

A Study of Morphological and Physical Development Characteristics of Footballers (U17) in Algeria

دراسة خصائص النمو المورفولوجي والبدني لدى لاعبي كرة القدم (تحت 17 سنة) في الجزائر

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Abstract : This study aimed to examine the anthropometric and physical development characteristics of youth football players in Algeria. The sample consisted of cadet-category footballers from the national U17 team and their counterparts from the Ouargla province. Through the use of standardized anthropometric measurements and physical development indices, a comparative analysis was conducted. The findings revealed that Ouargla-based players exhibited significantly lower anthropometric values. Furthermore, indicators such as BSA, Kaup Index, and Sheldon's Ponderal Index suggested that the players from Ouargla demonstrated limited physical development, particularly in muscular and skeletal components. These disparities may reflect regional inequalities in training infrastructure, nutritional access, and talent identification protocols. The results underscore the importance of integrating morpho-functional assessment into youth football development strategies to enhance talent selection and performance optimization in underserved areas.

Keywords: Morpho-functional profile, Youth football, Anthropometry, Physical development

الملخص : هدفت هذه الدراسة إلى تحليل خصائص النمو الأنثروبومتري والبدني لدى لاعبي كرة القدم الشباب في الجزائر. تألفت العينة من لاعبي فئة الأشبال من المنتخب الوطني تحت 17 سنة ونظرائهم من ولاية ورقلة. ومن خلال استخدام قياسات أنثروبومترية موحدة ومؤشرات النمو البدني، تم إجراء تحليل مقارنة بين المجموعتين. كشفت النتائج أن لاعبي ورقلة سجلوا قيماً أنثروبومترية أقل بشكل ملحوظ. كما أشارت مؤشرات مثل مساحة سطح الجسم (BSA)، ومؤشر كاوب، ومؤشر شيلدون البنيوي إلى أن لاعبي ورقلة يعانون من نمو بدني محدود، خاصة في الجوانب العضلية والهيكلية. وقد تعكس هذه الفروقات وجود تفاوتات جغوية في البنية التحتية للتدريب، والوصول إلى التغذية، وبرامج اكتشاف المواهب. وتؤكد النتائج على أهمية دمج التقييم المورفو-وظيفي ضمن استراتيجيات تطوير كرة القدم لدى الفئات السنية، من أجل تحسين انتقاء المواهب وتعزيز الأداء في مناطق الظل.

الكلمات المفتاحية : البروفيل المورفو-وظيفي، كرة القدم ، الأنثروبومتري، النمو البدني.

INTRODUCTION

Sport practice is widely recognized as a field that requires the integration of various research methods from both educational and biological sciences to enhance athletic performance across the different domains of preparation—namely physical, technical, tactical, and psychological (Nikolaidis & Knechtle, 2020).

Among these domains, sports morphology has emerged as a key biological science with significant relevance in sports research. This discipline focuses on analyzing the structural changes in the human body resulting from physical training, and on understanding the adaptive and recovery mechanisms in athletes at various stages of biological development (Malina et al., 2015).

Given its importance, scientific inquiry in sports morphology seeks to assess a range of body dimensions—including lengths, widths, circumferences, and skinfold thicknesses. By applying morphological analysis techniques, researchers can establish morphological profiles of athletes, which are crucial for talent identification and training individualization. Morphological indicators also enable the examination of correlations between anthropometric parameters and physical performance outcomes (Sedeaud et al., 2014).

Exploring the relationship between sports performance and morphological traits is particularly relevant, as this field relies on precise somatometric tools and anthropometric databases collected directly from athletes to enhance their preparation and selection. Several earlier and contemporary researchers (Schwartz & Krouchev, 1984; Naceur et al., 1990; Nikolaidis & Knechtle, 2020) have emphasized the predictive value of morphological variables in determining athletic potential.

The age group targeted in this study (15–17 years) warrants specific focus, as it represents a critical period for identifying future athletic talent. This

stage is also considered a transitional phase from general physical training to performance specialization and is particularly favorable for motor development and physiological adaptation (Weineck, 1993; Malina et al., 2015).

