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Relations Between Some Exogenous Factors and Anthropometric Factors of Growth and Development of Male Children and Youngsters in the Tuzla Region, Bosnia and Herzegovina

Jasminka Hadžihalilović[1], Rifat Hadžiselimović[2], Rifet Terzić[3], Edhem Hasković[2], Adisa Ahmić[1], Amir H. Halilović[4], Munevera Osmić[5], Šaćira Mešalić[6] and Hajrija Hamidović[1]

[1] Faculty of Science and Mathematics, University of Tuzla, Bosnia and Herzegovina
[2] Faculty of Science and Mathematics, University of Sarajevo, Bosnia and Herzegovina
[3] School of Medicine, University of Tuzla, Bosnia and Herzegovina
[4] Gymnasium »Meša Selimović«, Tuzla, Bosnia and Herzegovina
[5] Health Care Center, Tuzla, Bosnia and Herzegovina
[6] Faculty of Defectology, University of Tuzla, Bosnia and Herzegovina

ABSTRACT

Dynamics of growth of male children and youths from the Region of Tuzla influenced by some exogenous factors was researched by a corresponding analysis of the sample which included 751 tested individuals, aged from 11 to 17 years. The analysis performed is primarily based on the scientific elaboration of the registered state in two time-points (1996 and 1999) in the tested part of broader population. This research involved the period of four-year aggression on Bosnia and Herzegovina, taking into consideration the fact that the tested persons spent one period of their growth and development in extremely bad wartime living conditions. By quasicanonic correlative analysis it was established that the next factors participated in connection of variables of both sets (initial and final measurements): mother's standard, total mother's and father's standard of living, mother's age and sequence of births participated to some less extent in connection of both sets of variables. Anthropometric variables that had most significant impact of both sets of variables are: length parameters, body mass, width parameters, circumferences had somewhat less impact, while indexes of head and sitting height had the least impact on this connection.

Key words: *growth and development, exogenous factors, growth dynamics*

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Introduction

Exogenous factors of individual growth affect growth and development, as well as the formation of individual phenotype to some extent, directly or indirectly.

Climate-ecological and geographical factors

Climate-ecological and geographical factors may affect growth in all developmental stages, but in contemporary conditions their influence is more or less than believed so far. It was established that some indexes of growth may be very similar in population from quite different climates. On the contrary, significant population differences can be found in the same climate zone. So, for example, female Nigerians and Eskimos same way fed and cared for, approximately have nearly the same period of development until menarche appearance (aged around 14.5 years), as well as female Burmese and Europeans (aged around 13 years)[1]. Equatorial Africa is populated by some of the highest people (Vatutsies, average height 176 cm; and of the shortest people (Pygmies, average height 142 cm)[2]. Europeans in tropic regions have average body mass smaller than population in cold regions[3].

There are some data on the influence of yearly rhythm of seasonal climate changes on growth acceleration. So, higher increase of body mass was recorded in spring and summer in moderately cold regions of Europe and North America (stature growth), while ponderal growth is relatively more intensive in autumn and winter[4–7]. There are some contradictory opinions about geographical and climatic factors influence. According to Ivanović[8], Marussson (1968) found children from south regions »higher« than the children from northern regions. On the contrary, Zeljcler[9] concluded that there are no differences in growth of children coming either from north or south.

There are opposite opinions on altitude influence on growth and development, as well. Some authors establish no difference in body mass and height between children from plains and mountains[10], while the others report that children living in plain regions are »higher« and »heavier« than those living in mountain regions[11]. The populations living in high altitude regions (Kirghises and residents of Tajikistan from Pamir) have growth and maturity processes slower than those coming from low-altitude and plain regions[12].

Migrations of population affect growth and development, as well. Japanese children immigrated to USA are shown to be of significantly larger body measures (some of them) than their parents. Groups of Jews, Sicilians, Portuguese and others emigrated to USA are established to differ from their parents in Europe[13].

Many authors thought that maturity comes earlier in the south of the Earth[14]. So, one study on body height increase in American adolescents, says that black girls mature earlier than the white ones[15]. It was noticed in many countries that mean height is smaller in the country than in town[16,17].

If we exclude genetic differences, this appearance could be explained by influence of modern life style, nutrition, hygiene and generally better living conditions in urban environment. Švob and Bravo[18] found that city children mature earlier than the country ones. On the contrary, more often we hear those who speak about lack of developmental differences between city and country children, as well as those who have doubts about the findings that country children are more developed than the children of their age from city. Korsunskaja[19] on the basis of a lot of analysis of pre-school children,

speaks about smaller differences in body height and weights between country and city children.

Urban pollution and exposure to influence of lead, polychlorinated biphenyl, noise and different toxic waste materials dangerously affect human growth before and past birth[20].

