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Original article

The somatotype of the high-level performance female Cuban baseball player

El somatotipo de la jugadora de béisbol cubana de alto nivel de actuación

O somatótipo da jogadora de beisebol cubana de alto desempenho

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ABSTRACT

The somatotype is the classification of the human figure according to three sequential elements: endomorphy or relative adiposity, mesomorphy or relative skeletal muscle development, and ectomorphy or relative linearity. The specific objectives of this study were to establish reference data for the somatotype of the team and by playing positions in Cuban female baseball players, and to compare the somatotype characteristics between playing positions, with an international population. Twenty-one athletes were evaluated through

the Heath-Carter anthropometric somatotype technique; all were members of the national team that participated in the first Caribbean Cup and in the 2022 Pan-American qualifier. The age of the athletes was the chronological and sporting average of 26.8 and 12.4 years, respectively. The players were divided into four groups: pitchers, fielders, infielders, and first basewomen + catchers, and their average somatotypes were 4.5-5; 5-2.2; 4,3-4; 7-1.4; 4,5-4; 5-1.5; 4,2-5 and 5-1,7. The somatotype was not significantly different between players of different positions ($p \leq 0.05$). The pitchers were the most homogeneous among the positions. Of the thirteen somatotype categories described, the Cuban players showed six. The dominant category was the mesoendomorphic somatotype and the anthropometric somatotype of the Cuban player was similar to that of the international player.

Key words: Baseball, constitution, somatotype.

RESUMEN

El somatotipo es la clasificación de la figura humana de acuerdo a tres elementos secuenciales: endomorfia o adiposidad relativa, mesomorfia o desarrollo músculo esquelético relativo y ectomorfia o linealidad relativa. Los objetivos específicos de este estudio fueron establecer datos de referencia para el somatotipo de la selección y por posiciones de juego en jugadoras cubanas de béisbol, y comparar las características del somatotipo entre posiciones de juego, con una población internacional. Se evaluaron 21 atletas, a través de la técnica del somatotipo antropométrico de Heath-Carter; todas fueron miembros de la selección nacional que participaron en la primera Copa del Caribe y en el clasificatorio panamericano 2022. La edad de las atletas fue la cronológica y deportiva promedio de 26,8 y 12,4 años, respectivamente. Las jugadoras se dividieron en cuatro grupos: lanzadoras, jardineras, jugadoras de cuadro y primera base + receptoras, y sus somatotipos promedios fueron 4,5-5; 5-2,2; 4,3-4; 7-1,4; 4,5-4; 5-1,5; 4,2-5 Y 5-1,7. El somatotipo no fue significativamente diferente entre jugadoras de diferentes posiciones ($p \leq 0,05$). Las lanzadoras fueron las más homogéneas entre las posiciones. De las trece categorías del somatotipo descritas, las jugadoras cubanas mostraron seis. La categoría

dominante fue la de somatotipo mesoendomórfico y el somatotipo antropométrico de la jugadora cubana fue similar al de la jugadora internacional.

Palabras clave: Béisbol, constitución, somatotipo.

RESUMO

O somatotipo é a classificação da figura humana de acordo com três elementos sequenciais: endomorfia ou adiposidade relativa, mesomorfia ou desenvolvimento muscular esquelético relativo e ectomorfia ou linearidade relativa. Os objetivos específicos deste estudo foram estabelecer dados de referência para o somatótipo da seleção e por posições de jogo em jogadoras cubanas de beisebol e comparar as características do somatótipo entre as posições de jogo com uma população internacional. Vinte e uma atletas foram avaliadas com a técnica de somatotipo antropométrico de Heath-Carter; todas eram membros da equipe nacional que participou da primeira Copa do Caribe e das eliminatórias pan-americanas de 2022. A idade dos atletas era a média cronológica e esportiva de 26,8 e 12,4 anos, respectivamente. Os jogadores foram divididos em quatro grupos: arremessadores, jardineiros, jogadores de campo interno e primeira base + apanhadores, e seus somatotipos médios foram 4,5-5; 5-2,2; 4,3-4; 7-1,4; 4,5-4; 5-1,5; 4,2-5 e 5-1,7. O somatótipo não foi significativamente diferente entre jogadores de diferentes posições ($p \leq 0,05$). Os arremessadores foram os mais homogêneos entre as posições. Das treze categorias de somatotipo descritas, os jogadores cubanos apresentaram seis. A categoria dominante foi o somatotipo mesoendomórfico e o somatotipo antropométrico do jogador cubano foi semelhante ao do jogador internacional.

