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Keywords: Physical Condition; Body Composition; Muscular Power; Muscular Strength; Futsal.



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Article

Body Composition, Strength and Muscle Power Indices at the different Competitive Levels of Futsal

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Abstract. (1) Background: The aim of this study was to verify the differences in body composition, power and lower limb muscle strength in futsal players from three competitive levels. (2) Methods: The study involved 68 players (24.26 ± 4.63 years), divided into three competitive levels: elite, sub-elite and amateur. To assess physical condition, we used the Inbody270, the ChronoJump and the Isokinetic Dynamometer and used the non-parametric Kruskal-Wallis test to compare the three independent variables. (3) Results: There were no differences in body composition between the players at the three competitive levels. With regard to lower limb muscle power and strength, the elite group showed, on average, better performance and capabilities, especially when compared to the amateur group, and all groups showed an H/Q ratio > 60%. (4) Conclusions: We conclude that there are not many differences in physical condition between the three competitive levels of futsal, despite the unequal sporting demands between them. However, the elite group has greater power and muscle strength, and both groups showed a high probability of lower limb muscle injury at this stage of the sporting season, alerting sports training professionals to the importance of individualized analysis of physical condition and performance capacity.

Keywords: physical condition; body composition; muscular power; muscular strength; futsal

1. Introduction

Futsal is a high-intensity team sport in which players are required to constantly perform offensive and defensive tasks at a substantially high intermittent pace [1]. For this reason, this sport places a premium on the physical condition of its players in order to respond to the demands imposed by the game and the opponent, such as shooting, changing direction, accelerating, turning, among others [2].

According to the evidence in literature, it is a sport of great physical intensity and it is extremely important for sports' professionals to know the demands of the sport and its relationship with the physical condition of their players in order to better prescribe training [3,4]. Nevertheless, it is a growing sport, it is still little studied, and some authors find it surprising that there is a lack of research into the physical condition, particularly the strength, muscle power and anthropometric features of players in this sport, and the different competitive levels [2,3,5].

Given the very prominent evolution that futsal has undergone in the last decade, its players should be encouraged to work very close to their limits, especially given the increasing physical, tactical, technical and psychological demands [6]. For this reason, it would be essential for the development of futsal to understand in detail the physical requirements of this sport. According to Dogramaci et al. [7], that identifying the key aspects of physical condition is important because it can affect various aspects of the game, including training methods.

Body composition is essential for any athlete, as its parameters can positively or negatively influence their sportive performance and thus represent a highly informative predictor for training methodology [8]. Closely related, in terms of physical abilities, strength and power are key

determinants of better performance, since strength is related to the muscle's ability to resist a certain resistance and power is related to the ability to generate maximum force in the shortest possible time [9,10] such as analyzing the height of a jump.

Intuitively, excess body fat represents an inert load that is likely to impair physical and sportive performance and subsequently predispose the player to an increased risk of injury [11]. On the other hand, lean muscle mass plays a fundamental role in optimizing strength and power and is an integral component of a player's physical condition [12]. In this sense, it is relevant to assess the physical condition of futsal players and verify the differences between the different competitive levels, making it a regular practice to improve the planning and prescription of training and subsequently obtain better results [13].

The comparison between competitive levels highlights that sub-elite or amateur level players need a substantially higher volume of training and intensity to achieve the same physical condition and body composition as elite athletes [14,15]. Although the importance of assessing body composition is recognised, López-Fernández et al. [16] point out that there are no reference values for futsal players using bioimpedance, and in the field of strength and power there is not much literature available relating them to futsal. For the above reasons, the aim of this study was to verify the differences between the various competitive levels of futsal in terms of body and muscle composition. According to the existing literature, we expect to find better results in body composition, strength and power of the lower limbs at the elite level of futsal, compared to the sub-elite and amateur groups [5,15].

With this study, we hope to highlight the importance of assessing physical condition, which is a valuable step in sports success, as it allows professionals associated with training and physical preparation to identify the individual needs of players and health professionals to identify modifiable risk factors that potentially reduce the risk of injury [17].

