

Physical performance of elite and subelite Spanish female futsal players

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ABSTRACT: The aim of this study was to determine the parameters distinguishing top female futsal players from lower level players. Twenty-seven female futsal players participated in the study, composed of professional first division (elite; n=15) players and semi-professional second division players (sub-elite; n=14). Active and passive straight leg raise tests, isokinetic strength of the knee extensor and flexor muscles at 60°·s⁻¹ angular velocity, squat and counter movement jumps, 30 m sprint, 30 m agility, repeated sprint ability test and maximum ball speed during shooting were measured. The elite players were more agile and kicked harder than sub-elite players in maximum ball speed during the shooting test (P≤0.05). However, no significant differences between teams were observed in active and passive hamstring flexibility, jumping ability, repeated sprint ability test, 30 m sprint time, H/Q ratio and absolute and relative torque from 60°·s⁻¹ angular velocity. Based on these findings we conclude that agility and maximum ball speed during shooting may be important determinant factors of Spanish female futsal actions and could distinguish ability at high-level games.

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INTRODUCTION

Futsal is a form of indoor soccer between two five-a-side teams. It is officially sanctioned by the Federation International of Football Association (FIFA) [1] and is played by more than 1.1 million people worldwide [2]. In addition, futsal is an intermittent high-intensity team sport that provokes high physical, technical and tactical demands on the players [3]. Futsal actions depend on anaerobic power of the neuromuscular system, and this is considered an important factor for team sport performance such as futsal [4]. Furthermore, some of the determinant physical capacities for successful performance in futsal are sprinting, strength levels to kick, tackle, turn and change pace, repeat sprint ability [1] and explosive type efforts such as jumps and duels during game actions [5].

Futsal players must be able to recover rapidly following high-intensity exercise because the intensity and rhythm of the game are very high and do not decline as the match progresses [3]; for these reasons, sprinting performance is a decisive factor. The studies about physiological demands of futsal show that players spent 5 and 12% of game time sprinting and performing high-intensity running [3] and they attain 90 and 75% of their maximal heart rate (HR_{max}) and oxygen uptake (VO_{2max}), respectively [6,7]. Indeed, the inability to

maintain repeated-sprint performance has been attributed mainly to accumulation of metabolites, such as increase in [La] [8], the accumulation of H⁺ [9], the depletion of muscle phosphocreatine [10] and changes in the neuromuscular coordination of muscle contraction [11]. Therefore, repeat sprint ability (RSA) is considered as another determinant factor for futsal [1].

The mechanics and performance of kicking are of major interest for futsal and soccer coaches because the goal represents the most important part in the process of finalization during the match, determining the final result of the team [12]. Although the velocity of the shot is not the only component of the goal, it signifies a relevant element in the team performance [13]. Moreover, in team sports such as futsal it is normally considered that the quadriceps muscle plays an important role in jumping and ball kicking. In addition, the hamstring stabilizes the knee joint during changes of directions or tackles and directs the running actions [14]. This fact means that assessment of lower limb muscle strength is an important factor because it is involved in some motor actions of futsal [15]. Also, the vertical jump has been considered a relevant action in team sports [16] because during an outdoor soccer game, the player jumps an average

of only 15.5 times [17]. On the other hand, reduced flexibility has been associated with a greater risk of injury and lower physical performance [18].

The technical skill of futsal players is influenced by the size of the field and the smaller ball. Futsal players respond by controlling and possessing the ball more quickly and technically than footballers and they are often found under 1vs1 situations [19]. The capacity of players for quick movement of the entire body with a change of direction and speed, known as agility, is a determinant factor in futsal because it enhances performance, reduces the injury risk and neutralizes the opponent [20]. Agility also contributes to the ability of successful manipulation of an external object such as the ball [21].

Although futsal has enjoyed a spectacular increase in popularity over recent years and is played worldwide in both professional and amateur leagues by men and women [1], scientific knowledge regarding female futsal characteristics is rather limited.

