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The effect of continuous running training, power endurance, and muscle endurance on increasing leg power for football athletes

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Abstract

The purpose of this study was to determine the effect of the continuous running method with power endurance and muscle endurance on increasing leg power. This research method is an experimental method using the Two-Group Pretest-Posttest Design research design. The population in this study was the entire SSB Darma Sakti football team, namely 50 people. and the sample for this study were 16 SSB Darma Sakti Kuningan Regency football athletes who were divided into two groups, 8 people in the continuous running training group with power endurance and 8 people in the continuous running training group with muscle endurance. This sampling used purposive sampling because the researcher had certain criteria. The instrument used in this research was three hop jump. The results of this research are that there is a significant increase in leg power. The increase in the continuous running group with power endurance was more significant with a score of 3.90% compared to the continuous running group with muscle endurance with a score of 3.70%. It is hoped that this training method will be developed in further research and become a solution for preparation before participating in the competition.

Keywords: continuous running, power endurance, muscle endurance, leg power, football

INTRODUCTION

Soccer is a very popular and in-demand sport today. The appeal of soccer lies in the skill with the ball, the intense and dynamic movements, and the tactical surprises that mesmerize the audience (Mappaompo, 2024; Anwar et al., 2023). Football is one of the sports that requires various optimal physical components, including leg muscle strength (Mendes, 2016). Football players need to be physically fit, fast, strong and skillful to play the game (Dahlan et al., 2020). This study aims to evaluate the effect of continuous running training with power endurance and continuous running with muscle endurance on improving leg power in soccer athletes. This topic is important because leg muscle strength is a vital aspect in the performance of soccer athletes, which can have a direct impact on success in a match (Hammami et al., 2018).

In the game of soccer there are several important physical components needed, including strength, speed, endurance, agility, and coordination (Ferley et al., 2020). Among these components, leg muscle strength is the main focus of this study because this strength plays an important role in the ability to kick, run fast, and defend in a match. A study published in the Journal of Strength and Conditioning Research states that leg muscle strength has a significant relationship with sprinting ability and overall physical performance of soccer players (Chamari, 2011).

Training is essential to the needs of athletes in developing and improving physical and technical skills, the success of which is the result of planning, hard work, commitment, and practice. Exercise program planning is the foundation of exercise planning that is tailored to the needs of the athlete (Choi et al, 2005). One of the physical components that must be possessed by an athlete is endurance, endurance training can improve the quality of the game in sports, and athletes who have high endurance can change the course of the game (Ishee & Foster, 2003).

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Muscular endurance training is one of the effective methods to improve leg muscle strength and endurance (Kondrič et al., 2013). It involves the repetition of low-to-moderate intensity movements over long periods of time, which helps increase the capacity of muscles to work for longer without fatigue. In the context of soccer, muscular endurance training is particularly important because the game requires players to maintain their optimal performance throughout a match that can last 90 minutes or more (Rica et al., 2023).

Continuous running training is one of the individual training needs of soccer athletes which has an impact on improving physical fitness (Gale et al., 2020). Continuous running is an exercise method that is known to be effective in improving muscular endurance and strength. It involves running without stopping for a certain duration, which can help improve cardiovascular capacity and muscular endurance. In addition, continuous running can also increase muscle power, which is very important in the game of soccer (Juan-Recio et al., 2020).

The ability to maintain this performance depends not only on technical and tactical skills but also on adequate muscular strength and endurance. Strong and durable leg muscles allow players to perform sprints, changes of direction, and various other explosive movements with greater efficiency and effectiveness (Ferley et al., 2020). In addition, good leg muscle strength also plays an important role in injury prevention. Injuries are often caused by muscle fatigue and lack of stability, which can result in decreased control and increased risk of injuries such as sprains, muscle tears and others.

Leg muscle strength can be improved through various training methods, one of which is power endurance training. Power endurance training is designed to increase muscle strength and endurance simultaneously so that athletes are able to maintain high performance for longer periods of time. This is especially important in the context of soccer matches, where players must constantly move, run, and perform various intense movements throughout the match (Bompa, T.O., & Haff, 2019).

In addition to endurance, players must have excellent leg power (explosive power). Leg muscle power is the ability of the leg muscles to perform activities quickly and strongly so as to produce maximum energy (Taweel et al., 2022). The function of leg muscle power is clearly visible in the game of soccer. Players must be able to jump as high as possible to receive high passes from their teammates (Hammami et al., 2018). High passes can be in the form of corner kicks, free kicks, and passes from teammates. With good leg muscle power, players are able to compete with their opponents for the ball. In addition, good leg muscle power will produce strong and fast kicks, so the possibility of scoring goals becomes greater (Maliki et al., 2017).

