



EFFECT OF CIRCUIT AND INTERVAL TRAINING METHODS ON THE AGILITY AND VO₂max OF PORPROV FOOTBALL PLAYERS IN PATI REGENCY IN TERMS OF LEG MUSCLE ENDURANCE

Ahmad Badawi^{1ABCDE} and Ahmad Nasrulloh^{1ABCD}

¹Universitas Negeri Yogyakarta

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Corresponding Author: Ahmad Badawi, E-mail: abadawi938@gmail.com

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Abstract

This study aimed to determine: (1) the effect of circuit and interval training methods on agility and VO₂max; (2) the difference in the effect of high leg muscle endurance and low leg muscle endurance on agility and VO₂max; (3) the interaction between circuit training, interval training and leg muscle endurance (high and low) on agility and VO₂max.

Materials and methods. This research is an experiment with a 2×2 factorial design. In this study, the number of samples used was 20 players selected by purposive sampling. Agility was measured with the Illinois agility test instrument, VO₂max was measured with a multistage fitness test, and leg muscle endurance was measured with a wall sit test. Data analysis used a two-way ANOVA test with a significance level of $\alpha < 0.05$.

Results. The results of this study are as follows: (1) there is no difference in the effect of the circuit and interval training methods on the agility of football players, there are significant differences between the circuit and interval training methods in their effect on the VO₂max of football players; (2) there is a difference between high and low leg muscle endurance for agility and VO₂max, $\alpha < 0.05$; (3) there is an interaction between the circuit, interval training, and leg muscle endurance (high and low) on agility, $\alpha < 0.05$.

Conclusions. There is an interaction between circuit training, interval training, and leg muscle endurance (high and low) on the agility of Porprov soccer players in Pati Regency. Meanwhile, there was no interaction between circuit training, interval training, and leg muscle endurance (high and low) on the VO₂max of Porprov football players in Pati Regency.

Keywords: circuit training, interval training, agility, VO₂max, football.

Introduction

Football is the most watched and complex sport, and it has developed and become more modern as science and technology have advanced. Currently, women's football players are treated the same as men. Professional soccer players have very high levels of fitness, skill, strategy and mental toughness (Nayiroğlu et al., 2022; Dobrowolski et al., 2020). There has been a 9% growth from 242 million to 265 million active football players worldwide from 2006-2009, according to estimates by the Federation Internationale de Football Association (FIFA). Soccer is a team activity that requires not only physical strength but also mental acuity (the ability to "read the game") and fast reflexes (the ability to capitalize on scoring opportunities).

The fundamental component of a soccer player is their physical condition; if a player's physical condition is poor, they will get fatigued more quickly (Sulasmono, 2016). The evolution of contemporary football demonstrates that it is essential for

players to be in good physical shape in order for them to be able to move around efficiently while competing. When it comes to their physical preparation, soccer players often dedicate one week to working on their strength, endurance, and speed respectively (Gomez-Piqueras et al., 2019).

Physical fitness is a need for football players since it enables them to display their talent and skill without significant hurdles. Every training session requires frequent and intensive preparation (Paul et al., 2019).

Provincial Sports Week or often referred to as porprov is a party event held at the provincial level which competes for various sports, including football. Because soccer is the sport that is most easily recognized by the wider community, soccer is the sport that is most in demand by participants from various districts and cities. The reason is, football can make a district or city proud when it succeeds in donating a gold medal, so that football is the most anticipated sport by some participants. A huge amount of work remains to be done in order for athletes to achieve the levels of agility and VO₂max required by professional soccer players. Currently, these two physical components are still receiving

a lot of attention because there are still several gaps in their availability.

Based on the findings of observations made by researchers, which were then refined with tests to assess players' agility and VO₂max skills using the Illinois test to determine player agility and aerobic endurance tests using graded fitness tests. Measurement tests conducted on twenty porprov players in Pati Regency yielded the following results: one player was in the good category, nineteen players were in the sufficient category, and the VO₂max test results were as follows: fourteen players were in the sufficient category, five players were placed in the less category, and one player is placed in the very less category; these are the players who scored the highest. From the results of the examination that has been carried out, it can be concluded that players will need more practice to improve agility and VO₂max to achieve the goal of completing the Pati Regency Porprov qualification round.

