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Original scientific paper

Growth and Development of Male Children and Youth in Tuzla's Region after the War in Bosnia and Herzegovina

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A B S T R A C T

A four-year aggression on Bosnia and Herzegovina was extremely unfavourable period for growth and development of children and youth. In spite of that, it is established that ontogeny of male children and youth (between 10.5–19.5 years) on the observed region is going well, and it is within the limits at the average European standards. By parallel analysis of growth of domestic and expatriate persons, it is established that the average (sum) values of almost it's all indexes are significantly bigger for domestic (object) inhabitants. However, after the end of growth, they become approximately the same. By comparison of indexes of growth and development of the tested sample and samples from 1980 (of the same population), the soft acceleration trend for majority (indexes) of parameters is established, what is mostly seen in postpuberty age. The tested persons in pre-puberty and puberty age had the same or even less average values comparing to the tested persons from 1980. This is probably a direct result of negative influence of exogenous factors (war vital conditions), which caused temporary stoppage in growth and development in that period of growth when growth is the most intensive. Despite the fact that war life conditions have negatively affected the growth and development of the subjects studied, it has been found that the development of male children and youth, meaning the growth of different parameters on the studied area were in synchrony.

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Introduction

In the war vital conditions, almost all exogenous factors of growth and development were disturbed. Forced migrations of population, banishment, killing and suffering of the people, had in Bosnia and Herzegovina during four war years the most unfavourable influence on health and hygiene, socio-economic factors, and particularly nutritional and other stress factors in the surviving part of population (especially children and youth, who were indifferent periods of growth and development during the war). Influence of these factors is mostly expressed in extremely hard and long periods of poverty or malnutrition. Insufficient and poor nourishment and long–term hunger of long duration had negative consequences on the youngest children.

Statistical data about the movement of body mass and height of children and youth in some west-European countries from the beginning of this century till now show noticeable falls of growth during world wars.

First evidence of these measures range in corresponding part of our population during the war in Bosnia and Herzegovina (especially in besieged towns) announces harder consequences in growth and development. It is noticed, however, that stoppage in growth and development, provoked by an acute illness, or by bad nourishment during a short period, or by hunger (if a period of special sensitivity to such cases is excluded) will be compensated. A child will come back to its tempo of growth, from which a child was forcibly separated, when the factors, which caused stoppage of growth end[1].

It is expected that acceleration of growth and development follow the improvement of socio-economic conditions of life, and reversely in falls in the course of crises. Since 1980 there is evidence that it has been falling or even stopped in these countries[2,3]. These signs in industrialized countries point to possibility of children reaching maximal expression of their genetic potential or those social conditions stopped getting better[4].

In Bosnia and Herzegovina there are no comprehensive investigations of growth and development, which include all the regions such investigations could form the basis of understanding the factors important for growth and development in our conditions, and about breakdowns of that process in local populations. Hadžiselimović[1,5–8], Berberović[9–11], Švob[12–14], Novaković[15–17] and Terzić[18] were occupied with anthropological investigations and laws of ontogenetic development of human population in Bosnia and Herzegovina.

The presence of refugees on commune Tuzla's territory influenced changing of demographic structure of Tuzla's population as well as the results of our research.

The purposes of this work are:

a) On the basis of anthropometric measures of male children and youth in Tuzla community, and of chronological age ranging from 10.5 to 19.5 years, to establish and to analyse the basic indicators of growth and development process in the light of the essential current factors determining those indicators in the local population (including four aggression consequences in our country);

b) To compare the measurement results of male children (boys) and youth of the domicile population and of refugees and to establish the existence of possible differences in growth and development between these two studied groups;

c) To establish if there are any temporal differences in growth and development of male children and males on Tuzla's commune, by comparing them with the research results from 1980. That makes it possible to study, analyse and define the

TABLE 1
SAMPLE SIZE BY AGE GROUPS

Age (years) generations:	11	12	13	14	15	16	17	18	19	=9
Number of examined pupils:	139	143	165	184	156	133	146	155	100	=1321

16 years old trend of changing in growth and development to consider the relative contribution of its possible factors.

Materials and Methods

Cross-sectional methods of investigation included 1321 examined male pupils, with chronological age from 10.5 to 19.5 years (400 examined pupils are refugees, and 921 of them are domicile population). The sample was chosen by chance and stratified by age categories. The sample by age group is given in Table 1.

The study was carried out in the fall of 1996 in 2 secondary schools and in 4 primary schools on Tuzla's territory. According to data from the Secretary for Public Relationships in the commune of Tuzla[19], at the end of the first term of school year 1996/97, there were 9,743 male pupils of chronological age between 10.5–19.5 years. Our sample amounts to 13% of the total number in the population. In 1996 there were 4,100 banished boys of corresponding age from Tuzla[20], so our sample of refugees was 9.76 of the total number. All planned measures were in keeping with regulations of IBP, by anthropological methods and standard instruments, from the collection of Martin's anthropometric parameters and they are: 1. Height; 2. Weight; 3.sitting height; 4. Length of arm; 5. Length of leg; 6. Minimal circumference of breasts; 7. Middle circumference of breasts; 8. Maximal circumference of breasts; 9. Scope of thigh; 10. Scope of brachium; 11. Width of shoulders; 12. Width of pelvis; 13. Width of head, and 14. length of head.

The data were subjected to variational analysis, which included an estimation of central tendency and degree of internal--group variation. Index of sitting height and index of head were calculated. Significance of differences was established between middle values (t-test for each parameter) of domicile and expelled persons. The significance of differences between results of these investigations estimated by the same method.

