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Anthropometric profile as a selection criterion for prepubescent swimmers

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Abstract : The purpose of this reserach is to determine the anthropometric profil of 64 young boys swimmers in the age racket of (9.79±0.69 years old).

45 anthropometric parameters (weight, stature, lengths, diameters, circumferences and skinfolds) were measured according to the standards of Martin R. (1928), Ross and al. (1982). We also calculated the body surface area (Du Bois & Du Bois, 2000), Skele index (%) according to Manouvrier (Vandervael, 1980), and some morphological indexes. For the dryland tests we used Sargent test Methods (1921) and AAHPER (1976), both used by Hansen and al. (1997) and NAPFA from Singapore (Quick, J.J., 1993).

In the water part we realized the ventral glide (Cazorla et al., 1984) and the buoyancy test (Cazorla, 1993). Finally, ANOVA and ACP are the statistical methods that allowed us to plot the anthropometric profils of young prepubescent swimmers to our sample, which can eventually be used to the swimming selection.

Keywords: prebubescent swimmers, anthropometric profile, anthropometric indexes

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1. INTRODUCTION

Anthropometric parameters and buoyancy are closely related to the energy cost of swimming (Pendergast and al., 1978 ; Cazorla and al., 1985 ; Chatard and al., 1985 ; Costill and al., 1985 ; Montpetit (1984) ; Chatard and al., 1985a). This energy cost which is dependent on performance (Chatard et coll., 1991 ; Diprampero and al., 1974) is strongly influenced by swimming technique (Zamparo and al., 1996) and morphology (Chatard and al., 1987) because the relationship between the levers (upper and lower limbs) and the body proportions determine the hydrostatic's swimmer qualities (Onoprienko and al., 1990).

The anthropometric settings such as, body weight components (bone, muscle, fat), body surface area, stature, length of lower limbs, hands, arms, legs and leg, shoulders, pelvis and rib cage diameters, as well as body mass, which varies according to the swimming speciality, have great importance to the efficiency of the stroke movements (Boulgakova, 1990).

Young group age swimmer's selection is based on anthropometric parameters (Boulgakova, 1978), although they are only weakly related to future swimming's outcomes (Boulgakova, 1990). In a study of a prepubertal boys (11±1) Duché and al (1993) showed that body size with other bioenergetic variables (VO2max, Wan max, W30s), presented a great importance in swimming performance. Moura et al. (2014) also showed the importance of morphological parameters (height, fat percentage) in young (9 - 17 years) swimmers propulsion.

In this study, we therefore have a battery of anthropometric tests and statistical analyzes (ANOVA, ACP) to highlight the anthropometric profiles of young prepubescent swimmers (9.79 ± 0.69 years) in order to determine their physical development, and possibly use it as a reference in the selection of young prepubescent swimmers.

Methods

Subjects

64 young boys swimmers aged 9,79 (SD 0,69) years, took part in this study with their parent's consent. The group trained on average 2 h per session, during twice a week in year one, three times in year two, and four times in year three.

Each subject underwent the following tests : (1) anthropometric measurements (2) dry evaluation, and (3) aquatic tests.

(1) We measured Body mass and the 45 anthropometric parameters (Table 1) including lengths, diameters, circumferences and skin folds, estimated the body area (SA) and calculated IS, IE, and calculated BCD/ BAD (%), TL/S (%), ULL/S (%), LLL/S (%), BAD/S (%), BCD/S (%),fat component (FC kg), muscle component (MC kg) and bone component (BC kg).

Table 1. Average values of anthropometric characteristics and physical development indices of the general group (9-10-11 years)

Index	*Mean*	*SD*	*C.V*
Age (ans)	*9,8*	*0,7*	*7,08*
mass (kg)	*31,59*	*5,8*	*18,24*
stature (cm)	*135,45*	*6,6*	*4,89*
FC (kg)	*44,37*	*18,84*	*42,46*
MC (kg)	*9,7*	*0,47*	*4,89*
BC (kg)	*5,01*	*0,25*	*4,89*
AS (m^2)	*1,14*	*0,12*	*10,16*
SI (%)	*35,45*	*6,63*	*18,7*
QI (%)	*232,52*	*35,86*	*15,42*
ShouIder index (%)	*68,89*	*6,75*	*9,8*

FC: fat component; MC: muscle component; BC: bone component; AS: absolute surface; SI: Skele Index; QI: Quetelet Index; SHI: Shoulder Index.

Table 2. The average values of the body proportions of the general group (9-10-11 years)

Index	*Moy*	*SD*	*C.V*
TL/Stature (%)	*63,66*	*5,27*	*8,28*
BAD/ Stature (%)	*20,24*	*1,29*	*6,4*
DBC/ Stature (%)	*15,15*	*0,85*	*5,64*

ULL/ Stature (%)	*43,63*	*1,28*	*2,93*
LLL/ Stature (%)	*53,57*	*1,46*	*2,72*

T.L: trunk length; BAD: biacromial diameter; U.L.L: upper limb length; L.L.L: length lower limb.

