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Comparisons and correlations between the anthropometric profile and physical performance of professional female and male soccer players: Individualities that should be considered in training

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Abstract

For male soccer players, the anthropometric profile and physical performance is already known but in women it is not well documented, the knowledge of these differences can qualify the training. Therefore, the aim of this study was two-fold: (i) to compare the anthropometric profile and physical fitness of Brazilian professional female and male soccer players; and (ii) analyze the relationships between anthropometric and physical fitness measures per sex. A cross-sectional study including 92 professional soccer players 44 women and 48 men was conducted. After one week of the end of the pre-season, the players from four different teams were assessed to anthropometric profile assessments and physical performance tests (e.g., jumping, linear sprint, change-of-direction and aerobic based test). Comparisons, correlation, and effect size analysis were performed between groups. Apart from the age and change-of-direction test, all other anthropometric and physical performance variables were significant different between women and men. Men were significantly faster than women in the 20 m linear sprint test (8.87%; $p < .001$; $d = 2.382$). The sum of skinfolds was correlated with some physical performance variables; however, body mass and body height were corrected with physical performance only for female soccer players. Thus, men performed better than women for most physical tests and presents differences in the anthropometric profile. Finally, coaches should consider that the anthropometric and performance profile are correlated differently between female and male soccer players. Thus, coaches should consider gender-specific parameters to create goals about the anthropometric and physical performance profile of players.

Keywords

Association football, change of direction, countermovement jump, gender differences, skinfolds, sprints

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Introduction

Soccer is an intermittent intensity multifaceted sport, in which success depends on several physical, technical, and tactical factors.[1,2] From the physiological perspective, soccer combines aerobic and anaerobic efforts at different intensity levels with irregular pauses and short duration intense actions such as repeated high-speed bouts.[3,4] Moreover, it is a team sport with unique performance characteristics and demands[3–5] and a number of physical and anthropometric prerequisites are necessary to compete at the elite level.[6] Through anthropometry it is possible to measure the human body and to quantify and define morphological characteristics.[7] The role of morphological characteristics and body constitution is critical and affects performance in modern soccer.[7,8] For male soccer players the morphological structure is already known[7] but in women it is not well documented.

Although female participation in soccer has experienced rapid growth in recent years, there is a significant imbalance in the volume and consistency of scientific research on elite female soccer in comparison to their male counterparts.[9] During playing time different skills, such as sprinting, jumping, and changing direction, are combined with technical-tactical elements, such as dribbling, passing, and shooting, among others.[10] Female as male players are expected to possess well developed aerobic fitness and anaerobic power, coupled with good agility[11,12] to be capable of maintaining high intensity and power during fast movements over the entire match.[13] The assessment of player's lower limb power, linear speed, and aerobic/anaerobic performance is extensively utilized to assess if players possess the required physical attributes to meet the match demands. The YoYo intermittent recovery test level 1 test (YoYo IRL1) has been related to the ability to perform bouts of high intensity exercise during men's and women's soccer.[13,14] Mujika et al.[15] reported that the ability to perform intermittent high-intensity exercise for prolonged periods of time, as measured by the YoYo IRL1, constitutes a discriminative variable both in Spanish women and men soccer players. In the Mujika et al.[15] study, the senior female players were only able to cover half the distance covered by their male counterparts in the YoYo IRL1. It is known, however, that differences in YoYo IRL1 performance have been reported to depend on training status, period of the season, and explosive strength of the lower limbs.[14,16] The difference reported by Mujika et al.[15] between the genders, in the performance of YoYo IRL1, may be partly explained by the difference reported by Krustrup et al.[13] in high-intensity activities in elite female soccer match-play with respect to the men's game. This finding may also probably reflect the lower level of development of female soccer endurance and power performance in the context in which this Mujika et al.[15] study was performed. Despite match fatigue showing a similar profile across the sexes, elite female players have been reported to cover less distance (~33% less) at high intensity (speed >15 km/h) than male players matched for age and competitive standard.[13] However, it has been shown that the physiological demand, namely the percent of maximum heart rate and the percent of maximum oxygen consumption imposed on male and female elite players, is similar.[1]

Given the high demands of the match, elite soccer players of both genders must be trained to cope successfully with physical stress. The knowledge of anthropometric and fitness profiles of players has been indicated as valuable resource information to coaches and sport scientists for the development of procedures and specific training protocols.[9,10,17,18] The studies present in the literature help with this information, however, to the best of our knowledge, no study was found that analyzed the anthropometric profile and physical performance of male and female soccer players after professionalization in women's soccer in Brazil. With the results of the study, the coaches will be able to verify if the goals for the anthropometric profile and physical performance should take into account the player's gender. In addition, coaches will be able to understand whether the player's gender interferes in the relationships between the variables, helping in the training prescription.

Thus, the aim of this study was two-fold: (i) to compare the anthropometric profile and physical fitness of Brazilian professional female and male soccer players; and (ii) analyze the relationships between anthropometric and physical fitness measures per sex. Based on the cited studies, it was hypothesized that the anthropometric and performance measures would be different between the sex and that associations between performance variables are related to the anthropometric profile.

