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Quantitative Estimation of the Predictive Relationship Between Body mass and Anaerobic Capacity in Soccer Players

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Abstract:

This research aimed to estimate the predictive relationship between body mass and anaerobic capacity in soccer players. A correlational descriptive approach was adopted. The research sample included 25 players from the senior Nadjm Lakhdaria (Algeria) team. Their body mass was measured using a Camry scale, and the RAST test was administered. After data collection and analysis, the results showed a moderate positive correlation between body mass and anaerobic capacity. Furthermore, a simple linear regression model explained 21% of the variance in anaerobic capacity, using body mass as a predictor variable. Therefore, the researchers recommended implementing training programs to improve body composition, which positively affects anaerobic and athletic performance.

Keywords: Body mass; Anaerobic capacity; Soccer.

1. Introduction

Soccer is a sport that places a heavy burden on the body's systems, requiring 80% of energy production from the anaerobic system and 20% from the aerobic system (Qasmi, 2016). Soccer players rely on rapid movement and alternating between fast and moderate running, with few breaks. What we often observe today are intense games played in close succession, yet players still demonstrate high levels of performance and speed, exerting considerable effort throughout the game (Seghiri, 2014).

Since modern soccer demands high levels of speed due to frequent, high-intensity exertion, players must have a high anaerobic capacity. From a physiological perspective, this capacity is linked to anaerobic lactic acid production via anaerobic glycogenolysis (Guerroumi, 2023). Bekris et al. (2016) reported that during a professional soccer game, players perform between 1000 and 1400 repetitive movements, with variations in speed, pace, and effort. Anaerobic capacity is an essential ability for soccer players, as it contributes to better performance during games (Guldal & Bilge, 2019).

On the other hand, studies and research have confirmed the link between body composition and athletic performance in soccer (Ishida et al., 2021). Lean body mass (LBM) plays a significant role in enhancing running performance among soccer players, affecting both aerobic and anaerobic capacities. Ishida et al. (2021) reported that favorable body composition (relatively low body fat percentage and relatively high muscle mass) can improve sprint performance over short and long distances. Their study found a negative correlation between LBM and sprint performance times, suggesting a direct relationship between muscle mass and speed. Furthermore, Loturco et al. (2020) provided evidence that the ability to generate vertical force is crucial for soccer players, as it is directly correlated with sprint performance.

Studies have examined anaerobic capacity and body composition in soccer players from various perspectives. However, we recognize the importance of investigating the predictive relationship between body mass and anaerobic capacity. Therefore, this research aims to quantitatively estimate the predictive relationship between body mass and anaerobic capacity in soccer players. To achieve this goal, we hypothesized that body mass is a predictor of anaerobic capacity in soccer players.

The expected results of the research can provide coaches and physical trainers with a clear, numerical picture of the proportion of variation in anaerobic capacity explained by the body mass variable in soccer players, helping them customize and adapt training programs to each player's condition to avoid injury and improve athletic performance.

2. Methodology

2.1. Research approach:

We adopted a correlational descriptive approach, as it is suitable for the nature of the topic. Data were collected and analyzed using quantitative methods.

2.2. Research Sample:

The sample included 25 soccer players from the senior Nadjm Lakhdaria (Algeria) team, which competes in the second regional level. They were selected using the convenience method due to their ease of access and interaction.

2.3. Research Delimitations:

The research included 25 players and was conducted during the 2024-2025 sports season. The measurements and testing were conducted at Mansour Khodja Stadium in Lakhdaria.

2.4. Research variables:

The research included a predictor variable represented by body mass and an outcome variable represented by anaerobic capacity.

2.5. Research instruments:

* Body Mass Measurement: The players' body mass was measured in kilograms using a Camry scale.

* Running Anaerobic Sprint Test (RAST):

- Purpose: To measure anaerobic capacity.
- Procedure: After a suitable warm-up, subjects performed six 35-meter sprints with 10 seconds of passive rest. The direction of the sprint was reversed each time so that the finish line of the first sprint became the starting point of the next. Five-second countdowns were used as starting signals. Subjects were verbally motivated during the test.
- Scoring: The sum of the times for the six sprints (in seconds) was recorded (Hazir et al., 2018).

* Note: Body mass and anaerobic capacity measurements were taken in the second week of the start of the preseason.

2.6. Statistical Analysis:

JASP version 0.95.1.0 and SPSS version 27 were used to analyze the data. Statistical indicators for the sample characteristics were calculated and presented as the minimum, maximum, arithmetic mean, standard deviation, and coefficient of variation. A significance level of 0.05 was adopted to test the research hypothesis. The correlation between the two variables was calculated using Pearson's correlation coefficient, after checking the data's normality with the Shapiro-Wilk test. To estimate the predictive relationship between body mass and anaerobic capacity, simple linear regression was calculated, and the effect size was interpreted as R^2 according to Cohen's levels: "0.01 small, 0.09 medium, 0.24 large" (Yockey, 2016, p. 173). Graphs supporting the assumptions for using simple linear regression were generated, such as a scatter plot of residual values versus expected values and a Q-Q plot of the normal distribution of residuals.

