



Improves VO₂max: Hiit Vs Rst In Elite Players Of Persema Malang

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Abstract

HIIT and RST crucial to soccer performance, particularly when it comes to sustaining high-intensity efforts during the game. however, their effects on players remain unexplored, especially with regard to which maximum aerobic capacity (VO₂max) is better between two method. An experimental research design was used in this study. Design of pre-test and post-test control groups, with 20 PERSEMA Malang players with a similar age range of 21 years. Group A was given HIIT Training and Group B RST Training, each group consisted of 10 samples research, and experimental for six weeks of instruction. Results of the study of the two groups between pretests and posttests showed that both groups had a significance of 0.00 which showed $< P = 0.05$, However, the outcomes of the ANOVA difference test showed that the value was 0.044 ($> P = 0.05$). This research can be inferred that there is a notable distinction between pretest and posttest on HIIT and RST training methods in increasing VO₂max of Persema Malang players.

Keywords: *VO₂Max, HIIT, RST*

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INTRODUCTION

Most popular sport in the world is soccer by demanding skill, mental and physical abilities of players. Physical soccer players are required to have high endurance with medium-high intensity for 90 minutes in normal time, the endurance ability of soccer players can be measured by VO₂max (Maximal Oxygen Uptake). VO₂max is a parameter of physical performance in the endurance soccer players, especially in Persema Malang. However, after the competition holiday, the athlete's physical condition will decrease again so that a proper and fast training program is needed that can raise the soccer players' VO₂max to navigate upcoming competition. So that this becomes a problem for the coach in determining the appropriate program in improving the athlete's performance again, especially in VO₂max for Persema Malang football athletes.

High Volume Low-Intensity Training (HVLIT), continuous training, moderate-intensity continuous training, high-intensity continuous running, sprint-interval training (SIT), repeated-sprint training (RST), and the most well-liked high-intensity interval training (HIIT)

are some of the training programs available for soccer that increase VO₂max. Generally, the higher the VO₂max (VO₂peak), the better the soccer athlete's aerobic system. But is only the HIIT method the most suitable and positive in increasing the VO₂max of soccer players or are there other training methods / programs that can raise the soccer players' VO₂max. This is still a debate, as in research (Avar et al., 2019) by comparing HIIT training with Moderate Continuous Training for 6 weeks that Moderate Continuous Training can improve better in athletes' aerobic abilities compared to HIIT which tends to be good at anaerobic systems. However, other studies explain that HIIT and CIET programs may raise VO₂, or peak oxygen consumption. with the advantage of HIIT being slightly superior to CIET (Runacres et al., 2019). In addition, research by Uber & Eat, (2010) soccer players with an average age of 21 who engage in endurance training and SIT to raise their VO₂max, with SIT training will increase VO₂max faster than endurance training. So that based on several different opinions, according to earlier research, it is still up for debate which training model is quicker and more efficient at raising soccer players' VO₂max.

HIIT is characterized by program training with intensities up to >Low-intensity activity intervals alternate with intervals of 90% of HRpeak (Menz et al., 2019), and the small sided games model of HIIT in soccer athletes, the program shows enormous potential to enhance specific endurance-related skills of soccer players (Santos, 2021). This HIIT training will enhance important factors linked to soccer success, for example, VO₂peak/VO₂max and maximal running performance (e.g., fast ball return sprints) as well as performance related to distance traveled, how many times a player makes contact with the ball and how many times they run or sprint during a game (Kunz et al., 2019). The model and length of training periods and rest intervals can be adjusted according to needs whether using SSG, RIT, short term/long term HIIT (Clemente et al., 2021). Based on published theories that the HIIT method is very good at increasing VO₂max depending on the training model to be used, but not only HIIT is often used in training to increase VO₂max but also other training models, namely RST.

