

Comparative analysis of the anthropometric characteristics of young Senegalese U18 and U20 handball players with young handball players from other African and global nations: Towards an optimal morphological profile for high-level competition

Ndarao Mbengue¹, Mountaga Diop¹, El Hadji Mama Guène¹, Ndiack Thiaw¹, Papa Serigne Diène¹, Daouda Diouf², Mame Ngoné Bèye¹, El Hadji Mamouthiam Diop¹, Amadou Diouf², Thierno Diouf², Abdoulaye Ba², and Abdoulaye Samb²

¹Research Laboratory in Science and Technology of Physical and Sports Activities, Youth and Leisure at the National Higher Institute of Popular Education and Sport at Cheikh Anta Diop University in Dakar, Senegal

²Physiology and Functional Explorations Laboratory, Faculty of Medicine, Pharmacy and Odontostomatology, Cheikh Anta Diop University, Dakar, Senegal

Copyright © 2025 ISSR Journals. This is an open access article distributed under the **Creative Commons Attribution License**, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT: This study analyses the anthropometric characteristics of young Senegalese handball players (U18 and U20 categories) in order to determine the extent to which their morphological profile is compatible with the demands of high-level handball. Based on measurements of height, weight, body mass index (BMI), wingspan and hand span, the data collected from a representative sample were compared with data from young international handball players who participated in the 10th World Youth Handball Championship (U19) in Croatia in 2023. The results show that while the height and wingspan of Senegalese players are broadly in line with African and European benchmarks, their weight, BMI and hand span are lower. The study concludes that a morpho-functional approach is needed in the detection and training of young handball players.

KEYWORDS: Handball, Anthropometry, Young handball players, Morphology, Talent detection.

1 INTRODUCTION

In the current context of increasingly demanding international competition, performance in handball relies heavily on morphological profiles suited to specific roles in the game. Many researchers have emphasized the importance of anthropometric characteristics in sporting success, particularly in high-intensity team sports such as handball [1], [2]. According to Carter and Heath [3], morphology plays an essential predictive role in directing athletes towards disciplines where their physical profile can be optimized.

Senegal, although rich in raw talent, struggles to compete with the major handball nations such as Egypt, Tunisia, France and Germany. This situation can be explained in particular by a lack of knowledge or underutilization of anthropometric parameters in training programs. As noted by Milanese and al [4], morphological analysis makes it possible to identify optimal profiles for different playing positions, thereby contributing to better collective performance.

The aim of this article is therefore to analyze the morphological data of young Senegalese handball players and compare them with those of young African and world-class players who participated in the 10th World Youth Handball Championship in 2023 in Croatia in order to define a profile that meets the requirements of high-level competition and formulate practical recommendations for talent identification and training.

2 METHODOLOGY

The study is based on a rigorous anthropometric measurement protocol applied to a sample of young Senegalese handball players (U18 and U20) from national teams and data collected from the literature during the World Youth Championship (U19) in Croatia in 2023. Height (in cm), weight (in kg), body mass index (BMI, in kg/m²), wingspan (distance between the two ends of the outstretched arms) and hand span (distance between the thumb and little finger) were measured only in young Senegalese handball players. The

variables for young people from other countries were collected from the International Handball Federation (IHF) website during the World Youth Handball Championship in Croatia in 2023. The tools used included a wall-mounted height gauge for height, electronic scales, and a flexible measuring tape for arm span and hand span. The results were processed using descriptive statistics, intergroup comparisons (young Senegalese handball players and the rest of the world), box plots, correlations and Ward's algorithm dendrogram.

2.1 EQUIPMENT

The study was conducted at the INSEPS STAPS/JL laboratory, which was mobilized during the U18 and U20 team training camp organized from 3rd to 5th March 2024 to collect the players' anthropometric data.

2.1.1 SAMPLE

Our sample consisted of 33 players, 16 of whom belonged to the U18 team and 17 to the U20 team. All participants were called up to the national team and gave their informed consent in accordance with the ethical requirements of the research.

Our sample includes handball players aged between 16 and 20, with a valid federal license for the 2023–2024 season, officially selected for the U18 or U20 national team, and who gave their written consent.

