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Research Article

Impact of Kho-Kho playing on physiological changes and development of some specific skill-related physical fitness factors

V. Sai Abhinav[1], M. S. Pasodi[2], Shrisha Gourish Nayak[3]

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ABSTRACT

The present study was carried out to identify the impact of Kho-Kho playing on physiological changes and skills related to physical fitness. From the results of the present study, it can be concluded that Kho-Kho playing significantly increases speed, agility, and explosive strength, so coaches need to design a specific training schedule to target the development of specific SRPF components. Moreover, from a physiological perspective, Kho-Kho playing significantly contributes to the development of aerobic capacity and, thereby, endurance, decrement of resting, and peak heart rate, thereby improving cardiorespiratory fitness.

Keywords: Heartrate, Kho-Kho, Skill related physical fitness

INTRODUCTION

Kho-Kho is an Indian traditional game. The Kho-Kho game is played mainly in rural and urban areas. Kho-Kho game originated in India and has a considerably long tradition. The Kho-Kho game is, at present, becoming the most popular among the Indigenous activities in Physical Education in India and neighboring South Asian countries. Different games are provided to do the body activities differently. The theory of coordinative abilities is rapidly getting recognition in sports. However, no general agreement exists regarding the number of coordinative skills required for sports.

Monitoring a training program provides valuable information to scientists and coaches about its effectiveness, the athlete's physical condition and preparation for competition. For monitoring to be effective (i.e., providing updated and accurate information on physiological profiling), the tests must be administered at regular, predetermined intervals based on training cycles. In addition, testing should be specific to the sport, ideally conducted in the athlete's training environment, to obtain ecologically valid and reliable results. A situation where physiological, anthropometric, and sport-specific data can be obtained simultaneously provides the most accurate and informative results due to the ease of comparisons and the complete profiling achievement. Research in other team sports has suggested that changes in performance parameters over a season may not follow the expected trend. It was found that preseason training of field hockey players decreased body fat percentage and increased maximum oxygen uptake but decreased muscular strength.

Extensive research was carried out by Menial and Schobel (1987) regarding the introduction of new and wide-term coordinative abilities in place of agility as one of the essential components of physical fitness. To achieve excellence in the field of Kho-Kho and Kabaddi, these components of physical fitness and coordinative ability must be possessed by the 'Kabaddi and Kho-Kho' player. Studies by Jana and Karak 2013 showed that there was no significant difference in lean body mass, body mass index, and percentage of body fat among football and Kho-Kho players which established an important fact that in body contact sports and sports that require ample endurance, strength, agility, and speed physical fitness remains same for the athletes involving in the same type of sports.

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Research studies by Dhanula *et al*., 2012 showed significant differences in body composition and trunk and hip flexibility between Kabaddi and Kho-Kho Players. Furthermore, the two groups had a significant difference in muscular endurance. Research studies have proved that Kho-Kho players have better speed and agility than Kabbadi players.

However, more work needs to be done regarding their comparison level with ordinary people or other sportspeople. Therefore, in the context of the previous studies, it has been observed that Kho-Kho playing might impact the development of speed, agility, and explosive strength, which has yet to be reported by any research studies.

Therefore, the present study unveils the impact of Kho-Kho on the physiological changes and development of some specific skill-related physical fitness factors.

MATERIALS AND METHODS

The subjects of the present study were randomly selected from Kalaburagi district. Twenty-two female players were selected randomly, and the ages ranged from 16 to 18 years. All subjects were familiar with all the testing, including field and laboratory assessments.

Experimental Design

To observe the impact of Kho-Kho playing, we have taken 22 females of the age group 16–18 from the district of Kalaburagi. They were divided into two groups, namely (n = 11) control and experimental. Control group → Female subjects of age group (16–18) below 18 years who were not involved in Kho-Kho playing or any sports or heavy physical activity.

For experimental group →Female subjects of the age group (16–18) below 18 years who were involved in Kho-Kho playing for about 2 months a period was set for one and half months [6] during the training period of Kho-Kho players (to allow the physiological and physical impact on the body system) which are mentioned here as experimental period. However, no such training was given for control group subjects.

All the parameters were tested for both the groups before and after the experimental period to observe whether Kho-Kho playing had any impact on the increment in agility, explosive strength, and speed.

Measurement of Physiological Data

Age

The age of the subjects was recorded from their college and university registers.

Height

The anthropometric rod recorded the subjects' height in centimetres (cm).

Weight

Using a portable weighing machine, the subject's weight was recorded in kg and approximated to the nearest whole numbers.

Resting and Peak heart rate

The subjects' resting and peak heart rates were recorded according to the standard procedure using an automated upper arm-cuff HR monitor.

Aerobic capacity

The aerobic capacity of the subject was determined according to the standard procedure using a digital treadmill.

The Procedure for Collecting Data

The subjects were assembled and informed about the purpose of the study. They were instructed to complete the tests following the standard procedure. They were motivated to give their best performance. Tests were taken 2 times, i.e. before and after an experimental period.

Flying 30 m Test

Test administration

This test requires the subject to sprint 60 m.

- The subject conducts a warm-up for 10 min
- The assistant marks out a 60 m straight section.

(AC) with cones and places a cone at the 30 m point (B)

- From a sprint start with appropriate start commands (on your marks, set, "GO") from the assistant, the subject sprints the 60 m
- The assistant starts the stopwatch on the command.

"GO"

The assistant records the time the subject torso crosses the 30 m point (B) and the 60 m point (C).

"T" Drill Test

Test Administration: This test requires the subject to touch a series of cones set out in a "T" shape whilst side-stepping and running as fast as possible.

- The subject warms up for 10 min
- The tester placed three cones 5 m apart on a straight line (A, B, C), and a 4th cone (D) was placed 10 m from the middle cone (B) so that the four cones form a "T".
- The subject stands at the cone (D) at the base of the "T" facing the "T"

- The subject gives the signal to "Go," starts the stopwatch, and the athlete commences the test The athlete runs to and touches the middle cone (B), side steps 5 m to the left cone (A) and touches it, side step 10 m to the far cone (C) and touches it, side step 5 m back to the middle cone (B) and touches it and then runs 10 m backwards to the base of the "T" and touches that cone (D)
- The tester stops the stopwatch and records the time when the subject touches the cone at the base of the "T".