Nutritional factors

Prerequisites for normal growth and development are quantitatively and qualitatively adequate child's nutrition including enough proteins (essential aminoacids), carbohydrates, lipids and vitamins (particularly from groups A and D). Larger growth of East Asia and USA population than in their relatives in native land, Smajkic explains by different nutrition (in new homeland it is richer in vitamins and animal proteins, and ability to adapt oneself, which depends on a reactive norm and genetic base of an organism.

Japanese people experienced, and still do, a fast socio – economic development and changes in nutritional habits, particularly children in the period after the end of the World War II. These events (western life style) had a great impact on growth of Japanese people. Thus, Japan today experiences negative impact of exaggerated nutrition and excessive intake of fats, particularly[21].

Insufficient and irregular nutrition, as well as starving, have a negative impact on the youngest children. Thus, two groups of Ruanda inhabitants, raised in very different conditions of nutrition and hygiene, were researched in the course of school-age. Morphologic differences, noticed in the age of 6, did not get expressed later on: different living environment left trails before that age, but later it just retained the achieved level[22].

Tanner[23] underlines that longer starvation causes slowness of growth and development of a child, and that insufficient nutrition impact on definite sizes of an adult person depends on the age when a child was fed incompletely. However, the period of maximal sensitivity on such cases, when a danger of negative outcomes is maximal, is the period of the last months of pregnancy till first month after delivery. The last starvation in Ruanda left physical consequences only in survived children of the mentioned age. All that points to supposition that those children experienced definite damage and will be more stunted than their friends who were restored completely when starvation finished. This lagging behind in body development registered in Ruanda children who have undergone starvation in period before and after delivery, was found only in boys. Females are more resistant to harmful impact of environment[22].

Malnutrition of pregnant women results in delivery of small babies, registered in tragic war years of starvation in concentration camps and because of unheard sufferings that our country also underwent in the course of four-year aggression (1992 – 1995).

Mother's food in pregnancy is very important for fetus development and later development, as well. If mother starves chronically, she delivers smaller child, preterm born, or with developmental disorders in bone and muscle mass. Fetus is considerably protected from consequences of mother's malnutrition if it is not severe and long-term[24].

Bosnia and Herzegovina presently records decreased standard of certain larger number of inhabitants, associated with, most probably, decreased energetic value of average daily meal and aggravation of the meal's biological value. Families of lower living standard are particularly affected by bad nutrition, as well as preschool and school children, and the elders.

Health-hygienic factors

Health-hygienic factors depend on a couple of climate-ecologic, nutritional, social, economical, housing and other factors, particularly on measures of general and special health care during developmental period. Serious acute and moderate chronic illnesses temporarily slow, i.e. inhibit growth and development of children. Infectious and parasite diseases inhibit growth and development of children, either. Child's age when a disease hits, is also important, the younger child, the worse outcome regularly[5]. Physical activity of a person can be also included into this category of factors, which particularly can affect body mass increase, as well as increase of strength, width measures and circumference of certain body parts[25].

Socio-economic factors

Socio-economic factors and living standard have special significance for biological and social existence of a human being. These factors include housing, nutrition, monthly income resources, working conditions, health condition, level of hygienic and physical culture development, family relationships, etc. Father's profession impact on growth and development of students showed that those from higher social class have larger body height in comparison to those from lower-standard families[26].

Socio-economic impact on growth is usually noticed in relation to parents' education, economic status, number of family members, etc. Socio-economic status of parents affects their children growth. Genetic factors impact is not excluded, but unequal nutrition and hygiene influence can be certainly established on different social levels[22]. Children from well-off families (higher living standard) are »higher« and »heavier« than those from poor families in the same region. The lower social status – the smaller babies, smaller children-smaller parents[27]. Different nutrition favors positively demonstration of different genetic constitutions. All the factors mentioned do not follow growth and development of each child, what results in interindividual differences, respectively.

Basic demographic and economic features of the studied region

Tuzla region is a powerful cultural, educational and administrative center, not only on the Region itself, but also on the entire Bosnia and Herzegovina territory. It is the biggest city in the Region, with the biggest number of inhabitants, with specific characteristics of most industrial towns in Bosnia and Herzegovina. Rapid economic development between the two wars (1945–1992) resulted in hasty increase of inhabitants' number, primarily by means of mechanical increase in the population (migrations), and in the war (from 1992 to 1999) by forced migrations, which changed demographic picture of this Region. Main and important economic characteristics of the Tuzla Region were mining and chemical industry, whose capacities were mainly located on wider territory of the Town of Tuzla. Number of the inhabitants rapidly increased, so in 1996 year (when our researches started) it amounted 154,384; 24.98% refugees, and 75.02% domiciles. Mixing inhabitants from different localities with domiciles before the war, as well as the presence of refugees in the course and after the war in the Tuzla Region affected (and will do in the future) increased possibilities of a new gene combination and the changes in genetic structure of population.