2. Materials and Methods

2.1. Study Design

This research is part of a quantitative approach, considered as a cross sectional study. With regard to the nature of the sample, we can say that it was selected intentionally and conveniently, as it suited the type of study in question and we classified it as non-probabilistic, as it was based on the researcher's subjective criteria and in accordance with the study's specific objectives [18].

2.2. Participants

This study involved 68 athletes (24.26 ± 4.63 years old) from five teams (one from the 1st National Division, two teams from the 2nd National Division, one from the 3rd National Division and one from the Castelo Branco District Championship) divided into three groups: elite (N=13, 23.77 ± 4.38 years old), sub-elite (N=39, 25.36 ± 4.83 years old) and amateur (N=16, 22 ± 3.55 years old).

For the selection of the sample, the inclusion criteria were all senior male players from the respective teams accordingly registered with the club; and the exclusion criteria were the existence of an injury at the time of the assessment.

2.3. Instruments

To assess body composition, we used a Bioimpedance scale (InBody 270, Biospace, California, USA) with a Tetrapolar electrode system with 8 electrodes and frequencies of 20 and 100 kHz, allowing us to obtain values for muscle mass, fat mass and %BF, and a portable stadiometer was used to identify and enter height on the scale. A ChronoJump platform (ChronoJump Boscossystem) was used to obtain lower limb power values verified by analyzing jump height. To assess lower limb muscle strength, we used an isokinetic dynamometer (System 4, Biodex Medical Systems, Shirley, New York, USA).

2.4. Procedures

Primarily, a formal and institutional contact was made with the clubs, presenting the objects and asking for their cooperation, after which the participants were given a questionnaire and an informed consent form. Next, all the players were explained, within the defined inclusion criteria, the evaluation procedures and purposes of the study which respect and preserve all the ethical principles, norms and international standards that concern the Declaration of Helsinki and the Convention on Human Rights and Biomedicine.

All the assessments were carried out individually for approximately 45 minutes in a specific laboratory, following a certain sequence:

Firstly, body composition was assessed using a bioimpedance scale (InBody 270), in which the player climbs onto the device by placing their feet in a specific place, at the indication of the device they take the two electrodes for their hands and move their arms away from their torso, maintaining this position for 60 seconds, while the device performs the test, in order not to compromise the results of the analysis, the participants were informed of some previous precautions, such as: fasting 4 hours before the test; abstaining from intense physical activity 24 hours before the test; empty bladder and bowels before the test [19].

Secondly, muscle power was assessed using the CMJ, asking the athletes to keep their hands on their hips in order to minimize the influence of the upper limbs on jumping and coordination, followed by the instruction to perform a squat up to approximately 90°, involving flexion of the knees and hips, followed immediately by extension of the limbs with the aim of jumping as high as possible, according to the method proposed by Bosco et al. [20] by jumping with both feet, without pausing at the base of the squat. Each athlete performed three CMJ's from the bipedal position, with a brief recovery interval between repetitions, until they were ready to perform the next jump, and the maximum height obtained from the best of the three jumps was recorded.

Third, muscle strength was assessed using concentric isokinetic tests on the flexor and extensor muscles of the dominant and non-dominant limb, following the protocol used in other studies [21]. Initially, the players warmed up on a cycle ergometer for 10 minutes at a low speed, then they were properly positioned on the dynamometer, with the knee and hip at 90°, the knee flexion angle was set at 110° and 0° in extension. The weight of the limb was used to correct for the effects of gravity. Three straps were used to secure the thoracic region, the hip and the knee to prevent undesired movements. Afterwards, the athletes were asked to perform five repetitions of knee extension and flexion at 60°/s, this being the recommended angular velocity to recruit the greatest number of motor units [22]. The athletes were verbally encouraged to perform maximum strength during the tests. We recorded the peak concentric torque of the extensors and flexors of the knee joint, as well as the strength ratio between these muscles (H/Q ratio).

All the data was collected by the same research team, using a record sheet set up for the purpose. At the end of the data collection, those were made available to the respective technical teams so that they were aware of their players' abilities.