Standing Broad Jump

Test administration

A demonstration of the standing broad jump was given to a group of subjects to be tested. The subject was then asked to stand behind the starting line with the feet parallel to each other. The subject was instructed to jump as far as possible by bending their knee and swinging their arms to take off for the broad jump in the forward direction. The subject was given three trials.

Scoring: The distance between the starting line and the nearest point of landing provides the score of the test. The best trial is used as the final score of the test.

Statistical Analysis

The collected data were analyzed using statistical methods. Mean and standard deviation were calculated for each parameter of each group.

RESULTS

Analysis of Physiological Variables

Table 1 represents the Mean ± SE value of the physiological variables of subjects of the control group and experimental group. The mean and SE of the height of the control group and experimental group were 71.82 ± 7.16 cm and 73.13 ± 8.86 cm, and the Mean and SE of the weight of the control group and experimental group were 22.68 kg ± 2.31 and 20.25 kg ± 2.82, respectively. Resting and peak heart rates of Kho-Kho players were significantly higher than the general student (*$P < 0.01$), whereas aerobic capacity also increased with training for Kho-Kho, playing 68.25% (*$P < 0.01$).

Values are expressed as Mean±SE. *$P < 0.01$ compared to general student values using Student's "t" test. Table 2 represents the resting heart rate, peak heart rate, and aerobic capacity of control students and Kho-Kho players. Resting heart rate, peak heart rate, and aerobic capacity did not significantly differ after the experimental period for the control group as they were not involved in Kho-Kho playing. However, the resting heart rate significantly decreased for the experimental group after the experimental period, and peak heart rate and aerobic capacity were increased considerably. The possible explanation is that they were involved in Kho-Kho playing.

Table 1: Personal data of control students and Kho-Kho players

Personal data	Group	
	Control subject	Kho-kho players
Age (years)	8.49±0.61	8.16±0.68
Height (cm)	71.82±7.16	73.13±8.86
Weight (kg)	22.68±2.31	20.25±2.82
Resting heart rate (bpm)	35.20±0.69	28.60±1.04
Peak heart rate (bpm)	71.58±1.10	66.13±2.8
Aerobic capacity (mL/kg/min)	16.85±0.89	28.35±1.50

Table 3 represents the Mean±SE values of the 30 m fly test, "T drill test" and standing broad jump test of control subjects and Kho-Kho players. Speed, explosive strength (legs) and agility were not significantly increased after the experimental period for the control group as they were not involved in Kho-Kho playing. However, the speed, explosive strength of legs and agility were significantly (*$P<0.01$) increased for the experimental group after the experimental period as they were involved in kho-kho playing.

DISCUSSION

The game of Kho-Kho is based on natural principles of physical and mental development and fosters a healthy combative spirit among the youth. Kho-Kho game demand physical fitness, strength, speed and endurance, and a good amount of agility. Dodging, feinting and bursts of controlled speed make this game quite thrilling. To catch by pursuit – to chase, rather than just run – is the capstone of Kho-Kho. Several studies have focused on psychological factors or comparative studies based on body composition, flexibility, etc. Some physiological works regarding cardiopulmonary changes during periodized training throughout the year have already been reported. Therefore, the present study attempts to investigate the impact of this playing on the development of explosive strength, agility, and speed.

We have observed for the Kho-Kho playing group that all the parameters have increased significantly due to Kho-Kho playing, whereas all these three parameters were not increased significantly; the possible reason might be due to organized training that leads to some physiological changes, which are not possible for the control group. Bio energetically is the admixture of aerobic and anaerobic activities, so speed and explosive strength are developed.

Moreover, for the Kho-Kho playing group (experimental), aerobic capacity significantly increased after the experimental period, which is the indicative measurement of endurance. Moreover, resting heart rate decrement correlates with the

Table 2: Changes in physiological variables of control students and Kho-Kho players before and after an experimental period

Test	Pretest		Post test	
	Control subject	Kho-kho players	Control subjects	Kho-kho players
Resting heart rate (bpm)	30.20±1.20	28.60±1.04	35.64±1.22	25.10±1.21
Peak heart rate (bpm)	71.58±1.10	66.13±2.8	72.52±2.56	63.27±2.59
Aerobic capacity (ml/kg/min)	16.85±0.89	28.35±1.50	17.17±2.00	32.19±2.00

Values are expressed as Mean±SE; **P*<0.01 compared to general student values using the Student's "*t*" test.

Table 3: Changes of values of the 30 m fly test, T drill test and standing broad jump test of control students and Kho-Kho players before and after the experimental period

Tests	Control subject			Kho-kho Players		
	30-meter fly test (s)	T Drill test (s)	Standing broad jump test (mts)	30-meter fly test (s)	T Drill test (s)	Standing broad jump test (mts)
Pretest	2.24±0.16	7.6±0.35	0.75±0.10	2.19±0.37	6.58±0.38	0.84±0.10
Post-test	2.21±0.16	7.9±0.39	0.74±0.32	1.68±0.36	5.78±0.53	1.08±0.16

Values are expressed as Mean±SE; **P*<0.01 compared to general student values using the Student's "*t*" test

resting bradycardia due to training, and so does the peak heart rate. All these physiological parameters were not increased in the case of the control group as they were not involved in Kho Kho playing.

CONCLUSION

The study findings suggest that participation in Kho-Kho significantly increases speed, agility, and explosive strength. As a result, coaches must develop a specialised training regimen that targets enhancing specific SRPF components. These factors could also serve as essential criteria for selecting players. Additionally, from a physiological perspective, playing Kho-Kho significantly contributes to the development of aerobic capacity, thereby improving endurance, reducing resting and peak heart rates, and enhancing cardiorespiratory fitness.

