

Morphotypology of Malian children aged 9-12 years old

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Abstract :

The aim of this work is the study of height and weight development in students aged 6 to 12 schooled in Mali, capital Bamako. and determining the growth status of that population. Means and Methods; 300 students aged 6 to 12 took part in this study. divided into 2 age categories 6-8 years, 9-12 years. Anthropometric measurements were carried out using standardized and verified instruments, as well as weight, height, BMI (body mass index) for determining the state of corpulence, and some indices of physical development. The weight growth in boys evolve in favor of children from the age of 9-10 years. While in girls, the weight is greater at 11-12 years (t-test $p < 0.01$). Concerning the stature, no significant difference was recorded between the two age groups although this parameter knows a significant acceleration from the age of 10, which is confirmed by the literature. Conclusion: Somatic growth is in linear progression in both sexes. Concerning the weight, the boys are increasingly heavy ((t-test $p < 0.001$) while in girls, the difference is significant ((t-test $p < 0.01$). These results invite us to investigate encompassing a broader assessment related to growth and diet through a longitudinal study that could be compared with WHO international benchmark

1. Introduction

Childhood represents a stage of transformation which will gradually lead it towards adulthood. This introduces the fact that there will be changes taking place both quantitatively and qualitatively. It is a period of life that interest's parents and educators (teachers, coaches and facilitators); As a result, knowledge of the biometric and physiological characteristics of school-aged children is very useful in the social and epidemiological fields and more particularly in the context of the detection, selection and guidance of young people in different sports. The detection of a good morpho-functional state is a premise for better efficiency of mechanical performance with good development of physical qualities. It offers a certain guarantee for achieving high performance (Gürtler, 1982).

1.1. Literature Review

It would therefore be interesting to highlight, on the one hand, the development of children's morphological parameters and, on the other hand, to analyze their impact on the improvement of motor qualities of endurance, coordination and strength- speed, especially since the growth of children is a physiological process linked to the increase in the dimensions of the organism (Beunen et al., 2000). This is quantitative data which is accessed by anthropometric measurement and which makes it possible to assess weight gain and the increase in the size of an organ or organ. It constitutes a final phase of complex physiological, morphological and anatomical mutations. This process of complex transformations begins with the increased activity of the hormonal system followed by a series of modifications which will produce in the medium term a subject transformed in size, weight, and sexually mature.

Maturation, or differentiation, which is a qualitative data means that at certain periods of development, a tissue or an organ modifies and then acquires other possibilities of functioning. This phenomenon determines the development of various biological qualities as well as motor coordination.

This development has direct repercussions on the physical exertion possibilities of children and adolescents. Thus, the exercise loads applied must in no case constitute a quantitative reduction in the physical work capacity imposed on adults. Moreover, Claparède – cited by Weineck, J.

1992, concludes that “the child is not a miniature adult and his mentality is not only quantitatively,

The main objective of our work is to identify the best morphological parameters for a selection of students enrolled in two basic schools in Mali, in a rural environment (Kéleya basic school) in the Bougouni Educational Animation Center. and in an urban environment 2 basic schools in commune V of the Bamako district.

2.Method and Materials

This study focused on anthropometric and physical indices. In this context, we carried out measurements of the standing and sitting height, the lengths of the thoracic and pelvic limbs, the thoracic circumferences, the bi-trochanteric diameter and the development indices of the children in order to see the morphological progression of this group of children. age, which was classified by level into two categories namely 9-10 years and 11-12 years according to the classification of stages of development according to chronological age (Malina, 1994) and according to the endocrine system by Brauner (1986) and Brauner (2001) who cite that sexual characteristics develop in 95% of cases between eight and thirteen years of age in girls and nine to fourteen years of age in boys.

The research protocol will include all anthropometric measurements. It will be accompanied by a sheet containing the legend which will allow its content to be deciphered. The name, first name, gender, date and place of birth, and the number of years of sporting practice will be indicated. Equipment Only a good instrument allows you to have precise results and the possibility of comparing them.

2.1. Participants

Students from two basic schools in Yirimadio in the Bamako district participated in our cross-sectional study. Out of a population of 300 students, girls and boys in school, aged between 9-12 years old, only 82 children (30 girls, 52 boys) among the population took part in the study.