2.2 METHODS

2.2.1 WEIGHT MEASUREMENT

Anthropometric measurements were taken according to a rigorous protocol. Weight was measured using a SECA electronic scale, graduated from 0 to 150 kg. The player, barefoot and in underwear, stood upright with arms at their sides eyes looking straight ahead. A single weighing was performed. The ideal weight of each player was then calculated using the Lorentz formula:

$$\text{Ideal weight} = 50 + (\text{height in cm} - 150) \times 0.75.$$

2.2.2 HEIGHT MEASUREMENT

Height is measured using a GIMA metal height gauge. The player stands upright with their back straight, heels together and gaze fixed horizontally. The experimenter moves the cursor until it touches the head. The height value is then read.

2.2.3 MEASURING SPAN

Hand span is defined as the maximum distance between the thumb and little finger when the hand is fully open. The player stands upright with their dominant arm extended horizontally, and the measurement is taken with a tape measure between the two extremities.



Photo 1. Span measurement taken during the experiment

2.2.4 MEASURING ARM SPAN

The wingspan is measured with the arms stretched out to the sides, middle fingers aligned, and the back against a wall. Marks are made with chalk and the measurement is taken between the two ends using a tape measure.



Photo 2. Measurement taken and published with the player's consent

3 RESULTS

MAIN CORRELATIONS

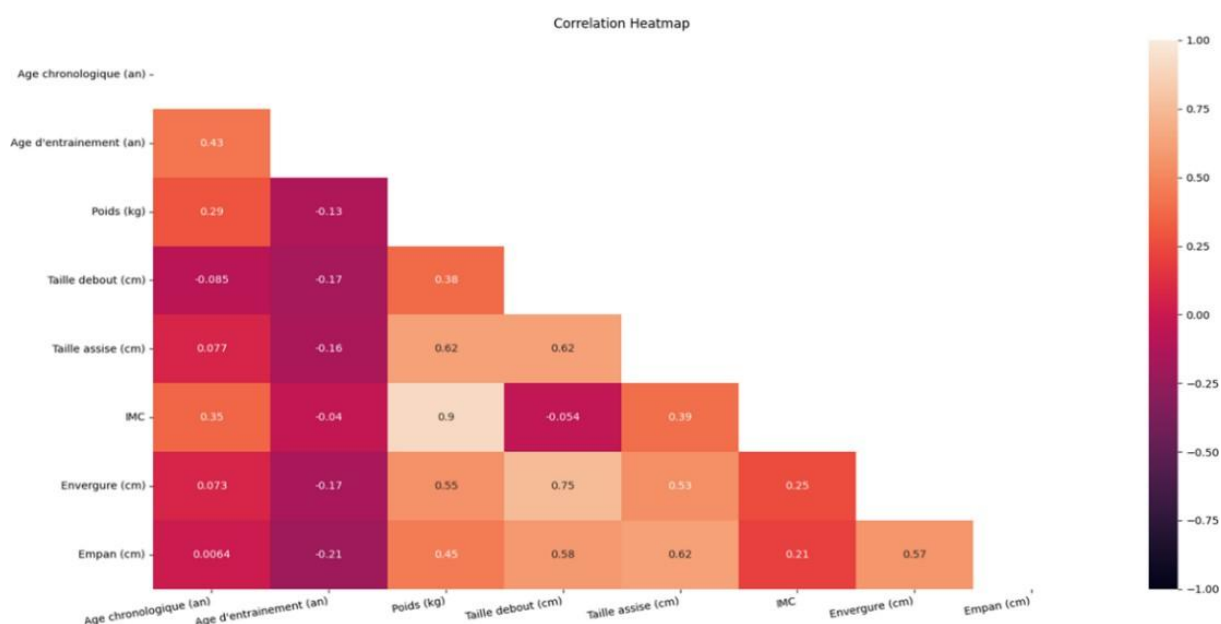


Fig. 1. Correlations between anthropometric variables – consistency between measurements reinforces the benchmarks for morphological selection

The analyses reveal a strong correlation between weight and BMI (0.90), between standing height and wingspan (0.75), and between hand span and sitting height (0.62). These correlations indicate the importance of body segments in handball performance, particularly for ball handling and defensive duels.