Previously, several studies have been conducted to examine the effect of physical training on improving the performance of soccer athletes. However, there are still some weaknesses in these studies, such as the absence of specific measurements of leg muscle strength and the absence of research that considers the effect of various types of physical exercise simultaneously. This study will try to overcome these weaknesses by examining the effect of continuous running training, power endurance, and muscle endurance simultaneously on increasing leg power in soccer athletes. Through this study, it is hoped that more in-depth information can be obtained about the effectiveness of continuous running training in improving essential physical components for soccer players, as well as providing practical guidance for coaches in designing optimal training programs for their athletes.

From the background explanation above, the purpose of this study is to determine the effect of countinuous running training with power endurance and muscle endurance on increasing leg power of SSB Darma Sakti Football athletes.

METHOD

The method in this study is an experimental method using a two-group pretest-posttest design, which is given treatment, but before being given treatment, a pretest is carried out first. Thus the results of the treatment can be known more accurately because they can be compared with the situation before treatment.

The participants involved in this study were researchers, supervisors, and 50 SSB Darma Sakti soccer athletes. To determine the sample to be used, the researcher used a purposive sampling technique. Based on research needs, the sample must be classified first. The classification in question is athletes who are 17 years old and have participated in inter-city / district competitions. In this study, 16 people will be sampled.

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The instrument used is the three-hop jump test. The equipment used in this study is one meter, record sheets, stationery, and boundary lines, to measure how far the jump is. While data collection was carried out at the Damarwulan stadium, Jalan alun-alun selatan no 146 Darma. For the treatment, it was carried out from October to December 2021. The implementation of the exercise is carried out 6 weeks 3 times a meeting in one week on the purpose of the exercise in accordance with the provisions of the principles and norms of training loading in achieving the objectives of physical exercise. As said by Moran et al. (2018) 6-8 weeks has had a considerable effect on athletes.

Data Collection Procedure

In accordance with the design used, the procedure of this study is as follows:

1. Conducting field studies, namely determining the population and sample that will be the object of research.
2. Conduct a pre-test of leg power to the sample.
3. Provide an exercise/treatment program to the sample.
4. Conduct a post-test of leg power to the sample.
5. After that, process and analyze the data.
6. The final step determines the conclusion based on the results

Training program

In training to produce a reliable athlete there is a good and correct training program, in the process of making an exercise program there are several basics and planning. As said by Moran et al. (2018) There are several requirements, namely long-term plans, medium-term plans, and short-term plans. This study uses an exercise program that includes a macro cycle and can be broken down into a micro cycle exercise program as well as the table below.

From the two macro and micro cycles above, it serves to facilitate understanding in research, which is considered one macro with a period of one month (Bompa, T.O., & Haff, 2019). And the micro cycle itself is a training cycle that uses time per week or what is called weekly training.

This study uses continuous running treatment with power endurance and continuous running with muscle endurance. Continuous running with a time of 40 minutes and in each subsequent week added time by the amount of 5 minutes. As said by (Busyairi & Ray, 2018) Continuous running for more than 30 minutes at a moderate tempo below anaerobic threshold will result in good aerobic adaptation.

Muscular endurance is involved in this study which is contained in the research treatment where athletes try wall-sit movements with the strongest time for individual athletes as said by (Nourollahnajafabadi et al., 2013) The wall sit position of a person who is measured like a person sitting in a chair with his back against the wall with his hands hanging next to his body and to avoid knee injury, the knee position is set by the trainer according to the appropriate position and the person maintains it with all his strength or until he stands up.

This study uses continuous running training treatment with power endurance and for power endurance using hurdle jumps calculated during the time the athlete is still strong to do the hurdle jump movement, the time of implementation is as said by the athlete (Juskhia John & Dikdik Zafar Sidik, 2017) The athlete stands to one side with both feet flat on the ground, perpendicular to the obstacle. The timing starts from the first movement. The athlete jumps off both feet and lands on both feet on the other side of the hurdle, then back again.

RESULTS AND DISCUSSION

From the results of the data collected by researchers with a series of tests given to the entire sample of 16 soccer players from SSB DARMA SAKTI, which were divided into two groups of 8 treatment groups (doing continuous running training with power endurance) and 8 treatment groups (doing continuous running training with muscle endurance). This research data was obtained from the results of the leg power pre-test using the three hop jump test. This pre-test is done to find out the initial data on the results of the leg power test before being given treatment / treatment and this post-test aims to find out if there is an increase after being given the exercise.