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Research Article

Investigation on the Aggressiveness of Football and Handball Players at the Inter-University Level

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ABSTRACT

This hybrid science combines sport, science, and psychology to study the behavior of athletes, mainly focusing on the interaction between the mind and muscles, their influences, and outcomes in the sporting context. Aggression refers to a range of behaviors resulting in physical and psychological harm to oneself, others, or objects in the environment. As sports have become increasingly competitive due to the rise of competition over the past century, sports psychology has emerged as a distinct and essential addition to psychology. The study was formulated based on simple random sampling. The samples were selected from the 20 football and 20 handball players from the Inter-University South Zone tournament. A significant difference was not observed between football and handball concerning aggression scores ($t = 0.027$, $P < 0.05$) at a 0.05% significance level. Hence, the null hypothesis is accepted, and the alternative hypothesis is rejected. This means football players have significantly higher aggression scores (mean = 11.81) than handball players (mean = 10.43). Inter-university-level football players have substantially higher aggression than inter-university-level handball players.

Keywords: Aggressiveness, Behavior of athletes, Football, Handball

INTRODUCTION

Sports psychology is a rapidly growing field that aims to analyze, describe, and understand the behavior of athletes in both practice and competitive settings to improve performance. Nowadays, sports psychology is considered an essential component of any sport. From philosophy, psychology has evolved into a vast field with numerous branches, including sports psychology. Sports psychological intervention involves coping strategies and mental skills such as visualization and concentration. Team interaction and communication are essential tasks in which athletes, teachers/coaches, and sports psychologists all play mutually supportive but crucial roles. Ultimately, success in athletic events or sports begins in the mind. Applied sports psychology aims to study human performance stabilization and enhance sports performance. Physical education and sports are vital components of a holistic education. While physical activities are essential, psychological factors should be given equal importance. The holistic development of an individual is a crucial goal of education, with physical education being just as important. Initially, individuals should spend their leisure time engaging in physical activities that bring them joy and happiness.

Over time, the population has grown, leading to an increase in participation in physical activities. This shift has resulted in a rise in interest and competition. As a result, many athletes are now pursuing a professional career. In today's highly competitive environment, athletes' success requires more than physical prowess, motor skills, and peak physical abilities; psychological factors such as motivation, achievement drive, goal-setting, anxiety management, aggression control, and team cohesion also play a crucial role. Therefore, psychological training is essential to help athletes excel in their respective sports.

Therefore, success in sports needs both physical and psychological factors. This makes us understand that training physical education teachers and coaches in these psychological factors is necessary as they are directly linked with the people involved in sports.

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This level of aggression also depends on the sports, age, surrounding environment, and the different types of sports activities involved. Physical education trends have developed recently to incorporate a greater variety of activities. Introducing students to activities such as bowling, walking/hiking, or frisbee at an early age can help students develop good activity habits that will carry over into adulthood. Some teachers have even begun incorporating stress reduction techniques such as yoga and deep breathing. Teaching non-traditional sports to students may also provide the necessary motivation for students to increase their activity and can help them learn about different cultures.

Football

Soccer, or football, is a team sport played between two teams, each consisting of 11 players. It is a ball game played on a rectangular grass (sometimes artificial turf) field with a goal at each end. The object of the game is to score by maneuvering the spheroid ball into the opposing goal. Besides the goalkeepers, players may refrain from using their hands or arms to propel the ball in general play. The winner of the match is the team that has scored the most goals at the end of the game. The sport is known by many names throughout the English-speaking world, although football is the most common. Other names, such as association football and soccer, often distinguish the game from other football codes since the word football may refer to several different games.

Handball

Field handball is a team sport of the handball family. The game can be played on a synthetic field or a mud field. The game of field handball is played between two teams of seven players, including the goalie.

Handball is a famous team game, an exciting game with many dramatic single combats. This competitive sport requires the technical and tactical versatility of the players and a splendid fight between the goal-getter and the goal-keeper. It is a team game played by the whole world.

It is a sport that you can play indoors or outdoors on grass or timber floors. It is where players are encouraged to be athletic, flamboyant, and inventive and work together as a team.

Handball is one of the rare and second-fastest games in the world.

It is a game played between two teams of seven players each in an area of 40 × 20 m under specific rules and regulations.

Psychology

Understanding where we are going sometimes helps to look at where we have been. While psychology is a relatively young discipline, it has a rich and colourful history with iconic figures such as Sigmund Freud and B.F. In Skinner, studying psychology's history provides an intriguing glimpse into the minds of some of the pre-eminent thinkers of the past century.

Aggression

In psychology, the term aggression refers to a range of behaviors resulting in physical and psychological harm to oneself, others, or objects in the environment. The expression of aggression can occur in several ways, including verbally, mentally, and physically.

Statement of the Problem

The study aims to find out aggression among football and handball players.

SIGNIFICANCE OF THE STUDY

- The study investigates the difference between football and handball players regarding their aggression
- The study's findings may guide physical education teachers and coaches in preparing training programmers based on the survey
- It may further help researchers interested in football and handball games
- The study's findings may add to the quantum of sports and physical education knowledge.

OBJECTIVES OF THE STUDY

- The research will determine the level of aggression toward the football and handball players at the inter-University tournament
- The study was formulated based on simple random sampling. The samples were selected from the 20 football and 20 handball players from the inter-University South Zone tournament.

Data Analysis

From the results of Table 1, we see that a significant difference was not observed between football and handball concerning aggression scores ($t = 0.027$, $P < 0.05$) at a 0.05% significance level. Hence, the null hypothesis is accepted, and the alternative hypothesis is rejected. This means that football has significantly higher aggression scores (mean = 11.81) than handball

Table 1: Results of t-test between football and handball concerning aggression scores

Group	*N*	Mean	SD	t-value
Football	20	11.81	3.14	0.27
Handball	20	10.43	3.16	

(mean = 10.43). The mean and SD scores for aggression are also presented.

CONCLUSION

Based on the analysis, the researchers are confident in arriving at certain conclusions based on the study results, which are as follows. University-level football players have significantly higher aggression than inter-university-level handball players.