2.2. Materials

The research will be carried out with standardized and verified instruments, with a large G.P.M type anthropometric kit, including the following instruments:

An anthropometric kit such as G.P.M. (Siber Hegner) containing: - The MARTIN system anthropometer, intended to measure the linear

(longitudinal) and transverse dimensions of the body. Its precision is 0.5 cm.

- Thickness compass with olive ends: large ruler of the anthropometer, graduated from 0 to 600 mm to which we add two curved rods, to measure certain large transverse dimensions (diameters) of the body.
- A thickness caliper with olive tips; used to measure small diameters, i.e. the distance between two points. - A HARPENDEN type pliers (or caliper) for measuring adipose panicles with an accuracy of 10g/mm²
- Steel tape: (0 - 2000 mm) or linen tape (0 - 2500 m), reinforced with brass wires. It ensures absolute precision over the entire length. We use it to measure the circumferences of the body and its segments.
- The medical scale: Used for weighing weight with an accuracy of 50 gr.

2.3 Anthropometric method

The measurements were carried out using basic anthropometric techniques. index (IK) also called body mass index (BMI)

The Skele index (IS): reflects the proportion of the lower limb in relation to the trunk

The Shoulder Index (EI) characterizes the degree of thoracic kyphosis and tells us about the child's physical attitude

Body surface area (SC): The size of the surface area of the human body is taken into consideration when evaluating physical development. (Olivier, 1961).

Bone landmarks and measurements were standardized by Ross et al. (1982). For measurements, it is agreed (International Agreement of 1912) to operate on the left side according to Vallois H.V (1948). However, in our study, and regarding a sample of students enrolled in primary school, the measurements were made on the right side of the subject. We start the series of measurements with the highest points, in order to have an idea of the order of magnitude of the variability of the characteristics measured. It should be noted that all measurements were carried out by the same person, with the same anthropometric equipment.

Over a period of six months. We carried out the measurements over a period of three weeks and from December 20 to January 15 and two days were retained in the week: Thursdays and Saturdays.

All measurements were taken in the morning, under the same environmental conditions (temperature: 25 to 30°C from 8 a.m. to 12 p.m.) and all subjects were in sports clothing.

Anthropometric measurements: In this study, the longitudinal dimensions used are:

- Body lengths
- Body weight (PDS) Weight is the anthropometric constant measured using a personal scale. According to CAZORLA (1991), weight is one of the very first indicators of the athlete's state of form or lack of shape. A variable used to describe the evolution of the individual (DUFFOUR et al; 1988).
- Stature (STAT): it is a linear measurement of the distance from the ground (support surface) to the vertex.

Indexes Calculation

- ✓ Kaup index (IK) also called body mass index (BMI)
- ✓ The Skele index (IS): reflects the proportion of the lower limb in relation to the trunk
- ✓ The Shoulder Index (EI) characterizes the degree of thoracic kyphosis and tells us about the child's physical attitude
- ✓ Body surface area (SC): The size of the surface area of the human body is taken into consideration when evaluating physical development. (Olivier, 1961).

2.4 Descriptive statistics

We used descriptive statistics (mean, standard deviation and coefficient of variation which makes it possible to measure the variation between two dates of a magnitude expressed in %, for CV 10% (sparsely dispersed population, the average means something). Comparisons between groups will be made using the Student test. Calculations were carried out using Excel and SPSS software.

2. Results

Table 1 : Total sampling

Sexe	Age (ans)	Height(Cm)	Weight (Kg)
Boys	10±1	140.91±7.95	36.31±9.17
Girls	10±1	140.08±6.05	35.57±9,80

Table 1 represents the total parameters of the study sample, which shows an average age of 10 ± 1 , average weight of $(36.31 \pm 9.17 \text{ kg})$ and height

(140.91 ± 7.95 cm) for boys, while for girls the results give an average age equivalent to 10 ± 1 , the average weight is of the order of 35.57 ± 9.80 kg for stature equal to 140.08 ± 6.05 cm.