The results of the initial and final tests after continuous running treatment with power endurance and continuous running treatment with muscle endurance.

Data Description

Deskriptif data merupakan tahapan pengolahan untuk memperoleh informasi mengenai data. Adapun data yang dideskripsikan adalah sebagai berikut:

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Tabel 1 Deskripsi Data

Group	N	Minimum	Maximum	Mean	Std. Deviation
Pretest CR+PE	8	3.96	6.95	5.64	0.85
Posttest CR+PE	8	4.50	7.50	5.86	0.89
Pretest CR+DTO	8	5.35	6.30	5.67	0.29
Posttest CR+DTO	8	5.45	6.40	5.88	0.35

In the data description table above, the data is processed into percentage data with calculations stated.

Percentage data = final mean – initial mean x 100%
CR+PE mean pre test
= 5.86 – 5.64 x 100%
5.64
= 3.90 %

Percentage data = final mean – initial mean x 100%
CR+DTO mean pre test
= 5.88 – 5.67 x 100%
5.67
= 3.70 %

From the results of the calculation of the average percentage increase in leg power in the initial test, the continuous running sample with power endurance obtained a percentage of improvement data of 3.90%. While the percentage of continuous running training groups with muscle endurance is 3.70%.

Normality Test

The normality test is carried out to determine whether the pre-test and post-test data in the continuous running training group with power endurance and the continuous running training group with muscle endurance are normally distributed or not. So it is necessary to test normality using IBM SPSS Version 25.

The normality hypothesis in this study is :

H_0 : Data is normally distributed

H_1 : Data is not normally distributed

The significance level is 0.05 so that the criteria for making normality decisions are:

If the significance value is greater than 0.05, then H_0 retrieved

If the significance value is smaller than 0.05, then H_0 rejected

The following are the results of the normality test data processing obtained can be seen in table 2 below.

Table 2. Normality Test

Group	*Sig.*	Decision	Conclusion
Pretest CR+PE	0.200	H_0 Retrieved	Normal data
Posttest CR+PE	0.200	H_0 Retrieved	Normal data
Pretest CR+DTO	0.200	H_0 Retrieved	Normal data
Posttest CR+DTO	0.200	H_0 Retrieved	Normal data

Based on table 2, the data is declared normally distributed if the significance value is greater than 0.05 or P> 0.05 and vice versa if the significance value is smaller than 0.05 or P < 0.05, the data is declared to be abnormally distributed. The following is a data analysis and normality test results on the results of the leg power test seen from Kolmogorov-Smirnov. Conclusion, based on SPSS output, it is

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known that P (0.200) > 0.05 on the pretest of the Continuous Running Exercise group with Power Endurance, P (0.200) > 0.05 on the posttest of the Continuous Running Exercise group with Power Endurance, P (0.200) > 0.05 on the pretest of the Continuous Running Exercise group with muscle endurance, P (0.200) > 0.05 on the posttest of the Continuous Running Exercise group with muscle endurance, the data is normally distributed.

Homogeneity Test

The data homogeneity test shows the test results from the Levene's Test to test the assumption of equal variance, in other words, this test relates to the same or different data categories (Pallmann P., Hothorn LA., 2014). The probability value (p) or significance (Sig.). The significance test is as follows: "If the Sig. or P-value > 0.05 then the data is declared homogeneous". "If the Sig. or P-value < 0.05 then the data is declared inhomogeneous".

Tabel 3. Homogeneity Test

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Test results	Based on Mean	3,568	1	14	,080
	Based on Median	2,601	1	14	,129
	Based on Median and with adjusted df	2,601	1	8,820	,142
	Based on trimmed mean	3,385	1	14	,087

Judging from table 3, the significance value of homogeneity is 0.087>0.05, so the data is declared homogeneous. Indicating the Final Test variable in the two treatment groups is homogeneous, with Levene Statistic 3.385.

Hypothesis Test

Based on the results of the assumption test, namely normally distributed data, then further data processing is carried out with parametric statistics using the Paired Sample T-Test test to see if there is a difference in the average increase in Pretest & Posttest leg muscle power for continuous running training groups with power endurance or continuous running training groups with muscle endurance.

The hypotheses in this study are:

H_0 : There is no effect of continuous running training method with power endurance and continuous running training with muscle endurance on increasing leg power.

H_1 : There is an effect of Continuous Running Training method with Power Endurance and Continuous Running Training with Muscle Endurance on Increasing leg power.

