



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

## Performance profiles of professional male beach soccer players: Evidence from the Serbian national team

### Perfiles de rendimiento de jugadores profesionales masculinos de fútbol playa: Evidencia del equipo nacional de Serbia

Milan Pašić<sup>1</sup>; Nemanja Čopić<sup>1</sup>

<sup>1</sup>Faculty of Sport, University "Union – Nikola Tesla", Belgrade, Serbia

\*Correspondence Author: Milan Pašić, [milan.pasic@fzs.edu.rs](mailto:milan.pasic@fzs.edu.rs)

**Editorial schedule:** Article received 11/03/2026 Accepted: 19/05/2026 Published: 01/07/2026

<https://doi.org/10.55040/8nkzrs86>

#### To cite this article, use the following reference:

Pašić, M.; Čopić, N. (2026). Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. *Sportis Sci J*, 12 (3), 1-27 <https://doi.org/10.55040/8nkzrs86>

#### Specific contribution of the authors:

M.P. and N.C. conceptualized the study, designed the methodology, collected and analyzed the data. M.P. wrote the original draft of the manuscript. N.C. handled review and editing.

#### Funding

The authors reported there is no funding associated with the work featured in this article.

#### Informed consent for study participants:

All participants provided written informed consent.

#### Conflict of interest

No potential conflict of interest was reported by the authors.

#### Acknowledgements

We extend our sincere gratitude to the players and coaching staff of the Serbian national beach soccer team for their professionalism and cooperation throughout this study.

#### Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT o1 Pro (OpenAI) and Grammarly (Grammarly Inc.) to proofread the manuscript for grammar, syntax, and overall clarity.

Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

### Abstract

This study aimed to examine the performance profile of elite male beach soccer players, with particular emphasis on anthropometric characteristics, physical capacities, and neuromuscular function across playing positions. A total of eighteen professional players from the Serbian national team ( $28.7 \pm 5.62$  years;  $182.7 \pm 4.99$  cm;  $82.1 \pm 7.57$  kg) participated, including goalkeepers ( $n = 3$ ), defenders ( $n = 5$ ), midfielders ( $n = 5$ ), and forwards ( $n = 5$ ). All participants underwent a comprehensive battery of assessments, including body composition, sprint performance (5 m, 10 m, and flying 5 m), agility (zig-zag and 505 tests), lower-body power (countermovement and squat jumps), and flexibility (sit-and-reach). Large positional effects were observed for countermovement jump ( $\epsilon^2 = 0.343$ ), squat jump ( $\epsilon^2 = 0.325$ ), and flexibility ( $\epsilon^2 = 0.325$ ). Correlation analyses indicated significant relationships among body composition, sprint, agility, and neuromuscular outputs. Regression models indicated that higher body fat was associated with slower sprint times ( $\beta = 0.61-0.62$ ,  $p < 0.01$ ), whereas greater body muscle ( $\beta = -0.53$  to  $-0.51$ ,  $p < 0.05$ ) and higher countermovement jump ( $\beta = -0.48$ ,  $p = 0.046$ ) were associated with faster sprint performance. These findings provide coaches with a practical, exploratory position-specific reference profile for anthropometric and physical profiling in elite beach soccer. Future research should incorporate sand-specific testing to enhance evaluation, training optimisation, and injury prevention.

**Keywords:** anthropometry; physical fitness; sand sports; sports performance

### Resumen

Este estudio tuvo como objetivo examinar el perfil de rendimiento de jugadores masculinos de élite de fútbol playa, con especial énfasis en las características antropométricas, las capacidades físicas y la función neuromuscular según la posición de juego. Un total de dieciocho jugadores profesionales de la selección nacional de Serbia ( $28.7 \pm 5.62$  años;  $182.7 \pm 4.99$  cm;  $82.1 \pm 7.57$  kg) participaron en el estudio, incluidos porteros ( $n = 3$ ), defensores ( $n = 5$ ), centrocampistas ( $n = 5$ ) y delanteros ( $n = 5$ ). Todos los participantes realizaron una batería completa de evaluaciones, que incluyó composición corporal, rendimiento en sprint (5 m, 10 m y 5 m lanzados), agilidad (pruebas zig-zag y 505), potencia del tren inferior (saltos countermovement y squat) y flexibilidad (sit-and-reach). Se observaron efectos posicionales elevados en el salto countermovement ( $\epsilon^2 = 0.343$ ), el salto squat ( $\epsilon^2 = 0.325$ ) y la flexibilidad ( $\epsilon^2 = 0.325$ ). Los análisis de correlación indicaron relaciones significativas entre la composición corporal, la velocidad de sprint, la agilidad y las variables neuromusculares. Los modelos de regresión mostraron que un mayor porcentaje de grasa corporal se asoció con tiempos de sprint más lentos ( $\beta = 0.61-0.62$ ,  $p < 0.01$ ), mientras que una mayor masa muscular ( $\beta = -0.53$  a  $-0.51$ ,  $p < 0.05$ ) y un mayor rendimiento en el salto countermovement ( $\beta = -0.48$ ,  $p = 0.046$ ) se asociaron con un mejor rendimiento en sprint. Estos hallazgos proporcionan a los entrenadores un perfil de referencia práctico, exploratorio y específico por posición para el perfilado antropométrico y físico en el fútbol playa de élite. Investigaciones futuras deberían incorporar pruebas específicas en arena para mejorar la evaluación, la optimización del entrenamiento y la prevención de lesiones.

**Palabras clave:** antropometría; condición física; deportes en arena; rendimiento deportivo



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

## Introduction

Beach soccer (BS) has evolved from traditional football into a distinct discipline characterized by unique technical, physiological, and tactical demands. The unstable sand surface, barefoot movement, and modified rules create a performance context that substantially alters movement patterns, force production, and game dynamics (FIFA, 2024; Kostenko, 2023; Leite & Barreira, 2014). Within contemporary sport science, performance in team sports is increasingly understood as a multidimensional construct, emerging from the continuous interaction between physical capacities, technical execution, tactical organisation, and perceptual-cognitive skills.

In this regard, tactical behaviour represents a central integrative component of performance, as it constrains and shapes the expression of physical and technical abilities during competition. In BS, the reduced playing area, frequent transitions, and high-scoring nature of the game places a premium on rapid decision-making, spatial awareness, and coordinated team actions under time pressure. Match analyses in elite BS has shown that the unstable sand surface produces irregular rebounds that hinder precise passing and make coordinated team play difficult to implement, forcing players to rely on quick individual decisions within small-group contexts (Scarfone & Ammendolia, 2016). FIFA technical reports highlight that successful teams increasingly employ innovative tactical systems specifically designed for the unique demands of BS, such as strategic player positioning to facilitate rapid attacking transitions (FIFA Technical Study Group, 2024). These characteristics differentiate BS not only from traditional football but also from other small-sided games, requiring context-specific investigation rather than direct generalisation from related sports.

Current evidence indicates that BS demands higher intensity than football or futsal, largely due to the mechanical resistance of sand (Leite, 2016a). The sport's substitution rules allow coaches to facilitate the maintenance of a high tempo (Leite, 2016b). While speed, agility, and explosive lower-limb strength have been associated with competitive success (McGowan et al., 2023), the specific relationships between anthropometric characteristics, neuromuscular function, and performance in elite BS remain poorly understood.



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

Playing positions in BS impose distinct physical and technical demands. Goalkeepers require rapid reactions and explosive power; defenders and midfielders perform frequent accelerations and changes of direction; attackers depend on sprint speed, agility, and coordination for complex actions such as volleys and bicycle kicks (Lima et al., 2024; Lima et al., 2025; Vaccaro Benet et al., 2024). Positional profiling is widely recognized as valuable for optimizing training and talent identification in team sports (Kostenko, 2025; Nalbant & Süer, 2025). Nevertheless, BS remains substantially underexplored in the scientific literature compared with football and futsal. Previous studies have primarily focused on general physiology or injury patterns, leaving positional demands and inter-limb asymmetries largely unexamined (Leite & Barreira, 2014; Muazu Musa et al., 2020). Examining leg dominance and neuromuscular symmetry may provide insights into both performance and injury prevention on sand.

