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Original Article

Comparison of aerobic performance and body composition according to game position and its relationship between variables in professional women's soccer players.

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Abstract

Introduction: The variables of body composition and aerobic performance are decisive to evaluate the profiles of soccer players, for this reason the sports scientific community is in constant search of information on what values to discriminate to generate training strategies more in line with this type of population. **The aim** of this research is to compare the maximum oxygen consumption and body composition according to game position and study their relationship. **Material and methods**: This study has a descriptive, comparative and correlational design. The study was conducted with 26 professional female players (25.5 ± 4.0 years; body mass of 57.7 ± 5.0 kg; the height of 161.7 ± 5.7 cm) from a Chilean first division soccer club. For the evaluation of body composition, body mass (BM), standing height, perimeters, sum of six skinfolds (Σ6 skinfolds), estimated percentage of muscle mass (%MM) and percentage of body fat (%BF). For aerobic performance, VO2max was evaluated by means of this test, the following variables were determined: maximum relative oxygen consumption (VO2max ml/kg/min), maximum aerobic speed (MAS km/h), ventilatory threshold velocity 1 and 2 (VT1 and VT2 km/h), percentage of ventilatory threshold VO2 1 and 2 (% VO2 VT1 and 2), ventilatory threshold heart rate 1 and 2 (HR VT1 and 2) and maximum heart rate (HRmax). **Results**: The goalkeepers as the central defenders presented a significantly lower %VO2 VT2 than the lateral defenders p = 0.043 and p = 0.012 respectively. Comparisons of body composition variables according to game position, no variable showed significant differences between game positions (p > 0.05). The simple linear regression (r2) that showed the greatest explanation between variables was VO2max (ml/kg/m) with BM (r2 = 0.220), MAS km/h (r2 = 0.480), VT1 speed (r2 = 0.412) and VT2 speed (r2 = 0.613). **Conclusion**: The variables MAS and Vel VT1 and VT2 seem to be elements that have a high explanation of the variance in VO2max, therefore, it is suggested to consider these elements as a guide in the planning of aerobic or continuous interval training, in order to better VO2max performance.

Key Words: testing fitness, athletes, profiles, training, maximum oxygen consumption, anthropometry.

Introduction

Women's soccer has grown exponentially worldwide in recent years and Chilean female soccer has not escaped this phenomenon, after the participation of the women’s national team in the last World Cup, France 2019 and the Olympic Games, Japan 2021 (Villaseca-Vicuña, Otero-Saborido, et al., 2021). This background creates the need to follow the development of women's soccer in a scientific way to better understand the evolution of this sporting case and also it'sitsularity. This evolution shows that players’’profilese are changing due to the implementation of professional training processes (full-time professional players), associated with the economic injection made by the clubs to create more competitive teams (FIFA, 2019b).

The assessment of aerobic performance is an important variable for female players who participate in competitions that require prolonged activity, such as soccer (Green et al., 2013), The assessment of aerobic power is an important measure for these kinds of sports that require prolonged activity, such as soccer, since maximal oxygen uptake (VO2max) or maximal aerobic power are important functional parameters for prolonged exertion, due to their relationship with endurance and performance variables in official matches, such as total distance and distances at ha high intensity (>18 km/h) (Villaseca-Vicuña et al., 2021). In this sense, it has been demonstrated that during matches (90 minutes), an average intensity close to 80-90% of the maximum heart rate (HRmax) is reached, with intermittent high-intensity activities, such as jumping, kicking, tackling, turning, change of rhythm or direction and strong contractions to maintain balance and control of the ball against rival pressure (Stolen et al., 2005). It should be noted that VO2max is an important physiological determinant of physical performance in many team sports (Esco et al., 2014), It should be noted that VO2max is an important

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physiological determinant of physical performance in many team sports (Datson et al., 2014). A high VO2max could benefit the performance of the players, facilitating a faster recovery between efforts, delaying the onset of fatigue and allowing to maintain high-intensity efforts for a longer period (Datson et al., 2014).

