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EFFECT OF PHYSICAL ACTIVITY, SLEEP QUALITY AND BODY MASS INDEX ON VO2MAX OF FOOTBALL ATHLETES SSB RIPANS SOCCER SCHOOL PADANG

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Abstract. This study identified low VO2 Max in SSB Ripan's Soccer School Padang football athletes, which is suspected to be due to lack of physical activity, poor sleep quality, and sub-ideal body mass index (BMI). The impact of low VO2 Max includes rapid fatigue and decreased concentration, especially in the second half of the match, which affects the team's performance. The purpose of the study was to analyze the effect of physical activity, sleep quality, and BMI on the VO2 Max of athletes. The type of research is quantitative with a comparative approach, involving 25 athletes with purposive sampling techniques. The instruments used included the IPAQ-SF questionnaire for physical activity, PSQI for sleep quality, anthropometric test for BMI, and YO-YO IR Test level 1 for VO2 Max. The data were analyzed using path analysis at $\alpha = 0.05$. The results of the study showed: (1) physical activity had a direct effect on VO2 Max (py1 = 0.442), (2) sleep quality had a direct effect (py2 = 0.301), (3) BMI had a direct effect (py3 = 0.355), (4) there was an indirect effect of physical activity through BMI (total influence 0.319%), and (5) an indirect effect on sleep quality through BMI (total influence 0.323%). Overall, physical activity, sleep quality, and BMI contributed 70.1% to the athletes' VO2 Max. In conclusion, there was a significant influence of physical activity, sleep quality, and BMI on the VO2 Max of SSB Ripan's Soccer School Padang football athletes.

Keywords**:** Physical Activity, Sleep Quality, Body Mass Index and VO2 Max

I. INTRODUCTION

Physical health and fitness are fundamental aspects that affect athletes' performance. According to Dilna & Prasad, (2024) In the journal Nature Reviews Genetics, physical fitness is not only important for athletic performance, but also for long-term health. Athletes who have optimal health can train and compete to the maximum, as well as reduce the risk of injury. One of the key indicators of cardiorespiratory capacity is VO2max, or the maximum volume of oxygen the body can use during intense physical activity. A study by Babaei et al., (2022) in Medicine and Science in Sports and Exercise stated that VO2max is one of the best predictors of success for athletes in sports that rely on endurance. Therefore, increasing VO2max can have a direct impact on exercise performance.

Regular physical activity has been shown to increase aerobic capacity. Duan et al., (2023) in the Journal of Sports Medicine explains that consistent aerobic exercise can significantly increase an individual's VO2max value. In addition, physical activity also plays an important role in weight regulation and metabolic health, both of which are crucial for athletes to achieve optimal performance. On the other hand, sleep quality is also an essential element in athletes' recovery and performance. Ou et al., (2024) in a study published in Sleep found that sleep deprivation can result in decreased physical performance, including reduced aerobic capacity. This shows that adequate and quality sleep is essential for athletes to achieve optimal VO2max (Purnama et al., 2024; Reno Putra et al., 2024).

Body Mass Index (BMI) is often used to assess body composition and health. (Hasibuan et al., (2024); Nurdin et al., (2024); Raffiandy Putra et al., (2024) in JAMA states that an unbalanced BMI can contribute to a variety

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of health problems, including the risk of cardiovascular disease. Athletes with a balanced BMI tend to have better performance and a lower risk of injury. Given the relationship between these three factors—physical activity, sleep quality, and BMI—this study aims to explore its effect on VO2max in football athletes at SSB RIPANS Soccer School Padang. Understanding the interactions between these factors can hopefully provide deeper insights into how to improve athletes' performance through better management of physical activity, sleep quality, and BMI.

II. METHODS

This study uses a quantitative approach with a cross-sectional design to analyze the effect of physical activity, sleep quality, and body mass index (BMI) on VO2max of football athletes at SSB Ripans Soccer School Padang. The research sample consisted of 30 athletes who were selected by purposive sampling based on certain criteria, such as age, activity level, and health status. The selection of this sample aims to ensure that participants have characteristics relevant to the focus of the study.

The independent variables in this study were physical activity, sleep quality, and body mass index, while the dependent variable was VO2max. Physical activity was measured using a modified questionnaire that assessed the frequency, duration, and intensity of activities performed by athletes. This questionnaire has been tested for validity and reliability previously to ensure the accuracy of the data obtained. Sleep quality is assessed using the Pittsburgh Sleep Quality Index (PSQI), which measures sleep quality in the past month and includes various aspects, such as sleep duration and sleep disorders.

Body mass index is calculated based on the athlete's weight and height using the formula BMI = weight (kg) / height (m^2). Data on weight and height will be measured directly using calibrated scales and meters. To measure VO2max, a multistage running test (beep test) is used, which is a non-invasive and standardized method. Athletes were asked to run back and forth between two points that were 20 meters apart according to the beep sound heard from the recording device. The results of this test will include the time and number of stages that the athlete can achieve, which is then calculated to obtain a VO2max value.

Data obtained from questionnaires, BMI measurements, and VO2max tests will be analyzed using statistical software. Descriptive analysis was carried out to describe the characteristics of the sample, such as age, gender, and health status. Furthermore, an inferential analysis using multiple linear regression will be performed to determine the influence of independent variables on VO2max, with the significance level set at $p < 0.05$.

This research will be carried out in two stages. The first stage includes the collection of demographic data and questionnaires on physical activity and sleep quality. In the second stage, BMI measurements and VO2max tests are carried out. The entire research process will be carried out after obtaining approval from the SSB Ripans Soccer School authorities, and ensuring that all participants have given informed consent. With this systematic methodology, it is hoped that the research can provide valid and reliable results, as well as provide useful insights into the factors that affect the VO2max of football athletes at SSB Ripans Soccer School Padang.