Despite the global expansion of BS, scientific research has not kept pace, creating a gap in empirical data. Coaches often rely on personal experience or adapt training models from surface-based football that do not account for sand-specific challenges. What remains unknown is how anthropometric, neuromuscular, speed, agility, and asymmetry variables collectively profile elite BS players across different positions. Furthermore, the interplay between neuromuscular variables and speed-agility performance in this specific context has not been systematically investigated.

The primary objective of this study was to examine the performance profiles of elite male BS players, with a focus on anthropometric characteristics, physical capacities, and neuromuscular function across playing positions. A secondary objective was to analyze the relationships between neuromuscular variables and speed–agility performance.

## Methodology

### *Study design*

A cross-sectional, observational study with a descriptive-analytical approach was conducted to primarily profile the anthropometric characteristics, neuromuscular abilities, speed, agility, flexibility, and technical–motor performance of elite professional male BS players. The primary objective was to characterize the performance profiles of



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

international-level players across playing positions (goalkeeper, defender, midfielder, forward), thereby establishing positional reference data. A secondary objective was to analyze the relationships between neuromuscular variables and speed-agility performance. Although descriptive in orientation, the analytical approach incorporates correlation and regression analyses to explore multidimensional performance structures. Ethical approval was obtained from the institutional ethics committee (approval number: 127/1/18), and all procedures adhered to the Declaration of Helsinki. All participants provided written informed consent.

### *Participants*

Eighteen elite male players from the Serbian national BS team participated voluntarily ( $n = 18$ ). Players were categorized by primary playing position: goalkeepers (GK,  $n = 3$ ), defenders (DF,  $n = 5$ ), midfielders (MF,  $n = 5$ ), and forwards (FW,  $n = 5$ ). All players were active internationals with  $4.3 \pm 1.9$  years of BS experience, including participation in FIFA Beach Soccer World Cup qualification (UEFA), the Euro Beach Soccer League, and the Euro Beach Soccer Cup. Players also had  $9.8 \pm 5.2$  years of prior senior football experience. Participant characteristics (age, height, weight, body fat percentage, body muscle percentage, and body mass index) are presented in Table 1 (global and by position). Performance level was classified as "elite" according to McKay et al. (2022), based on international competition participation at the highest level.

### *Experimental procedures*

Data were collected over a one-week period during the preparatory phase of the competitive season (summer training period), following two weeks of standardized team training. This ensured that players were in a stable physiological state, without acute competition-induced fatigue. Players completed six training sessions per week (90–120 minutes each). All tests were conducted in the morning (09:00–11:00) on a standardized sandy surface (20–24°C). To ensure consistency, all participants completed the same testing protocol in a fixed sequence of anthropometric assessment, neuromuscular testing, speed testing, agility testing, flexibility assessment, and technical–motor testing.



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

### ***Data collection procedures***

All participants completed a familiarization session one week before testing, where they practiced each test. On the testing day, they completed a standardized warm-up (10 minutes of light running and mobility work plus 10 minutes of dynamic stretching), and all measurements were taken by the same trained examiner, with equipment calibrated daily.

### ***Anthropometric characteristics and body composition***

All anthropometric characteristics and body composition measurements were performed by the same examiner under controlled conditions: morning testing, standardized hydration status, and no intense physical activity for at least 24 hours prior to testing. Participants were tested barefoot. Regarding pre-testing nutrition and hydration, participants maintained their habitual routines and were asked to refrain from eating for at least two hours before testing. No further nutritional or hydration standardization was imposed, as the study was conducted under field-based conditions with elite athletes who maintained consistent daily routines. Body height was measured using a portable stadiometer to the nearest 0.1 cm, following standard anthropometric procedures. Body composition variables, including body mass (kg), body fat percentage (%), and body muscle percentage (%), were assessed using bioelectrical impedance analysis (BIA) via Tanita BC-730F (Tanita, Amsterdam, Netherlands), from which body mass index (BMI) was subsequently calculated as kg/m<sup>2</sup>. It should be noted that the principles of the International Society for the Advancement of Kinanthropometry (ISAK) were applied only to height measurement (Marfell-Jones et al., 2012), whereas body composition was assessed indirectly via BIA.

### ***Performance tests***

Sprint and agility performance were measured using photoelectric timing gates (Microgate, Bolzano, Italy) with a time resolution of 0.001 seconds. All tests were conducted barefoot on a standardized sand surface, following beach soccer competition rules.



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

Linear speed was assessed using three sprint tests: a 5-m standing start (S5m) to evaluate initial acceleration, a 5-m flying sprint (S5Fm) to assess maximal sprint speed, and a 10-m standing start (S10m). Each test was performed twice with 2–3 minutes of recovery between trials, and the best time was retained for analysis.

Change-of-direction ability was evaluated using the 505 agility test with both the dominant (505DL) and non-dominant leg (505NDL), as well as the zig-zag agility test performed without the ball (ZZ) and with ball control (ZZWB). Completion time was recorded in seconds. Each test was performed twice with 2–3 minutes of recovery between trials, and the best time was retained. Testing both limbs allowed for the calculation of inter-limb asymmetry (DiffDL–NDL). The change-of-direction deficit (Codd) was derived as the difference between the 505 test time and the 10-m sprint time (Codd = 505 – S10m). To examine how ball control affects movement efficiency, a zig-zag performance index was calculated (ZZPI = ZZ ÷ ZZWB), reflecting the impact of technical skill on agility performance.

Explosive lower-body power was assessed using the countermovement jump (CMJ) and the squat jump (SJ). Jump height was measured with the Optojump Next system (Microgate, Bolzano, Italy) to a precision of 0.1 cm. Each participant performed three trials per jump with 30-second recovery intervals, and the best result was used for analysis. From these measures, the stretch-shortening cycle index (SSCI = [(CMJ – SJ) ÷ SJ] × 100) and the eccentric utilization ratio (EUR = CMJ ÷ SJ) were calculated as indicators of neuromuscular efficiency.

Hamstring flexibility was assessed using the sit-and-reach test. Two trials were performed, and the best result was recorded in centimetres.

The selected test battery consists of widely used, field-based measures that are well validated in team sports for assessing acceleration, maximal speed, agility, and change-of-direction ability on unstable sand surfaces, neuromuscular power, flexibility, and technical-motor integration. These variables are particularly relevant to beach soccer because movement on sand demands greater neuromuscular coordination, stability, and energy expenditure than on firm surfaces.



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

### *Statistical analysis*

Data are presented as mean  $\pm$  standard deviation, along with 95% confidence intervals (CI). Normality of distribution was assessed using the Shapiro–Wilk test. Most variables met the assumption of normality ( $p > 0.05$ ), with the exception of the 5-m sprint (S5m), which showed a deviation ( $p = 0.021$ ). Due to the small sample size ( $n = 18$ ), all results were interpreted with caution. However, because parametric tests are generally robust to moderate violations of normality in samples of this size, parametric procedures were retained for variables meeting normality assumptions. For regression analyses specifically, results are treated as exploratory and hypothesis-generating rather than confirmatory, with no claims of generalizability.

To describe positional characteristics, non-parametric procedures were applied, primarily due to the small sample size and the possibility of unequal variances between groups. Accordingly, the Kruskal-Wallis test was used to examine differences in variable distributions across playing positions. Since the main focus of the study was on profiling, greater emphasis was paid to effect sizes ( $\epsilon^2$ ), as they provide a better indication of practical relevance. Effect sizes were interpreted as small (0.01–0.059), medium (0.06–0.139), and large ( $\geq 0.14$ ). In line with the second aim of the study, the relationships between neuromuscular variables and speed and agility performance were examined using Spearman's rank correlation coefficients ( $\rho$ ). Correlations were interpreted as weak (0.30–0.49), moderate (0.50–0.69), and strong ( $\geq 0.70$ ).