2.5. Statistical Analysis

The data was analyzed using the Statistical Package for the Social Sciences (SPSS) (v.23.0). All the data collected was gathered and descriptive statistics were used to calculate means, standard deviation, minimums and maximums. The Kolmogorov-Smirnov test ($n > 30$) and the Shapiro Wilk test ($n < 30$) were used to verify the normality of the data distribution. We then used the non-parametric Kruskal-Wallis test to see if there were any differences between the three competitive levels of the sport, and a post hoc comparison with Bonferroni correction to compare the results of the groups between pairs. The significance level for these tests was set at 5%. Inferences were also made based on the magnitude of the effects using the following scale (Cohen's d): 0-0.2, trivial; 0.21-0.6, small; 0.61-1.2, moderate; 1.21-2.0, large; ≥ 2.0 , very large [23].

3. Results

Table 1 shows a general characterization of the sample, in which the youngest players belong to the amateur group and the oldest to the sub-elite group. It is also the players in the amateur group who have lower weights, greater heights and consequently lower BMI values; however, it is the elite players who have more years of federated practice of the sport, a greater number of training sessions and a greater number of hours of practice per week.

Table 1. General characterization of participants.

Group	N	Age	Weight	Height	BMI	Years in Practice	No. training sessions	No. hours
Elite	13	23,77 ±	73,32 ±	1,75 ±	23,71 ±	13,77 ±	10	20
		4,38	6,23	0,05	1,93	5,40		
Sub-Elite	13	25,36 ±	72,56 ±	1,73 ±	24,07 ±	13,46 ±	4,5	6,5
		4,83	7,99	0,05	2,13	4,54		
Amateur	16	22,01 ±	72,96 ±	1,76 ±	23,49 ±	11,69 ±	3	4,5
		3,55	15,61	0,07	5,11	5,21		

Table 2 shows the results of the body composition analysis, based on muscle mass, fat mass and %BF at the different competitive levels of futsal. There were no statistically significant differences when comparing the body composition variables between groups. However, a descriptive analysis of the average for each group shows that the elite group had more muscle mass, less fat mass and lower %BF and, in opposition, the amateur group had the worst results in all three variables.

Table 2. Comparisons of groups according to level of competition in relation to body composition variables.

Dependent Variable	Group	N	M ± SD	Effect Size	p *
Muscle mass (Kg)	Elite	13	35,7 ± 3,3	0,22	0,609
	Sub-Elite	39	34,9 ± 3,8		
	Elite	13	35,7 ± 3,3	0,39	
	Amateur	16	34,1 ± 4,7		
	Sub-Elite	39	34,9 ± 3,8	0,19	
	Amateur	16	34,1 ± 4,7		
Fat mass (Kg)	Elite	13	11,2 ± 3,1	0,03	0,826
	Sub-Elite	39	11,3 ± 3,8		

Body fat (%)	Elite	13	11,2 ± 3,1	0,22	0,925
	Amateur	16	12,8 ± 9,9		
	Sub-Elite	39	11,3 ± 3,8	0,20	
	Amateur	16	12,8 ± 9,9		
	Elite	13	14,9 ± 3,6	0,97	
	Sub-Elite	39	15,3 ± 4,2		
Elite	13	14,9 ± 3,6	0,23		
Amateur	16	16,3 ± 7,7			
Sub-Elite	39	15,3 ± 4,2	0,16		
Amateur	16	16,3 ± 7,7			

* $p \leq 0.05$ used in the Kruskal Wallis test; significant values and their associated effects are shown in bold. N- Number of Subjects; M- Mean; SD- Standard Deviation.

Table 3 shows an analysis of lower limb power at the different competitive levels of futsal using the CMJ. In the comparisons between groups, there were only statistically significant differences between the elite and amateur groups, with the elite group showing better performance in the CMJ, expressed by the height of the upper body, compared to the amateur group ($28.9\text{cm} \pm 3.2$ vs $23.6\text{cm} \pm 3.9$). However, it's important to note that it was the elite group that showed the greatest power in the lower limbs, followed by the sub-elite group, and with the least power the amateur group.