To our knowledge no study in female futsal players has analysed simultaneously the influence of different practice levels on isokinetic peak torque of the knee flexor and extensor muscle, 30 m sprint performance, jump power, hamstring flexibility, maximum ball speed during shooting, agility and repeat sprint ability. A better understanding of the physiological and neuromuscular profiles of female futsal players is important in order to enhance the training programme and to optimize the training load of the players. Furthermore, it may assist to prevent injuries and to detect future talents. Therefore, the aim of this study was to determine the differences between elite and subelite female futsal players in muscle flexibility and strength of lower limb, agility and repeat sprint ability and to study possible correlations between variables, by attempting to clarify which one(s) distinguish the top players from the lower level. A secondary aim was to establish descriptive data for Spanish female futsal players, since little recent information exists for either professional or semi-professional teams.

MATERIALS AND METHODS

Design. A comparative cross-sectional study was performed. All measurements were taken at the beginning of the competitive season. All the tests were completed over two different sessions, 7 days apart. During the first testing session the active and passive hamstring flexibility test and isokinetic test were performed. In the second testing session, vertical jump, 30-m sprint, agility, kicking performance and RSA were assessed on the same futsal field. A full recovery (20 min) was allowed between different measurements, and tests were performed in the same order. Prior to testing, each subject underwent a 10 min warm-up period consisting of 5 min of running followed by supervised dynamic stretching of the lower limbs.

Subjects

Twenty-seven female futsal players participated voluntarily in the study, including 14 professional first division (elite) players, and 13 semi-professional second division players (sub-elite). Descriptive anthropometric data of the subjects are shown in Table 1. On average, elite and sub-elite players had trained $8-10 \pm 1.6$ hours per week and had played one game per week for the previous 4 years. None of the players tested had had any prior experience in isokinetic practice before the test. The elite group was considered a Spanish elite team because: (1) they finished fourth in the First Division Female Futsal League in the previous season, (2) two of their players had been internationals, (3) the Spanish Futsal League is considered one of the best leagues in the world and (4) the Spanish Female Futsal Team won the European Futsal Championship and reached the final of the World Futsal Championships. Prior to the test, the experimental procedures and risk and discomforts associated with the study were explained to all subjects and they provided signed informed consent, approved by the University's Institutional Review Board and in accordance with the Declaration of Helsinki.

TABLE 1. Main characteristics of subjects.

	Age (years)	Height (cm)	Weight (kg)	Fat mass (%)
Elite (n=14)	21.1 \pm 2.3	163.5 \pm 4.2	61.8 \pm 4.6	26.7 \pm 4.6
Sub-elite (n=13)	21.8 \pm 2.5	166.2 \pm 3.1	65.1 \pm 1.6	26.1 \pm 5.4

Note: the values are mean \pm SD.

TABLE 2. Hamstring flexibility (ASLR and PSLR test ($^{\circ}$)) in elite and sub-elite female futsal players.

	ASLRd	ASLRnd	PSLRd	PSLRnd
Elite	68.3 \pm 10.2	68.9 \pm 9.6	82.9 \pm 10.2	82.0 \pm 10.6
Sub-elite	68.3 \pm 10.1	68.7 \pm 5.9	84.3 \pm 4.9	82.4 \pm 7.3
P-value	0.991	0.959	0.754	0.928

Note: the values are mean \pm SD; ASLR: active straight leg raise test; PSLR: passive straight leg raise test d: dominant leg; nd: non-dominant leg.

Procedures

Flexibility test

In the first testing session hamstring flexibility was measured with the active straight leg raise (ASLR) test and passive straight leg raise (PSLR) test using an inclinometer (Microfet6, Draper, USA). A low-back protection support was used to maintain the normal lordotic curve and tests were performed without warm-up. Dominant and non-dominant legs of each player were tested in randomized order in the PSLR and ASLR tests. PSLR was performed before ASLR. In the PSLR test, the participant was placed in the supine position with her legs straight and the ankle of the tested leg in a relaxed position. The test administrator placed the inclinometer over the external distal tibia while the free hand was placed over the opposite knee. A trained examiner kept the contralateral leg straight and fixed the pelvis. The ankle was in a relaxed position to minimize the influence of the gastrocnemius muscle [22]. The test evaluators had previous experience in the test. Players were guided but not assisted by the researcher for the ASLR whilst the researcher moved the limb into position for the PSLR. The test finished when the examiner perceived resistance and/or pelvic rotation. The maximum angle determined by the inclinometer at the point of maximum hip flexion was used. Players performed the ASLR and PSLR test two times separated by a 5 min recovery period. If the coefficient of variation was higher than 1% a third measurement was performed. The mean of the two valid trials was used for subsequent analysis.