Palavras-chave: Beisebol, constituição, somatotipo.

INTRODUCTION

According to Stewart (2010), in one of the most current definitions, kinanthropometry is the academic discipline that involves the use of anthropometric measurements in relation to other specific parameters and/or subject areas, such as human movement, physiology, and sciences applied to health.

Kinanthropometry is one of the sciences applied to sports that has had the most international impact in the history of the Cuban sports movement. The innumerable publications and own methodologies show a highly standardized work system for the Cuban milieu (Carvajal, 2017, 2021).

In this area of knowledge, the sport that has the greatest lack of information that prevents the evaluative work of the athletes, within the framework of sports preparation, is women's baseball. After a search carried out in databases such as PubMed and Scielo, it was found that this limitation persists internationally, which in the long run prevents having a clear idea of what distinctive features should be taken into account when select or compete at the highest level.

The most recent international publications have studied the pitcher, his bone and muscle mineral composition, as well as the mechanics of pitching (Lizzio, *et al.,* 2020; Sada, *et al.,* 2020; Montenegro, *et al.,* 2021; Manzi, *et al.,* 2022 and Nose, *et al.,* 2022). Other studies have focused on the study of adaptations to training loads with the dual energy X-ray absorptiometry technique (Tenforde, *et al.,* 2018; *Peart, et al.,* 2019; Czeck, *et al.,* 2019 and Dobrosielski, *et al.,* 2021). Finally, Watanabe *et al.* (2019) compared the physical condition at the end of the preseason and the performance of the games of the season, in professional baseball players from Japan.

In Cuba, the studies of sciences applied to this sport are increasing, as demonstrated by García *et al.* (2019), Arce *et al.* (2020), Cañizares *et al.* (2020), Rios *et al.* (2020), Crespo *et al.* (2021), Durañona *et al.* (2021) and Pérez *et al.* (2021) who have dedicated their research to baseball from different angles, whether in studies related to the mechanics of pitching, performance and the field of psychological studies of pitchers, such as improving the preparation of pitchers and batters.

One of the traits that provide more information about the optimal characteristics of baseball players is the anthropometric somatotype of Heath-Carter (1990) based on the quantification of adiposity, skeletal muscle development and relative linearity in a sequential manner. No report was found in the specialized literature that distinguishes the anthropometric somatotype of this type of player; therefore, the present work aims to establish reference

data for the somatotype of the team and by game positions in Cuban female baseball players, and to compare the characteristics of the somatotype between game positions and with an international population.

MATERIALS AND METHODS

A descriptive and prospective research was carried out that covered the period between the pre-competitive stages where the athletes prepared to participate in the first Caribbean Cup (April 2022) to the Pan-American baseball qualifier (June 2022).

In total, 21 athletes were evaluated, the composition of the universe according to the playing positions was six pitchers, seven fielders, eight infielders (including a first basewoman and three catchers), the catchers and the first basewoman joined for the study and that make up the group of first base + receivers. The average chronological and sporting age of the group was 26.8±4.8 and 14.2±4.6 years.

Of the universe, 33 % were mixed race, 22 % black, and 45 % white. All the athletes studied gave their consent to carry out the anthropometric tests and to use the data to improve the quality of medical control of sports training. The study complies with internationally established bioethical standards (World Medical Association).

The measurements for the determination of the anthropometric somatotype were carried out by level I and II anthropometrists of the International Society for the Advancement of Kinanthropometry (ISAK), who completed their restricted and full profile certifications during this assessment exercise of the baseball players and were carried out at the "Manuel Fajardo" Higher School of Physical Education, during the preparatory concentration of the athletes.