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Research Article

Comparative analysis of bone mineral density in university-level male long-distance runners and weight lifters

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ABSTRACT

The objective of the study was to analyze the bone mineral density (BMD) of sports persons participating in long-distance running and weight lifting. This study selected 60 university-level male sports persons with long-distance runners ($n = 30$) and weight lifters ($n = 30$). BMD analyzer Achilles EXPII (Part 1) was used to measure BMD of the subjects. The data were recorded and descriptive statistical technique t test was employed to analyze the difference between the groups. This study found a significant difference in BMD among long-distance runners and weight lifters. The analyses were conducted using a significance level of 0.05.

Keywords: Aerobic exercise, Anaerobic exercise, Bone mineral density, Weight training

INTRODUCTION

Physical training is important for maintaining bone mass as it acts by means of mechanical and metabolic stimuli, modeling the synthesis of the bone matrix Knapik *et al*., (2014). Training, however, offers a range of application techniques with varying durations and intensities that support various mechanical and metabolic stimuli Camargo Filho *et al*., (2014).

Aerobic and anaerobic exercise are distinguished and categorized among the several types of physical training based on their metabolic dominance. Unlike anaerobic training, which has a high intensity and short duration, aerobic training has a low intensity and a long duration Castoldi *et al*., (2013).

It is important to state that numerous variations of exercise regimen may emphasize speed, strength, power, endurance, or coordination. As specific stimuli cause specific adaptations, exercise protocols that focus on coronary heart disease risk factors generally differ from those that target muscle or bone strength. For example, endurance type exercises are primarily used to reduce coronary heart disease risk factors Houde and Melillo, (2002). In contrast, resistance-type exercises such as strength or power training are favored to improve muscle and bone strength Boreham and McKay, (2011).

The long-term benefits of weight-bearing exercise for bone health have been extensively acknowledged Boreham and McKay (2011), Karlsson and Rosengren (2012). Research has demonstrated that those who engage in physical activity have greater bone mineral density (BMD) and a lower risk of long-term fractures compared to those who do not. Karlsson, M. K. & Rosengren, B. E. (2012), Moayyeri A (2008) & Baxter□Jones *et al*., (2011). A person's peak bone mass and subsequent risk of osteoporosis and fragility fractures are strongly influenced by the amount of bone mass they acquire during their childhood and adolescence Baxter□Jones *et al*., (2011). However, compared to athletes engaged in ball and power sports, adolescents and adults who engage in endurance sports like running and non-weight-bearing sports like biking and swimming frequently have lower BMDs, and occasionally, their BMDs are even lower than those of their inactive peers. (Fredericson *et al*., (2006), (Fredericson *et al*., (2005) Nagle and Brooks (2011). Athletes with low BMD are more susceptible to stress and fragility fractures during their competitive career and in later life Kelsey *et al*., (2007). In this study, we aimed to investigate the BMD of weight trainers and long-distance runners.

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METHODOLOGY AND PROCEDURE

Selection of Subjects

To achieve the purpose of the study, a total of 60 university-level male participants, with long distance runners (n = 30) and weight lifters (n = 30) were selected as subjects. All the subjects were informed about the objective and protocol of the study, and after their consent, they voluntarily participated in this study.

BMD analyser Achilles EXPII (Part 1) was used to measure the BMD of the subjects. The test was conducted in physiology laboratory of department of physical education at Punjabi University Patiala. The data were carefully recorded and descriptive statistical technique t test was employed to analyze the difference between the groups, the level of significance was set at 0.05.

Inclusive and Exclusive Criteria

Athletes who have competed at the interuniversity level in their respective sports were included in the study. According to this study, athletes who consistently compete in running races longer than 3000 m are considered long-distance runners. The participants included in the study were healthy and free from any musculoskeletal problems. Any subject having any health problem and medical condition was excluded from the study.

Criteria Measure

BMD analysis

The BMD of the certain population was examined using the BMD analyzer. The os calcis bone in the heel is assessed using high-frequency sound waves, or ultrasonography, by Achilles EXPII bone ultrasonometers Bi *et al*., (2023). When taking an Achilles EXPII measurement, the subject must be seated with one foot resting on the Footplate. Warm water contained between inflated membranes envelops the heel. The best medium for ultrasound transmission is water. An electrical signal is converted into a sound wave through a transducer on one side of the heel, and the sound wave travels through the water and the person's heel. The sound wave is received by a transducer situated at a fixed distance on the opposite side of the heel, which transforms it into an electrical signal for analysis. The Achilles EXPII measures both the frequency-dependent attenuation of sound waves (also known as broadband ultrasonic attenuation, or BUA) and the speed of sound. These measurements are combined to provide a clinical metric known as the Stiffness Index Wilson *et al*., (2014) and Weerasinghe *et al*., (2020).

Analysis and interpretation of the data

The mean and standard deviation (Mean ± SD) regarding the BMD of long-distance runners was 108.37 ± 13.54 and 114.56 ± 10.14 for the weight lifters. The t-value regarding the BMD was 2.00 and the *P*-value was 0.0497 and was found to be statistically significant at 0.05 level of significance $P < 0.05$.

Table 1: Descriptive statistics of Bone mineral density of long-distance runners and weight lifters

Groups	N	Mean	SD	SEM	*t*-value	*P*-value
Long distance runners	30	108.37	13.54	2.47	2.00	0.0497
Weight lifters	30	114.56	10.14	1.85		

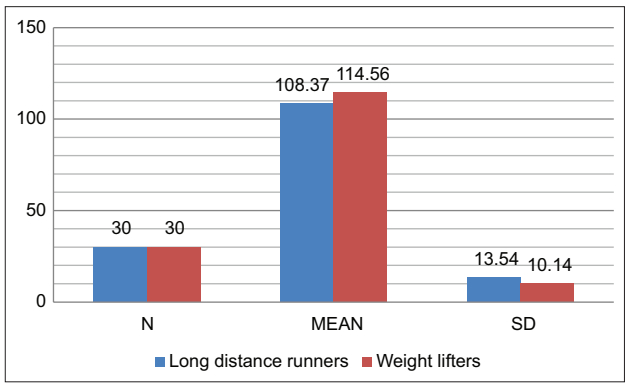

Figure 1: Showing the mean and standard deviation of bone mineral density

RESULTS AND DISCUSSION

The study found that the variable BMD vary significantly between long distance runners and weight lifters. The results are supported by the study conducted by Scofield and Hecht. (2012), During their study, they found that athletes who participate in various endurance sports activities such as running and athletes participating in swimming and biking have lower BMD than those participating in ball and power sports. Another study conducted by Sagayama *et al*., (2020) concluded that weight-classified athletes have significantly higher BMD than endurance athletes. In another study conducted by dos Santos and Borges (2010) it is concluded that physical exercise is an important factor in both the prevention and treatment of the elderly affected by osteoporosis disease, and the specificities of the exercise must be according to the objectives.