Isokinetic test

Following a standardized warm-up consisting of 10 min sub-maximal stationary cycling and dynamic stretching, an isokinetic dynamometer (Biodex 3, Biodex Corporation, Shirley, NY, USA) was used to measure peak torque values and the torque angle of both legs during knee flexion and extension. The motor axis was visually aligned with the axis of the knee. The player was seated and stabilized by straps so that only the knee to be tested was moving with a single degree of freedom. The hip extensors and flexors in the dominant and non-dominant leg were tested concentrically. Both the 'dynamic ramping' (limb acceleration and deceleration) and 'gravity correction' features were used in all tests to avoid previously documented problems, such as torque overshoot and gravity effects. The dynamometer was calibrated, using the protocol from the Biodex 6000 manual, at the beginning of the test session. All subjects performed five continuous maximum effort concentric contractions of the knee flexors and extensors for both legs in random order at the angular velocity of $60^\circ \cdot s^{-1}$. Before the trial set, a specific warm-up consisting of two series at 50 and 80% of the players' perceived maximum effort was carried out. The test started 5 min after the warm-up trials had been completed to prevent fatigue. A recovery period of 5 min between legs was used. The first and last repetitions were excluded from the data analysis. The second, third, and fourth contractions were averaged for the determination of the optimum angle by fitting a 4th order polynomial curve. Only the highest peak torque values of the fitted

curve of the flexors and extensors of each leg were used in the analysis. Peak torque was normalized, expressed relative to body mass ($kgf \cdot N \cdot m^{-1}$). The deficit between dominant and non-dominant peak torque of the flexors and extensors was analysed. The H/Q ratio was taken from the ratio of peak torque between the knee extensors and flexor at $60^\circ \cdot s^{-1}$.

Vertical jump test

The jumping ability of the players was evaluated with a force platform with a sampling rate of 1000 Hz (Kistler 9286AA Portable, Kistler, Switzerland). The players performed two different jumps, a squat jump (SJ) and a counter movement jump (CMJ) with the arms kept at the waist at all the times to minimize any contribution to jump impulse by the upper body. All players had experience in these types of actions. Three attempts were carried out for each type of jump, and the best result was used. A 2 min rest was allowed between jumps to minimize the effect of fatigue. The SJs were performed starting from a 90° knee angle position, and no drop or countermovement was permitted. If any countermovement was detected on force-time display, the subject was required to repeat that trial. For the CMJs, the subjects were instructed to perform the jump as fast as possible with the aim that the stretch-shortening cycle would be active. Jump height (cm) and maximal power (W/Kg) were determined in SJ and CMJ. Jump heights (h) were calculated from the take-off vertical velocity (v_i) using the following equation: $h = v_i^2 \cdot 2g^{-1}$. Power was calculated as follows: vertical force x instantaneous vertical velocity of the system's centre of mass.

Kicking performance test

The kicking performance of the players was evaluated from maximum ball speed during shooting. The speed ($km \cdot h^{-1}$) was measured with a radar gun (Stalker Professional Radar, Radar Sales, Plymouth MN, USA) with a record data frequency of 33 Hz. The radar was set up behind the goal, and the soccer ball was placed on the penalty line. It was then struck by the dominant leg after a free run-up. The best of five attempts was used for analysis.

Velocity and agility test

Futsal players performed three 30 m sprints separated by a 5 min recovery period. The players started on a visual signal from a stationary position and ran the 30 m distance as fast as possible. Players performed 30 m sprint tests which were similar to the velocity tests, but in the agility test 10 cones were positioned aligned with a distance of 3 m between each consecutive cone. Futsal players had to run while dodging the cones on the right and left consecutively. In both tests, running velocity was measured using electronic timing lights (Witty, Microgate, Italy) positioned at 30 m. The fastest of three trials of each test was used for subsequent analysis. The starting position of the players was standing up, 0.5 m before the first infrared photoelectric cell.

