A COMPARISON OF BODY BUILD, BODY COMPOSITION AND SELECTED FUNCTIONAL CHARACTERISTICS IN TUNISIAN AND CZECH BOYS OF 11 TO 12 YEARS OF AGE

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Industrially developed and advanced societies give to their population much better conditions, as far as health care and nutrition, as well as care of the young generation are concerned, than the developing countries. Therefore we are sometimes faced with the problem if and to what extent the children from developing countries show signs of retarded development with respect to the differences in the individual factors of socio-economic conditions. We are also trying to find out how the effects of these differences are manifested, whether they apply to all indices equally, and how it is possible to evaluate these changes, which are at present under intensive scrutiny, in a complex manner.

The authors have investigated 160 healthy boys between 11 and 12 years of age in the capital city of Tunisia, Tunis. The first group T_1 were boys of primary schools, aged on the average 11.7, and belonged, according to social criteria, to poorer classes of the society. They had more modest, but sufficient living conditions (according to the classification of Centre International de l'Enfance they represented the social class IV). Further, the authors have investigated 29 pupils of a lycée (T_2), aged on the average 11.7, and another 100 lycée pupils who were one year older (T_3, 12.5 years of age). These two groups of pupils belonged to privileged social classes with better living conditions. According to the classification of Centre International de l'Enfance they represented the social category II. The results of these investigations were then compared with those gained from an examination of Czech boys of the same age and with comparable living conditions, and from the same type of school ($C_1 - n = 28$
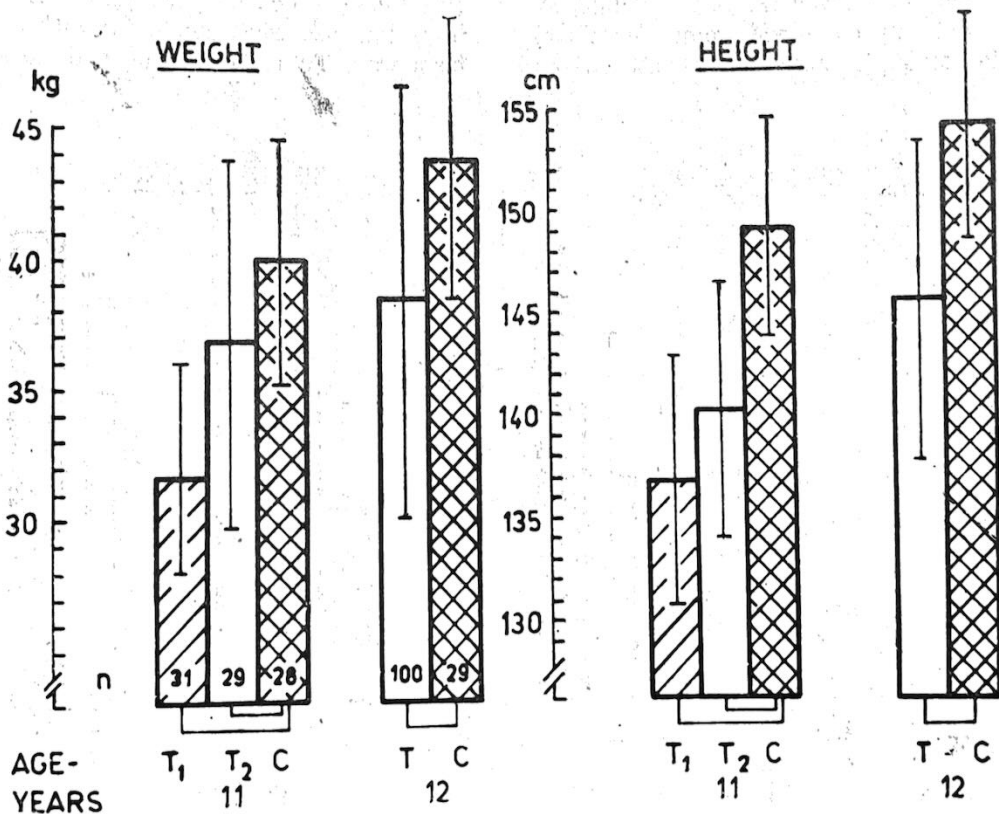

FIG. 1
Weight and height in Tunisian and Czech boys of 11 and 12 years of age.

