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Effect of exercise type and body mass index on cardiovascular endurance in football players

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Abstract: Football players need to be able to breathe deeply and hold their breath. The level of play displayed by each player has a significant impact on the outcome of the match. Players frequently grow weary while competing, which impairs their attention and leads to match failure. This study seeks to understand how exercise style and body mass index affect cardiorespiratory endurance. A 2 × 2 factorial experimental design was utilized in this study. Utilizing the Multistage Fitness Test (MFT) data were gathered. The VO_2 prediction max from the test results was then compared to the MFT norm. The investigation's findings were as follows: The fartlek training group and the circuit training group have different levels of cardiorespiratory endurance. The fartlek cardiorespiratory endurance training group outperformed the circuit training group in terms of effectiveness. Cardiorespiratory endurance varies across people with high and low body mass indices. The tall body mass index group outperformed the short body mass index group in terms of cardiorespiratory endurance. Cardiorespiratory endurance is influenced by both the type of exercise and body mass index.

Keywords**:** Exercise type, body mass index, cardiorespiratory endurance

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Introduction

Football demands not just technical, tactical and cerebral proficiency, but also strong cardiorespiratory stamina. A skill may serve as a gauge for one's level of proficiency (1). Football demands high cardiorespiratory endurance in addition to talent and technique. Thus, they can perform at their best when participating in a competition.

In order to attain accomplishments at the regional, national, and worldwide levels, achievement sports were guided and developed (2). Through competitions, it is carried out in a planned, graduated and sustainable way (3). Sports are all organized activities that support, encourage and develop people's social, spiritual and physical potential (4). The physical part of sports is just one of many aspects (5). A physical condition can be improved and maintained as a single, integrated whole. Physical aptitude is one of the most important factors in success (6). According to Pouyandekia et al (7) physical ability is connected to motor educability. Programs for professional training include physical capacity as claimed by Rattanapian et al (8).

To contend with severe competitiveness in a football game, one needs to have good cardiorespiratory endurance. The players' bodies must be in peak physical condition to compete. Being in good physical health is insufficient. Even though a player feels healthy, they may not be in the best shape to participate in a game. Not only must a player be disease-free,

but they must also be in outstanding physical condition. One necessity for enhancing an athlete's performance is physical fitness.

The training plan is influenced by the athlete's physical condition. It exists in regular life (9). Physical activity has a good effect on health in daily life (10). Physical circumstances and human activity in engaging in physical activity are strongly associated (11). Programs for physical training must be organized and systematic. Its goal is to increase bodily systems' functional capabilities and physical fitness, which will let athletes perform at a higher level. Peak athletic performance can be attained through a methodical, planned, consistent and ongoing coaching procedure (12).

One sign of having increased physical fitness is improved bodily health (13). It is evaluated by using measurements (14). The primary condition for increasing athlete performance is physical fitness (15). Athletes that are physically fit can play at their best during competitions. The state of one's physical body as a whole. All of these must be cultivated in order to improve physical condition, both in terms of improvement and maintenance. Strength, stamina, explosive power, quickness, flexibility, balance, coordination, agility, and responsiveness are all part of it.

Football is an endurance sport that calls for strong cardiorespiratory endurance from its participants. They do not become fatigued easily while practicing or playing. One of the components of physical fitness, cardiorespiratory endurance refers to the body's capacity to supply oxygen-rich blood to the muscles while engaging in physical exercise (16). Because the capacity to take up oxygen during physical activity reflects an athlete's metabolic capacity, cardiorespiratory endurance can be utilized as a direct indicator of the level of physical condition of football athletes. The maximal capacity to breathe in, distribute, and use oxygen is known as cardiorespiratory endurance. After a series of activities, a person with good heart-lung endurance won't get exhausted easily. Cardiorespiratory endurance is a measure of VO_2max, which is expressed in ml/Kg BW/minute.

Male cardiorespiratory endurance and peak muscular mass peak at ages 18 to 25 years (9). When the VO_2 max value for men hits 44-52.9 ml/kg/min, adequate cardiorespiratory endurance is achieved at a young age of less than 29 (17). Numerous studies have revealed that young athletes in Indonesia do not have good cardiorespiratory endurance. 39.96 ml/kg/minute was used in Abraham's experiment on 16 football players in PPLP South Sulawesi (18). The average VO_2 max for 18 student football players in Andhika's study in Surabaya was 41.13 ml/kg/minute (19).

A superior physical foundation is required to play soccer, supporting his appearance. The physical make-up of a player affects how he appears during a game. Players must aspire for great performance, and achieving this goal necessitates a significant amount of preparation, one of which entails building cardiorespiratory endurance. Before participating in a match, players must be developed and have enhanced cardiorespiratory endurance so that they are prepared to handle any demands that may come during the game, including both mental and physical stress. In order for a game to be successful, a player's cardiorespiratory endurance needs to be strong.

Because players need energy, the physical composition of a player should not be overlooked. If their nutritional demands are addressed, players are able to do daily tasks well. A player's poor body mass index will result in poor physical condition, which has a significant impact on the decline in cardiorespiratory endurance. Soccer is one of the sports that most heavily depends on cardiorespiratory endurance. An individual with a strong aerobic capacity has a healthy heart and blood circulation, which can provide the muscles with blood, enabling them to function continually without becoming overly exhausted.