Repeated sprint ability (RSA) test

The RSA test consisted of 8x30 m sprints separated by 25 s of passive recovery [23]. The athlete started 0.5 m behind the start line, which was marked by a photocell (Witty, Microgate, Italy). Before starting, the athletes were instructed to run as fast as possible to the end of the 30 m course. Following each sprint, athletes decelerated and walked to the starting line in readiness for the subsequent sprint. The best (RSA_{best}) and mean sprint time (RSA_{mean}) were recorded as the performance indices. The percent sprint decrement (RSA_{dec}) was calculated according to the following equation proposed by Spencer et al. [24], where RSA_{total} is the total time of the 8 sprints.

$$RSA_{Sdec} = \left(\left(\frac{RSA_{total}}{RSA_{best} \times 8} \right) \times 100 \right) - 100$$

Also, the differences between the first and the last sprint (RSA_{change}) were evaluated according to the equation proposed by Pyne et al. [24]:

$$RSA_{change} = \left(\frac{RSA_{last} - RSA_{first}}{RSA_{first}} \right) \times 100$$

Statistical analysis

Data collection, treatment, and analysis were performed using the SPSS for Windows statistical package (v.20.0). Descriptive statistics (mean and standard deviation) were calculated. Before using parametric tests, the assumptions of normality and homoscedasticity were verified using the Shapiro-Wilk W-test. An independent t-test was used to investigate differences in strength, power, and physiological and flexibility variables between elite and subelite players. For all procedures a level of $P \leq 0.05$ was selected to indicate statistical significance.

RESULTS

No significant differences were observed between elite and sub-elite futsal players in active and passive hamstring flexibility in the dom-

inant and non-dominant leg (Table 2). Furthermore, when we compared the dominant and non-dominant leg by team in the hamstring flexibility test, there were no statistically significant differences in ASLR and PSLR between the elite and sub-elite group.

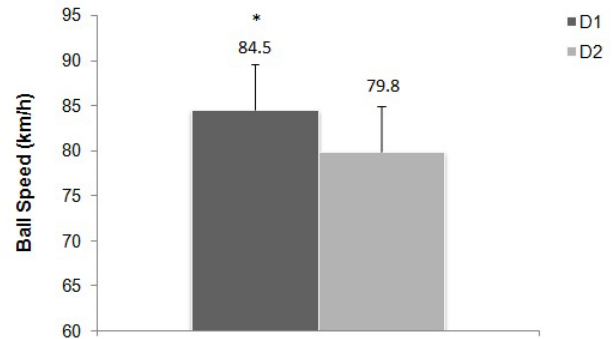


FIG. 1. Differences in maximum ball speed during shooting test between teams. * $P \leq 0.05$.
D1 – elite futsal players
D2 – sub-elite futsal players

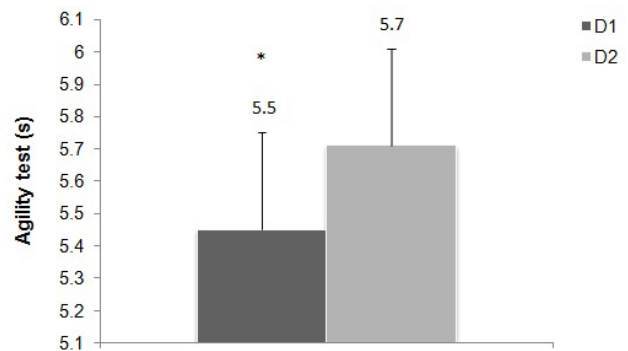


FIG. 2. Differences in agility test between teams. * $P \leq 0.05$.
D1 – elite futsal players
D2 – sub-elite futsal players

TABLE 3. Comparison of isokinetic variables between elite and sub-elite female futsal players.