Limitations of the study include nutritional aspects like calcium and Vitamin D intake, and the number of hours of training per week. Long-distance runners should assess their existing bone health status and take appropriate precautions. Athletes are encouraged to follow a weight-training plan recommended by coaches and medical professionals to help preserve their bone health.

CONCLUSION

This study found that the variable BMD varies significantly between long-distance runners and resistance-training persons. Athletes with low BMD should modify their exercise programs to include weight training to improve BMD.

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Research Article

Effect of core strength training for development of explosive power among softball players of Telangana State

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ABSTRACT

The objective of the study is to determine the effect of core strength training on the development of explosive power among softball players of Telangana State between the age group of 18 and 22 years. The sample for the present study consists of 20 male softball players out of which 10 are experimental group and 10 are controlled group. Core strength training exercises such as reverse body plank, trunk extension, sit-ups, front plank, and side plan were given to the experimental group on alternate days, that is, three sessions per week, and the controlled group was given general training for 8 weeks. To assess the explosive power in legs, standing broad jump tests were used in the pre-test and post-test of the study. This study shows that the experiment group increases the explosive power compared to the control group. It is concluded that due to core strength training, there is an improvement of explosive power among softball players.

Key words: Core strength training, Softball, Explosive power, etc.

INTRODUCTION

Good core strength plays an essential role in achieving optimal performance in your chosen sport. Since the core is the foundation of all bodily movements, training it to work effectively helps you achieve the kinds of fast and powerful body movements required by your sport, and reduces your risk of injury because it helps your muscles and joints to function more efficiently.

Core training is important for sports because all sports involve core-based movements of one form or another. Because training your core helps your mobility, stability, and strength, it will increase the power, efficiency, and consistency of the movements you make, while improving your stability and balance, and reducing your chances of injury. Strengthening your core helps stabilize your spine and pelvis.

Maintaining good "core strength" can be extremely beneficial to softball players because that strength can help soft players in their performance. Strength in their core enables them to maximize their power output, while stability allows them to perform complex athletic movements that require coordination, balance, and technical skill.

Mahendiran and Chandramohan (2020) studied the effect of plyometric training and functional core strength training on explosive power among Kabaddi players. To achieve the purpose of the present study, 45 male Kabaddi players from affiliated colleges of Bharathidasan University, Tiruchirappalli, Tamil Nadu, India. Were selected as subjects at random and their ages ranged from 18 to 25 years. The subjects were divided into three equal groups of 15 each. Experimental Group I was exposed to plyometric training, experimental Group II was exposed to functional core strength training and the control group underwent no training. The duration of the experimental period was 12 weeks. The pre-test and post-test scores were subjected to statistical analysis using analysis of covariance to find out the significance among the mean differences, whenever the "F" ratio for the adjusted test was found to be significant, Scheffe's *post hoc* test was used. In all cases, 0.05 level of significance was fixed to test hypotheses. The plyometric training and functional core strength training had shown significant improvement on explosive power of male Kabaddi players.

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Table 1: The mean values and independent samples test of standing broad jump between experimental and control groups of softball players

Variables	Group	Pre-test Mean±SD	Post-test Mean±SD	t	*P*-value
Standing broad jump	Experimental	2.30±0.157	2.41±0.185	3.55	0.001
	Control	2.26±0.159	2.22±0.161		

*Significant at 0.05 level

PURPOSE OF RESEARCH

The objective of the study is to determine the effect of core strength training for development of explosive power among softball players of Telangana State between the age group of 18 and 22 years.

METHODOLOGY

The sample for the present study consists of 20 male softball players out of which 10 are experimental group and 10 are controlled group. Core strength training exercises such as reverse body plank, trunk extension, sit-ups, front plank, and side plan were given to the experimental group on alternate days, that is, three sessions per week, and the controlled group was given general training for 8 weeks. Pre-test and post-test were conducted in standing broad jump among the experimental group and controlled group of softball players.

RESULTS AND DISCUSSION

The independent samples *t*-test statistics are applied for the study. The comparison was made among the experimental group and control group in pre-test and post-test mean.

In Table 1, the mean value of the experimental group of softball players in the pre-test is 2.30 and the control group of softball players is 2.26. Due to core strength training the experimental group increased the mean values in the post-test is 2.41 and due to general training, the control group decreased from 2.26 to 2.22. The results of the study show that the experimental group of softball players has increased in the performance of the standing broad jump.

CONCLUSION

It is concluded that due to core strength training, there will be an improvement in explosive power among softball players. In this study, due to the core strength training exercises, there is an improvement in the explosive power of legs among softball players.

Recommendations

It is recommended that similar studies can be conducted on other events in other events and also female softball players. This type of study is useful to coaches to give proper coaching for the development of motor qualities for improvement of performance in sports and games.

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Research Article

Effect of weight training on the development of explosive strength among college basketball players of Mahabubnagar

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ABSTRACT

The purpose of the study was to find the effect of weight training on the development of explosive strength among basketball players of Mahabubnagar district in Telangana state. For the present study, the 30 basketball players who were studying in Mahabubnagar district, Telangana, were selected at random and their ages ranged from 18 to 22 years. For the present study, pre-test–post-test random group design which consists of control group and experimental group was used. The subjects were randomly assigned to two equal groups of thirty (15) each and named as experimental group and control group, in which group – I (n = 15) underwent weight training exercises for 3 days per week for 6 weeks and group – II (n = 15) act as a control group. The weight training exercises such as military press, back press, bench press, upright rowing, good morning exercise, half squats, full squats, and heel raise were given to experimental group for 6 weeks on alternate days. The standing broad jump test was conducted among two groups to assess the explosive strength. In the results of the study, it was found that there was a significant difference in performance due to weight training exercises when compared with the control group for the development of explosive strength.

