Sport Training

Physical fitness of young and professional women's soccer players at the start of pre-season: transitioning from youth to professional levels

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Abstract - Aim: The aim of this study was to compare the anthropometric profile and physical performance of female soccer players from the under-15, under-18, and professional categories during the pre-season. **Methods:** Seventy-five female soccer players participated: 20 under-15 players (aged 13.35 ± 0.75 years), 26 under-18 players (aged 15.69 ± 0.68 years), and 29 professional players (aged 21.48 ± 5.33 years). Assessments were conducted one week after the start of the pre-season, including tests for body mass, height, squat jump (SJ), countermovement jump (CMJ), drop jump from 30 cm (DJ), and Yo-Yo Intermittent Recovery Level 1 (Yo-Yo IRL1). **Results:** There were significant differences in anthropometric profiles, body mass, and height between groups ($p < 0.001$), with professional players being taller and heavier. No significant differences were found between the under-15 and under-18 players. Physical fitness was significantly higher in professional players compared to the younger groups ($p < 0.001$). **Conclusion:** This study identified that professional female soccer players have superior physical performance compared to under-15 and under-18 players at the start of the pre-season. It is recommended that professionals involved in the transition of young female soccer players to the professional level take these differences into account.

Keywords: women, talent identification, football, training, physical fitness, physical performance.

Introduction

Women's soccer is in constant development, this can be seen in the increase in the number of practitioners and in the interest of the public. This evolution is also noted in the scientific literature[1,2]. With the evolution of the modality, an increase in the physical demands of the game is expected[3-5]. In this context, it is important that women's soccer players have some well-developed physical abilities to integrate into professional soccer teams[6,7]. Therefore, professionals who work in women's soccer should have greater control over training loads since athletes who reach the professional category need higher levels of physical performance[5]. The development of women's football also influences the transition process from the basic categories to the professional, highlighting the need to develop methods for identifying talent that reflect the current and specific demands of the game[7].

Soccer is a sport where the result is dependent on several factors related to physical performance[8]. Among these factors are anthropometric profile variables, vertical jumps, and aerobic resistance[9-11]. In this sense, the anthropometric profile has a relationship with performance, mainly linked to the specific game actions of the athletes[12-14]. In women's soccer, the literature presents studies with reference values that seek to trace the anthropometric profile of the players[15,16] and studies that present the comparison between young players and professional women's soccer[4,17]. However, to date, few studies have performed these comparisons during the pre-season[4].

Vertical jumps are related to the power of the lower limbs, which is reflected in the actions of jumping, kicking, and sprinting that are performed in different moments of the soccer game. In this way, the counter-movement jump, squat jump, and drop jump tests are used to identify the power of the lower limbs, stretching-shortening cycle capacity, and reactive strength[18,19]. It is possible to observe that in women's soccer there are studies that investigated the performance in the Counter Movement Jump, Squat Jump, and Drop Jump tests[4,10,17,20,21]. In addition, there are comparisons between young female and professional soccer players, but only one of these studies investigated these capabilities in the preparatory period[4,17,20].

Aerobic resistance is also an important physical capacity related to physical performance in soccer. In this sense, the Yo-Yo test is an important physical assessment of aerobic resistance, widely used in the context of football. This test is related to the ability to perform actions at high intensity during games[22], especially in the final part of the soccer game[23]. Recent studies provide reference values for the distance covered in meters in the Yo-Yo test[24]. Some studies present data obtained during the preparatory period of young and professional female soccer players[4,25]. It is also possible to find studies that compare different categories at different times of the competitive season[4,10,17].

In women's soccer, the transition process of young players to the professional category often occurs during the pre-season. During this period, young women's soccer players who stand out in their category are often tested in the professional squad. However, few studies were found investigating physical differences between categories during the pre-season. Knowing this, it is important to develop studies that allow coaches to identify the existing physical and anthropometric differences between young female soccer players and professional female soccer players during the pre-season. This could help women's soccer coaches and coaching staff identify female soccer players for the professional category. Thus, the aim of the present study was to compare the anthropometric profile and physical performance of female soccer players from the under-15, under-18, and professional categories during the pre-season. Based on the studies found, the hypothesis of the present study is that the anthropometric profile and physical performance are different between the base and professional categories of women's soccer during the start of the competitive pre-season.