(2) We used two tests (Table 3), SARGENT (1921) and AHPER (1976) used in children (Hansen et al. 1997) and found in the Singapore NAPFA test battery (Quck, J. J., 1993).

(3) In the water we used the ventral glide test (Cazorla, 1984) and flotation test (Cazorla, 1993).

Table 3. Average values of test results (floating, sinking, Aahper, Sargent) for the general group (9-10-11 years old)

Index	*mean*	*SD*	*CV*
buoyancy (pts)	*2,73*	*0,71*	*26,01*
glide (cm)	*502,13*	*57,38*	*11,43*
Aahper test (cm)	*154*	*15,48*	*10,05*
Sargent test (cm)	*26,75*	*4,63*	*17,31*

We used the ANOVA method to compare the relative means of the three age groups.

The principal component analysis (ACP) allowed us to identify relationships and redundancies between characteristics of the same group and to select the most representative anthropometric parameters to be taken in order to draw the profiles of our sample. The method of determining the anthropometric profile is intended to evaluate physical development, according to the well-defined indices that represent the traits selected with the help of ACP. The physical development of an individual is evaluated by comparing these physical data with those of the home group or a reference group, according to the index I.

I : estimation index.
X1 : value of a subject or average of the group to compare.
$\bar{X}2$: mean of the reference group.
σ : the standard deviation of the reference group.

Results

1. Comparisons. No significant correlation (Figue 1) was recorded between all morphological parameters and physical tests for the group of young prepubertal swimmers (9-10-11 years).

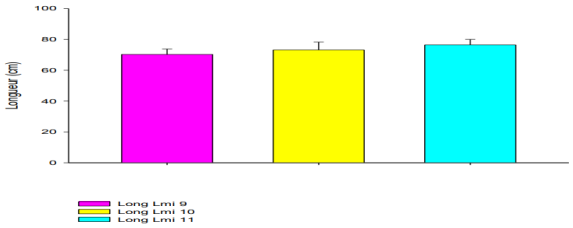

Figure 1: Comparison between the means of the 3 age groups 9, 10 and 11 years, example of lower limb length (LLL).

2. Principal component analysis.
The ACP (Table 4) of the lengths revealed six principal components, with the highest correlation coefficients (SD) at F1 with 71.82%, a second lowest (15.04%) on F2 and it decreases to the sixth (1.61%).

Tableau 4. The eigenvalues of the principal component analysis of the lengths

	F1	*F2*	*F3*	*F4*	*F5*	*F6*
Eigenvalue	*87,376*	*18,302*	*5,895*	*3,778*	*2,901*	*1,959*
Variability (%)	*71,829*	*15,046*	*4,846*	*3,106*	*2,385*	*1,611*
cumulative %	*71,829*	*86,875*	*91,722*	*94,827*	*97,212*	*98,822*

The principal component analysis of the lengths revealed strong correlations on the first, between the lengths, stature, sitting height, upper limb, arm, lower limb, thigh and leg, and highlights correlation between sitting height and trunk on F2 (Table 5).

Table 5. Correlations between variables and factors in the principal component analysis of lengths

Variable	*F1*	*F2*	*F3*	*F4*	*F5*	*F6*
ST	***0,995***	*0,049*	*0,011*	*-0,058*	*-0,051*	*0,017*
LSW	*0,723*	*0,621*	*-0,106*	*-0,056*	*-0,171*	*-0,016*
T	*0,347*	***0,857***	*-0,283*	*-0,102*	*0,157*	*0,038*
ULL	***0,868***	*0,078*	*-0,031*	*0,433*	*0,182*	*-0,131*
AL	*0,620*	*0,190*	*-0,104*	*0,469*	*-0,479*	*-0,273*
FL	*0,523*	*-0,036*	*0,176*	*-0,245*	*0,595*	*-0,504*
HL	*0,446*	*-0,035*	*-0,120*	*0,554*	*0,326*	*0,591*
Lll	***0,945***	*-0,300*	*0,078*	*-0,047*	*0,032*	*0,033*
TL	*0,719*	*-0,581*	*-0,365*	*-0,067*	*0,020*	*-0,009*
Ll	*0,670*	*0,296*	*0,663*	*0,002*	*0,026*	*0,057*

ST: stature; L.S.W: length sitting waist. T.L: trunk length; U.L.L: upper limb length; A.L: arm length; F.L: forearm length; H.L: hand length; L.L.L: length lower limb; T.L: length of the thigh; L.L: leg length.

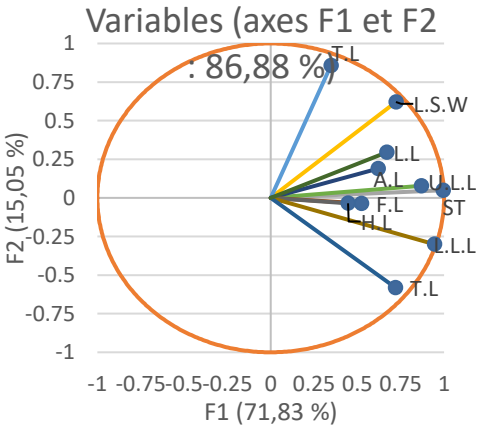

Figure 2. Graphical representation of the lengths in two axes, horizontal and vertical (F1, F2).

