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Anthropometric and capacitive analysis of the Ecuadorian senior national women's soccer team

Análisis antropométrico y capacitivo del equipo nacional femenino de fútbol de mayores de Ecuador

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Abstract. The development of women's football worldwide points to the resignification of the approach to team preparation, where anthropometric and capacitive variables play an important role. Ecuador shows no precedent for studies in high-level female soccer players. Accordingly, the objective focused on analyzing the state of anthropometric and capacitive variables of 22 soccer players of the Ecuadorian senior women's national team, which represent 100% of the population. It started from the morphological diagnosis of equipment applying 19 measurements under the protocol of marking and measurement of the International Society for the development of Kineanthropometry (ISAK), the evaluation of the explosive force through three jumps (Tests SJ, CMJ and Abalakob (AB) and speed (35 meters), The data were subjected to normality criteria (Shapiro-Wilk test), the result of which indicated that the values did not follow a normal distribution, therefore the non-parametric ANOVA test of a Kruskal - Wallis Factor for independent samples. The study was preceded by three research hypotheses. It is shown that there are no significant differences in the variables analyzed by position, being $p > 0.05$, H0 is accepted in all cases. The results allowed to characterize the team morphologically with a Meso-Endomorph somatotype, irregularities were found in some variables of the morphology of the soccer players (IDG / IMO), suggesting how conclusion a nutritional dietary planning, and enhance muscle mass in the lower extremities from the management of physical direction.
Key Words: women's soccer, anthropometry, explosive strength, speed.

Resumen. El desarrollo del fútbol femenino a nivel mundial, apunta hacia la resignificación del enfoque de la preparación de los equipos, donde juega un rol importante las variables antropométricas y capacitivas. Ecuador no muestra precedentes de estudios en mujeres futbolistas de alto nivel. En concordancia el objetivo se centró en analizar el estado de variables antropométricas y capacitivas de 22 futbolistas del equipo nacional femenino de mayores de Ecuador, las cuales representan el 100% de la población. Se partió del diagnóstico morfológico de equipo aplicando 19 mediciones bajo el protocolo de marcaje y medición de la Sociedad Internacional para el desarrollo de la Cineantropometría (ISAK), la evaluación de la fuerza explosiva a través de tres saltos (Tests SJ, CMJ y Abalakob (AB) y la rapidez (35 metros), Los datos se sometieron a criterios de normalidad (test de Shapiro-Wilk), cuyo resultado indicó que los valores no siguen una distribución normal, en virtud de ello se empleó la prueba no paramétrica ANOVA de un Factor de Kruskal - Wallis para muestras independiente. El estudio estuvo precedido por tres hipótesis de investigación. Se demuestra que no existen diferencias significativas en las variables analizadas por posición; al ser $p > 0{,}05$ se acepta H_0 en todos los casos. Los resultados permitieron caracterizar morfológicamente al equipo con un somatotipo Meso-Endomorfo, se comprueba irregularidades en algunas variables de la morfología de las futbolistas (IDG/ IMO) sugiriendo como conclusión una planificación dietético nutricional, y potenciar la masa muscular en las extremidades inferiores desde la gestión de la dirección física.
Palabras Clave: fútbol femenino, antropometría, fuerza explosiva, velocidad.

Introduction

In the last decade, women's football has developed worldwide with a high acceptance, surpassing the 40 million women footballers in the International Federation(FIFA: Fédération Internationale de Football Association),highlighting the potential of countries such as the United States, Sweden, Germany, the Netherlands, France, Canada, Brazil, England, among others (Almagiá-Flores, Rodríguez-Rodríguez, Barrraza-Gómez, Lizana-Arce & Jorquera-Aguilera, 2008; Pérez-Muñoz, Castaño-Calle, Sánchez-Muñoz, Rodríguez-Cayetano, de Mena-Ramos, Fuentes-Blanco & Castaño-Sáez, 2018; FIFA; 2021).

In the Qualifying Rankin for the 2023 Women's World Cup, Ecuador is listed in 65th position with

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1386,37 points, 723,88 points from first place (United States: 2110,25 points), in this the current status of the Women's World Ranking (WWR) is displayed according to the actual strength per team, according to the FIFA website (FIFA, 2021).

By virtue of the development of Ecuadorian women's football, the technical direction of the national team has been implementing countless controls that obey the planning planned for this cycle, among which are the anthropometric evaluations and those conditioning and determining capacities of the competitive activity; procedures that have been articulated to scientific studies that seek to strengthen, under the protection of science, decision-making in the process of performance management and nutritional dietary direction and physical preparation of the team.

At this point it is worth noting that anthropometry, within the framework of sport, allows the quantification of size, shape, proportions, composition, maturation and gross function of body structure. Its modeled application gives the possibility of monitoring the athlete to verify the progress or involutions depending on the activity carried out or not carried out within the preparation process (Ross, Carr & Carter, 1999).

Beyond the quantitative results collected in the anthropometric evaluation, the morphological analysis of the athlete and the interpretation of the data derived from the correlation mechanisms that can be established between the anthropometric measures and capacitive parameters that condition or determine the competitive exercise are significant, with the intention of understanding the state of the athlete and the level of use of the preparation (Véliz-Véliz, Maureira-Cid & Jaurés-Rodríguez, 2020).