Table 3. Comparisons of groups according to level of competition in relation to performance in the CMJ.

Dependent Variable	Group	N	M ± SD	Effect Size	p^*
Highest jump (cm)	Elite	13	28,9 ± 3,2	0,47	0,188
	Sub-Elite	39	26,6 ± 6,2		
	Elite	13	28,9 ± 3,2	1,49	< 0,001
	Amador	16	23,6 ± 3,9		
	Sub-Elite	39	26,6 ± 6,2	0,58	0,211
	Amador	16	23,6 ± 3,9		

* $p \leq 0.05$ used in the Kruskal Wallis test; significant values and their associated effects are shown in bold. N- Number of Subjects; M- Mean; SD- Standard Deviation.

Finally, table 4 shows the values obtained by analyzing the muscle strength of the lower limbs, based on the maximum moment of force (peak torque) of each muscle group and the ratio between knee extensors and flexors (H/Q ratio), at the different competitive levels. In this sense, we can see that the right lower limb recorded, on average, higher strength values in both the extensors and flexors, at all three competitive levels, to the detriment of the left lower limb. The elite group had the highest peak maximum strength in both muscle groups, followed by the sub-elite group and the

amateur group with the lowest peak maximum strength. However, there were only statistically significant differences between the elite and amateur groups ($\chi^2(2)=6.415$; $d=0.8$; $p=0.047$) in the flexors of the left lower limb, with the elite group showing greater strength compared to the amateur group.

The table shows that the average H/Q ratio values (%) for all limbs and all competitive levels (<60%) indicate a high probability of injury.

Table 4. Comparisons of groups according to level of competition regarding performance in the isokinetic test for maximum strength values.

Isokinetics	Group	Elite (N=13)		Sub-Elite (N=39)		Amateur (N=16)	
		Right	Left	Right	Left	Right	Left
Extenders		M ± SD					
Peak Torque		254,5 ±		234,7 ± 41,7	234,1 ± 35,6		227,3 ± 53,9
	(Nm)	27,8 (198 – 306,8)	249,9 ± 38,7 (193,4 – 355)	(149,1 – 367,8)	(137,5 – 296,8)	229,7 ± 45,1 (124,1 – 314,4)	(123,2 – 317,3)
Flexors		M ± SD					
Peak Torque		138,8 ±	136,7 ± 18,4*	133,2 ± 22,5	129,9 ± 18	127,5 ± 32,7	114,7 ± 35,3*
	(Nm)	(109,5 – 189,1)	(106,7 – 177,1)	(89,2 - 181)	(97,5 – 163,5)	(73,8 – 198,5)	(65,8 – 195,5)
H/Q ratio (%)		54,9 ± 8,2	55,3 ± 7,9	57,2 ± 7,2	56,3 ± 9,3	55,5 ± 8,9	50,7 ± 9,5

* $p \leq 0.05$ used in the Kruskal Wallis test; significant values and their associated effects are shown in bold. N- Number of Subjects; M-Median; SD-Standard Deviation;(min-máx); H/Q ratio= flexor/extensor ratio.

4. Discussion

This study aimed to verify the differences between futsal players in body and muscle composition according to their competitive level. The data observed allows us to deduce, in general terms, that in the variables analyzed it was the elite group that showed, on average, better results in body and muscle composition, and conversely it was the amateur group that showed, on average, worse results in the evaluations carried out. When we consulted the available literature on the subject, we didn't find any studies comparing these three variables at the three competitive levels. However, there are some studies that have analyzed these variables individually using similar methodologies.