Rejection criteria H_0 :

Based on the Probability value

The probability value or sig. (P) < 0.05, H0 is rejected

Probability or sig value. (P) > 0.05, H0 is accepted

The results of data processing using the Paired Sample T-Test can be seen in tables 4 and 5 below.

Tabel 4. Paired Sample T-Test CR+PE

Paired Samples Test									
		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	Df	Sig.(2-tailed)
pair 1	PreTest CR &PE - PostTest CR & PE	-,21375	,17029	,06021	-,35611	-,07139	-3,550	7	,009

Based on table 4 above, it is known that t is -3.550 with sig (p) = 0.00 <0.05, namely Ho is rejected. So there is an influence of the results of countinous running training with power endurance.

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Tabel 5 Uji Paired Sample T-Test CR+DTO

Paired Samples Test									
		Paired Differences					t	Df	Sig.(2 tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PreTest CR & DTO - PostTest CR & DTO	-,21375	,24053	,08504	-,41484	-,01266	-2,514	7	,040

Based on table 5 above, it is known that t is -2.514 with sig (p) = 0.04 <0.05, namely Ho is rejected. So there is an influence of the results of countinous running training with muscle endurance. It can be concluded from these two statistical results that the most influential exercise on increasing leg power is continuous running training with muscle endurance.

Discussion

Research on improving leg power in soccer athletes has been conducted extensively by various academics. Leg power is almost required by all sports including soccer (Prawirakusuma & Sukoco, 2019). This research mainly focuses on different types of physical training that aim to improve strength, endurance and overall athletic performance. Continuous running training has been shown to improve aerobic endurance in soccer players, which is crucial for maintaining performance during games. Midgley et al. (2007) showed that continuous running can improve players' aerobic capacity. However, these studies have mainly focused on aerobic endurance rather than specifically improving leg power. This study addresses this gap by integrating continuous running with other training components to examine its combined effects on leg power.

Muscular endurance training is another important area explored in previous studies. Spurrs et al. (2003) found that power endurance training can improve explosive power and sprinting ability in soccer players. Despite these findings, these studies did not specifically measure improvements in leg power, instead focusing on overall sprinting performance. This study aims to fill this gap by specifically measuring the impact of muscular endurance training on leg power, providing a deeper understanding of its benefits. Muscular endurance training has also become an important focus in sports science. Muscular endurance training has also become an important focus in sports science. Hoffman et al. (2009) shows that increased muscular endurance helps athletes maintain their physical performance during long matches. However, these studies often neglect the aspect of explosive power, which is important for fast and powerful movements such as kicking a ball. By combining muscular endurance training with explosive strength training, this study seeks to balance muscular endurance and leg power.

The findings of this study indicate that continuous running, muscular endurance, and power endurance training have a significant impact on improving leg power among soccer athletes. This is in line with previous studies that have shown that certain physical exercises can improve athletes' abilities in various physical aspects, including leg power. For example, a study by Rica et al. (2023) showed that an interval training program significantly improved aerobic and anaerobic capacity, which are important for strength and running performance in soccer players. Similarly, Haghighi et al. (2012) found that a combination of plyometric and resistance training can improve leg power and vertical jump ability in youth soccer players, which supports the finding that strength and endurance training together can improve leg power. In addition, Ferley et al. (2020) showed that high-intensity plyometric training significantly improved leg power and sprinting performance in soccer players. In addition, Hoff & Helgerud (2004) showed that structured resistance training improved aerobic capacity and muscle strength in soccer athletes. These results corroborate the finding that various types of physical training, including continuous running, muscular endurance, and power endurance, play an important role in improving the physical performance of soccer athletes.

This study has several important implications. First, the results of this study can be used by coaches to design more effective training programs, focusing on exercises that are proven to increase

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leg power. This will assist soccer athletes in improving their ability to kick the ball more powerfully and accurately, run faster, and defend better during matches, thus improving overall performance on the field. Secondly, increased leg power also plays an important role in injury prevention, which is often caused by muscle fatigue and lack of stability. Thus, a training program based on the findings of this study will not only improve athletes' performance but also reduce the risk of injury. Finally, the implications of this study also include contributing to the scientific literature in the field of sports science, providing references for further research, and development of better training policies in soccer clubs, academies, and sports institutions.

CONCLUSION

Based on the results of data analysis and processing that has been done, the author can conclude which the conclusion also answers the problem formulation that has been listed. Based on the results obtained, it can be concluded that:

1. There is an effect of continuous running training with power endurance on increasing leg power.
2. There is an effect of continuous running training with muscle endurance on increasing leg power.
3. The exercise that has the most effect on increasing leg power is continuous running training with power endurance.

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