Haugen, Tønnessen, Hem, Leirstein, & Seiler (2014), studied 199 female soccer players from Norway between 1989 and 2007, and published figures related to VO2max (L/min) in female athletes of different competitive levels, where national team players obtained a mean of 3.58 ± 0.37, first division players 3.25 ± 0.30, second division players 3.08 ± 0.35 and youth national team players 3.39 ± 0.36. In addition, these same authors postulated figures according to the positions of the players, where midfielders obtained the best record with 3.63 ± 0.40, followed by defenders at 3.54 ± 0. goalkeepers at 3.50 ± 0.20 and forwards in last place at 3.46 ± 0.41. When considering only national team players, midfielders had 7.8% higher VO2max than goalkeepers, but no differences were observed with the other positions on the field despite having the highest values. Recently Villaseca-Vicuña, Molina-Sotomayor, Zabaloy, & Gonzalez-Jurado (2021), recently evaluated a total of 50 Chilean selected players, during the training period for the Women's World Cup France 2019 and the Olympic Games Japan 2021, with the Yo-yo field test of intermittent recovery level I and obtained VO2max values (ml/kg/m) by the position of 43.9 goalkeepers, 47.4 defenders, 48.9 midfielders and 46.9 forwards, suggesting that there are differences in aerobic performance according to playing position. Similarly, it should be considered that both playing position and level of competition may be factors that influence aerobic performance. Haugen et al. (2014), determined that players of the Norwegian national team had 5% higher VO2max than 1st division players, 13% higher than 2nd division players and 9% higher than youth players, from the same country.

On the other hand anthropometric composition aims to quantify morphological characteristics and provide an objective picture of the growth status of the individual. Anthropometric characteristics seem to be very important for selection in most sports disciplines, including soccer (Cárdenas-Fernández et al., 2019). In soccer, it may vary according to the periods of preparation (higher values of adipose tissue in the transition period vs. the competition period), as well as differences in anthropometric values of adipose tissue in the transition period (Madic et al., 2018),) as well as differences in anthropometric values between playing positions (Kammoun et al., 2020). Villaseca-Vicuña et al. (2021) reported that goalkeepers are heavier and taller than the rest of the field players. In the rest of the anthropometric measures and morphological variables, there are no statistically significant differences between the players playing in the different positions of the team (Gjonbalaj et al., 2018). Therefore, the morphological characteristics of high-level soccer players seem to be of great interest to some authors to find the best morphological somatotype for certain levels of competition and player positions, although the specificity depends on the development of technique and tactics (Sæther, 2017). It is important to consider that excess adipose tissue has a negative influence on sports performance since the increase in body weight derived from fat is not accompanied by an increase in the ability to produce higher strength (Villaseca-Vicuña et al., 2021). Considering that acceleration is directly proportional to force but inversely proportional to body mass, excess adipose tissue at a given level of applied force will result in slower changes in velocity (Barraza, Báez, Rosales., 2015). In short, both VO2max and body composition are important elements in the development of female soccer players (Villaseca-Vicuña et al., 2021), which has been widely documented in men's soccer, but requires further study in women's soccer and in Chile the literature is scarce (Lillo et al., 2018). In this sense, the number of scientific investigations, although they have increased in recent years, is still far below the number of publications in men's soccer (Martínez-Lagunas et al., 2014). Therefore, the aim of our study is to compare the maximum oxygen consumption and body composition according to playing position and to study their relationship, to use these findings as parameters and guidance for coaches in this sports context.

Material & methods

Design This study has a descriptive, comparative and correlational design. We investigated the differences according to playing positions in professional soccer players in the variables of aerobic performance and body composition and also their relationship between variables.

Participants The study was conducted with 26 professional female players (25.5 ± 4.0 years; body mass of 57.7 ± 5.0 kg; the height of 161.7 ± 5.7 cm) from a Chilean first division soccer club and champions during the 2020 are of the local league, who volunteered to participate in this study. The players had to meet the following inclusion criteria: be over 18 years of age and train regularly at the club five days a week (Fenley et al., 2018). The intervention protocol considered specific requirements of the club, according to the work times and the needs of each player, so that normal practices were not altered and motor actions were not generated that were different from those commonly performed. Along with this, all players were informed of the procedures, objectives, risks and benefits, before the beginning of data collection and were free to withdraw from the study at any time. The players signed an informed consent form, framed within the ethical regulations of the Club and following the Helsinki treaty ("World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects," 2013 ("World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects," 2013).