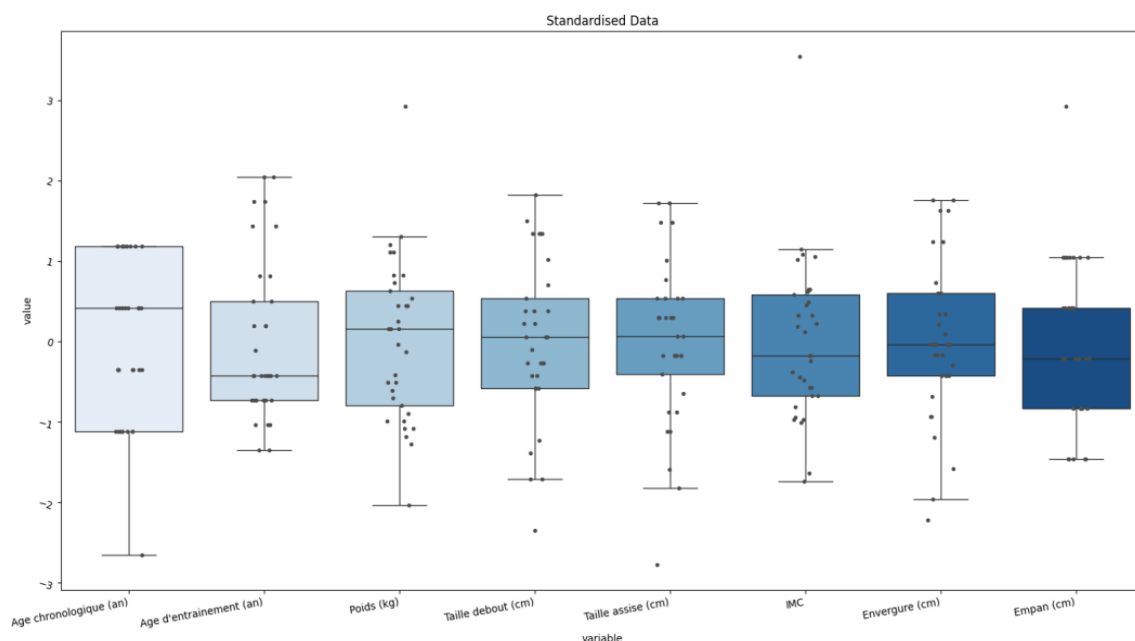


Fig. 2. Boxplot of anthropometric variables for young Senegalese handball players in the U18 and U20 national teams

The overall boxplot of standardized variables provides an overview of the distributions of the players' various morphological characteristics, among which weight, standing height, BMI, wingspan and hand span are mainly studied. The scale is standardized and allows for direct comparison of distributions.

Weight and standing height show a narrower distribution with a median close to zero, indicating that these variables are relatively homogeneous among players. However, a few extreme values are observed, reflecting certain individual disparities in terms of morphology. Body Mass Index (BMI) and hand span also show a concentration around the median with scattered values, suggesting differences in body composition among players, possibly due to variability in muscle mass and fat distribution and the presence of atypical profiles that could influence performance.

Wingspan, on the other hand, shows a relatively balanced distribution, although there are a few extreme values, which could indicate players with atypical body types for their category. These observations suggest that some players have morphological characteristics that may give them an advantage in specific aspects of the game. This can be interpreted as a sign of uniformity in player selection criteria or in their physical development over years of training.

GOALKEEPERS BETWEEN DEFICITS AND POTENTIAL

Table 1. Average values of anthropometric variables for young goalkeepers from different countries

Player	Age (years)	Weight (kg)	Height (cm)	BMI (kg/m ²)
Senegal (average)	18.8	78.6	180.8	24.02
Algeria	18.5	87.0	186.7	24.98
Egypt	19.0	85.7	190.0	24.44
Morocco	17.7	73.7	171.7	24.33
Burundi	16.5	62.5	183.5	18.54
Rwanda	18.0	73.0	183.0	21.77
Germany	19.0	89.0	189.0	24.91
Denmark	19.0	101.5	196.5	26.29
Spain	19.0	88.0	191.0	24.15
Croatia	19.0	94.0	195.0	25.63
Portugal	18.5	104.0	192.3	28.50
South Korea	18.5	88.0	185.0	25.15
USA	18.0	79.3	186.7	23.30