In addition, as an exploratory component of the analysis, multiple linear regression models were used to examine the contributions of body composition and neuromuscular performance variables to sprint performance. Sprint outcomes (S5Fm and S10m) were treated as dependent variables, while body fat percentage, body muscle percentage, and CMJ were included as predictors. Model performance was assessed using the coefficient of determination ( $R^2$ ) and adjusted  $R^2$ , along with the F-test as an indicator of overall model fit. Standardized beta coefficients ( $\beta$ ) were reported to describe the relative contribution of predictors, while variance inflation factors (VIF) were used to assess potential multicollinearity.

All statistical analyses were performed using IBM SPSS Statistics (version 26.0), with the level of statistical significance set at  $p \leq 0.05$ .



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

## Results

### *Descriptive statistics*

All 18 participants completed all measurements without any missing data or exclusions. This study aimed to profile the anthropometric and physical performance characteristics of elite male BS players, both globally and across playing positions. Descriptive statistics for anthropometric characteristics and body composition are presented in Table 1, and physical performance variables in Table 2.

GK were the tallest and heaviest players, recording the highest body fat percentage. DF exhibited the lowest body fat percentage and the highest body muscle proportion. MF and FW fell between these extremes, showing average anthropometric profiles compared to the other roles.

The wide CIs observed for several anthropometric variables reflect the study's limited sample size, meaning population estimates should be interpreted with caution. This variability is most pronounced in age, height, weight, and body composition markers across playing positions. GK and DF exhibit the broadest intervals, indicating that these specific groups are less physically homogeneous than MF or FW.

Table 1. Anthropometric characteristics and body composition by playing position

| Variable                 | GK (n = 3)<br>Mean ± SD<br>[95% CI] | DF (n = 5)<br>Mean ± SD<br>[95% CI] | MF (n = 5)<br>Mean ± SD<br>[95% CI] | FW (n = 5)<br>Mean ± SD<br>[95% CI] | Total (n = 18)<br>Mean ± SD<br>[95% CI] |
|--------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-----------------------------------------|
| Age (years)              | 29.0 ± 3.0<br>[21.5–36.4]           | 28.4 ± 7.92<br>[18.6–38.2]          | 25.6 ± 3.58<br>[21.2–30.0]          | 32.0 ± 5.34<br>[25.4–38.6]          | 28.7 ± 5.62<br>[25.9–31.5]              |
| Height (cm)              | 186.7 ± 4.73<br>[174.9–<br>198.4]   | 181.5 ± 2.87<br>[177.9–<br>185.1]   | 182.4 ± 7.4<br>[173.2–<br>191.6]    | 181.7 ± 4.12<br>[176.6–<br>186.8]   | 182.7 ± 4.99<br>[180.2–185.1]           |
| Weight (kg)              | 90.8 ± 4.65<br>[79.2–102.3]         | 78.4 ± 4.12<br>[73.2–83.5]          | 80.7 ± 9.09<br>[69.4–92.0]          | 81.9 ± 7.55<br>[72.6–91.3]          | 82.1 ± 7.57<br>[78.3–85.9]              |
| Body fat (%)             | 25.5 ± 0.32<br>[24.7–26.3]          | 20.2 ± 3.28<br>[16.1–24.2]          | 23.7 ± 7.45<br>[14.4–33.0]          | 22.6 ± 2.56<br>[19.4–25.8]          | 22.70 ± 4.55<br>[20.4–25.0]             |
| Body muscle (%)          | 34.7 ± 2.05<br>[29.6–39.8]          | 42.5 ± 3.96<br>[37.6–47.4]          | 37.5 ± 7.1<br>[28.7–46.3]           | 37.9 ± 2.66<br>[34.5–41.2]          | 38.5 ± 5.03<br>[36.0–41.0]              |
| BMI (kg/m <sup>2</sup> ) | 26.1 ± 1.31<br>[22.8–29.3]          | 23.8 ± 1.43<br>[22.0–25.6]          | 24.3 ± 2.47<br>[21.2–27.3]          | 24.8 ± 1.26<br>[23.2–26.4]          | 24.6 ± 1.76<br>[23.7–25.4]              |

*Note:* Values are presented as mean ± standard deviation with 95% confidence intervals. n = number per group; SD = standard deviation; 95% CI = 95% confidence intervals; GK = goalkeepers; DF = defenders; MF = midfielders; FW = forwards; cm = centimetres; % = percentage; kg = kilograms; m = meters; BMI = body mass index

MF achieved faster sprint times over S5m, whereas DF performed better in the ZZ. In contrast, GK generally showed slower agility performance and higher variability,

Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

although sprint results were not consistently the lowest across all distances. Despite these mean differences, sprint performance was statistically similar across all positions, as indicated by the substantial overlap in their CI. The data show that GK and MF exhibited greater variability in short-distance acceleration, while DF and FW maintained more consistent performance profiles reflected by their narrower CI.

GK exhibited wider CI for agility variables, 505DL, 505NDL and CODD, compared to other positional groups. The overlapping CIs suggest comparable sprint capacities across positional groups. The width of certain intervals also reflects the uncertainty associated with the relatively small number of players within each group.

FW achieved the highest average heights in the CMJ and SJ, while DF and MF had slightly lower jump heights. SSCI and EUR values were highest in MF. Similarly, for muscle strength variables (CMJ, SJ, SSCI, EUR), GK and MF presented broader intervals, while DF and FW were more consistent. While flexibility results overlapped across all positions, GK exhibited the most precise estimates with the narrowest intervals.

Table 2. Physical performance characteristics by playing position

|         | Variable       | GK (n = 3)                  | DF (n = 5)                 | MF (n = 5)                  | FW (n = 5)                 | Total (n = 18)             |
|---------|----------------|-----------------------------|----------------------------|-----------------------------|----------------------------|----------------------------|
|         |                | Mean ± SD<br>[95% CI]       | Mean ± SD<br>[95% CI]      | Mean ± SD<br>[95% CI]       | Mean ± SD<br>[95% CI]      | Mean ± SD<br>[95% CI]      |
| Speed   | S5Fm (s)       | 0.82 ± 0.03<br>[0.74–0.89]  | 0.84 ± 0.11<br>[0.7–0.98]  | 0.86 ± 0.19<br>[0.62–1.09]  | 0.88 ± 0.1<br>[0.76–1.01]  | 0.86 ± 0.12<br>[0.79–0.91] |
|         | S5m (s)        | 1.19 ± 0.07<br>[1.01–1.36]  | 1.27 ± 0.1<br>[1.14–1.40]  | 1.08 ± 0.21<br>[0.82–1.33]  | 1.15 ± 0.15<br>[0.96–1.34] | 1.17 ± 0.16<br>[1.09–1.25] |
|         | S10m (s)       | 2.0 ± 0.05<br>[1.89–2.12]   | 2.08 ± 0.15<br>[1.9–2.26]  | 2.04 ± 0.25<br>[1.73–2.34]  | 2.04 ± 0.08<br>[1.94–2.13] | 2.04 ± 0.15<br>[1.97–2.11] |
| Agility | 505DL (s)      | 2.63 ± 0.17<br>[2.22–3.04]  | 2.51 ± 0.21<br>[2.25–2.77] | 2.36 ± 0.24<br>[2.07–2.65]  | 2.4 ± 0.14<br>[2.22–2.58]  | 2.46 ± 0.2<br>[2.36–2.56]  |
|         | 505NDL (s)     | 2.79 ± 0.16<br>[2.39–3.2]   | 2.52 ± 0.15<br>[2.33–2.7]  | 2.57 ± 0.14<br>[2.4–2.74]   | 2.5 ± 0.06<br>[2.43–2.57]  | 2.57 ± 0.16<br>[2.5–2.65]  |
|         | DiffDL-NDL (s) | 0.16 ± 0.11<br>[-0.12–0.44] | 0.01 ± 0.09<br>[-0.1–0.11] | 0.21 ± 0.26<br>[-0.11–0.54] | 0.1 ± 0.11<br>[-0.04–0.24] | 0.12 ± 0.17<br>[0.03–0.2]  |
|         | CODD (s)       | 0.63 ± 0.18<br>[0.2–1.07]   | 0.43 ± 0.3<br>[0.05–0.81]  | 0.32 ± 0.2<br>[0.07–0.57]   | 0.36 ± 0.13<br>[0.21–0.52] | 0.41 ± 0.22<br>[0.30–0.53] |
|         | ZZ (s)         | 7.03 ± 0.34<br>[6.18–7.89]  | 6.49 ± 0.43<br>[5.96–7.03] | 6.76 ± 0.35<br>[6.33–7.19]  | 6.58 ± 0.17<br>[6.38–6.79] | 6.68 ± 0.36<br>[6.5–6.86]  |
|         | ZZWB (s)       | 8.58 ± 0.37<br>[7.67–9.49]  | 8.05 ± 0.94<br>[6.88–9.22] | 8.46 ± 0.29<br>[8.11–8.82]  | 8.34 ± 0.57<br>[7.63–9.04] | 8.33 ± 0.6<br>[8.03–8.63]  |
|         | ZZPI           | 0.82 ± 0.06<br>[0.66–0.98]  | 0.81 ± 0.07<br>[0.72–0.90] | 0.8 ± 0.04<br>[0.75–0.85]   | 0.79 ± 0.05<br>[0.73–0.85] | 0.8 ± 0.05<br>[0.78–0.83]  |

Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

|                 |                    |                               |                              |                               |                               |                               |
|-----------------|--------------------|-------------------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------|
| Muscle Strength | CMJ (cm)           | 30.13 ± 3.91<br>[20.41–39.86] | 25.90 ± 1.5<br>[24.03–27.77] | 27.72 ± 3.11<br>[23.86–31.58] | 30.42 ± 1.67<br>[28.35–32.49] | 28.37 ± 2.99<br>[26.88–29.86] |
|                 | SJ (cm)            | 27.87 ± 3.75<br>[18.56–37.17] | 24.08 ± 1.51<br>[22.2–25.96] | 25.4 ± 2.70<br>[22.04–28.76]  | 29.1 ± 1.93<br>[26.7–31.5]    | 26.47 ± 3.03<br>[24.96–27.98] |
|                 | SSCI               | 8.2 ± 2.29<br>[2.51–13.89]    | 7.68 ± 4.94<br>[1.55–13.81]  | 9.15 ± 5.14<br>[2.77–15.53]   | 4.66 ± 3.94<br>[–0.24–9.56]   | 7.34 ± 4.41<br>[5.14–9.53]    |
|                 | EUR                | 1.08 ± 0.02<br>[1.02–1.14]    | 1.08 ± 0.05<br>[1.02–1.14]   | 1.09 ± 0.05<br>[1.03–1.16]    | 1.05 ± 0.04<br>[1.0–1.1]      | 1.07 ± 0.04<br>[1.05–1.09]    |
| Flexibility     | Sit-and-Reach (cm) | 20.83 ± 1.04<br>[18.25–23.42] | 29.1 ± 3.96<br>[24.18–34.02] | 25.8 ± 4.09<br>[20.73–30.87]  | 29.5 ± 3.08<br>[25.67–33.33]  | 26.92 ± 4.5<br>[24.68–29.15]  |

*Note:* Values are presented as mean ± standard deviation with 95% confidence intervals. n = number per group; SD = standard deviation; 95% CI = 95% confidence intervals; GK = goalkeepers; DF = defenders; MF = midfielders; FW = forwards; cm = centimetres; s = seconds; S5Fm = 5-m flying sprint with a running start; S5m = 5-m sprint from a standing start; S10m = 10-m sprint from a standing start; 505DL = 505 agility test – performed with the dominant leg; 505NDL = 505 agility test – performed with the non-dominant leg; DiffDL-NDnumberL = 505DL – 505NDL = Difference in 505 agility test time (dominant leg and non-dominant leg); CODD = change of direction deficit (the difference between performance in the 505DL and the 10-m sprint time); ZZ = zig-zag agility test; ZZWB = zig-zag agility test with ball; ZZPI = ZZ / ZZWB = zig-zag performance index (without ball / with ball); CMJ = countermovement jump height; SJ = squat jump height; SSCI = stretch-shortening cycle index, calculated as (CMJ-SJ) / SJ × 100; EUR = eccentric utilization ratio, calculated as CMJ / SJ.

### Non-parametric analysis and effect sizes

Because of unequal variances, the Kruskal-Wallis test was used to compare positions. While no significant differences were found, effect size analysis ( $\epsilon^2$ ) highlights meaningful positional trends (Table 3). Large effects were observed for vertical jump performance variables (CMJ and SJ) and flexibility. Moderate effects were observed for body muscle percentage, 505NDL agility, weight, and ZZ.

Table 3. Effect sizes for anthropometric and performance variables

| Variable      | $\chi^2$ | df | p     | $\epsilon^2$ |
|---------------|----------|----|-------|--------------|
| CMJ           | 7.802    | 3  | 0.050 | <b>0.343</b> |
| Sit-and-Reach | 7.554    | 3  | 0.056 | <b>0.325</b> |
| SJ            | 7.547    | 3  | 0.056 | <b>0.325</b> |
| Body muscle   | 6.268    | 3  | 0.099 | <b>0.233</b> |
| 505NDL        | 5.172    | 3  | 0.160 | <b>0.155</b> |
| Weight        | 5.103    | 3  | 0.164 | <b>0.150</b> |
| ZZ            | 4.991    | 3  | 0.172 | <b>0.142</b> |



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

*Note:*  $\chi^2$  = chi-square statistic; df = degrees of freedom; p = significance level (p-value);  $\epsilon^2$  = epsilon squared effect size; CMJ = countermovement jump height; SJ = squat jump height; 505NDL = 505 agility test – performed with the non-dominant leg; ZZ = zig-zag agility test.

### ***Correlation analysis***

Spearman rank correlation analysis indicated that body weight relates strongly to fat percentage, BMI, and height, but inversely to body muscle. Body weight showed strong positive correlations with body fat percentage ( $\rho = 0.831$ ,  $p < 0.001$ ), BMI ( $\rho = 0.748$ ,  $p < 0.001$ ), and body height ( $\rho = 0.674$ ,  $p = 0.002$ ). Body weight was strongly negatively correlated with body muscle percentage ( $\rho = -0.742$ ,  $p < 0.001$ ). Body muscle percentage demonstrated negative associations with body fat percentage ( $\rho = -0.900$ ,  $p < 0.001$ ) and BMI ( $\rho = -0.792$ ,  $p < 0.001$ ), while BMI showed a strong positive correlation with body fat percentage ( $\rho = 0.909$ ,  $p < 0.001$ ).

Sprint performance is interconnected. The 10-m sprint time was moderately correlated with S5Fm ( $\rho = 0.542$ ,  $p = 0.020$ ) and strongly correlated with S5m ( $\rho = 0.719$ ,  $p = 0.001$ ). S5m performance showed a negative correlation with DiffDL–NDL ( $\rho = -0.474$ ,  $p = 0.047$ ) and a positive correlation with sit-and-reach flexibility ( $\rho = 0.539$ ,  $p = 0.021$ ).

Neuromuscular variables share a strong relationship, with the high correlation between CMJ and SJ ( $\rho = 0.931$ ,  $p < 0.001$ ). Agility measures showed moderate correlations, including 505DL with 505NDL ( $\rho = 0.525$ ,  $p = 0.025$ ) and ZZWB with ZZ percentage ( $\rho = 0.527$ ,  $p = 0.025$ ). In addition, ZZPI showed a strong negative correlation with ZZWB performance ( $\rho = -0.629$ ,  $p = 0.005$ ).

Agility measures showed strong internal relationships. The 505DL test correlates highly with CODD ( $\rho = 0.838$ ,  $p < 0.001$ ), while 505NDL relates to both CODD ( $\rho = 0.553$ ,  $p = 0.017$ ) and ZZ ( $\rho = 0.576$ ,  $p = 0.012$ ). DiffDL–NDL was strongly negatively correlated with 505DL ( $\rho = -0.658$ ,  $p = 0.003$ ).

Better flexibility is associated with faster 505NDL performance ( $\rho = -0.482$ ,  $p = 0.043$ ), DiffDL–NDL ( $\rho = -0.514$ ,  $p = 0.029$ ), and ZZ ( $\rho = -0.564$ ,  $p = 0.015$ ). Finally, the nearly perfect correlation between EUR and SSCI confirms they measure identical aspects of stretch-shortening cycle efficiency ( $\rho = 0.999$ ,  $p < 0.001$ ).