Materials and methods

Design and setting

This study followed a cross-sectional design. Four professional soccer teams (two male and two female) were evaluated. Thus, the players were assessed in average one weeks after the beginning of the pre-season. In the middle time, they performed eight training sessions. Players were recruited by convenience sampling. The context of data collection involved a rest period of 20 hours between the last training session and the data collection day. The assessments were performed in the morning starting at 9 a.m., approximately 1 hour after the breakfast and 1 hour and 30 minutes after waking up. The assessment started with anthropometry and skinfolds, and followed the same order with a standardized warm-up protocol consisting in 10 minutes of dynamic movements normally used before soccer games, a 5 minutes of rest, jumping tests, 5 minutes of rest, linear 20-m sprint test, 10 rest, change-of-direction test, 10 minutes rest, and the aerobic capacity test.

Participants

A priori sample size calculation was made considering the objectives of the study. The sample calculation performed in the G * Power 3.1 program (Heinrich Heine, Düsseldorf, Germany) with result of the comparison between the performance in the 5-m linear velocity test in female and male soccer players (ES = 1.77)[19] identified the need of at least 16 players (8 men and 8 women) for the study sample, considering a power of 90%. In addition, the sample calculation performed with the result of the correlation between the performance in the 10-m sprint test and sum of six skinfolds in soccer players ($r = 0.499$, $p = 0.01$)[10] identified the need for at least 38 players for the study sample, considering a power of 90%. Ninety-two professional soccer players (44 women: 23.90 ± 5.46 years old; 48 men: 22.80 ± 3.41 years old) with at least one year of experience in professional competitions voluntarily participated in the study. The female's soccer players were part of two professional women's soccer teams in Brazil that went to the final stages of the Brazilian championship of the first division, in addition they were part of the cast of the player teams that were periodically summoned to the Brazilian women's soccer team. The men's soccer players were part of two professional men's soccer teams in Brazil that competed in the same professional competition in the state of Rio Grande do Sul. The team trained regularly five to six days a week, with an average training time of 1 hour and 10 minutes. Players were informed of the risks and benefits of the assessment prior to data collection and team officials provided written informed consent prior to the investigation. The eligibility criteria were: (i) the players must be cleared by the team's medical department; (ii) have played professional games during the season. The study was approved by the Institutional Review Board (or Ethics Committee) of Polytechnic Institute of Viana do Castelo, School of Sport and Leisure (code: CTC-ESDL-CE001-2021). This study was conducted in accordance with the World Medical Association's code of ethics (Declaration of Helsinki), printed in the British Medical Journal (18 July 1964).

Procedures

Anthropometric profile and physical performance tests of players were assessed: (i) Body mass and stature; (ii) skinfolds; (iii) squat jump (SJ); (iv) countermovement jump (CMJ); (v) drop jump 30-cm (DJ); (vi) 20-m sprint test; (vii) 20-m change of direction (COD) test; and (viii) YoYo IRL1. Players were asked to maintain their regular diet before the assessments. The objectives and methodological procedures of the study were explained to the players and the free and informed consent form was signed. Then, the age, body mass, body height, and sum of seven skinfolds were measured. After the anthropometric assessment, the players performed a warm-up protocol consisted in 5 minutes of dynamic stretching followed by 5 minutes of actions that simulated the tests that would be performed. Finally, the players performed the warm-up and proceed to perform the jump tests, sprint test, COD test, and the YoYo IRL1.

Anthropometric profile

The evaluations took place at 9 a.m., being carried out 1 hour after the first meal of the day. For body mass assessment, the players were asked to be barefoot on a scale with a resolution of 100 g (G-TECH—Accumed Produtos Médico Hospitalares Ltda, Duque de Caxias, Brazil). To measure body height, the players were asked to remain in an orthostatic position with their backs against the wall where a measuring tape with a resolution of 1 mm was vertically fixed to the wall. With this, the evaluator measured the body height of the players. Then, the skinfolds (triceps, biceps, subscapularis, axillary, suprailiac, abdominal, thigh, and calf) were measured with a body fat caliper (CESCORF—Equipamentos Antropometricos, Porto Alegre, Brazil) with a resolution of 0.1 mm. The assessments were performed by the same observer, with eight years of experience. The skinfolds were assessed two times, and the average measure was used for further data treatment. The time of rest between each trial was 2 minutes. The main outcomes used for further data treatment were body mass (kg); stature (cm); and sum of skinfolds (mm).

Jumps tests

Three attempts were made for each type of jump. The interval between attempts was 1 minute with a 3-minute interval between the different types of jumps. Squat jump, CMJ, and DJ were performed on a contact mat (Jump System, Cefise, Nova Odessa, Brazil). For the SJ test, the player started from an upright standing position with hip and knees flexed approximately 90°, and the hands remained on the hips. After an audible command, the player performed rapid hip and knee extension for the jump performance, without using countermovement[20,21] The intraclass correlation coefficient and Cronbach's α coefficient for this measure were 0.975 and .977, respectively. For the CMJ, the player started from an upright standing position with the hands on the hips. After an audible command, the individual performed rapid hip and knee flexion (approximately 90°), followed by the extension of these joints for the accomplishment of the jump[20,21] The intraclass correlation coefficient and Cronbach's α coefficient for this measure were 0.986 and .987, respectively. Then, to perform the DJ, the player started from an upright position with hands on hips and on top of a 30-cm box.[22] After a sound command, the player jumped from the box and as soon as he touched the contact mat with his feet, he performed rapid hip and knee flexion, followed by the extension of these joints to perform the jump.[20,21] The intraclass correlation coefficient and Cronbach's α coefficient for this measure were 0.972 and .972, respectively. Jump heights were calculated using the Jump System 1.0 software (Jump System, Cefise, Nova Odessa, Brazil) installed on a portable computer connected to the contact mat. The calculation used was $h = g \times t^2/8$, which "h" is the height, "g" is the value of the acceleration due to gravity and "t" is the flight time. From the three trials, the outcome extracted was the best of the trials. The main outcomes extracted for further statistical analysis were the SJ (cm), CMJ (cm) and DJ (cm).

