhou.

We determined the current state of college students' involvement in recreational sports, physical fitness, and related influencing factors in Fuzhou City by analyzing the mean and standard deviation of 400 valid questionnaires.

Table 1 Descriptive statistical analysis of recreational sports participation and physical fitness of university students in Fuzhou (N = 400)

Item	Mean	S.D.
Gender	1.50	0.50
School	9.09	5.13
Grade	2.40	1.11
Major	13.94	10.28
Ethnicity	1.31	1.06
Chronic Disease History	1.12	0.32
Frequency	3.40	1.11
Purpose	2.38	1.14
Intensity	2.82	1.14

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Item	Mean	S.D.
Time	2.92	1.24
Type	1.84	1.00
Place	1.48	0.50
Sports Form	2.21	1.07
Sports awareness	3.56	0.49
Sports motivation	2.35	0.47
Sports satisfaction	3.65	0.84
Health-related physical fitness	3.66	0.77

According to the study, the sample's gender ratio was even (1.50±0.50), and its majors (13.94±10.28) and schools (9.09±5.13) were widely distributed. An equitable distribution of grades (2.40±1.11) was observed, with a greater percentage of sophomores and juniors. In Fuzhou City, Han Chinese made up most college students (1.31±1.06). Most students (1.12 ± 0.32) did not have chronic illnesses that interfere with their ability to exercise. With the primary goal of fat loss and shaping (2.38±1.14), exercise intensity of medium and above (2.82±1.14), and diverse types of exercise (1.84±1.00), including resistance training (self-weighted or weighted fitness-type movements) and aerobic training (e.g., yoga, basketball, aerobics, badminton, etc.), more than half of the college students played recreational sports three to four times a week (3.40±1.11). There was a uniform distribution of sports venues (1.48±0.50) and a range of sports (2.21±1.07), including ones played with friends, classmates, and family. Many university students believed that regular recreational sports activities help to increase physical fitness, with a high degree of sports cognition (3.56±0.49). The reasons influencing their continued involvement in recreational sports were varied (2.35±0.47); extrinsic variables included a lack of favorite sports, while internal issues included a severe workload of studies and a lack of time and energy. Their primary motive for engaging in recreational sports activities was relaxation and relief from academic strain; encouragement and acknowledgment from professors, classmates, and friends played a significant role in this regard. According to most university students, their overall physical fitness was good (3.66±0.77), and they were highly satisfied with recreational sports activities (3.65±0.84). To provide fundamental data for subsequent analysis of the impact of these variables on Health-related physical fitness, the standard deviations of the variables showed a wide distribution of data and some variety in the sample.

2. Develop a recreational sport program for promoting physical fitness among university students in Fuzhou

A recreational sports program that can enhance the physical fitness of Fuzhou City University students was ultimately developed through expert interviews and questionnaire findings. The program was created to address a variety of physical fitness-related topics, including flexibility, cardiorespiratory fitness, muscular strength, and muscular endurance. It also included topics related to frequency, intensity, duration, category, and training volume (see Table 1). It was not necessary to interfere with the body composition alone because it was influenced by several variables, including body weight, resistance training, aerobic training, etc.

Main Goal: Sculpting and fat loss, **Workout Type**: Split, **Training Level**: Beginner, **Program Duration**: 8 Weeks, **Days Per Week**: 3 days, **Time Per Workout**: 90 minutes, **Equipment**: Barbell, Cables, Dumbbells, Machines, Other, **Target Gender**: Male & Female

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Table 2 Develop the program of FITT-VP for promoting physical fitness among university students in Fuzhou.