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

### Regression analysis

Given the small sample size ( $n = 18$ ), multiple linear regression was conducted as an exploratory analysis to examine the contribution of body composition and performance variables. The results should be interpreted with caution due to sample size limitations. Variance inflation factors (VIF) were 1.0 for all models, indicating the absence of multicollinearity (Table 4).

Table 4. Multiple regression analysis of sprint performance based on body composition and performance variables

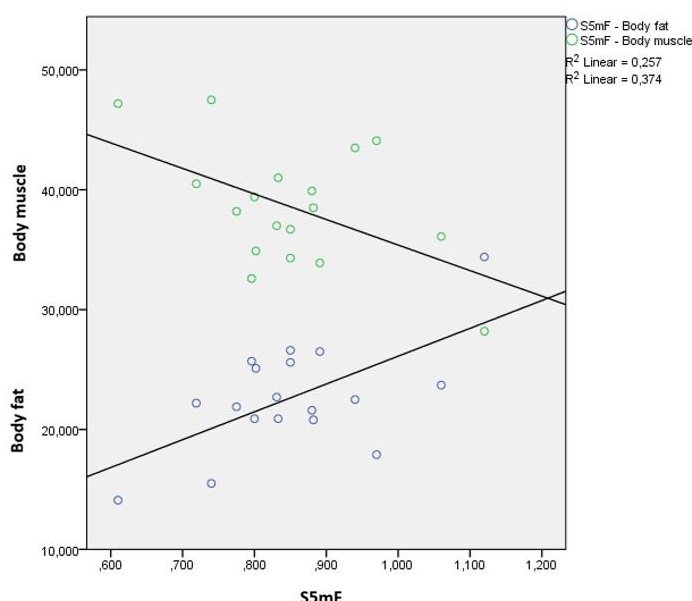
| Dependent Variable | Predictor   | B      | $\beta$ | t      | p    | $R^2$ | Adjusted $R^2$ | 95% CI for B     |
|--------------------|-------------|--------|---------|--------|------|-------|----------------|------------------|
| S5Fm               | Body fat    | 0.016  | 0.611   | 3.090  | .007 | .374  | 0.335          | 0.005 – 0.027    |
|                    | Body muscle | -0.012 | -0.507  | -2.355 | .032 | .257  | 0.211          | -0.023 – -0.001  |
| S10m               | Body fat    | 0.020  | 0.619   | 3.155  | .006 | .384  | 0.345          | 0.007 – 0.034    |
|                    | Body muscle | -0.016 | -0.533  | -2.519 | .023 | .284  | 0.239          | -0.029 – -0.002  |
|                    | CMJ         | -9.62  | -0.476  | -2.166 | .046 | .227  | 0.178          | -19.035 – -0.204 |

Note: S5Fm – 5-m flying sprint; S10m – 10-m sprint; CMJ – countermovement jump; B – unstandardized regression coefficient;  $\beta$  – standardized regression coefficient; t – t-value; p – significance level;  $R^2$  – coefficient of determination; Adjusted  $R^2$  – adjusted coefficient of determination; 95% CI – 95% confidence interval for the unstandardized regression coefficient.

Body fat percentage emerged as a significant positive predictor of S5Fm ( $\beta = 0.611$ ,  $p = 0.007$ ), indicating that higher body fat levels were associated with slower sprint times. The model explained 37.4% of the variance in performance. The model demonstrated a statistically significant fit ( $SE = 0.098$ ), substantial proportion of variance in sprint performance ( $F = 9.549$ ).

Body muscle percentage was identified as a significant predictor of S5Fm ( $p = 0.032$ ), suggesting that greater body muscle correlates with faster sprint times, with the model explaining 25.7% of the variance. The predictor showed a moderate negative correlation with sprint performance ( $\beta = -0.507$ ), with a small standard error of the estimate ( $SE = 0.005$ ). The regression model remained statistically significant ( $F = 5.548$ ), as illustrated in Figure 1.

Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>



*Note:* Relationships between body fat ( $R^2 = 0.374$ ), body muscle ( $R^2 = 0.257$ ), and 5-m flying sprint performance (S5Fm).

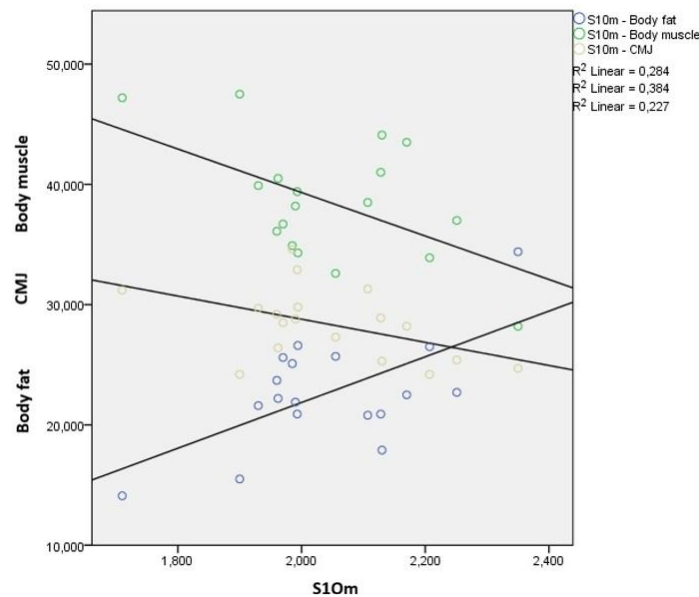
Figure 1. Regression relationships between body composition (body fat and body muscle), and 5-m flying sprint performance

Body fat percentage was found to be a significant predictor of 10-m sprint performance. Higher fat levels correlate with slower sprint times. The predictor displayed a moderate positive correlation with sprint performance ( $\beta = 0.619$ ) and a low standard error ( $SE = 0.006$ ). The model explained 38.4% of the variance in sprint performance. The regression model showed a statistically significant fit ( $F = 9.956$ ,  $p = 0.006$ ).

Body muscle percentage appeared to be a predictor of sprint performance over 10 m. The negative correlation between body muscle and sprint time ( $\beta = -0.533$ ) shows that players with greater body muscle tended to achieve faster sprint times. The model explained 28.4% of the variance in sprint time ( $R^2 = 0.284$ ). Each 1% increase in body muscle reduced sprint time by 0.016 s. The model showed statistical significance ( $F = 6.344$ ,  $p = 0.023$ ), with a small standard error ( $SE = 0.006$ ).

CMJ performance emerged as a significant predictor of sprint ability (S10m), with the model explaining 22.7% of the variance. Better explosive power correlates with faster sprint times ( $\beta = -0.476$ ,  $F = 7.368$ ,  $p = 0.046$ ), as illustrated in Figure 2.

Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>



*Note:* Relationships between body fat ( $R^2 = 0.384$ ), body muscle ( $R^2 = 0.284$ ), countermovement jump (CMJ) ( $R^2 = 0.227$ ), and 10-m sprint performance (S10m).

Figure 2. Regression relationships between body composition (body fat and body muscle), explosive power (CMJ), and 10-m sprint performance

## Discussion

The primary objective of this study was to profile the anthropometric characteristics, body composition, neuromuscular abilities, speed, agility, and technical–motor performance of elite male BS players according to their specific playing positions. The discussion below interprets the observed positional profiles, acknowledges the limitations imposed by small sample sizes, particularly for GK, and contextualises the findings within the existing literature on BS and related team sports.

### *Anthropometric characteristics and body composition profiling by position*

In this section, anthropometric characteristics refer to structural parameters (height, weight, BMI), while body composition refers to tissue composition (body fat percentage, body muscle percentage) assessed via bioelectrical impedance analysis.

GK were the tallest and heaviest players and also exhibited higher body fat percentages, potentially contributing to improved shot-blocking ability. DF had the lowest body fat and highest body muscle for strength and mobility (Santos et al., 2014), leaving MF and FW with intermediate values suited for high metabolic demands linked



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

to repeated accelerations, transitions, and attacking actions. These findings are consistent with previous research in football and BS, where greater height and weight may provide advantages in goal coverage and may be potentially advantageous for shot-blocking situations (Costa et al., 2022).

