International Journal of Clinical Science and Medical Research

ISSN(print): 2770-5803, ISSN(online): 2770-582X

Volume 05 Issue 08 August 2025

DOI: https://doi.org/10.55677/IJCSMR/V5I8-02/2025, Impact Factor: 8.005

Page No : 187-197

The Relationship Between Fat Percentage and Muscle Mass with Concentric and Eccentric Endurance of Limb Muscles of Football UKM Members of Hasanuddin University

Ambar Widyasari Maharani[1*], Irianto[2]

[1]Physiotherapy Study Program, Faculty of Nursing, Hasnuddin University - Jl. Perintis Kemerdekaan Km.10, Kec. Tamalanrea, Makassar City, Indonesia

[2]Physiotherapy Study Program, Faculty of Nursing, Hasnuddin University - Jl. Perintis Kemerdekaan Km.10, Kec. Tamalanrea, Makassar City, Indonesia

ABSTRACT

Soccer was including an high-intensity game that lasts for 2x45 minutes in an intermittent manner (Jarkasih and Fardi, 2020) which consists of walking to sprinting activities. Leg muscle endurance is the main and most dominant component in soccer games with a long duration of play (Prayoga et al., 2023). Excess body weight characterized by a high percentage of fat and muscle mass can affect muscular endurance performance. So that researchers are interested in seeing the relationship between the percentage of fat and muscle mass with concentric and eccentric endurance of leg muscles. The purpose of this study was to determine the relationship between the percentage of fat and muscle mass with concentric and eccentric endurance of leg muscles of UKM Football members of Hasanuddin University. This study is a quantitative analytical study with a cross sectional approach and purposive sampling method with 45 samples that met the inclusion criteria, measuring instruments for fat percentage and muscle mass using a karada scan, concentric endurance using the home step test, and eccentric endurance measured using the nordic hamstring performance test. Of the 45 total respondents, the research results were obtained in the form of an average fat percentage of 12.70%, an average muscle mass percentage of 36.94%, concentric endurance of leg muscles using the home step test instrument obtained an average of 113.60%, and eccentric endurance of leg muscles using the Nordic hamstring performance test instrument with an average of 113.60%.

36.47º. The results of the correlation test between variables using somers'd test showed significance (>0.05) which means that there is no relationship between the percentage of fat and muscle mass with concentric and eccentric endurance of the limb muscles of UKM Football members of Hasanuddin University.

Published Online : August 30, 2025

KEYWORDS:

fat percentage; muscle mass percentage; concentric endurance; eccentric endurance; football.

INTRODUCTION

Sports are done with a variety of goals, ranging from just filling spare time, recreation, health, fitness, prestige, or achievement. Sports with the aim of achieving achievement require a detailed and properly measured training process, either individually or in teams (Danu et al., 2023). Improving the performance of an athlete can be realized through improving physical performance. Physical fitness plays a role in supporting an athlete's performance. Leg muscle endurance is the main and most dominant component in physical fitness in soccer games with a fairly long game duration (Prayoga et al., 2023). Muscular endurance is needed to maintain activities that are dominated by the use of muscles or muscle groups. Muscular endurance consists of a combination of physical endurance and general endurance. Thus, muscular endurance means the ability of a skeletal muscle or group of muscles to continue contraction over a long period of time and to recover quickly after fatigue (Prakoso and Sugiyanto, 2017). With good endurance, athlete performance will remain optimal because it has a long time to fatigue (Nugraheningsih

Corresponding Author: Ambar Widyasari Maharani

****Cite this Article: Ambar Widyasari Maharani, Irianto (2025). The Relationship Between Fat Percentage and Muscle Mass with Concentric and Eccentric Endurance of Limb Muscles of Football UKM Members of Hasanuddin University. International Journal of Clinical Science and Medical Research, 5(8), 187-197***

and Saputro, 2019).

Football is a high-intensity game that lasts for 2x45 minutes in an intermittent manner (Jarkasih and Fardi, 2020) which consists of walking to sprinting activities. Soccer games consist of several physical condition components including strenght (strength), power (muscle power), speed (speed), agility (agility), coordination (coordination) and endurance (endurance) which are interconnected with each other (Nidomuddin et al., 2020). Leg muscle endurance is needed by soccer players to perform various repetitive movements. Kicking, running, and jumping movements occur due to concentric contractions of the muscles where the muscles shorten when producing power. These contractions play an important role in performing various dynamic movements performed by soccer athletes.

Assessment of concentric endurance of leg muscles can be done by giving a home step test which aims to monitor the development of the cardiovascular system and athlete's leg muscle endurance (MacKenzie, 2015). Then the eccentric movement commonly performed by soccer athletes is when they sprint and then suddenly slow down or change direction. During this phase, the leg muscles, including the hamstring muscles, undergo eccentric contractions to control and reduce body speed while remaining elongated (Askling et al., 2003; Opar et al., 2015; Schuermans et al., 2017). Assessment of limb muscle eccentric endurance can be done by administering the Nordic hamstring performance test.