On figure 2, is represented the grouping of the variables and their redundancies, thus the variables approaching most the circle of correlation are: the length of the stature (L.S) representing all the body, of the trunk (L.T) and of the waist sitting (T.A) representing the upper segment, of the upper limb (L.M.S) and of the arm (L.B) representing the upper limb, of the inferior limb (L.M.I), of the thigh (L.C) and of the leg (L.J) representing the lower limb.

The ACP allowed us to select 16 anthropometric parameters (Tableau 6) that seemed the most representative out of the 45, taking into consideration the requirements of the discipline.

Table 6. Anthropometric parameters selected from the ACP

mean age	Lengths	Diameters	Circumferences	*skin folds*
9,79±0,69ans	*ST* *T.L* *ULL* *LLL*	*BAD* *TCD* *BCD* *SB*	*CIC* *CAC* *PC* *LC*	*SSF* *TSF* *BSF* *TSF*

B.A.D: biacromial diameter ; T.C.D: transversal chest diameter ; B.C.D: bicretal diameter,; S.B: shoulder bow; C.I.C: chest inspiration circumference; C.A.C: contracted arm circumference; P.C: pelvis circumference; L.C: leg circumference; S.S.F: subscapular skinfold; T.S.F: tricipital skinfold; B.S.F: belly skinfold; T.S.F: thigh skinfold.

Anthropometric profile

The ACP of our sample allowed us to eliminate redundancies and to select the most representative anthropometric parameters having an importance in swimming. From this selection we have drawn the profiles of the general group (9.79±0.69 years), the 9 years old, the 10 years old and finally the 11 years old.

Apart from the values of the length of the lower limb, the length of the upper limb, the circumference of the thorax in inspiration and that of the belly (ULL,

LLL, CIC, PC) for the general group (9.79 ± 0.69-year-old) which present a high physical development with M + 1 σ to M + 2 σ, the other anthropometric parameters showed a medium physical development (M + 1 σ to M - 1 σ) (Figure 3).

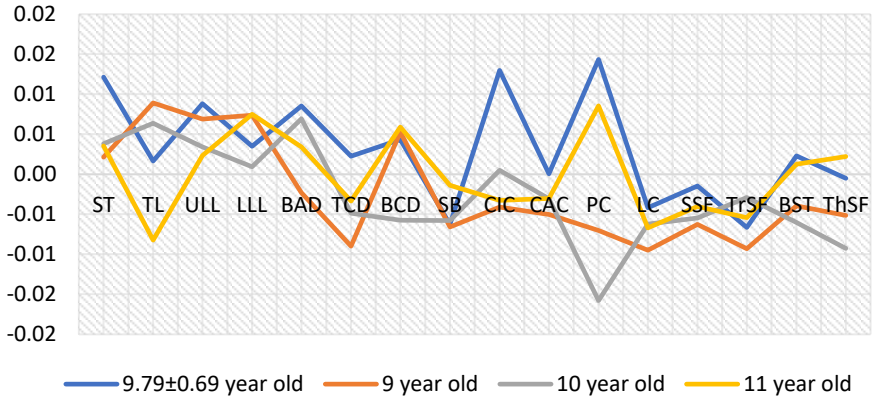

Figure 3. Morphogram of the young Algerian male swimmer (9.79±0.69-, 9, 10- and 11-year-old)

Regarding the age groups, 9, 10 and 11 years, all the values of the anthropometric parameters of each group showed an average physical development located in a range of variability from M + 1 σ to M - 1 σ, with the exception of the pelvic circumference (PC) where a lower physical development is observed (M + 1 σ to M - 1 σ).

Conclusion

At the term of our study, we concluded with the population used for our research that there are no significant lien connecting the anthropometric settings (parameters) with the flotation, front glide and or the vertical and horizontal jump.

We came up with an observation that let us believe on the 45 anthropometric settings that allowed us to conclude our research, only a small number of 16 participants can actually give us a closer vue on what a young swimmer's anthropometric profile (9-10 and 11 years of age) should be.

After the final results and conclusion to our study, we came with a constate that *the stature, the length of the legs, the circumferences, of the rib cage in maximum inspiration and the hip* constitutes a really important components for young

swimmers aged 9.79 ± 0.69 years old. For the 9-year-old group, special attention should be paid to trunk, upper limbs, lower limbs lengths and bicretal diameter. *Lower limbs length and the biacromial diameter* are parameters that should not be overlooked in 10-year-old children. On the other hand, for 11-year-olds, we draw attention to *the length of the lower limb, the biacromial diameter and the circumference of the pelvis*.

Thus, from a practical point of view, our research work led to the definition of a typical anthropometric profile of the young Algerian prepubescent swimmer (9, 10 and 11 years old), on the basis of a limited number of anthropometric parameters which could be used in the selection in swimming at the youth.

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