In contrast to the findings of Banitalebi Dehkordi et al. (2022), who reported that BS players in the Iranian BS premier league presented with a younger age ( $24.64 \pm 4.01$  y), lower weight ( $75.08 \pm 8.15$  kg), and similar body mass index ( $22.76 \pm 2.36$ ), the present study's players also differed from other elite populations. Specifically, they differed from the Portuguese national team players examined by Costa et al. (2022), who had a similar age ( $29.4 \pm 6.9$  years) and height ( $1.82 \pm 0.06$  m) but a lower body weight ( $74.1 \pm 7.9$  kg), and the Portuguese elite players studied by Carvalho et al. (2025), who also presented with a similar age ( $27.8 \pm 6.1$  years) and height ( $180 \pm 6$  cm) but lower body weight ( $73.2 \pm 8.8$  kg) and body fat percentage ( $8.2 \pm 8.8\%$ ). However, the players in the present study showed some similarities to the Turkish BS players (both national team and league players) examined by Nalbant & Süer (2025), particularly in body weight ( $81.35 \pm 11.34$  kg for the Turkish national team players). Furthermore, the players in the present study showed some similarities to those assessed by Vaccaro Benet et al. (2024), who examined Spanish national team players with similar age ( $27.5 \pm 3.2$  years), but slightly lower height ( $180 \pm 6$  cm) and lower body weight ( $75 \pm 8$  kg). These cross-national differences may reflect variations in competitive level, training history, genetic pool, or tactical playing styles, and should be interpreted descriptively rather than as evidence of superior or inferior physical capacity.

Within the present sample, strong intercorrelations among body composition variables indicated a coherent physiological structure. Higher body weight was associated with greater body fat and BMI, while muscle mass percentage was inversely related to these indicators. This pattern likely reflects the expected interdependence of body composition parameters in trained athletes.

Flexibility showed moderate associations with several agility variables, suggesting that greater range of motion may contribute to more efficient movement during directional changes. Although flexibility is not a primary determinant of agility, it supports efficiency in dynamic actions. Large effect sizes in CMJ, SJ, and sit-and-reach



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

suggest that these variables may be strongly influenced by playing position, even though the sample size did not allow for statistical significance. Moderate effect sizes for body muscle percentage, body weight, 505NDL, and ZZ further support this idea, suggesting that position-specific demands can modify these characteristics. Similar conclusions were noted in elite soccer and small-sided sports, where overlapping positional demands reduce group differences despite clear role-specific tendencies (Kosec et al., 2024; Leite, 2016a; Leite & Barreira, 2014; Rosario et al., 2015).

The small sample of GK ( $n = 3$ ) produced wide CI for several anthropometric and body composition variables. These wide CI reduce precision and require cautious interpretation. Nevertheless, they still provide a valid descriptive profile of the elite Serbian BS players who constituted the entire accessible population at the time of testing.

### ***Linear sprint speed and change of direction performance profiling by position***

Speed and agility are widely recognised as important physical qualities in high-intensity BS. In the present sample, MF achieved slightly faster times in the S5m, while DF had better values in the zig-zag agility test. These observations suggest that positional demands may influence speed and agility expression, aligning with previous research in BS that indicates the importance of these qualities in offensive roles (McGowan et al., 2023; Muazu Musa et al., 2020). Compared with Larsen et al. (2021), who reported S5m means of 1.01 s (under 20 years), 1.02 s (20–30 years), and 1.07 s (over 30 years), the Serbian national team players in the present study generally showed faster times. These findings suggest that factors other than age, such as competitive level and testing conditions, may contribute to sprint performance differences across studies.

GK demonstrated different performance levels compared to DF and FW in 505NDL, but inter-limb indices and direction-change deficits remained symmetrical, suggesting sand-specific movement requires bilateral engagement may promote more balanced neuromuscular engagement. Similar adaptations have been reported (Larsen et al., 2021; Shimakawa et al., 2016), where the unstable sand surface promotes balanced neuromuscular development. Agility measures demonstrate clear interrelationships, where the strong association between 505DL and CODD shows that athletes with better change-of-direction performance exhibit smaller deficits, and since moderate to large



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

effect sizes indicate practical relevance, even minimal differences in acceleration or agility are decisive given the reduced field dimensions of BS and frequent goal-scoring opportunities.

Sprint tests across different distances were significantly related, showing that short-distance acceleration reflects performance over longer sprints, a relationship that highlights acceleration as a key speed component, while overlapping CI across sprint and agility variables suggest that underlying capacities remain relatively similar across elite positions, indicating that positional specialization in BS relies on a combination of technical, tactical, and physical attributes rather than clear distinctions in isolated physical indicators.

### *Neuromuscular performance and explosive power profiling by position*

FW achieved the highest average values in the CMJ and SJ, while DF and MF showed somewhat lower values. MF showed the highest SSCI and EUR values, potentially reflecting more effective use of the stretch-shortening cycle. These results reflect the explosive needs of FW in aerial duels and the agility required by MF. The sand surface imposes neuromechanical limits, hindering elastic energy reuse and altering force-velocity dynamics (Scarfone & Ammendolia, 2016). Regarding CMJ performance, the results obtained in the present study were generally lower than those reported by Carvalho et al. (2025) for Portuguese elite BS players, whose CMJ values ranged from  $35.1 \pm 5.0$  cm to  $38.9 \pm 6.1$  cm before and  $38.2 \pm 4.7$  cm to  $40.6 \pm 6.1$  cm after, at temperatures between  $22.0$  °C and  $36.5$  °C. This discrepancy may be attributable to differences in testing conditions (e.g., sand temperature, surface hardness), athlete preparation, or competitive level, and should be interpreted cautiously.

The small GK sample ( $n=3$ ) caused wide CI and high variability, particularly in CMJ ranged from 20.41 to 39.86 cm, indicating considerable variability in explosive leg power within this subgroup. In contrast, certain positional groups displayed narrower CI, suggesting more stable performance profiles. For instance, FW demonstrated relatively consistent results in agility tests such as the 505NDL and zig-zag test, as indicated by the narrower confidence ranges. Similarly, DF showed stable anthropometric and performance characteristics across several variables.



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

Significant correlations between neuromuscular variables and speed-agility performance demonstrate that higher CMJ and SJ values were associated with superior sprint times and agility, supporting the idea that lower-limb explosive strength may represent an important contributor to performance despite the mechanical challenges of an unstable sand surface (Castellano & Casamichana, 2010; Santacruz Marin et al., 2025; Scarfone et al., 2010). Connecting these results with the study that demonstrated that a higher level of bilateral deficit (BLD) affects the decline in performance variables related to the CMJ and back squat (Moya Ortega et al., 2025), it is essential to develop both explosive strength and balance between limbs to ensure movement efficiency during professional BS match play.

The extremely high correlation observed between CMJ and SJ, as well as EUR and SSCI, likely reflects the methodological relationship between these variables, as both indices describe aspects of stretch–shortening cycle efficiency from shared raw data.

Body composition variables were significantly associated with performance outcomes: higher body fat percentage and BMI were associated with reduced sprint and jump capacity, whereas greater muscle mass was associated with better speed and agility. This pattern may reflect a mechanical disadvantage of excess weight on sand, which elevates energy expenditure and reduces movement efficiency, as previously proposed by Shimakawa et al. (2016).

### *Sand-specific performance requirements*

The sand surface directly affects movement mechanics, typically decreasing sprint speed and change-of-direction efficiency compared to firm ground (Larsen et al., 2021). Because sand is inherently unstable, it elevates energy expenditure and neuromuscular strain, particularly in the lower limbs. These mechanical constraints influence both physical load and performance outcomes during match play. In the present study, all speed, agility, and jumping assessments were conducted directly on sand to capture the specific neuromechanical reality of competitive BS.