An athlete needs a good body composition according to their sport to support skills and performance. The amount of body fat percentage can increase the burden on the body and reduce the efficiency of movement. Body composition is described as the percentage of body parts from the percentage of bone, water, muscle, and fat mass (Avissa et al., 2021). There are three variables used in assessing body composition, namely body mass index, body fat percentage, and muscle mass (Gardasevic et al., 2019; Gardasevic et al., 2020).Body fat percentage is proven to affect the aerobic capacity of professional soccer athletes, this is because excess body fat can result in non-optimal oxygen absorption from working muscles. The lower the percentage of body fat, the better the aerobic capacity. However, this value must remain within the ideal value range of an athlete (Wibowo and Dese, 2019; Shabrina et al., 2022). Athlete performance is also influenced by muscle mass, the higher the muscle mass owned, the stronger the physical performance will be because muscle tissue moves the body frame and consists of cells that produce energy. Based on previous research, the percentage of muscle mass also has a positive correlation with athlete performance (Aikawa et al., 2020) and there is a significant relationship with endurance in the quadriceps muscle (Purwaningtyas et al., 2021). A measuring tool to accurately assess body composition ranging from the percentage of muscle mass and body fat, BMI, and body weight is a karada scan, this tool can provide an overview of body composition using the Bioelectrical Impedance (BI) method (Abdalla and Choo, 2020).

METHODS

This research was conducted on soccer athletes in the Hasanuddin University Football Student Activity Unit (UKM). This research is a quantitative analytic study using a cross sectional approach and purposive sampling method. This study aims to determine the relationship between the percentage of fat and muscle mass with concentric and eccentric endurance of leg muscles in members of UKM Football at Hasanuddin University. The population in this study were 50 members of UKM-SB Unhas. Sampling in accordance with the inclusion and exclusion criteria amounted to45 people. Data collection was done by primary data collection through measurement of fat percentage and muscle mass using karada scan, concentric endurance measured by home step test, and eccentric endurance measured by nordic hamstring performance test.

The data obtained will then be processed using univariate and bivariate analysis. Univariate analysis is used to determine the frequency distribution of each variable. While bivariate analysis is processed using the somers'd test to determine the relationship between variables through the Statistical Product and Service (SPSS) 23 computer program. In this study, respondents were protected from all research processes by applying a research code of ethics that respects individuals, is beneficial, and is fair in accordance with the approval recommendation from the research ethics commission of the Faculty of Nursing, Hasanuddin University with number 672/UN4.18.3/TP.01.02/2024.

RESULTS

Table 1. General characteristics of respondents

	Category	Frequency	Mean	Percentage
Age	17	1	19,89	2,2%
	18	5		11,1%
	19	14		31,1%
	20	10		22,2%
	21	10		22,2%
	22	3		6,7%

	23	2		4,4%
Faculty	FAPET	11	4,60	24,4%
	FET	2		4,4%
	FAHUTAN	4		8,9%
	FAPERTA	9		20,0%
	FIKP	4		8,9%
	FISIP	1		2,2%
	FT	4		8,9%
	FEB	6		13,3%
	FKG	1		2,2%
	FIB	1		2,2%
	FH	1		2,2%
	FMIPA	1		2,2%
Playing position	Midfielder	8	3,76	17,8%
	Back	15		33,3%
	Stopper	3		6,7%
	Winger	12		26,7%
	Striker	5		11,1%
	Goalkeeper	2		4,4%
Training frequency/week	0	6	3,09	13,3%
	1	8		17,8%
	2	9		20,0%
	3	20		44,4%
	5	2		4,4%

Source: (Primary Data, 2024)

Table 1 illustrates the characteristics of respondents in terms of age, faculty of origin,
playing position in soccer and frequency of training each week. From the table presented, the results show that respondents have an age range of 17 - 23 years with an average age of 19.89 years. Based on the faculty of origin of members in UKM-SB, respondents are dominated by the faculty of animal husbandry with a total percentage of 24.4%. For playing positions, the back position dominates respondents with a percentage of 33.3% or as many as 15 respondents. And based on the frequency of training, respondents have an average routine training of 3.09 times a week.

