



## Detecting young middle-distance talent through morpho-functional parameters.

### Détection des jeunes talents pratiquant le demi-fond à travers les paramètres morpho-fonctionnels.

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#### Abstract :

Every year, there are almost 350 active athletics clubs, associations and structures in Algeria, practicing middle-distance running. We describe Algerian children by their very nature as middle-distance runners. Our current focus is on the 11, 12 and 13 age groups, characterized by a high proportion of runners interested in the remarkable performances recorded, i.e. an Algerian record every two years (FAA, 2020). Our sample consisted of 198 young athletes, aged 12.80. We carried out anthropometric investigations to determine the main morphological characteristics to be retained for detection and selection. To do this, we used multifactorial analysis. This must attract the attention of decision-makers and implement and exploitation of the scientific aspect of sports detection, as an essential factor of sporting excellence that accompanies the young sports talent, within a multi-annual model of systematic sports training and validated by general and specific methodological rules (Vladimir, L et al, 2014). Young people in this age group undergo well-defined training loads, either through a framework of games and in most cases through intensive training loads; to participate in local and national competitions. We know that around the age of 12 and 13, the training regime can reach 20 hours per week for periods ranging from 6 to 11 months per year (Platonov 1984). We therefore set ourselves the task of determining the detection for a given specialty, considering the morphological and functional aspects of young populations.

**Keywords:** middle-distance, young athletes, morphology, principal component analysis

#### Résumé :

La pratique de l'athlétisme en Algérie compte chaque année près de 350 associations, structures et clubs sportifs actifs pratiquant la discipline de course à pied sur les des distances de demi-fond. Nous qualifions l'enfant algérien par sa nature, qu'il est demi-fondeur.

Actuellement, notre préoccupation s'inscrit pour l'étude de la tranche d'âge 11,12 et 13 ans ; caractérisée par une proportion élevée de nombre de pratiquants intéressé par les performances remarquables enregistrées, soit un record d'Algérie chaque deux ans (FAA, 2020). Notre échantillon est de 198 jeunes pratiquants, âgés de 12,80 ans.

Nous avons réalisé des investigations anthropométriques pour déterminer les principaux caractères morphologiques à retenir pour la détection et sélection. Pour cela nous avons utilisé les analyses multifactorielles.

Ceci doit attirer l'attention des décideurs et mettre en œuvre et l'exploitation de l'aspect scientifique de la détection sportive, en tant que facteur essentiel de l'excellence sportive qui accompagne le jeune talent sportif, au sein d'un modèle pluriannuel d'entraînement sportif systématique et validé par des règles méthodologiques générales et spécifiques (Vladimir, L et al, 2014). Les jeunes de cette tranche d'âge subissent des charges d'entraînement bien définies, soit par un cadre de jeux et dans la plupart des cas par le biais des charges d'entraînement intensives ; afin de participer aux compétitions locales et nationales. Nous savons que vers l'âge de 12 et 13 ans, le régime de l'entraînement peut atteindre 20 heures par semaine pour des périodes s'étalant de 6 où 11 mois par an (Platonov 1984). Pour cela nous nous assignons comme tâche la détermination de la détection pour de en prenant en considération l'aspect morphologique et fonctionnel des populations jeunes au niveau d'une spécialité donnée.

**Mots clés :** demi-fond, jeunes athlètes, morphologie, analyse en composantes principales

## Introduction :

In athletics and depending on the different disciplines practiced (jumping, throwing and running) there is a precise morphological profile for each discipline. In athletics on the world and international competitive stage, middle-distance running events take place on the track outdoors or indoors, on the road or on natural terrain (cross-country). Track distances generally range from 800 to 3,000 meters. This includes the 800 meters, 1500 meters and 3000 meters steeples, which are Olympic disciplines, but other distances are also included in the middle-distance table: the 1000 meters, the mile (1609 m), the double mile, the 2000 meters and the 3000 meters flat (Wikipedia, 2020). The body composition for each distance run is very precise.

To access these different morphotypes, it is important to detect talent in a large population of young athletes. Talent is defined as all the superior aptitudes and abilities, natural or acquired, in each type of activity, a concept which we will replace with the notion of 'subjects with superior potential', which we feel is less definitive and more appropriate (Cazorla, 1984).