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

Profiling the neuromuscular characteristics of players on sand may have implications for injury prevention, given the documented incidence of lower-limb trauma in elite BS (Brynzak et al., 2023; Lima et al., 2025; Sharifatpour et al., 2020; Shimakawa et al., 2025). The positional tendencies observed here suggest that FW and MF could be exposed to higher neuromuscular fatigue due to their frequent involvement in explosive and repeated high-intensity actions. However, the present study did not directly measure injury incidence or fatigue, and this interpretation remains speculative pending further research.

The relationships identified between body composition, explosive power, and agility align with established evidence regarding the necessity of muscle balance and workload management in sand-based disciplines. Integrating anthropometric profiling with neuromuscular monitoring allows for performance optimization while simultaneously mitigating injury risk. Furthermore, the link between inter-limb asymmetry and change-of-direction capacity observed in previous studies (Banitalebi Dehkordi et al., 2022; Costa et al., 2022; De Lira et al., 2017; Doroodgar & Dehaghani, 2024; Lima, 2023; Sabzevari et al., 2023; Sannicandro et al., 2024) suggests that bilateral coordination may be a functional prerequisite for efficient movement on unstable terrain.

Taken together, these findings provide a descriptive profile of the physical and functional characteristics associated with elite BS players and their specific positions. A comprehensive assessment strategy, one that integrates body composition, explosive power, and agility, can provide objective data to inform player monitoring, position-specific training design, and talent identification within the unique mechanical and environmental context of BS.

## Conclusion

The present study aimed to profile elite male BS players according to anthropometric characteristics, body composition, neuromuscular performance, sprint ability, agility, and flexibility across playing positions. The primary contribution of this study is not the identification of statistically significant between-position differences, which were limited, likely due to the small and uneven sample, but rather the provision



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

of position-specific performance profiles and practical reference ranges for elite BS players competing at international level.

Several positional tendencies emerged that may inform future hypothesis-driven research. GK demonstrated distinct anthropometric characteristics (greater height and body mass), DF showed balanced speed-power profiles, MF exhibited enhanced flexibility and agility with ball control (ZZPI), and FW presented favorable explosive strength values (CMJ, SJ) relative to other positions. While confidence intervals varied across roles, reflecting the inherent variability within smaller positional groups, medium to large effect sizes ( $\varepsilon^2$ ) suggested meaningful positional patterns that carry practical relevance in elite BS.

The present data suggest that performance in elite BS may depend on multiple interacting factors. Specifically, lower-limb explosive strength (CMJ, SJ), agility (particularly with ball integration), and flexibility, combined with optimized body composition, appear to be associated with effective movement and technical execution on sand. However, given the exploratory nature of this study and the sample constraints, these findings should be interpreted as hypothesis-generating rather than confirmatory. The reported positional benchmarks may serve as a useful reference for coaches and practitioners working with elite BS players, particularly for talent identification and individualised training prescription.

### ***Practical applications***

Given the exploratory nature of this study and the specific context of the Serbian national BS team, the following practical recommendations should be applied with appropriate caution.

Coaches and practitioners may consider using the positional performance ranges reported in this study as reference benchmarks for profiling players and identifying individual strengths and weaknesses relative to elite-level positional norms. When designing training programs, attention could be directed toward body composition management, acceleration capacity (S5m, S10m), and maximal speed (S5Fm), as these variables showed meaningful associations with positional roles within this sample.



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

Given the exploratory evidence, enhancing lower-limb power (CMJ, SJ) and integrating agility drills with ball-related tasks (e.g., ZZWB) might benefit match readiness, particularly for outfield players. Inter-limb asymmetries in change of direction (505DL vs. 505NDL) may warrant individualised monitoring, although the present data do not permit firm conclusions regarding injury risk or performance thresholds.

Importantly, these recommendations are specific to elite male BS players competing at international level and should not be generalized to other populations (e.g., amateur, female, or youth players) without further validation. Future research should seek to confirm whether these positional patterns replicate across different national teams and competitive levels.

### ***Limitations and future research***

Several limitations should be considered when interpreting the present findings. First, the focus on a single national team and the relatively small sample size ( $n = 18$ ), particularly within the goalkeeper subgroup ( $n = 3$ ), necessitate cautious interpretation of positional tendencies. Second, although the statistical approach was appropriate for exploratory profiling in elite beach soccer, the regression findings should be interpreted as exploratory and hypothesis-generating rather than predictive due to the limited sample size. Third, the cross-sectional design prevents causal inferences regarding the determinants of performance. Finally, the absence of longitudinal monitoring, nutritional tracking, and match-derived tactical metrics limits the broader contextual interpretation of the physical performance measures.

Future studies should expand to multi-level samples (multiple national teams or clubs), adopt longitudinal frameworks to track changes across competitive seasons, and integrate match-derived tactical metrics (e.g., positional tracking, decision-making analysis) to further validate sand-specific assessment protocols. Despite these limitations, the reported positional performance ranges serve as a preliminary benchmark for profiling elite BS players and understanding the physical rigors of international competition. Replication studies with larger, more diverse samples are strongly encouraged.



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

## References

- Banitalebi Dehkordi, S., Faramarzi, M., Rahimi, M., & Sadeghi, A. (2022). Seasonal variations of haematological, biochemical and physical performance indices in elite beach soccer players. *New Approaches in Exercise Physiology*, 4(7), 120–144. <https://doi.org/10.22054/nass.2022.69760.1118>
- Brynzak, S., Putrov, S., Olena, O., Kostenko, M., & Shnichenko, V. M. (2023). Analysis of the use of isometric exercises to prevent injuries in beach soccer players. *Journal of Physical Education and Sport*, 23(2), 440–448. <https://doi.org/10.7752/jpes.2023.02054>
- Carvalho, T., Rago, V., Brito, J., Praxedes, P., Abreu, M., Silva, D., ... & Afonso, J. (2025). Physical and physiological demands of official beach soccer match-play in relation to environmental temperature. *Sports*, 13(4), 118. <https://doi.org/10.3390/sports13040118>
- Castellano, J., & Casamichana, D. (2010). Heart rate and motion analysis by GPS in beach soccer. *Journal of Sports Science & Medicine*, 9(1), 98–103.
- Costa, J. A., Figueiredo, P., Prata, A., Reis, T., Reis, J. F., Nascimento, L., & Brito, J. (2022). Associations between training load and well-being in elite beach soccer players: A case report. *International Journal of Environmental Research and Public Health*, 19(10), 6209. <https://doi.org/10.3390/ijerph19106209>
- De Lira, C. A., Mascarín, N. C., Vargas, V. Z., Vancini, R. L., & Andrade, M. S. (2017). Isokinetic knee muscle strength profile in Brazilian male soccer, futsal, and beach soccer players: A cross-sectional study. *International Journal of Sports Physical Therapy*, 12(7), 1103–1110. <https://doi.org/10.26603/ijsp20171103>
- Doroodgar, A., & Dehaghani, P. E. (2024). *The effect of plyometric training plus arginine supplementation on injury prevention related to physical fitness level of beach soccer players*. *Exercise Physiology and Performance*, 2(1). <https://doi.org/10.30486/epp.2024.1105000>
- FIFA. (2024). *FIFA beach soccer manual 2024*. Fédération Internationale de Football Association.
- FIFA Technical Study Group. (2024). *Defending corners and Spain's transitions to attack*. Fédération Internationale de Football Association Training Centre.



