



## Differences in Body Composition in Football Players by Playing Position

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### ABSTRACT

The aim of this study was to examine differences in body composition among football players according to their playing positions. The study employed a cross-sectional comparative design and included a sample of 50 active football players from FC Sileks, aged 17–30 years, who were regularly engaged in training and competitive match play. The sample comprised 50 outfield players classified into three positional groups: defenders (n = 20), midfielders (n = 14), and forwards (n = 16). Body composition was assessed using bioelectrical impedance analysis with an InBody 720 body composition analyser. Eight body composition variables were evaluated: skeletal muscle mass (kg), skeletal muscle mass (%), bone mineral content (kg), bone mineral content (%), body fat mass (kg), body fat percentage (%), fat-free mass (kg), and body mass index (BMI). Data were analysed using descriptive statistics, multivariate analysis of variance (MANOVA), univariate analysis of variance (ANOVA), and Games–Howell post hoc comparisons. Prior to inferential analyses, the assumptions of normality (Shapiro–Wilk test) and homogeneity of variances (Levene's test) were verified. Effect sizes were estimated using partial eta squared ( $\eta^2_p$ ). The results revealed statistically significant multivariate differences in body composition among players occupying different playing positions. At the univariate level, significant differences were observed in skeletal muscle mass (kg), bone mineral content (kg), body fat mass (kg), body fat percentage (%), fat-free mass (kg), and body mass index. Defenders demonstrated higher absolute values for these variables than midfielders and forwards, whereas no significant positional differences were observed in the percentage of skeletal muscle mass or bone mineral content. These findings indicate that body composition represents an important component of position-specific profiling in football and may contribute to more effective talent identification, player monitoring, and the individualization of training programmes.

### Research Article

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### Introduction

Modern football is characterized by complex physical, physiological, and technical-tactical demands that vary considerably according to playing position. Although all players contribute simultaneously to team performance, their functional roles and movement demands differ substantially. Defenders are more frequently engaged in aerial duels, physical contact, positioning, and short accelerations, whereas forwards typically perform explosive sprints, rapid changes of direction, abrupt changes in movement intensity, and direct confrontations with opponents (Bangsbo, 1994; Bloomfield et al., 2007; Stølen et al., 2005). These position-specific demands contribute to the

development of distinct morphological and body composition profiles. Within this context, body composition represents an important link between talent identification, training adaptations, and competitive performance. Rather than being determined solely by body height or body mass, football performance is also influenced by the distribution of body mass among its major components, including skeletal muscle, bone, and fat tissue. ([Reilly et al. 2000](#)) emphasized that elite football players are not characterized by extreme values in individual anthropometric or physiological variables but by an optimal combination of characteristics that meets the functional demands of their playing position. Excess body fat may reduce movement efficiency and repeated high-intensity performance, whereas insufficient skeletal muscle mass may compromise physical strength, explosive actions, and the ability to perform repeated high-intensity movements ([Reilly et al., 2000](#); [Sporis et al., 2009](#); [Sutton et al., 2009](#)). Previous research has consistently demonstrated position-specific differences in the body composition of football players. Goalkeepers and defenders are generally reported to be the tallest and heaviest players, whereas midfielders typically exhibit lower body mass and greater functional mobility. Forwards usually occupy an intermediate position within this morphological spectrum ([Matković et al., 2003](#); [Sporis et al., 2009](#); [Sutton et al., 2009](#)). More recent evidence further supports these positional differences. A systematic review by ([Sebastiá-Rico et al. 2023](#)) demonstrated that body composition, particularly skeletal muscle mass and fat-free mass, differs significantly according to playing position. Similarly, ([Slimani and Nikolaidis 2019](#)) concluded that body fat percentage, somatotype, and explosive strength represent important factors distinguishing football players across different playing positions and competitive levels. Contemporary positional profiling consistently places goalkeepers and central defenders at the upper end of the morphological spectrum. In a large sample of professional football players, ([Bongiovanni et al. 2023](#)) reported that goalkeepers and central forwards were the tallest and heaviest players, whereas central defenders exhibited the highest values for most body composition variables. Comparable findings have been reported in elite youth football, where goalkeepers and central defenders were significantly taller than players in other positions ([Sun et al., 2025](#)), while central defenders also demonstrated greater skeletal muscle mass than midfielders ([Leão et al., 2022](#)). Taken together, these findings provide an important reference framework for interpreting the present results and facilitate comparison of the observed positional differences with those reported in previous international studies. Despite the growing body of evidence, important questions regarding position-specific differences in body composition remain unresolved. First, methodological heterogeneity across previous studies limits the direct comparability of findings, as body composition has been assessed using different techniques, including skinfold measurements, bioelectrical impedance analysis, and dual-energy X-ray absorptiometry (DXA) ([Leão et al., 2019](#); [Sebastiá-Rico et al., 2023](#)). Second, most available evidence originates from highly developed football systems, whereas professional leagues in South-Eastern Europe remain underrepresented in the scientific literature ([Gontarev et al., 2016](#); [Matković et al., 2003](#)). Third, many studies do not clearly distinguish whether positional differences reflect absolute quantities of body tissues or their relative proportional distribution. This distinction is of practical importance rather than merely methodological. Absolute values, expressed in kilograms, represent the total amount of skeletal muscle, bone, or fat tissue and are particularly relevant for performance tasks that depend on overall body size, such as physical duels, aerial challenges, and defensive actions. In contrast, relative values, expressed as percentages of total body mass, reflect body composition independently of body size and are therefore more informative when evaluating movement efficiency and comparing players with different anthropometric characteristics. Because these two approaches provide complementary information, the present study examines both absolute and relative body composition variables. This enables a clearer interpretation of whether positional differences reflect greater quantities of specific tissues or genuine differences in body composition ([Bongiovanni et al., 2023](#); [Sebastiá-Rico et al., 2023](#)). These gaps also have important practical implications. Coaches, strength and conditioning specialists, and sports medicine practitioners frequently make decisions regarding individualized training programmes, nutritional strategies, and body composition targets throughout the competitive season. However, reference values derived from the strongest European football leagues are not always directly applicable to regional football environments, which may differ in their competitive standards, talent identification systems, and training methodologies. Consequently, additional evidence from domestic and regional football contexts is needed to improve our understanding of how internationally recognized positional body composition profiles are reflected in clubs operating under different organizational and competitive conditions ([Hencken & White, 2006](#); [Rienzi et al., 2000](#); [Sutton et al., 2009](#)). Against this background, the present study aimed to examine differences in body composition among first-league football players from FC *Sileks* according to their playing positions. Using multivariate and univariate analyses of variance, the study investigated whether defenders, midfielders, and