Procedure- Data collection on aerobic performance was performed on a treadmill was conducted on the premises of a specialized clinic. Before the test, each participant was asked to abstain from food or caffeine intake for at least 8 h. In addition, each participant was asked to avoid strenuous exercise and alcohol consumption for 24 h previous data collection (Esco et al., 2014).). The test was conducted in an air-conditioned laboratory with temperatures between 22° C and 24° C and relative humidity between 50% and 60%, in the same morning period (Fenley et al., 2018). The maximal incremental exercise test was applied to the participant. After a 3 min warm-up at 4 km/h, the test started at 8 km/h with an increment of 1 km/h for every 1 min and the treadmill with an inclination of 1% until maximum effort and/or exhaustion was achieved) until the maximum effort and/or exhaustion of the athlete was achieved, which guaranteed the completion of the test. Maximum effort was considered if the player reached a plateau in VO2, HRmax, the player's inability to execute the load imposed by the treadmill or the respiratory exchange ratio (RER) > 1.15 (Fenley et al., 2018). At the end of the exercise, the players performed an active recovery time of 1 min at 4 km/h followed by a passive recovery time of 5 min after the interruption of the load. The tests were performed under the supervision of a physician and the team's coaching staff, who were attentive to signs or symptoms inappropriate to exercise. In addition, the gas analyzer was calibrated according to the manufacturer's instructions (Archiza et al., 2018).

The anthropometric evaluation was carried out before training at the club's facilities, by an expert in this evaluation of ISAK level III (International Society for the Advancement in Kinanthropometry). The players wore light clothing to facilitate the measurement, which was carried out under the ISAK marking and measurement protocol (Carter & Heath, 1990).

Test protocol Maximal oxygen uptake (VO2max): For the evaluation of the exercise test a HP Cosmos stellar® lt med treadmill was used, the gas analyzer was a METAMAX Cortex, manufactured by Cortex biophysik GmbH and the HR was recorded throughout the test period, using a Polar model Ft60. The following variables were determined by this test: relative maximum oxygen consumption (VO2max ml/kg/min), maximum aerobic speed (MAS km/h), ventilatory threshold velocity 1 and 2 (Vel VT1 and 2 km/h), percentage of ventilatory threshold VO2 1 and 2 (% VO2 VT1 and 2), ventilatory threshold heart rate 1 and 2 (HR VT1 and 2) and maximum heart rate (HRmax).

Body composition: The Rosscraft SRL anthropometric kit validated by the ISA was used, consisting of the following instruments and calipers: Campbell 20, Campbell 10, retractable segmometer, metallic square, Gaucho Pro plicometer, metallic tape measure, Seca 220 portable stadiometer and a Seca digital scale to measure weight with 100 g precision. With these instruments, body mass (BM kg), standing height (cm), sum of six folds (Σ6P: triceps, subscapular, supraspinal, abdominal, medial thigh, maximum calf) and waist, hip, arm and thigh perimeters were measured to estimate the percentage of body fat (BF %) and muscle mass (MM %) (Villaseca-Vicuña et al., 2021).

Statistical Analysis Descriptive statistics of means and standard deviation were obtained from the total sample. The normality of the data was verified using the Shapiro-Wilk test, then the comparison between the different playing positions was performed using the one-factor Anova statistical test and when a difference was identified, Tukey's Pos hoc was used and if normality was not met, Games Howell was used. The effect size (ES) was calculated using Eta^2 partial (0.01: small, 0.06: medium, 0.14: large). In addition, correlations were calculated using Pearson's or Spearman's r according to the normality of the variables, to study the degree of association between body composition and aerobic performance variables. The r values were interpreted as trivial (0.00-0.09), small (0.10- 0.29), moderate (0.30-0.49), large (0.50-0.69), very large (0.70-0.89), almost perfect (0.90-0.99), and perfect (1.0) (Hopkins et al., 2009). Simple linear regression (r^2) was also performed to indicate the percentage of incidence of one variable on another. The analyses were performed with SPSS *software* (version 27).