Lenghts

Table 2 : Body lenghts for both sexes

Lenghts (Cm)	Sitting lenght (T.A)	Upper limb lenght	Lower limb lenght
Boys	59.31 ± 5.79	66.06 ± 4.23	80.89 ± 4.96
Girls	59.48 ± 6.15	65.91 ± 4.40	81.74 ± 5.53

The results of the lengths are almost similar between the values of boys and those of girls for all the parameters d studied, which respectively are for boys of the order of 59.31 ± 5.79 cm for the T.A, to 66.06 ± 4.23 cm for the LMS, to 80.89 ± 4.96 cm for the LMI. For girls and for the same parameters, the values obtained are respectively equal to 59.48 ± 6.15 , cm to 65.91 ± 4.40 , cm to 81.74 ± 5.53 cm. These results obtained make it possible to show perfect homogeneity for all the length parameters measured, with a coefficient of variation which is around 10%.

Girths

Table 3 : Presentation of girths for both sexes

Girths	Girth contracted arm (GBC) cm	Girth thigh (GC) cm	Girth Thorax Rest (GTHR) cm
Boys	20.10 ± 1.63	35.93 ± 3.52	61.93 ± 3.95
Girls	20.88 ± 3.07	36.80 ± 4.66	64.65 ± 6.99

The table 3 presents the results of three circumference parameters including the contracted arm circumference (CBC), the thigh circumference (CC) and the resting thorax circumference (CTHR).

♣ In boys, the contracted arm circumference gave an average of 20.10 ± 1.63 cm while girls an average of 20.88 ± 3.07 cm.

♣ For the diameters of the thigh circumference the average of measurements gave an average of 35.93 ± 3.52 cm in boys and 36.80 ± 4.66 cm in girls.

♣ For the resting thorax diameter, it is equal to an average of 61.93 ± 3.95 for boys and an average of 64.65 ± 6.99 for girls.

Through the results obtained, we note that most of the morphological parameters studied are characterized by low standard deviations, which tells us about the homogeneity which characterizes the two sexes.

Diameters

Through the results obtained, we note perfect homogeneity with a value less than 10% for the biacromial diameter, the bicretal diameter, the transverse thorax diameter while the homogeneity is average for the distal arm diameter, the distal thigh diameter and thorax diameter rest.

Table 4 : Presentation of diameters for subjects for both sexes

Diameter	Biacromial	Bicretal	Thorax rest	Distal Arm	Distal thigh
Boys	24.58±2.48	18.41±1.66	20.97±1.56	5.49±0.64	8.07±0.63
Girls	24.04±2.15	19.15±2.35	20.52±1.36	5.3±0.74	7.74±0.87

Morphological Indexes

Table 5 : Presentation of morphological indexes for subjects of both sexes

Indexes	Skele Index %	BMI g/cm ²	Shoulder I.%	Body surface m ²
Garçons	136.82±18.03	1.81±0.34	113.86±6.66	1.19±0.20
Filles	140.13±16.41	1.78±0.38	113.18±10.63	1.16±0.19

Morphological indexes such as the Body mass index (BMI), Skele index (IS) and body surface area (SC) present values which are characterized by average homogeneity with coefficients of variation greater than 10%. For the crural index, homogeneity is perfect with a coefficient of variation less than 10%.

Comparative analysis of morphological parameters between children aged 9-10 and 11-12 years old

♣ Weight kg:

