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# Anthropometric features and somatotypes of female handball players by category

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***Abstract:***
***Background:*** *Handball is a sport with a variety of player movement patterns and different ability levels required for sports success. Studies that evaluate morphofunctional parameters of men´s division players are common but not in the women´s division. This study compares the anthropometric characteristics and somatotype of Mexican women handball players to identify if they can be defined in three distinct age categories.*
***Materials and Methods*****:** *A total of 36 Sonoran players from teams prioritized for competition from the categories Cadet (n= 15, 14.4 ± .54 y), Juniors (n= 11, 16.5 ± .46 y) and Under-20 (n= 10, 18.7 ± .71 y) were included. Basic anthropometric characteristics required for somatotype calculation were evaluated, considering the standardized techniques and procedures of the International Assessment of Kinanthropometry (ISAK). One-way ANOVA was applied to identify the parameters between categories; the mathematical model of the somatotype attitudinal distance (SAD) was applied to compare somatotypes.* ***Results:*** *The anthropometric parameter that showed differences between the categories regarding longitudinal dimensionality was tibiale laterale height, with this being greater ((p < .05) in players from the Under-20 category (44.9 ± 3 cm) compared to Cadets (41.7 ± 2.7 cm). The somatotype of the players is mesomorphic endomorph and does not differ in the three categories (p >.05). The endomorphic component in cadets and juniors is of high relative adiposity, abundant subcutaneous fat with roundness in the trunk and extremities, and greater fat accumulation in the abdomen. The fat component tends to decrease moderately in players in the U-20 category, but this is not significant. The three categories present mesomorphia as the second most predominant component with moderate musculoskeletal development.* ***Conclusion:*** *The differences in anthropometric factors of the players suggest a natural maturation process between the diverse categories, but morphological characteristics between them cannot be defined. The training process requires an emphasis on the reduction of body fat and greater musculoskeletal development.*
***Key Word****: Endomorph, Cadets, Juniors, U 20.*

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## I. Introduction

Handball is one of the oldest ball games in Europe. It is characterized by fast movements and intense physical demands where the player must perform different movements in a short time and a specific order due to the tactical situation [1]. It is a sports discipline that is not well known in Mexico but is developing in the educational setting; it is hoped that it will soon have greater projection because of its characteristics and similarity with other more practiced sports. There is interest in research in handball because it is a complex sports activity where successful performance depends on a series of basic motor abilities such as cortical regulation of movement, explosive strength (of throwing type in particular), basic trunk strength, and psychomotor speed [2]. It presents a variety of player movement patterns and different ability levels required for sports success; therefore, data that allow assessment of morphofunctional parameters of athletes are commonly studied [3,4]. Anthropometric evaluations are a useful tool for detecting talent and evaluating the efficacy of training programs [5]. Certain factors are determinants to reach elite levels in handball, such as body size and arm span. These allow good throws, thanks to the greater application of isometric strength by the individual, both in women and men. Finger and hand length are indicators of accurate launch and throw, allowing an increase in maximum grip strength. It is also important to know the somatotype of the athlete since this estimates body shape and composition. In handball, it must be homogeneous, with lean and athletic morphologies[6].

The success of a handball team is determined by psychological characteristics, anthropometrics,

physical performance, techniques, and tactics [7]. Hence, publications of handball players that refer to their body composition and somatotype and their physical aptitudes by playing position, category, and sports level are common in the men´s division [8,1,9,10]. However, publications about the morphological characteristics of young women from training categories are scarce [11,12,13], even in Latin America. Therefore, this study aims to identify the anthropometric and somatotype characteristics of young Mexican women handball players from the Cadet, Youth, and Under-20 categories and determine if these morphological characteristics can be defined between categories to achieve elite professional levels.

## II. Materials and Methods

**Study Design:** This is a descriptive observational cross-sectional study performed during the training period before the maximum national competition 2020.

**Subjects & selection method**: A total of 36 women from the women´s handball division, with ages between 14 and 20 years that form the representative handball team of the Sonora State Sports Commission (CODESON, in Spanish) in Mexico participated. Inclusion criteria were voluntary participation of all Mexican athletes prioritized for competition in the Cadet (14-15 years), Youth (16-17 years), and Under-20 (18-20 years) categories according to the National Sports Commission classification (CONADE, 2020) and who officially belong to the team. Players who were not prioritized for the national competition phase were excluded. Since some participants were minors, both the players and their legal guardians voluntarily provided written informed consent where they agreed to participate. All of the procedures were in accord with the Declaration of Helsinki. Ethically, the methods used were innocuous and harmless, categorizing the research as minimal risk according to the Regulations of the General Health Law in Health Research Matters of Mexico.