forwards differed in their overall body composition profiles and whether these differences were reflected in absolute or relative body composition variables. By addressing these questions, the study contributes to the limited body of evidence on body composition in professional football players from South-Eastern Europe and provides additional insight into the position-specific characteristics of body composition in elite football.

## Materials and methods

### *Participant sample*

The study employed a cross-sectional comparative design and included a purposive sample of 50 active male football players from FC *Sileks*, aged 17–30 years. All participants were regularly engaged in organized training and competitive match play during the study period. Players were classified according to their primary playing position within the team. For the comparative analyses, only outfield players were included and assigned to three positional groups: defenders ( $n = 20$ ), midfielders ( $n = 14$ ), and forwards ( $n = 16$ ). Goalkeepers were excluded because the limited number of players in this position did not permit meaningful statistical comparison. Before data collection, all participants received detailed information about the purpose and procedures of the study and the non-invasive nature of the measurements. Written informed consent was obtained from all participants prior to testing. For participants younger than 18 years of age, additional written informed consent was obtained from a parent or legal guardian. Participation was voluntary, and participants were informed of their right to withdraw from the study at any stage without any consequences. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and received approval from the appropriate institutional ethics committee for research involving human participants. All body composition assessments were performed using standardized measurement procedures.

### *Variables and measurement procedure*

Body composition was assessed using bioelectrical impedance analysis (BIA) with an InBody 720 body composition analyser (InBody 720, InBody Co., Ltd., Seoul, South Korea), a multifrequency tetrapolar device equipped with an eight-point tactile electrode system. Bioelectrical impedance analysis is widely used in sports science and field-based settings because it enables rapid, non-invasive assessment of multiple body composition components. However, accurate interpretation requires standardized measurement conditions, and caution is warranted when comparing results obtained using different body composition assessment methods ([Leão et al., 2019](#); [Torres-Luque et al., 2015](#); [Sebastiá-Rico et al., 2023](#)). Eight body composition variables were analysed: skeletal muscle mass (MMkg, kg), skeletal muscle mass (%; MM), bone mass (KMkg, kg), bone mass (%; KM), body fat mass (MTkg, kg), body fat percentage (%; MT), fat-free mass (LBM, kg), and body mass index (BMI, kg/m<sup>2</sup>). Body mass index was interpreted together with the remaining body composition variables because, in athletic populations, it does not differentiate between skeletal muscle mass and adipose tissue and therefore provides only limited information regarding body composition.