Linear sprint test

This test was evaluated through 20-m sprint. To measure the sprints time, a triggered timing system by a photocell system positioned at the beginning, 5-m, 10-m, 15-m, and end of the course (20-m), with a resolution of 1 ms (CEFISE, São Paulo, Brazil). The photocells were placed in a height of 100 cm from the ground. Three attempts were made with an interval of 5 minutes The players were instructed to start with always the same split position on a marl 30 cm form the first photocell. After the sound signal by means of whistle, the player should run at maximum intensity until completely transposing the last photocell so that the timing system could capture the time it took the athlete to cover the distance of 5, 10, 15, and 20 m, the player should perform this test in the shortest possible time.[23–25] At 5 m from the end point there was a cone, which the player should keep sprinting, in order to, do not slow down before crossing the last photocell. The shortest time in seconds measured in the three attempts was considered. The average speed on the route was calculated from the distance covered in the test by dividing the running time and converted to kilometers per hour. The intraclass correlation coefficient and Cronbach's α coefficient for this measure (20-m sprint) were 0.959 and .959, respectively.

Zigzag 20-m COD test

The players were instructed to start with one foot positioned on a mark 30 cm from the first photocell. The photocells were placed in a height of 100 cm from the ground. Then, after the sound signal by means of a whistle, the player should run at maximum intensity until completely transposing the second photocell so that the timing system could capture the time it took the player to cover the distance of 20 m (four sections of 5 m marked with cones fixed at 100° angles, always performing the displacements on the outside of the cones), they should perform this test in the shortest possible time.[24,25] A cone was placed 5 m from the end point of the test so that they could run to it without slowing down before crossing the second photocell. The shortest time in seconds measured in the three attempts was considered. The average speed on the route was calculated from the distance covered in the test by dividing the running time and converted to kilometers per hour. The intraclass correlation coefficient and Cronbach's α coefficient for this measure were 0.776 and .774, respectively.

Yo-yo intermittent recovery test level 1

The players performed 20-m shuttle run, with 10 seconds of active recovery. The speed of the 20-m run was informed by a beep through a stereo system sound. The time between the beeps decreases, increasing the speed of sprint through the test Players stopped the participation every time they fail in to sustain the intensity and/or made two consecutive fails in to reach the line in synchronization with the audio beep. Cones indicated the begging and ending of the 20-m lanes and the 5-m for active recovery.[26] The total distance completed by the players was extracted as the main outcome.

Statistical analysis

Intraclass correlation coefficients 2.k and Cronbach's alpha reliability coefficients were used to determine the players' intertrial reliability on physical performance tests. Descriptive statistics with means and standard deviations for the descriptive values of the data. In addition, the age of the players was presented in absolute frequency. The normality and homogeneity of the data were verified using the Shapiro–Wilk and Levene tests, respectively. For comparisons between professional female soccer players and professional male soccer players, the t-test for independent samples was used when the data showed normal distribution (body height, squat jump, countermovement jump, drop jump, sprint 5 m, sprint 10 m, change of direction test, and YoYo IRL1) and the Mann–Whitney U test when the data did not meet this assumption (age, body mass, sum of skinfolds, sprint 15 m, and sprint 20 m). Additionally, for comparison between the groups, effect size calculations were performed, adopting the "Hedges's g" method. In addition to quantification, a qualitative interpretation was adopted, considering that values <0.19 were insignificant, values between 0.20 and 0.49 small, between 0.50 and 0.79 medium, between 0.80 and 1.29 large and >1.30 very large.[27–29] To determine the correlations between the variables, Pearson's product-moment correlation test was performed when the data showed a normal distribution, and the Spearman's correlation coefficient test when the data showed a non-normal distribution (female: sprint 15 m and sprint 20 m; male: body mass and sum of skinfolds). In addition to the quantitative analysis of the correlations, a qualitative analysis was considered, where $r = 0$ was considered null correlation, ranging from 0 to 0.3 weak, 0.3 and 0.6 moderate, 0.6 and 0.9 strong, 0.9 and 1 very strong, and 1 full.[30] The level of significance was set at $\alpha < .05$. The SPSS program (version 22.0; IBM Corp., Armonk, NY, USA) was used. The graphs in Figures 1 and 2 were constructed using the Jamovi program (version 2.2.5; Sydney, Australia).