Item / FITT-VP	Warm-up	Flexibility (Muscle activation)	muscular strength	muscular endurance	cardiorespiratory fitness	Flexibility Stretching)
Frequency	3 d · wk $^{-1}$					
Intensity	low intensity	Low to Moderate intensity Stretch to the point of feeling tightness or slight discomfort.	Moderate to vigorous intensity (or level of fatigue of 7-8）	Moderate intensity (or level of fatigue of 5-6）.	Moderate to vigorous Target HR:132-144	Low intensity, each movement lasts for 30 seconds.
Time: 90 mins	training					
	5	5	25	15	30	10
	Take a break					
	0	0	11	2	2	0
Type	Light-intensity aerobics	Dynamic stretching	resistance training 60%-80% (1-RM)	resistance training, 40%-50% (1-RM)	aerobic training	Static stretching
Volume	Light perspiration Warm-up (Walking)= 51.05 kcal/week	Repetitions : 10 Sets:1 sets Flexibility (Muscle activation) =97.46 kcal/week	Repetitions:8-10 Sets:2 sets Muscular strength = 306.29 kcal/week	Repetitions :15-20 Sets:2 sets Muscular endurance = 176.97 kcal/week	Cardiorespiratory fitness (kcal): Week1 =343.41 Week2=361.98 Week3=371.26 Week4=371.26 Week5=389.82 Week6=426.95 Week7=445.51 Week8=607.94	Flexibility (Stretching) =47.92 kcal/week
Pattern	**Flexibility**. Repetition of each flexibility exercise 2- 4 times is recommended. 2. Flexibility exercise is most effective when the muscle is warmed through light-to-moderate aerobic activity or passively through external methods such as moist heat packs or hot baths. **Muscular strength:** 1. Rest intervals of 2-3 min between each set of repetitions are effective. 3. A rest of ≥48h between sessions for any single muscle group is recommended. **Cardiorespiratory fitness**: Exercise may be performed in one continuous session, in one interval session, or in multiple sessions of ≥10 min to accumulate the desired duration and volume of exercise per day. Exercise bouts of <10 min may yield favorable adaptations in very deconditioned individuals.					
Progression	1.A gradual progression of greater resistance, and/or more repetitions per set, and/or increasing frequency is recommended.					

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Item / FITT-VP	Warm-up	Flexibility (Muscle activation)	muscular strength	muscular endurance	cardiorespiratory fitness	Flexibility Stretching)
	2.A gradual progression of exercise volume by adjusting exercise duration, frequency, and/or intensity is reasonable until the desired exercise goal (maintenance) is attained. 3.This approach of "start low and go slow" may enhance adherence and reduce risks of musculoskeletal injury and adverse cardiac events.					

Note: See 4 for details on calculating weekly training volume.

3. Evaluate the feasibility of the developed program of recreational sports for promoting physical fitness among university students in Fuzhou

Table 3 Comparison of Pre and Post-Experimental Physical Fitness Metrics Among University Students

Group	N	Mean	S.D.	T	P
Pre-weight	30	58.93	10.36	4.04	0.00
Post-weight	30	57.40	9.32		
Pre-BMI	30	20.89	2.84	4.10	0.00
Post-BMI	30	20.34	2.30		
Pre-lung function test	30	3395.37	680.73	-13.41	0.00
Post-lung function test	30	3584.67	678.38		
Pre- sit-and-reach test	30	11.68	4.19	-11.38	0.00
Post-sit-and-reach test	30	17.76	4.84		
Pre- women’s 800 m	15	4.17	0.26	8.99	0.00
Post-women’s 800 m	15	4.12	0.27		
Pre-men’s 1000 m	15	4.13	0.35	8.27	0.00
Post-men’s 1000 m	15	4.07	0.34		
Pre-- women’s one-minute sit-up test	15	33.73	5.46	-7.73	0.00
Post-women’s one-minute sit-up test	15	40.60	4.24		
Pre-Men’s pull-up test	15	5.53	2.20	-9.43	0.00
Post-Men’s pull-up test	15	9.27	2.58		
Pre-bench press	30	22.03	8.48	-13.70	0.00
Post-bench press	30	35.63	10.83		
Pre-leg press	30	52.43	18.40	-17.68	0.00
Post-leg press	30	86.23	25.42		

a. Body Composition

The data indicate a significant reduction in weight and BMI over the last four weeks of the intervention. The mean weight decreased from 58.93 kg (S.D. = 10.36) to 57.40 kg (S.D. = 9.32), with a T-value of 4.04 and a p-value of 0.00, suggesting this change is statistically significant. Similarly, the BMI decreased from a mean of 20.89 (S.D. = 2.84) to 20.34 (S.D. = 2.30), with a T-value of 4.10 and a p-value of 0.00, indicating a significant change.

b. Cardiopulmonary Fitness

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Lung Function: The mean lung function test scores increased from 3395.37 (S.D. = 680.73) to 3584.67 (S.D. = 678.38), indicating a significant improvement in lung function. This notable improvement is indicated by the T-value of -13.41 and the p-value of 0.00.