TAB. 1

Anthropometric measures in Tunisian and Czech boys of 11 and 12 years of age (cm)

Age-years	11						12			
	T_1		T_2		C		T		C	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Length of lower extremities	82.8	3.4	86.3	4.2	91.3	4.4	88.9	5.8	95.2	4.3
Chest circumference (inspirium)	70.8	3.4	75.4	5.8	75.3	3.7	76.6	6.2	77.6	4.1
Biacromial breadth	29.8	1.8	30.8	1.5	30.2	1.9	31.3	1.9	32.6	1.5
Chest breadth	22.1	2.2	22.7	2.5	21.0	1.4	22.9	2.0	22.3	1.4
Chest depth	15.3	1.1	15.8	1.0	14.9	1.1	15.9	1.3	16.3	1.3
Bicristal breadth	21.7	1.3	22.9	1.5	22.1	1.4	23.0	1.8	22.3	1.5
Bitrochanteric breadth	23.4	1.9	25.1	1.5	24.8	1.6	22.7	1.9	26.7	1.7

average age 11.7 yers; $C_2 - n = 29$, average age 12.6 years).

The authors have measured a number of characters in keeping with the requirements of the International Biological Program, and also the thickness of ten skinfolds, which were measured with a caliper. The relative and absolute values of lean body mass and fat were calculated according to the nomographs of the Research Institute of Physical Culture (after Pařizková) worked out for children. Further, the authors examined some functional parameters, for example muscular strength, which was measured with electric dynamometer based on the tensometr principle (after Merhautová). Evaluated were also the results of a modified version of step-test (frequency 24/minute, height of step 30 cm).

In figure 1 the reader will find the values of height and weight. It is evident that the values of height and weight for Czech boys are higher. Tunisian boys of the first group were significantly shortest and lightest, not only in comparison with Czech boys, but also when compared with eleven-year old boys from Tunis (T_2). Length of lower limbs was
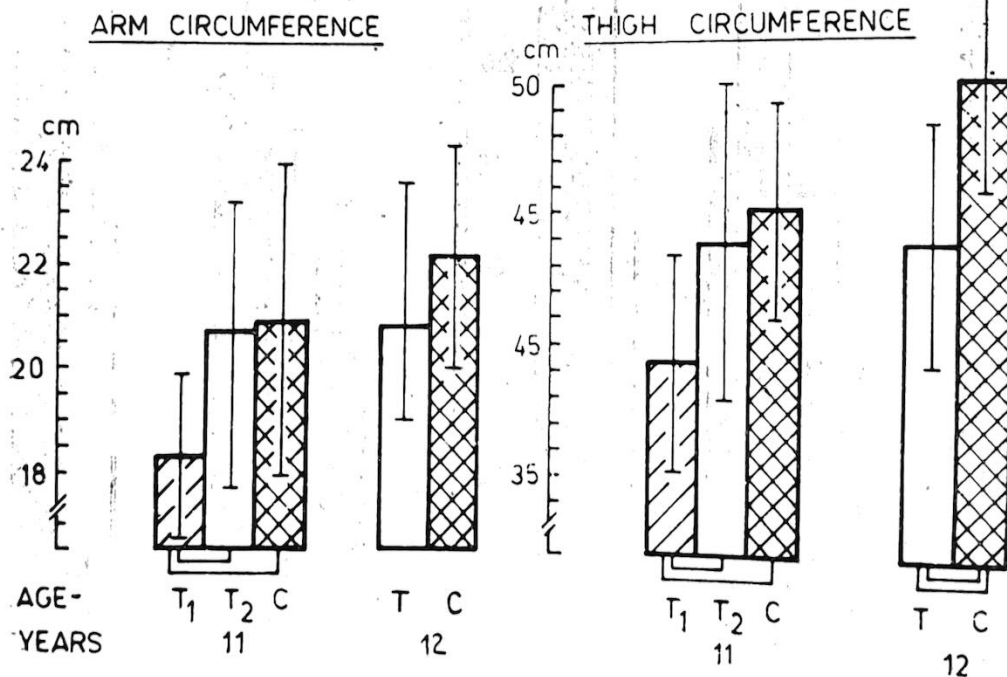