As for the age of the players, although there were no significant differences between the groups, in our study we found that the amateur players were the youngest, unlike the study by Barbero-Alvarez et al. [1] in which the youngest players were from the Elite group. Also in the study by Naser & Ali [24] it was found that the players in the lower competitive level "Social Players" were the oldest and those in the "Semi-elite" group the youngest. The differences in height were not significant either, with the amateur group being taller, as was the case in the study by Ayarra et al. [5]. With regard to the weight and BMI variable, we found that there were no statistically significant differences between the three competitive levels, as we had already seen in Pedro et al. [25] e Ayarra et al. [5]. With regard

to the other body composition variables, we found no significant differences in any of them between the three competitive levels, predicting that these characteristics are similar in the athletes, regardless of the level of competition in which they participate, the same was found by López-Fernández et al. [16], Pedro et al. [25] and Spyrou et al. [26] in which no significant differences were found in anthropometric characteristics between elite and sub-elite futsal players.

Specifically, with regard to muscle mass, it was the elite players who showed higher average values, similarly, the study by Matias et al. [27] with players from the 1st, 2nd and 3rd futsal divisions in Portugal already showed that elite players had higher average muscle mass values. On the other hand, in the fat mass and %BF variables, it was also the elite players who had lower values, as was also the case in the study by Sekulic et al. [28]. Though there were no significant differences, the fact that elite players showed, on average, better results in body composition variables may coincide with a greater volume, intensity and demand of training and competition, that is why our study also found that elite athletes had a greater number of training sessions and a greater number of hours of practice per week [14,27].

When analyzing the power of the lower limbs, as literature states, we based our analysis on the height of the jump, which is the most appropriate value for evaluating the power of a limb because the more muscle power the greater the height of a jump (CMJ) and according to this evaluation we can see that, as in the study by García-Unanue et al. [29] elite players have the best results compared to amateur players, on the other hand Naser & Ali [24] found no significant differences when comparing this variable at the three levels of competition, although there was a tendency for the higher the competitive level, the higher the players' jump height. However, in our study, the values obtained for jump height at elite level are substantially lower when compared to the average values obtained in the study by Cuadrado-Peñañiel et al. [30] and Loturco et al. [31].

As for the muscle strength of the lower limbs at the different competitive levels, it was found that in all groups, it was the right limb that recorded higher strength values on average, both in extensors and flexors, clearly indicating that the right lower limb is the dominant limb, as described by Spyrou et al. [26] the dominant limb appears to be stronger, i.e. to reach higher peak torque values, than the nondominant limb.

For futsal, the quadriceps muscle group plays a decisive role in jumping and shooting, while the hamstrings control running and provide a protective mechanism for the knee during changes of direction and tackles [32]. In our study, the elite players had higher average values in the knee flexor muscles than the amateur players, as previously found Cometti et al. [33].

In recent literature, isokinetic evaluation is one of the most discussed and requested methods for assessing the risk of injury, with the H/Q ratio being the main indicator of injury recorded during isokinetic testing [34]. This ratio plays a decisive role in the stability of the knee joint, reflecting the muscular balance between the extensors and flexors and in our study the results obtained are similar to those of Lira et al. [32] in which the average values of H/Q ratio (%) in both limbs and at all competitive levels indicate a high probability of injury, since according to Aagaard et al. [35], values below 60%, as was our case, increase the susceptibility to injury. Also Ferreira et al. [17] suggest that injury prevention strategies should focus on the normative value of 60% at an angular velocity of 60°/s (as was our case). Croisier et al. [34] indicated that muscle strength imbalances put a player at an average 4.6 times greater risk of developing hamstring injuries, so our results alert us to this possibility in the players assessed.

As for the limitations of this study, the size of the sample, particularly in the Elite and Amateur groups, does not allow us to draw generalized conclusions for the other teams participating at these competitive levels, as well as the fact that the evaluation was carried out at the start of a season, when the players are after their longest competitive break and have not yet undergone the positive changes of the demands of their competition, as well as the lack of research in the area that allows a comparative link in terms of results. It is suggested that future studies replicate the study with a larger number of players and more teams at different competitive levels and at distinct stages of the season.

5. Conclusions

In general terms, we can conclude that there are not many differences in physical condition, particularly in body and muscle composition between the three competitive levels of futsal, despite the unequal sports demands between them. Even so, the elite group has more power and muscle strength, and both groups have shown, at this stage of the sports season, a high probability of lower limb muscle injury, alerting sports training professionals to the importance of individualized analysis of physical condition and especially of predictive indicators of injury.