Series of short sprints (3-7 seconds in duration), punctuated by a short recovery period (<60 seconds)" is the definition of repeated-sprint training (RST). RST is a sophisticated training approach that focuses on improving metabolic function (i.e., recovery in between efforts) and neuromuscular function (i.e., single sprint performance), or both at once. RST can be divided into two namely short term RST (2-5 weeks of training) and long term RST (6-10 weeks). RST also suits soccer athletes because it is effective strategy to simultaneously improve various measures athlete performance relevant to the needs of a soccer team such as running speed, explosive power, high-intensity running performance, and repeated sprint

ability (RSA). All of these parameters exist in the sport of soccer. RST is usually done with distance and reps (15-20 reps) with several sets (2-5 sets) depending on whether using long term or short term. As in research (Iaia et al., 2017) using short term RST can significantly increase VO_{2max} in young soccer players. In addition (Kargarfard et al., 2020) explains that with RST combined with plyometric training can help soccer players increase maximum oxygen uptake (VO_{2max}). so the RST training model also includes a training model that can increase VO_{2max} in soccer players.

Based on background that has been described, researcher aims to compare HIIT with RST in increasing maximal oxygen uptake (VO_{2max}) in Persema Malang soccer players. which training model is more efficient at increasing VO_{2max} . both results of these methods will be able to become a reference for coaches and soccer players to increase VO_{2max} .

METHOD

This study compares and evaluates effects of HIIT and RST training on raising VO_{2max} in soccer players using an experimental research design that includes a pre-test, post-test, and control group design. Sample withdrawal in this study used stratified random sampling with paired matching technique with 20 PERSEMA Malang players with almost same age range of 21 years. Before group division will be pretested to determine division of groups A and B because it uses paired matching techniques. So that the average VO_{2max} of players will be balanced between groups A and B, group A (HIIT Training) and Group B (RST Training), each group consists of 10 group A players and 10 group B players.

Study it will be conducted for 6 weeks to determine effectiveness of HIIT and RST on increasing VO_{2max} in soccer players. This study was conducted before competition began and included: 1) Pretest testing, 2) 6-week intervention training period, and 3) Posttest testing. The procedure for determining the VO_{2max} value of soccer players by doing bleep test. Group A (HIIT Training) and Group B (RST Training) were intervened for 6 weeks before competition began. Furthermore, data analysis will be carried out.

Results data obtained were analyzed with SPSS 25 starting from descriptive statistics followed by paired sample t-test and ANOVA difference test. This is to determine the effect of pretest and posttest values and differences in HIIT and RST training interventions in increasing VO_{2max} in soccer players.

RESULTS AND DISCUSSION

Result

Table 1 displays the findings of a descriptive analysis of how HIIT (High-Intensity Interval Training) and RST (Repeated-Sprint Training) affected Persema Malang players' VO_{2max} .

Table 1. Results of Descriptive Analysis of the effect of HIIT (High-Intensity Interval Training) and RST (Repeated-sprint training)

No	Variabel	Kelompok	A	B	A	B
			Pretest	Pretest	Posttest	Posttest
1	IMT	Mean	20,9	20,66	21,8	20,9
		Min	19,5	19,72	19,8	19,6
		Max	21,9	21,63	21,8	21,9
2	VO_{2max}	Mean	42,89	42,72	46,96	48,15
		Min	38,8	39,2	43,6	43,3
		Max	48,9	50,1	51,4	54,5

Description:

A : HIIT group

B: RST group

Based on descriptive analysis of IMT and VO_{2max} with mean IMT Groups A and B are close to same with an average value of IMT group A (HIIT) of 20.9 and group B (RST) with a value of 66 for pretest, while after treatment there is a change in IMT with group A 21.8 and group B 20.9. And for VO_{2max} variable for average pretest value of group A (HIIT) is 42.89 and group 42.72, this indicates that VO_{2max} value before treatment of the two groups is balanced and category is sufficient. Furthermore, posttest after treatment there was higher group with group A in terms of average VO_{2max} value, HIIT value was 46.96 group A and group B 48.15 and both groups were in good category. Descriptive analysis value of VO_{2max} can be seen in Figure 1 graph.