Results

The results of absolute age frequency of female and male soccer players are presented in the supplementary material (https://doi.org/10.6084/m9.figshare.21183898). Table 1 presents data comparing age, anthropometric profile and physical

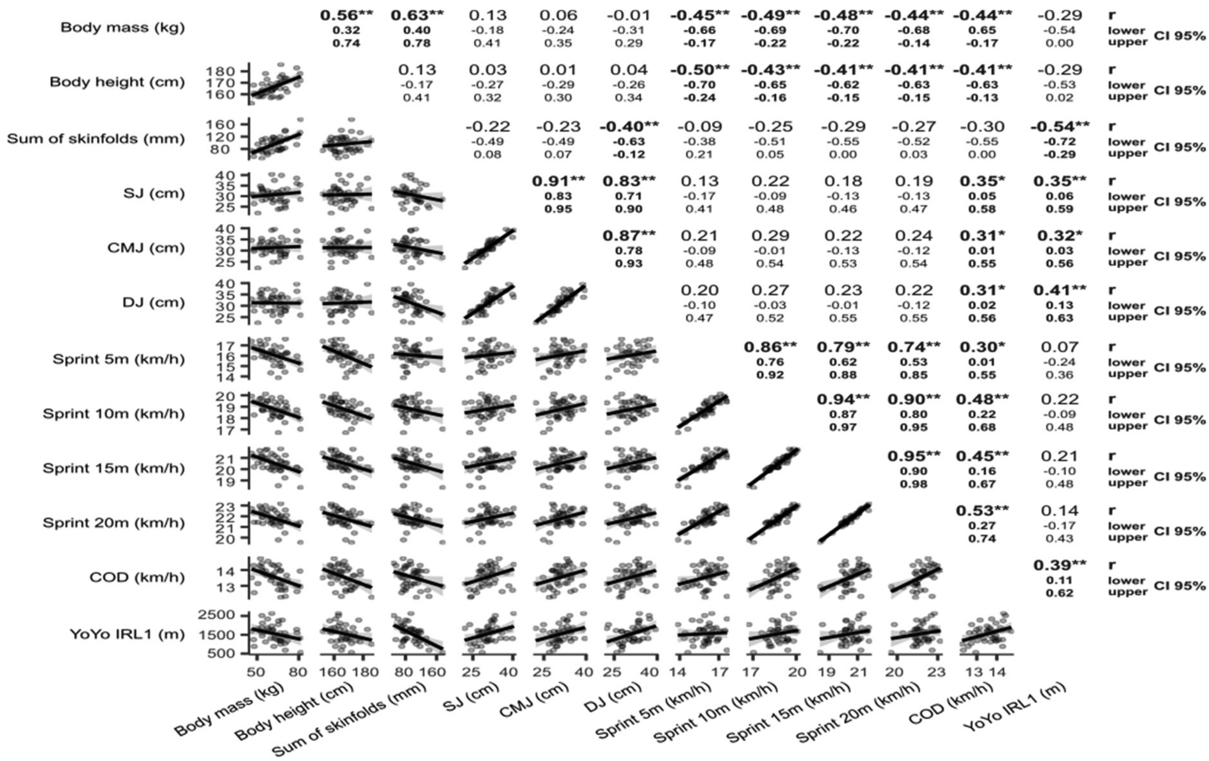

Figure 1. Correlation of anthropometric profile and physical performance of professional female soccer players. * = $p < .05$, ** = $p < .01$, SJ = squat jump, CMJ = countermovement jump, DJ = drop jump, COD = change of direction, IRL1 = intermittent recovery level 1.

performance between professional female soccer players and professional male soccer players. Female soccer players had higher sum of skinfolds than male soccer players (29.53%; $p < .001$; $d = 1.212$). However, male soccer players showed higher values for body mass (19.99%; $p < .001$; $d = 1.592$), body height (8.27%; $p < .001$; $d = 1.964$), squat jump (18.98%; $p < .001$; $d = 1.549$), countermovement jump (21.26%; $p < .001$; $d = 1989$), drop jump (19.79%; $p < .001$; $d = 1.758$), sprint 5 m (7.58%; $p < .001$; $d = 1.216$), sprint 10 m (8.31%; $p < .001$; $d = 1.885$), sprint 15 m (8.45%; $p < .001$; $d = 2.152$), sprint 20 m (8.87%; $p < .001$; $d = 2.382$) and YoYo IRL1 (31.46%; $p < .001$; $d = 1.128$). Age (4.60%; $p = .762$; $d = 0.242$) and velocity in the change of direction test (0.54%; $p = .540$; $d = 0.127$) were the only measures that did not show significant differences.

The effect sizes of comparing the anthropometric profile and physical performance between professional female soccer players and professional male soccer players are shown in Figures 3 and 4. The sum of skinfolds presented a large effect size in favor of professional female soccer players. The other measures of anthropometric profile and physical performance showed effect sizes that ranged from large to very large in favor of male soccer players, except for velocity in the change of direction test, which showed insignificant effect size.

