ANTRHOPOMETRIC PROFILE IN FEMALE ELITE HANDBALL PLAYERS BY PLAYING POSITIONS

Helena VILA[1], Carmen MANCHADO[2], Arturo ABRALDES[3], Pedro ALCARAZ[1], Nuria RODRIGUEZ[1], Carmen FERRAGUT[4]

[1]UCAM, Murcia; [2]UA, Alicante; [3]UM, Murcia; [4]University of Alcalá de Henares, Madrid Spain.

Abstract
Female handball is a sport which has been enjoying a loud development in the last decade. The aim of this study was to identify possible differences in the anthropometric characteristics in terms of individual playing positions in female handball players. Statistical differences have been established in wings with the others specific playing positions, especially with pivot and backs.

Keywords: *Performance, somatotype, body composition.*

Introduction
The body composition of the athletes, has attracted the interest of the scientific community, which is evidenced by the great amount of papers that have been published describing the anthropometric profile of different sports (Ackland, Schreiner and Kerr, 1997; Bayios, Bergeles, Apostolidis, Noutsos and Koskoloul, 2006; Chaouachi, Brughelli, Levin, Boudhina, Cronin and Chamari, 2009; De Garay, Levine and Carter, 1974; Hasan, Reilly, Cable and Ramadan, 2007). Research published since the 1928 Olympic Games have shown correlations between different sports and physical characteristics as another factor to consider in the sport´s success. It has been reported that in some sports there is a clear physical prototype necessary to reach the highest levels of performance (De Garay et al, 1974). It seems the body prototype proposed by researchers one decade ago is being substituted by another prototype based on specialization (Norton and Olds, 2001). These authors proposed that in sport, and also within the same sport, positions occupied in the playing field require unique physiological and physical attributes in order to get the highest performance. These issues are also important in handball because each specific position will require its own skills according to its task.

The aim of this study was to identify possible differences in the anthropometric characteristics in terms of individual playing positions in female handball players (centers, backs, wings, pivots and goalkeepers).

Methods
Subjects
A total of 130 elite female handball players (25.74 ± 4.84 years) with a regular competitive background in handball (14.92 ± 4.88 years) participated in this study. All of them were playing in the top Spanish professional handball league. The sample was divided according to the specific playing positions of 16 centers, 36 backs, 41 wings, 18 pivots and 19 goalkeepers.

Assessment Procedures
The study was approved by the San Antonio Catholic University Committee for research involving human subjects. All participants received verbal and written information about the study and gave informed written consent before anthropometric and conditional assessment.

Anthropometric evaluation
The International Society for the Advancement of Kinanthropometry (ISAK) protocol was used to determine the anthropometric profile of the handball players. Subjects were measured during one session and all of them postprandial state. Unilateral measurements were taken on the right side of the body. Participants wore light clothing and were barefoot.

Physical characteristics were measured in the following order: height, body mass, arm span, skinfolds, body girths and skeletal breadths. The anthropometric program included about 30 measurements. Height and weight measurements were made on a set of scales (Seca, Barcelona, Spain) with an accuracy of 0.01 kg and 0.001 m, respectively. Nine skinfolds (triceps, subscapular, biceps, axilar, abdominal, iliac crest, suprailiac, front thigh and medial calf) were measured by Holtain Skinfold Caliper with 10 $g.mm^{-2}$ constant pressure. Ten limb and trunk girths (arm relaxed, arm flexed and tensed, forearm, wrist, chest, waist, gluteal, thigh, calf and ankle) were measured using a Lufkin metal tape, (Lufkin Executive Thinline, W606PM, USA) and six skeletal breadths (biacromial, biepicondylar-humerus, biepicondylar, biiliocristal, bitrochanteric and bistyloid) were measured using an anthropometer (GPM, Switzerland) with an accuracy of 0.01 cm. Four lengths were measured using an anthropometer (GPM, Switzerland) with an accuracy of 0.01 cm in upper limbs (upper limb length, forearm length, hand length and hand width).
Several variables were found: a) the body mass index (BMI) was calculated as weight (kg) divided by height (m^2), b) sum of four (triceps, subscapular, suprailiac and abdominal) and six skinfolds (triceps, subscapular, suprailiac, abdominal front thigh and medial calf), c) fat free mass (FFM) (kg) using the method described by Lee (Lee et al,2000), d) selected anthropometric measures were used to determine somatotype following the methods described by Carter (Carter and Heath, 1990).

Statistical analysis
Standard statistical methods were used to calculate the mean and standard deviations. All data is expressed as mean ± standard deviation (all data were checked for distribution normality and homogeneity with the Kolgomorov-Smirnov, Lilliefors and Levene tests). A one-way analysis of variance (ANOVA) together with a Tukey HSD post-hoc test was used to determine if significant differences existed among 5 playing positions (center, back, wing, pivot and goalkeeper). The $p \leq 0.05$ criterion was used for establishing statistical significance.

Results and discussions
Mean samples were 67.55 ± 8.06 kg, 171.31 ± 7.42 cm, 22.97 ± 1.86 (%) for weight, height and BMI respectively. Wings are less heavy, shorter and show less arm span, than goalkeepers, backs and pivots ($p \leq 0.001$). Additionally pivots are heavier than centers

(p≤0.001). These results are not in line with those published by Hasan et al. (2007), but they are in line with the physical demands of each position (Srhoj, Marinovic and Rogulj, 2002).

No significant differences among playing positions were found, neither in BMI nor in sum of four and six skinfolds. Nevertheless, backs and pivots exhibit higher muscular mass than wings (p≤0.001).