As for the athletes' performance in the evaluation of power through the assessment of jump height and muscle strength through the isokinetic dynamometer, the athletes in the elite group showed better ability and more significantly when compared to the amateur group. Even so, the few differences between the groups should be noted, highlighting the fact that training methodology at the amateur level is increasingly trying to approximate that of the elite level, so it seems, in this sample, that the physical performance of the athletes should not be considered the only discriminating criterion of competitive level.

It should also be noted that one of the most alarming results of the study, expressed by the H/Q ratio, indicates that there is a high probability of injury to the lower limbs of the players assessed, in all competitive groups, highlighting the importance of deepening knowledge on this emerging issue in Futsal.

6. Practical implications

- This study shows that there are no differences in body composition between futsal players of different competitive levels.
- Elite futsal players have more power and muscle strength in the lower limbs.
- Based on the H/Q ratio values, all groups had a high probability of lower limb injury.
- This study demonstrates the importance of individualized analysis of physical condition and, above all, of predictive indicators of injury.

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References

1. Barbero-Alvarez, J. C.; Soto, V. M.; Barbero-Alvarez, V.; Granda-Vera, J. Match Analysis and Heart Rate of Futsal Players during Competition. *J Sports Sci* 2008, 26 (1), 63–73. <https://doi.org/10.1080/02640410701287289>.
2. Gorostiaga, E. M.; Llodio, I.; Ibáñez, J.; Granados, C.; Navarro, I.; Ruesta, M.; Bonnbau, H.; Izquierdo, M. Differences in Physical Fitness among Indoor and Outdoor Elite Male Soccer Players. *Eur J Appl Physiol* 2009, 106 (4), 483–491. <https://doi.org/10.1007/s00421-009-1040-7>.