Results

Table 1 shows the descriptive data on aerobic performance and body composition.

Table 1. Descriptive statistics and normality test considering age, experience, anthropometry and cycloergometer performance for the total sample (n = 26).

Variables	Units	M	SD	95% IC	Shapiro-Wilk value	Shapiro-Wilk *p*
Age	Years	25.9	4.0	(23.7 a 27.3)	0.943	0.228
Height	cm	162.1	0.1	(159.2 a 163.9)	0.971	0.737
BM	kg	57.6	4.7	(55.5 a 59.7)	0.975	0.813
Σ6SF	Σ	64.9	12.8	(59.2 a 70.6)	0.844	0.003
BF	%	27.6	29.2	(25.9 a 29.4)	0.934	0.150
MM	%	44.2	44.0	(42.6 a 45.7)	0.982	0.942
VO2max	ml/kg/min	46.3	4.0	(44.5 a 48.1)	0.972	0.813
MAS	km/h	16.1	0.9	(15.7 a 16.4)	0.762	0.000
Vel. VT1	km/h	9.89	1.1	(9.4 a 10.4)	0.937	0.170
VO2 VT1	%	67.9	7.0	(64.8 a 71.0)	0.963	0.559
HR VT1	Hbpm	163.2	1.0	(12.2 a 13.1)	0.954	0.370

Vel. VT2	km/h	12.6	1.0	(12.2 a 13.1)	0.925	0.096
VO2 VT2	%	84.2	4.7	(82.1 a 86.3)	0.984	0.968
HR VT2	Hbpm	177.2	9.0	(173.4 a 181.3)	0.960	0.493
HRmax	Hbpm	189.6	6.4	(186 a 192.4)	0.974	0.800

*Abbreviation: Mean (M); SD (standard deviation); CI (confidence interval); BM (body mass); Σ6SF (sum of six folds); BF (body fat); MM (muscle mass); VO2max (relative maximum oxygen consumption); MAS (maximum aerobic speed); Vel VT1 (ventilatory threshold velocity 1); Vel VT2 (ventilatory threshold velocity 2); VO2 VT1 (percentage of ventilatory threshold oxygen consumption 1); %VO2 VT2 (percentage of ventilatory threshold oxygen consumption 2); HR VT1 (ventilatory threshold heart rate 1); HR VT2 (ventilatory threshold heart rate 2); HRmax (maximum heart rate).

Table 2 shows the results of the comparison of aerobic performance variables according to playing position. Differences are shown in % VO2 VT2 ($p = 0.008$), where both goalkeepers and central defenders presented a significantly lower %VO2 VT2 than lateral defenders $p = 0.043$ and $p = 0.012$ respectively. The rest of the variables showed no differences between playing positions ($p > 0.05$).

Table 2. Variables by playing position obtained in the evaluation of aerobic performance.

Variables	**Goalkeeper (n=4)**	**Lateral Defender (n=4)**	**Central Defender (n=5)**	**Mid Fielder (n=8)**	**Striker (n=5)**	**Groups comparison**	
	M ± SD	**M ± SD**	**M ± SD**	**M ± SD**	**M ± SD**	***p* value**	**Eta^2**
VO2max (ml/kg/min)	46.3 ± 5.7	43.0 ± 1.0	45.5 ± 5.1	48.0 ± 4.4	46.6 ± 2.6	0.522	0.191
MAS (km/h)	16.0 ± 1.0	15.7 ± 0.6	15.8 ± 1.0	16.1 ± 1.1	16.4 ± 0.9	0.407	0.156
Vel VT1 (km/h)	10.4 ± 1.3	10.0 ± 0.9	9.8 ± 1.8	9.3 ± 0.9	10.3 ± 0.9	0.605	0.214
% VO2 VT1	70.7 ± 5.1	72.3 ± 7.5	65.3 ± 7.4	65.4 ± 7.8	69.2 ± 6.6	0.548	0.329
HR VT1	158.0 ± 24.6	158.0 ± 2.0	164.5 ± 10.5	165.4 ± 7.8	165.2 ± 8.4	0.783	0.157
Vel VT2 (km/h)	12.3 ± 1.5	12.6 ± 0.6	12.0 ± 1.1	12.8 ± 1.2	13.1 ± 0.5	0.616	0.176
% VO2 VT2	80.3 ± 5.5[a]	89.3 ± 2.5	79.3 ± 2.5[a]	85.9 ± 4.1	85.2 ± 2.3	0.008	0.547
HR VT2	173.3 ± 22.5	174.7 ± 7.6	178.0 ± 2.6	179.4 ± 7.3	177.8 ± 5.4	0.889	0.068
HRmax	193.7 ± 10.6	187.0 ± 7.5	186.8 ± 4.6	190 ± 6.9	189.6 ± 3.6	0.649	0.228