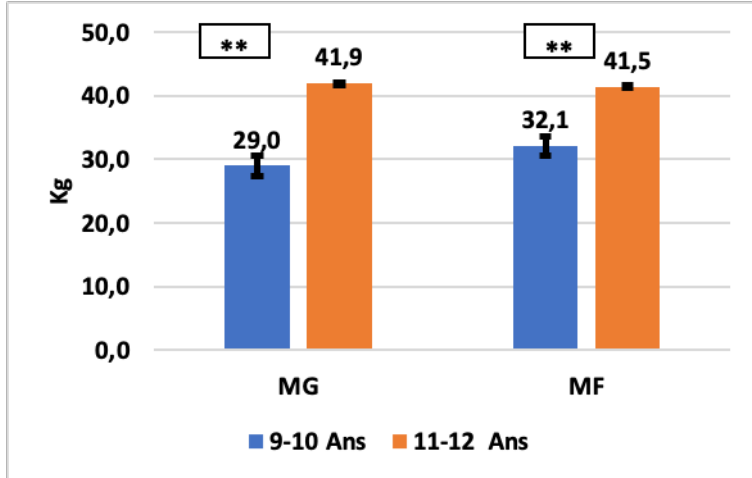
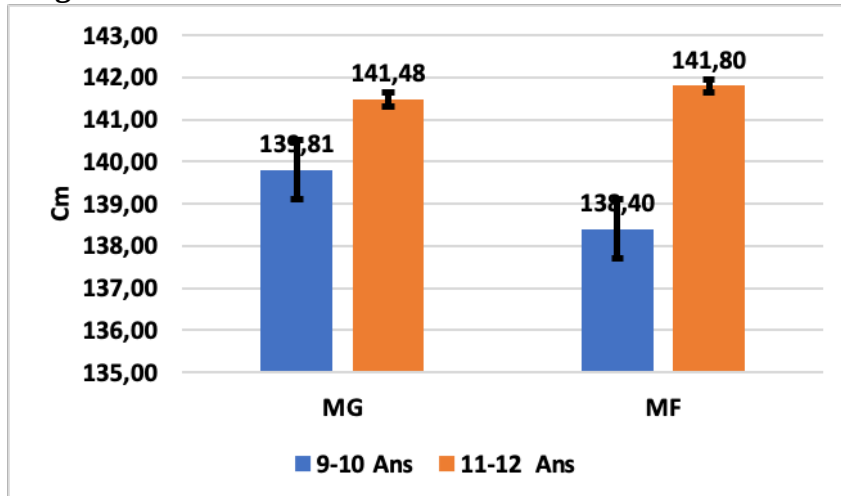


Figure 1: Comparison of weight between children aged 9-10 and 11-12 years

Figure 1 reveals the weight of children aged 11-12 (girls and boys) higher than that of children aged 9-10, and the existing difference is statistically significant for the significance thresholds $p < 0.01$.

Height cm :



The histogram above reflects the height of children aged 11-12 (girls and boys) higher than that of children aged 9-10, with a statistically insignificant difference for the significance thresholds.

Lengths cm :

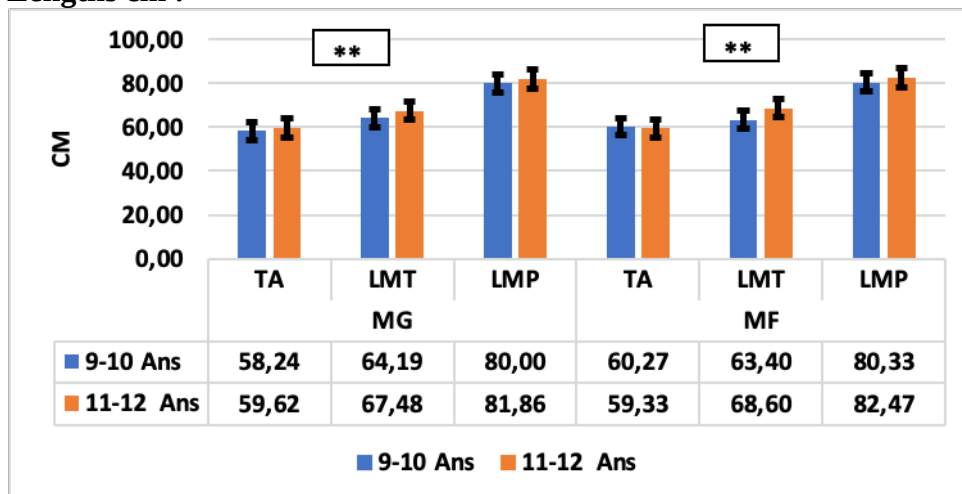


Figure 3: Comparative state of lengths between children aged 9-10 years and 11-12 years old

For the length parameters, Figure 3 presents higher values for children aged 11-12 years for the lengths of the upper and lower limbs (LMS and LMI) and are not significant, unlike the thoracic limb length is statistically significant at $p < 0.01$. These results show that the sitting height of girls aged 9-10 is greater than that of 11-12 years old and the difference is statistically insignificant. While among boys, those aged 11-12 dominate.