Test at Fixed Distance: The 800-meter women's run time improved from 4.17 minutes (S.D. = 0.26) to 4.12 minutes (S.D. = 0.27). According to the p-value of 0.00 and the T-value of 8.99, this shift is significant. Similarly, the men's 1000-meter timings improved from 4.13 minutes (S.D. = 0.35) to 4.07 minutes (S.D. = 0.34), with a T-value of 8.27 and a p-value of 0.00, showing a substantial improvement in cardiovascular fitness.

c. Flexibility

Flexibility, assessed by the sit-and-reach test, improved significantly. The mean score increased from 11.68 (S.D. = 4.19) to 17.76 (S.D. = 4.84), with a T-value of -11.38 and a p-value of 0.00, indicating a significant enhancement in flexibility.

d. Muscular Strength

Bench Press: Bench press performance showed a significant increase from a mean of 22.03 (S.D. = 8.48) to 35.63 (S.D. = 10.83), with a T-value of -13.70 and a p-value of 0.00.

Leg Press: Leg press performance also showed a significant increase from 52.43 (S.D. = 18.40) to 86.23 (S.D. = 25.42), with a T-value of -17.68 and a p-value of 0.00, indicating a significant improvement in lower body strength.

e. Muscular Endurance

Women's One-Minute Sit-Up Test: Scores increased from a mean of 33.73 (S.D. = 5.46) to 40.60 (S.D. = 4.24), with a T-value of -7.73 and a p-value of 0.00, reflecting significant improvement.

Men's Pull-Up Test: Scores increased from 5.53 (S.D. = 2.20) to 9.27 (S.D. = 2.58), with a T-value of -9.43 and a p-value of 0.00, indicating a significant enhancement in muscular endurance.

Significant gains in several physical fitness indices, such as weight, BMI, lung function, flexibility, cardiovascular fitness, and muscular strength and endurance, have been shown by the post-intervention data. These outcomes show how successful the fitness program that was put in place throughout the eight weeks was.

4. The effect of an 8-week experiment on the physical fitness of university students

Using paired-samples t-tests, we found that all five dimensions of physical fitness (body composition, cardiorespiratory fitness, flexibility, muscular strength, and muscular endurance) exhibited significant gains. However, it is unclear where these enhancements fall in the overall physical fitness score (Very lean, Excellent, Good, Fair, Poor, Very poor). This was the primary objective of this study.

We have compared the scoring values for each item to the scoring criteria in Annex 1 to further understand the ratings for each particular indication. Physical fitness is valued at 100 points based on the criteria, with 20 percent of the points going to each facet. The following is the precise calculation formula:

Physical fitness = body composition x 20% + cardiorespiratory fitness x 20% + flexibility x 20% + muscular strength x 20% + muscular endurance x 20%

The specific formula is broken down as:

Physical fitness =BMI×20%+(lung function test + women’s 800 m + men’s 1000 m)×20% + sit-and-reach test×20% + (bench press + leg press) ×20% + (women’s one-minute sit-up test + Men’s pull-up test)×20%

Table 4 Physical fitness of men and women at different stages of the experiment

Gender	Item	Scoring	Rating
Men	Pre-physical fitness	51.57	Fair
	Post-physical fitness	62.34	Good
women	Pre-physical fitness	61.10	Good
	Post-physical fitness	72.35	Good
Total	Pre-physical fitness	56.33	Fair

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Gender	Item	Scoring	Rating
	Post-physical fitness	67.34	Good

The ratings and fitness scores for both males and females at three separate times prior to, during, and post the fitness test are displayed in this table.

For males, their average rating before the fitness test was 51.57, with a rating of "Fair". During the fitness test, men's ratings rose to 55.27, and the rating remained "Fair". After the fitness test, men's ratings further increased to 62.34, and the rating increased to "Good". This indicates that the males showed significant improvement during the physical fitness training, with their fitness level improving from fair to good. The score data in the table shows that the individuals' levels of physical fitness increased significantly before, during, and after the experiment. The rating went from " Fair" to "Good," and the mean score improved from 56.33 before the experiment to 67.34 following it.

For females, the average rating before the fitness test was 61.10, with a rating of `Good'. During the fitness test, the rating for females increased to 65.42, with the rating remaining at "Good". After the fitness test, females' ratings further increased to 72.35, and the rating remained 'Good'. This indicates that the women's ratings remained at a good level throughout the physical training, although the ratings increased, showing a steady and consistent improvement in their physical fitness.