Table 2. Frequency Distribution of Fat Percentage and Concentric Muscle Endurance

		Category Concentric Muscle Endurance (%)							Total
		Very Poor	Poor	Below Average	Average	Above Average	Good	Excellent	
Category Fat (%)	Low	6 13.3%	6 13.3%	2 4.4%	2 4.4%	2 4.4%	4 8.9%	2 4.4%	24 53.3%
	Normal	4 8.9%	4 8.9%	2 4.4%	2 4.4%	1 2.2%	2 4.4%	1 2.2%	16 35.6%
	High	1 2.2%	1 2.2%	2 4.4%	0 0.0%	1 2.2%	0 0.0%	0 0.0%	5 11.1%
Total		11 24.4%	11 24.4%	6 13.3%	4 8.9%	4 8.9%	6 13.3%	3 6.7%	45 100.0 %

Source: (Primary Data, 2024)

Table 2 shows the frequency distribution of fat percentage with concentric muscle endurance in members of UKM Football Hasanuddin University. Respondents who have a low percentage of fat are dominated by the very poor,

poor, and below average categories totaling 14 respondents whose scores are below average. As for the percentage of normal fat, respondents are also dominated by categories with scores below the average, namely the very poor, poor, and below average categories totaling 10 respondents.

Table 3. Frequency Distribution of Fat Percentage and Eccentric Muscle Endurance

		Eccentric Muscle Endurance Category (%)			
		Low Performance	Intermediate Performance	High Performance	Total
Category Percentage Fat (%)	Low	12	11	1	24
		26.7%	24.4%	2.2%	53.3%
	Normal	9	5	2	16
		20.0%	11.1%	4.4%	35.6%
	High	4	1	0	5
		8.9%	2.2%	0.0%	11.1%
Total		25	17	3	45
		55.6%	37.8%	6.7%	100.0%

Source: (Primary Data, 2024)

Table 3 shows the frequency distribution of the percentage of muscle mass with eccentric muscle endurance in members of UKM Sepak Universitas Hasanuddin. Respondents with a low percentage of fat were dominated by the low performance category as many as 12 respondents. Then respondents with normal fat percentage also obtained the most scores below the average, namely in the low performance category as many as 9 respondents.

Table 4. Percentage Frequency Distribution of Muscle Mass and Concentric Muscle Endurance

		Category Concentric Muscle Endurance (%)					Total		
		Very Poor	Poor	Below Average	Average	Above Average	Good	Excellent	
Categories	Low	6	6	4	2	4	4	2	28
Mass		13.3%	13.3%	8.9%	4.4%	8.9%	8.9%	4.4%	62.2%
Percentage	Normal	5	5	2	2	0	2	1	17
Muscle (%)		11.1%	11.1%	4.4%	4.4%	0.0%	4.4%	2.2%	37.8%
High		0	0	0	0	0	0	0	0
		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total		11	11	6	4	4	6	3	45
		24.4%	24.4%	13.3%	8.9%	8.9%	13.3%	6.7%	100.0%

Source:(Primary Data, 2024)

Table 4 shows the frequency distribution of the percentage of muscle mass with eccentric muscle endurance in members at UKM Sepak Universitas Hasanuddin. Respondents who have a low percentage of muscle mass but with concentric endurance values above the average amounted to 10 respondents. As for respondents who have a normal percentage of muscle mass but on the contrary, they have low concentric endurance values totaling 12 respondents.

Table 5. Frequency Distribution of Muscle Mass Percentage and Eccentric Muscle Endurance

Eccentric Muscle Endurance Category (%)					
		Low Performance	Intermediate Performance	High Performance	Total
Category Percentage of Mass	Low	16	10	2	28
Muscle (%)		35.6%	22.2%	4.4%	62.2%
Normal		9	7	1	17
		20.0%	15.6%	2.2%	37.8%

	High	0	0	0	0
		0.0%	0.0%	0.0%	0.0%
		55.6%	37.8%	6.7%	100.0%
Total		25	17	3	45

Source: (Primary Data, 2024)

Table 5 shows the frequency distribution of the percentage of muscle mass with eccentric muscle endurance in members of UKM Sepak Universitas Hasanuddin. Respondents with a low percentage of muscle mass but obtained the highest eccentric muscle endurance amounted to 2 respondents. While for respondents with a normal percentage of muscle mass but actually obtained low eccentric muscle endurance amounted to 9 people.

Table 6. Test Analysis of the Relationship Between Percentage of Fat with Eccentric Muscle Endurance

			Value	*Asymptotic Standardized Error[a]*	*Approximate T[b]*	*Approximate Significance*
Ordinal by Ordinal	Somers' d	Symmetric	-.041	.118	-.347	.728
		Category Percentage Dependent Fat	-.035	.100	-.347	.728
		Concentric Muscle Endurance Category Dependent	-.050	.143	-.347	.7

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

The results of data analysis conducted using the somers'd test to identify the relationship between the percentage of fat with concentric endurance of leg muscles in soccer athletes at UKM Hasanuddin University obtained a p-value of 0.72 or p>0.05, which means that the hypothesis is rejected because the percentage of fat and concentric endurance of leg muscles are not correlated with each other in members of UKM Football at Hasanuddin University.

