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Somato-physiological profile of under-17 female futsal players.

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ABSTRACT

The somato-physiological characterization in sport is an essential tool to assist the elaboration of the training planning. Therefore, the present study aimed to (a) characterize the somatotype and physiological profile in young female futsal players, (b) provide a comparison between playing positions, and (c) test associations between dependent measures. Eighteen Brazil state-level players from the under-17 category participated in the study. Anthropometric measurements (body mass, height and somatotype determination), aerobic fitness (multistage 20 m shuttle run test) and the ability to perform repetitive sprints (Running Anaerobic Sprint Test) were assessed. These procedures were divided into two 24 h apart sessions. A Bayesian statistical approach was adopted. The results indicated the predominance of the endo-ectomorph somatotype for players and a negative and moderate correlation between body fat and maximum rate of oxygen (VO_{2MAX}) (r = -.54; BF_{10} = 3.34). Despite the association between a high percentage of body fat and poor performance, the physiological profile presented by the athletes seems to be enough for futsal demands (VO_{2MAX}: 34.73 ml.kg$_{-1}$.min^{-1}; maximum power: 371.16 W; and maximum speed: 21.1 km.h^{-1}). Interestingly, participants presented a homogeneous somatotype and physiological profile across playing positions.

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Perfil somato-fisiológico de atletas de futsal feminino sub-17.

RESUMO

A caracterização somato-fisiológica no esporte é uma importante ferramenta para a elaboração do planejamento dos ciclos de treinamento. Portanto, o objetivo do presente estudo foi (a) caracterizar o perfil somato-tipológico e fisiológico de jovens atletas de futsal, (b) fornecer uma comparação entre as posições de jogo, e (c) verificar as possíveis associações entre as medidas dependentes. Participaram do estudo 18 jogadoras que disputavam o Campeonato Estadual Sub-17. As participantes foram submetidas a uma rotina de avaliação que envolveu medidas antropométricas como massa corporal, estatura, avaliação do somatotipo e testes para estimativa da capacidade aeróbia (*Multistage 20 m Shuttle Run Test*) e de habilidade de sprints repetidos (*Running Anaerobic Sprint Test*). A avaliação foi dividida em dois dias com intervalo de 24 horas. Uma abordagem estatística Bayesiana foi adotada. Os resultados indicaram a predominância do somatotipo endo-ectomórfico para as atletas e uma correlação negativa e moderada da gordura corporal com o $VO_{2máx}$ (*r*= -.54; BF_{10} = 3.34). Embora o elevado percentual de gordura corporal não seja um bom indicador de desempenho, o perfil fisiológico apresentado parece ser o indicado para as exigências do futsal ($VO_{2máx}$ de 34.73 $ml.kg_{-1}.min^{-1}$, potência máxima de 371.16 watts/s e 21.1 $km.h^{-1}$ no teste de velocidade). Interessantemente, as atletas apresentaram perfil somatotipológico e fisiológico homogêneos.

PALAVRAS-CHAVE:

Futsal. Somatotipo.
Fisiologia.
Categoria de Base.

INTRODUCTION

The characterization of the somatotype profile of futsal players can be decisive for game performance (Calthorpe et al., 2019; Martinez-Riaza et al., 2017; Queiroga et al., 2021). Futsal is a team sport with intermittent characteristics in which there is a significant amount of high intensity and short duration efforts that require significant use of the aerobic and anaerobic energy systems (Dos-Santos et al., 2020; Milioni et al., 2016; Palucci Vieira et al., 2020). The game demands require a somatotype profile that reduces energy expenditure and facilitate physiological performance during practice (Avelar et al., 2008; Queiroga et al., 2021; Rosa, 2011).