Figure 1 shows the correlations between the anthropometric profile and physical performance of professional female soccer players. As for the anthropometric profile, there was a significant correlation between body mass and body height with sprints of 5, 10, 15 and 20 m and the change of direction test sum of skinfolds was significantly correlated with drop jump and the yoyo IRL1. For the physical performance variables, the squat jump was significantly correlated with the change of direction test and yoyo IRL1, while the countermovement jump and drop jump were correlated with the change of direction test and yoyo IRL1. There were also significant correlations between the different distances of the sprints of 5, 10, 15 and 20 m and the change of direction test Finally, the yoyo IRL1 was significantly correlated with the change of direction test The other correlations that occurred between the anthropometric profile measurements, jumps and sprints are also presented in Figure 1.

Figure 2 presents the correlations between the anthropometric profile and physical performance of professional male soccer players. Of the anthropometric profile variables, only the sum of skinfolds was correlated with physical performance. The sum of skinfolds was significantly correlated with the drop jump, 10, 15-, and 20-m sprints and the yoyo IRL1. For the physical performance

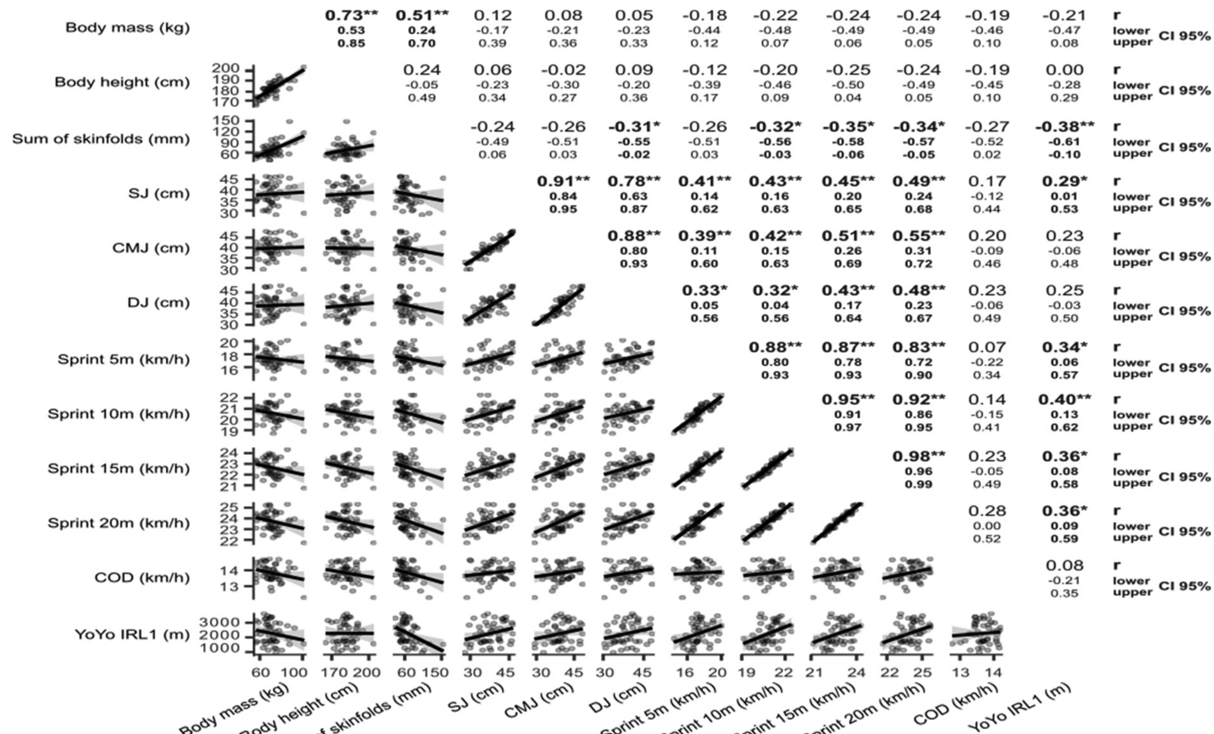

Figure 2. Correlation of anthropometric profile and physical performance of professional male soccer players. * = $p < .05$, ** = $p < .01$, SJ = squat jump, CMJ = countermovement jump, DJ = drop jump, COD = change of direction, IRL1 = intermittent recovery level 1.

Table 1. Comparison of age, anthropometric profile and physical performance between professional female soccer players and professional male soccer players.

	Female ($n = 44$)			Men ($n = 48$)			CI 95% of the difference			
	Mean	SD	CV (%)	Mean	SD	CV (%)	Lower	Upper	p	ES
Age (years)	23.9	±5.46	22.85	22.8	±3.41	14.96	−2	3	0.762	0.24
Body mass (kg)	62.25	±8.83	14.18	77.8	±10.42	13.39	−18.9	−11.1	< 0.001	1.59
Body height (cm)	166.52	±7.44	4.47	181.54	±7.71	4.25	−18.16	−11.87	< 0.001	1.96
Sum of skinfolds (mm)	95.32	±25.24	26.48	67.17	±20.81	30.98	19	37.5	< 0.001	1.21
SJ (cm)	30.69	±4.13	13.46	37.89	±5.00	13.20	−9.1	−5.28	< 0.001	1.55
CMJ (cm)	31.31	±3.74	11.95	39.77	±4.61	11.59	−10.21	−6.71	< 0.001	1.99
DJ (cm)	31.26	±3.91	12.51	38.98	±4.72	12.11	−9.52	−5.91	< 0.001	1.76
Sprint 5 m (km/h)	16.07	±0.88	5.48	17.38	±1.23	7.08	−1.76	−0.87	< 0.001	1.22
Sprint 10 m (km/h)	18.8	±0.75	3.99	20.5	±1.01	4.93	−2.07	−1.34	< 0.001	1.89
Sprint 15 m (km/h)	20.54	±0.76	3.70	22.43	±0.97	4.32	−2.27	−1.52	< 0.001	2.15
Sprint 20 m (km/h)	21.81	±0.77	3.53	23.93	±0.98	4.10	−2.53	−1.75	< 0.001	2.38
COD (km/h)	13.56	±0.63	4.65	13.48	±0.50	3.71	−0.16	0.31	0.54	0.13
YoYo IRL1 (m)	1556.4	±470.23	30.21	2270.8	±743.64	32.75	−974.9	−454.1	< 0.001	1.13