Table 7. Test Analysis of the Relationship Between Fat Percentage and Eccentric Muscle Endurance

			Value	*Asymptotic Standardized Error [a]*	*Approximate T[b]*	*Approximate Significance*
Ordinal by Ordinal	Somers' d	Symmetric	-.115	.134	-.851	.395
	Dependent	Category Fat Percentage Eccentric Dependent	-.118	.140	-.851	.395
		Muscle Endurance Category	-.111	.129	-.851	.395

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Based on the results of data analysis conducted using the somers'd test to assess the relationship between the percentage of fat with eccentric endurance of leg muscles in soccer athletes at UKM Hasanuddin University, the p-value is 0.39 or p>0.05, which means that the hypothesis is rejected because the percentage of fat and eccentric endurance of leg muscles are not correlated.

Table 8. Test Analysis of the Relationship Between Percentage of Muscle Mass and Eccentric Muscle Endurance

			Value	*Asymptotic Standardized Error* [a]	*Approximate T*[b]	*Approximate Significance*
Ordinal by Ordinal	Somers' d	Symmetric	-.125	.124	-1.002	.316
		Category Mass Percentage Dependent Muscle	-.098	.098	-1.002	.316
		Muscle Endurance Category Concentric Dependent	-.172	.171	-1.002	.316

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

The acquisition of the results of data measuring the percentage of muscle mass and concentric endurance of leg muscles is categorical, so researchers use the somers'd test to analyze the relationship between these variables. Based on the results of the data analysis, a p-value of 0.31% or p>0.05 was obtained, which means that the hypothesis is rejected because the percentage of muscle mass and concentric endurance of leg muscles are not correlated.

Table 9. Test Analysis of the Relationship Between Percentage of Muscle Mass and Eccentric Muscle Endurance

			Value	*Asymptotic Standardized Error* [a]	*Approximate T*[b]	*Approximate Significance*
Ordinal by Ordinal	Somers' d	Symmetric	.031	.144	.216	.829
		Category Mass Percentage Dependent Muscle	.029	.135	.216	.829
		Muscle Endurance Category Eccentric Dependent	.034	.156	.216	.829

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

The acquisition of the results of data measuring the percentage of muscle mass and eccentric endurance of leg muscles is categorical, so researchers use the somers'd test to analyze the relationship between the two variables. Based on the results of the data analysis carried out, the p- value obtained is 0.82% or p>0.05, which means that the hypothesis is rejected because the percentage of muscle mass and eccentric endurance of leg muscles is not correlated.

DISCUSSION

Based on data from the results of research on 45 respondents, it shows that the dominance of respondents is at the age of 19 years with a frequency of 14 people with a percentage of 31.1%. This research was conducted after the Hasanuddin University Football UKM had just recruited new members so this allowed the dominance of respondents to be at that age. At the age of 19, many individuals experience peak interest and participation in various sports activities, including soccer. This can be due to a variety of factors, such as peer pressure, social pressure, or a desire to improve athletic skills. Several studies have shown that interest and participation in sports tend to increase during adolescence (Cale et al., 2019). Respondents with a playing position as a back dominated the type of playing position in this study, totaling 15 people with a percentage of 33.3%. Back position in football players, especially center backs, tend to require high physical endurance as they are responsible for the team's defense and are often involved in situations that require good physical strength and endurance. This research is more accessible to backs due to their awareness of the importance of physique and endurance in their role, as well as their motivation to improve their performance on the field (Bangsbo et al., 2006; Bradley and Ade; 2018). Training performed 3x per week is a common training frequency and is often considered the standard in training programs for soccer players who want to improve their muscular endurance and physical performance because doing 2x - 3x per week is included in the training class (Atiq et al., 2020). Players who train with this frequency are more disciplined and consistently involved in their training program because the training schedule of UKM Sepak Universitas Hasanuddin is indeed carried out 3x in each week, namely on Monday, Wednesday and Friday so they are more likely to be willing to participate in research on muscular endurance.

The absence of a relationship between fat percentage and concentric endurance of leg muscles is likely due to factors that affect physical fitness such as age, nutritional status, physical activity, hemoglobin levels, smoking habits,

and training patterns carried out by athletes (William, 2007 in Widayati et al., 2018). In addition, researchers assume that with a training frequency of 3x and done per week, the possible cause of the lack of concentric muscle endurance possessed by UKM members with a low and normal percentage of fat can occur due to a lack of intensity and type of exercise performed. This thought is in line with research that found that structured exercise varieties can produce greater improvements in muscle mass, strength, and muscular endurance than monotonous training (Häkkinen et al., 2003; Baz-valle et al., 2019). This is related to the existence of training principles that include overload, specificity, and progression (Kurniawan and Nasirudin, 2023; Kusmita et al., 2022). Based on the information obtained on the personal data filling form, respondents who have low fat but whose concentric muscle endurance is dominated in the category with a value below the average actually do the most training, namely 3x a week as many as 9 people, most of them are also in faculties and study programs that study more in the field, and playing positions are dominated by the back position where this position plays a role in securing the team's defense and reducing the movement of opposing strikers so that they must move quickly and intelligently to close space and support team attacks when possible (Abrori, 2020; Sucipto, 2023).