		Peak torque extensors (N·m)	Peak torque flexors (N·m)	Peak torque extensors (N·m·kg ⁻¹)	Peak torque flexors (N·m·kg ⁻¹)	H/Q ratio	Optimum angle of torque during extension (°)	Optimum angle of torque during flexion (°)
DL	Elite (n=14)	133.7 ± 23.4	77.0 ± 23.4	2.0 ± 0.8	1.2 ± 0.5	0.6 ± 0.1	67.1 ± 5.2	45.4 ± 10.0
	Sub-elite (n=13)	136.3 ± 25.5	74.4 ± 11.6	2.1 ± 0.3	1.2 ± 0.2	0.5 ± 0.2	66.7 ± 6.6	42.9 ± 4.6
	P	0.874	0.751	0.682	0.895	0.257	0.567	0.495
NDL	Elite (n=14)	137.3 ± 24.1	70.2 ± 19.6	2.0 ± 0.7	1.1 ± 0.5	0.6 ± 0.1	66.2 ± 4.5	39.5 ± 10.4
	Sub-elite (n=13)	143.3 ± 17.3	71.3 ± 23.4	2.2 ± 0.2	1.1 ± 0.4	0.5 ± 0.2	63.7 ± 7.2	39.2 ± 13.3
	P	0.780	0.849	0.485	0.756	0.210	0.658	0.857

Note: the values are mean ± SD; DL: dominant leg; NDL: non-dominant leg.

TABLE 4. Comparison of CMJ and SJ variables between elite and sub-elite female futsal players.

	CMJ		SJ	
	Pmax (W · kg ⁻¹)	h (cm)	Pmax (W · kg ⁻¹)	h (cm)
Elite	43.1 ± 4.2	26.7 ± 0.3	42.2 ± 2.4	26.1 ± 0.4
Sub-elite	43.6 ± 4.7	24.3 ± 0.3	40.8 ± 3.6	24.2 ± 0.3
P-value	0.743	0.167	0.366	0.207

Note: the values are mean ± SD; h: jump height; Pmax: maximal power; SJ: squat jump; CMJ: counter movement jump.

TABLE 5. Times over 30 m sprint and RSA test in elite and sub-elite female futsal players.

	30 m sprint	RSA _{best}	RSA _{total}	RSA _{change}	RS _{Adec}
	(s)	(s)	(s)	(%)	(%)
Elite	4.9 ± 0.2	4.9 ± 0.2	41.1 ± 1.9	3.6 ± 3.9	4.9 ± 2.2
Sub-elite	5.0 ± 0.2	5.0 ± 0.2	41.8 ± 1.7	4.6 ± 5.1	4.7 ± 1.8
P-value	0.456	0.282	0.317	0.601	0.821

Note: the values are mean ± SD; RSA: repeated sprint ability.

Table 3 shows the results for isokinetic variables. No significant differences between groups were found in any leg or knee flexor or extensor muscles in the relative torque from 60° · s⁻¹ angular velocity. Also, there were no statistically significant differences in H/Q ratio or in optimum angle of torque development during knee flexion and extension at 60° · s⁻¹ angular velocity in both legs between the teams. Moreover, no differences between the teams were found in hamstring deficit (elite: 9.6 ± 6.5%; sub-elite: 18.1 ± 5.6%) or quadriceps deficit (elite: 9.3 ± 7.6%; sub-elite: 6.5 ± 5.9%).

Furthermore, no significant differences were observed between teams in SJ and CMJ in jump height (cm) and maximal power (W · s⁻¹) (Table 4). However, elite players kicked harder than sub-elite players in maximum ball speed during the shooting test (Figure 1).

Moreover, there was no statistically significant difference in the 30 m sprint time (Table 4). However, elite futsal players were more agile than subelite players (p≤0.05) (Figure 2). Finally, no significant differences were found in RSA_{best}, RSA_{total}, RSA_{change} or RSA_{dec} between elite and sub-elite futsal players (Table 5).

DISCUSSION

To our knowledge, this is the first study that has examined the physical capacities and performance of female futsal players of different competitive levels. The main finding of this research was that female professional futsal players achieved better scores than the semi-professional ones in agility and kicking performance during shooting.