The equipment used included a scale (Detecto, USA) with a precision of 0.1 kg, for measuring body weight; two stadiometers (Holtain, United Kingdom) with a precision of 0.1 mm, for measuring height; four skinfold calipers (10 g/m$^{3)}$ accurate to 0.2 mm (Holtain,

UK); two 1 mm precision compasses to determine bone diameters and three 1 mm precision tape measures (Holtain, United Kingdom) to determine circumferences.

Therefore, the anthropometric measurements were developed according to the protocol of the ISAK always in the morning. The technical error of the gauges was less than 4.3 % for skinfolds (subscapularis, triceps, supraspinal, calf) and less than 1 % for the rest of the measurements, including diameters (humerus and femur), circumferences (flexed arm and calf), weight and height. With these measurements, the somatotype was determined in an Excel spreadsheet designed for this purpose.

The calculation and qualification of the anthropometric somatotype, as well as the representation made in the somatocharts were carried out using the Heath-Carter methodology. The quantitative value derived from each component was categorized on a scale that defines values from 0 to 2.9 as low, from 3 to 5.4 as moderate, from 5 to 5-7 as high, and values greater than 7 as very high. To determine the somatotype frequencies, the 13 categories described by these same authors were taken into account.

The somatotype dispersion index that represents the area occupied by all individuals at the population level in the somatochart was determined by the Heath-Carter methodology. For the design of the somatochart where the distributions of the World Cup and Cuban baseball players appear, the average somatotype and the dispersion index of each group were used; both the average values of the somatotype and the index were entered into an Excel spreadsheet designed to generate the somatochart, based on the proposed methodology.

To comply with the research objectives, descriptive statistics were used for each of the variables studied. The absolute and relative frequencies of individuals within each category of the somatotype were taken as bases. The mean (X) and standard deviation (SD) were used to refer to the average somatotype for each playing position.

To contrast the hypothesis of the equality of means between weight, height and between the components of the somatotype (endomorphy, mesomorphy and ectomorphy) by position, the Kruskal-Wallis analysis of variance was used. The statistical processing was carried out with the statistical package IBM SPSS 22.0 for Windows, from the database created. The

significance level used to draw conclusions was p<0.05. The results were reflected in tables and figures.

RESULTS AND DISCUSSION

Table 1 shows the characteristics of a population group that has an average mesoendomorphic somatotype, where relative skeletal muscle development (X=5.0; SD=1.5) is dominant over adiposity (X=4.4; SD= 1.4) and linearity does not stand out from these (X=1.7; SD=1.5). Overall, adiposity and mesomorphy were moderate and linearity low.

The average height of the Cuban baseball player is 163.9 cm (SD=7.8) and she weighs 64.3 kg (SD=10.3). Pitchers and first basemen + catchers had greater body mass and height than the rest (p<0.05).

The average somatotype of pitchers and first basemen + catchers was also mesoendomorphic, with moderate adiposity and high mesomorphy; for their part, the infielders and outfielders were moderately mesomorphic-endomorphic, with equal dominance in adiposity and relative musculoskeletal development. Despite the categorical differences, no game position showed significant differences between the indicated components (p>0.05) (Table 1).

Table 1. - *Descriptive statistics of the components of the anthropometric somatotype by game positions*

Components	Pitchers		Outfielders		First catchers		Infielders		Sig.
	X	DE	X	DE	X	DE	X	DE	
Weight,kg	67.2	13.1	59.9	9.2	71.1	4.5	59.9	9.4	0.010
Height, cm	169.5	5.1	160.0	7.0	169.3	7.4	158.4	5.9	0.02
Endomorphy	4.5	1.8	4.3	0.7	4.2	1.8	4.5	1.7	0.966
Mesomorphy	5.5	2.8	4.7	1.7	5.5	2.2	4.5	2.5	0.622
Ectomorphy	2.2	23	1.4	0.7	1.7	1.5	1.5	1,3	0.950

Sig. Statistical significance of the Kruskal-Wallis test.