As far as anthropometric measurements are concerned, researchers preferably rely on the «Manual of International Standards for Anthropometric Evaluation» (ISAK, 2001), whose procedure can go in search of the evaluation of a complete profile or restricted profile, the latter by virtue of the muscular planes that intervenes mainly in the competitive exercise of sport; in the case of football the attention is mainly focused on the measurement of the lower segments.

For this, the management of anatomical sites is considered vital in order to identify the precise location of the areas and monitor the athlete, make controls of motor performance, shape and body composition (ISAK; 2001).

Various authors (Zúñiga & De León Fierro, 2007; Correa, 2008; Fernández, Kazarez, Agazzi & Albín, 2014; Hernández, López, Cruz & Avalos, 2016; Huiracocha-Rueda, 2017) indicate that the anthropometric profile of the footballer can vary in accordance with the position on the pitch and the physiological demands associated with it, which justifies the criterion of Jorquera-Aguilera, Rodríguez-Rodríguez, Torrealba-Vieira, Campos-Serrano, Gracia-Leiva & Holway (2013), by maintaining that the data derived from anthropometric analysis and morphostructure allow players to be placed in the most suitable playing position, tempered to capacitive and anthropometric potentialities, making performance predictions, among other actions coupled with performance management.

On the subject, it should be clarified that anthropometric studies (Bahamondes-Ávila, Cifuentes-Cea, Lara-Padilla & Berral-de la Rosa, 2012; Ariza-Viviescas, Niño-Pinzón, Dutra-de Souza, Esteban-Moreno, Benítez-Medina & Sánchez-Delgado, 2020) recurrently highlight the importance of recording basic variables such as (Age (cm), weight (kg), Height in standing position (cm), Height in seedling (cm), Caporal Mass Index (BMI = weight (kg) / [height (m)]2, and size measurement (cm), the latter parameter expresses the maximum distance between the ends of the middle fingers.

Another important criteria is the evaluation of the skin folds (mm), within which are the tricipital, subscapular, bicipital, iliac crest, supraspinal, abdominal, subcutaneous fold of the anterior thigh, calf or medial leg. The evaluation of the thickness of the skin folds allows to establish the indirect estimation of the percentage of body fat, using as a tool the formula of Siri (1961).

In this regard, it is recommended, for a better reading, the measurement of a minimum of three sites, since the thickness of the subcutaneous adipose tissue can present wide variations between the different sites of fold in the same individual; these are generally significantly correlated with the total adiposity of the athlete. For this procedure is regularly used. On the subject, it is noted that there are no reference values of subcutaneous folds in elite athletes (Garrido-Chamorro, Sirvent-Belando, González-Lorenzo, Blasco-Lafar & Roche, 2012), and Ecuador still does not show referential statistics in this regard in the female sex.

In the framework of sports anthropometry, it is important to monitor body composition (BC) and individual adiposity indices, derived from the sum of skin folds (Barr, 1994). In this sense, it is considered that the increase or decrease in the total value of the sum of the

folds reveals a similar displacement of fat mass and the amount of body fat in the lower or upper train. Other authors propose that the analysis of body composition also contemplates the state of lean tissue (muscles, organs, bones and blood) and fat tissue.

At this point the fat mass is an essential element of energy reserve and thermal insulation, which can vary depending on age, sex and training. It is composed of fabrics and components associated with strength, and is generally related to greater sports performance (Sánchez-Ureña, Araya-Ramírez, Blanco-Romero & Crespo-Coco, 2016).

The Fat Distribution Index (FDI) is another reference of great importance in the analysis of the anthropometric profile of the athlete, this expresses the relationship between the kilos of muscle that an individual has and his kilos of bone. When talking about optimal values, the correlation of five (5) kilos of muscle for each kilo of bone is considered, this value expresses the level of health and sports performance.

On the evaluation criteria Pacheco (1996) cited in Martínez-Sanz & Urdampilleta (2012), explains that «the values >1 mean that the amount of relative fat of the limbs is greater than that of the trunk, if it is <1, the relative amount of fat of the trunk is greater than that of the limbs».

The evaluation of the body perimeters (cm) (BP), allow to know the evolution of the muscle mass (MM) of the athlete as a result of the structural changes that have been promoted by the preparation process itself, whose changes, at the anatomophysiological level, are specified between eight (8) and 12 weeks of the preparation or the stimulus applied in the athlete. In this sense it is possible to consider for the body perimeter (cm) the measurement of the relaxed arm, flexed or contracted arm, waist, hip, medial thigh and calf or leg. When talking about the evaluation criteria Cabañas & Esparza (2009) and Martínez-Sanz & Urdampilleta (2012), agree that for football the values of the sum of the body perimeters should be about 63.7 mm, on the subject they point out that in the «majority of high performance athletes do not usually experience substantial changes in body composition despite the volume of exercise they perform systematically as a result of adaptations hormonal and/or metabolic produced by training for years»(Martínez-Sanz & Urdampilleta, 2012).