Circuit training is a way of exercising that is broken down into several sections, each of which has a different purpose. Exercises are performed in a certain order, from the beginning of the exercise to the end, in sets of sessions or repetitions of the exercise (Gopinathan, 2019). Soccer players can increase their stamina and performance by taking part in circuit training. This kind of exercise improves the body's metabolic processes by increasing the efficiency of blood being pumped to and from the heart (Jannah et al., 2022). Circuit training is a great way for coaches to get their players to work on their talents all at once and in a short amount of time (Rahmat et al., 2021). Circuit training is a more diverse and more attractive training model for players, where the training is divided into several posts with different versions of the exercise at each post, so that players can make better use of their practice time.

The success of a soccer player is highly dependent on his physical fitness. The interval training paradigm that varies the duration, frequency and intensity of the exercise is one option for physical conditioning activities (Kholid et al., 2020). Physical conditioning using the interval training technique can greatly increase VO₂max. Increased VO₂max during high-intensity exercise (70% of maximum capacity) and more dramatic rest periods (2-3 minutes). Interval training is when players get a workout based on how long, how hard, and how often they need to rest Interval training can help coaches improve the physical condition of soccer players in a number of ways. Based on the principles of training, one way is to increase the player's agility and VO₂ max (Busyairi & Ray, 2018).

Materials and methods

Study participants

Experiments using a design known as a 2×2 factorial are included in studies of this kind. A version of the experimental design known as the factorial design is one that takes into account the potential moderating factors that have an effect on how the independent variable is treated on the outcome of the dependent variable (Sugiyono, 2013). The sample of this study consisted of twenty soccer players from Pati province.

In this experimental investigation, two groups were used, each of which was given a unique treatment, namely the circuit training treatment and the interval training treatment

versus both groups. The following table presents the research design or design known as the 2×2 factorial design:

Table 2. 2×2 factorial design

Manipulation Variable	Training Method	
	Circuit Training (A1)	Interval Training (A2)
Height (B1)	A1.B1	A2.B1
low (B2)	A1.B2	A2.B2

Information:

A1B1: A group of Porprov football players in Pati Regency who have high leg muscle tone were given treatment circuit training.

A1B2: A group of Porprov soccer players in Pati Regency who had low leg muscle endurance were given treatment circuit training.

A2B1: A group of Porprov soccer players in Pati Regency who had high leg muscle endurance was given treatment interval training.

A2B2: A group of Porprov soccer players in Pati Regency who had low leg muscle endurance were given treatment interval training.

Study organization

This research was conducted with the Porprov football team in Pati Regency to find out how to use circuit training and interval training in soccer as a treatment. The research was conducted from 1 November 2022 to 30 November 2022 during 16 meetings which took place twice a week on Mondays and Wednesdays. Then a sample of 20 football players from Pati Regency.

Statistical analysis

This study used SPSS 22 data analysis. This study used two-way ANOVA. Using the Shapiro-Wilk test in SPSS 22, the distribution is said to be normal if $p > 0.05$ (5%) and abnormal if $p < 0.05$ (5%). Levene Test homogeneity test in this study. Suitability If $F_{count} < F_{table}$, then the test is homogeneous; otherwise, it is not homogeneous. Testing a hypothesis determines its acceptance. The Post Hoc test with a significance threshold of $p < 0.05$ is continued if the data is regularly distributed. If the data is not normally distributed, use a non-parametric test. The Kruskal-wallis test continues. Post-Hoc Test.

Results

The results of the research on agility and VO₂max training methods for soccer players in Porprov Pati Regency can be seen in the image below.

Discussion

Significant Influence Method Circuit And Interval Training Against Agility and VO₂max Football Players Porprov Pati Regency

Based on the results of the Comparison of variance analysis, the finding that there is no significant difference

between the effect of circuit and interval training on the agility and VO₂max of Porprov soccer players in Pati Regency shows the results of the proposed hypothesis. The F value for agility is 0.010, and the significance value is 0.923 > 0.05. It can be said that there is no significant difference between the effect of interval training and circuit training on the agility of Porprov football players in Pati Regency.

While the VO₂max capacity produces an F value of 7.775 with a significance of 0.013 < 0.05, it can be stated that the VO₂max capacity has an effect on circuit training and interval training for VO₂max soccer players in Porprov Pati Regency.

