

# Fitness Profiles of Highly Trained Female Futsal Players According to Their Playing Positions

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**Purpose:** Although women's futsal has experienced great growth recently, few studies have analyzed the physical profiles of female futsal players. The objectives of this study were to determine the physical and anthropometric characteristics in elite women's futsal using laboratory and field tests and to analyze the differences between the different playing positions. **Methods:** Forty-one female futsal players from the second division of the Spanish league (age 22.69 [4.76] y; body height 161.28 [6.03] cm; body mass 62.20 [10.34] kg) were evaluated for body composition with dual-energy X-ray absorptiometry anthropometrically, lower-body power using a force platform (countermovement jump, squat jump, and drop jump), linear speed (5, 10, 15, and 25 m), changes of direction (505 modified, V-Cut, and L-Run), and repeated-sprint ability measured through photoelectric cells. **Results:** The results reveal that there are no significant differences between the physical profiles of players depending on playing position. Despite this, wingers seem to have the best physical profiles, and goalkeepers have the highest body mass index (26.9 [4.48] vs 23.3 [2.82];  $P = .069$ ) and fat percentage (31.9 [7.81] vs 29.96 [6.08];  $P = .101$ ), but they present very similar values to the other positions in all other tests performed, except for repeated-sprint ability (4.64 [0.45];  $P = .009$ ). **Conclusion:** Relevant descriptive data were presented to provide useful information for coaches to optimize their training programs, reporting that playing position does not identify different physical profiles in elite female futsal players.

**Keywords:** physical fitness, physical performance, gender, body composition

Women's futsal has undergone an unprecedented revolution in recent years leading to a greater professionalization of the sport and a significant growth in the level of competitions. Sports federations have supported this need demanded by women's futsal by providing institutional support, promoting and demanding the creation of professional leagues, and raising the number of official national and international tournaments in female futsal. This development of female futsal will reach its culmination with the celebration of the first International Federation of Association Football Futsal Women's World Cup™ in November of 2025. This tournament will offer new possibilities increasing the visibility it has been

demanding in recent years and will allow female futsal to go on a global scale. In this context, research is increasingly necessary to study the characteristics of women's futsal to help coaches prepare their players.

Futsal is an indoor team sport of cooperation and opposition that is sanctioned by the International Federation of Association Football, in which 5 players per team (1 goalkeeper and 4 outfield players) compete in 40-minute matches divided into 2 parts of 20 minutes each. It is played on a 40 × 20-m court, with 3 × 2-m goals, stopping the clock every time the game is interrupted, or the ball goes out of the court. Additionally, teams can make unlimited number of substitutions throughout the matches and request a time-out of 1 minute per half.<sup>1</sup>

Futsal players are exposed to high physiological, physical, technical, tactical, and psychological demands.<sup>2</sup> Competitive requirements characterize futsal as a high-intensity intermittent sport in which there is a constant succession of situations of attack, defense, and quick defense-attack transitions, with frequent high-intensity actions, such as sprints, accelerations, decelerations, or changes of direction.<sup>1,2</sup> This scenario requires players to have a high physical capacity to perform at the highest level, including optimal body composition values,<sup>3-5</sup> a high aerobic capacity,<sup>2,6,7</sup> and a high level of lower body strength and power.<sup>1,2</sup> Overall, male futsal players cover a total distance between 3 and 4 km per game, roughly 230 m per minute of play; 18% of the total distance is covered in running (12–18 km/h), and 4% in sprinting (>18 km/h), reaching an average maximum speed of 20.5 km/h. In addition, they perform an average of 5 accelerations and decelerations per minute (>2 m/s<sup>2</sup>) and numerous actions of change of direction

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(COD) of 90° or higher.<sup>8,9</sup> More studies are needed to confirm the competitive demands by playing positions. Unknown yet in women and still uncertain in males, it seems that defenders and wingers have higher levels of external loading than pivots, covering greater distances at high-speed running (>12 km/h), and sprinting (>18 km/h) and performing a higher number of accelerations and decelerations.<sup>10,11</sup>

Conditional demands in futsal can vary according to gender, competitive level, and playing position. Barbero-Alvarez et al<sup>12</sup> found that elite players showed superior aerobic fitness, as measured by  $\text{VO}_2\text{max}$  and ventilatory threshold, compared with lower level players. Similarly, Naser and Ali<sup>13</sup> and Sekulic et al<sup>5</sup> reported better performance in elite futsal players in terms of speed, anaerobic endurance, and reactive strength associated with directional changes, sprints, jumps, acceleration, and deceleration, as well as passing and shooting skills. However, Spyrou et al<sup>14</sup> and Ramos-Campo et al<sup>15</sup> found no significant differences in jumping tests between the different performance levels. Regarding playing positions, Figueiredo Machado et al<sup>16</sup> did not observe any differences in  $\text{VO}_2\text{max}$  or maximal velocity between playing positions and Spyrou et al<sup>14</sup> also did not observe any differences between playing positions in any of the countermovement jump (CMJ) variables they analyzed. All this information, which shows discrepancies in the differences between positions in men, is practically unknown in women. Therefore, these results underline the need for more specific and detailed studies that take into account the unique characteristics of each gender, level of play, and position to optimize physical performance in women's futsal.