FIG. 2
Circumferential measures in Tunisian and Czech boys of 11 and 12 years of age.

Breadth of the wrist and femoral condyles in Tunisian and Czech boys of 11 and 12 years of age (cm)

Age-years	11						12			
	T_1		T_2		C		T		C	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Wrist breadth	4.49	0.20	4.60	0.27	4.78	0.37	4.68	1.04	5.05	0.34
Femoral condyles breadth	8.22	0.40	8.49	0.46	8.86	0.50	8.61	0.65	9.15	0.48

significantly greatest in Czech boys (tab. 1) of 11 and also 12 years of age. Boys of the first Tunisian group were found to have significantly shortest limbs in comparison with all other groups examined (T_2, T_3, C_1, C_2). The differences in body height were caused, as is now clear, by shorter limbs, which is also confirmed by the values of sitting height. The circumference of thorax and biacromial breadth were the same in the 11-year old Tunisian boys and the comparable Czech group, while the values of these two characters were lower in the T_1 category. At the age of 12 the biacromial breadth was shorter in the T_3 category than in the comparable Czech group. The breadth and depth of thorax were greater than those of Czech boys at the age 11, in categories T_2 and T_3, but at the age of 12 this difference disappears.

Breadth of pelvis was again greater in Tunisian boys. In the values of body build the Tunisian boys differ from the Czech ones first of all in greater measures taken on the trunk and in shorter limbs.

The circumferences of the limbs did not differ between Tunisian and Czech boys of the same age, but they were significantly of lowest values in T_1 category (fig. 2). The robusticity of skeleton evaluated on the basis of the breadth of wrist and the femoral condyles (tab. 2) was of the same value in all groups examined. The relative values of lean body mass and fat (fig. 3) were again the same in all groups of boys; the only significant difference has been found in absolute values of lean body mass, which were lowest in T_1 category and highest in C_1 and C_2 categories.
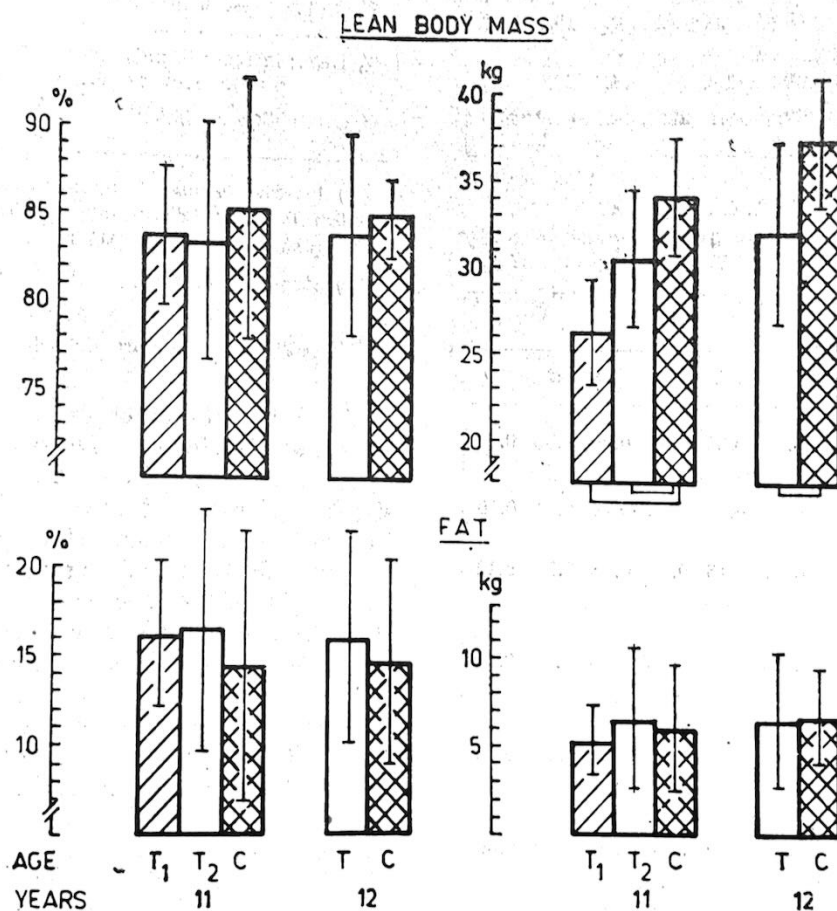
LEAN BODY MASS