For example, excess body fat is typically associated with more limited technical skills like dribbling (Abarghoueinejad et al., 2021; Kooshakia et al., 2014), reactive strength and specific agility (Sekulic et al., 2021). Also, excess body fat impairs the aerobic component (Nikolaidis et al., 2019) and accentuates fatigue and risk of injuries (Martinez-Riaza et al., 2017) in soccer and futsal. Characterizing the somatotype profile and understanding its relationship with physiological variables may enable the selection of the most skilled players, as well as help perform individual adjustments in the training of the physical component (Barbieri et al., 2012; Queiroga et al., 2021), making the somato-physiological characterization in futsal an indispensable tool to assist in the preparation of the training planning (Șenol et al., 2018).

Several previous studies determined futsal players' somatotype (Barbieri et al., 2012; Lago-Fuentes et al., 2020; Oliveira et al., 2017) and physiological characteristics (Ayarra, et al., 2018; Barbero-Alvarez et al., 2015; Ramos-Campo et al., 2016). However, such studies focused predominantly evaluating male players, while studies with female players have investigated mostly senior players. The literature has revealed that for senior female players, the mean somatotype is meso-endomorph (Queiroga et al., 2021), being typically similar among top-ranked teams (Queiroga et al., 2018, 2021) as well as between starting and non-starting squad players (Queiroga et al., 2018). Conversely, the evaluation of youth sportswomen showed the predominance of the endo-mesomorphic profile (Levandoski et al., 2007). These results demonstrate that, although slight morphological variations are expected in senior players, different somatotype profiles can be observed in the younger categories and players with less competitive levels.

Considering that it is common to promote players to categories above to compose the squad in futsal (Palucci Vieira et al., 2020), a better knowledge of the somato-physiological profile of the younger categories would potentially facilitate the choice of who is prepared to be promoted and how will be their adaptation. However, to date, knowledge about female players' somatotype aged under-20 categories is still scarce. Therefore, due to the strong association between somatotype and performance (Nikolaidis et al., 2019; Sekulic et al., 2021) and the emerging need to characterize the younger categories, the purpose of the present study was to characterize the somatotype profile and the physiological performance of female under-17 futsal players. Furthermore, participants' somatotype and physiological profiles were compared according to their position in the game. It is expected that the somatotype profile of players in the under-17 category may be different among positions. In addition, we expect an association between somatotypical variables and physiological performance.

METHOD

PARTICIPANTS

The study included 18 female futsal players belonging to the under-17 age group (15 ± 1 years, 52.1 ± 7.8 kg and 160 ± 70 cm) with at least one year of specific training for futsal and affiliated to the Brazilian futsal confederation. The players had no history of health problems and signed a free and informed consent term approved by the University local ethics committee (#221/09) according to Helsinki's declaration.

EXPERIMENTAL DESIGN

Participants underwent an assessment routine that involved anthropometric measurements and tests in estimating aerobic fitness and repeated sprints' ability y that occurred during the competitive period. The tests and measurements were divided into two 24 h apart sessions. On the first day, body composition and repeated sprint ability measurements were performed using the Running-based Anaerobic Sprint Test (Zagatto et al., 2009). On the second day, the aerobic parameters were evaluated by the Multistage 20 m Shuttle Run Test (Léger et al., 1988). The participants were instructed to avoid strenuous activities in the 24 h preceding the assessments and prevent drastic changes in sleep and diet during the investigation period.

Body mass was measured using an anthropometric scale (Mechanical Scale, Welmy, Brazil) with a precision of 100 g and height utilizing a wooden stadiometer with a precision of 0.1 cm (WCS, São Paulo-SP, Brazil), according to the procedures described by Gordon et al. (1988). The thickness of the skinfolds was measured in millimeters using a premier scientific adipometer (Cescorf®, Porto Alegre-RS, Brazil). Skin folds in the tricipital, subscapular, supra iliac (supraspinal), thigh and medial leg regions were highlighted by obtaining three measurements and using the average for calculations (Ross & Marfell-Jones, 1982). The biepicondilian bone diameters of the femur and humerus were determined by a metal pachymeter (Somet®, 150 mm, Inox, Czech Republic) with a measurement scale of 0.1 cm. The circumference measurements of the contracted arm and leg (vaster area in the calf) were performed with the aid of a flexible measuring tape Gulick model of 150 cm (Mabis®, Waukegan, Ilinois, USA).