The dominance of characteristics in terms of training frequency, faculty, and playing position of respondents with low performance in low and normal fat percentage is the same as in the previous point. So, when looking at other triggering factors that cause there to be no relationship between fat percentage and eccentric muscle endurance from this study, it was found that the dominance of age at the age of 19 years amounted to 9 respondents. The performance of athletes at the age of 19 has not reached its maximum peak because maximum performance is usually reached in the early to mid-20s depending on the type of sport and individual factors such as genetics, training, and competitive experience (Oh et al., 2005; Low et al., 2015; Magfiroh and Jannah, 2022). Respondents with low and normal fat percentages are dominated in the low performance category, which means that members of UKM Football at Hasanuddin University have low eccentric muscle endurance. Of the total 21 respondents who obtained low performance results, the highest frequency of training was carried out 3x per week by 9 people followed by a frequency of training 2x a week by 7 people. The faculty with the most respondents is the Faculty of Agriculture which usually integrates learning in the field and in the classroom to provide practical and theoretical experience and understanding.(Biscaya, 2013; Mahamboro et al., 2023). Then for playing positions, respondents were also dominated by the back position as many as 9 people, even though this position requires fast movement because it is tasked with maintaining defense so that this position has an important role in blocking passes, supporting team attacks, and providing crosses (Powel, 2023).

Based on the information obtained from filling out the personal data form, respondents who have low muscle mass but have high concentric endurance of leg muscles do the frequency of training 3x per week by 5 people. There are various causes of athletes' muscle mass not reaching the ideal value despite doing regular training 3x a week, including aspects such as improper nutrition because although training is an important part of muscle mass development, proper nutrition intake. If athletes do not get enough nutrients, especially protein to repair and build muscle, then muscle growth can be inhibited, inadequate rest patterns such as not giving the body enough time to recover after training can inhibit growth in muscles. In addition, different genetic factors or potential can also affect a person's ability to build muscle mass (Philips, 2014; Schoenfeld et al., 2017; Schoenfeld and Aragon, 2018; Wackerhage et al., 2019). Respondents with a normal percentage of muscle mass but actually obtained concentric muscle endurance values below the average value could be due to the frequency of the most exercises only being done once. This could be due to a number of factors, including a lack of specialized strength and endurance training, an imbalance in muscle training, injury, or metabolic issues. Based on the respondent's personal data form, out of a total of 25 respondents who were only in the low performance category when performing the eccentric muscle endurance test, the age of the most respondents was 19 years old. Age can affect the performance of a soccer athlete, performance peaks at a more mature age such as the mid-20s. Although by the age of 19 an athlete has developed significant strength and skill, development continues into adulthood, and suggests that peak/maximal performance is often achieved at ages after 19 years (Stulberg and Magnes 2017; Casserly et al., 2019). Factors such as physical growth, experience, and training may be the influences needed to achieve maximum performance. Then, the frequency of training was mostly done 3x a week by 10 respondents with a normal percentage of muscle mass but still obtained eccentric muscle endurance values that were not ideal. This can be caused by several factors such as a lack of variation in the type or intensity of training which results in suboptimal adaptation of the muscles, an imbalance between agonist and antagonist muscle training causes an imbalance in muscle activation, and a lack of rest and recovery between training sessions can hinder the ability of muscles to recover and adapt to training because rest and recovery prevent athletes from overtraining (Schoenfeld et al., 2013, Helms et al., 2016; Schoenfeld et al., 2019).

During the data collection process carried out in March, members of UKM Football only do routine training by playing on the field without doing special exercises according to their respective playing positions. Exercises

performed without considering the playing position can affect the resulting performance because each position in a sports game has different physical demands. In addition, training that is not focused on the specific demands of the playing position can reduce the efficiency of the athlete's movements. A study showed that training tailored to the playing position can improve an athlete's performance because it develops the abilities required for specific tasks in the game (Kraemer et al., 2002; Lloyd et al., 2014; Comfort and Jones, 2019). A coach plays an important role in designing the training program that will be carried out so that the resulting performance can be maximized including concentric and eccentric muscle endurance of the leg muscles. A well-designed training program should take into account the athlete's goals, physical condition, period in competition, and individual needs by considering appropriate exercises (targeting the muscles involved), exercise variety for balanced muscle growth, exercise intensity such as the use of appropriate weights and the optimal number of repetitions, and monitor and evaluate to monitor the athlete's progress and the effectiveness of the training program for further adjustments (Haff and Triplett, 2016; Schoenfeld et al., 2019).