Keywords: Basketball, Explosive strength, Weight training, etc.

INTRODUCTION

Basketball is a team game played between two teams of five players each, on the court. Very high amount of energy (calories) expenditure is there in this game. It also helps in building bone and muscle strength and boosts the immune system. This game also develops self-discipline and concentration among young players.

Strength training, also known as weight training or resistance training, involves the performance of physical exercises that are designed to improve strength and endurance. It is often associated with the lifting of weights. It can also incorporate a variety of training techniques such as bodyweight exercises, isometrics, and plyometrics.

Purpose of the Study

The purpose of the study was to find the effect of weight training exercises on the development of explosive strength among basketball players of Mahabubangar district in Telangana state.

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METHODOLOGY

For the present study, the 30 basketball players who were studying in Mahabubnagar and Telangana were selected at random and their ages ranged from 18 to 22 years. For the present study, pre-test–post-test random group design which consists of control group and experimental group was used. The subjects were randomly assigned to 2 equal groups of thirty (15) each and named as experimental group and control group, in which group – I (n = 15) underwent weight training exercises for 3 days per week for 6 weeks and group – II (n = 15) act as a control group. The weight training exercises such as military press, back press, bench press, upright rowing, good morning exercise, half squats, full squats, and heel raise were given to experimental group for 6 weeks on alternate days. The standing broad jump test, pre and post-test, was conducted among two groups to assess the explosive strength of legs.

RESULTS AND DISCUSSION

From above Table 1, it is observed that power (standing broad jump) of the selected sample in experimental group, pre-test

Table 1: Paired t-test is used to test the effectiveness of plyometric training on experimental group than control group on the development of physical explosive strength among basketball players

Group	*n*	Pre-test		Post-test		Mean differences	t	df	*P*-value
		Mean	SD	Mean	SD				
Experimental group	15	2.20	0.05	2.51	0.09	0.30	19.9	29	0.02
Control group	15	2.15	0.06	2.19	0.06	0.04	6.96	29	0.00

Significance at 0.05 level of confidence

mean is 2.209 with standard deviation (0.059) and post-test mean is 2.513 with standard deviation (0.090). The mean difference from pre-test to post-test is 0.303. Here, the "t" calculated value is 19.993 which is greater than table value 2.045 at 29 degrees of freedom with 0.05 level of significance. It shows that there is a significant difference between pre-test to post-test seen. Whereas control group, pre-test mean is 2.152 with standard deviation (0.061) and post-test mean is 2.194 with standard deviation (0.063). The mean difference from pre-test to post-test is 0.042. Here, the calculated value "t" is 6.965 which is less than table value 2.045 at 29 degrees of freedom with 0.05 level of significance. It shows that there is no significant difference between pre-test and post-test seen which means that there is no significant difference in control group, due to the control group did not undergo weight training or any other specific training. Hence, there is no significant changes occurred in the control group. The above table clearly reveals that there is a significant effect of plyometric training on the development of power (standing broad jump) in experimental group better improvement than control group of college basketball players.

CONCLUSION

It can be concluded that there is a significant difference between the pre-test and post-test because of the weight training effect explosive strength among experimental group. It was concluded that the results showed that 6 weeks of weight training significantly improved the explosive power among legs.

RECOMMENDATIONS

Based on analysis of collected data, the investigators would like to recommend the research work to extend further more as mentioned below. Further research, as well as the published findings, will contribute to basketball coaching. The study also helps physical educationists and coaches understand the knowledge and performance of basketball players.

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Research Article

Impact of physical activity intervention programs on selected fitness variables in college men

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ABSTRACT

This study investigates the impact of structured physical activity intervention programs (PAIPs) on selected fitness variables in college men. With the increasing prevalence of sedentary lifestyles among young adults, it is imperative to explore effective strategies to enhance physical health and well-being. This research aims to evaluate the effectiveness of a tailored PAIP in improving key physical variables, including cardiovascular endurance (CE), muscular strength (MS), flexibility (FX), and body composition (BC). A unit of college men was selected and divided into intervention group (IVG) and non-intervention group (NIVG). The IVG participated in a comprehensive 12-week PAIP designed to address various fitness components. Pre- and post-intervention assessments were conducted to measure changes in the selected physical variables. The findings reveal significant improvements in the intervention group compared to the NIVG across all measured fitness metrics. Notably, CE showed a substantial increase, with participants demonstrating improved performance in endurance tests. MS and FX also exhibited marked enhancements, and positive changes in BC were observed, indicating reductions in body fat percentage and increases in lean muscle mass. These results underscore the efficacy of structured PAIP in promoting physical fitness and health among college men. The study highlights the importance of integrating regular exercise into the daily routines of young adults to combat the adverse effects of sedentary lifestyles. Future research should explore the long-term benefits and potential variations in response to different types of PAIP.

Keywords: Body composition, Cardiovascular endurance, Flexibility, Muscular strength, Physical activity intervention programs

INTRODUCTION

The prevalence of sedentary lifestyles among college students has become a significant public health concern, contributing to a range of adverse health outcomes, including obesity, cardiovascular disease, and decreased mental well-being (ACHA, 2021). Engaging in regular physical activity is recognized as a critical factor in mitigating these risks and promoting overall health and fitness (CDC, 2020). Despite this, many college students fail to meet the recommended levels of physical activity, often due to academic pressures, lack of motivation, and insufficient knowledge about effective exercise regimens (Keating *et al.*, 2005). Physical activity intervention programs have emerged as an effective strategy to address these challenges, providing structured and guided exercise routines tailored to the needs of specific populations (Dishman *et al.*, 2015). These programs are designed to enhance various physical fitness components, such as cardiovascular endurance, muscular strength, flexibility, and body composition, thereby improving overall health and quality of life (Warburton *et al.*, 2006).

