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Analysis of Football Players' Endurance Based on Playing Position: A Study of West Sumatra PON Players

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Abstract. The problem in this study is the lack of empirical evidence regarding the endurance performance of West Sumatra PON soccer players in various playing positions from a sports science perspective. Data on endurance capabilities is very important for coaches as a basis for developing measurable and structured training programs. The purpose of this study is to analyze the endurance capabilities of West Sumatra PON soccer players based on playing positions. This study uses a quantitative descriptive method with a survey approach. The participants were 26 male football players selected for the West Sumatra PON team. The instrument used was the yoyo intermittent recovery test. The collected data will be analyzed using statistical techniques with the help of SPSS 26 software and Microsoft Excel. From the test results, the mean value was 55.07, the standard deviation was 4.45, the minimum value was 47.49, and the maximum value was 63.22. Based on playing position, goalkeepers have an average VO2max of 51.69 (low), defenders 54.7 (moderate), full-backs 55.97 (moderate), midfielders 57.12 (moderate), wingers 56.36 (moderate), and forwards 52.64 (low). The results of this study generally indicate that players' endurance abilities are still not in accordance with the required endurance standards for soccer players. Coaches must improve players' endurance abilities in order to compete at the elite level. This data can be a reference for coaches to design and organize more effective training programs to improve players' endurance abilities.

Keywords: Endurance; Playing Position; Football; PON

INTRODUCTION

Modern football is fast-paced and high-intensity. The tempo of the game changes rapidly and becomes more dynamic throughout the match (Trombiero et al., 2023). The transition of the competing teams is carried out alternately, both the transition from attack to defense and the transition from defense to attack (Bortnik et al., 2024; Hughes & Lovell, 2019). This condition will require players to cover considerable distances during a match. Players can travel approximately 9-14 km per match (Bahtra, Arwandi, et al., 2025), of this distance running at high intensity is about 10% (Michailidis, 2022), high intensity actions 3-7% (Domčeková et al., 2023). Besides that, there are actions with the ball and actions without the ball (Martínez-Cabrera et al., 2020), high intensity actions such as sprinting, changing direction, accelerating/decelerating quickly, tackling, and fighting for the ball (Daly et al., 2022).

The various actions involved in football require players to be in good physical condition. One of the most important physical qualities for a football player is endurance. Good endurance will enable players to perform optimally during matches (Bahtra et al., 2021; Mallick, 2024). Endurance is very important for soccer players because soccer is a sport that is played over a long period of time (Bahtra, Harahap, et al., 2025; Megahed et al., 2023). Endurance is one of the elements of physical condition that is the foundation of a football match (Bahtra et al., 2024; Belamjahad et al., 2024). The endurance level helps players to be able to play optimally throughout the match (Cobar & Madrigal, 2016; Strudwick, 2016).

Each playing position in football has different activity characteristics and physiological demands. During a match, defenders engage in more duels and defend the defensive area (Akyildiz et al., 2022), midfielders have high mobility in helping with attacking and defensive transitions (Petr et al., 2022), Meanwhile, attackers are more dominant in sprinting and explosive movements to create goal scoring opportunities (Ventura et al., 2024; Zhou et al., 2020; Žuvela et al., 2025). These differences in characteristics lead to different endurance requirements between playing positions. The study found significant differences in endurance capacity between goalkeepers and outfield players, while no significant differences were reported among outfield players (who were divided into center-backs, central midfielders, wingers, and forwards) (Altmann et al., 2020).

In the context of developing sports achievements in Indonesia, the National Sports Week (PON) is the highest multi-event event. PON is a prestigious competition that serves as a benchmark for successful athlete development at the regional level (Yanti et al., 2022). One of the sports that is a favorite at PON is football (Firdaus Rahmayanto et al., 2022). The West Sumatra PON football team participated in this event. The West Sumatra PON football team is required to be in optimal physical condition to be able to compete with other regions. Evaluating players' endurance capabilities based on playing position can be a basis for coaches in developing training programs that are more focused, effective, and suited to the needs of each position.

Several literature and previous research findings indicate differences in the endurance capabilities of soccer players based on playing position. However, studies on the endurance profiles of soccer players at the PON level, particularly in West Sumatra, are relatively limited. This information is crucial for the application of sports science in developing regional competitive sports. Based on this description, this study aims to analyze the endurance capabilities of soccer players at the PON in West Sumatra based on playing position.

METHOD

This study used a quantitative method with a survey approach to measure endurance. The sample in this study consisted of 26 male soccer players from the National Sports Week (PON) with an average age of 20.2 years. The sample consists of players selected from districts and cities in West Sumatra. The selection team consists of football coaches and academics with coaching certifications. Of these 26 players, 4 were goalkeepers, 4 were defenders, 4 were full-backs, 6 were midfielders, 5 were wingers, and 3 were forwards. When the test is carried out, players are ensured to be in good health and not injured so that the data obtained is more optimal.