The relationship between athletes' anthropometric profiles and their competitive performance, along with potential differences across playing positions, is an area of growing interest in sports research. Sekulic et al<sup>5</sup> found a positive correlation between improved anthropometric values and higher levels of competition, suggesting that physical characteristics may play a crucial role in elite performance. Anthropometry and body composition are factors that also influence the sports performance of the players. In this sense, Figueiredo Machado et al<sup>16</sup> found that fat mass percentage has a significant negative correlation with maximum oxygen uptake ( $\text{VO}_2\text{max}$ ) and maximal speed in elite futsal players. However, in futsal, the anthropometric or body composition profiles of players and the differences between playing positions remain under-researched. In addition, some of the studies that have examined these relationships have used low-precision methods in the assessment of body composition which required further replication using high-quality and reliable measurements.<sup>16</sup> Ramos-Campo et al<sup>17</sup> reported no significant anthropometric differences between playing positions, while Castillo et al<sup>18</sup> noted that pivots and goalkeepers shared similar anthropometric traits, with both positions being significantly taller and heavier than players in other roles. Despite the growth that futsal has experienced in recent years and the increasing number of studies that have analyzed the competitive demands of futsal,<sup>7</sup> the scientific literature is still very scarce concerning the physical and anthropometric profiles of elite futsal players and the specific characteristics depending on the playing positions, being even more limited in the analysis of elite women's futsal.

Given the above, this study aimed to describe the physical and body composition characteristics of elite female futsal players and to recognize possible different physical profiles depending on the playing positions, identifying the main features of each position.

## Methods

### Experimental Approach to the Problem

This study investigated the physical characteristics of elite female futsal players from 3 futsal teams competing in the second national division of the Spanish League. Descriptive research was performed to identify and establish the physical profile of elite female futsal players. A cross-sectional approach was employed to examine potential systematic differences in physical characteristics among players across various playing positions. For a more comprehensive analysis of the physical profile, the participants underwent a battery of body measurements and athletic performance tests. Body measurements (anthropometric and body composition variables) included height, weight, body mass index (BMI), and body fat percentage (%FAT). The athletic performance included tests of running speed (5, 10, 15, and 25 m); COD (V-Cut, L-Run, and modified 505); repeated-sprint ability (RSA); and leg power (CMJ, squat jump [SJ], drop jump [DJ], and broad jump [BJ]).

### Subjects

Forty-one highly trained national level (TIER 3)<sup>19</sup> female futsal players (age: 22.69 [4.76] y; body height: 161.28 [6.03] cm; body mass: 62.20 [10.34] kg; prior experience in national competitions: 5.05 [3.65] y) were recruited during the 2023–2024 season belonging to 3 different teams from the second division of the Spanish League. The sample size was calculated post hoc with the G\*Power software (version 3.1.9.6, University of Düsseldorf): effect size,  $f=0.6$ ,  $\alpha$  err prob = .05; power ( $1 - \beta$  err prob) = 0.85.

Players were classified based on their playing positions into goalkeeper ( $n=8$ ), defender ( $n=8$ ), winger ( $n=17$ ), and pivot ( $n=8$ ).<sup>16</sup> All included players had at least 4 years of futsal experience and at the time of testing were performing 3 to 4 training sessions per week each lasting approximately 90 minutes, and played a match every weekend. All players performed 1 or 2 weekly conditioning sessions (approximately 45 min per session). For inclusion, subjects were required injury free at the time of testing and ready to compete.

All participants were informed about the study's nature, demands, and known health risks. They all voluntarily agreed to participate. They signed an informed consent document and were informed that they could withdraw from the study at any time, and also completed an initial questionnaire including their health history. For the under-18 players, parents or legal custodians were informed of the implementation and purpose of the study and authorized participation by signing an informed consent document. The study had the approval of the Clinical Research Ethics Committee of Aragon (CEICA), under reference number PI23-456, and it was carried out according to the Declaration of Helsinki.