Circumferences cm:

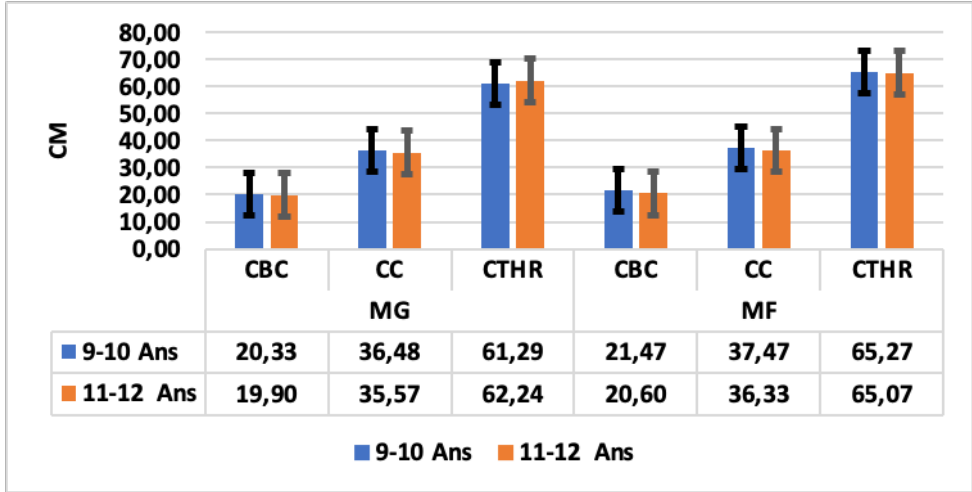


Figure 4: Comparative state of circumferences between children aged 9-10 and 11-12 years

Regarding body circumferences, the values are more or less equal between children aged 9-10 and 11-12 years for the parameters contracted arm circumference, thigh circumference and resting thorax circumference; confirmed by statistically insignificant results.

Diameters cm :

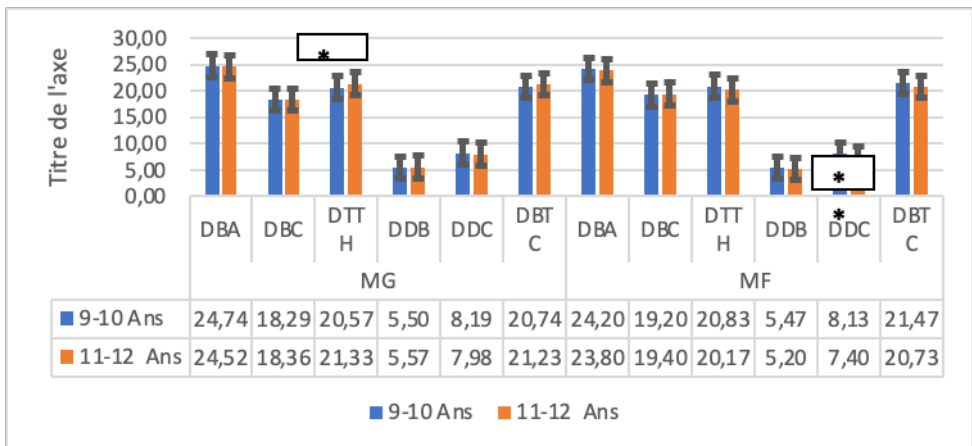


Figure 5: Comparative status of diameters between children aged 9-10 and 11-12 years

Morphotypology of Malian children aged 9-12 years old

The diameters present more or less equal values between boys aged 9-10 and 11-12 years for the diameters (biacromial diameter, bicretal diameter, distal arm diameter) and are not significant. On the other hand, the values are high for thorax transverse diameter and bi-trochanteric diameter for children aged 11-12 years, but the existing difference is statistically significant for thorax transverse diameter for $p < 0.01$. In girls aged 9-10, the biacromial diameter, transverse thorax diameter and bi-trochanteric diameter are greater than those of children aged 11-12. The existing difference is statistically insignificant.