Permaesih et al (6) discovered a significant inverse relationship ($r = - 0.45$, $p = 0.000$) between BMI and cardiorespiratory endurance. This study demonstrated that the level of

cardiorespiratory endurance decreased with increasing BMI (6). Better cardiorespiratory endurance is attainable with a good or optimal body mass index because all motion requires energy, and food with enough nutritional content provides the energy needed for motion. As a result, a player will display enthusiasm, agility, and activity while directing the game in order to improve their cardiorespiratory endurance.

Numerous variables influence it, including genetics, age, gender, physical activity, body composition, hemoglobin levels, and dietary consumption. The genotype of the angiotensin converting enzyme (kinase II) (ACE) is the genetic component that affects. Because ACE polymorphisms alter the metabolism of compounds involved in blood vessel remodeling, each person's reaction to exercise varies (16).

Cardiorespiratory endurance can be increased through physical activity that involves a certain level of intensity, duration, and frequency since it can result in physiological changes to the body's circulatory system (20). According to research by Helgerud et al (16) interval training involving as much as 44 minutes of fast running (90-95 percent upper-level pulse) interspersed with three minutes of slow running, performed regularly twice a week for eight weeks, can increase VO2 max from 58.1 4.5 ml/kg/min to 64.3 3.9 ml/kg/min (16). Each player needs to be in top physical shape. A player needs to have good skills and movement in games that proceed quickly and intensely. If a player lacks strong cardiorespiratory stamina, other players' systems will leave them behind. Every game requires players to have strong cardiorespiratory stamina. This is due to the fact that, whenever possible, they play the entire game. This justification makes it very clear why football players need to have strong cardiorespiratory endurance. The level of play displayed by each participant affects the game's outcome. Players frequently grow weary while on the field, which causes them to lose focus and make poor judgments that lead to a loss in the game. Each athlete has a distinct capacity for sustained cardiorespiratory effort. They are influenced by a variety of internal and environmental influences. Genetics, age, and gender are examples of internal elements that are already present in a person's body permanently. External influences include things like physical activity, environment, and other things.

Methods

To ascertain the impact of independent variables on the dependent variable, this quantitative study used experimental methods. Due to the fact that there were two independent variables in this investigation, each of which had two levels, a factorial design of 2 x 2 was chosen.

There were 45 football school athletes present, coming from the Jepara Regency's Putra Welahan, Mars, and Putra Mayong football schools. 45 football school athletes in total were utilized as the subject of a training-type treatment, with cardiorespiratory endurance serving as the dependent variable to a sample with a high degree of homogeneity and versatility in exercise. This sample consisted of 32 SSB athletes from the Jepara Regency's Putra Welahan Football School, Mars Football School, and Putra Mayong Football School. Purposive sampling was used with the idea that because similar individuals would face the same challenges, they could be reluctant to share the same aptitude and expertise to take part in this experiment.

The training regimen used in this study consisted of the following two exercises: 1). There are five training stations included in in-circuit training: push-ups, pull-ups, sit-ups, squat jumps, and high jumps and 2) Fartlek training, which involves sprinting, jogging, and walking. Athletes' BMI is calculated based on their height and weight, then it is protected. to categorize their BMI in accordance with the 2011 classification used by the Indonesian Ministry of Health. The Multistage Fitness Test device was used to gauge athletes' cardiorespiratory stamina.

From March 8 to April 19, 2020, a six-week period was used for this study. Three times per week for 16 meetings made up the training schedule. Welahan-Gotri Street, Kalipucang

Wetan, Welahan District, Jepara Regency served as the research location. The purpose of this experiment was to ascertain the relationship between exercise type and BMI. Data on VO_2max, which were collected from the Multistage Fitness Test, were used to calculate cardiorespiratory endurance. measurements prior to circuit training and fartlek exercise following 16 sessions of therapy. once more measuring VO_2max with the Multistage Fitness Test.

The following are the steps in data analysis: The mean, standard deviation, variance, maximum value, and lowest value are all calculated to explain the data. The non-parametric Kolmogorov Smirnov test is used for the normalcy test. Levene's test for homogeneity using SPSS 23.0. ANOVA, the Tukey test, and further analysis were used to assess the hypotheses.

Results

Table 1 shows that a significant value of less than 0.05 was achieved for the test findings for differences in the types of circuit and fartlek workouts on cardiorespiratory endurance. This indicates that the study's hypothesis is correct, and there is a significant difference in cardiorespiratory endurance between circuit training and fartlek (p 0.05).

TABLE 1

Discussion

Circuit training is a technique used by junior athletes to enhance their overall physical condition. Strength, cardiovascular endurance, flexibility, and speed are the elements of physical fitness that circuit training focuses on when junior athletes are transitioning into or entering the typical preparation phase (21).

Try different activities, such as a fartlek training regimen, which combines aerobic and anaerobic activity. According to research findings, persons who engage in fartlek workouts experience difficulty because those who typically jog in a slow, continuous rhythm try different options to fartlek training by combining sprint-walk-jog (22).