### Procedures

Testing was performed during the competitive season, near the end of the first half of the futsal season (weeks 19–20 of the 42-week season), when the teams had already overcome the initial loading phase and were in regular-season planning. The experimental protocol was conducted in 2 phases: 1 in the laboratory, from 10 AM to 1 PM, in which anthropometric and body composition data were taken and jumping tests were performed, and the other, in indoor sports facilities, from 7 to 9 PM, in which linear speed, changes of direction, and RSA tests were performed. Participants

were instructed to avoid intense physical exercise for 24 hours prior to the tests. All tests were performed under similar environmental conditions where the ambient temperature ranged from 19 °C to 22 °C, and, during the tests, the subjects wore a standard futsal kit. Subjects provided clear instructions on the procedures and were verbally encouraged to perform at their maximal effort. The players conducted 2 pretest familiarization sessions the week before data collection, in which all the evaluated tests were performed. A standardized RAMP (rise, activate, mobilize, and potentiate) system warm-up protocol was established.<sup>20</sup>

### **Anthropometry and Body Composition**

Body height (in centimeters) was measured barefoot using a standard stadiometer (SECA 225, SECA) to the nearest 0.001 m. Body mass (in kilograms) was obtained to the nearest 0.1 kg using a single standard electronic digital scale (SECA 813, SECA). Height and body mass measurements were taken wearing minimal clothing. BMI was calculated by dividing weight (in kilograms) by the square of the height (in meters). The %FAT was evaluated using a Dual-Energy X-Ray Absorptiometry densitometer for the whole body (Hologic Horizon-QDR, Hologic Corp, Software Hologic Inc).

### **Vertical-Jump Tests**

To assess the explosive power of the lower limbs in the vertical plane, the tests used were CMJ, SJ, and DJ using a KISTLER platform type 9260AA (Kistler instruments Ltd). The jump height was calculated using Kistler MARS Software. CMJ and DJ were performed bilaterally (CMJ<sub>BI</sub> and DJ<sub>BI</sub>) and unilaterally (CMJ<sub>R</sub>, CMJ<sub>L</sub>, DJ<sub>R</sub>, and DJ<sub>L</sub>). They performed all jumps with their hands on their hips. During the flight, subjects were instructed to maintain their legs straight. Each subject performed 3 trials of each type with a 30" rest between each one, and the best result was used for data analysis. DJ was evaluated from a 30-cm high box.<sup>21</sup>

### **Broad Jump**

A BJ test was assessed and performed bilaterally and unilaterally (BJ<sub>BI</sub>, BJ<sub>R</sub>, and BJ<sub>L</sub>) to measure explosive power in the horizontal plane.<sup>22</sup> The subject stood on the back of the starting line and jumped forward as far as possible with a simultaneous arm swing and freely flexing hips, knees, and ankles. A standard tape measure with up to 0.01 m accuracy was used to measure the distance, placed in a perpendicular line from the starting line to the rear heel at landing.<sup>23</sup> Three trials were conducted with a 30-second rest period between each, and the best result was selected for data analysis.

### **Sprint Test**

Running speed was evaluated with independent sprint tests of 5, 10, 15, and 25 m. Timing was measured using double-beam photoelectric cells (Witty, Microgate), set at a height of 0.75 m and spaced 1.5 m apart. In the initial position, subjects placed the front foot half a meter behind the initial timing gate. Each participant completed each test twice, with a passive recovery of at least 3 min between attempts. The fastest time was used for analysis.

### **505 Modified Test**

Participants sprinted from the start/finish line to the 5-m mark, crossing it with their foot, and then made a 180° turn to sprint back

to the start/finish line. Timing gates (Witty, Microgate), positioned 0.75 m height and 1.5 m apart, were used to record the times. At the starting position, subjects placed the leading foot half a meter behind the initial/final timing gate. Each subject completed 2 trials with each leg (505<sub>R</sub>, 505<sub>L</sub>), with a passive recovery of at least 3 min between them. The fastest time for each foot was used for the analysis.

### **L-Run Test**

For the L-Run test, 3 cones were placed 5 m apart in the shape on an "L." Players started with the leading foot half a meter behind the initial/final timing gate. They were required to run 5 m forward, turn 90° to the right (L-Run<sub>R</sub>) or left (L-Run<sub>L</sub>), depending on the side evaluated, run 5 m forward, then turn 180°, and return to the start/finish line reversing the course run. Timing gates (Witty, Microgate), positioned 0.75 m height and 1.5 m apart, were used to record the times. Players were verbally encouraged during the "L" run. Each player completed 2 attempts per side, with at least 3 min of passive recovery between attempts. The fastest time for each side was used for the analysis.

### **V-Cut Test**

In the V-cut test, players performed a 25-m sprint with 4 COD of 45° each 5 m, having to completely pass the line drawn on the floor with 1 foot at each turn, pointed by a gate of cones separated 0.7 m.<sup>24</sup> Timing gates (Witty, Microgate), positioned 0.75 m height and 1.5 m apart, were used to record the times. Players started with the leading foot half a meter behind the initial timing gate. Each player completed the test twice, with a passive recovery of at least 3 min between attempts. The fastest time was used for analysis.