The evaluation of bone diameters (cm) is a high-value procedure, which basically focuses on measuring the amplitude between two bone points, this can respond to the intention of determining the Somatotype (Carter & Heath, 1990) or to the measurement of anthropometric variables.

The most common measurements of bone diameters for a complete profile are: the biacromial, transverse thorax, anteroposterior thorax, biileoacrestal, bitrocanter, knees, ankles, elbows and wrists. It is proposed that for the analysis of a restricted profile, the humerus, femur (both measures indicate the degree of muscle development of the area) and wrist (itallows to estimate the size of the body structure in body composition studies to estimate the bone component) are measured, or other points that could be of interest to the researcher.

The determination of the type of somatotype in the athlete is complemented by the aforementioned variables, whose values allow to identify the morphological configuration of the person and place the individual in a category.

These criteria are based on a system designed by Sheldon in 1940 and modified by Carter and Heath in 1976, which is valid today.The procedure identifies three components with specific characteristics: the endomomorphic associated with relative adiposity, the mesomorphic characterized by a relative musculoskeletal robustness and the ectomorphic which exhibits a relative linearity or thinness (Rivera-Sosa, 2006).

The combination of these three somatotypic measurements (endomomorphic value / mesomorphic value / ectomorphic value) allows the subject to be placed in one of the thirteen classifications identified by Carter & Heath (1990). According to Vera, Chávez, David, Torres, Rojas & Bermúdez (2014), the type of somatotype in football could vary depending on the position of the player.

The waist hip index (WHP) is a parameter that provides information on the body composition of the subject, is used to assess the pattern of fat distribution and expresses the tendency or predisposition of the athlete to accumulate fat, or manifest cardiovascular diseases. The index value is derived from that resulting from the division of the waist circumference by the hip.

The results in women can range from values below 0,80 as normal or low-risk criteria and up to ,86 as a high-risk criterion. In sport, it is considered that athletes with a low waist-to-hip index (waist and narrow hip) are endowed with a better biomechanical potential to move.

Another element that is considered in the sports

anthropometric evaluation is the conicity index (CI). This variable (Fernández-González, Sánchez-Córdova, Lastres-Madrigal & Padrón-Pérez, 2019) shows the result of the relationship between several anthropometric measures such as body weight, height and circumference (perimeter) abdominal or waist (Cci), calculated under the following algorithm:

$$CI = \frac{Waist\ circumference}{0.109\sqrt{\frac{Body\ weight\ (kg)}{Height\ (cm)}}}$$

Multiple are the instruments that are used for the evaluation of the aforementioned variables, among which are the scale, wall tallimeter or stadiometer, lipocalibre, parking meters or bone calibrator, tape measure, demographic pencil, campbell, retractable segmometer, metal square, gaucho pro plicometer, dry digital balance to measure the weight among others.

On the subject, several studies (Deidan-Saavedra & Moreno-Reyes, 2020) draw attention to the importance of the relationship between anthropometric variables and the capacitive development of athletes, given the diagnostic procedure and as a predictive mechanism.

In this sense, it is based on the recognition of the characterization of the discipline, the systemic structural analysis of the actions, in addition to the energy demand that is manifested to satisfy the physiological and biomechanical demands of the actions.

In this regard, it is worth noting that football is characterized by the predominance of the aerobic-anaerobic or mixed energy system; for the duration of the matches (minimum of 90 minutes), the preponderant energy system is aerobic, however being a tactical, acyclic and varied sport, the actions must be mediated by the power in any of its variants or manifestations (Resistance to explosive force or explosive force) which basically depend on the potential of maximum strength of the athlete and speed, criteria shared by Vásquez, Escobar-del Cid, Vásquez, Olcina & Timón (2019).

In this sense, Vásquez, et al (2019) highlight the value of anthropometric studies and the contrast with the development of power can reveal important data to predict the physical state of the footballer and the optimization of competitive performance by position.

Accordingly, the researchers evaluate the explosive power or force through jumps, within which are referenced the Bosco Test, et al (1983) composed of: the Squat Jump (SJ) test that evaluates Explosive Force, Squat Jump with charges (SJ Cs:), Counter Movement Jump (CMJ), Abalakov (ABK) or CMJ with arms focused on looking for the maximum height in a vertical jump with arm swing, allowing two (2) attempts per subject, the Drop Jump or Plyometry (DJ) test, continuous CMJ (CMJ CR), among others.

From this perspective it is considered that, to evaluate the power, from the height reached, it is necessary to know the work done and the time invested in its execution. As a tool, various media are used, such as digital jump platforms or traditional means for measurement (Hernández & García, 2015; Camelo-Monroy & Velásquez-Castillo, 2018; Vásquez et al., 2019).

Contradictorily on the subject, there has been limited research in Ecuador where the effects of training in high-level women's football teams and its relationship with anthropometric variables are deepened. The main obstacle lies in the limited knowledge of the physiological bases of sports training, and of sports metrology to ensure an objective understanding of the use of preparation in real time, and in a predictive way.

Due to the limitations and the need to improve the approach to the management of preparation in the Ecuadorian Women's National Football Team, the objective of the research focused on determining the relationship between anthropometric parameters and the development of power in the players of the Ecuadorian women's football team.