Materials and methods

Design and setting

This study followed a cross-sectional design. Players from the under-15, under-18, and professional categories from the same elite female soccer team were evaluated. Thus, the female soccer players were assessed on average one week after the beginning of the preseason. In the middle, they conducted seven training sessions. The female soccer players were recruited through convenience sampling. The context of data collection involved a rest period of 20 h between the last training session and the data collection day. The assessments were performed in the period of mourning starting at 9 a.m., approximately 1 h after breakfast and 1 h and 30 min after waking up. The assessment started with anthropometry and followed the same order with a standardized warm-up protocol consisting of 10 min of dynamic movements normally used before soccer games, 5 min of rest, jumping tests, 5 min of rest, and the aerobic capacity test. The female soccer team evaluated in the present study is one of the main professional teams in Brazil. This team is considered a benchmark for detecting young players for elite female soccer.

Participants

The study included 75 female soccer players: 20 under-15 players aged 13.35 ± 0.75 years (3 goalkeepers, 5 defenders, 4 outsidebacks, 5 midfielders, and 3 forwards); 26 under-18 players aged 15.69 ± 0.68 years (2 goalkeepers, 5 defenders, 3 outsidebacks, 8 midfielders, and 8 forwards); and 29 professional female players aged 21.48 ± 5.33 years (4 goalkeepers, 4 defenders, 5 outsidebacks, 10 midfielders, and 6 forwards). All female soccer players who were available in their teams were evaluated (including only the anthropometric profile and jumping performance of goalkeepers); thus, power data were posteriorly calculated in the G* Power 3.1 program (Heinrich Heine, Düsseldorf, Germany). The female soccer players were part of an elite soccer team in Brazil. These female soccer players were at the beginning of their preparation to compete in the main competitions of their respective categories. The teams trained regularly, 5 to 6 days a week, with an average training time of 1 h and 15 min. Prior to data collection, female soccer players were informed of the risks and benefits of the assessment, and team officials provided written informed consent. The eligibility criteria were: (i) the female soccer players must be cleared by the team's medical department; (ii) they must be on the list of female soccer players who will participate in the competitions in their category. The study was approved by the Institutional Review Board (or Ethics Committee) of Federal University of Rio Grande do Sul, School of Physical Education, Physiotherapy and Dance (number: 5.899.290). This study was conducted in accordance with the World Medical Association's code of ethics (Declaration of Helsinki), printed in the British Medical Journal (July 18, 1964).

Procedures

Anthropometric profile and physical performance tests of female soccer players were assessed: (i) body mass and height; (ii) squat jump (SJ); (iii) countermovement jump (CMJ); (iv) drop jump 30 cm (DJ); (v) Yo-Yo IRL1. The female soccer players were asked to maintain their regular diet before the assessments. The objectives and methodological procedures of the study were explained to the female players, and the free and informed consent form was signed. Then, the age, body mass, and body height were measured. After the anthropometric assessment, the female soccer players performed a warm-up protocol consisting of 10 min of dynamic movements normally used before soccer games. Finally, the female players proceeded to perform the jump tests and the Yo-Yo IRL1.

Anthropometric profile

The evaluations took place at 9 am, being carried out 1 h after the first meal of the day. Anthropometric profile assessments were performed to characterize the group of female soccer players. For body mass assessment, the female soccer 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. The main outcomes used for further data treatment were body mass (kilograms) and stature (cm).

Jumps tests

Three attempts were made for each type of jump. The interval between attempts was 1 min with a 3 min 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 squat jump 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 female soccer player performed rapid hip and knee extension for the jump performance, without using countermovement[26,27]. The intraclass correlation coefficient and Cronbach's α coefficient for this measure were 0.963 and 0.965, respectively. For the countermovement jump, the female soccer 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[26,27]. The intraclass correlation coefficient and Cronbach's α coefficient for this measure were 0.972 and 0.972, respectively. Then, to perform the drop jump, the female soccer player started from an upright position with hands on hips and on top of a 30 cm box. 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[26,27]. The intraclass correlation coefficient and Cronbach's α coefficient for this measure were 0.956 and 0.957, 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 squat jump (cm), countermovement jump (cm) and drop jump (cm).

Yo-Yo intermittent recovery test level 1

The female soccer players performed 20 m shuttle run, with 10 s 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[23]. The goalkeepers did not perform the Yo-Yo IRL1test. The total distance completed by the players was extracted as the main outcome.