Results and Discussion

Physical height

Growth of average physical-height of male children and youth from Tuzla's community is intensive until 15th year of age, and after that it quickly falls and finishes in the age of 18 (Figure 1).

The lower growth in statue of banished children and youth were caused by war conditions, during which they were in Bosnia and Herzegovina (Figure 2).

Temporary cessation of growth in height is our conclusion after comparison with the results from 1980. Children are more sensitive on negative influence of exogenous factors in that period of their life, what most probably caused the stoppage of growth. After the age of 15, negative influence of exogenous factors did not significantly slow down growth. But, in spite of war conditions, significantly bigger average body-height ($p < 0.05$) in 1996 is attained after age of 15, and is a result of growth acceleration at the age of 16.

Tuzla's 18-year old boys are taller, in average by 1.07 cm than the males of the same age from 1980 (Figure 3).

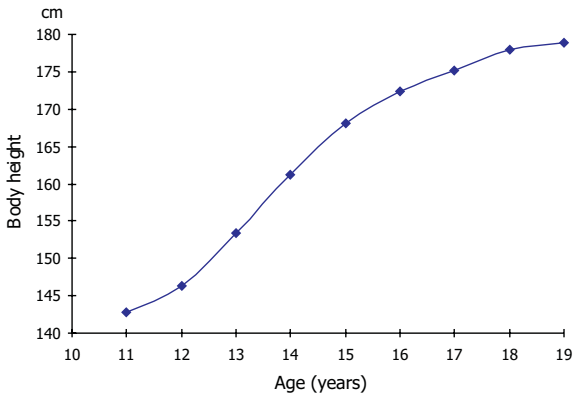

Fig. 1. Height of male children and youth from Tuzla.

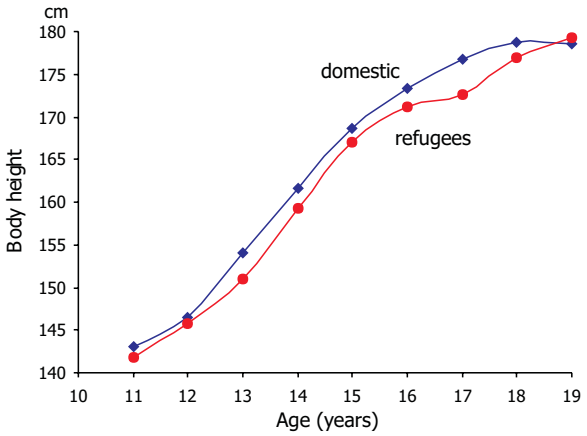

Fig. 2. Heights of domestic and banished youth from Tuzla.

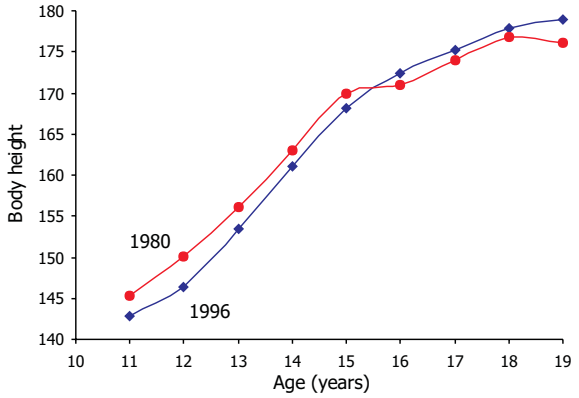

Fig. 3. Height of male children and youth from Tuzla (1980 and 1996).

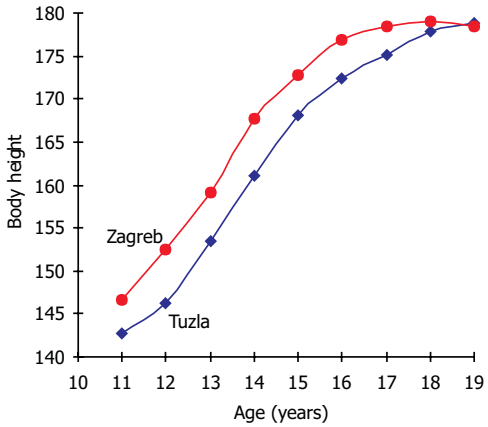

Fig. 4. Height of male children from Tuzla (1996) and Zagreb (1991).

Comparing analyses of Zagreb male youths reported by Prebeg and co-authors in 1995[21] and results of similar analyses made in Tuzla, we observe significant differences ($p < 0.05$) between them (Figure 4). All generations of Tuzla youth are shorter than the ones of the same age from Zagreb, except for those from Tuzla who are nineteen and who are on average 0.5 cm taller than the group of the same age from Zagreb. These differences may be a result of differences in genetic potential, and that they could have been smaller if the members of the population sample from Tuzla (from 1996) had not suffered four years of aggression.

Physical mass

The biggest intensity of mass and height increase is in the age group of 14. Accelerated growth in mass occurs between the age of 11 and 15, after which it weakens and becomes more varied (Figure 5).

Shorter average mass of banished people speaks clearly about the significance of consequences of suffering during aggression in Bosnia and Herzegovina (Figure 6). Average weight in the 1996 sample is lower or approximately equal to that of 1980. This temporary stoppage in increasing body weight can be explained by disordered common life standards (Figure 7).