FIG. 3
Lean body mass (LBM) and depot fat (relative and absolutevalues) in Tunisian and Czech boys of 11 and 12 years of age.

The results of anthropometric measurements and investigations seemed to indicate a retarded or inferior development of Tunisian boys, especially those who belonged to poorer social strata. The functional investigation, however, does not speak in favour of this assumption. The absolute values of muscle strength were for the most part greatest with T_1 category, or at least did not differ from the values found in Tunisian boys who were one year older. This difference was even more pronounced when we calculated the muscle strength in relation to 1 kg of body weight (tables 3 and 4).

Step-test shows again the best results within the T_1 group. Increase of pulse frequency during step-

TAB. 3
Muscle strength (absolute values — kp) in Tunisian boys of 11 and 12 years of age

Age — years	11				12	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Extensors of the trunk	61.4	11.3	58.1	9.8	61.9	12.0
Hand grip	15.8	3.6	16.7	3.3	19.4	4.7
Flexors of the elbow joint	20.1	4.4	18.4	3.6	20.2	4.7
Extensors of the elbow joint	14.1	2.2	12.8	2.2	13.6	2.6
Flexors of the knee joint	15.8	3.9	15.5	2.2	15.8	3.2
Extensors of the knee joint	29.3	3.9	28.2	4.4	30.9	5.7
Plantar flexors	39.4	9.1	39.6	10.1	42.2	11.4

TAB. 4
Muscle strength (relative values — per kg body weight) in Tunisian boys of 11 and 12 years of age

Age — years	11				12	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Extensors of the trunk	1.97	0.35	1.60	0.29	1.65	0.33
Hand grip	0.51	0.20	0.46	0.14	0.51	0.10
Flexors of the elbow joint	0.64	0.13	0.51	0.13	0.54	0.12
Extensors of the elbow joint	0.45	0.09	0.36	0.08	0.36	0.08
Flexors of the knee joint	0.54	0.15	0.43	0.10	0.42	0.09
Extensors of the knee joint	0.91	0.20	0.78	0.10	0.42	0.09
Plantar flexors	1.27	0.29	1.10	0.33	1.20	0.37

TAB. 5
Results of step-test in Tunisian and Czech boys of 11 and 12 years of age

Age — years	11		12			
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Increase in pulse frequency during step-test	346.1	53.7	370.0	86.9	361.3	43.9
Increase in pulse frequency during recovery period	54.6	25.8	64.9	43.5	64.4	33.0
Index	118.9	13.4	111.1	15.8	109.7	17.1

TAB. 6
Correlation coefficients of the relationship between relative amount (%) of depot fat and lean body mass, and the results of step-test in groups of Tunisian boys

Years	11	12
n	29	100
	r	r
% FAT: increase in pulse frequency during recovery period*)	0.547	0.262
% FAT: step-test index**)	—0.465	—0.379
% LBM: increase in pulse frequency during recovery period	—0.517	—0.253
% LBM: step-test index	0.502	0.286

*) Increase in pulse frequency during recovery period = = pulse frequency (PF) during 5 minutes of recovery — PF during 5 min rest (initial values).