Analysis of the anthropometric data of goalkeepers from different countries reveals several significant trends. Young Senegalese goalkeepers have an average height of 180.8 cm, which is below international standards (>190 cm), and a lower weight (78.6 kg compared to 90-100 kg). This may hinder their ability to cover the goal, but it does give them agility and speed. The average body mass index (BMI) is 24.56 kg/m² which is within the normal range for athletes. However, the standard deviation of 3.33 indicates variations in the body composition of goalkeepers. Some have a relatively low BMI (minimum 18.3 kg/m²), corresponding to a slimmer profile, while others have a higher BMI (maximum 36.6 kg/m²), indicating a high body mass that may be related to developed musculature or excess weight.

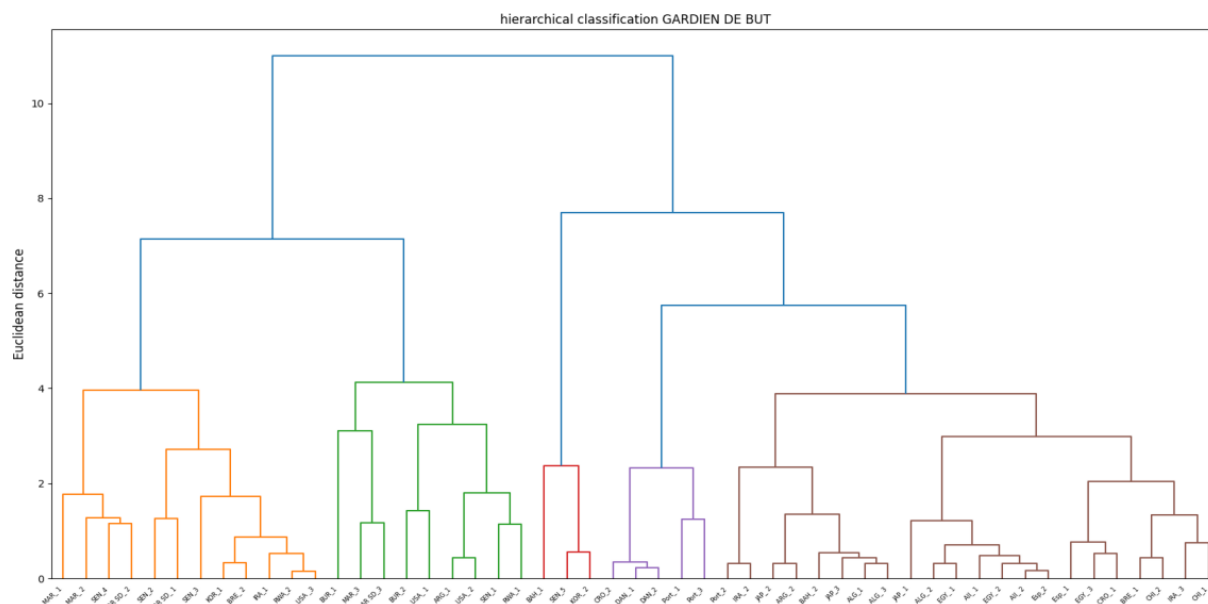


Fig. 3. *Ward's classification dendrogram of anthropometric variables for young goalkeepers from Senegal and other handball nations around the world*

The tree diagram shows the goalkeepers grouped into several distinct clusters, indicated by different colors. The hierarchical analysis generally classifies goalkeepers into three categories:

Physical and dominant goalkeepers with a height ≥ 195 cm, weight ≥ 95 kg and BMI ≥ 26 kg/m². This makes them excellent players for blocking long-range shots and controlling the air zone. An ideal asset for solid defensive systems requiring powerful and well-anchored goalkeepers. This is the case for goalkeepers from European countries such as Denmark, Croatia, Portugal and Germany, who are ready to provide stability in goal.

Mobile and responsive goalkeepers between 180 and 190 cm tall, weighing ≤ 85 kg and with a BMI < 25 kg/m². They are very quick on their feet and have excellent reflexes, making a significant contribution to high, aggressive defenses that require quick reactions. This is the case for the goalkeepers of South Korea, Brazil and Japan, who are more agile but sometimes less imposing.