3. Álvarez, J. C. B.; D'Ottavio, S.; Vera, J. G.; Castagna, C. Aerobic Fitness in Futsal Players of Different Competitive Level. *J Strength Cond Res* 2009, 23 (7), 2163–2166. <https://doi.org/10.1519/JSC.0b013e3181b7f8ad>.
4. Castagna, C.; D'Ottavio, S.; Vera, J. G.; Álvarez, J. C. B. Match Demands of Professional Futsal: A Case Study. *J Sci Med Sport* 2009, 12 (4), 490–494. <https://doi.org/10.1016/j.jsams.2008.02.001>.
5. Ayarra, R.; Nakamura, F. Y.; Iturricastillo, A.; Castillo, D.; Yanci, J. Differences in Physical Performance According to the Competitive Level in Futsal Players. *J Hum Kinet* 2018, 64 (1), 275–285. <https://doi.org/10.1515/hukin-2017-0201>.
6. Kurata, D.; Junior, J.; Nowotny, J. Incidência de Lesões Em Atletas Praticantes de Futsal. *Iniciação Científica CESUMAR* 2007, 9, 45–51.
7. Dogramaci, S. N.; Watsford, M. L.; Murphy, A. J. Time-Motion Analysis of International and National Level Futsal. *J Strength Cond Res* 2011, 25 (3), 646–651. <https://doi.org/10.1519/JSC.0b013e3181c6a02e>.
8. Mazic, S.; Lazovic, B.; Djelic, M.; Suzic-Lazic, J.; Acimovic, T.; Brkic, P. Body Composition Assessment in Athletes: A Systematic Review. *Med Pregl* 2014, 67 (7–8), 255–260. <https://doi.org/10.2298/MPNS1408255M>.
9. Hoff, J.; Helgerud, J. Endurance and Strength Training for Soccer Players. *Sports Medicine* 2004, 34 (3), 165–180. <https://doi.org/10.2165/00007256-200434030-00003>.
10. Young, W. B. Transfer of Strength and Power Training to Sports Performance. *Int J Sports Physiol Perform* 2006, 1 (2), 74–83. <https://doi.org/10.1123/ijsp.1.2.74>.
11. Nikolaidis, P. Association between Body Mass Index, Body Fat per Cent and Muscle Power Output in Soccer Players. *Open Medicine* 2012, 7 (6), 783–789. <https://doi.org/10.2478/s11536-012-0057-1>.
12. Milsom, J.; Naughton, R.; O'Boyle, A.; Iqbal, Z.; Morgans, R.; Drust, B.; Morton, J. P. Body Composition Assessment of English Premier League Soccer Players: A Comparative DXA Analysis of First Team, U21 and U18 Squads. *J Sports Sci* 2015, 33 (17), 1799–1806. <https://doi.org/10.1080/02640414.2015.1012101>.
13. Sutton, L.; Scott, M.; Wallace, J.; Reilly, T. Body Composition of English Premier League Soccer Players: Influence of Playing Position, International Status, and Ethnicity. *J Sports Sci* 2009, 27 (10), 1019–1026. <https://doi.org/10.1080/02640410903030305>.
14. Slimani, M.; Znazen, H.; Hammami, A.; Bragazzi, N. L. Comparison of Body Fat Percentage of Male Soccer Players of Different Competitive Levels, Playing Positions and Age Groups: A Meta-Analysis. *J Sports Med Phys Fitness* 2018, 58 (6), 857–886. <https://doi.org/10.23736/S0022-4707.17.07941-5>.
15. Slimani, M.; Nikolaidis, P. T. Anthropometric and Physiological Characteristics of Male Soccer Players According to Their Competitive Level, Playing Position and Age Group: A Systematic Review. *J Sports Med Phys Fitness* 2018, 59 (1). <https://doi.org/10.23736/S0022-4707.17.07950-6>.
16. López-Fernández, J.; García-Unanue, J.; Sánchez-Sánchez, J.; Colino, E.; Hernando, E.; Gallardo, L. Bilateral Asymmetries Assessment in Elite and Sub-Elite Male Futsal Players. *Int J Environ Res Public Health* 2020, 17 (9), 3169. <https://doi.org/10.3390/ijerph17093169>.
17. Ferreira, R.; Araújo, J. P.; Barreira, P.; Loureiro, N.; Diesel, W. Preseason Evaluation. In *Injuries and Health Problems in Football*; Springer Berlin Heidelberg: Berlin, Heidelberg, 2017; pp 493–514. https://doi.org/10.1007/978-3-662-53924-8_44.
18. Tuckman, B. W. *Manual de Investigação Em Educação*; Gulbenkian, F. C., Ed.; Lisboa, 2000.
19. Heyward, V. H. *Avaliação Da Composição Corporal Aplicada, Manole.*; 2000.
20. Bosco, C.; Mogroni, P.; Luhtanen, P. Relationship between Isokinetic Performance and Ballistic Movement. *Eur J Appl Physiol Occup Physiol* 1983, 51 (3), 357–364. <https://doi.org/10.1007/BF00429072>.
21. Kyritsis, P.; Bahr, R.; Landreau, P.; Miladi, R.; Witvrouw, E. Likelihood of ACL Graft Rupture: Not Meeting Six Clinical Discharge Criteria before Return to Sport Is Associated with a Four Times Greater Risk of Rupture. *Br J Sports Med* 2016, 50 (15), 946–951. <https://doi.org/10.1136/bjsports-2015-095908>.
22. Baltzopoulos, V.; Brodie, D. A. Isokinetic Dynamometry. Applications and Limitations. *Sports medicine* 1989, 8 (2), 101–116. <https://doi.org/10.2165/00007256-198908020-00003>.
23. Hopkins, W. G.; Marshall, S. W.; Batterham, A. M.; Hanin, J. Progressive Statistics for Studies in Sports Medicine and Exercise Science. *Med Sci Sports Exerc* 2009, 41 (1), 3–12. <https://doi.org/10.1249/MSS.0b013e31818cb278>.
24. Naser, N.; Ali, A. A Descriptive-Comparative Study of Performance Characteristics in Futsal Players of Different Levels. *J Sports Sci* 2016, 34 (18), 1707–1715. <https://doi.org/10.1080/02640414.2015.1134806>.