Anthropometric measurements allowed calculating the body mass index and body density (Jackson et al., 1980) and fat percentage (Siri, 1961). Body somatotype was estimated according to the guidelines of Heath and Carter (1967), and the anthropometric measurements for somatotype calculations were performed based on the suggestions of Ross and Marfell-Jones (1982). Then, players' somatotype classification (Carter et al., 1982) was performed employing a graphical analysis called somato-letter, according to Carter and Heath (1990). For this, the coordinate points (vertical - Y; horizontal - X) were calculated as follows: X = III – I; and Y = II – (I+III). Where I represent the endomorphic component, II the mesomorphic component and III the ectomorphic component.

The Running Anaerobic Sprint Test was adopted to evaluate repeated sprint ability (Burgess et al., 2016; Zagatto et al., 2009). The participants performed six maximum all-out 35 m running bouts separated by 10 s passive recovery. The test was conducted in an indoor futsal court, adequately marked and equipped. In addition, the participants were adequately fed to minimize nutritional effects on performance (Bishop et al., 2001). All actions were recorded and the time was calculated utilizing the Kinovea software (version 0.8.15). The power in each bout and the fatigue index were determined using the equations presented below (Zagatto et al., 2009). The maximum power and maximum velocity were selected among sprints and the average power (including all sprints) for each participant was calculated. The following equations were used to calculated power and fatigue index: Power = (Body mass x Distance2 ÷ Sprint time3) and Fatigue index = (100 x (total sprint time ÷ ideal sprint time)) – 100, where, distance is the distance covered in the test, total sprint time represents the sum of the time of all sprints and ideal sprint time represents the number of sprints multiplicated by fastest sprint time.

To assess aerobic fitness, Multistage 20 m Shuttle Run Test was used (Léger et al., 1988). The test involves a series of continuous and progressive 20 m runs, starting at a speed of 8.5 $km.h^{-1}$ and increments of 0.5 $km.h^{-1}$ every min (stages) until the impossibility of the participant to sustain the pre-stipulated speed or when she did not complete the 20 meters within the time stipulated by the audible warning twice in a row. The test was carried out in an official FIFA-standard futsal court, properly marked and equipped, with all players wearing futsal shoes they generally use in training/competition. Maximum aerobic capacity was estimated from the regression equation VO_{2max} ($mL.kg{-}1.min^{-1}$) = (6 x test speed) - 24.4, where test speed is the speed obtained at the last complete stage of the test.

STATISTICAL ANALYSIS

Initially, the normality of data distribution was confirmed by the Shapiro-Wilk test. All values are presented as mean ± standard deviation. The data were analyzed by one-way analysis of variance (ANOVA) for comparison between the game position and Pearson's correlation between somatotype and performance data. To verify the inter-individual variation for all variables, we adopted the calculation of the coefficient of variation (CV), as described by Hopkins (2000), considering 25% as the cut-off value for sample homogeneity (Field, 2009).

Statistical analyses were performed using Microsoft Office Excel 2016 spreadsheets and the JASP software (JASP Team, 2020) version 0.12.2, which offers Bayesian options to most used inferential tests. The Bayesian hypothesis test was adopted here because it offers a practical alternative, especially when it comes to interpreting the relative support of a null model against an alternative model (Lakens et al., 2020). The calculation of the Bayesian ANOVA was performed to compare the differences between the playing positions (winger, defender, goalkeeper and pivot) considering the somatotype types as independent (including body mass, height, fat percentage) and physiological as the dependent measure (from the Running-based Anaerobic Sprint Test and Multistage 20 m Shuttle Run Test). The Bayes factor was calculated for all variables employing the fixed effects of the "r" scale pre-defined by the JASP, and a width of 0.5 for the previous distribution. Pearson's Bayesian correlations were used to verify possible associations between somatotype and physiological variables. A "prior" beta default by the width 1 JASP was used, which assigns a prior probability equal to all correlation values between -1 and 1.