Methodology

The study assumes a type of non-experimental research, with descriptive scope and cross-sectional approach, since the phenomenon is studied at a given moment in reality. The specific objectives were consistent with the construction of knowledge, going through the determination of the theoretical references, later proceeded to carry out the morphological diagnosis of the women's national football team of Ecuador, the evaluation of explosive strength and speed (35 meters), a procedure consigned as a starting point in the preparation of the preseason with a view to the Copa America of 2022, key event that will deliver berths for the 2023 FIFA Women's World Cup Australia & New Zealand™

It was concluded with the analysis of the results and an assessment of the morphological composition of the team, data that will contribute to the predictive analysis of the performance of the players by position and the orientation of the physical direction of the team.

The methodological dynamics considered that in

Ecuador there is no reference standard to compare the results of professional female soccer players, therefore, the present study constitutes a starting point of reference for subsequent analyzes associated with the subject.

Participants

For the development of the research, we worked with 22 athletes of the women's soccer team of Ecuador senior category which represent 100% of the population. The study was developed with the consent of the soccer players, of the technical management of the team and the Ecuadorian Football Federation.

Structurally the team was composed of two (2) goalkeepers, four (4) centre-backs, two (2) defenders, three (3) forwards, one (1) hooker, one (1) scorer, one (1) midfielder and eight (8) wingers. The facilities of the Ecuadorian Football Federation in the city of Quito were used for the development of the research.

Table 1.
Characterization of the Ecuador women's national football team

	N	Mínimal	Máximum	Average	Desv. Desviación
Years	22	16	31	21,18	4,148
Size	22	147,00	178,40	161,8909	7,23378
Sports experience	22	8	17	10,77	2,581

The average chronological age of the population was 21 ± 4,1 years, the experience in the sport oscillated in a range of 8 and 17 years, which is justified with the variable age since there are four (4) footballers in the team with ages between 26 and 31 years.

The average height was 161,8 ± 7,2 cm, this variable is shown with some heterogeneity since of the 22 selected nine (40,99%) have a height between 1,47 cm and 1,59 cm (midfielder, midfielder, marker and striker) and four of these do not exceed 1,56 cm. 59,09% exhibit a size greater than 1,61 cm, above 1,65 cm and below 1,65 cm, between this value and 1,78 cm only six (6) players (27,27%) are found, indicating that the team has an average height of 161,8 cm.

Methods and instruments

The research dynamics required the use of methods of the theoretical, empirical and statistical mathematical level, playing a fundamental role the use of the test together with the measurement and statistical analysis.

For the morphological analysis of the athletes, 19 measurements were made (restricted profile). The anthropometric evaluation focused on the collection of information on basic variables such as: weight, height, wingspan, in addition to other anthropometric measurements that included: measurement of skin folds (8) (tricipital, subscapular, bicipital, iliac crest, supraspinal, abdominal, anterior thigh, calf), three bone diameters (humerus, wrist and femur), five (5) perimeters (relaxed arm, contracted arm, waist, hip, leg).

The evaluation of body composition, carried out through the four-component model, was also considered. The procedure included the analysis of %fat, %muscle, % bone, % residual, and its distribution in kilograms, which is equivalent to the total weight of the footballer. The data collected allowed to calculate the body mass index (BMI), waist-hip index, the conicity index, muscle-bone index (MBI), and the fat distribution index (FDI), valuable references for the morphological analysis of the footballers under analysis.

An aspect of high relevance was the evaluation of the somatotype of the footballers, a variable that was calculated using the anthropometric method of Heath-Carter (Carter, 1975) representing it graphically in the Somatochart through the Reuleaux triangle (Carter, 1975). Under the data collected, the degrees of manifestation of each somatotype per athlete were calculated: Endomorphy, Mesomorphy and Ectomorphy.

These procedures were performed under the marking and measurement protocol of the International Society for the Development of Kinanthropometry (ISAK: International Society for the Advancement in Kinanthropometry) and thad method of Heath-Carter, for this different tools were used such as: the Electrical Bioimpedance (BIA), Rosscraft SRL anthropometric kit validated by the ISA, the pakimeter, metal square, plicometer, metal tape measure, portable stadiometer, stopwatch (35-meter speed test) and a digital scale, the latter for the evaluation of explosive force.

To evaluate the explosive force, three tests were selected at the convenience of the researchers: (Jump tests: Squat Jump (SJ), Counter Moviment Jump (CMJ) and the Abalakob test (AB).

To develop the SJ test, the players were instructed to place their hands on the waist throughout the execution of the jump. They were insisted that the flexion of the knees should be in 90 degrees, and remain in that position for three seconds, at the signal of the evaluator, perform the jump seeking the maximum extension of the joint of the lower limbs (knees) during the flight phase, without any type of countermovement, trying that the fall was at the same starting point.

The CMJ test was developed on the same specifications, meaning the possibility of countermoving; that is, the initial position was with the knees fully extended and also with the hands at the waist. At the order

of the evaluator, the knee joint should be flexed to 90 degrees and propelled as high as possible.