Significantly smaller body weight of our sample compared to Prebegova et al. (1995)[21], and Ivanović (1985)[22], are the best examples of the effects of exogenous factors on the growth of Tuzla's male children and youth who survived the war (Figures 8 and 9).

Sitting height and index of sitting height.

Length of upper body is growing chronologically to age until 19th year (Figure 10). Relation of upper body's length to total body height (index of sitting height) is represented on Table 2. Sitting height is over 50% of total height in all age groups. From age 11 to age 15 extremities elongate, so values for the sitting height index decrease till age 15, and from age 15 till age 19, values increase (Figure 11).

Comparative analysis of our results and adequate data from 1980, it is established that in period of prepuberty and puberty, average sitting height of the same population is shorter now than 16 years ago. After puberty, the average values of this parameter are a bit bigger (Figure 12).

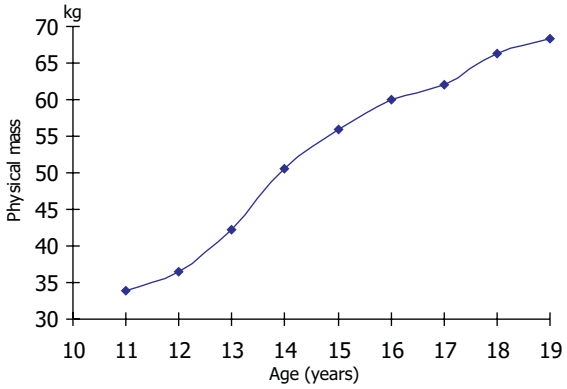

Fig. 5. Mass of male children and youth from the municipality of Tuzla.

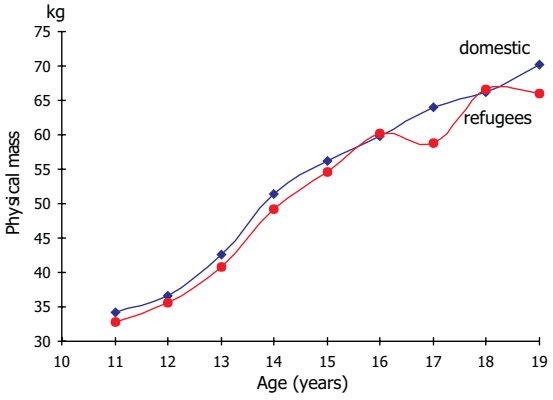

Fig. 6. Mass of domiciles and banished male children and youth from the municipality of Tuzla.

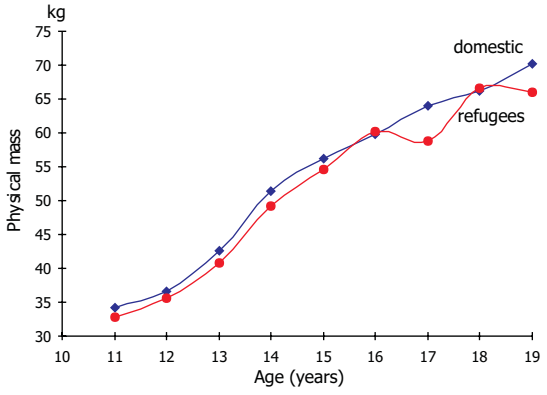

Fig. 7. Mass of male youth and children from Tuzla (1980 & 1996).

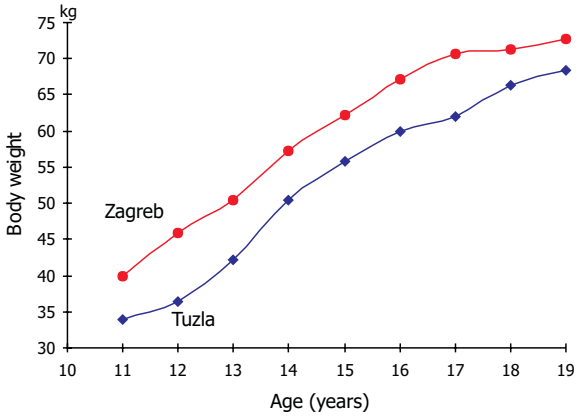

Fig. 8. Mass of male children and youth from Tuzla (1996) and Zagreb (1991).

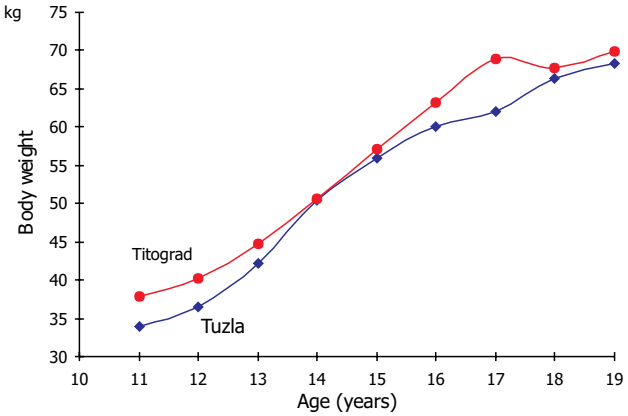

Fig. 9. Mass of male children and youth from Tuzla (1996) and Titograd (1985).