In all breadths studied, wings show significant differences with backs and pivots (p≤0.05). Wings exhibit significant differences (p≤0.05) with goalkeepers in biepicondylar, biiliocristal, bitrochanteric and bistyloid breadths. Wings show significant differences (p≤0.05) with centers in bistyloid breadth. In bitrochanteric breadth, statistical differences were found between centers and goalkeepers (p≤0.05) (Figure 1).

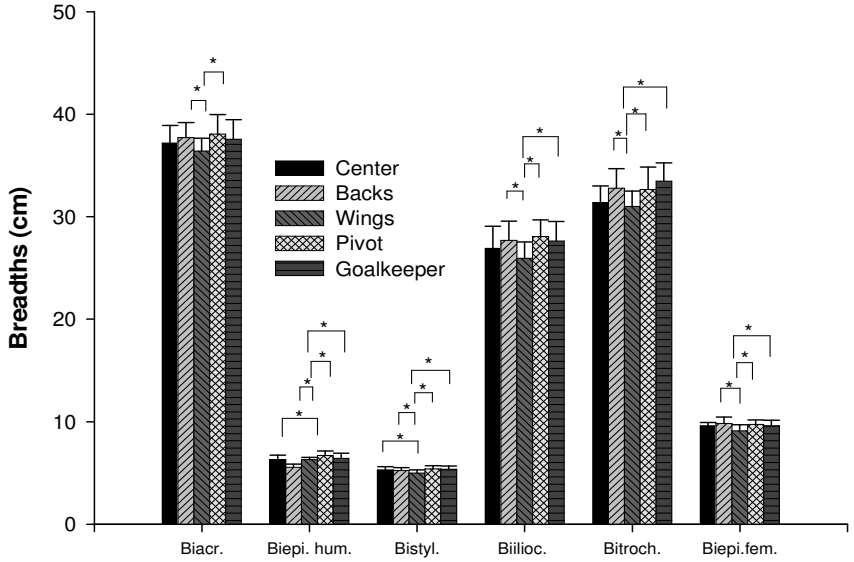

***Figure 1**. Bones breadths values. Significant differences among playing positions. (*) p<0.05.*

All girths analyzed show statistical differences (p≤0.05) between wings in contrast with backs and pivots. Likewise, centers show higher forearm girth than wings (p≤0.05). In gluteal girth, statistical differences have been found (p≤0.05) between pivots and centers.

The breadths are similar to the girths. They confirm the differences among the specific positions of pivots, and backs compared to wings. The goalkeeper needs an athletic body shape, with an important factor being longitudinal characteristics. Therefore biacromial, biiliocristal and bitrochanteric breadths can contribute to a larger occupation of the goal area (Srhoj, Marinovic and Rogulj, 2002). This can be confirmed by the greater values that the goalkeeper shows in these breadths compared to wings and centers. It is notable that breadths are morphological parameters that are not modifiable by training and that can be related with strength levels (Malina and Bouchard, 1991). Therefore it could be an interesting aspect in the process of talent selection in handball (Srhoj, Marinovic and Rogulj, 2002; Vila, Fernández and Rodríguez, 2002).

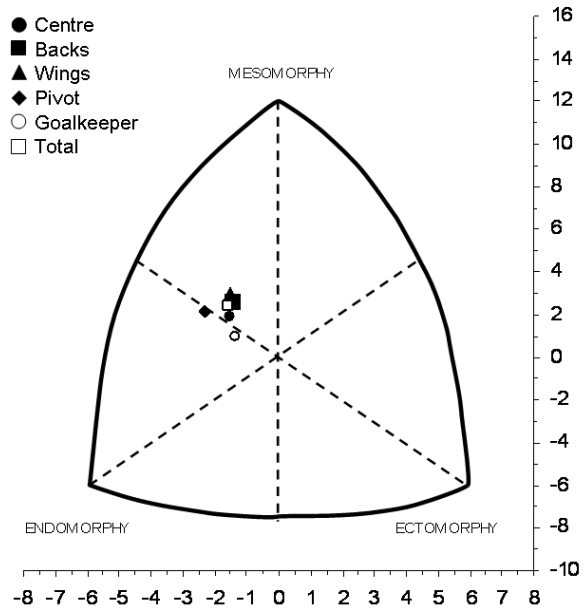

Figure 2*.Representation of the somatotype in elite Spanish female handball players.*

The total somatotype of the players in the study was characterised as mesomorphy-endomorphy (3.89 - 4.28 - 2.29). No significant differences in the three somatotype components were found among the five groups. Mesomorphy is the main component for centers (3.83 - 4.01 - 2.30), backs (3.80 - 4.40 - 2.31) and wings (3.72 - 4.44 - 2.18). Endormorphy is the main component for pivots (4.46 - 4.37 - 2.12) and goalkeepers (4.02 - 3.85 - 2.67). Ectomorphy is the least important component for all playing positions (Figure 2). When we analyzed the somatotype of playing positions, we did not find any differences among specific positions, but we can say that centers and pivots show an endomorphy-mesomorphy somatotype, where mesomorphy and endomorphy are predominant. These results concur with other papers published in male and female handball players (Malina and Bouchard, 1991; Bayios et al, 2006).

Conclusions

We can conclude that wings exhibit important anthropometric differences to the other specific playing positions in Spanish elite female handball players. In addition, mesomorphy is the principal component of the somatotype for all specific playing positions except pivots and goalkeepers. It can be confirmed that muscle mass in female handball players carries a significant importance.

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hvila33@gmail.com