The Bayes factor calculates the probability that the null (H0) or alternative (H1) hypothesis is true from the present data. If a significant Bayesian factor favorable to H1 (BF_{10}) was identified, a post-hoc was then performed (Westfall et al., 1997). The evidence for H1 was established as $BF_{10} > 3$ and the evidence for H0 was defined as $BF_{10} < 1/3$. BF_{10} was reported to indicate the strength of the evidence for each analysis (within and between) and interpreted as anecdotal (BF_{10} = 1-3), moderate (BF_{10} = 3-10), strong (BF_{10} = 10-30), very strong (BF_{10} = 30-100) and extreme ($BF_{10} > 100$) when favoring the alternative hypothesis; or anecdotal (BF_{10} = 1-0.33), moderate (BF_{10} = 0.33-0.01), strong (BF_{10} = 0.01-0.03), very strong (BF_{10} = 0.03-0.01) and extreme ($BF_{10} < 0.01$) when favoring the null hypothesis (Wagenmakers et al., 2018).

RESULTS

The under-17 female futsal players show homogeneity for the anthropometric characteristics (CV < 25%) with a strong endomorph component. table 1 shows the participants' anthropometric characteristics. According to the Bayesian ANOVA, there are only differences for the anthropometric variables, namely body mass (BF_{10} = 5.01, moderate), height (BF_{10} = 4.13, moderate) and body mass index (BF_{10} = 145.21, extreme). The post hoc test show that the wingers' body mass is lower than that of defenders (BF_{10} = 8.09, moderate) and goalkeepers (BF_{10} = 3.54, moderate). Regarding height, wingers are smaller than defenders (BF10 = 1.67, anecdotal), goalkeepers (BF_{10} = 1.15, anecdotal) and pivots (BF_{10} = 1.95, anecdotal). As for the body mass index, wingers present a lower value compared to defenders (BF_{10} = 354.15, extreme) and goalkeepers (BF_{10} = 37.23, very strong), while pivots presented a lower value compared to defenders (BF_{10} = 2.14, anecdotal) and goalkeepers (BF_{10} = 1.19, anecdotal).

TABLE 1. Means and standard deviations, coefficient of variations (CV), confidence intervals (CI 95%) and BF_{10} of the anthropometric characteristics of the participants by position and in general.

	Winger (*n* = 11)	Defender (*n* = 3)	Goalkeeper (*n* = 2)	Pivot (*n* = 2)	Mean (*n* = 18)	CV % (CI 95%)	BF_{10}	Qualitative interpretation
Age (years)	15 ± 1	15 ± 1	16 ± 2	15 ± 1	15 ± 1	7.2 (14.5–15.4)	0.36	Anecdotal for H_0
Body mass (kg)	48.5 ± 4.5	60.0 ± 7.5	61.5 ± 13.4	50.8 ± 5.3	52.1 ± 7.8	13.9 (48.2–56.0)	5.01	Moderate
Height (cm)	158.2 ± 6.9	167.0 ± 2.0	167.0 ± 2.8	170.0 ± 2.8	161.9 ± 7.3	2.2 (158.3–165.6)	4.13	Moderate
Sum of skin folds (mm)	60.0 ± 10.0	81.4 ± 22.6	78.8 ± 14.6	66.6 ± 11.7	66.3 ± 14.9	20.6 (58.8–73.7)	2.05	Anecdotal
Body fat (%)	20.1 ± 2.1	23.7 ± 4.1	24.0 ± 4.9	18.8 ± 1.3	21.0 ± 3.1	14.3 (19.4–22.5)	1.34	Anecdotal
Body Mass Index (kg/m²)	16.2 ± 1.0	21.5 ± 2.2	22.0 ± 4.1	15.6 ± 1.3	17.6 ± 3.0	11.4 (15.9–17.9)	145.21	Extreme
Endomorph	5.1 ± 0.7	5.6 ± 1.5	5.8 ± 0.8	5.0 ± 0.5	5.2 ± 0.8	16.0 (4.8–5.6)	0.46	Anecdotal for H_0
Mesomorph	2.6 ± 0.8	3.2 ± 0.7	3.5 ± 1.7	1.8 ± 0.2	2.7 ± 0.9	31.2 (2.2–3.1)	0.75	Anecdotal for H_0
Ectomorph	3.5 ± 0.9	2.8 ± 1.2	2.8 ± 1.8	5.1 ± 0.7	3.5 ± 1.2	32.8 (2.9–4.1)	0.81	Anecdotal for H_0