Physical tests as a research instrument taken in the afternoon before members of UKM Football do routine training are also a contributing factor to not maximizing the resulting performance. This can be caused because they have done a lot of activities before doing the test. For example, activities during different classes such as students with additional activities in the form of practicum either in the laboratory or in the field which drains a lot of energy because it involves various intensive physical activities such as walking long distances, lifting equipment, making observations, and may also work in uncomfortable environmental conditions. In addition, field practicum also requires high concentration and social interaction which can increase mental fatigue (Leichtfried et al., 2017). Other factors such as adequate rest before the test can also affect the resulting performance.

The implementation of research in this case conducting physical tests as a research instrument during Ramadan is one of the factors in the lack of maximum performance produced by members in UKM Football during research due to changes in diet and habits that can affect physical conditions, then the absence of fluid intake for hours can cause dehydration in the body. Dehydration can reduce blood volume, affect blood circulation, and reduce a person's physical and cognitive abilities during physical tests. Inadequate fluid intake can lead to electrolyte imbalances in the body. Electrolyte disturbances such as unbalanced sodium, potassium and magnesium levels can affect muscle contraction and neuromuscular function during physical tests. Furthermore, fasting can cause metabolic disturbances due to changes in diet and time of consuming food. This can affect blood sugar levels, iron, and other essential nutrients needed for optimal physical performance, as well as energy deficiencies due to the absence of intake for many hours (Roky et al., 2003; Maughan et al., 2012; Almudahka, 2020).

REFERENCES

1. Abdalla, M. M. I. and Choo, S. S. (2020). The Association Between Salivary Ghrelin Levels and Anthropometric Measures in Underweight, Normal, Overweight and Obese Healthy Adult Males. European Endocrinology, 16(1). doi: 10.17925/EE.2020.16.1.49.
2. Abrori, R. B. (2020). Leadership and Communication of Soccer Coaches. GUEPEDIA
3. Aikawa, Y., Murata, M., and Omi, N. (2020). Relationship of Height, Body Mass, Muscle Mass, Fat Mass, and The Percentage of Fat with Athletic Performance in Male Japanese College Sprinters, Distance Athletes, Jumpers, Throwers, and Decathletes. The Journal of Physical Fitness and SportsMedicine,9(1),7-14. https://doi.org/10.7600/jpfsm.9.7.
4. Almudahka, F. (2020). The effect of Ramadan fasting on athletes' physiology: A systematic review.Journal of Nutrition, Health and Aging, 24(3), 343-350.
5. Askling, C., Karlsson, J., and Thorstensson, A. (2003). Hamstring Injury Occurrence in Elite Soccer Players After Preseason Strength Training with Eccentric Overload. Scandinavian Journal of Medicine and Science in Sports, 13(4), 244-250.
6. Atiq, A., Henjilito, R., Syafii, I., Putro, R. A., Alfian, M., Alamsyah, R., Mustofa, A. S., LutfiadiA.I., Muhlisin, Pradana, A. J., Lusiana, Haryana, E., Juhanis, & Pahliwandari, R. (2020). Physical Training Strategies & Patterns for Beginner Athletes. Aloy House Library.
7. Avissa, A., Kuswari, M., Nuzrina, R., Gifari, N., and Melani, V. (2021). Effect of Exercise Training Program and Nutrition Education on Body Composition, Abdominal Circumference and Pelvic Circumference in Productive Age Women in Depok. Journal of Physical Activity,2(2),176. https://doi.org/10.20884/1.paju.2021.2.2.3947.
8. Bangsbo, J., Mohr, M., & Krustrup, P. (2006). Physical and metabolic demands of training and match-play in the elite football player. Journal of Sports Sciences, 24(7), 665-674.
9. Baz-Valle, E., Schoenfeld, B. J., Torres-Unda, J., Santos-Concejero, J., and Balsalobre-Fernández, C. (2019). The effects of exercise variation in

muscle thickness, maximal strength and motivation in resistance trained men. PloS one, 14(12), e0226989. https://doi.org/10.1371/journal.pone.0226989.