*Abbreviation: Mean (M); SD (standard deviation); CI (confidence interval); VO2max (relative maximum oxygen consumption); MAS (maximum aerobic speed); Vel VT1 (ventilatory threshold velocity 1); Vel VT2 (ventilatory threshold velocity 2); %VO2 VT1 (percentage of ventilatory threshold oxygen consumption 1); %VO2 VT2 (percentage of ventilatory threshold oxygen consumption 2); HR VT1 (ventilatory threshold heart rate 1); HR VT2 (ventilatory threshold heart rate 2); HRmax (maximum heart rate); a different than lateral defense.

Table 3 shows the comparisons of body composition variables according to playing position. No variable showed significant differences between playing positions ($p > 0.05$).

Table 3. Variables by playing position obtained in the evaluation of body composition.

Variables	**Goalkeeper (n=4)**	**Lateral Defender (n=4)**	**Central Defender (n=5)**	**Mid Fielder (n=8)**	**Striker (n=5)**	**Groups comparison**	
	Avg ± SD	**Avg ± SD**	**Avg ± SD**	**Avg ± SD**	**Avg ± SD**	***p* value**	**Eta^2**
Age (years)	23.2 ± 5.4	28.1 ± 3.7	27.2 ± 1.0	25.6 ± 4.0	23.9 ± 4.8	0.476	0.093
Height (cm)	169.3 ± 0.1	158.0 ± 0.0	161.0 ± 0.0	160.0 ± 0.1	161.0 ± 0.0	0.116	0.500
BM (kg)	62.7 ± 3.2	55.3 ± 1.9	55.8 ± 2.5	58.0 ± 7.0	56.9 ± 1.6	0.409	0.323
Σ6SF	62.5 ± 22.0	53.4 ± 1.1	75.0 ± 2.9	62.4 ± 15.2	68.7 ± 5.4	0.624	0.197
BF (%)	27.8 ± 7.3	26.3 ± 3.0	27.8 ± 2.2	26.9 ± 5.2	29.3 ± 0.1	0.931	0.053
MM (%)	42.0 ± 5.2	45.7 ± 4.1	43.0 ± 2.9	44.4 ± 4.3	45.2 ± 1.4	0.845	0.134

*Abbreviation: Mean (M); SD (standard deviation); CI (confidence interval); BM (body mass); Σ6SF (sum of six folds); BF (body fat); MM (muscle mass).