In 1996 there were 20.14% working people (excluded workers who lost their jobs due to downed economy by the war. Most of them were employed in industry and mining, 44.45% of total employed). Salary for 1996 amounted 253.10 KM[28].

From these data it can be concluded that Tuzla's population are mainly workers, which surely impacts socio-economic status of a family and population in general.

The objective of the present investigation was to analyze the influence of the most significant exogenous factors on growth and development of male children and youths aged 11 to 17 years, from Tuzla Region. The dynamics of basic indexes of growth and development has been analyzed taking into consideration the fact that all tested persons were growing and developing in extremely bad wartime conditions for one period, including the four-year of aggression on Bosnia and Herzegovina. These analyses will be performed using longitudinal anthropometric measurements.

Materials and Methods

Researches were performed in the Tuzla Region in two periods: autumn 1996/97 and spring 1998/99. Measurements were performed in elementary and secondary schools in Tuzla, by longitudinal method. Criterion for the sample formation was measuring pupils in two periods (1996 and 1999), and to ask them to answer the questionnaire, also two times.

Two measures of head and 12 measures of body were researched. Two indexes were calculated: index of head and index of sitting height. The characteristics tested and their informatics measuring units are: 1. body height (BODHE, cm); 2. body mass (BODMAS, kg); 3. circumference of chest (CIRCCH, cm); 4. circumference of thigh (CIRCTH, cm); 5. circumference of upper arm (CIRUPA, cm); 6. length of head (LENHEA, mm); 7. width of head (WIDHEA, mm); 8. index of head (INDHEA, %); 9. sitting height (SITHEI, cm); 10. index of sitting height (INDSIH, %); 11. length of arm (LENARM, cm); 12. length of leg (LENLEG, cm); 13. width of pelvis (WIDPEL, cm); 14. width of shoulder (WIDSHO, cm). Measurements were performed according to IBP by Martin's anthropologic instruments[29].

Influence of the following factors on growth and development was studied: 1. propagation mobility (PROMOB); 2. age of father (AGFATH); 3. age of mother (AGMOTH); 4. number of children (NUMCHI); 5. meals (MEALS); 6. sport (SPORT); 7. standard of father (STAFAT); 8. standard of mother (STAMOT); 9. standard of father and mother (STANFM); 10. financial income FININC); 11. living standard (LIVSTA); 12. sequence of births (SEQBIR); 13. walking (WALKIN).

For the analysis of *propagation mobility*, answers of the tested children about their birthplace and birthplace of their parents were divided into four categories as follows: 1. (1–1) both parents and child born in the same place; 2. (1–0) father and child born in the same place, mother is not; 3. (0–1) mother and child born in the same place, father is not; 4. (0–0) both parents are not from the place where child was born.

Age of parents (age of mother) was also divided into two categories as follows: Children born by mother under 25 years old and children born by mother over 25 years old. Fathers were under 30, and over 30 years old.

Sequence of child births categorized according to birth order (first, second, third, fourth).

Socio-economic status: number of children in a family and living standard. *Number of children:* 1. one child in the family; 2. two to four children in the family; 3. five and more children in the family.

Living standard of parents was researched from two aspects: 1. profession of father and mother, respectively and profession of father and mother together; 2. total monthly income of the family. Answers were divided into 3 categories, ei-

ther: 1. lower living standard; 2. average living standard; 3. higher living standard.

This three-category division was established after a questionnaire carried out on 60 persons (30 professors of University of Tuzla and 30 employed citizens of different profession, aged over 30 years). The questionnaire included list of 200 different professions according to unified classification[30]. Thus, we got the public opinion about the lowest, mean and higher level of standard. Housewives are in the 1st category.

The second criterion in the variable *total monthly income* of a family in comparison to the cost of *consumer's basket* (for July, 1999 cost of the consumer's basket for four-member family in Tuzla Canton was 385.32 KM)[28]. Using official data we got three categories of standard: 1. lower (cost of one consumer's basket); 2. average (cost of 1.5 consumer's basket); 3. higher (cost of over 1.5 consumer's basket). These data should be taken with reserve, taking into consideration the fact that all the tested did not know precisely total income of the family.

The variable *number of meals* meant number of daily meals (1996 and 1999). Three categories were formed: 1. one to two meals; 2. three meals; 3. four and more meals.

For the variable *going in for sports* answers given in 1996 and 1999, were put in three categories: 1. no sports; 2. sports only for recreation, 3. going in for sports intensively. For the variable *walking* from home to school, we made two categories; walkers and non-walkers (those using means of transportation). Walkers meaning those who were walking more than one kilometer from home to school.