To summarize, Table 5 shows how male and female ratings changed before and following the physical fitness program. In terms of fitness, males showed a noteworthy improvement, going from fair to good; females also demonstrated improvement, although their ratings stayed steady at good. During physical training, males improved more than females, while girls improved physically with time.

Throughout the eight-week formal experiment, the same thirty volunteers showed notable improvements in a range of physical health indices. Using paired-sample t-tests, the research team analyzed the data collected before and after the experiment and discovered significant improvements in lung function and cardiovascular fitness, significant reductions in weight and BMI, significant gains in flexibility as measured by the sit-and-reach test, and significant improvements in muscle strength and endurance as measured by the bench press, leg press, women’s one-minute sit-up test, and men’s pull-up test.

These findings demonstrate not only how well an organized recreational exercise program may improve the physical fitness of first-year students at Fuzhou Institute of Technology, but also how highly feasible and successful the experimental design and execution were. The experiment was carried out successfully because of a strict technique that includes careful subject selection, iterative pre-experiment optimization, and thorough data analysis. These techniques not only contributed to confirming the efficacy of the leisure exercise program, but they also offered insightful insights and direction for further research of a similar nature.

Weekly energy use during program execution

Generally speaking, the quantity of exercise is determined by multiplying the type of program, frequency, duration, and intensity of exercise. (American College of Sports Medicine, 2018, pp. 226-269)

$kcal \cdot min^{-1} = [(METs \times 3.5\ mL \cdot kg^{-1} \cdot min^{-1} \times body\ wt.\ in\ kg) \div 1{,}000)] \times 5$

Physical fitness ($kcal \cdot week^{-1}$) = Warm-up Flexibility (Muscle activation) + Muscular strength + Muscular endurance + cardiorespiratory fitness Flexibility (Muscle stretching) (Table 6).

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Table 6 Total training produced on physical fitness throughout an 8-week recreational sports program (Kcal/week)

Item	Warm-up	Flexibility (Muscle activation)	Muscular strength	Muscular endurance	Cardiorespiratory fitness	Flexibility (Muscle stretching)	Physical fitness
Week1	50.05	97.46	306.29	176.97	343.41	47.92	1022.1
Week2	50.05	97.46	306.29	176.97	361.98	47.92	1040.67
Week3	50.05	97.46	306.29	176.97	371.26	47.92	1049.95
Week4	50.05	97.46	306.29	176.97	371.26	47.92	1049.95
Week5	50.05	97.46	306.29	176.97	389.82	47.92	1068.51
Week6	50.05	97.46	306.29	176.97	426.95	47.92	1105.64
Week7	50.05	97.46	306.29	176.97	445.51	47.92	1124.2
Week8	50.05	97.46	306.29	176.97	607.94	47.92	1286.63

Table 6 shows that the energy expenditure of each exercise was measured in an eight-week physical fitness enhancement trial for university students by tracking the quantity of various types, frequency, durations, and intensities of exercise. The findings indicated that the athletes' average weekly energy expenditure for warm-up, flexibility, muscular strength, and muscular endurance and 306.29 kcal was 51.05 kcal, 97.46 kcal, and 47.92 kcal. Week by week, the quantity of cardiorespiratory fitness exercise rose from 343.41 kcal in week 1 to 607.94 kcal in week 8. The increase in cardiorespiratory fitness training volume was accompanied by an overall increase in weekly training volume.

Except for the aerobic training done for cardiorespiratory fitness, which exhibited a progressive incremental rise because of the program, the training volume of the other dimensions stayed constant. Additionally, in keeping with the progressive training concept, the weekly total amount of training rose progressively in proportion to the quantity of cardiorespiratory quality training.

Discussion

The present study provides an in-depth analysis of recreational sports participation and its impact on the physical fitness of college students in Fuzhou City. By examining the mean and standard deviation of 400 valid questionnaires, several key findings emerge.