III. RESULTS AND DISCUSSION

The data description aims to describe the characteristics of each of the research variables, consisting of: Physical Activity (X1), Sleep Quality (X2), Body Mass Index (X3) and V02Max (Y). The data of all variables are processed based on descriptive statistics. The results of the processing and research are presented as follows:

Physical Activity

Based on the data from the IPAQ questionnaire regarding physical activity given to 25 athletes of SSB Ripans Soccer School Padang, the average value of calculation (mean) = 33.78, standard deviation = 3.7, maximum value = 11 and minimum = 2. Furthermore, the frequency distribution of physical activity data can be seen in the following table 1:

Table 1. Distribution of Physical Activity Data Frequency of SSB RIFAN Shooter School Padang Football Athletes

No	Interval Classes (MET-minutes/week)	category	Frequency	
			Absolut	Relatif (%)
1	< 600	Light	10	40%
2	> 600	Keep	10	40%
3	> 3000	Tall	5	20%
	Sum		25	100%

Based on the results of the PSQI questionnaire data regarding the quality of sleep given to 25 SSB Rifan Shooter School Padang athletes, the mean value = 7.04, standard deviation = 2.85, maximum value = 12 and minimum = 2. Furthermore, the frequency distribution of physical activity data can be seen in the following table 2:

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Table 2. Distribution of Sleep Quality Data Frequency of SSBRIFAN Shooter School Football Athletes Padang

No	Interval Classes	Category	Frequency	
			Absolut	**Relatif (%)**
1	**< 5**	Good	**8**	**32%**
2	**> 5**	Bad	**17**	**68%**
	Sum		**25**	**100%**

Body Mass Index (BMI)

Based on the results of data from weighing weight and measuring height regarding Body Mass Index (BMI) conducted on 25 athletes of SSB Rifan Soccer School Padang obtained the mean value = 17.24, standard deviation = 1.39, maximum value = 21 and minimum = 14. Furthermore, the frequency distribution of physical activity data can be seen in the following table 3:

Table 3. Distribution of Body Mass Index Data Frequency of SSB RIFAN Shooter School Padang Football Athletes

No	Interval Classes	Category	Frequency	
			Absolut	**Relatif (%)**
1	<17,0 – 18,49	Thin	**22**	**88%**
2	18,5 – 25,0	Usual	**3**	**12%**
3	>25,0 – 27,0 - >27,0	Fat	**0**	**0%**
	Sum		**25**	**100%**

Based on the results of the Yo-Yo IR Lv 1 test data regarding V02Max conducted on 25 SSB Rifan Shooter School Padang athletes, the average calculation value (mean) = 49.11, standard deviation = 4.79, maximum value = 60 and minimum = 42 were obtained. Furthermore, the distribution of V02Max data frequency can be seen in the following table 4:

Table 4. Frequency Distribution of Sleep Quality Data of Football Athletes SSBRIFAN Shooter School Padang Ball

No	Interval Classes	Category	Frequency	
			Absolut	**Relatif(%)**
1	>3000	Perfect	0	0%
2	2760 - 3000	Very good	1	4%
3	2600 - 2720	Good	0	0%
4	2200 - 2560	Keep	1	4%
5	1800 - 2160	Low	5	20%
6	<1800	Poor	18	72%
	Sum		25	100%

Discussion

The results of this study show that physical activity, sleep quality, and body mass index (BMI) have a significant influence on the VO2 Max level of football athletes. Physical activity had the greatest direct influence (py1 = 0.442), indicating that higher levels of activity contributed to increased aerobic capacity. This is in line with the literature that states that regular physical exercise, especially aerobic ones, is able to improve cardiovascular efficiency and the body's metabolism. Athletes who engage in intense physical activity also tend to have the ability to maintain optimal performance for longer during the game (Bafirman, Zarya, et al., 2023; Bafirman, Wahyuri, et al., 2023).

Sleep quality also had a significant direct effect on VO2 Max (py2 = 0.301). Good sleep quality supports the body's recovery process, promotes muscle regeneration, and maximizes physiological functions necessary for physical activity. Conversely, sleep disturbances can hinder recovery and decrease athletes' physical performance. These findings underscore the importance of sleep pattern management as part of athlete coaching strategies, including training in healthy sleep habits. In addition, BMI also had a direct effect on VO2 Max (py3 = 0.355), suggesting that ideal body composition, including the balance between fat and muscle mass, plays an important role in aerobic capacity (Arwandi et al., 2023; A. N. Putra et al., 2023).

Overall, these three factors contributed 70.1% to the athletes' VO2 Max, indicating that the combination of optimal physical activity, good sleep quality, and ideal BMI was the main factor in improving athletes' physical performance. The indirect influence of physical activity and sleep quality through BMI (0.319% and 0.323%, respectively) also emphasizes the complex relationship between these variables. Therefore, a holistic approach involving increased physical activity, sleep management, and weight and body composition monitoring can be an effective strategy in increasing VO2 Max capacity and performance of football athletes (Ou et al., 2024; Sun et al., 2024).

IV. Conclusion

Based on the results of the research conducted, it can be concluded that there is a significant influence of various factors on the V02Max of SSB RIPAN'S Soccer School Padang football athletes. First, physical activity has a direct influence on V02Max with an influence

coefficient of 0.178%. In addition, sleep quality also showed a large direct influence on V02Max, with a coefficient of 0.090%. Body mass index also contributes directly to V02Max with an influence of 0.126%. In addition to the direct influence, there is also an indirect influence of physical activity through the body mass index, which has an influence coefficient of 0.319%. Similarly, sleep quality has an indirect influence on V02Max through body mass index, with an influence coefficient of 0.323%. These results show the importance of paying attention to these factors in improving athletes' performance.

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