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

<https://trainingcentre.fifa.com/en/thegame/technical-reports/beach-soccer-world-cup-2024>

- Kosec, S., Čopić, N., Pašić, M., Petrović, A., & Petronijević, S. (2024). Running performance of under-17 football players during official matches. *SportLogia*, 20(1), 9–17. <https://doi.org/10.7251/SGIA2420002K>
- Kostenko, M. P. (2023). Organization of the educational and training process at the initial stage of beach soccer. *Naukovyi Chasopys Ukrainskoho Derzhavnoho Universytetu Imeni Mykhaila Drahomanova. Serii 15*, 3K(162), 201–206. [https://doi.org/10.31392/npu-nc.series15.2023.3k\(162\).41](https://doi.org/10.31392/npu-nc.series15.2023.3k(162).41)
- Kostenko, M. P. (2025). Main criteria for selecting players for the men's national beach football team. *Naukovyi Chasopys Ukrainskoho Derzhavnoho Universytetu Imeni Mykhaila Drahomanova. Serii 15*, 10(197), 117–122. [https://doi.org/10.31392/UDU-nc.series15.2025.10\(197\).21](https://doi.org/10.31392/UDU-nc.series15.2025.10(197).21)
- Larsen, M. N., Ermidis, G., Brito, J., Ørner, C., Martins, C., Lemos, L. F., Krstrup, P., & Rago, V. (2021). Fitness and performance testing of male and female beach soccer players: A preliminary investigation. *Frontiers in Sports and Active Living*, 3, 636308. <https://doi.org/10.3389/fspor.2021.636308>
- Leite, W. S. (2016a). Physiological demands in football, futsal and beach soccer: A brief review. *European Journal of Physical Education and Sport Science*, 2(6). <https://doi.org/10.5281/zenodo.205160>
- Leite, W. S. (2016b). Beach soccer: Analysis of the goals scored and its relation to the game physiology. *International Journal of Physical Education, Fitness and Sports*, 5(1), 12–17. <https://doi.org/10.26524/1613>
- Leite, W., & Barreira, D. (2014). Are the team sports soccer, futsal and beach soccer similar? *International Journal of Sports Science*, 4(6A), 75–84. <https://doi.org/10.5923/s.sports.201401.11>
- Lima, Y. (2023). Comparison of dynamic balance among football, futsal, and beach soccer players. *Spor Hekimligi Dergisi/Turkish Journal of Sports Medicine*, 58(1). <https://doi.org/10.47447/tjism.0693>
- Lima, Y., Clarsen, B., & Bayraktar, B. (2025). Epidemiology of injuries and illnesses in national team male beach soccer players: A prospective seven-year cohort study.



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

*Science and Medicine in Football*, 1–9.

<https://doi.org/10.1080/24733938.2025.2567671>

Lima, Y., Gouttebarga, V., & Bayraktar, B. (2024). What do we know about beach soccer injuries? Systematic video analysis of four consecutive years with 580 match injuries. *Research in Sports Medicine*, 32(6), 981–991.

<https://doi.org/10.1080/15438627.2024.2324257>

Lima, Y., Karaçoban, L., Serner, A., Peek, K., & Köyağasioğlu, O. (2025). Potential head injuries in men's football, futsal and beach soccer: Distinct exposure-adjusted frequency and patterns from a comparative video analysis. *Knee Surgery, Sports Traumatology, Arthroscopy*, 1–11. <https://doi.org/10.1002/ksa.70158>

Marfell-Jones, M., Olds, T., Stewart, A., & Lindsay Carter, L. E. (2012). *ISAK manual: International standards for Anthropometric Assessment*. International Society for the Advancement of Kinanthropometry.

McGowan, L., Ellison, E., & Lastella, M. (2023). *Beach soccer histories* (1st ed.). Routledge. <https://doi.org/10.4324/9781003288541>

McKay, A. K., Stellingwerff, T., Smith, E. S., Martin, D. T., Mujika, I., Goosey-Tolfrey, V. L., Sheppard, J., & Burke, L. M. (2022). Defining training and performance caliber: A participant classification framework. *International Journal of Sports Physiology and Performance*, 17(2), 317–331. <https://doi.org/10.1123/ijsp.2021-0451>

Moya Ortega, M., Aparicio Aparicio, I., Arenas-Granada, J., Priego-Quesada, J. I., Encarnación-Martínez, A., & Pérez-Soriano, P. (2025). Bilateral deficit effects on counter-movement jump and back squat in university football players. *Sportis. Scientific Technical Journal of School Sport, Physical Education and Psychomotricity*, 11(2), 1–19. <https://doi.org/10.17979/sportis.2025.11.2.9744>

Muazu Musa, R., Abdul Majeed, A. P. P., Kosni, N. A., & Abdullah, M. R. (2020). Key performance indicators in elite beach soccer. In *Machine learning in team sports: Performance analysis and talent identification in beach soccer & sepak-takraw* (pp. 13–19). Springer. [https://doi.org/10.1007/978-981-15-3219-1\\_2](https://doi.org/10.1007/978-981-15-3219-1_2)



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

- Nalbant, Ö., & Süer, S. A. (2025). The effect of combined training on players' body composition and performance in beach soccer. *Physical Education of Students*, 29(4), 246–257. <https://doi.org/10.15561/20755279.2025.0401>
- Rosario, S., Antonio, T., Carlo, M., Laura, C., & Antonio, A. (2015). Match analysis heart-rate and CMJ of beach soccer players during amateur competition. *International Journal of Performance Analysis in Sport*, 15(1), 241–253. <https://doi.org/10.1080/24748668.2015.11868790>
- Sabzevari, F., Samadi, H., Ayatizadeh, F., & Machado, S. (2023). Effectiveness of mindfulness-acceptance-commitment based approach for rumination, cognitive flexibility and sports performance of elite players of beach soccer: A randomized controlled trial with 2-months follow-up. *Clinical Practice and Epidemiology in Mental Health*, 19. <https://doi.org/10.2174/17450179-v19-e230419-2022-33>
- Sannicandro, I., Cofano, G., Castro, F., D'Onofrio, R., & Aliberti, S. (2024). External and internal motor load in Italian young beach soccer players: A pilot study. *Journal of Physical Education and Sport*, 24(9), 1057–1063. <https://doi.org/10.7752/jpes.2024.09228>
- Santacruz Marin, C. A., España Chacua, W. A., Gaviria Chavarro, J., Motato Rodriguez, L. A., & Galeano Virgen, J. D. (2025). Predictive model of sprint performance based on countermovement jump and body mass index in football players. *Sportis. Scientific Technical Journal of School Sport, Physical Education and Psychomotricity*, 11(4), 1–19. <https://doi.org/10.17979/sportis.2025.11.4.11646>
- Santos, D. A., Dawson, J. A., Matias, C. N., Rocha, P. M., Minderico, C. S., Allison, D. B., Sardinha, L. B., & Silva, A. M. (2014). Reference values for body composition and anthropometric measurements in athletes. *PLoS ONE*, 9(5), e97846. <https://doi.org/10.1371/journal.pone.0097846>
- Scarfone, R., & Ammendolia, A. (2016). Match analysis of an elite beach soccer team. *The Journal of Sports Medicine and Physical Fitness*, 57(7–8), 953–959. <https://doi.org/10.23736/S0022-4707.16.06580-4>
- Scarfone, R., Tessitore, A., Minganti, C., Ferragana, A., & Ammendolia, A. (2010). Match demands of beach soccer between amateur and professional competition. In *International Conference of Sport Science* (pp. 8–10).



Original article. Performance profiles of professional male beach soccer players: Evidence from the Serbian national team. Vol. 12, n. ° 3; p. 1-27, July 2026. <https://doi.org/10.55040/8nkzrs86>

- Sharifatpour, R., Akochakian, M., Alizadeh, M. H., & Abbassi, H. (2020). Prevalence and mechanism of injuries in male beach soccer players. *Journal of Community Health Research*, 9(3), 184–190. <https://doi.org/10.18502/jchr.v9i3.4261>
- Shimakawa, T., Galmiche, S., Ueda, S., & Shimakawa, Y. (2025). Injuries and risk factors in men's beach soccer: Japanese national championships 2013–2023. *Science and Medicine in Football*, 9(4), 489–498. <https://doi.org/10.1080/24733938.2025.2558580>
- Shimakawa, T., Shimakawa, Y., Kawasoe, Y., Yoshimura, K., Chinen, Y., Eimon, K., ... & Ikeda, H. (2016). Beach soccer injuries during the Japanese national championships. *Orthopaedic Journal of Sports Medicine*, 4(1). <https://doi.org/10.1177/2325967115625636>
- Vaccaro Benet, P., Ugalde-Ramírez, A., Gómez-Carmona, C. D., Pino-Ortega, J., & Becerra-Patiño, B. A. (2024). Identification of game periods and playing position activity profiles in elite-level beach soccer players through principal component analysis. *Sensors*, 24(23), 7708. <https://doi.org/10.3390/s24237708>