Toivo Jûrimâe and Jaak Jûrimâe (2000) presented a study on the characteristics of growth and motor development in pre-pubertal children. By defining the anthropometric and motor properties specific to this period of pre-pubertal age. In the same context, Armstrong and Jûrimâe, (2009), also defined the particularities of the influence of physical exercise on growth and especially bone mineral density (BMD), in child swimmers (10-16 years), as well as on the different segments and body compositions (BMI). In a longitudinal study of Canadian pre-pubertal children in the sport-study class, Léone and Larivière (1998) defined morpho-functional characteristics in which a very large number of strong correlations between anthropometric and motor variables were found at the age of less than 13.25 years. Malina, (1975), indicates that there are correlations between stature, weight and motor performance in tests commonly used during adolescence. Espenshade (1963); Montoye et al, (1972) estimated that several relationships between age, stature and weight account for 25% of the variance in the running, jumping and shot put test in children aged 12 to 15 years, however a small percentage of the variance in performance that can be explained by age, stature and weight implies the significance of other factors (motivation, degree of maturity...etc.) during puberty.

It would be desirable to draw up a study to serve as a methodical and practical approach or expert opinion based on statistical investigations of anthropometric and motor parameters in this population. Several questions arise:

Are there reliable relationships between morphological and functional characteristics and between morphological indices to determine specific indices for identifying talented young Algerian middle-distance runners?

- What is the description of the anthropometric and motor characteristics of young Algerian middle-distance runners in the 11, 12 and 13 age groups ?

- Is there a statistical relationship between anthropometric and motor characteristics, examined and verified by the multidimensional statistical method of principal component analysis (PCA) ?

## Detecting young middle-distance talent through morpho-functional parameters

The main objective of this work is to define and highlight the anthropometric and motor profile of Algerian children (11, 12, 13 years old), boys practising middle-distance running events. This profile will serve as a model for the selection of young middle-distance runners according to the age group chosen. Using multifactorial methods to select the most representative anthropometric characteristics will make it possible to be more precise in the choice of morphological parameters selected during the tests.

### Methodology:

#### Presentation of the sample:

Our study was carried out on a sample of Algerian children, boys from the wilaya of Sétif (altitude 1200 m), who have already been selected to run middle-distance races in athletics. The subjects were aged 11-12-13, pre-pubescent and at school, and held sports licences with the following sports clubs: Club Olympic Setifis, CSA Mezloug, IR Ain k'bira and ESE Eulma. The athletes followed the competition programme of the Algerian Athletics Federation, in cross-country and middle-distance events. They do an average of 05 to 06 training sessions per week and 10 to 14 competitions per year. Many of these athletes are ranked in terms of results among the best athletes in their age category at national level. The total number of subjects in the sample was 198, with an average age of  $12.7 \pm 0.8$  years and a sporting seniority of  $1.75 \pm 0.73$  years.

#### Anthropometric investigation method:

Measurements were taken using basic anthropometric techniques. Bone landmarks and measurements were standardized by Martin R., (1928), then by Ross et al. (1982). All the measurements were taken by the same person, and the results were recorded on individual sheets for each athlete.

We used :

- An anthropometric suitcase of the G.P.M (Siber Hegner) type; An Anthropometer of the MARTIN type
- A caliper with olive tips, to measure body diameters.
- A tape measure.
- Lange-type folding forceps or caliper for measuring skinfolds.
- A medical scale to measure weight to an accuracy of at least 50 grams.

Body weight (Kg) is obtained using a medical scale.

For the statistical analysis, we used multivariate statistical methods, namely principal component analysis (PCA). PCA consists of performing a certain rotation in the space of variables to extract a reduced number of correlated components which cover the maximum of the variability induced by the data set.

Statistics are produced using Statistica 23.0 software.

## Results :

### 1 Total parameters

**Table 1. Descriptive statistics of total sample parameters (years)**

| Variables        | Number | Mean   | Standard deviation | Coefficient of variation% |
|------------------|--------|--------|--------------------|---------------------------|
| Age (ans)        | 198    | 12,07  | 0,81               | 6,75                      |
| Height(cm)       | 198    | 150,16 | 10,11              | 6,73                      |
| Weight (kg)      | 198    | 40,01  | 7,17               | 17,93                     |
| Sports seniority | 198    | 1,75   | 0,73               | 41,71                     |

The height is estimated at an average of  $(150.16 \pm 10.11)$  years), the body mass measures  $(40.01 \pm 7.17 \text{ kg})$ , our subjects practice middle-distance running events for an average duration of  $(1.75 \pm 0.73)$  years), the average weight of our population is  $(40.01 \pm 7.17 \text{ kg})$ . According to the reading of the data of the distributions relating to the degree of disparity, indicates to us a rapprochement of the data. The coefficient of variation (CV%) reflects a high homogeneity of the data on height (CV=6.73%), age (CV=6.75%); however, the weight has a (CV=17.93%) which is just average.

### 2. Principal component analysis of the morpho functional characteristics of young athletes

We used principal component analysis to eliminate redundancies and keep the variables significantly significant.