TABLE 2
SITTING HEIGHT INDEX OF MALE CHILDREN AND YOUTH IN TUZLA MUNICIPALITY

Stature (age)	Number	Mean	*s* of mean	SD	Coeff. of variability (%)
11	139	52.32	0.19	2.21	4.22
12	143	51.36	0.17	2.02	3.94
13	165	50.99	0.15	1.93	3.79
14	184	50.82	0.14	1.85	3.65
15	156	50.95	0.14	1.73	3.39
16	133	50.93	0.15	1.77	3.48
17	146	51.44	0.12	1.49	2.89
18	155	51.62	0.15	1.84	3.56
19	100	51.90	0.14	1.39	2.67

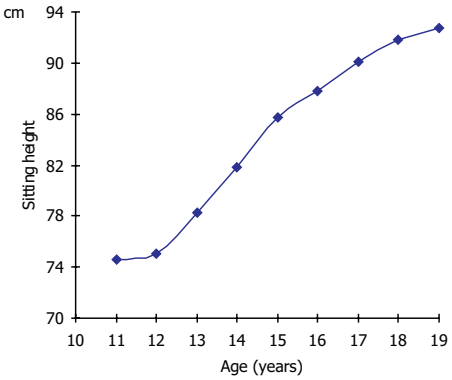

Fig. 10. Sitting-height of male children and youth in Tuzla.

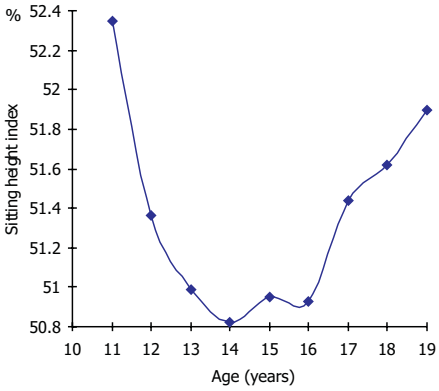

Fig. 11. Sitting-height index of male children and male youth in Tuzla.

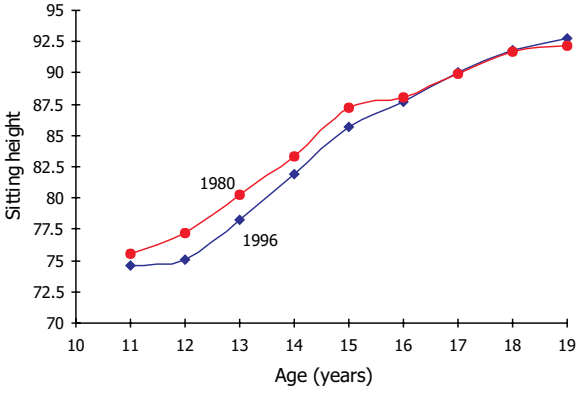

Fig. 12. Sitting height of male children and youth from Tuzla (1980 & 1996).

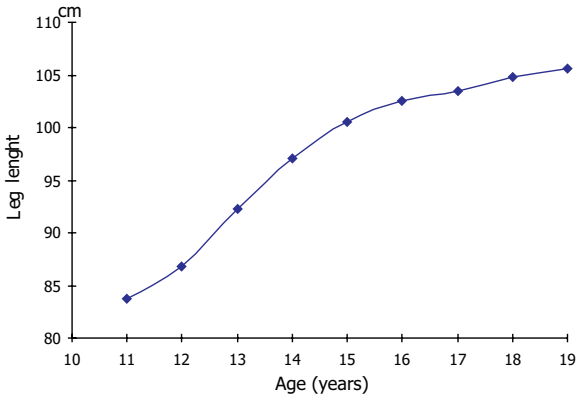

Fig. 13. Leg length of male children and youth from Tuzla.

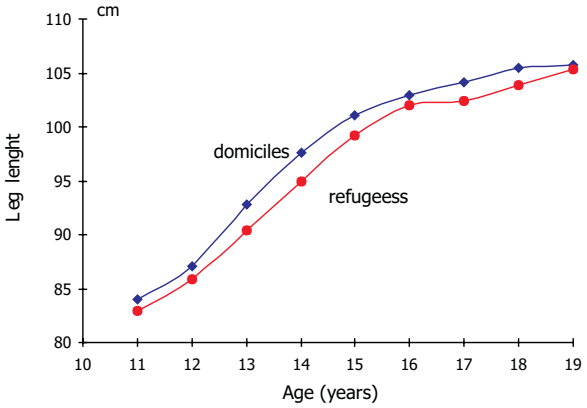

Fig. 14. Leg length of male children and youth of exiles and domestic population from Tuzla.

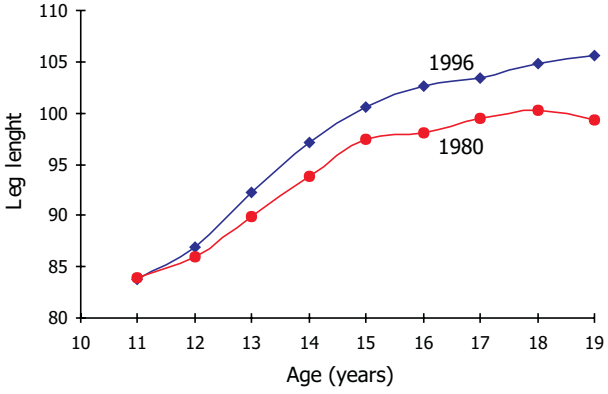

Fig. 15. Leg length of male children and youth from Tuzla (1980 & 1996).