Quasicanonic correlation analysis was made in the Central Computer Center in Zagreb[31,32]. By this multifactor analysis we tested connection between two variable sets on the same sample (between 13 variables-exogenous factors and 14 anthropometric variables) in two times points – 1996 and 1999. So, possible connections between included exogenous factors and anthropometric parameters of the tested indexes of growth development can be made objective.

Results

11 years olds

As quasicanonic variance is statistically significant ($p < 0.05$; Table 2) in initial, final and initial-final investigation, so is significant correlation between these two sets of variables. Analysis of significance level of quasicanonic coefficient (level of significance is R = 0.18 disre-

TABLE 1
AGE STRUCTURE OF THE TESTED SAMPLE IN SECOND MEASUREMENT (1996–1999)

Age (years)	Domiciles	Expatriates	Total
11 – 13.5	109	16	125
12 – 14.5	116	19	135
13 – 15.5	121	21	142
14 – 16.5	118	25	143
15 – 17.5	88	23	111
16 – 18.5	78	31	109
17 – 19.5	10	16	26
Total	640	151	791

TABLE 2
AGE 11: TEST OF SIGNIFICANCE OF QUASICANONIC COEFFICIENTS

	No. of extracted quasicanonic couple	Quasicanonic correlations	Quasicanonic covariance	χ^2	df	p
Initial	1	0.40	3.00	521.63	12	<0.001
Final	1	0.37	2.38	385.90	12	<0.001
Init.-Final	1	0.35	0.53	86.73	12	<0.001

TABLE 3
MATRICES OF THE SET I AND SET II VARIABLES: INITIAL (1996), FINAL (1999), INITIAL-FINAL (1996–1999)

Set I	Parallel projections & correlations of variables of I set on factors from II set			Set II	Parallel projections & correlations of variables of II set on factors from I set		
	Initial	Final	Init.-Fin.		Initial	Final	Init.-Fin.
PROMOB	–.17	.17	–.02	BODHEI	**–.33**	**.31**	.11
AGFATH	.09	–.08	–.14	BODMAS	**–.35**	**.32**	.15
AGMOTH	.12	–.13	–.18	CIRCCH	**–.25**	.19	.01
NUMCHI	**.26**	–.17	–.05	CIRCTH	**–.36**	**.29**	–.04
MEALS	–.13	.04	.05	CIRUPA	**–.32**	**.28**	.11
SPORT	–.16	.11	.07	LENHEA	–.19	.17	–.12
STAFAT	**–.20**	**.21**	.13	WIDHEA	**–.29**	**.26**	**–.20**
STAMOT	**–.25**	**.21**	**.27**	INDHEA	–.08	.08	–.12
STANFM	**–.24**	**.24**	**.25**	SITHEI	**–.25**	**23**	.01
FINANC	**–.20**	.19	**.23**	INDSIH	.06	–.09	–.07
LIVSTA	–.12	.13	.15	LENARM	**–.28**	**.34**	.22
SEQBIR	**.30**	**–.26**	–.13	LENLEG	**–.30**	**.29**	–.01
WALKIN	.04	–.06	–.18	WIDPEL	**–.25**	**.29**	.13
				WIDSHO	**–.29**	**.21**	–.10

garding the sign) and parallel projections and correlations of variables of the I set on the factors from the II set in their connection at age of 11 years (1996 year) shows the following*: sequence of births* – the later a child was born, the smaller his body sizes; *number of the family members* is either in negative correlation with anthropometric parameters, i.e. more family members, smaller anthropometric sizes; standard of father and mother together, standard of father and total monthly income are in positive correlation with anthropometric variables (Table 3).

Similar situation is after the second measuring, either (1999). So, anthropometric parameters are influenced significantly by: standard of father and mother together; mother's standard, father's standard: total income in money; sequence of births (if the tested person was born as first, or among first children, anthropometric parameters are larger).

TABLE 4
AGE 12: TEST OF SIGNIFICANCE OF QUASICANONIC COEFFICIENTS

	Extracted quasicanonic couple	Quasicanonic correlations	Quasicanonic covariance	χ^2	df	p
Initial	1	0.32	1.56	29.41	12	0.004
Final	1	0.29	1.73	40.32	12	<0.001
Init.-Final	1	0.30	0.97	46.80	12	<0.001

TABLE 5
MATRICES OF THE SET I AND SET II VARIABLES: INITIAL (1996), FINAL (1999), INITIAL-FINAL (1996–1999)