The objective sought through this part of the study, carried out through principal component analysis of anthropometric characteristics (lengths, diameters, perimeters, skin folds, physical development indices, components of body weight) examined in factorial analysis by crossing them with physical tests.

#### Principal component analysis of physical tests and total parameters:

**Table 2. Initial eigenvalues**

| Component | Total | Cumulative % | % of variance |
|-----------|-------|--------------|---------------|
| 1         | 2,22  | 31,75        | 31,75         |
| 2         | 2     | 60,32        | 28,56         |

The principal component analysis shows eigenvalues concerning the first and second components with a cumulative value of 60.32%; or the first component indicates a percentage of variance of 31.75%; while the second component is 28.56%. These values are sufficiently representative to explain the information and clarify the redundancy between the variables and the positive or negative correlations with the axes.

**Table 3. Correlation coefficients of total parameters and physical tests.**

| Variables           | Component 1 | Component 2 |
|---------------------|-------------|-------------|
| Weight (kg)         | <b>0,88</b> | 0,26        |
| Height (cm)         | <b>0,86</b> | 0,24        |
| Age (ans)           | <b>0,70</b> |             |
| Test 1200 m         | 0,24        |             |
| VO <sub>2</sub> max | -0,26       | <b>0,96</b> |
| VMA                 | -0,26       | <b>0,96</b> |

## Detecting young middle-distance talent through morpho-functional parameters

|                  |      |  |
|------------------|------|--|
| Sports seniority | 0,02 |  |
|------------------|------|--|

The variables height and body weight are highly redundant with each other and well represented on the first axis, which demonstrates their close link with the first principal component. On the other hand, the age variable presents a moderate correlation, while the 1200 m test index and sporting seniority turn out to be insignificant. The size effect explains the grouping of variables well represented on the first axis, highlighting the preponderant role of anthropometric parameters in the detection of young talents in the middle distance.

The analysis of the second axis, also called the second factor, highlights strong correlations between the variables attached to it. In particular, the VO<sub>2</sub> max and VMA indices are well represented on this axis, highlighting their importance in the identification of young middle-distance runners, particularly for the evaluation of physiological capacities and aerobic performance.

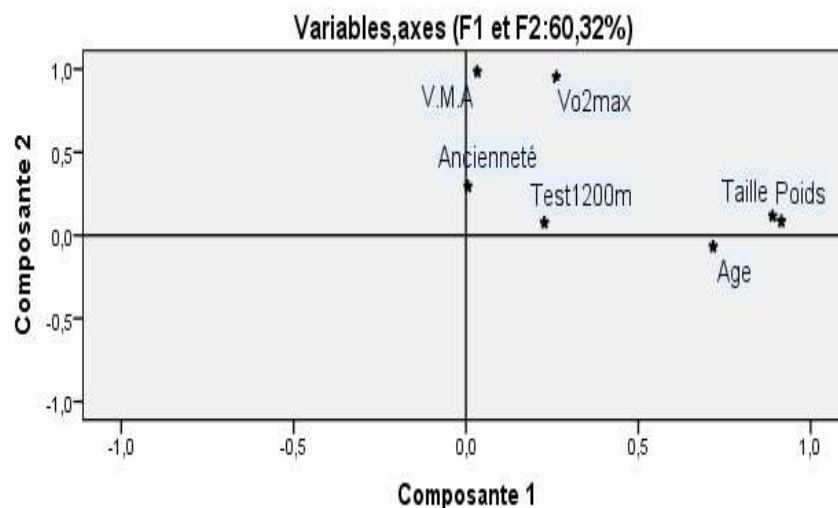


**Figure 1.** Representation of total parameters and physical tests with the principal components of the general group `

### 3. Principal component analysis of physical tests and body diameters

**Table 4.** Eigenvalues of the diameter variables

| Composant | Total | Cumulative% | % of variance |
|-----------|-------|-------------|---------------|
| 1         | 2,96  | 29,65       | 29,65         |
| 2         | 1,83  | 18,35       | 48,00         |

Principal component analysis (PCA) of the variables from physical tests and body diameters revealed that the first two principal components combine 48.00% of the initial total variance. The first principal component alone explains 29.65% of the variance, thus representing the majority share of inertia and information. The second component, for its part, contributes 18.35% of the total variance.