### **Repeated-Sprint Ability**

The RSA test involved 6 repetitions of maximal sprints of 25 m, with 25 seconds of active recovery, consisting of walking/jogging to the start line. Players were required to wait for the start signal at the starting position 3 seconds before the start of each sprint. Verbal feedback was given on the fifth, 10th, 15th, and 20th second of recovery. Timing gates (Witty, Microgate) were used to record the times at 0.75 m height and 1.5 m apart. Players started with their front foot a half meter behind the first timing gate.

### **Statistical Analyses**

All statistical analysis was performed using the R-Based Jamovi software (version 2.3.28) and Microsoft Excel (version 16.78.3). The normality of the distribution of the variables was analyzed using the Shapiro–Wilk test. Data are presented as mean (SD) and summarized through descriptive statistics for each playing position. These data were compared between the 4 playing positions through 4 × 1 repeated-measures analysis of variance followed by Tukey post hoc test (parametric variables) or the Kruskal–Wallis test followed by Mann–Whitney post hoc test (nonparametric variables). The significance level was set at  $P < .05$ . The intraclass correlation coefficient and coefficient of variation were used to assess the reliability of each test using a free-access specific spreadsheet<sup>25</sup> (Table 1); all test showed high reliability values. For the post hoc analysis, Cohen  $d$  (ES) was calculated and interpreted using Hopkins' categorization criteria:  $d > 0.2$  as small,  $d > 0.6$  as moderate,  $d > 1.2$  as large, and  $d > 2.0$  as very large.<sup>26</sup>

## Results

The descriptive data of the futsal female players are presented in Table 2. The analysis of variance analysis revealed significant differences in the weight between goalkeepers and wingers ( $P = .030$ ). The results showed that the goalkeepers have higher values in the variables weight, %FAT, and BMI than the rest of the playing positions (defenders, wingers, and pivots).

The parameters of athletic performance (running speed, COD, RSA, and leg power) are presented in Table 3. Statistical analysis presents significant differences in CMJ<sub>L</sub> variable between wingers and pivots with a very large effect size ( $P = .028$ ;  $d > 2.0$ ), and in RSA variables between goalkeepers and wingers in RSA<sub>2</sub> and RSA<sub>6</sub> with large effect size ( $P = .009$  and  $P = .010$ ;  $d = 1.437$  and  $d = 1.455$ , respectively), and between pivots and wingers in RSA<sub>4</sub> with moderate effect size ( $P = .037$ ;  $d = 0.676$ ).

**Table 1 Reliability Data of Each Test**

Test	ICC (90% CI)	%CV (90% CI)
5 m	.68 (.51–.80)	3.44 (2.90–4.25)
10 m	.84 (.75–.91)	2.05 (1.73–2.53)
15 m	.91 (.85–.94)	1.67 (1.41–2.06)
25 m	.82 (.71–.89)	2.71 (2.29–3.34)
V-Cut	.91 (.86–.95)	2.01 (1.70–2.48)
L-Run R	.82 (.71–.89)	2.55 (2.15–3.15)
L-Run L	.77 (.63–.86)	3.25 (2.74–4.02)
505 R	.57 (.36–.72)	3.32 (2.80–4.09)
505 L	.70 (.54–.81)	2.98 (2.52–3.68)
RSA	.94 (.90–.96)	1.63 (1.37–2.07)
CMJ BI	.99 (.98–.99)	1.84 (1.55–2.26)
CMJ R	.99 (.98–.99)	2.75 (2.32–3.39)
CMJ L	.98 (.97–.99)	3.45 (2.91–4.25)
SJ BI	.97 (.95–.98)	3.96 (3.33–4.92)
DJ BI	.98 (.97–.99)	2.82 (2.38–3.48)
DJ R	.98 (.97–.99)	3.42 (2.89–4.24)
DJ L	.95 (.91–.97)	4.72 (3.97–5.87)
BJ BI	.93 (.88–.96)	2.73 (2.31–3.36)
BJ R	.95 (.91–.97)	3.32 (2.80–4.09)
BJ L	.97 (.94–.98)	2.44 (2.06–3.00)

Abbreviations: BI, bilateral; BJ, broad jump; CMJ, countermovement jump; CV, coefficient of variation; DJ, drop jump; ICC, intraclass correlation coefficient; L, left; SJ, squat jump; R, right; RSA, repeated-sprint ability.