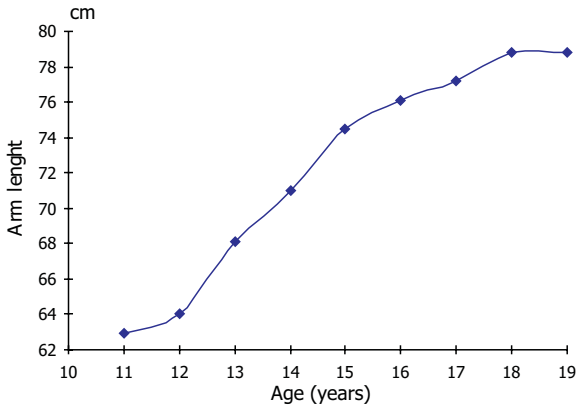

Fig. 16. Arm length of male children and youth from Tuzla.

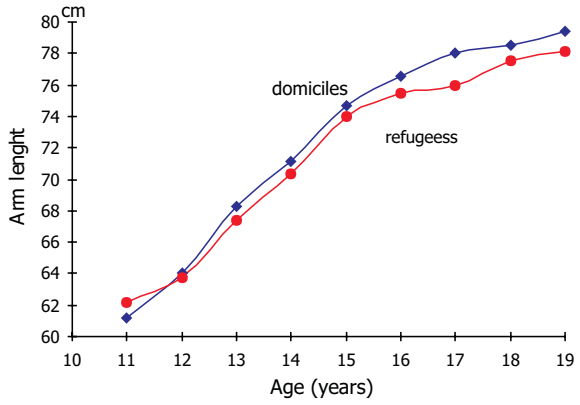

Fig. 17. Length of arm of domestic and exile male children and youth from Tuzla.

Length of a leg and length of an arm

Indexes of extremity growth in length coincide with the time of growth of entire body in height, i.e. with the period of body lengthening. The results of our research of these two variables are shown on Figures 13,14,15,16 and 17. Intensive growth of both parameters occurs in puberty, and completed in the 18th year of life (Figures 13 and 16). There was a significant difference ($p < 0.05$) in 13th, 14th and 17th year of life between domiciles and exiles. Differences also exit in length of arm ($p < 0.05$) recorded in 17th year of life (only < 0.05) (Figure 17). Our information for the length of a leg converses about an acceleration of extremity-growth, which coincides with the tempo of a height-growth of a whole organism.

Scopes

Rapid growth of breast scope occurs between 12th and 16th year, the most rapid growth being between the 13th and 14th year (Figures 18 and 19).

This parameter occurs between 1980 and 1996 and is present at all ages, but the biggest growth of it is after puberty (Figure 20).

Data for average scope of thigh and scope of upper arm are shown in Figures 21–26.

Width parameters

Width of shoulders is a good marker of development of the upper part of the body, torso and of the development of skeleton and musculature. The most intensive growth is in the 15th year, and it is finished in the 19th year (Figure 27).

Comparison of average width of shoulders of domestic children and youth and refugees showed no statistically significant differences.

By analyzing average values of width of shoulders and annual growth increase for this variable of the pattern for the same populations from 1980 and 1996, we can establish appearance of acceleration in all age categories ($p < 0.05$) (Figure 28).

The growth in width is synchronic in both pelvis and shoulders. Annual growth increase of average pelvis width is the biggest between 13th and 14th years.

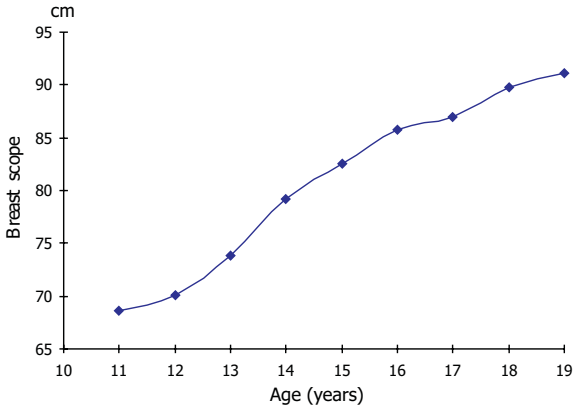

Fig. 18. Middle breast scope of male children and youth from Tuzla.

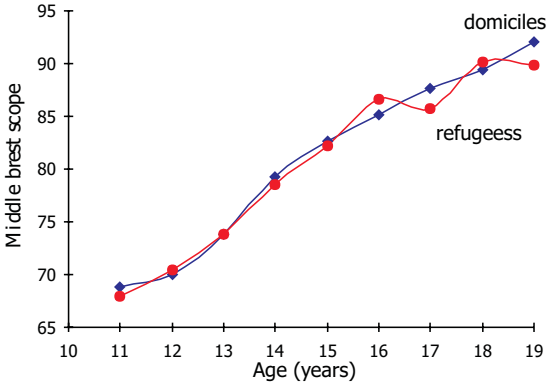

Fig. 19. Middle scope of breast of domestic and exile male children and youth from Tuzla.

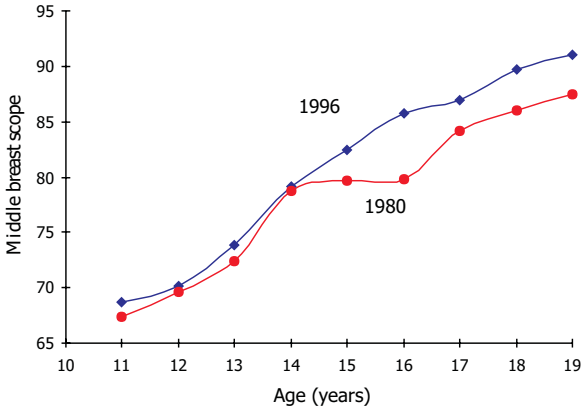

Fig. 20. Middle breast scope of male children and youth from Tuzla (1980 & 1996).