In the Algerian context, football is widely practiced in both the northern and southern regions. However, performance outcomes over recent years have consistently shown that teams from the north dominate national titles (leagues and cups). This observation raises the following critical question:

Could such disparities be influenced by physical and morphological differences among athletes from different regions?

This study, therefore, poses the following research question: Do the morphological parameters of U17 football players from southern Algeria reflect the reference model of the national elite?

To address this issue, we hypothesize that by examining the somatotype profiles and physical development indicators of southern Algerian U17 football players—compared with those of players in the national team—it will be possible to identify potential performance gaps or advantages. These findings could inform adjustments in the selection and training process, helping to align talent development strategies with scientifically supported morphological standards.

1.Objectifs

To achieve the aims of this study, we set the following specific objectives:

- To perform anthropometric measurements and physical fitness tests on youth football players.
- To compare anthropometric and physical data between players from northern and southern regions of Algeria.
- To conduct statistical analyses of the collected data in order to identify regional differences and potential morphological patterns.

These objectives are aligned with the growing need for region-specific profiling and development strategies in talent identification programs (Towlson et al., 2022; López-Fernández et al., 2020).

2.Participants

The study sample consisted of **male youth football players aged 15 to 17 years** participating in competitive championships within selected northern and southern provinces (wilayas) of Algeria. This age group represents a biologically sensitive period for athletic development and is often targeted in national scouting programs (Malina et al., 2015; Johnson et al., 2023).

- **National Team Cadet Players (U17):** 19 athletes from the Algerian U17 national squad.
- **Regional Players – Ouargla (South):** 14 athletes from the Ouargla wilaya U17 championship.

This comparative approach is in line with recent studies advocating for **contextualized profiling** of young athletes to address disparities in access, development, and representation (Rago et al., 2022; Slimani et al., 2019).

3.Methods

3.1. Anthropometric Measurements

Anthropometric data were collected based on standardized anatomical landmarks—such as bony prominences (e.g., condyles, apophyses), soft tissue reference points (e.g., skinfolds, umbilicus), and structural points (e.g., acromion, iliac crest, nipples).

The following measurements were included:

- **Basic metrics:** Body weight and height
- **Longitudinal dimensions:**
 - Upper limb length
 - Arm, forearm, hand lengths

- Lower limb length
 - Thigh, foot, and trunk lengths
- **Transverse dimensions:**
 - Biacromial and bicristal diameters
 - Distal diameters of upper/lower limbs (e.g., arm, forearm, thigh, leg)
- **Circumferences:**
 - Arm (at rest), mid-forearm, thigh, and lower leg
- **Skinfold thickness:**
 - Subscapular, abdominal, bicipital, tricipital, forearm, thigh, and leg skinfolds

These parameters are widely used in modern sports performance profiling to detect early morphological predispositions (Silva et al., 2021; Sedeaud et al., 2014).

3.2. Physical Development Indices

Several indices were calculated to assess biological maturity and somatic development:

- **Body Surface Area (BSA):** Estimated using the Izakson formula based on height and weight.
- **Kaup Index (1921)** also referred to as the Body Build Index, Sheldon's Ponderal
- **Index of Sheldon.**
- **Body Composition Components:** Estimated using Mateigka's formulas, allowing for the quantification of muscle mass, fat mass, bone mass, and residual mass.
- **Heath–Carter Somatotype Method:** This method uses anthropometric data (e.g., height, weight, skinfolds, girths) to classify

individuals into one of the somatotype categories (endomorphism, mesomorphism, ectomorphism) (Heath & Carter, 1975).

These indices are essential for distinguishing between normal maturational development and sport-induced adaptation, especially in youth populations (González-Ravé et al., 2018; Deprez et al., 2015).

4. Statistical Analysis

The statistical treatment of the data was performed using Excel Stat software (version 2024) to assess the morphological and physical development characteristics of elite and regional U17 football players. Descriptive statistics were calculated for all variables, including the arithmetic mean and standard deviation (SD) to describe central tendency and data dispersion, respectively.