Versatile goalkeepers who are around 185 and 195 cm tall and weigh between 85 and 95kg strike a good balance between size and speed, allowing them to adapt to different playing systems and the demands of the match. Goalkeepers from countries such as Senegal, Algeria and Egypt belong to this group in terms of their versatility but sometimes lack specialization.

From a practical point of view, this analysis allows coaches and physical trainers to adapt their strategies according to the profiles identified. For example, if a cluster includes goalkeepers with a high BMI, specific work on mobility and agility could be considered. Conversely, a cluster of lighter goalkeepers may require muscle strengthening or weight gain training.

PLAYMAKERS WITH AGILE BUT LIGHTWEIGHT PROFILES

Table 2. Average values of anthropometric variables for young back centers from different countries

Player	Age (years)	Weight (kg)	Height (cm)	BMI (kg/m ²)
Senegal (average)	18.2	62.7	179.3	19.65
Algeria	18.5	81.5	183.5	24.19
Egypt	19.0	80.0	184.0	23.79
Morocco	18.0	71.7	174.0	23.64
Burundi	17.5	66.0	176.0	21.31
Rwanda	18.7	71.7	176.7	22.84
Germany	19.0	88.0	188.7	24.75
Denmark	18.5	84.5	185.5	24.53
Spain	18.7	83.7	186.7	24.18
Croatia	18.5	80.0	183.7	24.08
Portugal	18.5	82.5	187.0	23.60
South Korea	18.7	77.6	181.0	24.07
USA	18.3	78.0	182.0	22.75

Analysis of this data highlights the significant differences between Senegalese center-backs and international standards, particularly in terms of their size. With an average height of 179.3 cm, they are smaller than center-backs from major European nations, who generally measure between 183 cm and 188 cm. This difference in size may limit their defensive reach and their ability to shoot from a distance, which is crucial for this position. In addition, their average weight of 62.7 kg is significantly lower than the 80 to 90 kg observed among the world's best players, which reduces their resistance to contact and their physical impact in one-on-one situations. With an average BMI of 19.65 kg/m² young Senegalese handball players have a deficit in muscle mass. This affects their impact in duels, despite their great mobility, which is useful in fast phases of play.