CV = coefficient of variation, CI = confidence interval, ES = effect size, SD = standard deviation, SJ = squat jump, CMJ = countermovement jump, DJ = drop jump, COD = change of direction, IRL1 = intermittent recovery level 1.

variables, the squat jump, countermovement jumps and drop jump were correlated with sprints of 5, 10, 15 and 20 m. In contrast, only the squat jump was correlated with the yoyo IRL1. Finally, the 5-, 10-, 15-, and 20-m sprints were correlated with the yoyo IRL1. The other correlations that occurred between the anthropometric profile measurements, jumps and sprints are also presented in Figure 2.

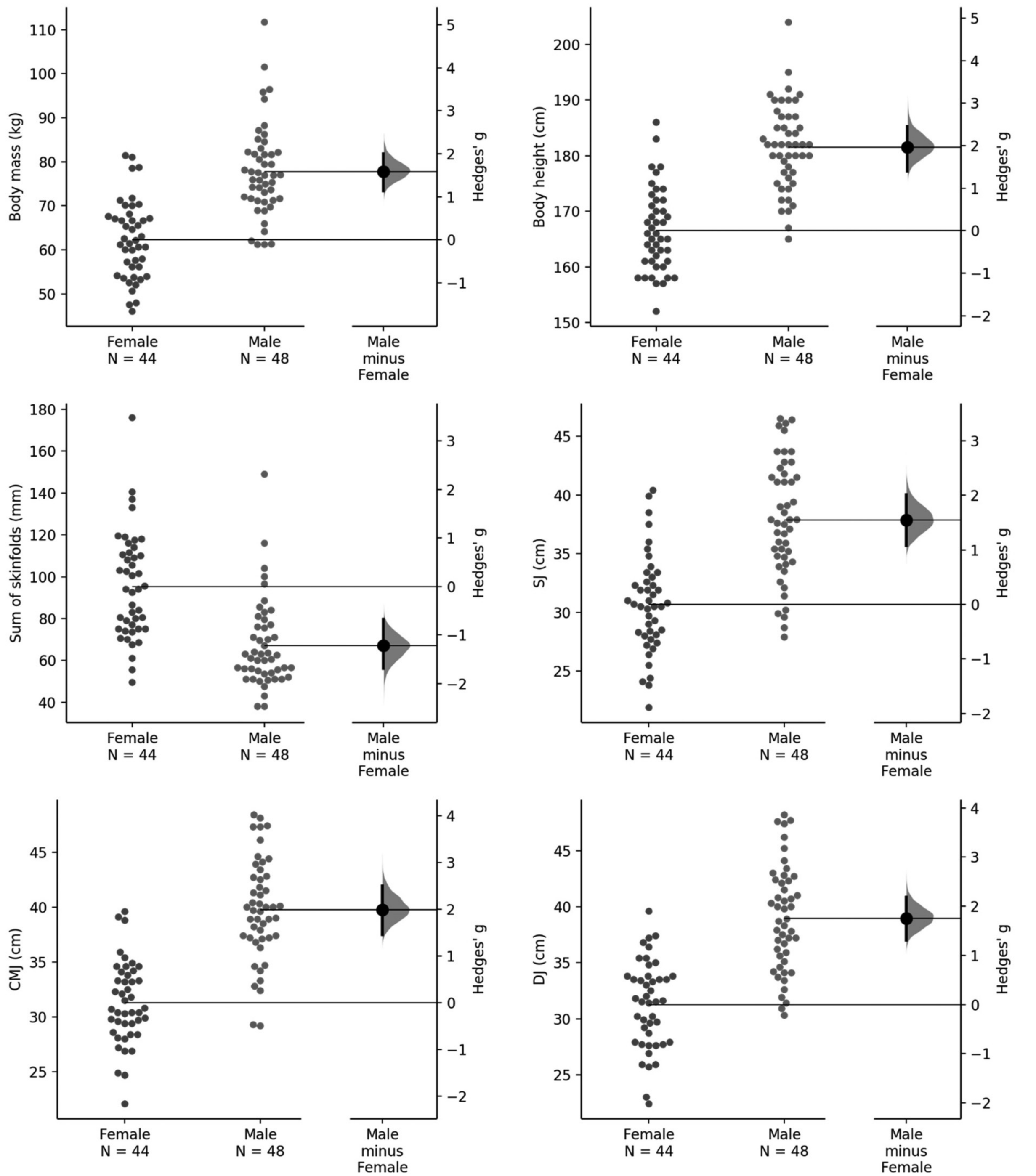

Figure 3. Comparison between female and male soccer players for body mass, body height, sum of skinfolds, squat jump (SJ), countermovement jump (CMJ), and drop jump (DJ). The Hedges'g between groups in the above Gardner–Altman estimation plot. Both groups are plotted on the left axes; the mean difference is plotted on a floating axis on the right as a bootstrap sampling distribution. The mean difference is depicted as a dot; the 95% confidence interval is indicated by the ends of the vertical error bar.