The test instrument used to measure the players' endurance was the Yo-Yo Intermittent Recovery Test (Yo-Yo IR Test) level 1 (Bangsbo & Mohr, 2015). The Yo-Yo IR1 is 25 m long, with 20 m as the test track (B – C) and 5 m as the rest area (A – B). Players start from B and run to C. After reaching C, they hear a beep and immediately run to B. Then, they recover in areas A and B. After 10 seconds, players start again for the next stage. If the player is late in arriving at the signal line, he is given 2 chances. If they are late twice, they must leave the track. And so on until the player's maximum

ability is reached. After the test is complete, the players' results are analyzed by calculating the distance traveled. This distance is then calculated using a formula to determine the player's VO2max. The formula is VO2max = Distance × 0,0084 + 36,4. Data analysis was conducted using Microsoft Excel to facilitate data processing and interpretation.

RESULT AND DISCUSSION

This study aims to determine the endurance capabilities of West Sumatra PON soccer players based on their playing positions. This data description represents factual findings in the field based on tests conducted on 26 participants. The test results yielded a mean score of 55.07, a standard deviation of 4.45, a minimum score of 47.49, and a maximum score of 63.22. For further clarification, see the following table:

Table 1. Player Endurance Test Results

No	Name	Position	VO2Max	Category
1	RF	GK	48,16	Poor
2	MZ		53,87	Low
3	FKA		50,18	Poor
4	MIP		54,54	Low
5	DAP	CB	50,85	Poor
6	TH		54,54	Low
7	MLH		63,22	Excellent
8	IS		50,18	Poor
9	WC	FB	58,91	Good
10	AS		59,92	Very Good
11	VA		50,85	Poor
12	RA		54,21	Low
13	SR	CMF	62,27	Excellent
14	YF		51,18	Poor
15	AGP		55,55	Moderate
16	FM		53,2	Low
17	HM		60,26	Very Good
18	MFA		60,26	Very Good
19	JTB	WF	51,52	Low
20	GTK		54,88	Moderate
21	LA		56,56	Moderate
22	SH		61,94	Excellent
23	ZK		56,89	Moderate
24	JRA	CF	47,49	Poor
25	FT		53,2	Low
26	MZJ		57,23	Moderate

Table 2. Category of Player Endurance Data

Category	VO2Max	FA	FR
Excellent	> 61,6	3	11,54
Very Good	59,58 - 61,6	3	11,54
Good	58,24 - 59,25	1	3,85
Moderate	54,88 - 57,90	5	19,23
Low	51,52 - 54,54	7	26,92
Poor	< 51,52	7	26,92
Total		26	100,00

Based on the data in Table 2 above, it can be explained that the endurance (VO2max) of players classified as poor is 7 people (26.92%), low is 7 people (26.92%), moderate is 5 people (19.23%), good is 1 person (3.85%), very good is 3 people (11.54%), and excellent is 3 people (11.54%). This data reveals that, in general, many players' endurance abilities are still in the moderate, low, and poor categories. Furthermore, this player endurance ability data is classified based on playing position. Complete data can be seen in the table below.

Table 3. Player Endurance Based on Playing Position

No	Position	Average VO2Max	Category
1	Goalkepper	51,69	Low
2	Center Back (CB)	54,7	Moderate
3	Full Back (FB)	55,97	Moderate
4	Central Midfielder (CM)	57,12	Moderate
5	Winger (WF)	56,36	Moderate
6	Central Forward (CF)	52,64	Low