**Table 5. Correlation coefficients of body diameters and physical tests**

| Variables                      | Component 1 | Component 2 |
|--------------------------------|-------------|-------------|
| <b>Biacromial</b>              | 0,87        | - 0,27      |
| <b>Bicretal</b>                | 0,81        |             |
| <b>Transverse Thorax</b>       | 0,70        | - 0,35      |
| <b>Distal forearm</b>          | 0,64        |             |
| <b>Bitrochanterien</b>         | 0,50        |             |
| <b>Antero-posterior Thorax</b> | 0,26        |             |
| <b>Distal thigh</b>            | 0,29        |             |
| <b>Test 1200 m</b>             | 0,18        |             |
| <b>VMA</b>                     | 0,44        | <b>0,86</b> |
| <b>VO<sub>2</sub>max</b>       | 0,60        | <b>0,77</b> |

We observe that the body diameters are positively correlated with the first principal component: the biacromial diameter presents a high correlation ( $r = 0.87$ ), followed by the bicretal diameter ( $r = 0.81$ ) and the transverse thoracic diameter ( $r = 0.70$ ). On the other hand, the other indices present weak correlations and contribute only weakly to the total inertia.

Concerning the functional indices, maximum aerobic speed (MAV) is strongly correlated with the second principal component ( $r = 0.86$ ), as is VO<sub>2</sub>max, with a correlation coefficient of  $r = 0.77$ . These results suggest that these two motor parameters are mainly linked to the second principal component, influenced by the size effect.

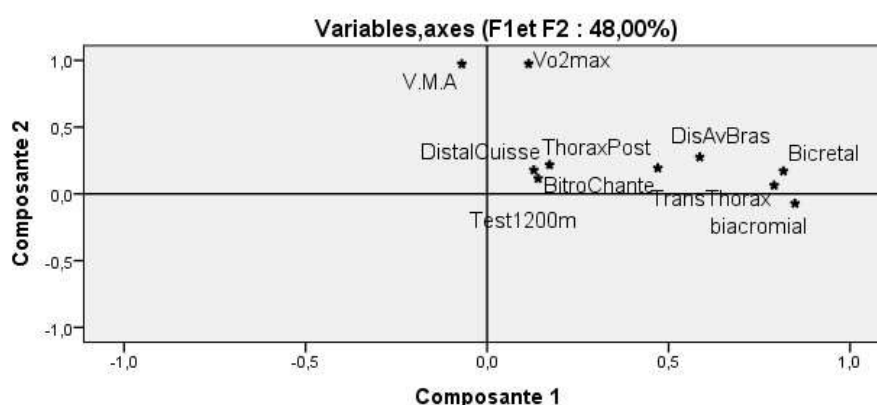


**Figure 2. Representation of body diameters and physical tests**

The biacromial diameter, the bicretal diameter and the transverse thorax diameter are well represented on the first principal component, mainly under the size effect. Their high redundancy indicates that they share similar inertias, suggesting that just one of these parameters could be sufficient to represent the others. Concerning the second main component, a strong positive correlation is observed with VMA and VO<sub>2</sub> max, these two

physiological indexes being well represented on this axis and being able to replace one another. This statistical complementarity underlines their relevance as key parameters for the detection of young talents in middle-distance running.

#### 4. Principal component analysis of physical tests and circumferences

**Table 6. PCA eigenvalues of circumferences**

| Component | Total | Cumulative % | % of variance |
|-----------|-------|--------------|---------------|
| 1         | 3,59  | 35,91        | 35,91         |
| 2         | 1,89  | 18,92        | 54,85         |

**Table 7. Correlation coefficients of circumferences and physical tests**

| Variables                | Component 1 | Component 2 |
|--------------------------|-------------|-------------|
| <b>Thorax rest</b>       | 0,82        | - 0,10      |
| <b>Contracted arm</b>    | 0,80        | - 0,14      |
| <b>Thigh</b>             | 0,77        | - 0,23      |
| <b>Abdomen</b>           | 0,66        |             |
| <b>Leg</b>               | 0,50        | - 0,21      |
| <b>Pelvis</b>            | 0,60        | - 0,26      |
| <b>Forearm</b>           | 0,19        | 0,15        |
| <b>Test 1200 m</b>       | 0,14        | 0,10        |
| <b>VMA</b>               | 0,26        | <b>0,94</b> |
| <b>VO<sub>2</sub>max</b> | 0,45        | <b>0,87</b> |

The first principal component is positively correlated with the following body perimeter variables :

Resting chest circumference has a strong correlation with the first principal component ( $r = 0.82$ ). A similarly high correlation is observed for arm circumference ( $r = 0.80$ ), followed by thigh circumference ( $r = 0.77$ ) and abdominal circumference ( $r = 0.71$ ). Concerning the functional indices, the VMA displays a very strong and positive correlation with the second principal component ( $r = 0.94$ ), as does the VO<sub>2</sub> max, which presents a correlation coefficient of  $r = 0.87$ . These results underline the importance of these morpho-functional indices, which can be exploited technically for the detection of young talents. On the other hand, the other variables appear to be of little significance.