### *Measurement procedure*

Body composition measurements were performed under standardized conditions to ensure the accuracy and reliability of the obtained data. During each assessment, participants stood barefoot in an upright position on the analyser platform, with their feet and hands correctly positioned on the designated electrodes in accordance with the manufacturer's instructions. Upon completion of each measurement, body composition data were recorded and prepared for subsequent statistical analysis.

### *Statistical Data Processing*

Data were analysed using descriptive and inferential statistical procedures. Descriptive statistics included the calculation of the mean and standard deviation for each body composition variable within each playing-position group. Prior to inferential analyses, the assumptions underlying parametric testing were evaluated. Normality was assessed using the Shapiro–Wilk test, homogeneity of variances using Levene's test, and homogeneity of variance–covariance matrices using Box's M test. Multivariate analysis of variance (MANOVA) was performed to examine overall differences in body composition among defenders, midfielders, and forwards. Following a significant multivariate effect, separate univariate analyses of variance (ANOVA) were conducted for each body composition variable to identify the specific variables contributing to the observed group differences. Because Levene's test

indicated heterogeneous variances for several variables, the robustness of the ANOVA results was additionally verified using Welch's adjusted  $F$  test, which yielded consistent findings. Games–Howell post hoc comparisons were performed for variables showing significant group differences because this procedure is appropriate for unequal group sizes and heterogeneous variances. Effect sizes were estimated using partial eta squared ( $\eta^2_p$ ), interpreted as small ( $\approx .01$ ), medium ( $\approx .06$ ), and large ( $\approx .14$ ) according to Cohen's (1988) guidelines. Statistical significance was established at  $p < .05$ . All analyses were conducted using IBM SPSS Statistics (Version 26.0; IBM Corp., Armonk, NY, USA). The selection and reporting of statistical procedures followed established methodological recommendations for multivariate and univariate analyses in the behavioural and sport sciences (Field, 2018; Tabachnick & Fidell, 2019).

## Results

The results of the multivariate analysis of variance (MANOVA) are presented in Table 1. A statistically significant multivariate effect of playing position on body composition was observed (Wilks'  $\Lambda = .287$ ,  $F(18, 78) = 3.757$ ,  $p < .001$ ), indicating that defenders, midfielders, and forwards differed significantly in their overall body composition profiles. The remaining multivariate statistics (Pillai's Trace, Hotelling's Trace, and Roy's Largest Root) confirmed the same pattern of significance (Table 1). Following the significant multivariate effect, separate univariate analyses of variance (ANOVA) were performed for each body composition variable. As presented in Table 2, significant positional differences were identified in six of the eight analysed variables: skeletal muscle mass (MMkg:  $F = 8.89$ ,  $p = .001$ ,  $\eta^2_p = .27$ ), bone mass (KMkg:  $F = 4.67$ ,  $p = .014$ ,  $\eta^2_p = .17$ ), body fat mass (MTkg:  $F = 14.51$ ,  $p < .001$ ,  $\eta^2_p = .38$ ), body fat percentage (MT:  $F = 7.53$ ,  $p = .001$ ,  $\eta^2_p = .24$ ), fat-free mass (LBM:  $F = 10.72$ ,  $p < .001$ ,  $\eta^2_p = .31$ ), and body mass index (BMI:  $F = 7.38$ ,  $p = .002$ ,  $\eta^2_p = .24$ ). Effect sizes were large for all significant variables, indicating substantial positional differences in body composition. Although the Shapiro–Wilk and Levene tests indicated deviations from normality and homogeneity of variances for several variables, Welch's adjusted  $F$  tests yielded the same pattern of statistically significant results, supporting the robustness of the findings. No statistically significant positional differences were observed in the percentage of skeletal muscle mass (MM:  $F = 0.67$ ,  $p = .514$ ) or the percentage of bone mass (KM:  $F = 1.88$ ,  $p = .164$ ). As shown in Table 2, defenders exhibited the highest mean values for skeletal muscle mass, bone mass, body fat mass, body fat percentage, fat-free mass, and body mass index compared with midfielders and forwards. Games–Howell post hoc comparisons identified defenders as the primary source of the observed positional differences. Specifically, defenders differed significantly from both midfielders and forwards in skeletal muscle mass (kg), body fat mass (kg), body fat percentage, and fat-free mass. In addition, defenders demonstrated significantly higher bone mass than midfielders and a higher body mass index than forwards. No significant differences were observed between midfielders and forwards for any of the analysed body composition variables, indicating that the overall positional variation in this sample was driven predominantly by the distinct body composition profile of defenders.