In addition, the coefficient of variation (CV) was computed to evaluate relative variability between the groups. To determine statistically significant differences in anthropometric and physical parameters between elite and regional players, an independent samples t-test (Student's t-test) was applied. Statistical significance was set at $p < 0.05$.

This combination of descriptive and inferential statistics provided a comprehensive basis for identifying meaningful inter-group differences and variability patterns in the development profiles of U17 footballers in Algeria.

5. RESULTS

To ensure clarity and scientific rigor, the results of this study will be presented in the following structure:

First, we will present the total anthropometric parameters—specifically, body weight and height—for both groups of Algerian youth football players: those from the national U17 team and those from the Ouargla regional team.

Next, we will focus exclusively on the segmental anthropometric parameters and the physical development indices recorded in both groups.

Following this, we will analyze the somatotype components of the players in each group, highlighting intergroup differences. This will be followed by a comparative assessment of the Heath–Carter somatotypes between the two teams and the corresponding somatochart visualization.

5.1.Total Anthropometric Parameters: National Team vs. Ouargla Team

• Segmental Anthropometric Parameters: National Team vs. Ouargla Team

The segmental anthropometric parameters presented below are recommended by Heath and Carter (1975) for the determination of somatotype. These include:

- Distal diameters of the arm and thigh
- Limb circumferences, specifically of the arm and lower leg
- Skinfold measurements, including the triceps, subscapular, suprailiac, and calf skinfolds.

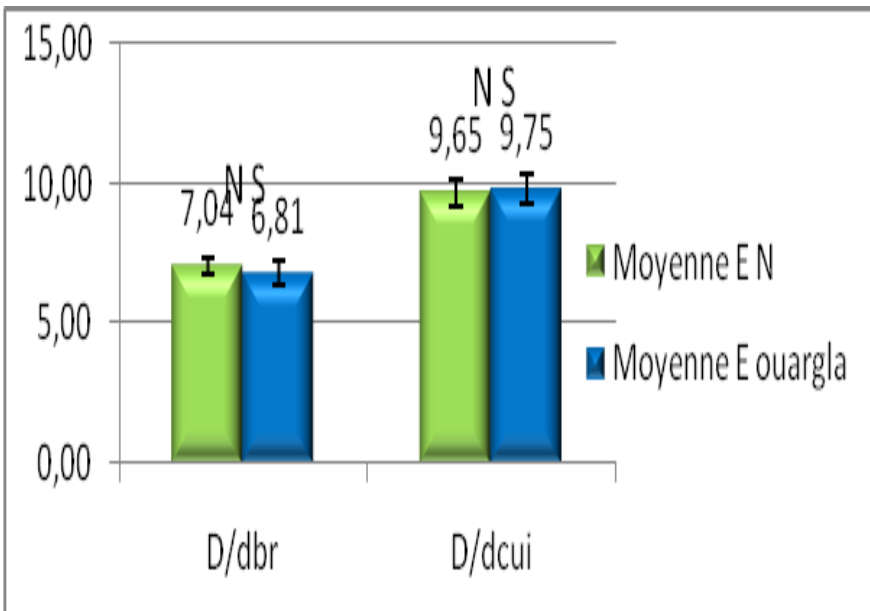


Figure 1. Graphical Representation of Distal Diameters (Arm and Thigh) in Footballers from Both Regions

The graph above illustrates that the distal diameter values for the arm and thigh are very similar between the two groups. Elite players (national team) recorded a mean value of 7.04 ± 0.32 cm, while players from the Ouargla region averaged 6.81 ± 0.44 cm. These differences are considered statistically non-significant (N.S.), indicating a comparable development of this parameter in both populations. A similar trend was observed for the distal forearm diameter, with no statistically significant difference between groups. The national team recorded a slightly higher mean of 5.43 ± 0.33 cm compared to 5.09 ± 0.40 cm for the Ouargla players.