Research has consistently demonstrated the positive impact of physical activity interventions on physical fitness and health outcomes. For instance, a study by Donnelly *et al.* (2009) found that college students who participated in a structured exercise program showed significant improvements in aerobic capacity, muscular strength, and body composition. Similarly, Murphy *et al.* (2012) reported that intervention programs could lead to substantial increases in physical activity levels and related health benefits among young adults.

Given the importance of physical fitness in the holistic development of college students, this study aims to evaluate the effectiveness of a physical activity intervention program on selected fitness metrics among college men. By focusing on key physical variables such as cardiovascular endurance, muscular strength, flexibility, and body composition, the research

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seeks to provide evidence-based insights into the benefits of structured exercise programs and their role in enhancing the physical health of this demographic.

METHODOLOGY

Study Design

This study employed a quasi-experimental design with pre-test and post-test assessments to evaluate the impact of a physical activity intervention program on selected physical variables among college men. Participants were divided into two groups: An intervention group that underwent a structured physical activity program and a control group that maintained their regular activities without any additional intervention.

Participants

The study recruited 60 male college students aged 18–25 years from a university's Department of Physical Education. Participants were randomly assigned to either the intervention group ($n = 30$) or the control group ($n = 30$). Inclusion criteria included being free from any chronic diseases or injuries that could affect physical activity participation, not being involved in any other structured exercise program, and providing informed consent.

Intervention Program

The intervention group participated in a 12-week physical activity program designed to enhance cardiovascular endurance, muscular strength, flexibility, and body composition. The program included the following components:

- Aerobic exercise: 45 min (including Warmup and Cooldown) of moderate-to-vigorous intensity aerobic exercise (e.g., running, cycling) three times a week (i.e., Morning 6.30 am to 7.30 am – Monday, Wednesday, and Friday)
- Resistance training: 45 min of resistance training focusing (including Warmup and Cooldown) on major muscle groups (e.g., weight lifting, bodyweight exercises) two times a week (i.e., Morning 6.30 am to 7.30 am – Thursday and Saturday).
- Flexibility exercises: 15 min of flexibility exercises (e.g., stretching, yoga) three times a week (i.e., Evening 4.30 pm to 5.30 pm – Monday, Wednesday, and Friday).
- Educational sessions: Weekly sessions on the importance of physical activity, proper nutrition, and maintaining a healthy lifestyle (i.e., Evening 4.30 pm to 5.30 pm – Thursday and Saturday).

The control group continued their usual activities without any additional structured exercise.

Measurements

Physical variables were assessed at baseline (pre-test) and after the 12-week intervention (post-test). The following measurements were taken:

- Cardiovascular endurance: Measured using the 20-m shuttle run test (beep test), which assesses aerobic capacity and endurance.
- Muscular strength: Assessed using the one-repetition maximum (1RM) test for bench press and leg press exercises.
- Flexibility: Evaluated using the Sit-and-Reach test, which measures the flexibility of the lower back and hamstring muscles.
- Body Composition: Determined using bioelectrical impedance analysis (BIA) to estimate body fat percentage and lean muscle mass.

DATA ANALYSIS

Descriptive statistics were calculated for all variables. Paired sample t-tests were used to compare pre-test and post-test results within groups, while independent sample t-tests were employed to compare differences between the intervention and control groups. A significance level of $P < 0.05$ was considered statistically significant (Table 1).

This table clearly demonstrates the effectiveness of the physical activity intervention program in improving the selected physical variables among college men (Table 2 and Figure 1).

DISCUSSION

The findings of this study underscore the substantial benefits of a structured physical activity intervention program on various

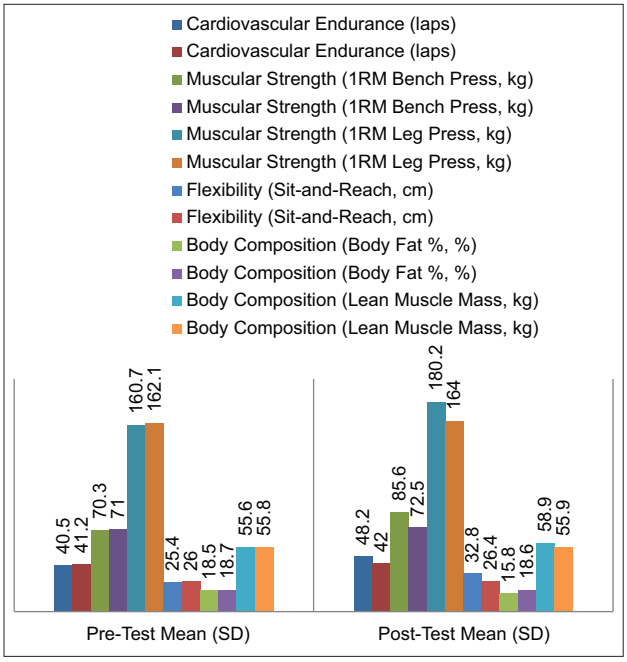

Figure 1: Bar diagram on selected physical fitness variable results in data

Table 1: Pre- and post-test results of selected physical variables

Variable	Group	Pre-test mean (SD)	Post-test mean (SD)	Mean difference (SD)	t-value	*P*-value
Cardiovascular Endurance (laps)	Intervention	40.5 (5.2)	48.2 (4.8)	7.7 (2.1)	12.45	<0.001
	Control	41.2 (5.1)	42.0 (5.0)	0.8 (1.5)	1.75	0.085
Muscular Strength (1RM Bench Press, kg)	Intervention	70.3 (8.4)	85.6 (7.9)	15.3 (3.8)	14.37	<0.001
	Control	71.0 (8.5)	72.5 (8.4)	1.5 (2.0)	2.14	0.040
Muscular Strength (1RM Leg Press, kg)	Intervention	160.7 (15.2)	180.2 (14.6)	19.5 (5.3)	12.89	<0.001
	Control	162.1 (15.0)	164.0 (14.8)	1.9 (3.1)	1.94	0.058
Flexibility (Sit-and-Reach, cm)	Intervention	25.4 (4.6)	32.8 (4.2)	7.4 (2.0)	15.67	<0.001
	Control	26.0 (4.5)	26.4 (4.4)	0.4 (1.1)	1.00	0.324
Body Composition (Body Fat %, %)	Intervention	18.5 (2.5)	15.8 (2.3)	-2.7 (1.1)	14.01	<0.001
	Control	18.7 (2.4)	18.6 (2.4)	-0.1 (0.5)	0.20	0.842
Body Composition (lean muscle mass, kg)	Intervention	55.6 (6.2)	58.9 (5.9)	3.3 (1.4)	10.67	<0.001
	Control	55.8 (6.1)	55.9 (6.0)	0.1 (0.6)	0.23	0.819