Table 1 Multivariate Differences in Body Composition Assessment Variables Among the Three Groups of Participants Playing Different Positions

|                    | Value | F                  | Hypothesis df | Error df | Sig. |
|--------------------|-------|--------------------|---------------|----------|------|
| Pillai's trace     | .926  | 3.833              | 18.000        | 80.000   | .000 |
| Wilks' lambda      | .287  | 3.757 <sup>a</sup> | 18.000        | 78.000   | .000 |
| Hotelling's trace  | 1.743 | 3.680              | 18.000        | 76.000   | .000 |
| Roy's largest root | 1.002 | 4.455 <sup>b</sup> | 9.000         | 40.000   | .000 |

Table 2 Univariate Differences in Body Composition Assessment Variables Among the Three Groups of Participants Playing Different Positions

|      | Defenders |      | Midfielders |      | Forwards |      | F     | Sig.        |
|------|-----------|------|-------------|------|----------|------|-------|-------------|
|      | Mean      | SD   | Mean        | SD   | Mean     | SD   |       |             |
| MMkg | 43.36     | 2.32 | 39.57       | 4.67 | 38.22    | 4.44 | 8.89  | <b>.001</b> |
| MM   | 54.50     | 2.50 | 55.26       | 2.07 | 54.38    | 2.08 | 0.67  | .514        |
| KMkg | 13.48     | 1.32 | 12.42       | 0.65 | 12.32    | 1.57 | 4.67  | <b>.014</b> |
| KM   | 16.91     | 1.08 | 17.47       | 1.16 | 17.51    | 0.87 | 1.88  | .164        |
| MTkg | 11.89     | 2.12 | 9.61        | 1.05 | 9.39     | 0.90 | 14.51 | <b>.000</b> |
| MT   | 14.75     | 1.63 | 13.45       | 0.68 | 13.42    | 0.74 | 7.53  | <b>.001</b> |
| LBM  | 67.85     | 3.65 | 61.81       | 5.50 | 60.43    | 6.28 | 10.72 | <b>.000</b> |
| BMI  | 23.77     | 0.60 | 23.15       | 1.34 | 22.63    | 0.69 | 7.38  | <b>.002</b> |

*Note.* Bold p-values denote statistical significance ( $p < .05$ ). The effect sizes (partial eta squared,  $\eta^2p$ ) were large for the six significant variables: MMkg = .27, KMkg = .17, MTkg = .38, MT = .24, LBM = .31 and BMI = .24. The Games–Howell post hoc comparisons showed that defenders differed significantly from midfielders and from forwards, whereas midfielders and forwards did not differ significantly from each other on any variable. Group sizes: defenders  $n = 20$ , midfielders  $n = 14$ , forwards  $n = 16$ .

## Discussion

The findings of the present study demonstrate that body composition differs significantly according to playing position, with the most pronounced differences observed among defenders. Compared with midfielders and forwards, defenders exhibited greater skeletal muscle mass, bone mass, body fat mass, body fat percentage, fat-free mass, and body mass index. These findings are consistent with previous research demonstrating that football players occupying different playing positions exhibit distinct anthropometric, morphological, and physiological profiles that reflect the specific physical and functional demands of their roles (Reilly et al., 2000; Sporis et al., 2009; Sutton et al., 2009). The present results further indicate that football players should not be regarded as a morphologically homogeneous group, despite participating in the same sport and being exposed to comparable training environments. Football performance is determined by the interaction of technical-tactical, motor, physiological, and morphological characteristics. Consequently, playing position represents an important contextual factor that reflects the combined influence of talent identification, long-term training adaptations, and the specific physical demands associated with different tactical roles on the field (Reilly et al., 2000; Stølen et al., 2005). Higher absolute values of skeletal muscle mass, bone mass, and fat-free mass observed in defenders are likely related to the specific functional demands of this playing position. Defenders are more frequently involved in physical contact, aerial duels, blocking actions, and maintaining positional stability, all of which require greater strength, robustness, and overall physical capacity. These observations are consistent with previous research demonstrating that the physical, physiological, and anthropometric profiles of football players vary according to playing position and reflect the specific movement patterns and match demands associated with each tactical role (Bloomfield et al., 2007; Sporis et al., 2009). Recent international evidence further supports this interpretation. In a large cohort of professional football players, (Bongiovanni et al. 2023) reported that defenders and other players occupying central field positions exhibited superior body composition characteristics compared with players in midfield and attacking roles. Similar positional patterns have been observed in elite youth football, where central defenders were consistently among the most physically robust outfield players (Sun et al., 2025) and demonstrated greater skeletal muscle mass than midfielders (Leão et al., 2022). The consistency of these findings across different countries, competitive levels, and age groups suggests that the robust body composition profile observed among defenders in the present study reflects a broadly consistent position-specific characteristic rather than a context-dependent phenomenon. An important contribution of the present study is the simultaneous evaluation of both absolute and relative body composition variables. Although defenders exhibited significantly greater skeletal muscle mass and bone mass expressed in kilograms, no significant positional differences were observed in the percentage of these components. This finding suggests that the distinctive body composition profile of defenders is primarily attributable to their larger overall body size rather than to differences in the proportional distribution of body tissues. These results support previous recommendations that body composition in football players should be evaluated using multiple complementary indicators rather than relying solely on percentage-based measures