**Procedure methodology.** All measurements and the protocol were performed according to the guidelines of The International Society for the Advancement of Kinanthropometry, ISAK [14]. Basic measurements of weight, height, sitting height, and arm span were made as well as diameters, perimeters, and skinfolds required for calculating somatotype considering standardized ISAK techniques and procedures.

Anthropometry. A SECA stadiometer model 21 and a SECA scale model 634 were used for measurements; a Rosscraft anthropometric tape, a Rosscraft pachymeter, and a Harpenden caliper were used for measuring skinfolds. Assessments in this study were performed by a Level II anthropometrist certified by ISAK.

Somatotype. The Carter and Heath method was used to determine the three components of somatotype in absolute values and somatocharts for graphic presentation. To determine the differences in somatotype between the categories, a tridimensional analysis employing a mathematical model was used to calculate *Somatotype Attitudinal Distance (*SAD*)* and the *Somatotype Attitudinal Mean (*SAM) since both confer more precise information when comparing the distance between somatotypes [15]. The latter concept was used to calculate the distance between somatype means of the categories using the tridimensional analysis.

**Statistical analysis**

Data were analyzed with the SPSS program v25.0 (IBM Corp., Armonk, NY, USA), and data distribution was analyzed with the Kolmogorov-Smirnov test. Descriptive data are shown as mean ± standard deviation. One-way ANOVA was used to assess differences in the morphological characteristics between categories. After verifying the homogeneity of variance, Tukey's post hoc test was applied. A $p$-value < .05 was considered the cutoff value of significance.

## III. Result

The basic and anthropometric characteristics of the players for each category are shown in Table 1. No significant differences in the means of the parameters, body mass, height, sitting height, and arm span, were found. Tibia height was longer ($p < .05$) in players from the Under-20 category (44.9 ± 3 cm) than in Cadets (41.7 ± 2.7cm). The rest of the body lengths did not have differences between the categories.

**Table 1.**
*Basic and anthropometric characteristics in women handball players by category.*

| | Category | | |
|---|---|---|---|
| Parameter | Cadets ($n$ = 15) | Juniors ($n$ = 11) | U-20 ($n$ = 10) |
| Age (y) | 14.4 ± .54** | 16.5 ± .46** | 18.7 ± .71** |
| Body Mass (kg) | 58.6 ± 6.5 | 65.6 ± 13.4 | 63.4 ± 11.6 |
| Body Height (cm) | 161.3 ± 4.2 | 162.4 ± 5.2 | 165.0 ± 5.0 |
| Sitting height (cm) | 85.4 ± 2.5 | 86.9 ± 2.8 | 86.9 ± 2.4 |

| | | | |
|---|---|---|---|
| Arm span (cm) | 164.3 ± 6.3 | 164.5 ± 7.7 | 169.4 ± 8.1 |
| A-R (cm) | 30.5 ± 1.4 | 30.5 ± 1.9 | 30.7 ± 1.6 |
| R-S (cm) | 24.3 ± 2.9 | 23.4 ± 1.3 | 23.9 ± 1.4 |
| Ms-D (cm) | 18.4 ± 1 | 17.9 ± 0.8 | 18.9 ± 1.1 |
| I-H (cm) | 93.8 ± 4.9 | 93.3 ± 6 | 96.1 ± 6 |
| Tr-H (cm) | 85.1 ± 3.7 | 86.7 ± 5.4 | 87.6 ± 2.5 |
| Tro-tib(cm) | 43.3 ± 2.7 | 44.6 ± 3.5 | 43.7 ± 1.5 |
| Tib-H (cm) | 41.7 ± 2.7 | 42.3 ± 1.7 | 44.9 ± 3* |
| Foot-L (cm) | 25.2 ± 2.4 | 24.3 ± 0.8 | 24.7 ± 1.1 |
| Tib med-sph tib (cm) | 35.4 ± 2.3 | 35.4 ± 2.3 | 36.7 ± 2.8 |