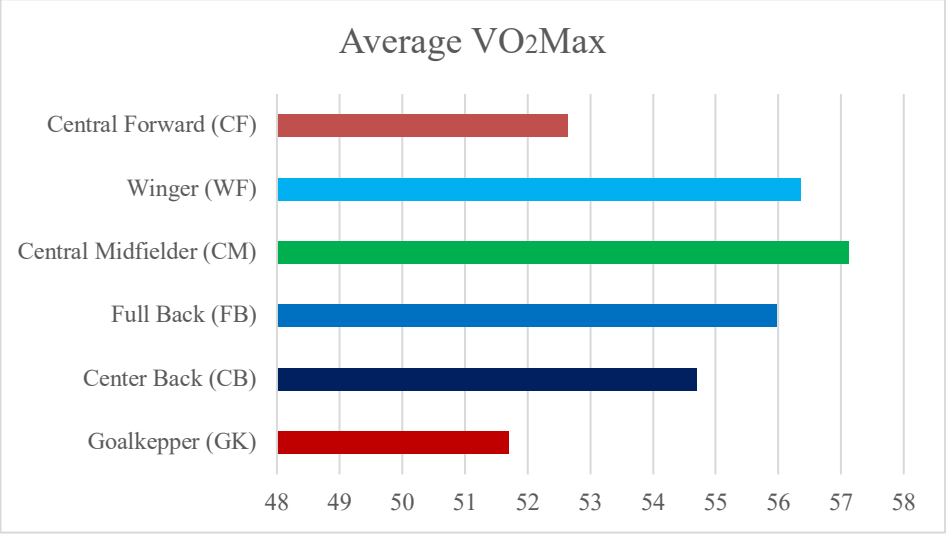

Figure 1. Histogram of Endurance Capacity

The data analysis revealed that the highest VO2max was 63.22 and the lowest was 47.49, while the overall average was 55.07. These results indicate that the players' endurance is still in the moderate category and does not yet meet the required standards. Good endurance will help players perform optimally in matches. Therefore, this study is crucial to analyze the endurance of young soccer players in West Sumatra. Through this study, coaches will understand the extent of their players' endurance capabilities, allowing them to design and implement effective endurance training.

Based on playing position, the average player's endurance capacity varies between positions. In the goalkeeper (GK) position, the average VO2max is 51.69, which is in the low category. This ability is still very lacking, even though the goalkeeper position is not very mobile in the game. However, in modern football, the goalkeeper is not only responsible for guarding the goal but also acts as the starting player for attacks (build-up) (Obetko et al., 2022). The goalkeeper's involvement extends beyond initiating attacks and playing during ball possession. All players, including the goalkeeper, must be involved in ball possession to increase their chances of scoring and winning. Therefore, improving the goalkeeper's VO2max is crucial to improve the team's performance in matches.

In the defender (CB) position, the average VO2max is 54.7, which is in the moderate category. Defenders play a crucial role in the match, namely guarding the defense against opposing attacks. In addition to defending, defenders also contribute to the attack (Morgans et al., 2024). There are many actions carried out by the defenders, such as holding off the opponent's counter-attack, duels over the ball (heading) with the opponent's striker, duels during corner kicks, free kicks and helping counter-attack moments through open play situations. All of these actions require considerable stamina; without it, players will struggle to execute these actions.

Furthermore, players playing the full-back (FB) position have an average VO2max of 55.97, categorized as moderate. The defenders who routinely assist in attacks are full-backs (attacks from the flanks). In modern football, full-back attacks not only involve sweeping the flanks but also inverted penetration and scoring goals. In addition to attacking, full-backs must also provide strong defense when attacked by opponents or withstand counterattacks (transitions from offense to defense) (Asian-Clemente et al.,

2024). With a position that requires moving up and down the side of the field, good endurance is the main factor that a player who plays the full-back position must have.

The average VO2max for midfielders is 57.12, which is in the moderate category and the highest among all positions. This aligns with the role of midfielders, which involves both defense and attack. Midfielders are responsible for breaking up opposing attacks when defending and controlling the attack (distributing the ball) when attacking (Wik et al., 2019). So the midfielder must have high mobility in the match, must be strong during transitions, both transitions from defense to attack and transitions from attack to defense (Oliva-Lozano et al., 2023). This condition requires the midfielder to have good endurance, without which the player will not be able to play fight for 2 x 45 minutes.

Next in attack are the wingers and forwards. Wingers have an average VO2max of 56.35, while forwards have 52.64. In attack, my players are tasked with providing feeds (from the wings) for the forwards, while also scoring goals by penetrating the penalty area. Meanwhile, the forwards' job is clearly to score goals. However, in defense, these two positions are the first to initiate defense. Wingers and forwards will apply pressure on the opposing defenders or goalkeeper in possession. Their movements will be more dynamic and they will participate in every transition in the match, from defense to attack and attack to defense. These movements require excellent endurance, so players will be strong in scoring goals and strong in defense.

The results of this study clearly show that the endurance of players in each position is not yet optimal. Players' endurance still needs to be improved to be able to play optimally for 2 x 45 minutes. Coaches must provide players with training using appropriate methods. Many endurance training methods can be used to increase a soccer player's VO2 max. Some commonly used endurance training methods include continuous training, interval training, fartlek training, cross-country, and others (Bahtra, 2021; Sidik et al., 2019). Apart from that, there are more specific training methods that use balls, such as the small side games training method (Akdoğan et al., 2021; Dello Iacono et al., 2021) and drill method (Bahtra et al., 2023). Effective training is very important so that the team's preparations can run smoothly towards the real competition.

CONCLUSION

The results of this study revealed that, in general, many players' endurance levels are still in the moderate, low, and poor categories. This data is still far from the endurance

standards required for football players to compete at the elite level. Therefore, it is crucial to develop players' endurance as early as possible. As a crucial element in the game of football, endurance deserves special attention from coaches. This research data can serve as a foundation for coaches in designing and developing endurance training programs. Selecting the right method is also crucial, especially one that is more holistic and specific to football. Equally important is that coaches continuously evaluate and monitor players' endurance throughout each training session.

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