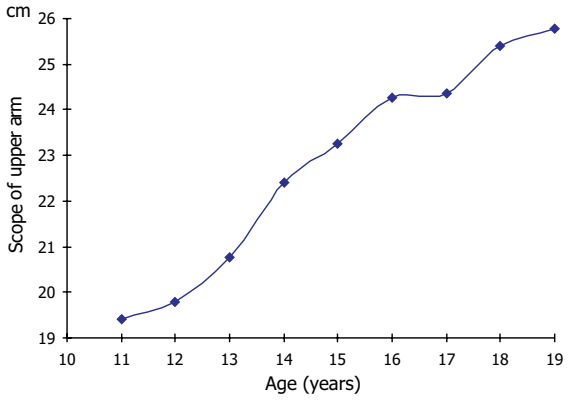

Fig. 21. Scope of upper arm of male children and youth from Tuzla.

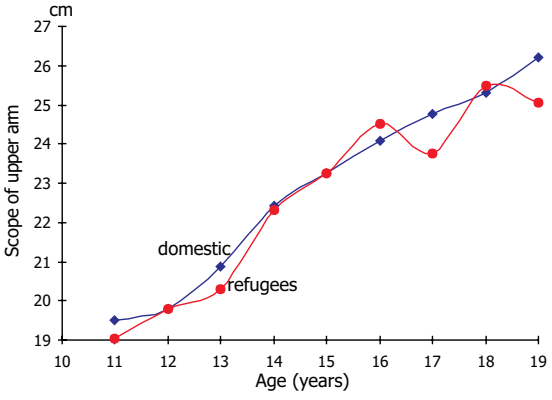

Fig. 22. Scope of upper arm of male children and youth of domestic people and refugees from Tuzla.

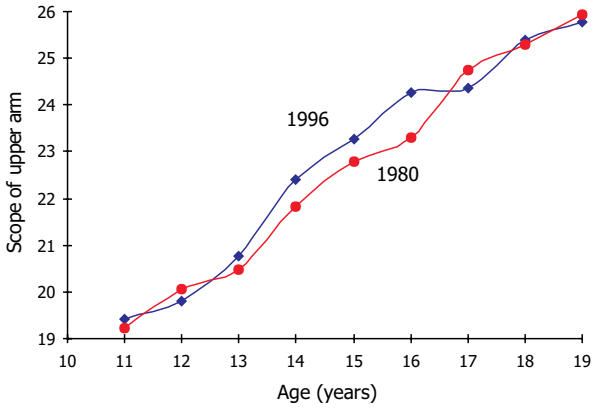

Fig. 23. Scope of upper arm of male children and youth from Tuzla (1980 & 1996).

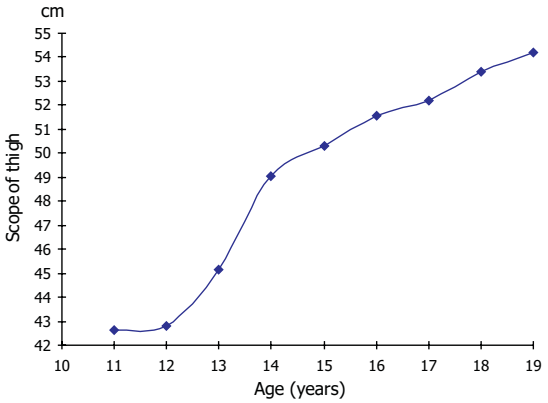

Fig. 24. Scope of thigh of male children and youth from Tuzla.

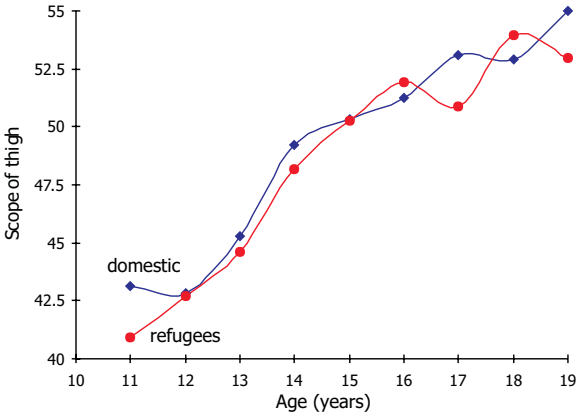

Fig. 25. Scope of thigh of male children and youth of domestic people and refugees from Tuzla.

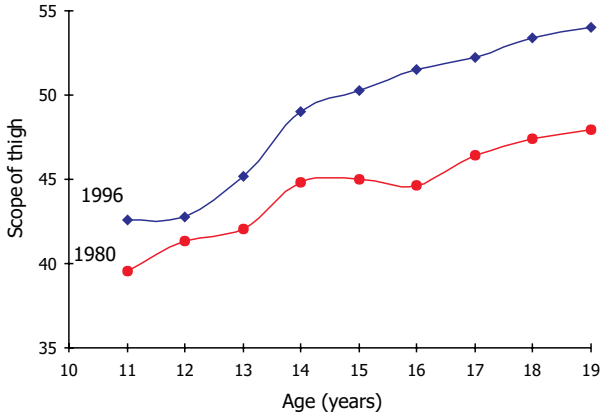

Fig. 26. Scope of thigh of male children and youth from Tuzla (1980 &1996).