Statistical analysis

Intraclass correlation coefficients 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. The normality and homogeneity of the data were verified using the Shapiro-Wilk and Levene tests, respectively. The One-Way ANOVA test with Least Significant Difference (LSD) post hoc was used to compare players' groups. Additionally, for comparison between the groups, Effect Size *f* calculations were performed, adopting the "Cohen's d" 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[28,29]. The level of significance was set at $\alpha < 0.05$. Power data were posteriorly calculated in the G* Power 3.1 program (Heinrich Heine, Düsseldorf, Germany). Data analysis was performed using the software SPSS (version 22.0; IBM Corp., Armonk, NmujiY, USA).

Results

Table 1 presents data comparing the anthropometric profile and physical performance among under-15, under-18, and professional female soccer players. As for the anthropometric profile, body mass and body height were significantly different between groups ($p < 0.001$), being higher for professional players and with no difference between under-15 and under-18 female soccer players. The performance in the SJ and CMJ was significantly different between the groups ($p < 0.001$), with superior performance for the professional players and no difference between the under-15 and under-18 women's soccer players. Performance on the DJ was also significantly different between the groups ($p < 0.001$), with professional female soccer players presenting the highest performance, fol-

Table 1 - Comparison of anthropometric profile and physical performance between U-15, U-18, and Professional female soccer players.

Variables	Under-15 (n = 20, G = 3)		Under-18 (n = 26, G = 2)		Professional (n = 29, G = 4)				
	Mean ± SD	CI 95%	Mean ± SD	CI 95%	Mean ± SD	CI 95%	*p*	ES	Power
Body mass (kg)	52.26 ± 7.55 a	48.73-55.79	56.15 ± 6.26 a	53.63-58.68	62.13 ± 8.27 b	58.98-65.27	< 0.001	0.544	0.989
Body height (cm)	161.20 ± 6.00 a	158.39-164.01	164.00 ± 4.89 a	162.03-165.98	168.38 ± 8.11 b	165.30-171.46	0.001	0.454	0.938
SJ (cm)	26.29 ± 4.02 a	24.40-28.17	27.90 ± 3.75 a	26.39-29.41	31.30 ± 4.44 b	29.61-32.99	< 0.001	0.513	0.979
CMJ (cm)	26.66 ± 4.09 a	24.75-28.57	28.12 ± 3.49 a	26.71-29.52	32.33 ± 4.59 b	30.58-34.07	< 0.001	0.595	0.997
DJ30 (cm)	26.54 ± 4.14 a	24.60-28.48	29.31 ± 4.16 b	27.63-30.99	32.30 ± 4.69 c	30.51-34.08	< 0.001	0.532	0.986
Yo-Yo IRL1 (m)	1040.00 ± 370.14 a	849.69-1230.31	1396.67 ± 425.27 b	1217.09-1576.24	1662.40 ± 469.98 c	1468.40-1856.40	< 0.001	0.625	0.987

CI = confidence interval, SJ = squat jump, CMJ = countermovement jump, DJ = drop jump, IRL1 = intermittent recovery level 1, G = goalkeepers, excluded in the analysis of Yo-Yo IRL1, ES = overall effect size *f*, Different letters indicate significant differences between groups ($p < 0.05$).

lowed by under-18 players, and lastly by under-15 players. The aerobic resistance of the female soccer players was also significantly different between the groups ($p < 0.001$), with the professional female soccer players presenting the best performance in the Yo-Yo IRL1, followed by the under-18 players, and finally the players under-15.

Discussion

The aim of the study was to compare the anthropometric profile and physical performance of female soccer players from the under-15, under-18, and professional categories during the pre-season. An anthropometric profile, vertical jumps, and aerobic resistance assessments were performed. The results found are in line with the study's hypothesis, allowing us to identify that there are significant differences in the anthropometric profile and physical performance of professional players and players from the base categories of women's soccer during the pre-season.

In the anthropometric profile of female soccer players, a significant difference was found between the groups, with professional players having greater height and body mass; on the other hand, there was no difference between the under-15 and under-18 categories. In the literature, it is also possible to observe differences in the anthropometric profile in the comparison of under-17, under-20, and professional athletes[5]. However, authors who compared under-15, under-17, under-20, and professional players from the Brazilian national team found differences only in height in the under-15 category in relation to other categories and in body mass between the under-15 and under-20[17]. Thus, the existing differences between the categories of women's soccer may be related to the context in which they are inserted, as it seems that the greater the monitoring of professionals and access to qualified materials and structures, the smaller the differences in the anthropometric profile are observed.