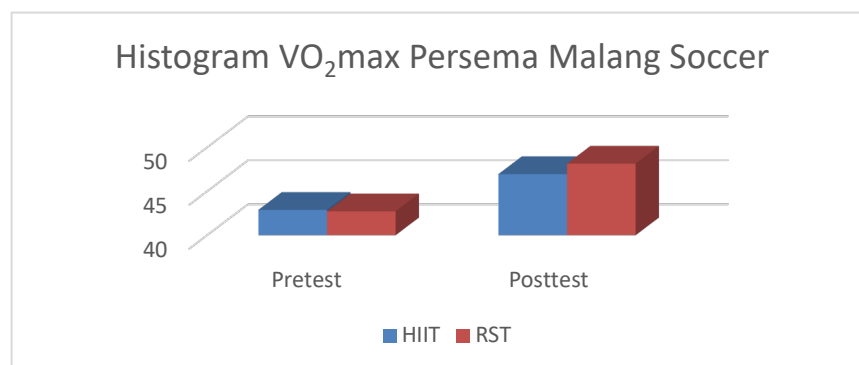


Figure 1. Histogram VO_{2max} Variable of 20 Persema Malang Soccer Players.

Table 2. Results of Pretest and Posttest Difference Tests

No.	Group	N	Sig.	Description
1	HIIT	10	0,000	P<0,05
2	RST	10	0,000	P<0,05

Table 2's paired sample t-test findings show that significance value for both groups is 0.000 ($P < 0.05$) so it can be concluded that there are differences before pretest and posttest HIIT group and RST group for 6 weeks of treatment. Then proceed to ANOVA difference test to determine whether there is a difference in significance value between HIIT group and RST group with significance ($p < \alpha = 0.05$), can be seen in table 3.

Tabel 3. ANOVA Test Result

	Sum Of Square	df	Mean Square	F	Sig.	Keterangan
<i>Between Group</i>	7,081	1	7,081	0,611	0,44	P>0,05
<i>Within Groups</i>	208,549	18	11,5			
<i>Total</i>	215.630	19				

Table 3's anova difference test results indicate that there is a 0.44 significant level between HIIT and RST groups ($P>0.05$). This means that there is no difference between HIIT group and RST on increasing VO_2max in Persema Malang players.

Discussion

Effect of HIIT on Increasing VO_2max in Persema Malang Players

According to table 2, paired sample t-test analysis revealed that the HIIT (High-Intensity Interval Training) training technique treatment was responsible for a significant difference between pretest and posttest, with a significance value of 0.00 ($P < 0.05$) on soccer players. This same as previous research by With a value of $t_{count} > t_{table} = 2.17 > 1.796$, the results indicated a substantial difference between two training approaches, with interval training being more successful. Therefore, it can be said that interval training increases soccer players' VO_2max more effectively than control group (Bahtra et al., 2023). Another study (Michailidis et al., 2022) performance two groups was significantly Therefore, it can be said that interval training increases soccer players' VO_2max more effectively than control group. Short-term HIIT workouts can enhance maximal oxygen uptake performance, according to one study. and previously conducted research on soccer players with a total of 176 that using HIIT demonstrated advantage over traditional training techniques in raising VO_2max , which helps soccer players' aerobic capacity (Ma et al., 2023). Difference in value can be influenced by an

increase in maximum aerobic capacity from an average of only 42.89 at pretest after being given a HIIT/posttest training intervention to 46.96.

Increase in maximum aerobic capacity (VO_{2max}) due to HIIT may be influenced by possibility that HIIT increases cardiac output, thereby increasing VO_{2max} . found (Wang et al., 2023) that improving cardiac function requires reaching and sustaining a high filling pressure in the heart; hence, it is crucial for soccer players to exercise at their maximal cardiac output per second. . According to other research, when HIIT is performed prior to tiredness, heart's cardiac output peaks during exercise in around one, two, or four minutes (Guo et al., 2023). (MacPherson et al., 2011) discovered that despite a 12% increase in VO_{2max} following a 6-week sprint interval training program, maximum cardiac output remained unchanged. Crucially, HIIT promotes the recruitment of glycolytic muscle fibers and fast oxidation, both of which enhance muscle contraction capacity, and modifications in muscle contractility raise venous blood flow and sustain cardiac output. Furthermore, altering kind of exercise, its level of intensity, and amount of time spent recovering between sessions can all aid in increasing cardiac output (Runacres et al., 2019). Consequently, it can be said that HIIT is effective in raising soccer players' maximal aerobic capacity.