In this study, intermediate training techniques for agility showed that circuit training produced an average value of 15.98, while interval training produced an average value of

Table 2. Data pretest-posttest player agility

High Leg Muscle Endurance						
No	Circuit training (A1, B1)			Interval Training (A2, B1)		
	Pretest	Posttest	Selisih	Pretest	Posttest	Selisih
1	16.88	15.25	1.63	16.32	16.56	-0.24
2	16.64	15.73	0.91	16.49	16.15	0.34
3	16.91	15.21	1.7	16.32	16.10	0.22
4	16.55	15.11	1.44	16.93	16.52	0.41
5	16.80	15.29	1.51	16.84	16.26	0.58
Amount	7.19 %			Amount	1.31 %	
Low Leg Muscle Endurance						
No	Circuit training (A1, B2)			Interval Training (A2, B2)		
	Pretest	Posttest	Selisih	Pretest	Posttest	Selisih
1	17.08	16.49	0.59	16.63	15.26	1.37
2	15.69	16.55	-0.86	16.74	15.89	0.85
3	16.59	16.64	-0.05	16.79	15.52	1.27
4	17.35	16.91	0.44	16.64	16.19	0.45
5	16.56	16.63	-0.07	17.08	15.24	1.84
Amount	0.06 %			Amount	5.78 %	

Table 3. Data pretest-posttest VO₂ max player

High Leg Muscle Endurance						
No	Circuit training (A1, B1)			Interval Training (A2, B1)		
	Pretest	Posttest	Difference	Pretest	Posttest	Difference
1	44.80	53.70	8.9	44.50	50.80	6.3
2	47.40	52.50	5.1	46.80	48.70	1.9
3	46.80	51.91	5.11	45.90	44.50	-1.4
4	45.90	48.70	2.8	43.80	47.40	3.6
5	46.80	49.30	2.5	39.90	43.90	4
Amount	24.41%			Amount	14.4%	
Low Leg Muscle Endurance						
No	Circuit training (A1, B2)			Interval Training (A2, B2)		
	Pretest	Posttest	Difference	Pretest	Posttest	Difference
1	39.90	47.40	7.5	37.40	43.30	5.9
2	43.90	43.30	-0.6	40.50	43.90	3.4
3	39.90	44.50	4.6	43.40	44.50	1.1
4	39.20	47.40	8.2	39.90	43.90	4
5	46.50	46.80	0.3	39.50	47.40	7.9
Amount	20%			Amount	22.3%	

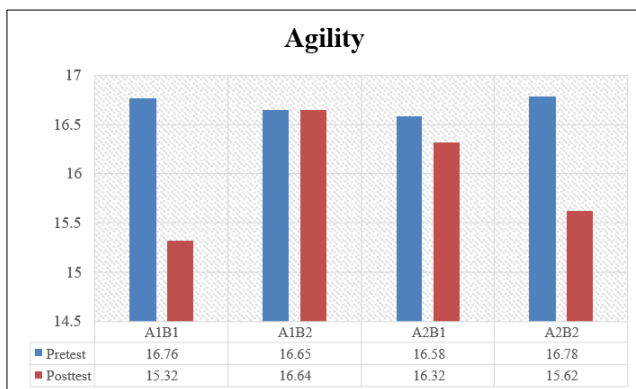


Fig. 1. Bar chart pretest and posttest agility

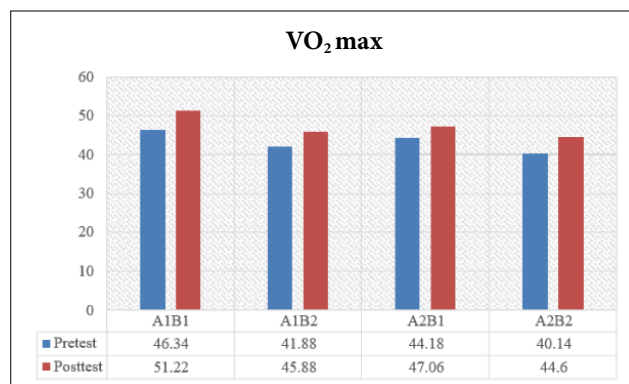


Fig. 2. Bar chart pretest and posttest VO₂ max

15.97; the difference between the two is 0.01. Due to the small findings from the analysis of the observed differences, it can be concluded that both circuit training and interval training increase the agility of Porprov football players in Pati Regency.

While the findings of data analysis on VO₂ max capacity show that circuit training produces an average value of 48.55, interval training produces an average value of 45.83 resulting in a difference of 2.72. Based on the difference value of 2.72 obtained from the results of the analysis, it can be concluded that both circuit training and interval training increase the VO₂max of Porprov football players in Pati Regency.