([Sutton et al., 2009](#); [Sebastiá-Rico et al., 2023](#)). Recent evidence further reinforces this interpretation. Studies of professional football players have shown that positional differences are expressed predominantly through variations in overall body size and absolute tissue mass rather than through substantial differences in relative body composition ([Bongiovanni et al., 2023](#); [Sebastiá-Rico et al., 2023](#)). Consequently, the body composition profile of defenders observed in the present study is consistent with the position-specific patterns reported in the contemporary literature. The higher body fat mass and body fat percentage observed among defenders should also be interpreted within the context of the functional demands of their playing position. In football, greater body mass is not inherently disadvantageous, as it may reflect higher levels of skeletal muscle mass and fat-free mass that contribute to strength and physical performance. Nevertheless, when increased body mass is accompanied by a greater proportion of body fat, its functional significance should be evaluated in relation to the specific physical demands of the playing position. Contemporary research emphasizes that optimal body composition cannot be defined using a single standard across all playing positions, as its interpretation depends on positional role, tactical requirements, and the individual characteristics of each player ([Reilly et al., 2000](#); [Sutton et al., 2009](#); [Sebastiá-Rico et al., 2023](#)). The lower absolute body composition values observed in midfielders and forwards compared with defenders should be interpreted in the context of the distinct functional demands associated with these playing positions. Midfielders are typically characterized by a high volume of continuous movement and frequent transitions between attacking and defensive phases, whereas forwards perform repeated explosive accelerations, short sprints, rapid changes of direction, and goal-scoring actions. Because the present study did not include direct assessments of physical performance or match activity, these explanations should be regarded as plausible functional interpretations rather than confirmed causal relationships ([Bloomfield et al., 2007](#); [Stølen et al., 2005](#)). The observed positional differences are likely influenced by several interacting mechanisms. First, talent identification and player selection may contribute to these profiles, as athletes with a larger body frame are frequently allocated to defensive positions. Consequently, the body composition profile of defenders may partly reflect long-term positional selection rather than training adaptations alone. Second, accumulated position-specific training stimuli may progressively influence muscular and skeletal development in accordance with the physical demands of each playing role ([Nobari et al., 2021](#); [Soós et al., 2022](#)). Finally, biological growth and maturation should also be considered, particularly because the present sample included younger players. Maturity-related differences are known to influence body size and body composition during late adolescence and may therefore accentuate apparent positional differences ([Dut et al., 2023](#)). Disentangling the relative contributions of talent identification, long-term training adaptations, and biological maturation will require longitudinal studies incorporating appropriate measures of biological maturity. Nevertheless, acknowledging these interacting influences allows the present findings to be interpreted within a broader developmental and performance context. Differences in body mass index (BMI) provide additional evidence of position-specific variation in body composition while simultaneously highlighting the limitations of BMI as an isolated indicator in athletic populations. In football players, an elevated BMI may reflect greater skeletal muscle mass and fat-free mass rather than excess adiposity, although it may also be associated with increased body fat. Consequently, BMI should always be interpreted alongside more detailed body composition measures rather than being used as a stand-alone indicator of morphological status ([Sebastiá-Rico et al., 2023](#)). From a theoretical perspective, the present findings support the concept that each playing position is associated with a distinct body composition profile. More importantly, they demonstrate that positional differences are not solely attributable to greater overall body mass but also depend on the specific body components contributing to that mass and on whether these differences are expressed as absolute or relative values. In the present study, defenders exhibited significantly greater absolute values for several body composition components, whereas the relative proportions of skeletal muscle and bone mass did not differ significantly across playing positions. This finding reinforces the importance of evaluating both absolute and relative body composition variables when profiling football players ([Sutton et al., 2009](#); [Sebastiá-Rico et al., 2023](#)). The practical implications of these findings are relevant for coaches, strength and conditioning specialists, and sports medicine practitioners involved in football player development. Position-specific body composition profiles should be considered when designing training programmes, monitoring seasonal adaptations, and supporting talent identification. For defenders, priority should be given to maintaining functional skeletal muscle and fat-free mass while controlling body fat levels. For midfielders and forwards, emphasis should be placed on maintaining an optimal body composition that supports repeated high-intensity efforts, speed, and movement efficiency. Such an approach is consistent with the contemporary view that football performance is determined by the interaction of multiple physical, physiological, technical-tactical, and psychological factors