25. Pedro, R. E.; Milanez, V. F.; Boulosa, D. A.; Nakamura, F. Y. Running Speeds at Ventilatory Threshold and Maximal Oxygen Consumption Discriminate Futsal Competitive Level. *J Strength Cond Res* 2013, 27 (2), 514–518. <https://doi.org/10.1519/JSC.0b013e3182542661>.
26. Spyrou, K.; Freitas, T. T.; Marín-Cascales, E.; Alcaraz, P. E. Physical and Physiological Match-Play Demands and Player Characteristics in Futsal: A Systematic Review. *Front Psychol* 2020, 11. <https://doi.org/10.3389/fpsyg.2020.569897>.
27. Matias, C. N.; Campa, F.; Cerullo, G.; D'Antona, G.; Giro, R.; Faleiro, J.; Reis, J. F.; Monteiro, C. P.; Valamatos, M. J.; Teixeira, F. J. Bioelectrical Impedance Vector Analysis Discriminates Aerobic Power in Futsal Players: The Role of Body Composition. *Biology (Basel)* 2022, 11 (4), 505. <https://doi.org/10.3390/biology11040505>.
28. Sekulic, D.; Gilic, B.; Foretic, N.; Spasic, M.; Uljević, O.; Veršić, Š. Fitness Profiles of Professional Futsal Players: Identifying Age-Related Differences. *Biomed Hum Kinet* 2020, 12 (1), 212–220. <https://doi.org/10.2478/bhk-2020-0027>.
29. García-Unanue, J.; Felipe, J. L.; Bishop, D.; Colino, E.; Ubago-Guisado, E.; López-Fernández, J.; Hernando, E.; Gallardo, L.; Sánchez-Sánchez, J. Muscular and Physical Response to an Agility and Repeated Sprint Tests According to the Level of Competition in Futsal Players. *Front Psychol* 2020, 11. <https://doi.org/10.3389/fpsyg.2020.583327>.
30. Cuadrado-Peñafiel, V.; Párraga-Montilla, J.; Ortega-Becerra, M.; Jiménez-Reyes, P. Repeated Sprint Ability in Professional Soccer vs. Professional Futsal Players. *E-balonmano.com: Revista de Ciencias del Deporte* 2014, 10 (2), 89–98.
31. Loturco, I.; Pereira, L. A.; Reis, V. P.; Abad, C. C. C.; Freitas, T. T.; Azevedo, P. H. S. M.; Nimphius, S. Change of Direction Performance in Elite Players From Different Team Sports. *J Strength Cond Res* 2022, 36 (3), 862–866. <https://doi.org/10.1519/JSC.0000000000003502>.
32. Lira, C. A. B.; Mascarin, N. C.; Vargas, V. Z.; Vancini, R. L.; Andrade, M. S. Isokinetic knee muscle strength profile in brazilian male soccer, futsal, and beach soccer players: a cross-sectional study. *Int j sports phys ther* 2017, 12 (7), 1103–1110. <https://doi.org/10.26603/ijsp20171103>.
33. Cometti, G.; Maffiuletti, N. A.; Pousson, M.; Chatard, J.-C.; Maffulli, N. Isokinetic Strength and Anaerobic Power of Elite, Subelite and Amateur French Soccer Players. *Int J Sports Med* 2001, 22 (1), 45–51. <https://doi.org/10.1055/s-2001-11331>.
34. Croisier, J.-L.; Ganteaume, S.; Binet, J.; Genty, M.; Ferret, J.-M. Strength Imbalances and Prevention of Hamstring Injury in Professional Soccer Players: A Prospective Study. *Am J Sports Med* 2008, 36 (8), 1469–1475. <https://doi.org/10.1177/0363546508316764>.
35. Aagaard, P.; Simonsen, E. B.; Magnusson, S. P.; Larsson, B.; Dyhre-Poulsen, P. A New Concept For Isokinetic Hamstring: Quadriceps Muscle Strength Ratio. *Am J Sports Med* 1998, 26 (2), 231–237. <https://doi.org/10.1177/03635465980260021201>.

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