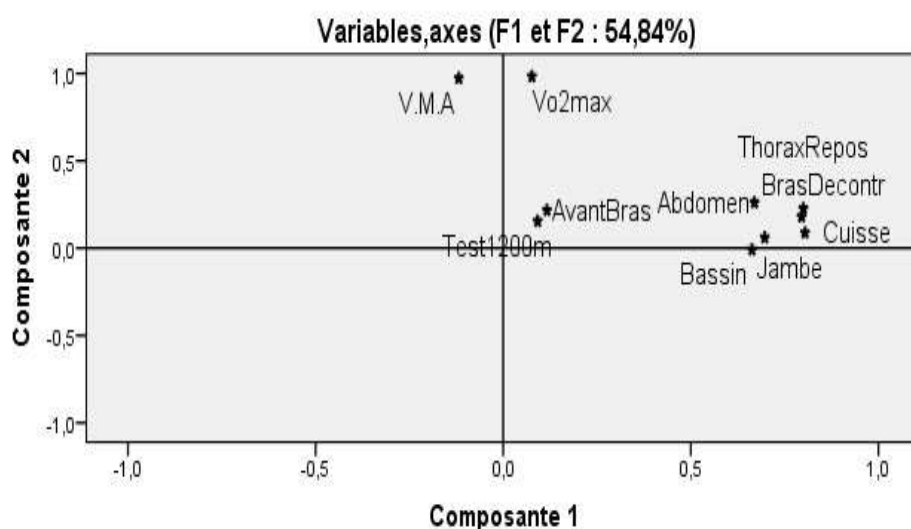


**Figure 3. Representation of body perimeters and physical tests according to axes 1 and 2 of the PCA.**

The circumferences of the thigh, the relaxed arm, the thorax in the resting position and the leg are well represented on the first principal component. They show a strong redundancy between them and group together under a size effect.

On the other hand, the second principal component is strongly correlated with the VMA and VO<sub>2</sub> max variables, highlighting their importance in the detection of young talents, particularly for their endurance potential.

## 5. Principal component analysis of physical tests and body lengths

**Table 8. Eigenvalues of lengths**

| Component | Total | Cumulative % | % of variance |
|-----------|-------|--------------|---------------|
| 1         | 3,21  | 35,71        | 35,7          |
| 2         | 1,72  | 19,16        | 19,16         |

The principal component analysis applied to body lengths (9 longitudinal dimensions) and the 3 physical tests made it possible to extract the first two principal components, which explain 54.47% of the total variance. The first principal component captures 35.70% of the total inertia, while the second principal component represents 19.16%. This distribution justifies the retention of the first two components for the analysis, thus making it possible to extract and interpret the main morphological and functional trends.

**Table 9. Correlation coefficients of body lengths and physical tests with principal components**

| Variables           | Component 1 | Component 2 |
|---------------------|-------------|-------------|
| Seated length       | <b>0,82</b> |             |
| Trunk length        | <b>0,77</b> |             |
| Arm length          | <b>0,70</b> | 0,22        |
| Upper limb length   | <b>0,69</b> | 0,41        |
| Lower limb length   | 0,46        | <b>0,63</b> |
| Thigh length        | 0,16        | <b>0,62</b> |
| Test 1200 m         |             | <b>0,84</b> |
| VMA                 |             | <b>0,79</b> |
| VO <sub>2</sub> max | 0,45        | <b>0,87</b> |

The first principal component is characterized by strong positive correlations, with:

- Seated height ( $r = 0.82$ )
- Trunk length ( $r = 0.77$ )
- Arm length ( $r = 0.70$ )
- Upper limb length ( $r = 0.69$ )

These correlations indicate that this first component is mainly influenced by long body segments, playing a key role in the detection of young talents through their morphology. The second main component, for its part, is determined by four variables:

- Lower limb length ( $r = 0.63$ )
- Thigh length ( $r = -0.62$ )
- VO<sub>2</sub>max ( $r = 0.84$ )
- VMA ( $r = 0.79$ )

This second component highlights the importance of physiological and motor capacities in the identification of young talents, particularly through Maximum Aerobic Speed (MAV) and VO<sub>2</sub>max. Thus, while the first component reflects a morphological dimension, the second component illustrates a functional and physiological dimension essential to performance.