Active and passive hamstring flexibility in the dominant and non-dominant leg were similar in both groups. In addition, no significant differences between legs were found. Cejudo et al. [18] affirmed that professional futsal players perform a correct flexibility training programme that produces no differences in range of movement in this population, but that other team sports that involve jump, sprint, change of direction and high intensity cause a decrease of flexibility. Previous studies performed with professional male futsal players [18], semi-professional male soccer players [26] and adolescent soccer players [27] did not find differences between dominant and non-dominant intra-group legs on PSLR. However, the mean PSLR score obtained in professional [18] and semi-professional [26] players was higher than in adolescent soccer players [27] (91°, 94°, 90.7° vs 82.7°). Adolescent soccer players had similar mean scores to our women sample (82.7°; 82.8°). Moreover, our results for both legs are higher than the ones obtained in the research by Ayala et al. [28] with female professional futsal players regarding PSLR. Therefore, a correct hamstring flexibility training programme is a perfect tool to prevent flexibility imbalances independently of the level of the female futsal players.

According to our results, elite and subelite players obtained similar values of isokinetic peak torque, H/Q ratio and optimum angle of torque at 60°·s⁻¹. As an explanation for our findings, the flexor muscles' peak torque and H/Q ratio were greatly diminished. This fact may be associated with an increase of hamstring injuries. These results were in accordance with Le Gall et al. [29], who found no difference in knee flexion or extension strength in young male soccer players. Manson et al. [30] reported similar values in the peak torque of extensor muscles of the knee in professional female soccer players. However, the results of flexor muscles and H/Q ratio were lower in our study than in the research of Manson et al. [30]. Furthermore, there were statistically significant differences between the dominant and non-dominant leg in both teams in the flexor and extensor muscle of the knee during the isokinetic test. These results were consistent with Ferreira et al. [15] with professional male futsal players. Moreover, if these differences exceed 10% [31] the injury risk increases; therefore the isokinetic results of both teams could be related to a muscle imbalance. Consequently, a strength training programme could be applied to improve the agonist-antagonist balance and to reduce the risk of injury in the thigh of the futsal players.

In our study, jumping ability did not differ between elite and sub-elite teams. It is possible that this fact is related to the period of the season when the test was made. The evaluation was performed at the beginning of the competitive season, and both teams had carried out the same pre-season training, when all physical capacities, including explosive strength, were trained. Furthermore, it appears that this capacity cannot be developed in match situations and is relatively stable at various stages of the competitive season [32]. However, it would be interesting to apply systematic plyometric programmes during the season, because it may increase the jump ability even more 8.8% in female futsal players [33]. The data ob-

tained in this study were in accordance with Cometti *et al.* [5], who found no differences in CMJ and SJ among three levels of performance in male soccer players. The heights of the CMJ and SJ tests in both teams of this research were lower than previous studies showed. For instance, Alvarez-Medina *et al.* [34] and Galy *et al.* [35], with professional futsal male players, obtained higher values of height of jump in SJ and CMJ than our research showed. Indeed, the results in jumping height and power could be used to measure the futsal performance, to detect future talents, to analyse training adaptations and training loads and as a tool to prevent injury prevention, but is not a differentiated factor between elite and subelite Spanish female futsal players.

Speed over 30 m showed no significant difference between the two teams. Therefore, the subjects of this study had the same sprint performance. The increase in velocity was related to increased motor unit function, neuromuscular adaptations and cellular regulations [36]. Thus, there is a training potential to be considered. As an explanation for our findings, elite players did not run faster than subelite players because 30 m is perhaps too long a sprinting distance and do not replicate actual futsal game situations. Therefore, technical and tactical skills are key determinants of the game and influence the differences between different level players. In the same way, further analysis of sprinting should take into consideration different distances (e.g. 5, 15, and 20 m) or introduce a skill component (e.g. sprinting with the ball) to analyse the effect of introducing shorter distances or technical skills on sprint performance [5]. The results of this study were not in accordance with the data reported in English soccer [37] but were in agreement with Cometti *et al.* [5] in the French Soccer League. Furthermore, Alvarez-Medina *et al.* [34] found that professional futsal players did not increase their speed during the season in the 10 m and 30 m sprint test, being a non-key factor of the futsal performance. Previous studies [34,35] reported in the speed measured with the 30 m sprint test in professional male futsal players better values (4.58 s, 4.72 s and 4.80s in 30 m sprint) than our research showed (elite: 4.89 s and sub-elite: 4.95 s in the same test). Therefore, it was assumed that the sprint ability of female futsal players might be improved by increasing both neuromuscular capacity and enzyme activities, which are both affected by training stimulus. The study suggests that improvements in velocity may provide an advantage for the players to effectively and continuously apply their technical skills and motor abilities under competitive conditions. Regarding the agility test, our results showed that elite players were significantly more agile than subelite players. This fact is justified because agility contributes to the ability to manipulate the ball [21] and elite futsal control and possess the ball more quickly and technically [21] than players of a lower level. Furthermore, these results suggest that elite futsal players are more successful during a futsal match in making changes of directions [33] and neutralizing the opponent [20], because the possession of good agility is a determinant factor of these game actions. For example, Benvenuti *et al.* [38] found that female futsal player were more agile than soccer players.