When developing the Abalakob Test (AB), it was established from the standing position, with the knees extended, at the order of the evaluator, the player would be propelled looking for the highest point, taking advantage of the swing of the arms and, the flexion of the knees up to 90 degrees.

The tool used was the digital platform for Salto brand Axon Jump, this is a kinematic instrument, composed of electronic circuits that measure movement (time, space and their derivatives) without inferring their causes. This means that we will obtain from it only kinematic variables such as time of flight with precision in milliseconds, jump height and speed.

The Jump Platform is connected to the computer where the data is collected, and the height of the vertical jump calculated internally through the following formula: $h = t^2 \times g \times 8\text{-}1$, where h = height of the jump, t = flight time in seconds, g = acceleration of gravity, with a value of 9,81 m / sec2.

Statistic analysis

For the analysis of the data, descriptive and inferential statistics were used, the first to analyze the measures of position and dispersion in the evaluation of the anthropometric data, the jump tests and the speed test.

To promote the reliability of data processing, they were subjected to normality criteria using the Shapiro-Wilk test, whose objective was to determine th $h = t^2$ e behavior of the distribution of the data in samples under 50.

Corroborating that the normality test showed that the values do not follow a normal distribution, it was decided to use a non-parametric test in this case it was the ANOVA test of a Kruskal - Wallis Factor for independent samples.

For statistical analysis, the SPSS program (IBM version 18,0 for Windows) was used.

The comparison of the results was preceded by three research hypotheses, one for the anthropometric variables and two for the capacitive variables: explosive force and speed being defined that:

H_i: There are significant differences in the anthropometric variables of the Ecuadorian footballers by positions of games in the field

H_0: There are no significant differences of the anthropometric variables of the Ecuadorian footballers by positions of games in the land

H_i:There are differences between the game positions and the explosive strength of the players

H_0: There are no differences between the positions of games and the explosive strength of the players

H_i: There are differences between the positions of games and the speed of the players

H_0: There are no differences between the positions of games and the speed of the players

Results

The anthropometric evaluation allowed a morphological analysis of the national women's football team of Ecuador. Table two shows the general statistical analysis of the team's somatotype, which contrasts with the results of the somatochart.

Table 2.
General statistical analysis of the somatotype of the Ecuadorian women's national football team

	N	Mínimum	Máximum	Mean	Standard deviation	p
Endomorph	22	1,86	4,73	3,1564	,86030	,544
Mesomorphs	22	1,57	5,56	3,6659	,92556	,993
Ectomorphism	22	,94	5,02	2,3918	1,12629	,257
N valid (per list)	22					

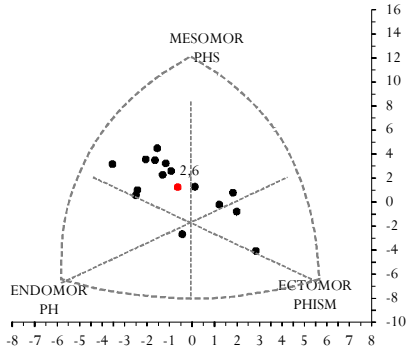
We can see that there is a predominance of a Meso-Endomorphic somatotype (3-4-2) where the second component is dominant and the first is greater than the third (Cabañas-Armesilla, Maestre-López, & Herrero-de Lucas, 2009).

The results of the data in the somatochart similarly show a preponderance of mesomorphism somatotypes as the main component where the value of «p» is greater than the present value, therefore, there are no significant differences per position.

Table 3.
General statistical analysis of the Somatotype data by playing position

	Goalkeepe r n=2	Central n=4	Defendin g n=2	Striker n=3	Hook n=1	Scorer n=1	Midfielder n=1	Winger n=8
Endomorph	1,94	1,63	3,21	3,14	1,04	2,80	1,77	2,60
Mesomorphs	4,22	3,13	2,87	2,90	4,33	2,68	2,71	3,04
Ectomorphism	4,12	3,89	3,41	3,31	3,78	3,38	3,91	3,63

The general mean of the mesomorphy somatotype and the preponderant value was 3,67, followed by an endomorphic trend with 3,16, which suggests a

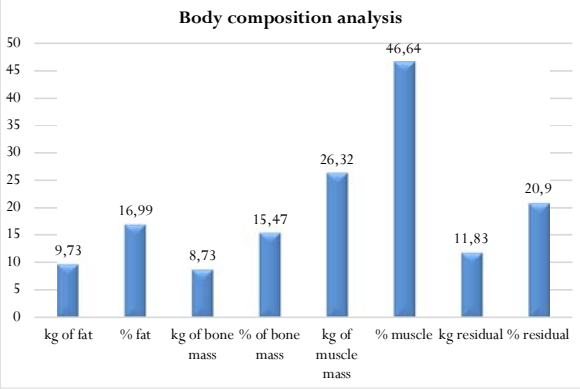


Graphic 1. Distribution of players' somatopoints Source: Somatochart

moderate relative skeletal muscle development, greater volume of muscle and bone, in addition to manifesting a tendency to a moderate relative adiposity and to a lesser extent a relative linearity of large volume, mainly in the front, midfielders, midfielders and goalkeepers, shown in graphic (1).