3. Results and Discussion

3.1. Results:

3.1.1. Presentation of the characteristics of the research sample:

Table 1. Statistical description of the variables specific to the research sample.

Variables	Minimum	Maximum	Mean	standard deviation	CV %
Age (years)	18	32	24.28	4.40	18.12
Height (m)	1.66	1.85	1.78	0.04	2.25
Body mass (kg)	68	84	74.84	3.35	4.48
Training age (years)	7	14	8.76	1.69	19.29
Anaerobic capacity (s)	41.58	49.44	46.33	2.05	4.42

Note. n = 25

The table shows that the coefficient of variation for the previous variables (age, height, body mass, training age, anaerobic capacity) was less than 30%, indicating that the research sample was homogeneous across these variables.

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3.1.2. Presentation of the normal distribution results:

The Shapiro-Wilk test was used to assess the normality of the data, as shown in Table 2.

Table 2. Shapiro-Wilk test for data distribution

Variables	Shapiro-Wilk	P-Value
Body mass - Anaerobic capacity	0.96	0.493

The table shows that the Shapiro-Wilk test is not statistically significant (Sh-W = 0.96, P = 0.493), indicating that the data are distributed normally.

3.1.3. Presentation of the relationship between body mass and anaerobic capacity in soccer players:

Table 3. Pearson's coefficient for the relationship between body mass and anaerobic capacity in soccer players.

Variables	Pearson's r	P-Value	Lower 95% CI	Upper 95% CI
Body mass - Anaerobic capacity	0.45	0.023	0.07	0.72

The table shows that the relationship between body mass and anaerobic capacity is statistically significant (r = 0.45, P = 0.023), indicating a positive, moderate correlation.

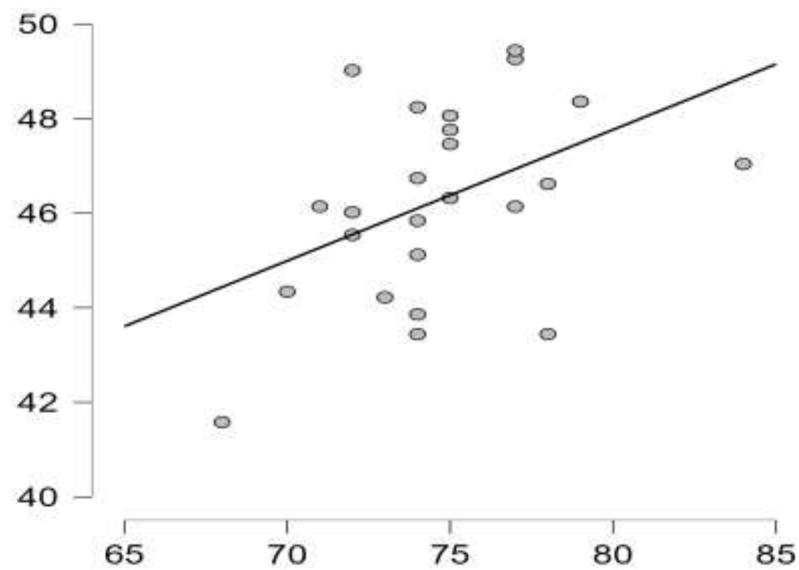

Figure 1. Scatter plot of the relationship between body mass and anaerobic capacity.

3.1.4. Presentation of the results of simple linear regression for the predictive relationship between body mass and anaerobic capacity in soccer players:

Table 4. Simple linear regression model for the relationship between body mass and anaerobic capacity in soccer players.

Model	R^2	F	P-Value	Coefficients			95% CI	
	0.21	5.95	0.023	B	T	P-Value	Lower	Upper
Constant				25.58	3.01	0.006	7.97	43.19
Body mass				0.28	2.44	0.023	0.04	0.51

The table shows that the simple linear regression model is statistically significant (F = 5.95, P = 0.023), explaining 21% of the variance in anaerobic capacity (the average effect size). Body mass (the predictor variable) was also statistically significant (T = 2.44, P = 0.023). Therefore, the research hypothesis was confirmed.

Anaerobic capacity can be predicted using the following regression equation:

Anaerobic Capacity = (0.28 * Body mass) + 25.58

The following figures (2 and 3) support the assumptions of simple linear regression.