● **Skinfold Thickness Measurements:**

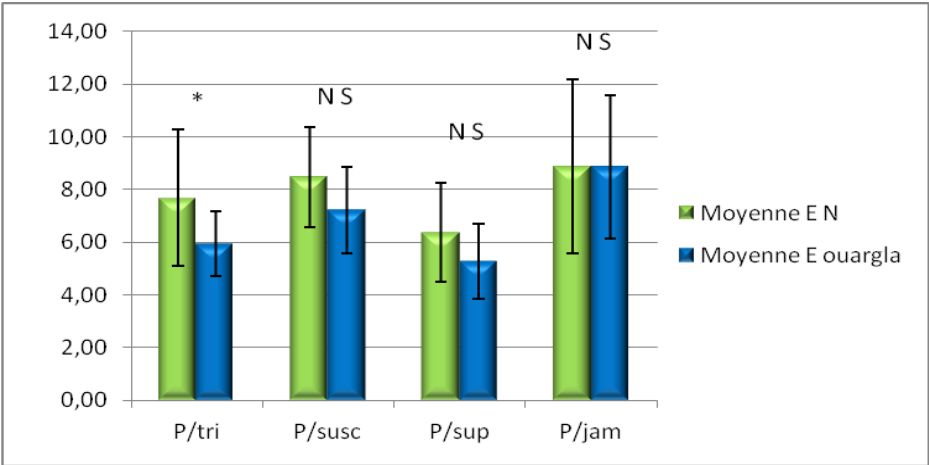


Figure 2. Graphical Representation of Skinfold Thickness in Footballers from Both Regions

Based on established skinfold classification criteria (Moreno, 2007), the footballers from both the national and Ouargla teams demonstrated acceptable levels of subcutaneous fat across key anatomical sites: triceps, subscapular, suprailiac, and calf regions. These values fall within healthy reference ranges for adolescent athletes, reflecting adequate body composition for this age group

(Silva et al., 2021; Mihajlovic et al., 2023). The analysis revealed that the mean triceps skinfold was significantly higher in national team players (7.68 ± 2.60 mm) compared to Ouargla players (5.94 ± 1.25 mm) ($p < 0.05$). This may indicate a slight accumulation of peripheral fat among the elite players, possibly due to variation in training load or maturation status (Carter & Ackland, 2020). For the subscapular skinfold, values were relatively close: 8.46 ± 1.83 mm (national) versus 7.23 ± 1.64 mm (Ouargla), suggesting similar trunk fat distribution. In terms of the suprailiac skinfold, the national team players again recorded higher mean values (6.37 ± 1.88 mm) compared to 5.27 ± 1.44 mm in the Ouargla group. However, calf skinfold measurements were nearly identical between both groups: 8.88 ± 3.31 mm and 8.86 ± 2.71 mm, respectively, with no statistically significant difference observed. Skinfold-based assessments remain a valid and cost-effective tool to evaluate relative fat mass in young athletes, especially when tracking developmental and regional variations (Berral de la Rosa et al., 2021; Mihajlovic et al., 2023).

- **Body Weight Components**

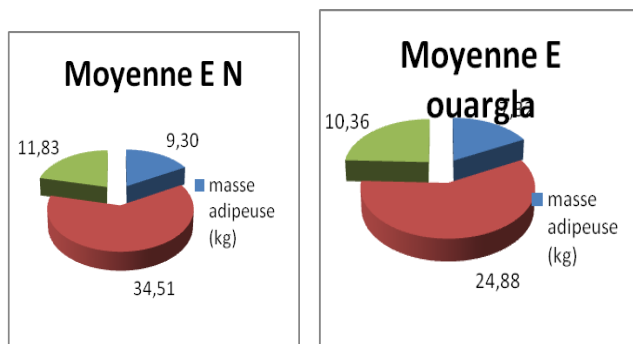


Figure 3. Graphical Representation of Mean Body Mass Components in Footballers from Both Groups.

The histogram presented in Figure 6 provides a clear indication of the differences in muscle mass percentage between the two groups. The national team players recorded a significantly higher muscle mass percentage (34.51%) compared to players from Ouargla (24.88%). This finding suggests that elite-level players benefit from a more advanced muscular development, likely due to more structured training regimes and greater physical conditioning (Mihajlovic et al., 2023; Malina et al., 2015).