Eighty-three % (n=5) of the pitchers were mesoendomorphic, in the fielders 57.1% (n=4), in the first base + catchers group 50% (n=2) and in the players frame 50% (n=2). The rest of the distribution was in the ectoendomorphic category, with a pitcher and an infielder; endomesomorphic, two outfielders and one infielder; balanced endomorphic, an outfielder; Mesoectomorphic, a first base + catcher and mesomorphic-endomorphic, into a first base + catcher.

The spatial location of the average anthropometric somatotype (indicated in red) in the somatocards (Figures 1, 2, 3 and 4) corroborated the Kruskal-Wallis result of equality of means, where no significant differences were found between the playing positions.

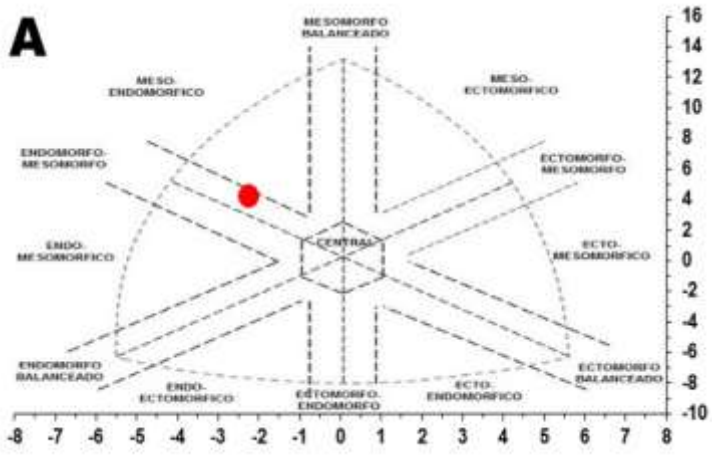

Fig. 1. *- Distribution of the average anthropometric somatotype of Cuban baseball players in the pitchers (A)*

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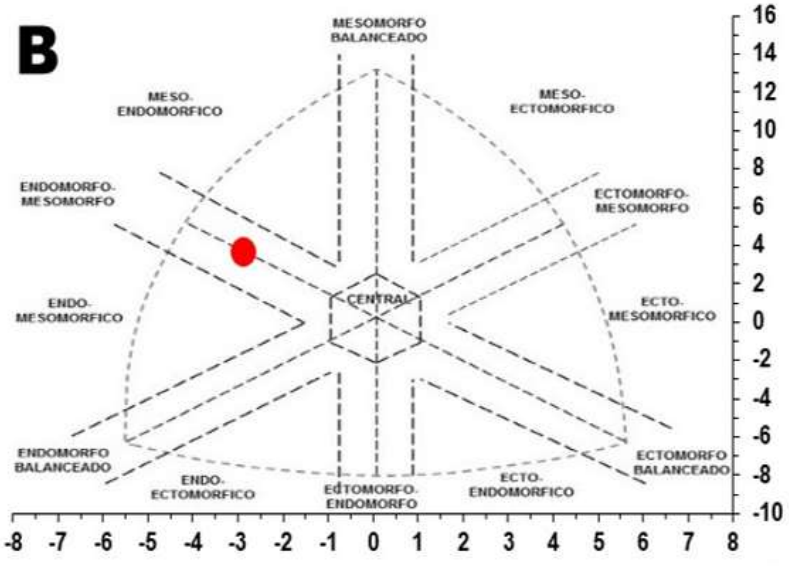

Fig. 2. *- Distribution of the average anthropometric somatotype of Cuban baseball players in the outfielders (B)*