Average width of the pelvis of tested sample is given in Figure 29.

A comparison of this parameter for domiciled and refugee population shows no statistically significant differences ($p < 0.05$), except in the age of 13 (Figure 30). Growth acceleration of pelvis width occurs in the age of 16 years (Figure 31).

Measurements and indexes of the head

Growth of the head in length and width goes on across puberty and is a little more intense at the beginning of it[23]. The total growth of head length and width between 11 and 19 years is relatively small (Tables 3–5).

Conclusions

Tuzla's youths today are slim, with body weight which is proportional to body height. The biggest annual increase for both measures is between 13 and 15 years of life. Scope of breast, upper arm

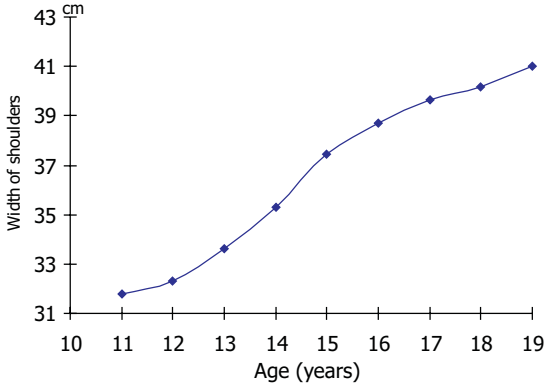

Fig. 27. Width of shoulders of male children and youth from Tuzla.

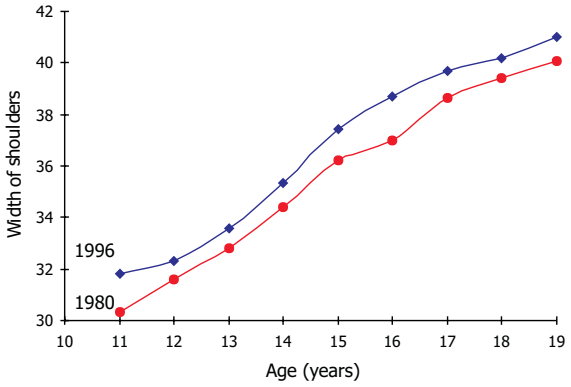

Fig. 28. Shoulder width of male children and youth from Tuzla (1980 & 1996).

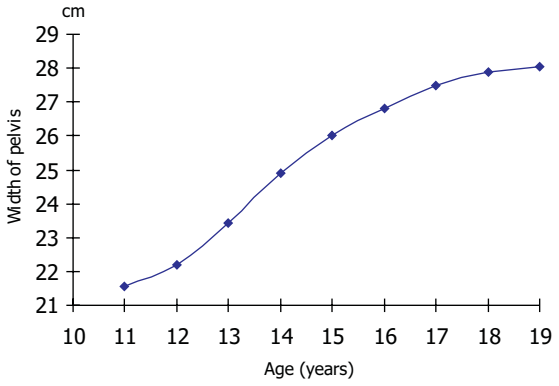

Fig. 29. Width of pelvis of male children and youth from Tuzla.

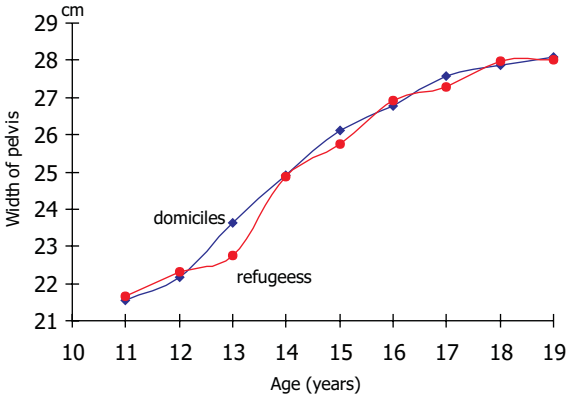

Fig. 30. Comparative presentation of pelvis width of male children and youth of domiciled population and refugees from the area of Tuzla.

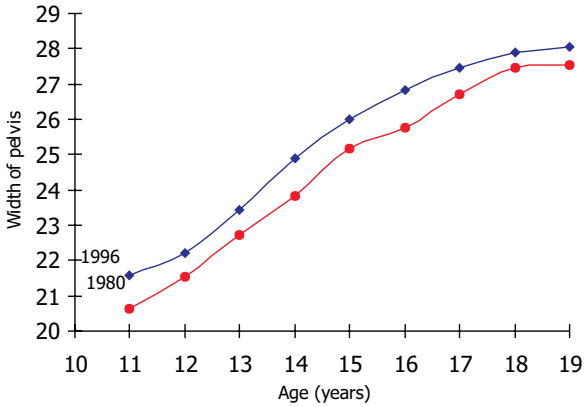

Fig. 31. Pelvis width of male children and youth from Tuzla (1980 & 1996).

and thigh at all stages are similar to other European population. Maximum annual increase in scope of breast is marked during adolescence. Growth intensity of thigh slope and upper arm slope shows two peaks: between the 13th and 14th year and between the 17th and 18th. The first peak is connected to a peak in general growth and development, while the second one is probably connected with more intensive development of muscles (during sport or other physical activity). Length growth of leg and arm is positively correlated with growth of height Dynamic growth for expanding parameters (width of pelvis and shoulders) point to the dynamic and harmonious development of skeleton and muscles. The relative length of upper part of body is over 50% of stature. Between the 11th and 15th year of life there is intensive growth of extremities, so sitting height indexes are decreased. After the 15th year of life those values get bigger until 19th year. Growth of the head is mostly finished in prepuberty development. Comparative analysis of development of domiciled and refugee people shows that average values of all its indexes are regularly significantly higher in domestic people. However, after growth was completed in both tested groups, they become almost the same. Youths were exposed to the most different stress situations and to a lot of