Effect of RST on Increasing VO_{2max} Persema Malang Players

Results of data analysis in table 2 show that in group B, namely RST (Repeated-sprint training) treatment shows a significances vale 0.00 (<0.05) indicating that There is a notable distinction between pre/pretest and post/posttest due to RST (Repeated-sprint training) treatment on soccer players Persema Malang. This is consistent with earlier studies by (Osses-Rivera et al., 2024) RST was used in experimental group to raise VO_{2max} of soccer players, and best time, average time, and total time showed significant pretest and posttest improvements. Other research RST can improve speed, running performance, VO_{2max} is useful for increasing physical fitness and physiological adaptability in trained athletes who complete three sets of six x 30 m sprints with two sessions each week for six weeks (Shaun et al., 2024). this is also reinforced According to earlier studies, doing RST considerably enhances physical performance measures, particularly for defenders and attackers. These results highlight how crucial position specialization is in training regimens to maximize soccer play (Gupta et al., 2025).

Increase in VO_{2max} induced by Because muscle has a stronger oxidative processing capacity (i.e., a greater arterial-venous oxygen difference), RST is more likely to result from an enhanced ability to extract and utilize oxygen (Shaun et al., 2024). The RST group's

increased VO₂max indicates that better oxygen transport and metabolic efficiency are basis for RST's cardiovascular effects (Helgerud et al., 2023) which occurs because during high-intensity exercise, oxygen is required more quickly and efficiently. With RST that continuously sprints a certain distance and several sets can affect body's metabolism, especially in heart and muscles because body has adapted to intensity of RST given during treatment. In addition, according to (MacPherson et al., 2011) this increase can be associated involves physiological changes such improved mitochondrial activity, lactate clearance, and phosphocreatine resynthesis. Since forwards and defenders are subjected to higher aerobic and anaerobic demands, these systems allow for prolonged performance and effective recovery (Michailidis et al., 2022). Therefore, RST is also very potential needs of coaches to improve performance, especially VO₂max variable of Persema Malang players.

HIIT Vs RST Toward Increasing VO₂max Persema Malang Players

Based on ANOVA test results in table 3, it is known that difference test value is 0.44, which means $P < 0.05$, showing that HIIT and RST groups did not significantly vary in their ability to raise Persema Malang players' VO₂max. However, According to the findings of a separate sample t test, both groups' pretest and posttest values considerably rose, which indicates that both methods are very suitable to be applied in increasing the maximum aerobic capacity of soccer players, especially in poor Persema players. this is in accordance with previous research by (Morais et al., 2025) it seems that RST is combined with maximum aerobic capacity of soccer players. It seems that RST combined with intervals is a more efficient training method for enhancing metabolic response VO₂max ability of athletes. Other research using the RST training method with a 20-30 s sprint time can increase VO₂max of athletes to the maximum (Nalçakan et al., 2018). Another study using RST with interval training method from pre-test to post-test using technique in a 40-meter sprint maximum (20.06 s) for 26 weeks showed significant results in increasing maximum oxygen uptake of young soccer athletes (Tønnessen et al., 2011). This shows that both RST and HIIT methods are suitable in increasing maximum oxygen content of soccer players.

VO₂max increase can be influenced during training both groups do interval method with 6 sets with a ratio of 3: 1 and continue to change intensity during weeks 1-6 to keep doing the training protocol so that the body will physiologically adapt to the training given so that physically player's cardiac output increases, cardiac output increases, heart and muscle metabolism improves so that VO₂max soccer players can increase. After a period of exercise RST will increase blood lactate concentrations can increase with intense exercise, which is

explained by an increase in glycolytic enzymes and muscle buffering capacity and RST can also increase anaerobic and aerobic capacity. This is because repeat sprint training is a crucial fitness need that involves having the capacity to recover rapidly so that one can undertake the subsequent sprint. To develop sprinting ability and VO₂max, Athletes and coaches frequently employ training techniques that entail doing brief sprints at maximal effort for varied lengths of time, punctuated by either lengthy or brief rest intervals. So it can be said that by doing repeated sprints and interval intensity can affect performance of athletes, especially in VO₂max soccer players. So it can be underlined that the RST and HIIT methods are very suitable for increasing the VO₂max of Persema Malang players in the competition.

CONCLUSION

According to the research findings presented, it can be inferred that Persema Malang players' maximal aerobic capacity (VO₂max) can be raised by both the HIIT (High-Intensity Interval Training) and RST (Repeated-Sprint Training) methods.

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