**Table 2 Descriptive Data of the Female Futsal Players**

	All (N = 41)	Goalkeepers (n = 8)	Defenders (n = 8)	Wingers (n = 17)	Pivots (n = 8)
Age, y	22.2 (4.73)	19.4 (3.62)	23.1 (2.42)	21.0 (4.49)	26.6 (5.18)
Futsal experience, y	12.1 (6.44)	9.9 (6.58)	16.8 (2.71)	10.4 (5.35)	13.6 (9.01)
Height, cm	161.3 (6.03)	161.7 (6.10)	160.9 (6.11)	159.7 (6.51)	164.6 (4.19)
Weight, kg	62.2 (10.34)	70.4 (13.11)*	60.1 (10.47)	57.8 (7.41)	65.4 (7.93)
%fat	29.3 (5.40)	31.9 (7.81)	29.7 (6.09)	28.3 (4.34)	28.3 (3.62)
BMI, kg · m <sup>-2</sup>	23.9 (3.39)	26.9 (4.48)	23.2 (3.82)	22.6 (1.93)	24.1 (2.71)

%fat = percentage of body fat; BMI = body mass index.

\*Significant difference between goalkeepers versus wingers,  $P < .05$ .

## Discussion

The objectives of this study were to determine the physical characteristics of elite female futsal players in terms of body composition, anthropometric and performance variables, and to identify potentially different physical profiles depending on the playing positions. To the best of our knowledge, this is the first study with elite female futsal players analyzing physical profiles, including several anthropometric and specific performance tests, and stratifying this analysis by playing positions. Castillo et al<sup>18,27</sup> investigated in female futsal players the relationship between body composition and performance but did not differentiate by playing position, and also studied the body composition, and anthropometric characteristics by position, but did not include sports performance variables in the study. The main finding of the present study is that there are no significant differences in the physical profile among elite female futsal players, both in body measurements or performance variables between any of the playing positions.

Differences in body composition could influence in long-term performance of the players, due to the significant negative correlation found by Figueiredo Machado et al<sup>16</sup> between variables such as %FAT and performance variables such as VO<sub>2</sub>max or maximal speed in futsal players.<sup>16</sup> The anthropometric and body composition results of this study reveal data of %FAT (29.3 [5.4]) and BMI (23.9 [3.4]) similar to those obtained in other similar studies with elite female futsal players.<sup>15,18,28</sup> Castillo et al<sup>18</sup> reported %FAT values of 27.3 (2.5) and BMI values of 19.3 (8.5), and Rubio-Arias et al<sup>28</sup> and Ramos-Campo et al<sup>15</sup> reported %FAT values of 27.1 (6.4) and 26.7 (4.6), respectively. These small differences could be due to the level of the players (first division) participating in the studies. However, other studies obtained %FAT values substantially lower than those presented in the previously forementioned studies.<sup>3,12,29</sup> Sekulic et al,<sup>3</sup> Ferreira et al,<sup>29</sup> and Barbero-Alvarez et al<sup>12</sup> reported values of 20.8 (3.9), 22.1 (5.2), and 17.6 (3.4), respectively. These wide differences may be due to the different methods used to evaluate the body composition in each of the studies, which can be done through different measures with diverse accuracy, such as dual-energy X-ray absorptiometry, bioelectrical impedance analysis, or skinfolds measured by an anthropometrist. Figueiredo Machado et al<sup>16</sup> found differences depending on the technique used in elite futsal players. Regarding specific playing positions, while some studies agree with ours in that there are no significant differences between the different playing positions,<sup>16,17</sup> other authors have found different physical profiles in goalkeepers, wingers, or pivots.<sup>18</sup> The present study aims to show data on women's futsal that have been scarcely studied so far.