Key Findings

- Cardiovascular endurance: The intervention group showed a significant increase in endurance, while the control group had a minimal change.
- Muscular strength: Significant improvements were observed in the intervention group for both bench press and leg press exercises, with minor changes in the control group.
- Flexibility: The intervention group demonstrated a substantial improvement in flexibility, whereas the control group showed negligible change.
- Body composition: The intervention group experienced a significant reduction in body fat percentage and an increase in lean muscle mass. Changes in the control group were minimal.

Table 2: Independent sample t-test results for selected physical variables

Variable	Test type	Group comparison	Mean difference (SD)	t-value	*P*-value
Cardiovascular endurance (laps)	Pre-test comparison	Intervention versus control	−0.7 (0.9)	−2.78	0.007
	Post-test comparison	Intervention versus control	6.2 (1.8)	11.29	<0.001
Muscular strength (1RM bench press, kg)	Pre-test comparison	Intervention versus control	−0.7 (1.3)	−1.35	0.183
	Post-test comparison	Intervention versus control	13.1 (3.5)	7.52	<0.001
Muscular strength (1RM Leg Press, kg)	Pre-test comparison	Intervention versus control	−1.4 (2.4)	−1.55	0.124
	Post-test comparison	Intervention versus control	16.2 (4.2)	8.28	<0.001
Flexibility (sit-and-reach, cm)	Pre-test comparison	Intervention versus control	−0.6 (1.3)	−0.92	0.360
	Post-test comparison	Intervention versus control	6.4 (1.9)	8.10	<0.001
Body composition (body fat %, %)	Pre-test comparison	Intervention versus control	−0.2 (0.6)	−0.55	0.585
	Post-test comparison	Intervention versus control	−2.8 (0.8)	−7.25	<0.001
Body composition (lean Muscle Mass, kg)	Pre-test comparison	Intervention versus control	−0.2 (0.8)	−0.26	0.794
	Post-test comparison	Intervention versus control	3.0 (1.0)	6.34	<0.001

SD: Standard Deviation, t-value and *P*-value are derived from independent sample t-tests comparing pre-test and post-test results between the intervention and control groups. A *P*-value <0.05 is considered statistically significant.

Key Findings:

- Cardiovascular endurance: Significant improvement in the post-test for the intervention group compared to the control group, indicating the effectiveness of the aerobic component of the intervention.
- Muscular strength: Significant improvement in the post-test for both bench press and leg press exercises in the intervention group, highlighting the impact of resistance training.
- Flexibility: Significant increase in flexibility in the intervention group post-test compared to the control group, supporting the benefits of flexibility exercises.
- Body composition: Significant reduction in body fat percentage and increase in lean muscle mass in the intervention group post-test, demonstrating the overall effectiveness of the combined aerobic and resistance training program.

physical variables among college men. The intervention group exhibited significant improvements in cardiovascular endurance, muscular strength, flexibility, and body composition compared to the control group, which maintained their usual activities without additional exercise interventions.

Cardiovascular Endurance

The significant increase in cardiovascular endurance in the intervention group, as evidenced by the 20-m shuttle run test, highlights the effectiveness of aerobic exercise in enhancing cardiovascular fitness. This finding is consistent with previous research indicating that regular aerobic exercise can significantly improve cardiovascular endurance. Warburton *et al.* (2006) emphasize that aerobic activities such as running and cycling are crucial for enhancing cardiovascular health and increasing endurance. The intervention group's improvement aligns with these findings, demonstrating the positive impact of incorporating structured aerobic exercises into physical activity programs for college students.

Muscular Strength

Significant improvements in muscular strength for both bench press and leg press exercises were observed in the intervention group. The independent sample t-tests confirmed that these improvements were statistically significant, highlighting the effectiveness of resistance training. Kraemer *et al.* (2002) found that resistance training is highly effective in increasing muscular strength and hypertrophy. The results of our study support these findings, demonstrating that incorporating resistance exercises into the intervention program significantly enhances strength levels. The minimal changes in the control group further emphasize the importance of structured resistance training in achieving strength gains.

Flexibility

The intervention group also showed a significant improvement in flexibility, as measured by the Sit-and-Reach test. This aligns with research by Behm and Chaouachi (2011), which suggests that flexibility training improves muscle elasticity and joint mobility. The significant increase in flexibility among the intervention group indicates that incorporating stretching and flexibility exercises into the program is beneficial for enhancing the range of motion and reducing the risk of injury. The negligible changes in the control group reinforce the effectiveness of the flexibility component of the intervention program.

Body Composition

The intervention group experienced a significant reduction in body fat percentage and an increase in lean muscle mass. This is consistent with research by Donnelly *et al.* (2009), which highlights the effectiveness of combined aerobic and resistance training in improving body composition. The significant changes observed in body fat percentage and lean muscle mass among the intervention group underscore the overall effectiveness of the comprehensive physical activity program. The minimal changes in the control group further highlight the impact of structured exercise in improving body composition and addressing obesity-related health issues.

Implications and Future Research

The results of this study have important implications for the design and implementation of physical activity programs in college settings. The significant improvements observed in the intervention group suggest that universities should prioritize providing access to structured exercise programs tailored to the needs of their students. Future research should explore the long-term effects of such interventions and examine variations in response to different types of physical activities.

Overall, the study contributes to the growing body of evidence supporting the benefits of physical activity interventions in promoting physical fitness and health among college men. By integrating regular aerobic and resistance training exercises, young adults can achieve significant improvements in cardiovascular endurance, muscular strength, flexibility, and body composition, leading to enhanced overall well-being and reduced risk of chronic diseases.

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