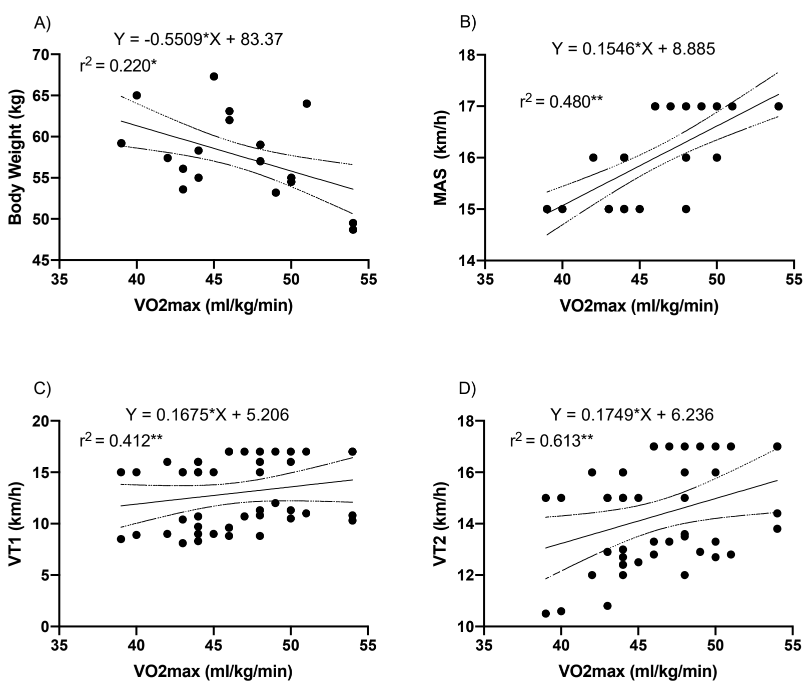
Table 4 shows the results of the correlations between VO2max with aerobic performance and body composition. It can be observed that VO2max presented a strong relationship with MAS and VT1 velocity ($r = 0.693$, $p = 0.000$ and $r = 0.642$, $p = 0.001$) respectively. Also moderately ($r = -0.453$, $p = 0.034$) and very large ($r = 783$, $p = 0.000$) with BM (kg). On the other hand, body composition variables that were shown to be related to aerobic performance indicators, BM with %VO2 VT2 ($r = 0.481$, $p = 0.037$), Σ6SF moderate with %VO2 VT1, and large with vel VT2 and %VO2 ($r = -0.435$, $p = 0.043$; $r = -0.501$, $p = 0.018$; $r = -0.717$, $p = 0.002$) respectively. MM% moderated with vel VT1 and HR VT2 ($r = 0.431$, $p = 0.045$ and $r = 0.438$, $p = 0.041$) respectively, while with vel VT2 and %VO2 VT2, the relationship was large ($r = 0.615$, $p = 0.002$ and $r = 0.642$, $p = 0.001$). Finally, the BF% was large with the %VO2 VT2 ($r = -0.551$, $p = 0.008$) and with the HR VT2 (r = -0.559, $p = 0.007$).

Table 4. Correlations between aerobic performance and body composition variables with VO2max.

Variables	VO2max (ml/kg/min)	Age (years)	Height (cm)	BM (kg)	Σ6SF	BF (%)	MM (%)	MAS (km/h)	Vel VT1 (km/h)	% VO2 VT1	HR VT1	Vel VT2 (km/h)	% VO2 VT2	HR VT2
Age (years)	0,092													
Height (cm)	-0,242	-0,213												
BM (kg)	-,453*	-0,394	0,738**											
Σ6SF	-0,382	-0,414	0,219	0,559**										
BF%	-0,380	0,488*	0,228	0,584**	0,756**									
MM%	0,355	0,386	-0,273	0,525**	0,614**	0,701**								
MAS (km/h)	0,693**	0,017	-0,063	-0,267	-0,251	-0,158	0,337							
Vel VT1 (km/h)	0,642**	0,036	0,014	-0,408	-0,419	-0,322	0,431*	0,674**						
% VO2 VT1	0,205	0,020	0,091	-0,133	0,435*	-0,284	0,324	0,303	0,677**					
HR VT1	0,099	0,218	0,081	-0,158	-0,269	-0,342	0,122	-0,021	-0,035	0,086				
Vel VT2 (km/h)	0,783**	0,199	-0,113	-0,422	0,501*	-0,399	0,615**	0,732**	0,697**	0,286	0,124			
% VO2 VT2	0,345	0,235	-0,420	0,446*	0,693**	0551**	0,642**	0,179	0,315	0,521*	0,267	0,548**		
HR VT2	0,195	0,322	0,072	-0,135	-0,306	0559**	0,438*	-0,014	0,048	0,143	,766**	0,275	0,445*	
HRmax	0,044	0,027	0,390	0,397	-0,081	-0,178	0,161	-0,022	-0,091	0,071	0,500*	0,108	0,209	0,723**