The predominant somatotype for female futsal players in the under-17 category is endo-ectomorph (FIGURE 1). When analyzed by position, we find that both goalkeepers and defenders show an endo-mesomorph somatotype profile, while wingers and pivots presented endo-ectomorph and ecto-endomorph characteristics, respectively. The Bayesian ANOVA show similarity for all physiological characteristics (TABLE 2). Concerning the CV, players present a similar physiological profile for all variables except for maximum power (CV = 34%) and fatigue index (CV = 52.8%) derived from the Running-based Anaerobic Sprint Test. Finally, the Bayesian correlation show that body fat percentage show a negative correlation with VO_{2MAX}, $r = -0.54$ ($BF_{10} = 3.33$, moderate). A complete list of correlations is shown in table 3.

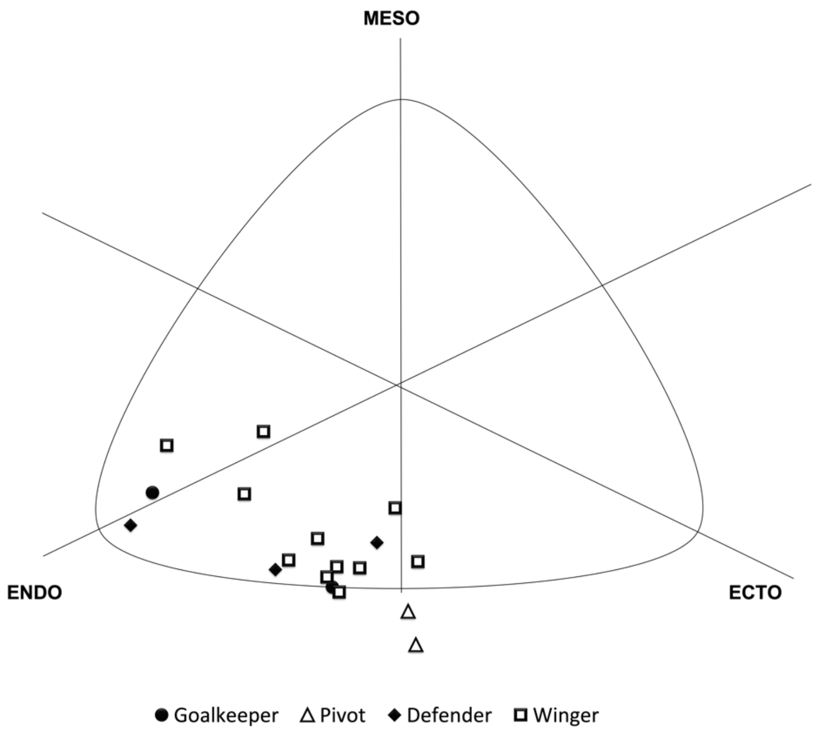

FIGURE 1. Individual representation of the somatotype for each female futsal player.

TABLE 2. Means and standard deviations, coefficient of variations (CV), confidence intervals (CI 95%) and BF_{10} of the physiological characteristics of the participants by position and in general.