In this regard, it is possible to appreciate that the height and weight correlation manifests itself unfavorably in the hooking, central and ruffled positions, showing a body weight (5 cases) above height. In the anthropometric measurements recorded, we can observe that there is correspondence between the mean of the wingspan (163,8) and the size of the team (1,61 cm), without significant differences (p = ,95) by playing position.

The % of fat recorded as a variable of body composition is considered moderately adequate.



Graphic 2. Distribution of body composition of the Ecuadorian women's national football team

In this sense of the 22 cases, only eight, footballers are below 15% fat and nine 40,91%) show values above 18%, with a range ranging between 18,29% and 22,13%. The highest % of fat were located in the archer position (20.54±1.05) and the hitch position (20.96). The sum of the four parameters correspond the body weight of each player, which speaks of the fidelity of the measurement.

Note that the distribution of muscle mass per kg of weight occupies 46,64% of body composition, followed by % fat and % bone mass. In this sense, the lean mass ensures the energy reserve for any activity, the greater the % of lean mass, the greater the working capacity of the footballer, the higher values of % of lean mass is occupied by the central, scoreboard and midfielder (47,02% / 48,89%).

Table (4) shows the fat distribution index (GDI) in this sense it is assumed that the values >1 mean that the amount of relative fat of the limbs is greater than that of the trunk (Pacheco, 1996). In this sense more than half of the sample, 13 cases (59,09%) are in a range of 1,07 to 1,60. Below this value (< 1) nine footballers (40,90%) are placed, indicating that the relative amount of fat of the trunk is greater than that of the limbs. In general, not there are significant differences by position (p= ,47), which is shown as a limitation considering that it is a high-level team and that each position has its peculiarities and demands in competitive exercise.

The average body weight of the team (56,60 kg) corresponds to the values of the waist-hip index (0,76), these values when registering above ,85 in women show a high cardiovascular risk. When oscillating between ,8 and ,85 there is a moderate cardiovascular risk according to Pancorbo (2008) and Cesar Augusto (2011).

At this point it is evident that 90,90% of the cases (20) to be below ,80 low cardiovascular risk, except for two players (midfielder and front) who show an index of 0,81 with moderate cardiovascular risk (steering wheel) and ,88 High cardiovascular risk (front), in this variable no significant differences are shown to be *p* = ,265

Associated with the provision of body composition data is the muscle-bone index (IMO), the latter expresses the relationship between the kilos of muscle that the athlete has and her kilos of bone.

Table 4.
Descriptive statistics of anthropometric parameters of the national women's football team of Ecuador

Average/Estándar deviation	Position							
	Goalkeeper n=2	Central n=4	Defending n=2	Striker n=3	Hook n=1	Scorer n=1	Midfielder n=1	Winger n=8	*p.*
Summ 6 folds	89,70±15,91	64,08±10,24	59,95±24,75	56,62±10,02	91,45	43,95	59,95	65,08±17,86	,308
Hips/weist index	,76±0,02	,74±0,04	,75±0,03	,80±0,08	,74	,76	,78	,76±0,03	,804
Conicity index (IC)	1,08±0,07	1,06±0,04	1,03±0,03	1,24±0,23	1,10	1,11	1,13	1,09±0,04	,265
FDI	1,00±0,23	1,01±0,24	1,22±0,07	,98±0,10	,77±	1,07±	1,25±	,443	,443
MBI	2,86±0,10	3,12±0,27	2,87±0,10	2,76±0,11	3,51±0,	3,09±	3,38±	,181	,181

IC: Conicity index; FDI: The Fat Distribution Index; MBI: muscle-bone index

The values of the muscular % only reflect in a general way 46,64% of the body composition, however, when analyzing the BMI, it is possible to appreciate that in the evaluation scale of the assumed indicator (Excellent (>4,5), good (4,1-4,5), acceptable (3,7-4,1), low (4-3,7), very low (<3,4) presents problems of sports recovery (Calbet, Ortega, Dorado, Armegol & Sarmiento, 1993; Cesar-Augusto, 2011), the values are concentrated in the scale of «low» with a footballer (1 case: 4,45%), and the bulk of the team in the scale of «very low» (21 case: 95,45%) therefore it is shown that they present problems in sports recovery. In this variable there are no significant differences as *p*=,181; lower than the preset value (,05).

Making a general assessment and a comparison of the existence of differences in anthropometric variables by playing position in the field, we can propose that the research hypothesis is rejected and the null hypothesis is accepted, being $p = .495$ and greater than the preset value (,05), which allows us to propose that there are no significant differences in the anthropometric variables of Ecuadorian footballers by positions of games in the field.