*Abbreviation: BM (body mass); Σ6SF (sum of six folds); BF (body fat); MM (muscle mass); VO2max (relative maximum oxygen consumption); MAS (maximum aerobic speed); Vel VT1 (ventilatory threshold velocity 1); Vel VT2 (ventilatory threshold velocity 2); VO2 VT1 (percentage of ventilatory threshold oxygen consumption 1); %VO2 VT2 (percentage of ventilatory threshold oxygen consumption 2); HR VT1 (ventilatory threshold heart rate 1); HR VT2 (ventilatory threshold heart rate 2); HRmax (maximum heart rate).p<0.05 **p<0.001.

Finally, Figure 1 shows the results of the simple linear regression (r^2) of VO2max (ml/kg/m) with BM (r^2 = 0.220), MAS km/h (r^2 = 0.480), vel VT1 (r^2 = 0.412) and vel VT2 (r^2 = 0.613), which were the variables that presented the greatest variance explained.



r^2 significant: **p* value < 0.05; ***p* value < 0.01.

Figure 1. Simple linear regression between maximal oxygen consumption and A) body mass; B) maximal aerobic speed; C) ventilatory threshold velocity 1; D) ventilatory threshold velocity 2.

Discussion

The aim of this study was to compare the maximum oxygen consumption and body composition according to playing position and to study their relationship in a Chilean first division women's soccer club.

Regarding the results of the descriptive analyses (Table 1) it can be observed that VO2max obtained in our study showed a mean of 46.3 ± 4.0 ml/kg/min, these figures are below those provided in the review Datson et al. (2014) in first division European players such as Danish 52.3, Australian 51.4, English 52.2 and Italian 49.7 ml/kg/min This highlights the importance of improving this physical capacity to reduce the gap between the most developed teams in women's soccer, in order to achieve a performance in line with the global context. Undoubtedly, in women's soccer as in men's, an optimal level of aerobic power, measured as VO2max can help to optimize individual and collective performance, therefore, it is vital to improve the level of aerobic power, measured as VO2max (Esco, Flatt, & Nakamura, 2016) therefore, it is of vital importance that coaches seek training strategies that promote the improvement of this capacity, with interventions of at least one day with aerobic interval training sessions, it has been shown that it can generate efficient improvements in female players (Favero & Stoll, 2016), In addition, elements such as volume, intensity and specificity should be considered, and a balanced nutrition is recommended to improve the body composition and aerobic profile of female soccer players (Oyón et al., 2016). In relation to the comparative results in the variables obtained from the VO2max test (Table 2), differences were only observed in % VO2 VT2 ($p = 0.008$), in which both goalkeepers and central defenders presented a significantly lower %VO2 VT2 than lateral defenders ($p = 0.043$ and $p = 0.012$, respectively). However, the rest of the variables showed no differences between positions ($p > 0.05$). This could be contradictory with what has been reported by Villaseca-Vicuña et al. (2021) in Chilean professional players, where differences in aerobic performance between goalkeepers vs. field players are evidenced ($p < 0.05$). In the same sense Haugen *et al*., (2014) after evaluating players from Norway, found differences between goalkeepers and midfielders ($p > 0.05$), which also differs from our study. This may be explained by the fact that the demands between outfield players compared to goalkeepers respond to different movement patterns and energetic demands during competition(FIFA, 2019a), It should be noted that previous studies compare elite players and our study compares national league players, this seems to be relevant when finding differences between positions, it is possible that the degree of specialization in high competition has to be greater and consequently demonstrate differences between playing positions (Hammami et al., 2020). Therefore, it can be inferred that the results obtained in this study are somewhat opposed to those published in other studies related to this subject, but it is certainly important to analyze that the possible problem is not the high performance of the goalkeepers in our sample, but rather, the low level of the lateral and central defenders, so the efforts in training plans should focus mainly on improving the performance of field players who should be at a higher level and thus approaching the values that elite athletes of North American and European teams have.