**Table 3 Athletic Performance of Female Futsal Players**

Test	All (N = 41)	Goalkeepers (n = 8)	Defenders (n = 8)	Wingers (n = 17)	Pivots (n = 8)
5 m, s	1.14 (0.06)	1.15 (0.08)	1.16 (0.07)	1.12 (0.06)	1.17 (0.05)
10 m, s	1.98 (0.10)	2.02 (0.14)	2.00 (0.095)	1.94 (0.08)	1.99 (0.074)
15 m, s	2.72 (0.14)	2.77 (0.23)	2.75 (0.12)	2.67 (0.12)	2.77 (0.08)
25 m, s	4.26 (0.26)	4.45 (0.39)	4.28 (0.17)	4.15 (0.21)	4.29 (0.16)
V-Cut, s	7.64 (0.50)	7.89 (0.50)	7.71 (0.54)	7.45 (0.54)	7.76 (0.29)
L-Run R, s	5.88 (0.31)	6.00 (0.40)	5.93 (0.33)	5.81 (0.30)	5.89 (0.22)
L-Run L, s	5.91 (0.32)	6.10 (0.39)	5.88 (0.34)	5.83 (0.29)	5.95 (0.24)
505 R, s	2.84 (0.12)	2.90 (0.14)	2.86 (0.11)	2.81 (0.12)	2.82 (0.08)
505 L, s	2.86 (0.15)	2.89 (0.18)	2.91 (0.14)	2.81 (0.14)	2.85 (0.13)
RSA 1, s	4.26 (0.26)	4.45 (0.39)	4.28 (0.17)	4.15 (0.21)	4.29 (0.16)
RSA 2, s	4.39 (0.26)	4.57 (0.36)*	4.47 (0.20)	4.24 (0.21)	4.43 (0.16)
RSA 3, s	4.43 (0.33)	4.70 (0.53)	4.43 (0.22)	4.27 (0.24)	4.49 (0.17)
RSA 4, s	4.46 (0.34)	4.70 (0.55)	4.48 (0.19)	4.29 (0.27)#	4.53 (0.19)
RSA 5, s	4.46 (0.37)	4.78 (0.60)	4.45 (0.22)	4.31 (0.27)	4.48 (0.22)
RSA 6, s	4.39 (0.26)	4.61 (0.30)*	4.39 (0.22)	4.27 (0.25)	4.43 (0.10)
CMJ BI, cm	25.70 (4.44)	26.3 (6.17)	26.3 (5.26)	26.1 (3.86)	23.6 (2.52)
CMJ R, cm	12.72 (3.04)	13.2 (3.17)	12.3 (3.53)	13.5 (3.06)	11.1 (1.98)
CMJ L, cm	12.97 (3.05)	12.5 (3.41)	13.8 (3.47)	14.0 (2.05)#	10.4 (2.99)
SJ BI, cm	20.83 (4.55)	20.8 (6.44)	20.8 (4.19)	21.7 (4.24)	19.0 (3.40)
DJ BI, cm	24.71 (4.39)	25.7 (5.05)	25.4 (5.07)	25.0 (4.22)	22.4 (3.15)
DJ R, cm	12.39 (2.92)	12.2 (3.36)	12.4 (3.14)	12.8 (2.98)	11.7 (2.51)
DJ L, cm	12.53 (2.50)	12.0 (2.68)	12.6 (2.90)	13.2 (2.51)	11.5 (1.73)
BJ BI, m	1.73 (0.18)	1.75 (0.21)	1.68 (0.14)	1.78 (0.19)	1.65 (0.16)
BJ R, m	1.40 (0.18)	1.42 (0.20)	1.32 (0.22)	1.43 (0.18)	1.39 (0.13)
BJ L, m	1.40 (0.17)	1.41 (0.19)	1.28 (0.16)	1.44 (0.17)	1.40 (0.17)

Abbreviations: BI, bilateral; BJ, broad jump; CMJ, countermovement jump; DJ, drop jump; R, right; L, left; RSA, repeated-sprint ability; SJ, squat jump.

\*Significant difference between goalkeepers versus wingers,  $P < .05$ . #Significant difference between wingers versus pivots,  $P < .05$ .

In our study, the linear velocity results obtained are very similar to those reported in elite female futsal players by Castillo et al<sup>27</sup> for distances of 5 and 25 m and to those reported by Nikolaidis et al<sup>4</sup> for the 10-m distance. In comparison with soccer, some authors have found better values in shorter distances in futsal, highlighting the unique characteristics of each sport,<sup>15</sup> but other authors have found better or very similar results.<sup>23</sup> The present study also found no significant differences between the different playing positions in the analyzed linear speed distances. Despite this, it seems that the wingers are the players who can cover these distances the fastest, which is in line with that reported by López-Mariscal et al.<sup>30</sup> In futsal, a key indicator of performance is the ability to perform the constant actions of quick defense–attack transitions, so the improvement of speed variables is presented as a crucial performance factor for the players.<sup>1,2</sup>

The ability to perform fast COD in team sports are an important factor as it has been shown that during matches players perform a large number of them and at different angles.<sup>1</sup> Gabbett et al<sup>31</sup> found a high-performance correlation between 505 and L-Run in elite rugby players, but Sporis et al<sup>32</sup> did not find such relationship in elite junior soccer players. Some authors hold the idea that COD tests are valid and reliable in the context of their sports,<sup>33</sup> but others point out that only those specific movement patterns and does not indicate an athlete's ability to change direction effectively.<sup>32</sup> The results obtained in our study in the L-Run test are similar to those

reported by Gabbett et al<sup>31</sup> in rugby players, the 505 test data are similar to those reported by Mainer-Pardos et al<sup>34</sup> in female soccer players, and the results obtained in V-Cut are similar but slightly worse to those reported in young male basketball players by Gonzalo-Skok et al.<sup>24</sup> In our study, no significant differences were found in COD according to playing positions, but the results reflect clear evidence that goalkeepers are the slowest players to perform changes of direction, except for the 505 test on the left side. These results are in line with those reported by Lockie et al<sup>23</sup> in their study with female soccer players. This could be explained by the specific characteristics of goalkeepers, in which their main plane of movement is the frontal plane, so their training is predominantly lateral displacements.