The findings of previous research (Sumerta et al., 2021) show that giving circuit training can increase the body agility of soccer players. Adoption of circuit model training can greatly increase agility (Chaudhary & Jadon, 2017). In this study it was shown that the application of circuit training and interval training can increase the agility of Porprov players in Pati Regency in accordance with the findings of previous studies. According to previous research on VO₂max capacity (Yunus & Raharjo, 2022) every player must have a good physical condition to play optimally. Maximum oxygen volume (VO₂max both circuit training and interval training increase VO₂max. However, circuit training is more effective than interval training in increasing VO₂max (Kachayut & Prachanban, 2020) Circuit training and interval training increase VO₂max efficiently. Circuit training is more useful than interval training to increase VO₂max football players in Porprov Pati Regency, according to the results of this study and previous studies.

Differences in Effect Between High Leg Muscle Endurance and Low Leg Muscle Endurance on Agility and VO₂max Football Players Porprov Pati Regency

Research on agility abilities revealed that there was a significant difference between high leg muscle endurance and low leg muscle endurance on the agility of Porprov soccer players in Pati Regency. The null hypothesis (H₀) can be rejected based on an F value of 6,607 and a significance value of 0.021<0.05 obtained from the results of SPSS data analysis.

In conclusion, there is a significant difference in the endurance of high and low leg muscles on the agility of the Porprov football players in Pati Regency. While the VO₂max capacity shows a significant difference between high leg muscle endurance and low leg muscle endurance compared to the VO₂max of Porprov players in Pati Regency, this difference is not statistically significant. Based on the F value of 15.981 and a significance value of 0.001<0.05, it can be concluded that the null hypothesis H₀ is rejected.

Previous research results (Prakoso & Sugiyanto, 2017; Adhi et al., 2017; Hidayat, 2021) claims that the results of athletes with high and low leg muscle endurance are drastically different. Karyono (2016), Yachsie (2021), Prakoso, (2016) states that athletes with high leg muscle endurance are more developed than those with poor muscle endurance. According to this study, the agility and VO₂max of soccer players with high and low leg muscle endurance are different.

Based on the analysis, players with high leg muscle endurance have an average score of 49.14, while players with low leg muscle endurance have an average score of 45.25 with a difference of 3.9. Because the difference is large, it can be concluded that there is a significant difference between VO₂max football players at Porprov Pati Regency with high and low leg muscle endurance.

Interaction Between Circuit Training, Interval Training and Leg Muscle Endurance (High and Low) Against Agility and VO₂max Football Players Porprov Pati Regency

Substantial interactions between circuit training, interval training, and leg muscle endurance (high and low) affect the agility of Porprov football players in Pati Regency, according to an analysis of agility ability study data.

Based on the findings of previous studies (Hidayat, 2021; Karyono, 2016) the researchers came to the conclusion that the two ways athletes were trained had a major effect on their agility. And from what we know (Prakoso, 2016) mengemukakan bahwa hasil VO₂ max yang diperoleh dari metode latihan yang diterapkan tidak saling berinteraksi.

Shows that the VO₂max results from different training methods do not affect each other. In line with this study, the results of the form of factor interaction between paired groups showed a relationship between the players' quick movement abilities and each group. Groups that interact with each other in real life include the following:

1. A group of players who do circuit training with low muscle endurance have better agility than players who do circuit training with high leg muscle endurance, with a significance value of 0.000<0.05.
2. The group of players who were trained with interval training had better leg muscle endurance compared to the group of players who were trained with circuit training. This is indicated by a significance value of 0.000<0.05.

3. The group of players who did circuit training and had low leg endurance was better in agility than the group of players who did interval training and had low leg endurance, with a significance value of 0.005<0.05.
4. The group of players who did interval training and low leg endurance was better than the group who did interval training and high leg endurance, with a significance value of 0.005<0.05.
5. The results of analysis of VO₂max capacity data show that there is no significant difference between circuit training, interval training, and leg muscle endurance (high and low) in Porprov football players in Pati Regency with VO₂max.

Conclusions

Regarding the results of the research above, from the results of data analysis that has been carried out by researchers, there are the following conclusions:

- There is no significant effect of the method circuit and interval training on the agility and VO₂max of Porprov Soccer players in Pati Regency, Methods circuit and interval training have different effects significant against VO₂max football players Porprov Pati Regency.
- There is a significant difference between the endurance of high and low leg muscles on the agility and VO₂max of Porprov football players in Pati Regency.
- There is interaction between Interaction Between Circuit Training, Interval Training and Leg Muscle Endurance (High and Low) Against the Agility of Porprov Soccer Players in Pati Regency. Meanwhile between circuit training, interval training and leg muscle endurance (high and low) there was no interaction with the VO₂max of Porprov football players in Pati Regency.