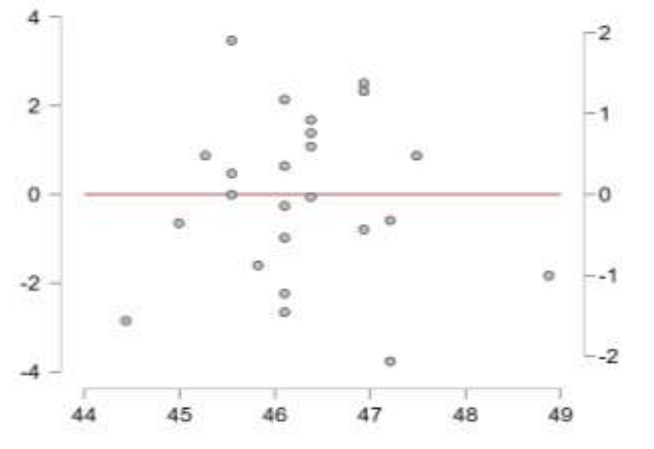

Figure 2. Scatter plot of residual values versus expected values.

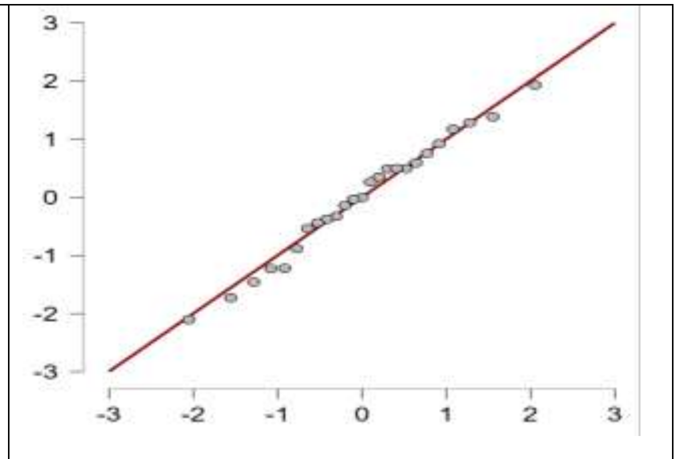

Figure 3. Q-Q plot of the normal distribution of residuals.

3.2. Discussion

The results showed a moderate positive correlation between body mass and anaerobic capacity, which is logical, since muscle mass can be associated with improved sprinting through its ability to generate force. A study found that increasing lean body mass may be favourable for sprinting ability in soccer (Ishida et al., 2021), as a positive relationship between muscle mass and anaerobic capacity was observed (Ramírez-Munera et al., 2025). Excessive mass can also create an additional mechanical burden, especially if it is fat mass, since increased body mass means increased inertia that must be overcome with each sprint repetition. In this context, previous literature has indicated that body composition can affect distance covered during moderate and high-intensity running in competitive games, as female players with lower body mass and total body fat percentage, as well as lower limb fat percentage, covered greater distance in moderate and high-intensity running (Di Lemme et al., 2024). However, the study by McCaskie et al. (2023) found that higher fat mass is associated with increased risk of injury and fatigue, which may hinder performance during the season.

The results also showed that body mass has a moderate predictive ability for anaerobic capacity, which can be explained by its effect on running performance, especially in high-intensity situations. The literature indicates that improving body composition is important for amateur soccer players to enhance performance (Kahraman et al., 2025). Research also indicates that decreases in total body fat and lower-limb fat mass are associated with greater distances covered during moderate and intense running in competitive situations (Di Lemme, 2020; Di Lemme et al., 2024). Conversely, an increase in body weight and fat mass is associated with a longer time to the agility test in amateur football players (Kahraman et al., 2025). An inverse relationship was also found between abdominal fat and sprinting performance in football players (Díaz Cevallos & Álvarez-Álvarez, 2024).

*** Limitations:**

The limitations of this research include the inability to precisely measure body mass, such as fat and lean mass, and instead use total body mass in kilograms. Additionally, the sample was selected based on convenience, limiting the generalizability of the results. Furthermore, although the RAST test has been used in several previous studies, the uncertainty about its psychometric properties in this study may affect measurement accuracy. It should be noted that the field test was conducted under standardized conditions for all participants and in accordance with the requirements for its use.

4. conclusion

This research aimed to quantitatively estimate the predictive relationship between body mass and anaerobic capacity in soccer players. After collecting and analyzing the data, we found a moderate positive relationship between body mass and anaerobic capacity. Furthermore, the relationship between body mass and anaerobic capacity in soccer players was modeled using a predictive equation, providing coaches and physical trainers with insight into the contribution of body mass to players' anaerobic capacity. Therefore, we recommend implementing training programs to improve body composition, which, in turn, positively affects anaerobic and athletic performance. Conversely, an excessive focus on weight loss can lead to adverse outcomes such as decreased muscle mass and energy levels, potentially impairing performance. Thus, a balance must be struck between fat loss and the preservation of muscle mass for optimal athletic performance. Additionally, anaerobic capacity training should be incorporated, with the player's body mass taken into account. Future research should also be conducted to predict anaerobic capacity using body composition indicators, such as lean and fat mass, using large, representative samples of soccer players.

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