	Winger (*n* = 11)	Defender (*n* = 3)	Goalkeeper (*n* = 2)	Pivot (*n* = 2)	Mean (*n* = 18)	CV % (CI 95%)	BF_{10}	Qualitative interpretation
VO_{2MAX} (ml kg^{-1} min^{-1})	35.2 ± 4.0	33.7 ± 1.4	32.6 ± 5.9	35.8 ± 5.1	34.7 ± 3.8	12.0 (32.8–36.6)	0.35	Anecdotal for H_0
vVO_{2MAX} (kmh^{-1})	10.1 ± 0.6	9.7 ± 0.3	9.8 ± 0.4	10.0 ± 0.7	9.9 ± 0.5	5.0 (9.2–9.7)	0.40	Anecdotal for H_0
Maximum power (W)	399.8 ± 289.4	360.1 ± 10.1	319.3 ± 93.0	282.1 ± 70.2	371.2 ± 227.7	34.0 (257.9–484.4)	0.32	Moderate for H_0
Mean power (W)	240.9 ± 64.3	252.7 ± 9.1	223.7 ± 40.9	214.9 ± 42.0	238.1 ± 52.7	16.8 (211.9–264.3)	0.32	Moderate for H_0
Minimum power (W)	160.0 ± 22.4	157.4 ± 12.3	163.0 ± 3.6	163.5 ± 40.5	160.3 ± 20.3	12.2 (150.1–170.4)	0.29	Moderate for H_0
Fatigue index (%)	17.5 ± 16.2	14.5 ± 0.2	13.6 ± 5.3	14.6 ± 10.0	15.1 ± 13.4	52.8 (11.7–16.0)	0.40	Anecdotal for H_0
35 m sprint speed (kmh^{-1})	20.7 ± 1.7	21.8 ± 0.7	22.3 ± 0.6	21.9 ± 1.1	21.2 ± 1.5	4.7 (20.8–22.4)	0.54	Anecdotal for H_0

Maximum oxygen uptake in the aerobic capacity test (VO_{2MAX});
Maximum speed in the aerobic capacity test (vVO_{2MAX}).

TABLE 3. Bayesian correlations between physiological and anthropometric variables (*n* = 18).

		VO_{2MAX}	vVO_{2MAX}	Maximum power	Mean power	Minimum power	Fatigue index	35 m sprint speed
Body mass	r BF_{10}	-.33 .66	-.20 .39	.03 .29	.16 .35	.16 .36	.05 .30	.32 .64
Height	r BF_{10}	-.15 .35	-.12 .32	.01 .29	.16 .35	.33 .67	-.07 .30	.23 .43
Sum of skin folds	r BF_{10}	-.49 2.19	-.46 1.62	-.03 .29	-.06 .30	-.13 .33	.00 .29	.50 2.26
Body fat	r BF_{10}	-.54* 3.34	-.44 1.42	-.01 .29	-.06 .30	-.20 .40	.08 .31	.47 1.73
Body Mass Index	r BF_{10}	-.3 .68	-.25 .46	-.01 .29	.11 .32	.04 .30	.04 .30	.31 .60
Endomorph	r BF_{10}	-.45 1.53	-.36 .77	-.14 .34	-.21 .40	-.23 .43	-.09 .31	.50 2.25
Mesomorph	r BF_{10}	-.34 .72	-.31 .59	-.01 .29	.00 .29	-.19 .38	.11 .32	.10 .31
Ectomorph	r BF_{10}	.20 .39	.09 .31	.04 .29	.03 .29	.20 .39	-.09 .31	-.15 .35

* BF_{10} = 3-10. *r*: Pearson's correlation coefficient; BF_{10}: Bayes factor favorable to H1.

DISCUSSION

This study characterized the somatotype and physiological profile in under-17 female futsal players, comparing these profiles between positions. A secondary goal was to identify the magnitude of associations between somatotype and physiological markers. The main findings of the investigation were that: (a) there was an average somatotype profile of endo-ectomorph characteristics in female youth players; (bi) physiological profile with VO_{2MAX} of 34.7 ml.kg^{-1}.min^{-1}, maximum power of 371.2 W, fatigue index of 15.1% and mean velocity of 21.1 km.h^{-1} at the maximum 35 m effort; (c) differences existed in body mass between positions, since goalkeepers and defenders presented greater body mass about winger players; and (d) body fat percentage and VO_{2MAX} were negatively and moderately related to each other.