Discussion

The aim of this study was to explore the anthropometric profile and physical fitness of Brazilian professional female and male soccer players, and to verify if there are gender-specific differences and possible correlations between the anthropometric and physical performance variables within and between genders. Apart from the age and COD test, all other anthropometric and physical performance variables were significant different between women and men.

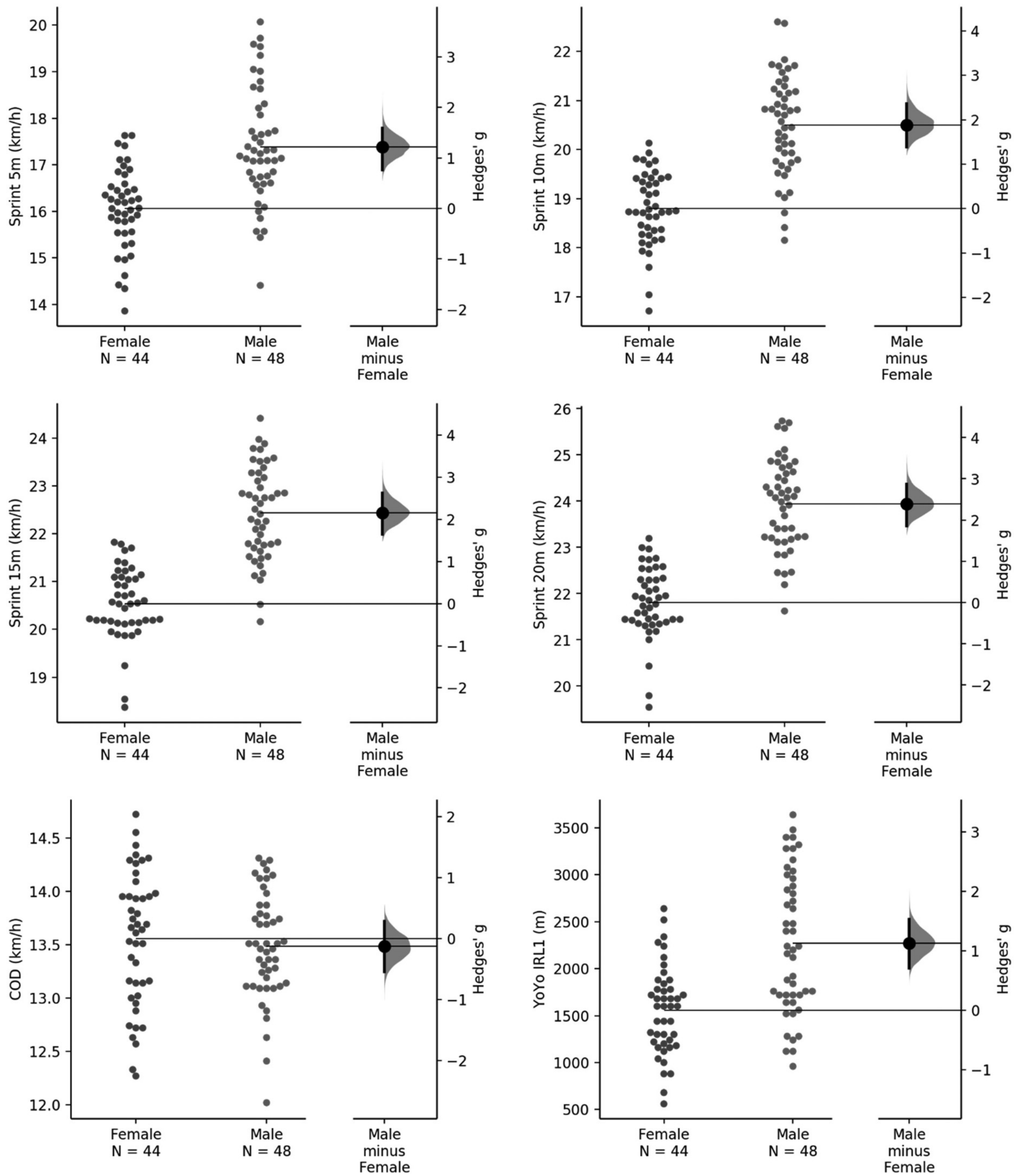

Figure 4. Comparison between female and male soccer players for sprint 5 m, sprint 10 m, sprint 15 m, sprint 20 m, change of direction (COD), and YoYo IRL1. The Hedges'g between groups in the above Gardner–Altman estimation plot. Both groups are plotted on the left axes; the mean difference is plotted on a floating axis on the right as a bootstrap sampling distribution. The mean difference is depicted as a dot; the 95% confidence interval is indicated by the ends of the vertical error bar.