10. Biscaya, J. (2013). How Effective is Outdoor Education as an Educational Tool to Promote Environmental Education Outcomes? Evidence from a Study in an Agricultural Science Context. Journal of Science Education and Technology, 22(2), 220-230.
11. Bradley, P. S., & Ade, J. D. (2018). Are current physical match performance metrics in elite soccer fit for purpose or is the adoption of an integrated approach needed? International Journal of Sports Physiology and Performance, 13(5), 656-664.
12. Cale, L., Harris, J., Chen, M., & Bauer, K. (2019). Sport Participation and Physical Activity Levels of Adolescents with Developmental Disabilities: A Systematic Review. Journal of Developmental and Physical Disabilities.
13. Casserly, N., Neville, R., Ditroilo, M. and Grainger, A. (2019). Longitudinal Changes in the Physical Development of Elite Adolescent Rugby Union Players: Effect of Playing Position and Body Mass Change. International journal of sports physiology andperformance,15(4),520-527. https://doi.org/10.1123/ijspp.2019-0154.
14. Comfort, P., and Jones, P. A. (2019). The effect of body position on lower body power production.Journal of Strength and Conditioning Research, 33(6), 1563-1570.
15. Danu, J. P., Daryono, and Mahendra, A. (2023). The Effect of Agility Training on Dribbling Ability in Soccer Players at Bhayangkara Youth Club Sungai Rotan Muara Enim Regency. Education and Learning Journal, 2(2), 163.
16. Gardasevic, J., Bjelica, D., Vasiljevic, I. and Masanovic, B. (2020). Differences in Body Composition between Young Soccer Players (U19) Members of the Best Soccer Clubs in Serbia, Bosnia and Herzegovina, and North Macedonia. Pedagogy of Physical Culture and Sports, 24(4). doi: 10.15561/26649837.2020.0404.
17. Gardasevic, J., Bjelica, D. and Vasiljevic, I. (2019). Morphological Characteristics and Body Composition of Elite Soccer Players in Montenegro. International Journal of Morphology,25(1). doi: 10.4067/S0717-95022019000100284.
18. Haff, G. G., & Triplett, N. T. (2016). Essentials of Strength Training and Conditioning (4th ed.). Human Kinetics.
19. Häkkinen, K., Alen, M., Kraemer, W. J., Gorostiaga, E., Izquierdo, M., Rusko, H., & Newton, R.U. (2003). Neuromuscular adaptations during concurrent strength and endurance training versus strength training. European Journal of Applied Physiology, 89(1), 42-52.
20. Helms, E. R., Zourdos, M. C., and Trexler, E. T. (2016). The Importance of Rest and Recovery in Strength Training. Sports Medicine, 46(12), 1839-1848.
21. Jarkasih, I., and Fardi, A. (2020). The Effect of Providing Aren Sugar in Endurance Training on VO2 Max Capacity of SSB Tan Malaka. Patriot Journal, 2(1), 301-314.
22. Kraemer, W. J., Ratamess, N. A., and French, D. N. (2002). Resistance training for health and performance. Current sports medicine reports, 1(3), 165-171.
23. Kurniawan, G. P., and Nasirudin, Y. (2023). The effect of plyometric training on leg muscle explosive power. Indonesian Journal of Physiotherapy and Health,3(1),30-36. https://doi.org/10.59946/jfki.2023.184.
24. Kusmita, F. S., Nurudin, A. A., & Saleh, M. (2022). Limb Muscle Strength Endurance Training to Increase 50 Meter Freestyle Swimming Speed. Journal of Educatio FKIP UNMA, 8 (3), 1052- 1057. https://doi.org/10.31949/educatio.v8i3.2864.
25. Leichtfried, V., Howe, L. C., Hume, M. P., Fraser, S. J., Varela-Mato, V., Davies, M. J., ... and Haines, T. P. (2017). University students' perspectives on physical activity: a qualitative study to enhance understanding and inform intervention design. Journal of Sports Sciences, 35(16), 1573-1580. DOI: 10.1080/02640414.2016.1222306.
26. Lloyd, R. S., Oliver, J. L., Faigenbaum, A. D., Myer, G. D., De Ste Croix, M. B. A., and Howard,R. (2014). Long-term athletic development- part 1: a pathway for all youth. Journal of strength and conditioning research, 28(5), 1439-1450.
27. Low, E., Tessler, R., Hauer, K. E., Leavitt, A. D., Miller, B., and Maa, J. (2015). The Surgical Clerkship and Medical Student Performance in a Standardized Patient Case of Acute Cholecystitis. Journal of surgical education, 72(5),1045-1051. https://doi.org/10.1016/j.jsurg.2015.04.019.
28. MacKenzie, B. (2015). 101 Performance Evaluation Tests. Electric World Plc.
29. Magfiroh, M. N., and Jannah, M. (2022). The Relationship between Mental Toughness and Competitive Anxiety in Athletes with Disabilities. Patriot Journal, 4(2), 123-138.
30. Mahamboro, D. B., Felix Korner, S. J., Abais, R. A. L., and Kristiyanto, N. (2023). Proceedings

International Conference On Theology, Religion, Culture, And Humanities:" Re-Imagining Theology, Religion, Culture, and Humanities Studies for Public Life". Sanata Dharma University Press.