Set I	Parallel projections & correlations of variables of I set on factors from II set			Set II	Parallel projections & correlations of variables of II set on factors from I set		
	Initial	Final	Init.-Fin.		Initial	Final	Init.-Fin.
PROMOB	–.09	.06	–.01	BODHEI	**.22**	**.24**	**.21**
AGFATH	**.18**	.10	–.01	BODMAS	**.27**	**.26**	**.20**
AGMOTH	**.21**	.15	.04	CIRCCH	.13	**.22**	**.28**
NUMCHI	–.16	–.11	.00	CIRCTH	**.21**	**.25**	.13
MEALS	.08	.06	.05	CIRUPA	**.20**	**.23**	.19
SPORT	–.11	.01	–.02	LENHEA	**.22**	.18	.02
STAFAT	.09	.12	.15	WIDHEA	**.28**	**.20**	–.10
STAMOT	**.23**	**.24**	**.22**	INDHEA	.04	.01	–.15
STANFM	.14	.14	.14	SITHEI	**.27**	**.24**	.11
FINANC	.14	.17	**.20**	INDSIH	.09	.05	–.02
LIVSTA	.14	.17	**.22**	LENARM	**.21**	.17	.09
SEQBIR	–.11	–.16	**–.19**	LENLEG	**.27**	**.24**	.13
WALKIN	.08	10	.16	WIDPEL	.15	.15	.12
				WIDSHO	.19	**.25**	**.21**

Significantly largest correlation with factors of the I set (1999) have: body mass, body height, length of leg, length of hand, circumference of thigh, circumference of upper arm.

Difference in increase of investigated anthropometric parameters for the period of 2.5 years was mostly contributed by following factors: mother's standard, standard of father and mother together, as well as monthly income of a family (Table 3).

12 years olds

In initial research on connection of the two sets, these factors act significantly: mother's standard depending on profession, mother's age and father's age; in final research mother's standard depending on profession (Table 5).

Projection of factors of the II set on the factors from the I set showed in initial study that: body mass, body height, length of leg, length of head, width of head, sitting height circumference of upper arm

TABLE 6
AGE 13: TEST OF SIGNIFICANCE OF QUASICANONIC COEFFICIENTS

	Extracted quasicanonic couple	Quasicanonic correlations	Quasicanonic covariance	χ^2	df	p
Initial	1	0.44	3.36	1071.85	12	<0.001
Final	1	0.43	3.25	85.21	12	<0.001
Init.–Final	1	0.31	0.65	51.11	12	<0.001

TABLE 7
MATRICES OF THE SET I AND SET II VARIABLES: INITIAL (1996), FINAL (1999), INITIAL–FINAL (1996–1999)

Set I	Parallel projections & correlations of variables of I set on factors from II set			Set II	Parallel projections & correlations of variables of II set on factors from I set		
	Initial	Final	Init.-Fin.		Initial	Final	Init.-Fin.
PROMOB	.12	.08	–.05	BODHEI	**.40**	**.36**	.02
AGFATH	.04	.05	.04	BODMAS	**.41**	**.40**	**.28**
AGMOTH	**.21**	**.23**	.18	CIRCCH	**.37**	**.38**	**.23**
NUMCHI	–.17	–.16	.00	CIRCTH	**.33**	**.37**	.10
MEALS	–.04	–.01	.06	CIRUPA	**.36**	**.34**	.12
SPORT	.11	.12	.02	LENHEA	.19	.17	–.09
STAFAT	**.20**	**.20**	**.18**	WIDHEA	.15	.11	–.12
STAMOT	**.37**	**.38**	**.29**	INDHEA	–.01	–.04	–.01
STANFM	**.40**	**.38**	**.23**	SITHEI	**.27**	**.26**	.08
FINANC	**.18**	**.19**	**.18**	INDSIH	–.14	–.07	.09
LIVSTA	.04	.07	.12	LENARM	**.39**	**.38**	.04
SEQBIR	–.09	–.06	.05	LENLEG	**.40**	**.35**	–.12
WALKIN	.04	.03	–.01	WIDPEL	**.27**	**.34**	**.20**
				WIDSHO	.19	**.25**	**.21**

and upper leg, width of shoulder had significant role in connection of both sets. In second study (1999) significant correlation with factors of the I set showed all length parameters (except length of hand), all tested circumferences, all width parameters (except width of pelvis; Table 5).

Significantly higher increase of parameters: body mass, body height, circumference of chest, circumference of upper arm and width of shoulder (for the researched period) was significantly affected by mother's standard, total monthly income of a family, living standard according to total income, sequence of births (in negative correlation).

13 years olds

Factors that significantly take part in connection of these two sets of variables in initial and final research, as on increase of anthropometric parameters at age of 13 to 15.5 year, are: joint father's and mother's standard depending on pro-

fession, mother's standard, mother's age, father's standard, total monthly income of a family (Table 7).

14 years olds

According to parallel projections of the I set of variables on factors of the II set, in initial research (age 14 years), we found the following exogenous factors to have significant role in connection of both sets: father's standard, joint father's and mother's standard depending on profession, mother's age, father's age, but in the limit of significance (Table 9). The same factors were significantly responsible for most anthropometric parameters in final research, as well (1999) on the sample 2.5 years older (Table 9). Variables of the I set did not significantly affect all circumferences and indexes, while they significantly affected the rest of the tested variables (all length parameters and width of shoulders in initial research).