THE PLAYMAKERS: CORRECT HEIGHT BUT INSUFFICIENT MUSCLE MASS

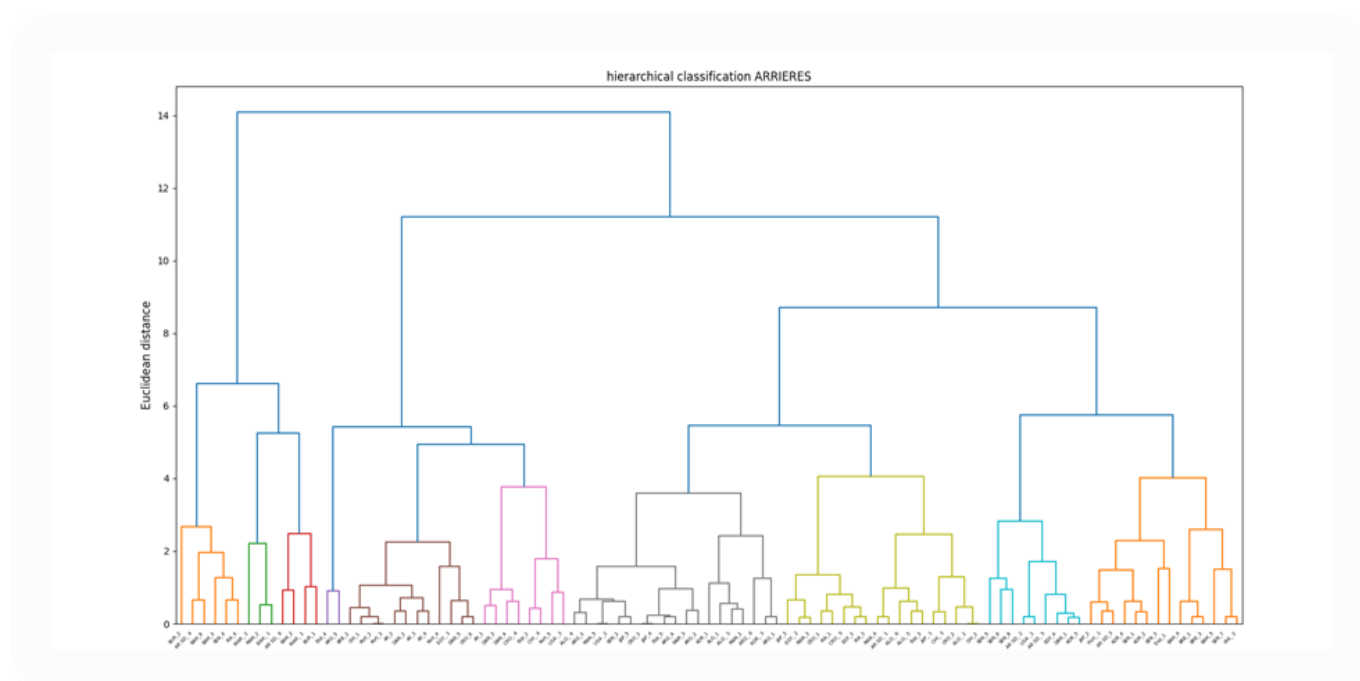


Fig. 4. Hierarchical classification dendrogram according to Ward's algorithm of young Senegalese back players and other playing handball nations

The results show an average height of 180.3 cm for the U20s compared to 176.8 cm for the U18s, which places the young Senegalese in the upper African average, but slightly below European standards (1.88 to 1.90 m). The average weight is 73.41 kg for the U20s and 67.13 kg for the U18s, which is below the Maghreb and European benchmarks, which range between 75 and 85 kg. BMI follows the same trend, with an average of 22.6 for the U20s and 21.5 for the U18s. The average wingspan is considered satisfactory (approximately 184 cm for the U20s), while the hand span remains below the optimal standards for ball handling and control.

Analysis of the dendrogram reveals three distinct groups:

The first group comprises physical and powerful back players, characterized by a height of over 190 cm, a weight exceeding 90 kg and a high BMI (≥ 25 kg/m²). These players are particularly effective in physical duels and long-range shots, making them essential in solid defenses and set attacks. This profile is dominant in European nations such as Germany, Denmark, Spain, Croatia and Portugal, where tall, heavy players are favored to ensure maximum power on the pitch.

The second group is full of mobile and fast defenders, who are distinguished by their moderate weight (75-85 kg) and great agility and explosiveness. These players excel in quick transitions and are suited to teams that favor fast, fluid play. This profile is particularly evident among Asian (South Korea, Japan) and South American (Brazil, Argentina) players, who rely on speed of execution and technical finesse rather than raw power.

The third group consists of versatile full-back players who are of average height (185-190 cm) and moderate weight (80-90 kg). These players have a balance of strength and mobility, allowing them to adapt to different styles of play. They are capable of playing both in attack and defense, depending on the needs of the team. This profile is typical of African and North African players, particularly those from Senegal, Algeria and Egypt, who are highly adaptable and can fit into several playing systems.

With an average height of 186 cm, Senegalese full-back players are close to international standards. However, their lower BMI reflects a lack of power, which can be compensated with targeted training.

FRAIL AND SMALL WINGERS

Table 3. Average values for anthropometric variables (height, weight, BMI) for wing players from different handball nations

Nation	Average height (cm)	Average weight (kg)	Average BMI (kg/m²)
Senegal	177.2	63.8	20.99
Algeria	186.2	84.3	24.3
Egypt	185.0	78.0	22.7
Morocco	173.0	70.5	23.0
Burundi	167.5	60.8	21.3
Rwanda	175.3	66.2	21.9
Germany	186.8	81.3	23.4
Denmark	187.3	82.5	23.6
Spain	186.7	80.5	22.9
Croatia	180.5	77.7	24.3
Brazil	184.5	75.7	22.1
South Korea	177.5	76.5	24.3

Analysis of the data shows that Senegalese wingers are smaller and lighter than players from other handball nations. Compared to the wingers from Algeria, Germany, Denmark and Spain, who are more imposing in stature, Senegalese players are smaller and lighter, which may affect their performance in physical duels and contact situations.