In contrast, the differences between the two groups in fat mass and bone mass were minimal and did not demonstrate notable divergence. These results highlight muscle mass as a key morphological factor distinguishing regional and elite youth players.

5.2. Physical Development Indices in Algerian Youth Footballers

To obtain a comprehensive understanding of the players' somatic profile, three key physical development indices were employed:

-Body Surface Area (BSA), calculated using the Izakson formula based on height and weight. This indicator reflects the overall metabolic surface of the body and is often used in pediatric and sports physiology to scale body dimensions.

-Kaup Index (also referred to as Body Build Index), calculated as:

$K = \frac{P}{T^2}$ where P is body weight (kg) and T is height (cm). This index provides an estimate of weight-to-height proportionality, particularly in youth.

-Sheldon's Ponderal Index, which provides insight into body linearity. It is calculated as:

This index is often used in morphological studies to distinguish ectomorphic tendencies in young athletes (Carter & Ackland, 2020).

These indices are frequently utilized in youth athlete profiling to assess maturation status, body proportionality, and training responsiveness (Deprez et al., 2015; Silva et al., 2021).

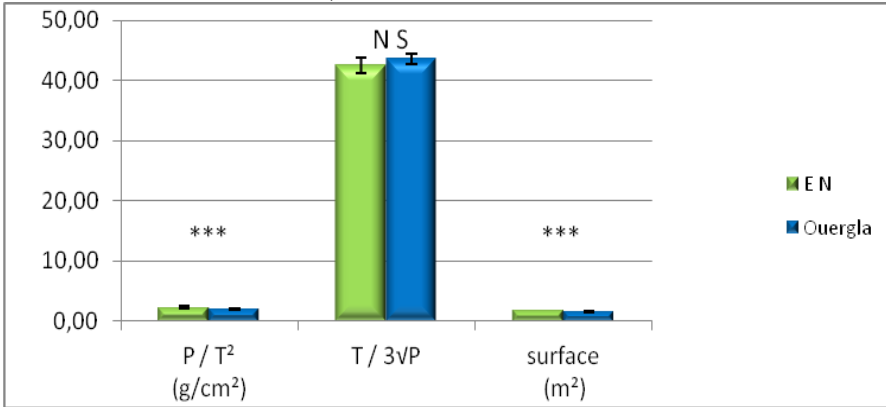


Figure 4. Graphical Representation of Physical Indices in Both Groups

Regarding the Body Mass Index (BMI), the national team recorded a mean value of 2.31 ± 0.16 g/cm², while the southern Algerian players (Ouargla) registered a lower mean of 1.99 ± 0.13 g/cm². ANOVA tests revealed a highly significant difference between the two groups ($p < 0.001$), suggesting a marked disparity in weight-to-height proportionality.

The Sheldon Index, which reflects body linearity, was 42.51 ± 1.23 in the national team and 43.60 ± 0.94 in the Ouargla group. While the values appear close, statistical analysis revealed a significant difference ($p < 0.05$), indicating subtle variations in somatic proportions between the two populations.

As for Body Surface Area (BSA), the national team displayed a higher value (1.88 ± 0.09 m²) compared to 1.58 ± 0.18 m² in the Ouargla players. The difference was highly significant ($p < 0.001$), further emphasizing the overall morphological advantage of elite-level youth footballers.

These three indices collectively support the view that body structure and development vary considerably between regional and national-level players—

likely due to differences in biological maturation and training exposure (Malina et al., 2015; Johnson et al., 2023).

5.3.Comparative Study of Somatotype: National Team vs. Ouargla Team

The comparative somatotype data (see Appendix) display the mean values and standard deviations for each component—endomorphy, mesomorphy, and ectomorphy—for both groups of players.