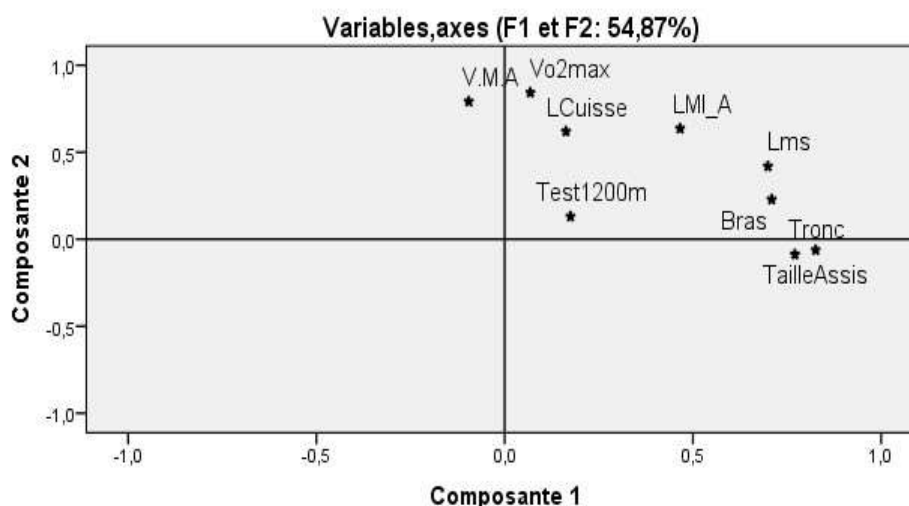


**Figure 4. Representation of body lengths and physical tests according to PCA**

The principal component analysis of body lengths and physical tests highlights an organization of variables along two main axes:

First axis : It is mainly influenced by body segments, in particular: • Seated height, • Length of the trunk, • Length of the arm, • Length of the upper limb. These variables present a strong redundancy between them, suggesting a marked influence of global morphology.

Second axis : It is dominated by parameters linked to aerobic performance: • Maximum Aerobic Speed (MAV), • VO2max. These indices are well represented on this axis, indicating their importance in the evaluation of physical capacities. On the other hand, the 1200 m test does not show a significant contribution to this analysis.

## 6. Principal component analysis of physical tests and body skinfolds of the general sample:

**Table 10. Eigenvalues of skin folds:**

| Component | Total | Cumulative % | % of variance |
|-----------|-------|--------------|---------------|
| 1         | 2,04  | 51,16        | 51,16         |
| 2         | 1,05  | 77,58        | 26,41         |

Principal component analysis (PCA) of skinfolds is based on the average sum of nine skinfolds. This average of skin folds is correlated with somatic indices and various motor variables, with the aim of identifying predictive models for the detection of young talents in middle-distance running. Principal components analysis, applied to four variables, made it possible to extract two principal components explaining 77.58% of the total variance. This percentage is sufficient to capture most of the inertia and information necessary for interpreting the results.

**Table 11. Correlation coefficients of body lengths and physical tests with principal components**

| Variables           | Component 1 | Component 2 |
|---------------------|-------------|-------------|
| VMA                 | 0,97        |             |
| VO <sub>2</sub> max | 0,97        |             |
| Test 1200 m         | 0,13        | 0,83        |
| Sum 9 skinfolds     | - 0,35      | 0,60        |

The first principal component is strongly correlated with aerobic capacities, with high correlation coefficients: Maximum Aerobic Speed (MAV):  $r = 0.97$ ; maximum oxygen consumption (VO<sub>2</sub>max):  $r = 0.97$ . In contrast, the second principal component is mainly associated with the 1200 m running test, with a strong positive correlation ( $r = 0.83$ ). The morphological index, represented by the sum of the nine skin folds, presents a moderate correlation with the second component ( $r = 0.60$ ).

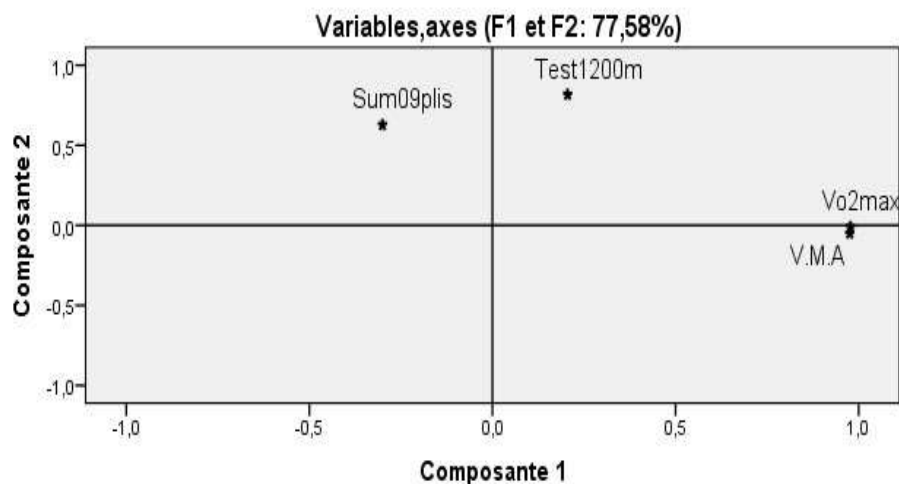


**Figure 5. Graphical representation of the sum  $\sum$  09 skinfolds and physical tests with the principal components**

Figure 5 illustrates the correlation between the two motor variables, VMA and VO<sub>2</sub>max, which are in complete redundancy and strongly represented on the first principal component. They have similar inertia, meaning one can be used as an indicator of the other. In addition, these two variables structure the first axis, influenced by a size effect. In contrast, the 1200 m test variable is strongly correlated with the second principal component, while the sum of the nine skinfolds is moderately related to it.