Table 6.
Descriptive statistics of the evaluation of explosive force and speed average/

	Goalkeeper n=2	Central n=4	Defender n=2	Forward n=3	Hooker n=1	Tracer n=1	Midfielder n=1	Winger n=8	p
Speed 35m	5,40±0,28	5,45±,30	5,40±,28	5,77±,33	5,45	5,53±	5,48	5,36±,35	,809
SJ	28,20±,00	32,30±5,0.3	31,30±5,52	29,57±3,09	27,30	29,20±	29,20	32,96±3,20	,541
CMJ	30,15±2,76	36,95±2,28	36,30±1,56	29,47±1,10	27,40	26,40±	30,20	35,39±3,34	,038
AB	33,70±3,68	36,45±2,58	45,30±,00	36,37±3,98	33,10	26,40±	35,20	38,26±3,35	,132

Table 5:
Kruskal-Wallis Hypothesis Test Summary

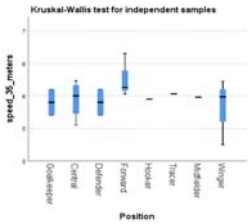
Total	22
Test statistic	6, 389a,b
Freedom degree	7
Bilateral test	,495

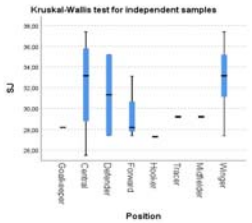
Analysis of the results of capacitive variables: explosive force and speed

The anthropometric analysis was complemented by the evaluation of the explosive force by means of three (3) jump tests and a speed test (35 meters).

The statistical analysis by position shows that the mean speed in 35 meters did not present significant differences (p= ,809) by playing position, most of the cases (19/86,36%), were between 5,05 sec and 5,73 sec, with a group mean of 5,4541 and a standard deviation of ,30134 and a range that ranged from 4,75 sec to 6,15. The best results were two (2) flyers, with 4,75 seconds and 4,90 seconds respectively. The extreme results were 6,15 (forward).

It is striking that two (2) forwards (5,63 sec/6,15 sec) and a left central footballer (5,74 sec) exhibit the slowest values in speed (35 meters), which disfavors the demands demanded by competitive exercise for both positions if we consider that, although they are in preseason, performance management is in a model of concentrated loads with regular competitions.





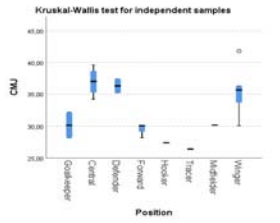
Graphic 3. 35-meter speed test Graphic 4. SJ test results by position

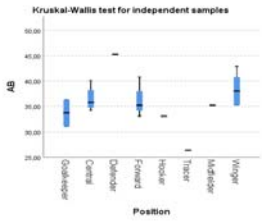
With regard to the explosive force, it was possible to appreciate that there are no significant differences by position in the SJ test and in the AB test when the value of «p» above (,005) was shown as a preset value; however, there are significant differences in the results of the CMJ test by position.

It should be noted that in the SJ the values ranged 25,50 and 37,40 with an average of 31,1955±3,62629, above 30,0 the bulk of the sample was located (12 cases / 54,54%), and between 25 and 27 there are five footballers (22,72%), the Kruskal-Wallis test revealed that there are no significant differences by position (p = ,541).

The results of the CMJ test show that there are significant differences by position (p=,038), since the data revealed heterogeneity. It should be noted that the average of the team was 33,4636±4,18302, the range ranged between a minimum value of 26,40 and 41,80. At this point the defenses, the midfielders and the center show the best results of the team, highlighting the defenses with 36,95 and a typical deviation of ±2,28.

In relation to the AB test, the results were acceptably homogeneous, without significant differences (p=,132), the results ranged between 26,40 and 45.30 with a mean of 36,98±4,624. By position the steering wheels showed the best results with an average of 38,26±3,35.





Graphic 5. CMJ test results by position Graphic 6. AB test results by position

By analyzing the results of the significant differences in the explosive force variable through the results of the Kruskal-Wallis test of each test, it is possible to propose that the research hypothesis is rejected and the null hypothesis is accepted as it is «p» greater than the prefixed value (0.05) in two of the three tests (SJ / AB).

Table 7.
Summary of hypothesis contrasts for the jump test and the speed test

hypothesis, supposition	Test	Sig.	Decision
1The distribution of SJ is the same between position categories.	Kruskal-Wallis test for independent samples	,541	The null hypothesis is preserved.
2The distribution of CMJ is the same between position categories.	Kruskal-Wallis test for independent samples	,038	The null hypothesis is rejected.
3The distribution of AB is the same between position categories.	Kruskal-Wallis test for independent samples	,132	The null hypothesis is preserved.
4The distribution of 35-meter speed test is the same between position categories.	Kruskal-Wallis test for independent samples	,809	The null hypothesis is preserved.

The same result is derived from the statistical analysis for the speed in 35 meters, being p = ,809 greater than the preset value it is shown that there are no significant differences by position, therefore, the null hypothesis is preserved and the research hypothesis is rejected.

Discussion

The research reveals an average size in the players of (1,61.89 cm) however it has been reported that height is not a determinant for sports performance in football, indicates Caballero-Ruíz, Carrasco-Legleu, De León, Candia-Luján, & Ortiz-Rodríguez (2019) that in the 2011 World Cup players were reported from 152 cm to 187 cm. The women's soccer team of Ecuador reports as minimum height 1,46 cm (Scoreboard) this player presents one of the lowest values in speed, which coincides with the justification of the authors.