Out of all variables of the I set, sequence of births had a significant affect on increase of the II set of variables (Ta-

TABLE 8
AGE 14: TEST OF SIGNIFICANCE OF QUASICANONIC COEFFICIENTS

	Extracted quasicanonic couple	Quasicanonic correlations	covariance	χ^2	df	p
Initial	1	0.35	1.70	195.05	12	<0.001
Final	1	0.39	2.05	224.93	12	<0.001
Init.-Final	1	0.30	0.49	417.51	12	<0.001

TABLE 9
MATRICES OF THE SET I AND SET II VARIABLES: INITIAL (1996), FINAL (1999), INITIAL-FINAL (1996–1999)

Set I	Parallel projections & correlations of variables of I set on factors from II set			Set II	Parallel projections & correlations of variables of II set on factors from I set		
	Initial	Final	Init.-Fin.		Initial	Final	Init.-Fin.
PROMOB	.10	.09	.01	BODHEI	**.34**	**.40**	**.24**
AGFATH	.19	**.25**	.08	BODMAS	**.20**	**.23**	**.22**
AGMOTH	.18	**.26**	.15	CIRCCH	.13	.13	**.21**
NUMCHI	–.11	–.13	.01	CIRCTH	.17	.12	.03
MEALS	.03	.11	.10	CIRUPA	.14	.13	.07
SPORT	.03	.06	–.04	LENHEA	**.37**	**.35**	.07
STAFAT	**.30**	**.26**	–.09	WIDHEA	.17	**.20**	.04
STAMOT	.17	**.22**	.01	INDHEA	–.15	–.13	–.02
STANFM	**.22**	**.26**	.03	SITHEI	**.28**	**.27**	**.22**
FINANC	.11	.09	–.05	INDSIH	.01	–.03	.01
LIVSTA	.12	.12	–.01	LENARM	**.24**	**.33**	.12
SEQBIR	–.04	.06	**.22**	LENLEG	**.31**	**.33**	**.23**
WALKIN	–.10	–.06	.18	WIDPEL	.17	**.23**	.18
				WIDSHO	.18	**.21**	.12

ble 9). Variables of the I set caused significantly higher increase of: body mass, body height, length of legs, sitting height, circumference of chest, width of pelvis.

15 years olds

In initial and final research, age of 15, factors that most significantly determined anthropometric parameters are: total monthly income, mother's standard (the less all forms of living standard, the less anthropometric variables; Table 11). Larger number of children in a family, as well as later birth sequence, either causes smaller anthropometric values (these variables are in negative correlation with anthropometric parameters (Table 11). In initial research body mass, body height, length of head, length of hand, length of leg, width of pelvis are of smaller sizes (with negative sign; Table 11), because of low standard (all forms), later birth sequence, larger number of children in a family.

In second study higher living standard of each parent respectively, and of both

TABLE 10
AGE 15: TEST OF SIGNIFICANCE OF QUASICANONIC COEFFICIENTS

	Extracted quasicanonic couple	Quasicanonic correlations	Quasicanonic covariance	χ^2	df	p
Initial	1	0.35	1.59	319.52	12	<0.001
Final	1	0.42	1.82	855.49	12	<0.001
Init.-Final	1	0.31	0.99	23.95	12	0.021

TABLE 11
MATRICES OF THE SET I AND SET II VARIABLES: INITIAL (1996), FINAL (1999), INITIAL-FINAL (1996–1999)

Set I	Parallel projections & correlations of variables of I set on factors from II set			Set II	Parallel projections & correlations of variables of II set on factors from I set		
	Initial	Final	Init.-Fin.		Initial	Final	Init.-Fin.
PROMOB	.01	–.01	.07	BODHEI	**–.28**	**.32**	**.26**
AGFATH	.00	.12	.14	BODMAS	–.18	.14	.17
AGMOTH	.07	.04	.18	CIRCCH	–.13	.04	**.20**
NUMCHI	**.25**	–.18	.17	CIRCTH	–.03	–.02	.03
MEALS	–.13	.13	–.06	CIRUPA	–.11	.06	.13
SPORT	–.01	.06	**–.21**	LENHEA	**–.27**	**.28**	.00
STAFAT	–.14	**.30**	.09	WIDHEA	–.13	.12	–.14
STAMOT	**–.19**	**.25**	.00	INDHEA	.12	–.15	–.12
STANFM	–.16	**.27**	.03	SITHEI	–.07	**.19**	**.23**
FINANC	–.18	**.26**	–.01	INDSIH	–.03	–.11	–.05
LIVSTA	**–.25**	**.33**	–.02	LENARM	**–.33**	**.40**	**.28**
SEQBIR	**.28**	–.13	**.29**	LENLEG	**–.33**	**.39**	.19
WALKIN	.10	–.12	–.01	WIDPEL	**–.21**	.18	.18
				WIDSHO	–.15	.11	**.21**

parents together, total family income, smaller number of children earlier birth order, caused larger values of all length parameters and width of pelvis. Mother's age, going in for sports (with negative sign) and sequence of births (Table 11) significantly affected increase of all anthropometric variables for the age (5 to 17.5). The highest increase in all length parameters: circumference of chest, width of pelvis and width of shoulder.