Physical development indexes

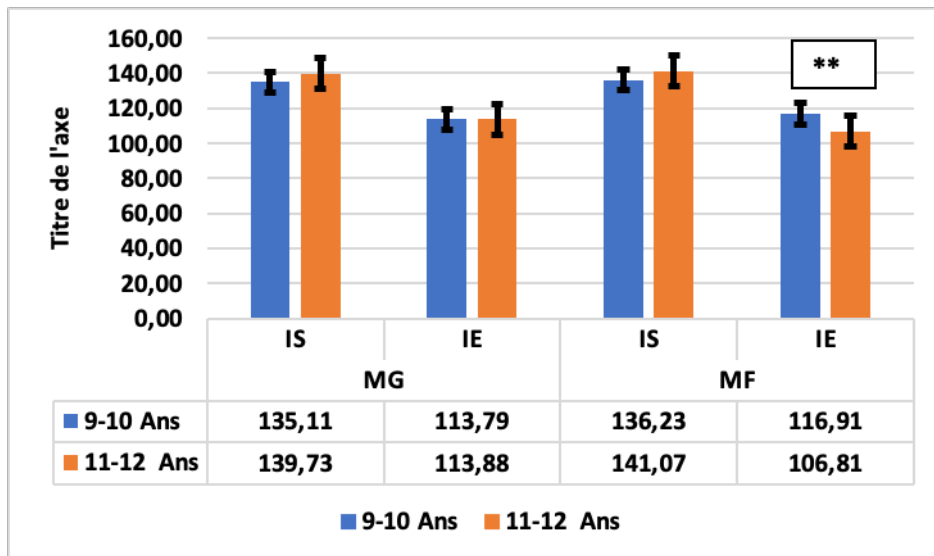


Figure 6: Comparison of Skele and Shoulder indexes between children aged 9-10 and 11-12 years old

For the Skele index and the shoulder index in boys the values are almost identical for the two age groups. Among girls, the Skele index of children aged 11-12 is the highest, however the shoulder index is higher for those aged 9-10. For the shoulder index, we see a significant difference between the two age groups at $p < 0.01$.

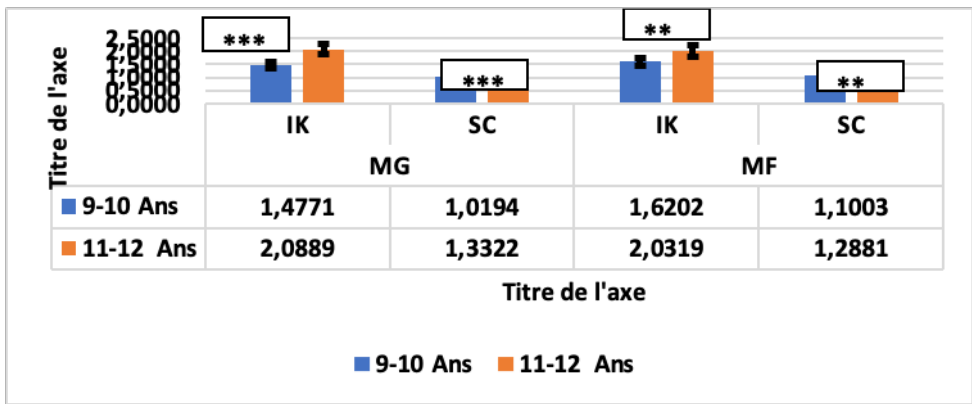


Figure 7: Comparison of Kaup indices and body surface area between children aged 9-10 and 11-12 years

For the parameters of the Kaup index and body surface area, higher values concern children aged 11-12 years for the aforementioned parameters and are statistically significant at $p < 0.01$ and 0.001 .

3. Discussion

The analysis of the morphological results recorded in girls and boys makes it possible to highlight a difference in terms of results between children aged 9-10 and 11-12 years with regard to the parameters as presented in the table below.