The agility interaction pairs between the factors as follows:

- Method-trained group of players circuit training with low muscle endurance better than the group of players trained by the method circuit training with high leg muscle endurance to agility, with a significance value of 0.000 <0.05.
- Method-trained group of players interval training and had better leg muscle endurance than the group of players trained by the method circuit training and has high leg muscle endurance to agility, with a significance value of 0.000 <0.05.
- Method-trained group of players circuit training with low leg muscle endurance better than the group of players trained by the method interval training and has low leg muscle endurance to agility, with a significance value of 0.005 <0.05.
- Method-trained group of players interval training with low leg muscle endurance better than the group trained by the method interval training and has high leg muscle endurance, with a significance value of 0.005 <0.05.

Conflict of Interest

The authors declare that there is no conflict of interest.

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ВПЛИВ МЕТОДІВ КОЛОВОГО ТА ІНТЕРВАЛЬНОГО ТРЕНУВАНЬ НА СПРИТНІСТЬ ТА VO_{2max} ФУТБОЛІСТІВ-УЧАСНИКІВ ЧЕМПІОНАТУ ПОРПРОВ У РЕГЕНТСТВІ ПАТІ (ІНДОНЕЗІЯ) ЗА ПОКАЗНИКАМИ ВИТРИВАЛОСТІ М'ЯЗІВ НІГ

Ахмад Бадаві^{1ABCDE}, Ахмад Насруллох^{1ABCD}

¹Джок'якартський державний університет

Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 6 с., 3 табл., 2 рис., 21 джерело.

Метою цього дослідження було визначити: (1) вплив методів колового та інтервального тренувань на спритність та МСК (VO_{2max}); (2) різницю у впливі високої витривалості м'язів ніг і низької витривалості м'язів ніг на спритність та МСК (VO_{2max}); (3) взаємовплив колового тренування, інтервального тренування та витривалості м'язів ніг (високої та низької) на спритність та МСК (VO_{2max}).

Матеріали та методи. Це дослідження є факторним експериментом, спланованим за схемою 2×2. Чисельність вибірки в цьому дослідженні становила 20 гравців, відібраних методом цільової вибірки. Для вимірювання спритності використовували Іллінойський тест на спритність, показник МСК (VO_{2max}) вимірювали за допомогою багатоетапного тесту фізичної підготовленості, а для вимірювання витривалості м'язів ніг використовували тест на присідання біля стіни. Для аналізу даних використовували двофакторний дисперсійний аналіз за рівня значущості $\alpha < 0,05$.

Результати. Результати цього дослідження є наступними: (1) різниці у впливі методів колового та інтервального тренувань на спритність футболістів не спостерігається, спостерігаються статистично значущі відмінності між методами колового та інтервального тренувань у впливі на показники МСК (VO_{2max}) футболістів; (2) спостерігається статистично значуща різниця між високою та низькою витривалістю м'язів ніг у впливі на спритність та МСК (VO_{2max}), $\alpha < 0,05$; (3) спостерігається взаємовплив колового тренування, інтервального тренування та витривалості м'язів ніг (високої та низької) на спритність, $\alpha < 0,05$.

Висновки. Існує взаємовплив колового тренування, інтервального тренування та витривалості м'язів ніг (високої та низької) на спритність футболістів-учасників чемпіонату Порпров у регентстві Паті (Індонезія). Тоді як взаємовплив колового тренування, інтервального тренування та витривалості м'язів ніг (високої та низької) на МСК (VO_{2max}) футболістів-учасників чемпіонату Порпров у регентстві Паті (Індонезія) відсутній.

Ключові слова: колове тренування, інтервальне тренування, спритність, максимальне споживання кисню (VO_{2max}), футбол.

Information about the authors:

Badawi, Ahmad: badawiahmad904@gmail.com; Universitas Negeri Yogyakarta, Jl. Colombo Yogyakarta No.1, Karang Malang, Caturtunggal, Kec. Depok, Kabupaten Sleman, Daerah Istimewa Yogyakarta 55281, Indonesia.

Nasrulloh, Ahmad: ahmadnasrulloh@uny.ac.id; <https://orcid.org/0000-0003-2859-7091>; Department of Sports Science, Universitas Negeri Yogyakarta, Jl. Colombo Yogyakarta No.1, Karang Malang, Caturtunggal, Kec. Depok, Kabupaten Sleman, Daerah Istimewa Yogyakarta 55281, Indonesia.

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