**) Step-test index =

$$= \frac{\text{lasting of step-test in sec.}}{\Sigma \text{ of PF in the 2nd, 3rd and 5th min. of recovery}} \times 100$$

test and in the course of recovery, for example, as well as the step-test index show that boys of T_1 category were physically best off. The course of step-test shows that boys of T_1 group performed the work in true steady state (tab. 5), which does not apply for the remaining groups of Tunisian boys. An analysis of the effectiveness of work shows again that the best results were found in the T_1 group. One of the explanations may be the amount of work executed in relation to the lean body mass of these groups; the results of step-test correspond in negative sense with the amount of body fat and in positive sense with lean body mass (tab. 6). The organism unhampered by high amounts of body fat performs the same work with more ease and with better effectiveness, the circulatory system is not under such a great strain. Thus, higher weight is not an advantage, even with children, when we take into account the effectiveness of work. In heavier and

especially fatter children we find worse results of functional tests, which is true not only as regards the results of step-test, but also of muscle strength. Some other comparisons with the results of functional tests registered in Czech children (Šabat, Kopcová, Merhautová) show that given the higher body weight Czech boys display the same results of functional tests. The shortest Tunisian boys of T_1 category always achieved the best or the same results in comparison with all other groups.

Similar conclusions may be drawn on the basis of other comparisons, such as the vital capacity of lungs, maximum minute ventilation, the forced expiration and (tab. 7) results in some sporting events: 50 m and 300 m runs, and broad jump (tab. 8).

The results mentioned in the paper show that in evaluating the development of children in underdeveloped countries it is not always correct and objective to relate the height and weight values to the standards set up in industrially developed countries. As evidenced by the results of complex investigation, lower height and weight values, and even lower values of lean body mass do not always mean that the children concerned are retarded in their development. These lower values are rather the expression of an adaptation to local nutritional, hygienic and other conditions and may be accompanied by a better functional development in comparison with not only the children from highly developed countries, but also taller and heavier children of their own country.

TAB. 7
Vital capacity and forced expiration in Tunisian boys of 11 and 12 years of age

Years	11 T_1		11 T_2		12 T	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Vital capacity (ml)	1953.2	284.2	2050.0	241.4	2191.0	391.2
Vital capacity/kg weight	62.1		55.6		56.9	
Vital capacity/kg LBM	74.2		67.2		68.4	
Forced expiration (ml/0.5 sec.)	1245.2	286.9	1263.8	237.8	1361.5	288.5

TAB. 8
Performance in several sport disciplines in Tunisian boys of 11 and 12 years of age

Years	11 T_1		11 T_2		12 T	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
50 m dash (sec.)	9.4	0.6	9.5	0.7	9.1	0.8
300 m run	67.5	6.1	69.4	6.4	65.7	8.0
broad jump (cm)	255.6	29.8	226.0	41.1	265.7	48.0

SUMMARY

160 normal healthy pupils of primary school (belonging to poorer social classes) and of lycée (privileged social classes) examined in the capital city of Tunisia, Tunis, were compared with 57 Czech boys of the same age (11 and 12 years) and the same social conditions. Height, weight and lean body weight, length of lower limbs, and biacromial breadth were significantly greatest in Czech boys. Wrist and femoral condyles breadth as well as relative values of lean body mass and fat did not differ. Chest breadth and depth, bicristal and bitrochanteric breadth were greater in Tunisian boys of higher social classes. Tunisian boys from poorer social classes seemed to be retarded in somatic development; as they showed the lowest values of nearly all anthropometric characters. But functional development, that is muscle strength (especially when related to total body weight), and results of step-test gave more favourable results for shortest Tunisian boys from poorer families. The same applied to respiratory functions tests and to the performance in selected sporting events.

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