## 8. Principal component analysis of physical tests and body weight components:

**Table 12. Total explained variance of the general group**

| Component | Total | Cumulative % | % of variance |
|-----------|-------|--------------|---------------|
| 1         | 2,29  | 38,18        | 38,18         |
| 2         | 1,39  | 23,3         | 61,48         |

The principal component analysis of the three morphological variables of body weight and the three functional indices of aerobic performance was carried out using a statistical treatment based on the method of extracting the first two principal components, by analyzing the eigenvalues of the variance. The results show that these two axes combine 61.48% of the total inertia, which is sufficient to explain the correlation relationships highlighted by this multifactorial analysis.

**Table 13. Correlation coefficients of body weight components and tests physics with the principal components**

| Variables                | Component 1 | Component 2 |
|--------------------------|-------------|-------------|
| <b>VMA</b>               | <b>0,83</b> | - 0,51      |
| <b>VO<sub>2</sub>max</b> | <b>0,91</b> | - 0,36      |
| <b>Test 1200 m</b>       | 0,19        | 0,23        |
| <b>Bone component</b>    | 0,55        | 0,27        |
| <b>Adipose component</b> | 0,33        | <b>0,77</b> |
| <b>Muscle component</b>  | 0,19        | <b>0,81</b> |

The VO<sub>2</sub>max is strongly positively correlated with the first factor, with a high coefficient of  $r = 0.91$ . Likewise, the VMA index presents a positive correlation with a coefficient of  $r = 0.83$ . On the other hand, the 1200 m test shows no significant correlation. Concerning the morphological variables, the composition of the adipose mass is positively correlated with the second component, with a coefficient of  $r = 0.77$ . As for the muscular component, it appears to be a determining factor, being also linked to the second component with a coefficient of  $r = 0.81$ .

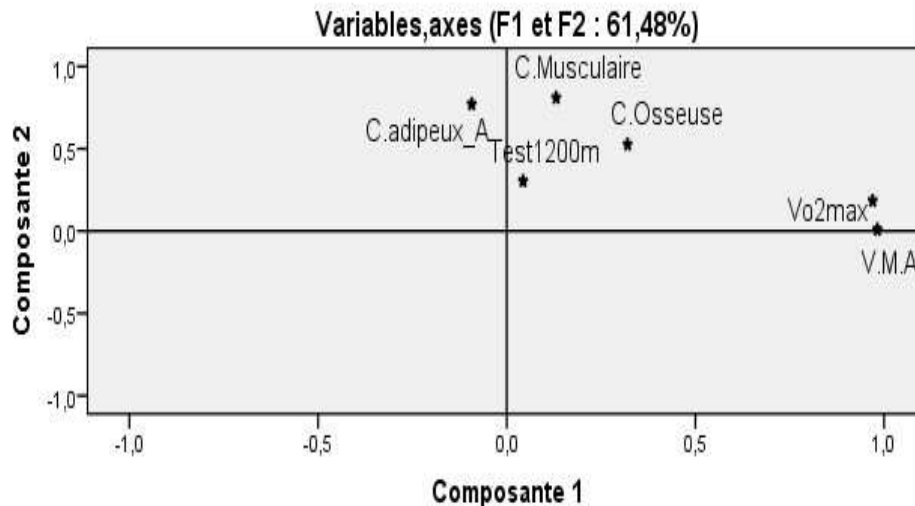


**Figure n° 6: Representation of the components of body weight and physical tests with the main components.**

The correlation plot (figure no. 6) highlights the importance of the two functional indices, VO2max and VMA, which present a strong correlation and a marked representation on the first axis, due to a size effect. These two variables are almost redundant, which means that one can represent the other in terms of information. On the second axis, the morphological component of muscle mass is strongly represented, while the adipose component appears moderately. On the other hand, the morphological index of bone mass as well as the motor index of the 1200 m test show no significant correlation.

## Discussion:

From a biological point of view, all these indices are directly influenced by growth in stature, where the secular evolution of height is mainly linked to the lengthening of the lower limbs (Tanner et al., 1990; Eveleth & Tanner, 1990; Kuh et al., 1991).