With an average score of 41.1344, circuit training outperformed fartlek training, which had a score of 39.7875. Circuit training, which combines cardio and strengthening workouts, is used to enhance strength, power, muscular cardiovascular endurance, speed, agility, and flexibility. Another effective method of increasing cardiorespiratory endurance is circuit training. Body fitness can be attained with circuit training without taking a lot of time (23).

Strength, endurance, speed, flexibility, mobility, and other aspects of body condition can all be improved with circuit training at the same time. Therefore, circuit training is more effective than fartlek training for boosting cardiorespiratory endurance.

Having a high body mass index and a low body mass index will affect your cardiorespiratory endurance

The body mass index (BMI) of a person is calculated by dividing their height in kilograms by their height in meters squared. To evaluate a person's weight and nutritional state, BMI is widely utilized. The results of studies conducted in a number of countries show that BMI is sensitive and responsive to changes in dietary needs, seasonal food supply, and personal productivity.

According to a study by Schmidt et al (24), the percentage of fat and fat mass had a significant link with boys' VO_2 max based on linear regression analysis. Daily physical activity and exercise involve skeletomuscular, cardiorespiratory, hematocirculatory, psychoneurological, and endocrine-metabolic body functions (25). Additionally, physical activity is important for maintaining brain function; in particular, increasing training intensity helps older men with dementia (26). Programs for health promotion belong in schools.

According to recent research, school-based programs are the most successful at promoting physical activity (12).

Results from the study by Fuller et al (27) showed how crucial it is to maintain the typical body mass index throughout the elementary school years in order to improve and sustain physical fitness. Adolescents that engage in vigorous physical exercise have proportionate body mass indexes and compositions, as well as higher levels of cardiorespiratory fitness (28). According to the findings, only arm muscle strength and endurance linked with body mass index and cardiorespiratory endurance. Among schoolchildren, body weight, height, sex, and body mass index are reliable indicators of respiratory endurance (29).

The average score for athletes with low BMI was 41.3469, which was higher than the average score for athletes with high BMI, which was 39.5750. Numerous studies have shown that BMI is a useful tool for evaluating obesity and it is advised for use in the clinical assessment of obesity in children. Based on the Quetelet index (body weight in kg divided by square of height in m (kg/m2)), the BMI is a tool for detecting if a person is overweight. Boys and girls have varied levels of body fat, therefore how the BMI is interpreted depends on the child's age and sex. BMI is the simplest measure to gauge obesity and is connected with body fat percentage, but it also plays a critical role in identifying obese patients who are at risk for health consequences (17). So, compared to athletes with high BMI, those with low BMI had greater cardiorespiratory endurance.

Cardiorespiratory endurance is affected by the type of exercise and body mass index

When two or more independent variables work together to influence a dependent variable, this is called interaction. In more detail, interaction refers to the effect that one independent variable has on another independent variable, depending on the magnitude of those other independent variables (30).

Fartlek and circuit training are two forms of exercise that, despite differences in how they are carried out, both aim to improve cardiorespiratory endurance. An athlete's cardiorespiratory endurance will be affected differently by various forms of exercise. The findings indicated that there was an interaction between two independent factors and one attribute variable with differential outcomes. This attribute variable was BMI, and its treatment with circuit training and fartlek training had different effects on high and low BMI, respectively.

Conclusions

It can be concluded that there are differences between the effects of high and low BMI on cardiorespiratory resistance, as well as between the effects of circuit training and fartlek training on the cardiorespiratory endurance of SSB athletes in Jepara Regency, where circuit training has been shown to be superior to fartlek training. In Jepara Regency, SSB athletes showed that athletes with low BMI had more cardiorespiratory endurance than athletes with tall BMI.

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Table 1. Tukey HSD test type of exercise calculation results

Exercise type		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Low-Cycle Exercise	Low-Fartlek Workout	3.2458*	.67317	.000	1.4079	5.0838
	High-Cycle Exercise	-1.4104	.67317	.179	-3.2484	.4275
	High-Fartlek Workout	2.0792*	.67317	.022	.2412	3.9171
Low-Fartlek Workout	Low-Cycle Exercise	-3.2458*	.67317	.000	-5.0838	-1.4079
	High-Cycle Exercise	-4.6562*	.67317	.000	-6.4942	-2.8183
	High-Fartlek Workout	-1.1667	.67317	.326	-3.0046	.6713
High-Cycle Exercise	Low-Cycle Exercise	1.4104	.67317	.179	-.4275	3.2484
	Low-Fartlek Workout	4.6562*	.67317	.000	2.8183	6.4942
	High-Fartlek Workout	3.4896*	.67317	.000	1.6516	5.3275
High-Fartlek Workout	Low-Cycle Exercise	-2.0792*	.67317	.022	-3.9171	-.2412
	Low-Fartlek Workout	1.1667	.67317	.326	-.6713	3.0046
	High-Fartlek Workout	-3.4896*	.67317	.000	-5.3275	-1.6516

Based on observed means.
The error term is Mean Square (Error) = 1.813.
*. The mean difference is significant at the 0.05 level.