● Endomorphic Component:

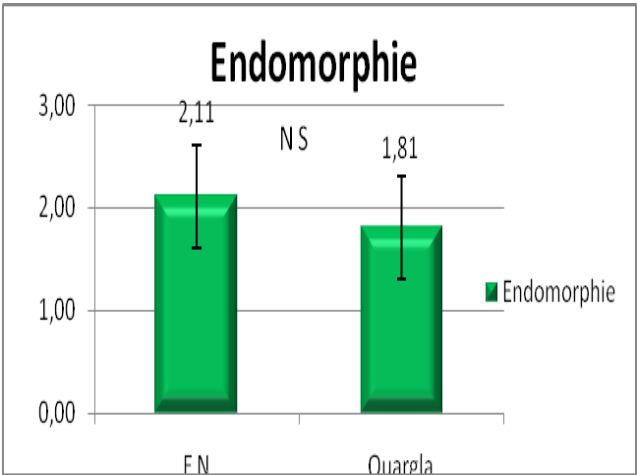


Figure 5. Representation of the Endomorphic Component in Footballers from Both Regions

The mean values of the endomorphic component differed between the two samples. Players from the national team recorded a higher average of 2.11 ± 0.59 , compared to 1.81 ± 0.42 in the Ouargla team. Despite this observed difference, statistical analysis revealed that the variation was not significant, suggesting a comparable level of relative fatness in both groups. These results align with findings from recent studies indicating that while elite youth footballers may exhibit slight variations in endomorphy, these differences are not always statistically relevant unless correlated with metabolic or maturation markers (Berral de la Rosa et al., 2021; Mihajlovic et al., 2023)

- **Mesomorphic Component:**

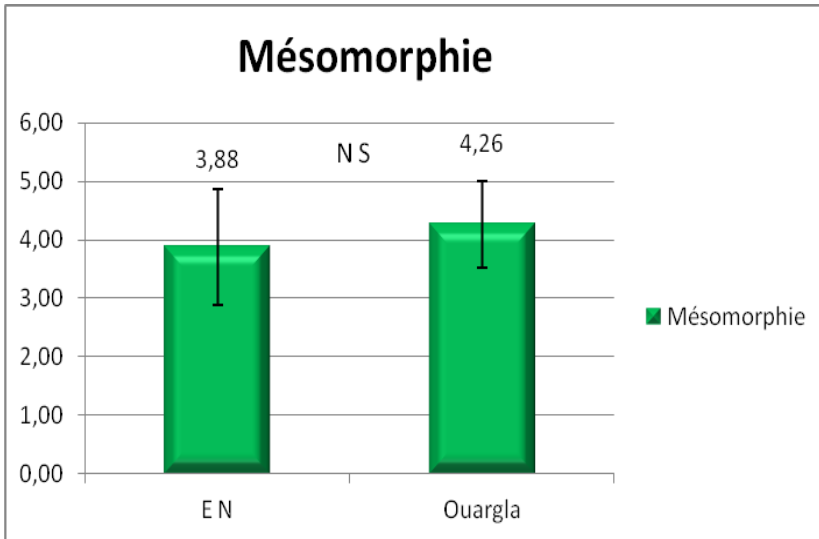


Figure 6. Graphical Representation of the Mesomorphic Component in Footballers from Both Groups

The mesomorphic component—which reflects the relative development of musculoskeletal mass—was observed in both groups of players. Notably, the national team players exhibited a lower mean mesomorphy score (3.88 ± 0.98) compared to their counterparts from Ouargla, who averaged 4.26 ± 0.74 .

However, the comparison of mean values for this component showed no statistically significant difference, indicating that the level of muscularity was relatively similar between the two groups, despite regional differences in training exposure and competition level.

These findings are consistent with previous literature suggesting that mesomorphy values in youth athletes can fluctuate depending on growth stage, positional role, and training frequency (Carter & Ackland, 2020; Silva et al., 2021).