It should be noted that the analysis considers references of games extracted from the literature where it is stated that an acceptable average in professional footballers of the female sex could be found in 21,31±3,87%, considering as a minimum range 15,6%, maximum 28,0%. Other sources maintain that between the ages of 19 and 30 years the % of fat should be managed between 13 and 18% as an optimal state (Garrido-Chamorro et al., 2012; Nahuel, 2020).

On the subject Sedano-Campo, Cuadrado-Sáenz, Redondo-Castán & de Benito-Trigueros (2009) in a study carried out in Spanish women footballers of high competitive level verify a predominance of the endomophical component, followed by the mesomorphic. Similar result indicates Betancourt-Idrobo (2017), when studying a team of women footballers of the position of goalkeepers in which it manifests the predominance of a dominant Endomorphism, with an average value of 5,00±1,24 followed by mesomorphism with an average value of 4,60±1,33 and Ectomorphism with an average value of 1,53±1,24.

Our study showed somatotype heterogeneity in terms of positions, but the bulk of the sample was evaluated with mesomorphic predominance (50%) with (11 cases) two (2) forwards, the marker, five (5) midfielder, an archer, a defense and a midfielder, which contrasts with the contributions of Lillo-Santander, Jorquera-Aguilera, Roco-Videla, Iñiguez-Carillo, Aguilera-Eguía, & Rojas-Pérez (2018) when analyzing the preponderant somatotype of morphological profile of professional fut players In Chile, the authors show that 7,.5% of the players presented a mesomorphism as the main component, with a predominance of the players who occupied the position of defense, compared to those of the rest of the positions. Results that demonstrate the limitations regarding the constitution of the somatotype of the team studying.

However, it is considered that this manifestation could affect the sports performance of the players and that they constitute the result of inadequate nutritional guidance and work management in the physical direction of the preparation in the study in question.

Caballero-Ruíz, et al (2019) when analyzing the somatotype of female university footballers by position on the field of play conclude that there is no homogeneity of somatotypes by playing position, between the groups, they also maintain that the predominance of the endomorphic-mesomorphic somatotype influences performance at a competitive level.

For their part Garrido-Chamorro, et al (2012) show in their study that for a professional footballer the % of fat must be about 11,3±1,6, the analysis of the results indicates that the data of the individual footballers are moderately acceptable, if we consider that the ages of the team range between 16 and 31 years, in this sense and given the demands of sport, it is considered that the data of the % of fat of the footballers demonstrate a poor nutritional management and an inadequate management of the performance specifically of the physical direction of the preparation (Fernández, Kazarez, Agazzi, & Albín, 2014).

The questioning is based on the result of other variables such as the Fat Distribution Index (IDG), which in this study found that the values <1, were located in two (2) flyers and in the hooking position, (,77 / ,78 / ,79) this corroborates that the distribution of the fat of the players is concentrated in the trunk and not in the extremities which is negative for the energy demand these positions in the game. Renda (2012) conducts a study with professional footballers and analyzes anthropometric variables by playing position, in which he shows that % average body fat behaved with an average of 10,59%. Similar analysis is carried out by Sánchez-Ureña, Ureña-Bonilla, Salas-Cabrera, Blanco-Romero & Araya-Ramírez (2011) which conclude that a professional football team's fat percentage can range between 12% and 13,7%.

In general, the percentage of body fat recorded in the preseason of the Ecuadorian women's national football team is close to those found by Sedano-Campo, et al (2009) in Spanish women footballers (21,88 ± 0,97%).

In relation to the capacitive variables analyzed, it is shown that the bulk of the sample is between 5,05 sec and 6,15 sec, values that when compared with other studies are very far from the means referred to by authors such as Gómez-López, Barriopedro-Moro & Pagola-Aldazabal (2006) in their research it is shown that the footballers in preseason can develop a speed in 35 meters of 4,96 ± 0,20.

Conclusions

It is verified that the national women's football team of Ecuador of the adult category, presents a preponderance of a Meso-endomomorphic somatotype. In agreement it is shown that in 59.09% the relative amount of fat of the trunk is less than that of the extremities, the rest of the team concentrates the % of fat in the trunk; It is recognized that there are problems in sports recovery and low cardiovascular risk.

Although there is an apparent homogeneity in the anthropometric parameters, it is necessary to include a nutritional dietary guidance for footballers,, incorporating the use of food supplements (compounds that provide the nutrients that the body needs), nutritional ergogenic aids before, during and after training or competition to improve the level of motor performance, the production of energy and the decrease of the concentration of lactic acid in muscle, and add to the planning functional foods which have bioactive compounds that influence the proper functioning of tissues, organs and organ systems.

The results of the morphological analysis of the players and the evaluation of explosive strength and speed, point towards the need to improve the process of managing physical preparation, considering the state of some variables as a reference of partid.

It is considered necessary to enhance muscle mass in the lower extremities, to ensure the energy demand of competitive activity per position, so that there are better morpho-physiological and motor responses at the time of being required in the competition.

The results of this study reveal the necessary feedback and interaction between the Technical Staff of the National Team of Ecuador and the technical direction of the Clubs that provide the selected ones and that are in charge of maintaining the performance of the players. It is considered of high value to include a nutritional dietary planning, and to enhance muscle mass in the lower extremities from the management of physical direction.

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