In futsal, high-intensity intermittent efforts predominate, being crucial the ability to repeat high-intensity actions with short recovery intervals.<sup>1</sup> The results obtained in our study on the ability to repeat sprints indicate that, with the RSA test model used (6 × 25 m with 25" of recovery), elite futsal players can perform these actions with a minimum loss of speed (in mean, RSA = 4.40; RSA<sub>Best</sub> = 4.26; RSA<sub>Worst</sub> = 4.46), managing well the fatigue caused by high-intensity actions (%RSA<sub>Change</sub> = 4.69%). In our study, RSA performance was lower than those reported by Torres-Torrelo et al<sup>35,36</sup> in 2 different studies (9 × 20 m with 25" of recovery), but concerning the percentage of decrease their results showed similar values to our findings (%RSA<sub>Change</sub> = 5.41%)<sup>35</sup> and

higher value of speed loss in another study ( $\%RSA_{\text{Change}} = 9.59\%$ ).<sup>36</sup> Also, Shalfawi et al<sup>37</sup> reported values that were very similar to those obtained in our study in terms of  $RSA_{\text{mean}}$  in 2 groups of elite female soccer players (5.07 and 5.01, respectively), although slightly higher explained by an increase in the distance of the test performance ( $7 \times 30$  m with 30" of recovery), the same as reported by Ramos-Campo et al<sup>15</sup> with elite female futsal players at that distance ( $RSA_{\text{mean}} = 4.9$ ), although observed lower percentage of change ( $\%RSA_{\text{Change}} = 3.9$ ). Castillo et al<sup>27</sup> reported in a protocol identical to that of our study mean RSA values better ( $RSA_{\text{mean}} = 3.87$ ) than those obtained in our study with female first-division futsal players. Relating to playing positions, our study only indicates significant differences between pivots and wingers in  $RSA_4$  and between goalkeepers and wingers in  $RSA_2$  and  $RSA_6$ , which shows that there is no clear difference between any of the playing positions similar to what Caetano et al<sup>38</sup> found in professional futsal players during official matches.

Many studies report the importance of strength training in team sports players for the improvement of sports performance.<sup>22,35,37</sup> In the analysis of the lower body power through the different tests performed (CMJ, SJ, DJ, and BJ), this research obtained comparable values in previous studies. Ramos-Campo et al<sup>15</sup> reported CMJ height values similar to ours in elite (26.7 [0.3]) and subelite (24.3 [0.3]) female futsal players but reported large differences in SJ height in both elite (26.1 [0.4]) and subelite (24.2 [0.3]) with higher jump heights to our data. David et al<sup>39</sup> reported similar values for the broad jump (1.73 [0.1]) in semi-professional female futsal players. Lago-Fuentes et al<sup>40</sup> found slightly higher CMJ values (27.3 [4.1]) and better SJ values (24.7 [3.8]) in their study of elite female futsal players, and López-Mariscal et al<sup>30</sup> also report similar values in CMJ (26.4 [4.4]) to those obtained in our study with elite female futsal players. However, greater differences were obtained with the data from the study by Castillo et al<sup>27</sup> who reported much higher values of both CMJ (31.4 [2.8]) and SJ (28.9 [2.6]) in elite female futsal players. In another study conducted by Lago et al<sup>41</sup> with elite female futsal players, we again found CMJ values (25.2 [3.5]) similar to those obtained in our study. The study by Ruiz-Pérez et al<sup>42</sup> reported higher values of bilateral and unilateral (with dominant and nondominant leg) CMJ than those found in our study, reporting values of  $CMJ_{\text{BI}} = 27$  (0.03),  $CMJ_{\text{DL}} = 15$  (0.03), and  $CMJ_{\text{NDL}} = 16$  (0.03) in elite female futsal players. In addition, in the same study, they also reported higher results in bilateral and unilateral DJ performance, achieving values of  $DJ_{\text{BI}} = 27$  (0.06),  $DJ_{\text{DL}} = 16$  (0.03), and  $DJ_{\text{NDL}} = 17$  (0.01), although the jump height of the DJ in this study was 40 cm. With the great variability of the existing data, more studies are needed to determine a lower body strength profile in elite female futsal players.

The discussion presented in this article regarding the different performance variables analyzed (linear speed, COD, RSA, and lower body power in vertical and horizontal plane) related to the playing positions is new in the scientific literature, where there are no articles with which to compare with the same profile of participants (female futsal players).