• Ectomorphic Component:

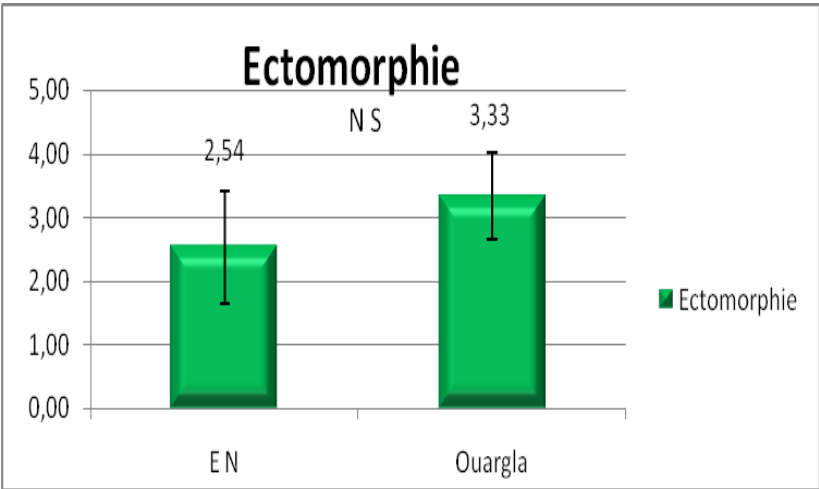


Figure 7. Graphical Representation of the Ectomorphic Component in Footballers from Both

Similar to what was observed in the endomorphic component, the ectomorphic profile showed that players from the Ouargla group had a higher mean score (3.33 ± 0.69) compared to their peers from the national team. This suggests a slightly greater tendency toward linearity and leanness among southern players. Nonetheless, the comparison of group means revealed no statistically significant difference, indicating that both groups share a relatively similar ectomorphic somatic tendency. with recent research emphasizing that ectomorphic tendencies in adolescent footballers are influenced by growth stage, nutrition, and metabolic balance rather than just training intensity (Esparza-Ros et al., 2020; Mihajlovic et al., 2023). Some studies further suggest that ectomorphy may be more prevalent in youth populations from regions with higher thermal stress or lower caloric intake (Silva et al., 2021; Towlson et al., 2022).

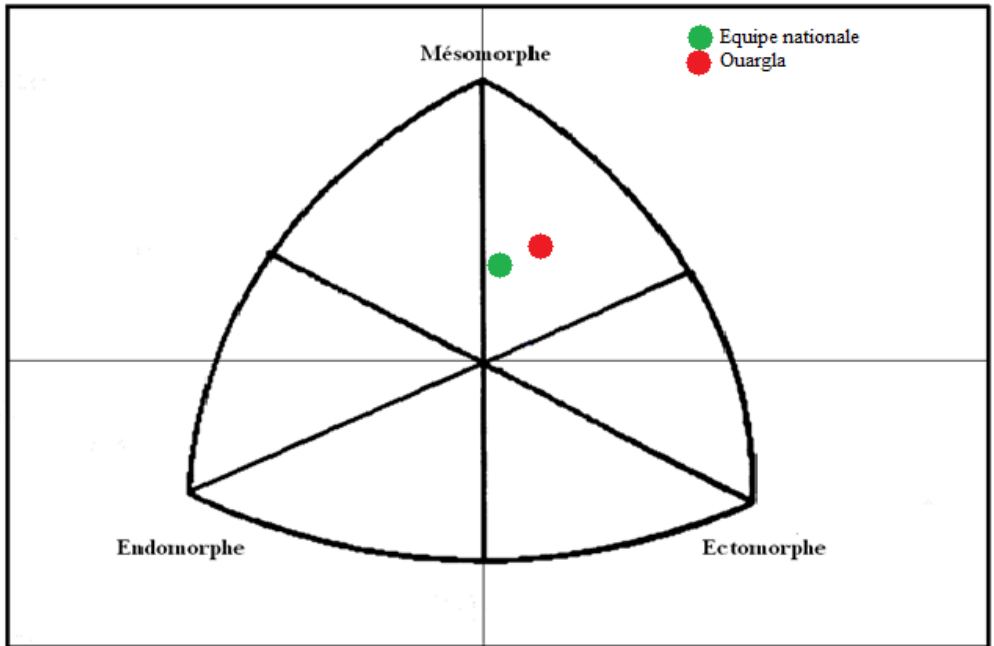


Figure 8. Somatotype Representation of National Team and Ouargla Footballers

The somatotype analysis of our sample reveals a predominant ecto-mesomorph classification:

- **National team:** 2.11 – 3.88 – 2.54
- **Ouargla team:** 1.81 – 4.26 – 3.33

This indicates that both groups possess relatively tall, lean bodies with moderate muscularity, typical of athletes in endurance-demanding team sports such as football (Carter & Heath, 1990; Ackland et al., 2012).