31. Maughan, R. J., and Shirreffs, S. M. (2012). Dehydration and rehydration in competitive sport. Scandinavian journal of medicine and science in sports, 22(3), 543-557.
32. Nidomuddin, M., Pamungkas, H., and Yusuf, H. (2023). The Correlation of Height and Weight on Concentric Type of Muscle Endurance of Malaysian Soccer Players from Sabah FC. Proceedings of the National Seminar on Physical Education and Sports.
33. Nugraheningsih, G., and Saputro, Y. A. (2019). Increasing Physical Fitness Through Pencaksilat Subjects of Sports Science Students. JPJOK (Journal of Physical Education, Sports, and Health). https://doi.org/10.33503/jp.jok.v3i1.560.
34. Oh, D. S., Lieu, S. N., Yamaguchi, D. J., Tachiki, K., Lambrecht, N., Ohning, G. V., Sachs, G., Germano, P. M., and Pisegna, J. R. (2005). PACAP regulation of secretion and proliferation of pure populations of gastric ECL cells. Journal of molecular neuroscience: MN, 26(1), 85-97. https://doi.org/10.1385/JMN:26:1:085.
35. Opar, D. A., Williams, M. D., Timmins, R. G., Hickey, J., and Duhig, S. J. (2015). The Effect of Previous Hamstring Strain Injuries on the Change in Eccentric Hamstring Strength During Preseason Training in Elite Australian Footballers. The American Journal of Sports Medicine, 43(2), 377-384.
36. Phillips, S. M. (2014). A brief review of higher dietary protein diets in weight loss: A focus on athletes. Sports Medicine, 44(Suppl 2), 149-153.
37. Powel, J. (2022, March 11). What is a defender in soccer? (Vital position). Soccer Blade.
38. Prakoso, G. P., and Sugiyanto, F. (2017). The Effect of Training Methods and Limb Muscle Endurance on the Results of Increasing VO2Max Capacity of Basketball Players. Journal of Sports, 5(2), 151. https://doi.org/10.21831/jk.v5i2.10177.
39. Prayoga, G. H., Supriyadi, S., Andiana, O., and Abdullah, A. (2023). Study of Physical Condition in Sinarmas FC Women's Soccer Players. Sport Science and Health, 5(7), 764-772.
40. Purwaningtyas, D. R., Wulansari, N. D., and Gifari, N. (2021). Factors Associated with Quadriceps Muscle Endurance of Taekwondo Kyorugi Youth Athletes in Jakarta. Journal of Sport Science and Fitness,7(1),9-18. https://doi.org/10.15294/jssf.v7i1.44677.
41. Roky, R., Chapotot, F., Hakkou, F., and Benchekroun, M. T. (2003). Daytime sleepiness during Ramadan intermittent fasting: a polysomnographic and quantitative waking EEG study. Journal of sleep research, 12(2), 95-101.
42. Schoenfeld, B. J., and Aragon, A. A. (2018). How much protein can the body use in a single meal for muscle-building? Implications for daily protein distribution. Journal of the International Society of Sports Nutrition, 15, 10.
43. Schoenfeld, B. J., Ogborn, D., & Krieger, J. W. (2017). Effects of resistance training frequency on measures of muscle hypertrophy: a systematic review and meta-analysis. Sports Medicine, 47(6), 1207-1220. doi:10.1007/s40279-016-0644-5.
44. Schoenfeld, B. J., Contreras, B. and Krieger, J. (2019). The Role of Variation in Strength Training: A Systematic Review. Journal of Strength and Conditioning Research, 33(10), 2827-2836.
45. Schoenfeld, B. J., Contreras, B., and Krieger, J. (2013). Effects of Exercise Order on Upper-body Muscle Activation and Exercise Performance. Journal of Strength and Conditioning Research, 27(12), 3286-3295.
46. Schuermans, J., Van Tiggelen, D., Palmans, T., Danneels, L., Witvrouw, E., and Roosen, P. (2017). Deviating running kinematics and hamstring injury susceptibility in male soccer players: Cause or consequence? Gait and Posture, 54, 133-139.
47. Shabrina, S., Ghozali, D. A., and Rahayu, D. (2022). Effect of body fat percentage on aerobic capacity of professional soccer athletes. Sporta Saintika, 7(1), 33-45.
48. Stulberg, B., and Magness, S. (2017). Peak performance: Elevate your game, avoid burnout, and thrive with the new science of success. Rodale.
49. Sucipto. (2023). Adept at Playing Soccer. Indonesia Emas Group.
50. Wackerhage, H., Schoenfeld, B. J., Hamilton, D. L., Lehti, M., and Hulmi, J. J. (2019). Stimuli and sensors that initiate skeletal muscle hypertrophy following resistance exercise. Journal of Applied Physiology, 1985(4), 1284-1294.
51. Wibowo, C., and Dese, D. C. (2019). Relationship between Body Mass Index and VO2Max in Basketball Athletes. Physical Education, Health and Recreation,3(2),19-25. http://jurnal.unimed.ac.id/2012/index.php/jpehr.
52. Widayati, A., Pontang, G. S., & Mulyasari, I. . (2018). The Correlation Between Body Fat Percentage And Physical Fitness Of Athletes In Center For Education And Training Of Student Sports (PPLOP) Central Java Province: The

Correlation Between Body Fat Percentage And Physical Fitness Of Athletes In Center For Education And Training Of Sports For Students (Pplop) As Central Java. Journal of Nutrition And Health,10(23),11-18.
https://doi.org/10.35473/jgk.v10123.38