First, the demographic analysis reveals a balanced gender ratio (1.50±0.50) and a wide distribution of majors (13.94±10.28) and schools (9.09±5.13), indicating a diverse sample. Most students did not have chronic illnesses that interfere with exercise (1.12±0.32), and their primary goal was fat loss and shaping (2.38±1.14). The frequency of exercise was three to four times a week (3.40±1.11), with moderate to high intensity (2.82±1.14) and diverse types of activities, including resistance and aerobic training (1.84±1.00). The high sports awareness (3.56±0.49) and satisfaction (3.65±0.84) suggest that students recognize the benefits of regular recreational sports in enhancing physical fitness.

These findings align with previous studies, such as those by Bauman et al. (2013)and Biddle and Mutrie (2007), which highlight the importance of regular physical activity in promoting health and well-being among university students. The positive perception of sports participation suggests a conducive environment for promoting physical activities in universities.(Sallis et al., 2000)

The eight-week program at Fuzhou Polytechnic University involved 30 participants (15 men and 15 women) and showed significant improvements across all physical fitness metrics.

Body Composition: There was a significant weight reduction ($T = 4.04$, $p < 0.001$) and BMI ($T = 4.10$, $p < 0.001$), reflecting effective fat loss and body shaping.

Cardiopulmonary Fitness: Lung function improved significantly ($T = -13.41$, $p < 0.001$), with better performance in fixed distance tests (women's 800 m: $T = 8.99$, $p < 0.001$; men's 1000 m: $T = 8.27$, p

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< 0.001). This aligns with studies showing the benefits of regular aerobic exercise on lung capacity and cardiovascular health(Ryan & Deci, 2000).

Flexibility: The sit-and-reach test showed significant improvement ($T = -11.38$, $p < 0.001$), indicating enhanced flexibility, which is crucial for overall physical fitness. This is consistent with a study by the American College of Sports Medicine (2010).

Muscular Strength: Both bench press ($T = -13.70$, $p < 0.001$) and leg press ($T = -17.68$, $p < 0.001$) performances improved significantly, reflecting increased muscular strength.

Muscular Endurance: The women's one-minute sit-up test ($T = -7.73$, $p < 0.001$) and men's pull-up test ($T = -9.43$, $p < 0.001$) also showed significant improvements, indicating better muscular endurance.

These results highlight the effectiveness of structured recreational sports programs in improving various aspects of physical fitness. The findings are consistent with previous research by Donnelly et al. (2009) and Garber et al. (2011), which emphasize the importance of combining aerobic and resistance training for comprehensive fitness improvements.

The study also assessed the weekly training volume and its impact on physical fitness. Participants engaged in 90-minute sessions, three times a week, for eight weeks. The consistency and intensity of the training program contributed to the significant improvements observed in the study.

Regular and structured training regimens have been shown to enhance physical fitness effectively(Swain & Franklin, 2006). The weekly volume of exercise aligns with recommendations by the American College of Sports Medicine (2010), which suggests at least 150 minutes of moderate-intensity exercise per week for substantial health benefits.

Conclusion

The comprehensive analysis of recreational sports participation and its impact on physical fitness among college students in Fuzhou City reveals several critical insights.

First, the balanced gender ratio and diverse representation of majors and schools indicate a broad interest in recreational sports, which can be leveraged to promote physical activity across different student groups. The high levels of sports awareness and satisfaction suggest that students recognize the benefits of recreational sports, which can be further enhanced through targeted interventions.

The eight-week recreational sports program demonstrated significant improvements in body composition, cardiopulmonary fitness, flexibility, muscular strength, and endurance. These results underscore the effectiveness of structured and consistent training programs in enhancing overall physical fitness. The significant improvements observed across all fitness metrics highlight the potential of recreational sports programs to promote health and well-being among college students.

The weekly training volume was found to be appropriate and effective, aligning with established guidelines for physical activity. This consistency in training volume is crucial for achieving substantial fitness improvements and should be maintained in future programs.

In conclusion, the study provides robust evidence supporting the positive impact of recreational sports participation on the physical fitness of college students. The findings highlight the importance of satisfaction, motivation, and diverse exercise types in promoting health-related fitness. Future programs should focus on enhancing these factors while addressing barriers to participation to maximize the benefits of recreational sports.

Recommendation

The results of this study are somewhat limited in their applicability because of the tiny experimental sample size (only thirty freshmen from the same college). To increase the study's external validity, larger sample sizes from future research with students in various majors and geographic locations should be included. Furthermore, a longer experimental period might be taken into consideration in the future to examine the long-term benefits of physical activity on physical fitness, as this study was only conducted for eight weeks.

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