6. Discussion

Compared to the national team players, those from Ouargla exhibited significantly lower values in both body mass and stature. This anthropometric gap was statistically confirmed ($p < 0.001$), and may reflect differences in growth trajectories, training exposure, and environmental adaptation.

Although anthropometric traits alone do not determine performance outcomes, numerous studies have emphasized their role in football-specific success. Body height and weight have been identified as critical selection criteria in high-level football academies (Marković & Mikulić, 2019; Towlson et al., 2022), as they influence biomechanical efficiency and physical presence in match situations (Masanovic et al., 2020).

Moreover, while physical training does not significantly impact final stature (Vandervael, 1980), the selection bias toward taller players in national programs may explain the height advantage observed in our elite sample.

Given that bone, muscle, and fat are the primary contributors to body mass, our data suggest that the national team players have superior muscular and skeletal development compared to their Ouargla counterparts. This could be attributed to biological maturation stages as well as greater exposure to structured strength and resistance training (Malina et al., 2015; Cumming et al., 2017).

The significant differences in muscle and fat mass between the groups may also be influenced by environmental and nutritional factors:

- Elevated ambient temperatures in southern Algeria may promote reduced fat storage as a thermoregulatory adaptation (Baker et al., 2021).
- Suboptimal nutrition in under-resourced regions may limit protein synthesis and muscle growth during adolescence (Eirale et al., 2020; Nikolaidis et al., 2022).

According to Sheldon's classification, both groups displayed low endomorphy, moderate mesomorphy, and moderate ectomorphy, indicating low fat accumulation and moderate levels of muscular and skeletal development.

The literature supports that successful footballers tend to exhibit high mesomorphic dominance, which contributes to power, speed, and resistance in competitive matches (Slimani et al., 2019; García-Pallarés et al., 2023).

Importantly, recent studies have shown that morphological and fitness differences tend to be more pronounced at younger age categories, particularly in under-17 groups. These findings underscore the need to review physical development protocols and ensure that talent identification strategies remain age-appropriate and biologically informed (Vaeyens et al., 2005; Rago et al., 2022).

Conclusion

At the conclusion of this modest study, and in light of the statistical analyses we conducted, our primary contribution lies in proposing a set of morphological and developmental indicators aimed at improving the performance levels of Algerian U17 footballers. Specifically, we propose a framework for physical profiling and classification that may assist coaches and sport scientists in optimizing training loads and enhancing performance through more individualized and evidence-based programming.

Firstly, regarding the total anthropometric parameters (body weight and stature), our findings indicate that footballers from the Ouargla region consistently showed lower values in both variables when compared to players from the national team. These disparities may reflect underlying differences in growth, maturation, and exposure to high-performance environments.

Moreover, the analysis of physical development indices—which link body weight to stature—revealed that players from both groups exhibit relatively limited somatic development, especially among the Ouargla group. These observations point to a need for targeted interventions focusing on nutrition, strength development, and load management during adolescence.

In terms of somatotype classification, and according to the Heath–Carter method, the players in our study generally fall into the ecto-mesomorphic category, with the Ouargla group showing a lower degree of muscular development. This somatic profile may hinder their ability to produce high-intensity physical efforts, and could partly explain their underperformance in competitive matches.

While talent selection in football is inherently multifactorial, the current results suggest that physical development metrics remain important—though not exclusive—predictors of success at elite youth levels. However, such measures alone may lack the sensitivity and predictive power required to serve as standalone tools for talent identification.

Therefore, future research and applied practice should adopt a multidimensional approach, incorporating not only morphological and physiological variables, but also psychological traits, technical abilities, and developmental histories. Such integrative models would allow for a more holistic understanding of what defines success in modern professional and international football.

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