Principal component analysis (PCA) of body diameters and motor indices allows us to conclude that VMA and VO2max parameters are strongly correlated with the second principal component, due to the theoretical interdependence that exists between them. On the other hand, the 1200 m running test turns out to be insignificant compared to the first factor. The scientific literature highlights that the greatest accumulation of bone mineral content occurs during puberty, even before growth is complete, thus giving the skeleton its final strength. Therefore, once growth is complete, additional mineral gain is no longer necessary (Parfitt et al., 1994; Slemenda, 1994). It is estimated that 50% of the variability in bone mass in adults is explained by the maximum bone mass acquired during puberty. According to Bailey & McKey (1999), peak bone mineral content in boys occurs approximately two years after peak stature growth, i.e. between 12 and 14 years of age. Finally, the bicretal, biacromial and transverse thoracic bone diameters are the most representative and form a size effect with the first principal component. We therefore recommend their use as part of programs to detect young talents in middle-distance running.

Principal component analysis (PCA) reveals a significant correlation of VO2max and VMA with the second principal component, while the 1200 m test remains insignificant. Body

circumferences provide relevant information, particularly regarding thoracic circumference, which is a key indicator of vital capacity and gas exchange in athletes. This index is directly linked to motor ability (Okley et al., 2004). Furthermore, the redundancy of body perimeters and their formation of a size effect with the first factor indicate that they transmit similar information in terms of inertia. Thus, particular attention must be paid to the circumference of the thorax, thigh, abdomen and leg, which can be used as parameters for evaluating and monitoring training and growth, but also as criteria for identifying young sporting talents (Léone & Larivière, 1998).

Principal component analysis (PCA) of physical tests and body lengths highlights the importance of several body segments, including sitting height, trunk length, lower limb length, and upper limb length. These parameters present similar inertia and strong redundancy, which is explained by harmonious growth in length at this age, implying the simultaneous development of all body segments (Susanne & Bodzsar, 1998; Susanne et al., 2001). In this context, sitting height appears to be a major anthropometric reference and must be considered as a key parameter in the morphological evaluation of athletes. The multifactorial analysis of the aerobic performance indices (VO<sub>2</sub>max, VMA, 1200 m test) and the sum of the 09 skin folds highlights the significant correlation of this morphological index with the second principal component. Due to its importance in epidemiological and anthropometric studies, it is recommended as a reference tool for the evaluation of young talents in middle-distance running (Jürumaä, 2012; Raudsepp & Jurâmae, 1996; Chiara et al., 2010). Finally, the 1200 m test is strongly represented on the second component, highlighting its importance in the evaluation of aerobic energy potential in young runners. This accessible and easy-to-apply tool constitutes a relevant indicator for detecting middle-distance talent.

On the other hand, the two parameters VO<sub>2</sub>max and VMA are strongly represented and in total redundancy on the first factor, due to a size effect. This close correlation between VO<sub>2</sub>max and VMA in determining performance in middle-distance running has been widely documented in the scientific literature (Di Prampero, 1981; Lacour et al., 1989; Peronnet & Thibault, 1989). Thus, the VMA appears to be an essential parameter in the control of training, the evaluation of athletes and the identification of young talents, while constituting a key indicator for predicting performance in the middle distance.

The functional parameters VO<sub>2</sub>max, VMA, adipose component and muscle component present a significant correlation with the first principal component. The muscular component displays a strong correlation with the second axis, which could reflect muscular development influenced by physical exercise within our study population (Malina, 1998). As for the adipose component, its moderate correlation can be interpreted according to the work of Malina (1998) and Pariskova (1977), who showed that in children aged 13 to 18 years, changes in fat mass occur as a result of training. A reduction in adipose tissue induced by sports training is also accompanied by a redistribution of fat after an intense training period of 15 to 20 weeks.

### Conclusion :

The results of this study reveal the existence of significant correlations between functional and anthropometric variables, established by principal component analysis (PCA). These results are, for the most part, in agreement with data from the scientific literature. The PCA made it possible to highlight the multifactorial relationships between motor and anthropometric parameters, thus confirming their interdependence. In this regard, we suggest that coaches and institutions responsible for identifying young middle distance talents take these results into account in their evaluation and selection processes. However, it should be emphasized that the growth and biological development of young athletes must be carefully considered during the detection and selection phases. The PCA also allowed us to identify the anthropometric parameters specific to the age group studied and to better understand their manifestations in the growth and development of young runners. As such, several morphological variables present high correlations with the factorial axes and significant redundancies, which leads us to recommend them as key indicators in the identification of young Algerian talents (11, 12 and 13 years old) specialized in middle-distance events.

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