16 years olds

For the age 16, in initial and final research significant correlation with factors of the II set had the following variables: place of birth of father and mother in relation with the child's birthplace, and sequence of births (in negative correlation and projection; Table 13).

All length parameters, body mass, width of shoulder, were in initial and final research significantly affected by ex-

TABLE 12
AGE 16: TEST OF SIGNIFICANCE OF QUASICANONIC COEFFICIENTS

	Extracted quasicanonic couple	Quasicanonic correlations	covariance	χ^2	df	p
Initial	1	0.39	1.13	817.29	12	<0.001
Final	1	0.41	0.94	23.25	12	0.026
Init.-Final	1	0.37	0.60	857.66	12	<0.001

TABLE 13
MATRICES OF THE SET I AND SET II VARIABLES: INITIAL (1996), FINAL (1999), INITIAL-FINAL (1996–1999)

Set I	Parallel projections & correlations of variables of I set on factors from II set			Set II	Parallel projections & correlations of variables of II set on factors from I set		
	Initial	Final	Init.-Fin.		Initial	Final	Init.-Fin.
PROMOB	**.31**	**.35**	–.02	BODHEI	**.39**	**.32**	**.33**
AGFATH	–.02	.08	**.27**	BODMAS	**.27**	**.29**	.18
AGMOTH	–.05	–.05	.08	CIRCCH	.17	.13	–.06
NUMCHI	–.11	–.09	.18	CIRCTH	.17	.11	–.06
MEALS	–.10	–.12	.02	CIRUPA	.15	.18	.11
SPORT	.09	.13	.02	LENHEA	**.22**	.17	.06
STAFAT	.07	.11	.09	WIDHEA	.12	.05	–.09
STAMOT	.11	.13	–.02	INDHEA	–.05	–.07	**.29**
STANFM	.05	.03	.00	SITHEI	**.30**	**.29**	.05
FINANC	.02	.08	.09	INDSIH	.03	.02	.19
LIVSTA	–.01	.06	.12	LENARM	**.25**	**.29**	.16
SEQBIR	**–.20**	–.12	**.27**	LENLEG	**.37**	**.37**	–.08
WALKIN	–.17	–.05	.19	WIDPEL	–.04	.05	–.05
				WIDSHO	**.33**	**.32**	.00

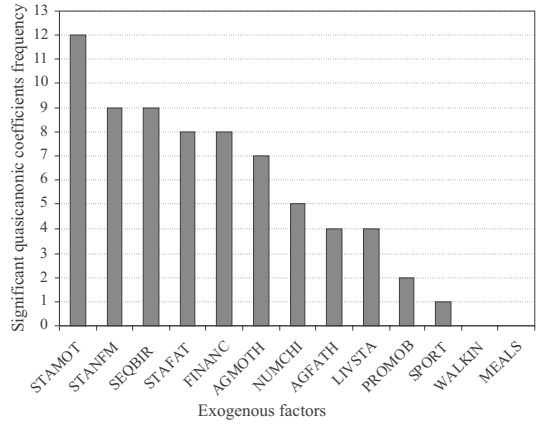

Fig. 1. Frequency of significant quasicanonic coefficients for the egzamined exogenous factors.

ogenous factors from the I set of variables.

Analysis of differences in increase for the period 1996–1999, in this generation of the tested persons, showed that father's age, number of children in a family, birth order had significant impact on increase in body mass, body height, index of head and index of sitting height (Table 13).

Results obtained for the age of 17 years can not be considered relevant, because sub sample of the tested subject is small (n = 26) for such a kind of analysis (Table 1).

Generally taken, exogenous factors that significantly take part in both sets of variable connection in initial measurement (for all generation) are: mother's standard; joint father's and mother's standard (a bit less it participated in both sets of variables connection), father's standard, total income of a family, mother's age and birth order.

In second study, factors that significantly determined anthropometric characteristics are: mother's standard; joint father's and mother's standard, father's standard, total income of a family.

Exogenous factors that significantly caused the highest increase in anthropometric parameters for the period of 2. 5 years are the following: birth order, mother's standard, total income of a family, mother's age, joint father's and mother's standard. Variables: number of meals a day, going in for sports and walking together with other exogenous variables had the least impact on determination of anthropometric characteristics (Figure 1).