TABLE 3
HEAD LENGTH (CM) OF MALE CHILDREN AND YOUTH FROM TUZLA'S REGION

Stature (years)	N	Mean	s error of mean	SD	Coeff. of variability	Growth increase (%)
11	139	17.88	0.06	0.69	3.87	0
12	143	17.99	0.06	0.70	3.91	0.61
13	165	18.11	0.06	0.79	4.34	0.66
14	184	18.43	0.06	0.81	4.39	1.76
15	156	18.66	0.08	0.95	5.06	1.24
16	133	18.67	0.06	0.65	3.49	0.05
17	146	18.70	0.06	0.67	3.59	0.16
18	155	18.79	0.06	0.73	3.89	0.48
19	100	18.95	0.06	0.65	3.43	0.85

TABLE 4
HEAD WIDTH (CM) OF MALE CHILDREN AND YOUTH FROM TUZLA'S REGION

Stature (years)	Number	Mean	*s* error of mean	SD	Coeff. of variability	Growth increase (%)
11	139	14.93	0.05	0.58	3.88	0
12	143	15.00	0.05	0.63	4.20	0.46
13	165	15.19	0.06	0.71	4.68	1.26
14	184	15.44	0.06	0.75	4.86	1.64
15	156	15.50	0.06	0.70	4.54	0.38
16	133	15.88	0.06	0.64	4.03	2.45
17	146	15.73	0.05	0.57	3.62	–0.99
18	155	15.83	0.05	0.61	3.84	0.63
19	100	15.93	0.07	0.72	4.53	0.63

TABLE 5
HEAD-INDEX OF MALE CHILDREN AND YOUTH FROM TUZLA'S REGION

Stature (years)	Number	Mean	s error of mean	SD	Coeff. of variability (%)
11	139	83.50	0.37	4.30	5.15
12	143	83.37	0.41	4.90	5.86
13	165	83.87	0.45	5.72	6.80
14	184	83.77	0.36	4.85	5.79
15	156	83.06	0.40	4.99	5.99
16	133	85.05	0.37	4.26	5.01
17	146	84.11	0.31	3.80	4.51
18	155	84.24	0.35	4.41	5.22
19	100	84.06	0.40	4.05	4.81

problems of adapting on new, worse living conditions and more intensive working of other exogenous factors of growth and development. The presence of refugees in Tuzla resulted in a bit smaller mean values for most of the indicators of growth and development of the complete sample. Comparing indicators of growth and development of subjects of the present study to subjects 16 years ago an accelerating trend has been identified for most of the parameters at postpubertal ages. For example, an 18 years old citizen of Tuzla is 1.06 cm taller than his coeval was in 1980. The tested group both during prepuberty and puberty in some parameters had the same or even decreased mean values in comparison to the group tested in 1980. This is probably a direct consequence of negative effects of exogenous factors (war living conditions) These factors caused temporary stagnation of growth and development at these age groups. In postpubertal period that stagnation was compensated relatively fast. Generally, by the comparative analysis of the variation of studied characteristics it has been found out that body weight and breasts, thighs, upper arms, show the highest level of heterogeneity (both within age groups and in temporal sense). Opposite to these indicators there are some parameters that show high level of stability such as the length and width of head or index of sitting height.

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RAST I RAZVOJ MUŠKE DJECE I MLADEŽI TUZLANSKE REGIJE NAKON RATA U BOSNI I HERCEGOVINI

SAŽETAK

Četverogodišnje razdoblje agresije na Bosnu i Hercegovinu bilo je izrazito nepovoljno za rast i razvoj djece i mladeži. Usprkos tome, ustanovljeno je da je razvoj muške djece i mladeži (između 10,5 i 19,5 godina) u promatranoj regiji u granicama europskog prosjeka. Paralelnom analizom rasta domicilnih i iseljenih osoba, utvrđeno je da je prosječna (zbirna) vrijednost gotovo svih indeksa, značajno veća u domicilnih ispitanika. Međutim, nakon završetka rasta oni postaju približno jednaki u obje skupine. Usporedbom indeksa rasta i razvoja na ispitivanom uzorku i uzorcima iz 1980. godine (iz iste populacije), utvrđena je blaga akceleracija trenda za većinu (indeksa) parametara, što je osobito zamjetljivo u postpubertetskom razdoblju. Testirane osobe u pretpubertetskom i pubertetskom razdoblju imale su iste ili čak niže prosječne vrijednosti ako ih uspoređujemo s osobama testiranim 1980. godine. To je, vjerojatno, izravni rezultat negativnog utjecaja egzogenih faktora (ratni životni uvjeti), koji su uzrokovali privremeno zaustavljanje rasta i razvoja u razdoblju u kojem je rast najintenzivniji. Unatoč činjenici da su ratni životni uvjeti negativno utjecali na rast i razvoj promatrani subjekata, ustanovljeno je da je razvoj muške djece i mladeži, uzimajući u obzir različite parametre, na ispitivanom području bio ujednačen.