Table 6: Summary of results of comparison of morphological characteristics between girls and boys

PARAMETER	BOYS		P-value	GIRLS		P-value
	9-10 ans	11-12 ans		9-10 ans	11-12 ans	
Weight	29,00	41,90	***	32,06	41,46	**
Height	139,80	141,47	NS	138,4	141,8	NS
Sitting height	58, 23	59,61	NS	60,26	59,33	NS
ULL	64,19	67,47	**	63,4	68,6	**
LLL	80,00	81,85	NS	80,33	82,46	NS
CAC	20,33	19,90	NS	21,46	20,6	NS
TC	36,47	35,57	NS	37,47	36,33	NS
CTh. at rest	61,28	62,23	NS	65,26	65,06	NS
Bia. D	24,73	24,52	NS	24,20	23,80	NS
Bic. D	18,28	18,35	NS	19,20	19,40	NS
TTD	20,57	21,33	*	20,83	20,16	NS
DAD	5,5	5,56	NS	5,46	5,20	NS
TD	8,19	7,97	NS	8,13	7,40	**
Bitroc. D	20,73	21,22	NS	21,46	20,73	NS
Skele index	135,11	139,72	NS	136,23	141,06	NS
Body mass index	1,47	2,08	***	1,62	2,03	**
Shoulder index	113,79	113,88	NS	116,91	106,80	**
Body surface	1,01	1,33	***	1,10	1,28	**

(ULL : upper limb length; LLL : lower limb length; CAC : contracted arm circumference; TC : thigh circumference; CTh : circumference thorax at rest; Bia.D : biacromial diameter; Bic. D : bicipital diameter; TTD : transversal thorax diameter; DAD : distal arm diameter; Bitroc. D : biacromion diameter).

Childhood is the period of life that is of particular interest to the educator. Commonly defined as "the period of human life which goes from birth to adolescence", childhood has been, since the beginning of the century, the subject of keen interest on the part of scientists and researchers and particularly in the sporting field. The orientation to sports practice of children aged 06-12 in the city of Bamako experiences enormous

difficulties due to the lack of knowledge of the morpho-functional particularities of this age group and also depending on the environment (rural and urban).). This study carried out among children aged 6 to 12 years old in the city of Bamako, Mali allowed the analysis of the evolution of anthropometric measurements of Malian children in school.

When reading the results of the total parameters, we note constant weight growth among both girls and boys (rural and urban). This leads us to say that weight growth is regular and increasing. As confirmed by the bibliographic analysis according to Eiben (1976), cited by Weineck (1992), which provides clarification on the rapid growth during infancy and at the beginning of childhood then regular growth during childhood, a further acceleration of growth during adolescence and finally a gradual decrease in the rate of growth until adult height.

Among Malian boys aged 6 to 12, weight growth is increasing linearly with significant differences between the two age groups. While among girls, at 9-12 years old, girls are heavier (t-test: $p < 0.01$). We suggest that these differences in height and weight, mainly in favor of Malian children, are due, in large part, to the living conditions and nutritional status of these children.

4. Conclusion

The growth curves for height and corpulence index are the key documents which allow us to know whether a given child has abnormal growth. Recent studies confirm the evolution of the weight and height of children. In both sexes, there is an increase in height from childhood until the puberty period.

“Weight, height, diameters, circumferences and indices of physical development” represent important characteristics in the evaluation of the child’s somatic development. For good growth and good health, it is important that height and weight evolve harmoniously, with values close to those of the majority of children. In view of our results, it appears that Malian boys present somatic growth which occurs through an acceleration from the age of 6.

Height shows a continuous increase for both boys and girls, the difference is not significant between the age groups. However, a diet well adapted to the nutritional needs specific to each age of children during their growth, the acquisition of good eating habits and a lifestyle promoting physical activity are desirable to improve growth processes and prevent risks on health in adulthood.

At the end of our study, the results recorded invite us to more extensive investigations encompassing a broader evaluation linked to growth, exercise and diet by means of a longitudinal study. A larger sample could be more sensitive and revealing of the state of growth of the Malian child. Furthermore, in the absence of references on the state of development of the Malian child (growth and physical indices), another study could be the subject of a comparison between this population and the international references of the WHO, and to define the degree of involvement of the environment, more particularly the lifestyle of the children of Bamako on their motor development.

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