In the present study, for the vertical jump tests, significant differences were also found in the physical performance of female soccer players from different categories. In both tests, the professional category players had significantly better results than the other groups, while the under-15 and under-18 categories did not show significant differences. These findings corroborate other studies found in the literature, where professional players performed better than the under-20, under-17, and under-15 categories in the squat jump[17]. Another study that also compared professional athletes with the sub-19 and sub-16 categories found that the sub-19 athletes had better performance in the squat jump and countermovement jump, while the professionals presented better results than the sub-16 category, indicating differences between the three categories[20].

Also, when comparing professional and junior women's soccer players, professional players had better results in the countermovement jump[4]. It is a fact that as the individual grows chronologically, the performance in these variables tends to grow[30], since the muscle mass also increases[31]. Therefore, considering that power is the relationship between strength and speed and maximum strength is correlated with muscle mass, the tendency is for female athletes to increase their capabilities for performing vertical strength as they age. Another possible explanation for these differences is the fact that professional athletes are exposed to higher training intensities and game volumes, which may reflect on the results found.

For the drop jump assessment, differences were observed between all categories. Professional female soccer players performed better than the under-18 and under-15 categories, and the under-18 category was superior to the under-15 category. There are few studies in the literature that compare drop jump performance between female soccer players from different categories. However, those who investigated this variable found similar results[10,21]. These differences may be associated with familiarization with the test, as the drop jump protocol presents a higher level of difficulty than the squat jump and countermovement jump protocols. Another possible explanation may lie in the developed training strategies, in which the involvement of reactive jumps can increase performance in vertical jumps. Therefore, it is important to add plyometric training involving reactive jumps to the base categories so that at the time of transition, performance differences can be minimized.

As for the performance in the Yo-Yo IRL1 test, the results indicate that professional female soccer players had the highest performance, followed by under-18 players, and lastly, under-15 players, with a significant difference between the three groups. In the study[17], professional athletes showed a significant difference from the under-20, under-17, and under-15 categories, followed by under-20 athletes, who showed a significant difference for the other two youth categories, while female soccer players from the under-17 and under-15 categories did not present significant differences. Another study, carried out at the beginning of the pre-season, corroborates the findings, pointing to a significant difference in performance between professional and junior athletes[4]. These differences found in the present study between female soccer players from different categories may be related to the existing differences in the competitive calendar, in which in Brazil the professional category has an annual competitive calendar that allows for a greater sequence of games and training for the players, allowing the development and maintenance of aerobic endurance during the competitive season. Thus, considering that performance in the Yo-Yo test is related to the ability of elite women's soccer players to perform actions at high intensity during professional games[22], it is fundamental that the players who are in the moment of transition to the superior category are evaluated and trained to verify that the aerobic resistance is adequate so that they can keep up with the training and games of professional women's soccer players.

A main limitation of this study is its limited generalizability, as it included athletes from a single elite team competing at the national level, which may reflect specific contextual factors. Additionally, the results may not fully capture the diversity of contexts within women's soccer in Brazil. This underscores a gap in the literature, particularly regarding physical performance during the transition between categories in female players. Future studies should explore this process in different settings. Despite these limitations, the present results offer practical insights for coaches and technical staff by providing updated reference values and highlighting physical differences across age groups. The anthropometric disparities reinforce the importance of early multidisciplinary approaches, while the lower jump and endurance performance among youth players suggests the inclusion of plyometric training and aerobic development strategies to support long-term progression and avoid premature specialization.

Conclusions

This study showed that professional female soccer players presented superior physical performance compared to under-15 and under-18 players during the preseason. Although no differences were observed between the youth categories in body mass, height, SJ, and CMJ, under-18 players outperformed under-15 players in DJ and aerobic endurance. Overall, professional players demonstrated higher jump performance, better aerobic capacity, and distinct anthropometric characteristics relative to both youth groups. Considering that category transitions in women's soccer often occur at the beginning of the competitive pre-season, these findings offer practical insights for managing this process. The observed differences in anthropometric and physical performance variables indicate that professional players are physically ahead of younger athletes. Therefore, coaches and staff should account for structural and contextual factors such as training routines, competitive level, and club resources to ensure that transitions align with the athletes' stage of physical development and preparation.

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