In modern handball, wingers must be fast, explosive and able to withstand physical challenges. However, the results obtained highlight several weaknesses among Senegalese wingers. First, there is a deficit in muscle mass, with an average weight 10 kg lower than the best nations, which reduces their ability to absorb shocks and impose themselves in duels. Secondly, they are slightly shorter, with a difference of 5 to 10 cm compared to European and North African players, which can limit their effectiveness in aerial duels and reduce their shooting range. Finally, their average BMI is less than 22 kg/m² which is insufficient to guarantee optimal performance in a sport where physical impact plays a key role.

However, this smaller stature can also be an asset in certain aspects of the game. A lighter build promotes greater mobility and agility, allowing players to be more responsive and move quickly on the pitch.

SMALL AND LESS POWERFUL PIVOTS

Table 4. Average values for anthropometric variables for different handball nations

Player	Age (years)	Weight (kg)	Height (cm)	BMI (kg/m ²)
Senegal (average)	18.6	78.0	184.0	22.73
Algeria	18.5	86.5	187.0	24.72
Egypt	18.0	96.5	194.5	25.52
Morocco	17.5	73.0	182.5	21.94
Burundi	17.3	67.3	176.0	20.40
Rwanda	18.5	79.0	183.5	23.64
Germany	18.7	102.3	190.0	29.19
Denmark	18.5	107.0	192.0	28.27
Spain	18.7	98.0	195.0	24.24
Croatia	18.7	96.7	195.0	25.34
Portugal	18.5	101.5	196.0	27.30
South Korea	18.6	88.5	187.3	26.15
USA	18.5	85.0	188.0	24.39

Analysis of the data shows that Senegalese pivots are lighter and slightly smaller than those of the top handball nations.

One of the first weaknesses identified is their height, which is below international standards. On average, Senegalese pivots measure 184 cm, while the global benchmarks for this position range from 190 to 196 cm. This difference in size may limit their ability to intercept balls, control play in the pivot zone and impose a dominant physical presence in defense. In a position where power and impact are essential, this height deficit can be a hindrance when facing more imposing opponents.

The weight and muscle mass of Senegalese playmakers are also a limiting factor. With an average weight of 78 kg, they are significantly lighter than their European counterparts, who generally weigh between 98 and 107 kg.

The BMI of Senegalese playmakers confirms these observations. With an average of 23.53 kg/m² it is below international standards, which range from 25 kg/m² to 29 kg/m² for a high-performing center.

4 DISCUSSION

The results of this study confirm that anthropometric characteristics play a crucial role in handball performance, as highlighted by Ziv and Lidor [1] and Nikolaidis and al [2]. Indeed, height, wingspan, weight and BMI are all factors that influence power, range of motion, defensive coverage and performance in one-on-one situations.

Firstly, although the average height of young Senegalese handball players increases with age (176.8 cm for U18s compared to 180.3 cm for U20s), it remains below European standards, particularly for positions requiring strong physical coverage such as backs and goalkeepers. According to Reilly and al. [5], high-intensity team sports require above-average size to optimize movement efficiency and defensive reach. This observation is particularly critical for goalkeepers, whose average height (180.8 cm) remains well below the 190 cm threshold considered optimal [6].

Furthermore, low body mass and reduced BMIs, particularly among center-halves (average BMI of 19.65), suggest a deficit in muscle development. However, several studies [7, 4] have shown that muscle mass is essential for repeated efforts, contact and powerful shots in offensive phases. Such a deficiency could limit the physical impact of these players in high-level competitions.

The profile of Senegalese players seems to be more akin to an ectomorphic somatotype (thin and slender), which is not conducive to contact, and this could justify early intervention in functional weight training to increase body density. This could be an advantage in terms of speed and agility, as demonstrated by the work of Marques and al. [8], which showed that lighter players benefit from shorter reaction times, greater agility and faster movement speeds, all of which are essential qualities during rapid transitions and diagonal runs towards the zone.