([Stølen et al., 2005](#); [Wisløff et al., 2004](#)). The principal contribution of the present study lies in its regional perspective. Evidence describing the body composition of first-division football players from South-Eastern Europe remains limited, and locally derived reference data are still scarce. The present findings therefore provide a valuable reference for player assessment, monitoring, and training individualization within comparable regional football environments. At the same time, the observed position-specific body composition profiles closely resemble those reported in international studies, suggesting that the regional patterns identified in this sample are consistent with broader trends observed across professional football ([Bongiovanni et al., 2023](#); [Collins et al., 2021](#); [Sebastiá-Rico et al., 2023](#)). Consequently, the study both strengthens the regional evidence base and complements the existing international literature by providing context-specific data from an underrepresented football environment. Several limitations of the present study should be acknowledged. First, the sample comprised players from a single professional club, which limits the generalizability of the findings to other clubs, leagues, and competitive levels. Second, the relatively small number of players within each positional group may have reduced the statistical power to detect more subtle differences. Third, goalkeepers were excluded from the comparative analyses because of the limited sample size, despite evidence indicating that they possess distinct body composition characteristics. Fourth, the cross-sectional design does not permit causal inference; consequently, it cannot be determined whether the observed positional differences reflect talent identification, long-term training adaptations, biological maturation, or the combined influence of these factors. Finally, body composition was assessed using bioelectrical impedance analysis, a practical and widely used field-based method that, despite its advantages, is less precise than reference techniques such as dual-energy X-ray absorptiometry (DXA) and may be influenced by prediction equations and measurement conditions ([Campa et al., 2023](#); [Sebastiá-Rico et al., 2023](#); [Sutton et al., 2009](#)).

Future research should include larger and more representative samples involving players from different clubs, competitive levels, and age categories. Longitudinal studies conducted across different phases of the competitive season would provide valuable insight into seasonal changes in body composition and clarify the extent to which positional differences reflect long-term training adaptations. Future investigations should also integrate body composition assessment with objective measures of physical performance, including speed, agility, explosive strength, aerobic capacity, repeated sprint ability, and match-performance indicators. Such a multidimensional approach would provide a more comprehensive understanding of the relationship between body composition and the functional demands associated with different playing positions. Overall, the present study demonstrates that body composition is an important determinant of position-specific profiling in football. The most notable finding is that positional differences were expressed primarily through absolute body composition variables, whereas the relative percentages of skeletal muscle and bone mass remained comparable across playing positions. These findings reinforce the importance of evaluating football players using a position-specific and multidimensional approach in which body composition is interpreted together with physical, physiological, technical-tactical, and psychological characteristics rather than as an isolated determinant of performance ([Reilly et al., 2000](#); [Sporis et al., 2009](#); [Sutton et al., 2009](#); [Sebastiá-Rico et al., 2023](#)).

## Conclusion

The findings of the present study demonstrate that football players occupying different playing positions differ significantly in their body composition characteristics. The most pronounced differences were observed among defenders, who exhibited greater skeletal muscle mass, bone mass, body fat mass, fat-free mass, and body mass index than midfielders and forwards. No significant positional differences were identified in the relative percentages of skeletal muscle and bone mass, indicating that positional variation was driven primarily by differences in the absolute quantity of body tissues rather than by proportional body composition. This distinction represents one of the principal contributions of the present study and highlights the importance of considering both absolute and relative body composition variables when evaluating football players. From a practical perspective, the findings support the use of body composition assessment as a valuable component of talent identification, player monitoring, and the individualization of training programmes. The principal contribution of this study is regional, as it expands the limited evidence on body composition in first-division football players from South-Eastern Europe and provides locally relevant reference data for position-specific player profiling. Although the observed positional patterns are consistent with those reported in international studies, further multi-club and

multinational investigations are required to establish broader reference values and determine the extent to which these findings can be generalized across different football environments.