However, we have not found any other studies that involve female futsal players and make use of the same test to measure speed of movement and coordination in an integrated way. The results obtained in this study in elite players are similar to those of Gravina *et al.* [39] obtained with young soccer players, but the agility values of D2 players were worse. Therefore, the increase of agility during the season enhances performance and reduces the injury risk of female players [33]. Also, agility values could be used to detect future female futsal talents.

Another interesting finding of the present study was that the professional group kicked the ball harder than the semi-professional group. It means that a higher performance level was a determining factor for ball striking speed. According to Barfield *et al.* [12] the identification of kicking variable differences may play a critical role in training of female soccer players. Following Young and Rath [40], one important consideration regarding the level of experience or performance of the athletes is that it is more difficult to find training-inducing gains in kicking performance with high-level athletes. Kicking is a complex skill involving proximal-to-distal muscle activation and is accomplished by segmental and joint movements in multiple planes [41]. De Proft *et al.* [42] found that kicking performance was not fully determined by the improvement in muscle strength, suggesting that technical skill is a predominant factor in the soccer kick, since the kick incorporates a complex series of synergistic muscle movements, involving the antagonist muscle as well. The results of our research were consistent with those of Barbieri *et al.* [43] with Brazilian amateur male futsal players who obtained 87.12 km/h maximum ball velocity. Moreover, Barfield *et al.* [12] reported that the mean of one female elite soccer player of three kicks on the dominant side was 86.94 km·h⁻¹. This value was similar to the results obtained in our study in elite players (84.5 km·h⁻¹) but was higher than the subelite team (79.83 km·h⁻¹). As expected, our results were not in agreement with other studies in men's soccer performed with players of different levels of experience [5] or professional male futsal players [13], who achieved 98.06 km·h⁻¹ maximum ball velocity during shooting. As an explanation for our findings, elite players were not heavier than subelite players but kicked the ball at a higher speed. Therefore, our higher level group results could be due to other more relevant factors such as shooting accuracy and execution technique. These results could be applied for the coach to detect future talents and to obtain information about the effectiveness of kicking at the goal and to select the better player to kick the corner, penalties and other kicks.

Our results showed an RSA performance decrease of 4.9% in elite and 4.72% in sub-elite players. This difference was not statistically significant. This fact suggests that both teams had the same ability to maintain repeated sprint performance, and the decrease observed is attributed to accumulation of metabolites, mainly increases in [La] [8] and H⁺ [9]. Also, the depletion of muscle phosphocreatine [10] and the changes in the neuromuscular coordination of muscle contraction [11] may be related to the RSA performance.

The results obtained in this study were in accordance with Ingebrigtsen et al. [44], who affirmed that RSA performance was not different between elite and sub-elite players. Furthermore, the RSA performance decrement obtained in this study was higher than Makaje et al. [1] obtained in male professional players (3.8 %). However our results were in accordance with the other group of players (amateur players) analyzed in the same study [1]. However, our results were similar to those obtained by Da Silva et al. [45] and Pyne et al. [25] in male soccer players. These results could be applied by the futsal coach during the season. It is important to improve RSA ability to develop physical performance during the preseason and increase or maintain these values during the in-season.

CONCLUSIONS

In conclusion, while futsal performance is not determined solely by physical factors, this research revealed that professional female futsal players differ from semi-professional players in terms of maximum speed of the ball during kicking and in the agility test. Greater emphasis on these aspects could help the coach to effectively develop training programmes and improve the performance of the players. Finally, agility and the kicking performance should be considered when selecting adolescent female futsal players.

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