With regard to hand span, the results indicate an average value below international standards. However, this indicator is fundamental to gripping, ball control and the ability to perform feints or long passes [1]. Its development could be integrated into specific programs from the youth categories onwards, in conjunction with hand-eye coordination.

The difference between U18 and U20 players, particularly in terms of weight (+6.28 kg) and height (+3.5 cm), is consistent with the natural growth curve, but also suggests that the 16–20 age group is strategic for optimizing morpho-functional development, as highlighted by Souleyman and al. [9] in a study of handball players in sub-Saharan Africa.

Finally, the lack of rigorous differentiation by position in the talent identification process could explain the heterogeneity observed in the profiles. In this regard, Milanese et al. [4] emphasize the need for morphological profiling by position, incorporating both body dimensions and role requirements (speed, power, coverage).

When considering all handball positions, young Senegalese handball players show deficits in anthropometric variables compared to other nations that dominate African and world handball.

The main recommendations arising from this analysis are the systematic integration of anthropometric measurements into the detection cycles, the positional orientation of players according to their morphology, and the implementation of individualized muscle and postural development programs. Closer collaboration with research centers such as HIPE Human Lab or specialized institutes could enable better modelling of high-performance profiles.

5 CONCLUSION

This study reveals that young Senegalese U18 and U20 handball players have morphological characteristics that are partially aligned with international standards. While their height and wingspan are relatively satisfactory, weaknesses remain in terms of weight, muscle mass (BMI) and hand span, affecting their physical competitiveness. These shortcomings highlight the importance of structured morpho-functional support between the ages of 16 and 20, a key period for athletic development.

The analysis revealed differences in the anthropometric characteristics of young Senegalese handball players according to their playing positions and those of the best African and world handball nations. Given the importance of morphological profiles, it is useful to identify them during detection and specialization by position. It is therefore recommended that anthropometric measurements be included in regular assessments, targeted strength training programs be reinforced, and movement coordination be improved from an early age.

Finally, enhanced scientific collaboration between local institutions and international centers is essential to establish more comprehensive performance profiles that integrate physical and physiological dimensions. A national detection strategy based on these data would strengthen the competitiveness of Senegalese handball on the world stage.

REFERENCES

- [1] Ziv G., Lidor R. Physical attributes, physiological characteristics, on-court performances and nutritional strategies of female and male basketball players. *Sports Medicine*, no 39 (7), pp. 547–568, 2009.
- [2] Nikolaidis P. T., Ingebrigtsen J., Jeffreys I., Leprêtre P. M. Physical and physiological characteristics of elite handball players: Position-specific analysis. *Journal of Sports Medicine and Physical Fitness*, no 54 (4), pp. 414–420, 2014.
- [3] J.E.L Carter, B.H Heath. Somatotyping: Development and Applications. Cambridge University Press 1990.
- [4] Milanese C., Piscitelli F., Lampis C., Zancanaro C. Anthropometry and body composition of female handball players according to competitive level or the playing position. *Journal of Sports Sciences*, no 29 (12), pp.1301–1309, 2011.
- [5] Reilly T., Bangsbo J., Franks A. Anthropometric and physiological predispositions for elite soccer. *Journal of Sports Sciences*, no18 (9), pp.669–683, 2000.
- [6] Massuca L. M., Branco B. H., Fragoso I. C. Anthropometric and physiological profile of elite male handball players according to playing position: Relevance for selection process. *Journal of Human Kinetics*, no 46, pp.219–228, 2015.
- [7] Gorostiaga E. M., Granados C., Ibanez J., Izquierdo M. Differences in physical fitness and throwing velocity among elite and amateur male handball players. *International Journal of Sports Medicine*, no 26 (3), pp.225–232, 2005.
- [8] Marques M. C., Van den Tillaar R., Vescovi J. D., González-Badillo J. J. Changes in strength and power performance in elite senior female professional volleyball players during the in-season: a case study. *Journal of Strength and Conditioning Research*, no 23 (5), pp.1510–1514, 2009.
- [9] Souleyman M., et al. Comparative study of the anthropometric and biomechanical profiles of young handball players in sub-Saharan Africa. *African Journal of Sports Science*, no 13 (2), pp.45–58, 2018.