Regarding body composition variables (Table 3), our findings did not present significant differences between playing positions ($p > 0.05$). The study conducted by Lockie et al. (2018) with American professional female players, it was evidenced that these athletes were taller (167.6 ± 6.1 cm) and heavier (62.5 ± 6.7 kg) than those in our study, implying a greater wingspan on the part of the American players. In terms of %MG, the players in our study have higher values when compared with the Chilean players of the national team (Villaseca-Vicuña et al., 2021), In terms of field players (28% vs. 25%), which means that the players in our study are shorter, maybe less heavy, but have a worse body composition due to their higher %BF, which may result in a lower VO2max performance, since it has been shown that there are negative relationships between adipose tissue and aerobic performance (Villaseca-Vicuña et al., 2021). On the other hand, the greatest differences were observed in %MM which was higher for all the selected women (Villaseca-Vicuña et al., 2021). These results indicate that the selection of athletes in positions such as goalkeepers, have a tendency to prefer higher profiles than in the rest of the positions and, in addition, leads us to assume that the female population that plays soccer in Chile is lower than athletes from North America or Europe. In relation to the positions used in the field of play, the results placed the goalkeepers as the tallest and heaviest players in this study and the lateral defenders as the shortest and lightest Barraza Gómez et al. (2015), findings coincide with those proposed by the authors of the study, who agree that goalkeepers are the tallest and heaviest players in comparison with the rest of the players. Something similar was evidenced by the FIFA report, where the goalkeepers who participated in the 2015 World Cup in Canada were taller and heavier than the field players (173 vs. 166 cm; 67 vs. 59 kg) respectively. The report by Villaseca-Vicuña *et al.* (2021), obtained the performance of 50 players of the Chilean national team, where the national defenders had a better performance than the central and lateral defenders of this study, as did the forwards, but no differences were observed in the midfielders and in both studies they, were the athletes with the best aerobic performance. These results show that the level of competition influences the performance of the athletes, given that, in the national teams, performance is expected to be optimized and the best players in the country are available

Finally, large relationships between MAS and VT1 and very large VT2 with VO2max have been evidenced. These findings are in agreement and reaffirm the methodological proposal for resistance training by Pallarés & Morán-Navarro (2012),) who propose to improve VO2max by managing volume and intensity through VT1 and VT2. These values showed large and very large relationships with maximal oxygen consumption. It is to be expected that thresholds are elements that relate to the relative value of oxygen consumption (Pallarés & Morán-Navarro, 2012). This is important because players with higher oxygen uptake could perform actions at higher intensity in official soccer matches (Villaseca-Vicuña et al., 2021). In fact, these variables associated with threshold speeds could be indicators to generate aerobic training proposals (Favero & Stoll, 2016).

Conclusions

It was demonstrated that of the anthropometric variables considered in the study, BM was the only variable that correlated moderately with VO2max, which does not make it clear what incidence the body composition variables considered in this study may have on VO2max performance. While the elements associated with speed such as MAS and Vel VT1 and VT2 seem to be elements that have a high explanation of the variance in VO2max, therefore, it is suggested to consider these elements as a guide in the planning of aerobic interval or continuous training, in order to improve VO2max performance. On the other hand, the findings showed that there are no differences between the different playing positions in VO2max, but there are differences with the literature in relation to the place that goalkeepers occupy within the teams, always being the worst evaluated in this variable, which does not occur in this study and they are better evaluated than the lateral and central defenders, which is not a problem of the goalkeepers themselves, but rather, it is a problem for the field players who have lower levels. The main limitation of this study is the number of the sample, which cannot be generalized to the rest of the women's teams in the country, but it also provides a reference in this area that can help in the development of other projects of greater magnitude. These data could contribute to the scientific community and coaching staffs of women's soccer to establish parameters that can respond to body composition and aerobic performance profiles according to playing positions. In addition, it could establish the running speeds that could allow to improve the aerobic training strategies according to the different thresholds.

Conflicts of interest

The author(s) declared no have conflict of interest concerning this work, authorship, and/or publications of this paper.

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