*Note: * = p < .05 Cadets vs U 20; ** p < .01*

*A-R = Acromiale-Radiale, R-S = Radiale-Stylion, Ms-D = MidStylion-Dactylion, I-H = Iliospinale Height, Tr-H = Trochanterion-Height, Tro-tib = Trochanterion-Tibiale laterale, Tib-H = Tibiale laterale Height, Foot-L=Foot Length, Tib med - sph tib = tibiale mediale–sphyirion tibiale,.*

The tridimensional somatype analysis for the three categories was interpreted as a mesomorphic endomorph, where the endomorphy component was predominant, followed by mesomorph (Table 2). The Cadet and Youth categories had high relative adiposity, abundant subcutaneous fat with roundness in the trunk and extremities, and greater fat accumulation in the abdomen. The players from the Under-20 category had a moderate endomorphic component where subcutaneous fat covers the muscle and bone contours with a softer appearance.

The three categories present mesomorphy as the second most predominant component with moderate musculoskeletal development. When comparing the categories with the mathematical model of SAD and SAM, no significant differences were found between the three categories.

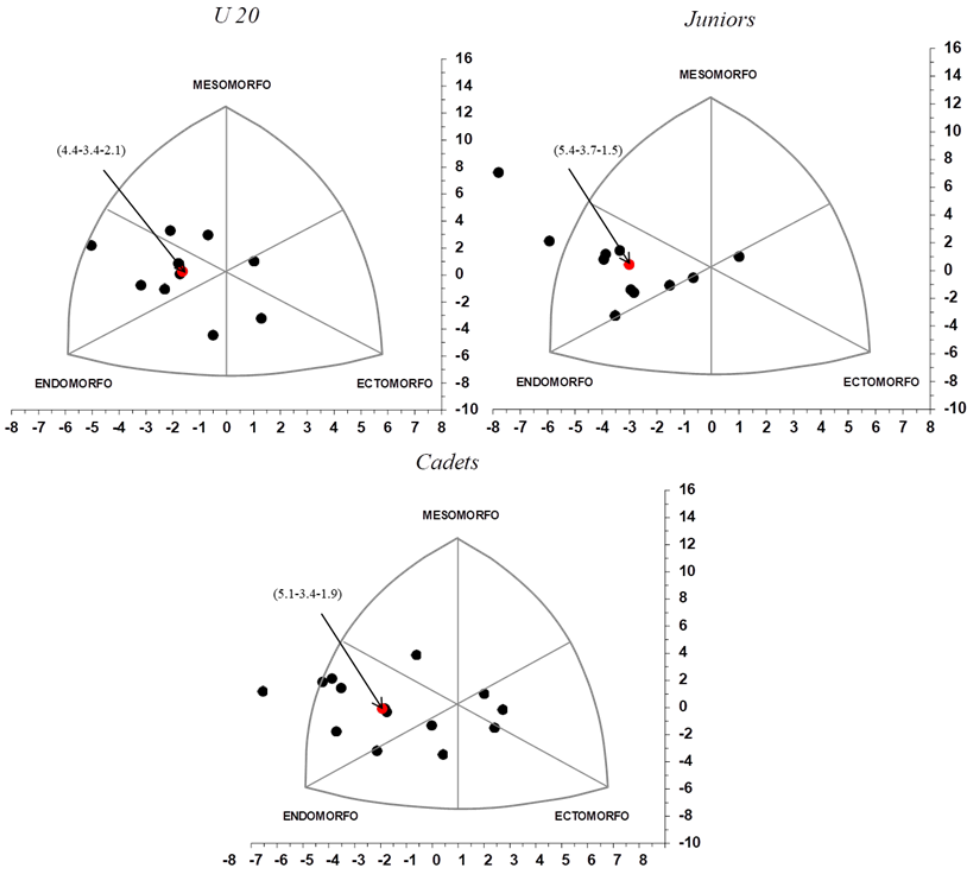
**Table 2.**
*Somatotype of handball players by category.*

| | Category | | |
|---|---|---|---|
| Parameter | Cadets (*n* = 15) | Juniors (*n* = 11) | U-20 (*n* = 10) |
| Endomorphy | 5.1 ± 1.7 | 5.4 ± 1.4 | 4.4 ± 1.5 |
| Mesomorphy | 3.4 ± 1 | 3.7 ± 1.2 | 3.4 ± 1.2 |
| Ectomorphy | 1.9 ± 1.1 | 1.5 ± 0.9 | 2.1 ± 1 |
| SAD | .58 | .72 | 1.2 |
| SAM | 2.0 | 2.0 | 2.0 |

*Note:* SAD=Somatotype Attitudinal Distance; SAM= Somatotype Attitudinal Media

The graphical analysis using the somatochart of the players where the points of each somatotype and the mean somatotype of the three categories are represented is shown in Figure 1.