Anthropometric variables (II set of variables) that had significant impact on connection of both variables sets, are: length parameters, body mass, width parameters, circumferences to less extent, and indexes of head and sitting height had the least impact (Figure 2).

Conclusions

From the analysis of exogenous factors impact on growth and development of male children and youth, we draw a conclusion that all the 13 factors more or less intensively affect all, or just certain phases of growth and development.

1. Quasicanonic correlation analysis established that factors which have the highest impact on growth and development, that is, mostly those factors that together participated significantly in both

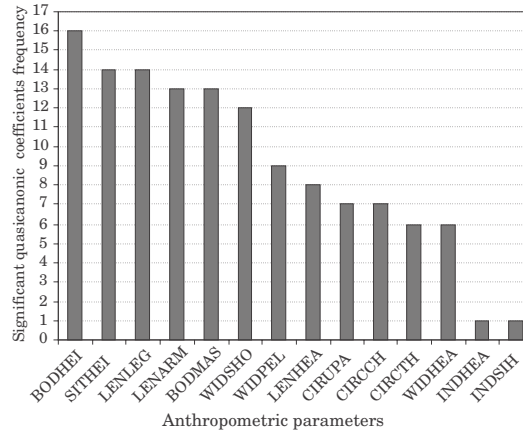

Fig. 2. Frequency of significant quasicanonic coefficients for the egzamined anthropometric variables.

variable sets connection, are: mother's standard, joint father's and mother's standard, father's standard, total monthly income, mother's age and birth order.

2. Socio-economic factors are in more positive correlation with most of the monitored anthropometric variables, which means those factors produced higher values of most anthropometric characteristics in comparison with tested subjects from lower living standard families.

3. The following factors impacted anthropometric indexes in all ages, less frequent, but statistically significant: mother's age and birth order.

4. Mother's age is in higher (negative) correlation with anthropometric indexes of tested subjects than father's age is, what is seen from the values and significances of quasicanonic coefficients. It was found that younger mothers have children of higher anthropometric indexes (in pre puberty and post puberty), in comparison with the older mothers' children. In our sample, nearly a half of the tested subjects (46.61%) were found to be the first child in the family in all the tested generations, and the children were delivered by mothers under 25 years old.

5. Birth order is the factor that is in a corresponding negative correlation with the tested anthropometric indexes, that is, the tested subjects born among the first children, have higher values of many anthropometric variables in comparison with those born later.

6. Number of children is in negative correlation with the tested anthropometric variables (statistically significant in age of 11, 15, 16 years); it means that the tested subjects from the families with more children have smaller mean values for most anthropometric indexes than those from the families with smaller number of children.

7. Factors that had the least impact on connection of both sets of variables are: number of meals, going in for sports and walking.

8. The following anthropometric variables (factors of the II set) had the most affect on the factors from the I set (exogenous factors) in connection of both sets of variables: length parameters: body height, sitting height and length of leg; circum-

ferences: circumference of chest; width parameters: width of shoulders. Those are the variables that were significantly changed under the influence of all exogenous factors together. Indexes had the least impact in this case.

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J. Hadžihalilović

Faculty of Science and Mathematics, Department of Biology, University of Tuzla, Univerzitetska 4, 75000 Tuzla, Bosnia and Herzegovina
e-mail: jasnahba@yahoo. com

VEZA IZMEĐU VANJSKIH FAKTORA I ANTROPOMETRIJSKIH OBILJEŽJA RASTA I RAZVOJA DJEČAKA I MLADIH U TUZLANSKOJ REGIJI

S A Ž E T A K

Proučavana je dinamika rasta dječaka i mladeži iz Tuzlanske regije, na koju su utjecali neki vanjski čimbenici. Uzorak se sastojao od 751 ispitanika, u dobi od 11 do 17 godina. Analiza se temelji na promatranju dva vremenska perioda (1996 i 1999), u testiranom dijelu šire populacije. Ovo istraživanje temelji se na podacima dobivenim tijekom četverogodišnje agresije na Bosnu i Hercegovinu, uzimajući u obzir činjenicu da su promatrani ispitanici proveli period rasta i razvoja u iznimno lošim ratnim uvjetima. Pomoću kvazikanoničke korelacijske analize utvrđeno je da su slijedeći čimbenici sudjelovali u vezi varijabli iz oba seta (prvo i posljednje mjerenje): standard majke, očev i majčin životni standard, dob majke i redoslijed poroda su u stanovitoj mjeri utjecali na oba seta varijabli. Antropometrijske varijable koje su imale najveći utjecaj na oba seta varijabli su: parametri visine, tjelesna masa, parametri širine, zatim opsega s nešto manjim učinkom, dok su indeksi glave i sjedeći indeksi imali najmanji utjecaj na ovu vezu.