Regarding anthropometric variables, a better profile was found for men than women which is in line with previous research[31,32] that also found higher body height, mass and lower fat mass values for man when compared to women. Considering physical variables, the present study found better significantly performance for all jump, sprint and running tests in men than in women. Overall, women players are known to present lower physical performance than man.[32] Intrinsically, there was only one exception in COD test where no difference between sex was found. It is relevant to highlight that all running, jump and sprint tests, as well as heigh and body mass variables were correlated with COD for women, while none of these variables presented correlation for men. This means that for women, height, body mass, sprint ability, running and jump performance seems to have a role in COD actions while for men, none of these variables was found to be relevant and maybe a more specific training in COD is required. While previous research supported correlation between COD with jump and sprint actions for women[33] and man athletes[33] our results only supported for women.

Beyond the correlation analysis for women between COD and the other variables, several correlations were found between sprints, plus COD with body weight and sum of skinfolds, plus between yoyo IRL1 with sum of skinfolds and all jump tests. Considering the anthropometric and sprint measures, the present results are not in agreement with a previous study conducted on a Chile professional soccer team that found correlations between the time completed in 10 and 30 m sprint with height and sum of skinfolds.[10] However, in line with our findings, the same study also found associations between the YoYo IRL1 with sum of skinfolds and all jump tests which supports that lower value of skinfolds can be associated with better performance in running tests.

These results are also similar to those reported by Villaseca-Vicuna et al.[10] that found lower sum of skinfolds were correlated with higher distance in YoYo IRL1.[10] In fact, Mujika et al.[15] stated that better results in the YoYo IRL1 test were associated with lower body fat percentage. In addition, in female soccer players, better performance in YoYo IRL1 seem to be associated with better performance in jump ability.

Contrary to our findings, one study found associations between 15 and 20 m sprints with CMJ and DJ.[10] The only difference between studies was that ours used the speed while Villaseca-Vicuna et al., used the time achieved in sprint tests.[10] This finding was also supported in young female soccer players.[34] The different form of analysis may explain the difference between the findings.

Regarding men, there were correlations between sum of skinfolds with DJ, sprint (10 to 20 m) and YoYo IRL1. Moreover, all jump tests were correlated with all sprint tests, while SJ and CMJ were also correlated with YoYo IRL1. Considering the jump ability and sprint tests associations, previous studies in under-20 soccer players also found such associations using sprints of 5, 10 and 17 m[35] or in 5 and 20 m[36] or in 10 and 20 m.[34] These findings were also supported by professional soccer players during 5, 10 and 15 m[37] or 10 and 30 m sprint tests.[38] The correlation between the different tests means that a faster time on sprint tests correlates with higher jump ability.[34]

From a mechanical conceptualization point of view, an athlete needs to apply a great strength during the take-off to jump higher.[20,39] Additionally, the transition from lower to higher sprint speeds provides shorter contact times with a simultaneously increase in vertical peak force.[40] Thus, athletes with higher jump ability will also be more efficient at accelerating and consequently, they will achieve higher velocities over short distances.[39] Furthermore, just like in the study of Loturco et al.,[35] our results showed a tendency oh higher correlations values with higher sprinting distances and speed with jump tests.

Despite the valuable contribution of the present study to the state or art, it also presents some limitations. Regarding anthropometric measures, body fat was not calculated from the skinfolds collected, but we opted to use the sum of skinfolds such previous recent study.[10] In addition, our battery test included nine different tests to assess different performance components while other assessments such as muscle strength, balance or specific soccer tests were not used in this study. Furthermore, bilateral jump tests were used, and soccer players may present limb asymmetry[41] which was not considered in the present analysis. Moreover, the time of data collection and the specific context of Brazilian soccer players may influence the obtained results which should be considered for a better results interpretation. Finally, playing position was not considered for analysis to not decrease size of the of both men and women groups, although this situation variable has been used in previous studies.[42,43]

Conclusion

The main finding of this study confirmed our first hypothesis where in general better performance was displayed by men than women. In addition, higher values of body mass and height, as well as lower values of sum of skinfolds were found for men when compared to women.

Considering our second hypothesis, our study showed that women presented correlation between COD and all other performance and anthropometric variables (with the exception of sum of skinfolds); between sprint and COD with body mass and body weight; between yoyo IRL1 with sum of skinfolds and all jump tests; while men presented correlations between sum of skinfolds with DJ, sprint (10 to 20 m) and YoYo IRL1; between all jump tests with all sprint tests; SJ and CMJ were also correlated with YoYo IRL1.

Practical application

The applicability of the present study is to get better knowledge for coaches and their staff about which anthropometric and performance tests can be used in soccer players and what are the association between them. Also, due to the growth of women's football in the world, many coaches and their coaching staff are migrating from male's soccer to coaching female's football teams. The present study presents differences that must be considered in the prescription of physical training considering the individuality of the players' gender. Thus, coaches should consider gender-specific parameters to create goals about the anthropometric and physical performance profile of players. In addition, training to achieve these goals must consider which variables were best related in each gender.

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Supplemental material

Supplemental material for this article is available online.

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