The somatotype may not be a reliable indicator of physical performance for female futsal players in the under-17 category. Despite indicating a probable reduced physiological performance due to the high percentage of body fat, our results corroborated those of Levandoski et al. (2007), who found a somatotype profile that is predominantly endomorph in female youth futsal players. However, our results disagreed with studies that analyzed the somatotype in senior players, in which the predominance of the mesomorph component was identified (Queiroga et al., 2021, 2008, 2005, 2018). Furthermore, regarding anthropometric characteristics, we observed that although our findings for body mass were lower than those previously identified by Levandoski et al. (2007) in youth players (~62.5 kg), and by Queiroga et al. (2018) in the senior category (~57.8 kg), the height was similar. In addition, although the percentage of body fat showed a negative and moderate correlation with VO_{2MAX} (r = -0.54; BF_{10} = 3.33), the anthropometric and physiological characteristics were homogeneous, as already demonstrated in male futsal players (Avelar et al., 2008; Cyrino et al., 2002; Rosa, 2011). Therefore, the transition from youth players to the senior team should be done with caution from an anthropometrical point of view.

Studies that evaluated elite senior female players identified a component of body fat that varied between 16 and 20% (Barbero-Alvarez et al., 2015; Lago-Fuentes et al., 2020; Palucci Vieira et al., 2021; Ramos-Campo et al., 2014), a range slightly lower than observed here. Excess body fat can be a detrimental factor in futsal performance, considering that this tissue may limit the quick actions performance of characteristic of this sport (Barbero-Alvarez et al., 2008; Castagna et al., 2009; Gorostiaga et al., 2009). In addition, excess body fat may also limit the performance of the technical actions (Kooshakia et al., 2014; Sekulic et al., 2021), as well as cause early fatigue and injuries (Martinez-Riaza et al., 2017), and impair the aerobic component (Nikolaidis et al., 2019).

This condition is reinforced by the negative correlation observed in our study, which indicates that VO_{2MAX} decreases as body fat increases. Therefore, considering the reference values presented in the literature together with those described in the current study, the rise to the senior level in female's futsal players may be related to the need in reducing players' body fat, which is, even at a young age, a limiting factor for the maintenance of prolonged efforts. This limitation may be compensated by the rule of unlimited futsal substitution (FIFA, 2020) and other components involving futsal, such as those of a technical and tactical nature. Another factor to be considered for the investigated category is the effects of maturation, which generally occurs in the development period between 10 and 17 years (Mortatti & de Arruda, 2007) and may increase body fat in women; but which was not evaluated in the present study. In addition, training is equally recognized as an alternative to improve the body composition of athletes (Cyrino et al., 2002), approaching a somato-typological profile closer to that found in female senior futsal players.

The physiological profile of aerobic component in under-17 female futsal players was lower than female senior futsal players. For instance, Barbero-Alvarez et al. (2015), using the Futsal Intermittent Endurance Test, identified a VO_{2MAX} of 45.3 ± 5.6 ml·kg^{-1}.min^{-1}, a value 30% higher than that found with under-17 sportswomen evaluated in our study, which corroborated with values found in the male category through the Yo-Yo Intermittent Recovery Test Level 1 (Ayarra et al., 2018). Although the results are dependent on the protocol applied, all tests adopted in the present study and in the literature provide a good correlation with laboratory data. Regarding the anaerobic component, under-17 futsal players produced good rates. They reached a higher speed (21.2 ± 1.5) in 35 m sprints when compared to female senior players (~18 $km.h^{-1}$) (Ramos-Campo et al., 2016). Therefore, athletes in the under-17 category seem to present a satisfactory sprint performance, a key ability on decisive actions during a futsal match. For this reason, more studies comparing the performance between youth categories and professional female futsal players would be necessary to determine the physiological characteristics appropriately in younger female futsal players.