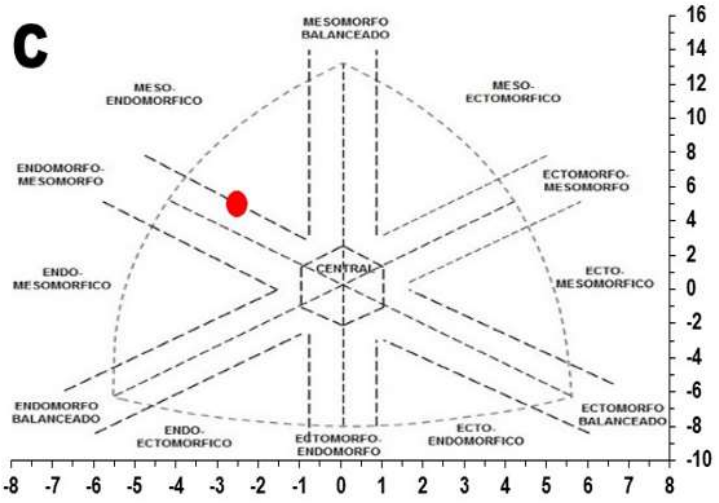

Fig. 3. *- Distribution of the average anthropometric somatotype of Cuban baseball players at first base + catchers (C)*

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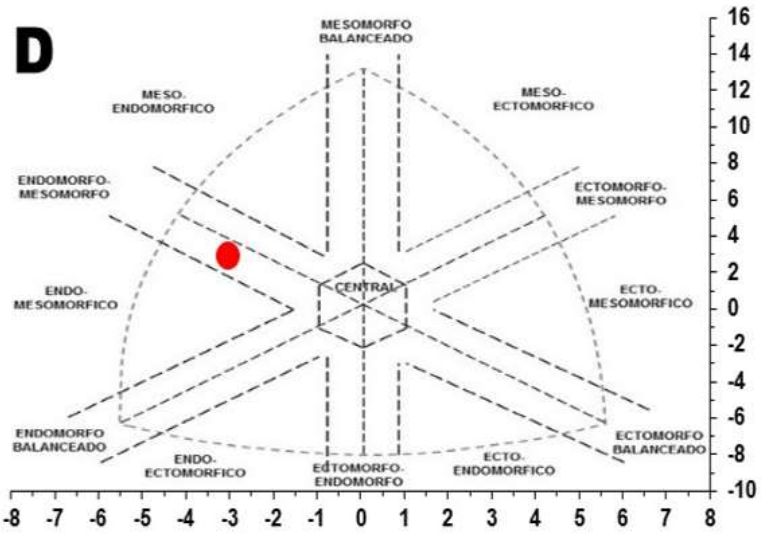

Fig. 4. *- Distribution of the average anthropometric somatotype of Cuban baseball players in infielders (D)*

The data available on international players participating in the world championship were provided by the Institute of Sports Medicine (IMD in Spanish) with the commitment not to disclose the data by game positions or make use of it in publications of any kind. The study was carried out in accordance with the declaration of the World Medical Association (WMA), which has promulgated the Declaration of Helsinki (2008) as a proposal for ethical principles for medical research in human beings, including the investigation of identifiable human material and information.

The sample of international players compared to the population under study has an average mesomorphic-endomorphic somatotype where relative skeletal muscle development (X=4.6; SD=1.5) is equally dominant as adiposity (X=4, 8; SD=1.5) and linearity does not stand out from these (X=1.8; SD=1.3). In this case, similarities were found with the average somatotype of the sample under study (4.4-5.0-1.7).

In figure 5, from the point of view of the population spatial distribution, population anthropometric somatotype of Cuban baseball players (blue) and World Cup players (red circle on the left), according to data from the IMD, almost 100 % of them were similar overlap and the centroid of each population coincided. The dispersion index of the World

Cup players (IDS=3.84) and of the Cuban players (IDS=5.46) reflects the area occupied by the players on the somatocard: the blue area did not differ much from the red area occupied by the international players with a body mass (X=66.9 kg; SD=13) and height (X=166.4 kg; SD=6.5) slightly higher than the Cuban ones (Figure 5).