According to the results obtained, no significant differences were found between playing positions in any of the jumps analyzed, except in the  $CMJ_L$  jump between wingers and pivots, in which wingers demonstrate a higher performance compared to pivots. This finding is in line with those found by Spyrou et al<sup>14</sup> and Da Silva et al<sup>43</sup> who also found no differences between the different playing positions when comparing vertical jumping ability. The data obtained reinforces the hypothesis that vertical jump and,

consequently, the complementary jump-land variables do not seem to differentiate the positions in elite futsal players. However, more studies are needed to continue studying the characteristics of the different types of jumps depending on the playing positions and, specifically, in the analysis of jumps in the horizontal plane, the main pattern of movement in futsal and where crucial forces are applied.

Another interesting relationship would be to analyze the anthropometric and performance values obtained by playing positions with the competitive demands of each specific playing position. Currently, this relationship is complicated since the scientific literature that has analyzed the competitive demands by playing positions has not found significant differences between these positions,<sup>10,11</sup> so the competitive demands found so far are similar in all playing positions (except for goalkeepers). More studies are needed, especially in female futsal, to determine different competitive demands by playing positions and thus be able to relate physical profiles based on competitive demands by playing positions.

The findings of previous research analyzing physical profiles by playing positions<sup>14,16</sup> reinforces the data obtained in our study that, despite not being able to establish a clear differentiation between playing positions, it appears that wingers tend to present a better body composition (%FAT) and conditional values (aerobic capacity, linear speed over different distances, CODs at different angles, ability to endure high-intensity efforts, and lower body power) than the other playing positions, both in male and female futsal elite players. The main difference between previous research and our study is in the lower body power, with the wingers not exhibiting higher data than other playing positions in our research, which could be explained by the difference in the competitive level (first or second division) between the subjects of the articles.

## Limitations and Future Directions

The study did not analyze the aerobic capacities of the players, which is one of the determining conditioning capacities in elite futsal. Despite this, a strength of this study is the inclusion of multiple RSA tests and the calculation of the percentage loss in speed as a fatigue index, reflecting the specific demands of the sport. However, the data obtained in the RSA tests reflect a controversial interpretation because the times registered in the last sprints are equal to or better than the first ones, which could be a limitation. Furthermore, this is a cross-sectional study which was performed during the competitive period, so potentially high levels of fatigue could influence the performance during the testing sessions. In addition, although the overall sample size was sufficiently powerful, dividing the sample by playing positions implies a smaller sample size in each group, which may make it difficult to identify clear differences between each group due to a reduced sample power.

Future research could include more physical evaluations, such as those related to aerobic capacity, and a larger sample by playing positions to clarify the possible differences between them. It would also be interesting that future research include longitudinal measurements, through periodic evaluations throughout the season, which would allow us to analyze how training, games, and recovery affect the physical and anthropometric metrics of the female players. Additionally, it would be interesting to set new lines of research related to players physical profiles by playing positions associated with the different game models.

## Practical Applications

This study aims to contribute to the literature by providing information on the physical, and anthropometric, and body composition profiles of elite female futsal players, for which, currently, very limited information is available. Coaches can use this information as a guideline to determine the anthropometric, body composition, and physical levels their players should reach, as well as the specific casuistic depending on the playing position, and thus design optimal training programs to maximize the competitive performance of their players in futsal games.

## Conclusions

In conclusion, the main results of our study show no significant differences between the anthropometric and body-composition variables and physical profiles of elite futsal players according to playing position. Despite this, the body-composition analysis indicates that goalkeepers tend to be heavier and have more fat mass and higher BMI than the rest of the players. In addition, although there are no significant differences in the analysis by playing position, a statistical trend could suggest that wingers may have better body measurements than defenders and pivots and may be the fastest players in short and medium distances (5–25 m), may have greater change-of-direction ability, and are more resistant to the accumulation of fatigue. However, this is just according to a statistical trend, so no clear conclusions can be drawn.

## Acknowledgments

**CRedit authorship contribution statement:** Albalad-Aiguabella contributed to the conceptualization, methodology, formal analysis, investigation, resources, data curation, writing-original draft, supervision, and project administration. Muniz-Pardos, Vicente-Rodríguez, and Mainer-Pardos contributed to the conceptualization, methodology, resources, data curation, writing-review, and editing. Roso-Moliner and Lozano contributed to writing-review and editing. **Ethics Statement:** The study involving the participation of human beings was approved by Clinical Research Ethics Committee of Aragon (CEICA), under reference number PI23-456, and was carried out according to the Declaration of Helsinki. Participants, or parents, or legal custodians for the under-18 players signed written informed consent to participate in this study. **Funding:** This work was supported by Universidad San Jorge (Internal Research Project 2024-2025) and Departamento de Ciencia, Universidad y Sociedad del Conocimiento from the Gobierno de Aragón (Spain) (Research Group ValorA No. S08\_20R). **Data availability statement:** The manuscript's authors will make the data available upon request. Vicente-Rodríguez and Muniz-Pardos contributed equally to this work.

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