The investigated under-17 female futsal players showed homogeneity in their anthropometric and physiological characteristics, regardless of their positional role. In men, game demands have also been reported as similar between different futsal positions, both in total distance covered (Ohmuro et al., 2020) and high-speed efforts (Caetano et al., 2015). However, the same information cannot yet be extrapolated to women futsal players, given the lack of investigations (Beato et al., 2017; Palucci Vieira et al., 2021). Furthermore, although the goalkeepers in our study presented a higher percentage of body fat, information similar to the literature (Marques et al., 2016), the physiological results indicated that the prescription of physical training for outfield players of this age group may be similar among players of different positions, as long as coaches and physical trainers pay attention to individual adjustments. In addition, considering only the physical characteristics, these findings indicate that the under-17 female futsal players can be involved in various roles interchangeably during the match since the anthropometric profile did not seem to be crucial for determining the futsal's game position/function (Ramos-Campo et al., 2014).

Despite the original information demonstrated in this study, some limitations are evident. The number of participants is small, especially when we analyze the number of players per position. In addition, the authors are aware that other aspects are crucial for futsal performance and not just the athletes' somatotype, anthropometry, and physiology. Therefore, additional factors, such as technical, tactical and other psychological aspects (Ramos-Campo et al., 2014; Spyrou et al., 2020) should also be considered when prescribing training and choosing the tactical function during the game. Hence, further studies with female futsal players that analyze the same components evaluated in this investigation with larger sample size and that equally consider the combination with measures of other elements that are important for futsal performance.

The results of this study can bring some practical applications for coaches since the somatotype determination is a non-invasive and low-cost tool and your results can help the coaches in the season planning or in the selection of players. Coaches must pay special attention to the somatotype profile of goalkeepers and especially defenders, where VO_{2MAX} may be a determining factor in performance during the match, because the negative correlation between body fat and VO_{2MAX} indicates that they may cause a loss in aerobic performance during the match, especially for goalkeepers and defenders. In addition, endo-ectomorph characteristics can be favorable for the athletes during the match, since futsal is a sport that involves a lot of physical contact.

In conclusion, female futsal players in the under-17 category showed homogeneous anthropometric and physiological characteristics, with a predominance of the endo-ectomorph somatotype. Also, the high percentage of body fat was directly related to reduced performance in VO_{2MAX}. Regarding the analysis between players of different positions, goalkeepers and defenders presented a significantly greater body mass than the wingers. In addition, although the participants showed a physiological profile with good sprint capacity levels that seemed to be adequate for futsal requirements, the aerobic component denoted reduced fitness.

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Desenvolvimento do nível de jogo numa época de jogos de invasão do modelo de educação desportiva: Efeitos do sexo e nível de habilidade dos alunos.

PALAVRAS-CHAVE:

Modelo de educação desportiva. Performance no jogo. Envolvimento no jogo.

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RESUMO

O presente estudo examinou o desenvolvimento do jogo (performance e envolvimento) dos alunos durante a sua participação em duas unidades de jogos de invasão lecionados através do modelo de educação desportiva, considerando o contexto (e.g., competição) e o sexo e nível de habilidade dos alunos. Foi implementada uma investigação-ação com dois ciclos iterativos de planeamento, intervenção, monitorização e reflexão. Vinte e seis alunos do 7.º ano de escolaridade (10 raparigas e 16 rapazes, M_{idades} = 12.3), participaram em 24 aulas de dois jogos de invasão. A análise diferencial foi realizada através de testes-*t* de amostras independentes e, posteriormente, para controlar o efeito do tempo de participação, foi conduzida uma análise de covariância. Verificaram-se maiores pontuações na performance e envolvimento no jogo nos rapazes e alunos com mais habilidade, nas duas épocas e contextos (e.g., performance no andebol, rapazes = 43.32 ± 7.84, raparigas = 36.86 ± 5.74; $t_{(24)}$ = 2.247, p = .034, d = .94; envolvimento no andebol= rapazes: 4.59 ± .96; raparigas: 3.75 ± 1.02; $t_{(24)}$ = 2.116, p = .045, d = .85). Os resultados sugerem, também, uma mediação do nível de habilidade na discriminação do contexto que favorece maiores níveis de performance.

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