## Declarations

### Conflict of Interest Statement

The authors declare no conflict of interest.

### Funding Statement

This research received no external funding.

### Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

### Ethical Statement

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki and relevant institutional ethical standards. The research was carried out as part of the author's PhD thesis entitled "*Transformational Morpho-Functional and Motor Effects of a Specially Programmed Functional Training Regimen in Football Players Performing at Different Playing Positions*" at the Faculty of Physical Education, Sport and Health, Ss. Cyril and Methodius University in Skopje. The doctoral research project was approved by the Faculty Council under archival/reference number 0201-644/7.1 (13 July 2018). All participants provided written informed consent prior to participation, while written parental or legal guardian consent was additionally obtained for participants under 18 years of age. Participation was voluntary, and participants were free to withdraw from the study at any stage without consequences.

### Author Contributions (CRediT Taxonomy)

Conceptualization: Z.T.; Methodology: Z.T. and S.G.; Software: Z.T.; Validation: S.G.; Formal analysis: Z.T.; Investigation: Z.T.; Resources: S.G.; Data curation: Z.T.; Writing – original draft preparation: Z.T.; Writing – review and editing: Z.T. and S.G.; Visualization: Z.T.; Supervision: S.G. All authors have read and agreed to the published version of the manuscript.

## References

- Bangsbo, J. (1994). The physiology of soccer with special reference to intense intermittent exercise. *Acta Physiologica Scandinavica. Supplementum*, 619, 1-155.
- Bloomfield, J., Polman, R., & O'Donoghue, P. (2007). Physical demands of different positions in FA Premier League soccer. *Journal of Sports Science and Medicine*, 6(1), 63-70.
- Bongiovanni, T., Rossi, A., Genovesi, F., Martera, G., Puleo, G., Orlandi, C., Spedicato, M., Iaia, F. M., Del Vescovo, R., Gallo, S., Cannataro, R., Ripari, P., Levi Micheli, M., Cataldi, S., & Trecroci, A. (2023). How do football playing positions differ in body composition? A first insight into white Italian Serie A and Serie B players. *Journal of Functional Morphology and Kinesiology*, 8(2), Article 80. <https://doi.org/10.3390/jfmk8020080>
- Campa, F., Bongiovanni, T., Rossi, A., Cerullo, G., Casolo, A., Martera, G., Trecroci, A., Moro, T., & Paoli, A. (2023). Athletic bioimpedance-based equations underestimate fat free mass components in male elite soccer players: Development and validation of new soccer-specific predictive models. *Journal of Translational Medicine*, 21, Article 912. <https://doi.org/10.1186/s12967-023-04795-z>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd ed.)*. Lawrence Erlbaum Associates.
- Collins, J., Maughan, R. J., Gleeson, M., Bilborough, J., Jeukendrup, A., Morton, J. P., ... McCall, A. (2021). UEFA expert group statement on nutrition in elite football: Current evidence to inform practical