**Figure 1**. Somatotype distribution for Mexican female players by category




## IV. Discussion

This research aimed to evaluate the anthropometric characteristics and somatotype of handball players and identify if these are different between the Cadet, Junior, and U-20 categories. Within the basic anthropometric characteristics, body height was considered a key physical parameter for performance and success in handball [1617 18 8]. Therefore, it is important to analyze how this variable acts in the different evaluated ages. Considering that the main increase in body height in girls occurs from 11 to 13 years and after 14 it decelerates, it is convenient to identify the maximum mean height at 18 years since girls reach 98% of their final height at the age of 16.5 years and visible growth stops around 18 years [11,19]. The mean height of the players from the sample did not show significant differences between the categories. This finding could mean that these teams have not considered height as a key criterion in the selection process which could impact international competitions. The height of the players from the U-20 category of our sample is lower than that of their Chilean Latin American peers (167.7 ± 7 cm)[20] and their European counterparts. Top elite Danish (176.3±6.6 cm) and Croatian players (172.02±6.74 cm) are taller, and also their European peers, Czechs, Greeks, and Spaniards [21]. The only parameter that showed differences between the categories was the tibia, which was longer in the U-20 category than the Cadets ($p < .05$); however, this difference was not defined in the longitudinal body dimensionality between the age groups.

Body mass was another parameter that has marked a high-performance definition in handball. Other studies have recorded that top elite players are usually heavier with a high lean component when compared with their counterparts from a lower sports level [123]. Studies that compare the Cadet and Junior categories show differences between the players´ body mass; the players from the Junior category are heavier and leaner [13]. The players from this study had a similar body mass; no differences were found when comparing weight between categories. Information about body mass alone is not a parameter that defines its impact on player performance; it must be complemented with the relationship between components [21]. Body mass can influence an athlete´s velocity, resistance, and power, while body composition can affect strength and agility. A greater muscle mass

is an advantage in sports like handball, where speed is a large part of its essence [3]. Body mass is a parameter that can be transformed under the influence of training and nutritional intervention [22].

The mean somatotype of the players did not show statistical differences between the categories when compared and when the tridimensional analysis was performed using SAM, where the players´ bodies showed an endomorphic followed by a mesomorphic predominance. In a study of Croatian handball players [11], the somatotype of the Cadet category was analyzed. The players presented an endomorph-mesomorph somatotype with moderate adiposity and moderate musculoskeletal development. This finding was in contrast with the cadet category players from our sample who presented an endomorphic component with relatively high adiposity. In another study with European Youth category players [12], a comparison was made between different sports levels; the top elite players have a central somatotype where the three components are in equal proportion. The elite and non-elite players had an endo-mesomorphic somatotype with a dominance of the endomorphic component like the players in our study from the same category, but they did not have a high fat component. The high fat component has a negative impact on the players´ performance due to an additional burden thus imposed on organism function, reducing the running speed, jump efficiency, resistance, and agility of the players [21,19].

Carter [23] states that changes in endomorphy and mesomorphy also influence ectomorphy, and it is not easy to identify which variables affect the somatotype in these ages since they can be genetic, growth hormone, nutritional, or physical activity per se. Therefore, it is important to evaluate the data of our athletes regarding international references and influence those that are modifiable as part of the key elements to achieve maximum sports performance.

## V. Conclusion

The findings of this study reveal that there are different anthropometric factors in the players of this sample that suggest the involvement of a natural maturation process when comparing categories. The players present a similar somatotype; thus, there is no definition of morphological components in the different age groups. Considering that several factors affect somatotype and that not all are controllable, it is necessary to orient training towards reducing the fat component and increasing musculoskeletal development in the players to drive body structures towards a similar prototype that successful handball players have.

**Conflict of interest:** The authors reported no conflict of interest

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