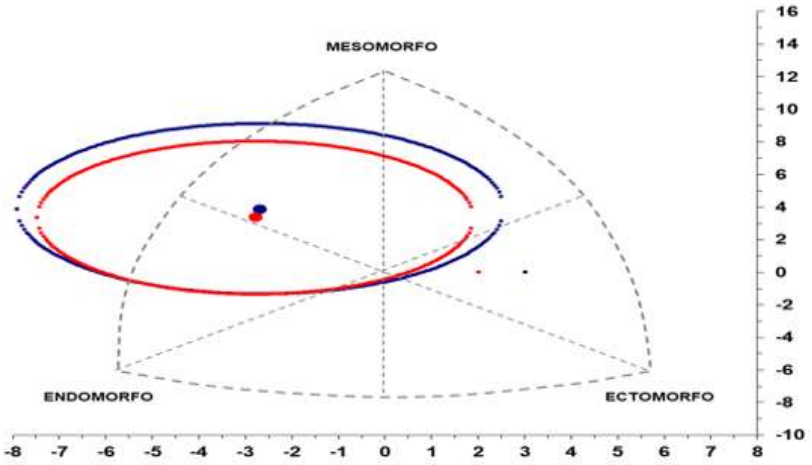

Fig. 5. - *Distribution of the population anthropometric somatotype of Cuban baseball players (blue) and World Cup players (red circle on the left).*

The point in the center of the distribution represents the average somatotype of each population.

This work corroborates that the average somatotype of the Cuban baseball player is mesoendomorphic, the same result obtained by Carvajal *et al.* (2018) for the male sex. Another important finding in this research is that the Cuban baseball player is characterized by having relative adiposity values higher than the average of the Cuban sports population, since only the super heavyweight categories of judo (X=6.5) and pitchers bala (X=4.5) showed greater adiposity than baseball players when they were descriptively compared with 34 sports modalities studied by Carvajal *et al.* (2018) in the characterization of Cuban sport.

Regarding mesomorphy, the studied baseball players had an average value that makes them among the athletes with the greatest relative skeletal muscle development, only surpassed by shot putters (X=6.2), javelin throwers (X=5 .6), canoe-kayak (X=5.2) and categories from

52 to over 78 kg in female judo (X>5.0) in a sports population of 34 sports in Cuba (Carvajal, *et al.,* 2018).

This finding is apparently disconcerting because high values of adiposity can be a drag on performance, but it does not differ from what is found in this sport at the international level, as was demonstrated when comparing Cuban players.

In recent studies, Watanabe *et al.* (2019) confirmed an approach made by Carter & Head (1990) who pointed out that neuromuscular indicators have a greater impact in baseball and demonstrated that the successful somatotype in this sport is the mesoendomorphic one; this, after characterizing players from the organized system of the major baseball leagues for years.

After reviewing the sites https://scielo.org/ and https://pubmed.ncbi.nih.gob, the authors realized that more than 95% of the research carried out on baseball players refer to aspects related to other areas of knowledge in male players, fundamentally. In the female sex, only a few isolated publications have been found that allude to aspects such as the female athlete triad (Peart, *et al.,* 2019; Czeck, *et al.,* 2019) and neuromuscular characteristics (Watanabe, *et al.,* 2019) of these in baseball and softball, but they ignore aspects as relevant for selection and preparation as the study of the anthropometric profile, where the somatotype constitutes its second most important pillar.

CONCLUSIONS

With the study presented, theoretical-practical reference values were provided, contextualized to the framework of the assessment of the high-performance athlete. Cuban female baseball players were characterized by having a mesoendomorphic somatotype, with dominance of musculoskeletal development. There were no somatotypic differences between playing positions, although relative adiposity and musculoskeletal development were more balanced in infielders and outfielders. It was found that the somatotype of the Cuban player was similar to that of international players.

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Declaration of conflict of interest and ethical conflicts:

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Contributions of the authors:

Yannara Quintero Batista: Conception of the idea, search and review of the literature, review of the application of the bibliographic standard used. Review and final version of the article.

Wiliam Carvajal Veitía: General advice due to the topic addressed. Carrying out anthropometric measurements. Statistical processing, analysis of the results. Correction of the article and translation of the abstract.

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