- recommendations and guide future research. *British Journal of Sports Medicine*, 55(8), 416. <https://doi.org/10.1136/bjsports-2019-10196>
- Dut, R., Akgül, S., Dönmez, G., Ulkar, B., Kanbur, N., & Derman, O. (2023). Adolescent male soccer players have higher growth rates and risk of injury is associated with biological maturity. *The Turkish Journal of Pediatrics*, 65(6), 990-1001. <https://doi.org/10.24953/turkijped.2023.140>
- Field, A. (2018). *Discovering statistics using IBM SPSS Statistics (5th ed.)*. SAGE Publications.
- Gontarev, S., Kalac, R., Zivkovic, V., Ameti, V., & Redjepi, A. (2016). Anthropometrical characteristics and somatotype of young Macedonian soccer players. *International Journal of Morphology*, 34(1), 160-167. <https://doi.org/10.4067/S0717-95022016000100024>
- Hencken, C., & White, C. (2006). Anthropometric assessment of Premiership soccer players in relation to playing position. *European Journal of Sport Science*, 6(4), 205-211. <https://doi.org/10.1080/17461390601012553>
- Leão, C., Camões, M., Clemente, F. M., Nikolaidis, P. T., Lima, R., Bezerra, P., Rosemann, T., & Knechtle, B. (2019). Anthropometric profile of soccer players as a determinant of position specificity and methodological issues of body composition estimation. *International Journal of Environmental Research and Public Health*, 16(13), Article 2386. <https://doi.org/10.3390/ijerph16132386>
- Leão, C., Silva, A. F., Badicu, G., Clemente, F. M., Carvutto, R., Greco, G., Cataldi, S., & Fischetti, F. (2022). Body composition interactions with physical fitness: A cross-sectional study in youth soccer players. *International Journal of Environmental Research and Public Health*, 19(6), Article 3598. <https://doi.org/10.3390/ijerph19063598>
- Matković, B. R., Misigoj-Duraković, M., Matković, B., Janković, S., Ružić, L., Leko, G., & Kondrič, M. (2003). Morphological differences of elite Croatian soccer players according to the team position. *Collegium Antropologicum*, 27(Suppl. 1), 167-174.
- Nobari, H., Oliveira, R., Clemente, F. M., Pérez-Gómez, J., Pardos-Mainer, E., & Ardigò, L. P. (2021). Somatotype, accumulated workload, and fitness parameters in elite youth players: Associations with playing position. *Children*, 8(5), Article 375. <https://doi.org/10.3390/children8050375>
- Reilly, T., Bangsbo, J., & Franks, A. (2000). Anthropometric and physiological predispositions for elite soccer. *Journal of Sports Sciences*, 18(9), 669-683. <https://doi.org/10.1080/02640410050120050>
- Rienzi, E., Drust, B., Reilly, T., Carter, J. E. L., & Martin, A. (2000). Investigation of anthropometric and work-rate profiles of elite South American international soccer players. *Journal of Sports Medicine and Physical Fitness*, 40(2), 162-169.
- Sebastiá-Rico, J., Soriano, J. M., González-Gálvez, N., & Martínez-Sanz, J. M. (2023). Body composition of male professional soccer players using different measurement methods: A systematic review and meta-analysis. *Nutrients*, 15(5), Article 1160. <https://doi.org/10.3390/nu15051160>
- Slimani, M., & Nikolaidis, P. T. (2019). Anthropometric and physiological characteristics of male soccer players according to their competitive level, playing position and age group: A systematic review. *Journal of Sports Medicine and Physical Fitness*, 59(1), 141-163. <https://doi.org/10.23736/S0022-4707.17.07950-6>
- Soós, I., Boryśławski, K., Boraczyński, M., Ihasz, F., & Podstawski, R. (2022). Anthropometric and physiological profiles of Hungarian youth male soccer players of varying ages and playing positions: A multidimensional assessment with a critical approach. *International Journal of Environmental Research and Public Health*, 19(17), Article 11041. <https://doi.org/10.3390/ijerph191711041>
- Sporis, G., Jukic, I., Ostojic, S. M., & Milanovic, D. (2009). Fitness profiling in soccer: Physical and physiologic characteristics of elite players. *Journal of Strength and Conditioning Research*, 23(7), 1947-1953. <https://doi.org/10.1519/JSC.0b013e3181b3e141>
- Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. (2005). Physiology of soccer: An update. *Sports Medicine*, 35(6), 501-536. <https://doi.org/10.2165/00007256-200535060-00004>
- Sun, Z., Liu, X., Fu, H., Shen, S., & Zhou, X. (2025). Comparisons of the anthropometric and physical characteristics of young elite Chinese male soccer players by age and playing position. *BMC Sports Science, Medicine and Rehabilitation*, 17(1), Article 22. <https://doi.org/10.1186/s13102-025-01070-0>
- Sutton, L., Scott, M., Wallace, J., & Reilly, T. (2009). Body composition of English Premier League soccer players: Influence of playing position, international status, and ethnicity. *Journal of Sports Sciences*, 27(10), 1019-1026. <https://doi.org/10.1080/02640410903030305>
- Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics (7th ed.)*. Pearson.

- Torres-Luque, G., Calahorra-Cañada, F., Lara-Sánchez, A. J., Garatachea, N., Nikolaidis, P. T., & Hassan, B. (2015). Body composition using bioelectrical impedance analysis in elite young soccer players: The effects of age and playing position. *Sport Sciences for Health*, 11(2), 203-210. <https://doi.org/10.1007/s11332-015-0226-0>
- Wisløff, U., Castagna, C., Helgerud, J., Jones, R., & Hoff, J. (2004). Strong correlation of maximal squat strength with sprint performance and vertical jump height in elite soccer players. *British Journal of Sports Medicine*, 38(3), 28