Essential Arterial Hypertension occurring in Children and Teenagers Anthropological Correlations

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ABSTRACT

Background: Arterial hypertension (AH) manifested during childhood and teenage years has been considered, for a long period of time, as being a rare disease and almost exclusively a secondary one. Within the last 10-15 years, as the diagnosis techniques improved and the research regarding juvenile AH extended, the diagnosis criteria have been reconsidered and as a consequence, the disease has become more frequent until reaching the age of 16, compared to the past periods of time.

Aim & Objectives: The research was carried out during the year 2011, within the partnership educational project, *Integration through Schools and Anthropology*, No. 357/2011. The general objective stated for the anthropological study implied by this project is to examine inter- and trans-disciplinary certain aspects of the lifestyle of the children and teenagers belonging to rural Roma people communities and its impact on their health, likelihood to develop certain diseases as well as to propose prophylactic measures. Within the general objective framework, for the purpose of this paper I isolated the findings related to the incidence of AH among children and teenagers and I explored its possible relation to the community lifestyle (eating habits, improper housing, family size) and genetic factors (AH family history, precocious appearance of secondary sexual features as a sign of early adulthood).

Methods/Study Design: The medical and anthropometrical research was carried out on two groups of students from the rural environment, aged between 10 and 16 years: one control group and an experimental group. The control group was formed of 100 Romanian students, 30% boys and 70% girls. The experimental group, formed of 100 Romanian students from a Roma people rural community, 26% boys, 74% girls. The Roma people rural communities preserve a more archaic lifestyle, including culinary habits, that can influence the incidence of AH. Questionnaires comprising 63 questions were administered for the completion of data regarding their lifestyle. For the statistical comparisons we calculated the Odds Ratio (OR) using CHI Square test with Yates' correction. Statistical analysis of variance (ANOVA) was used for the characterization of the anthropometric variables. The subjects involved in the research were not diagnosed with kidney, cardiovascular or endocrine diseases or with mental retardation.

Study Design: Prospective case-control.

Consent: The volunteers were selected after their parents had freely expressed their informed consent in written form.

Results/ Findings: The incidence of AH among the participating children and teenagers in both groups is within the limits mentioned in the field literature, 4.00% for the control group and 7.00% for the experimental group. There is a positive association (OR=1.8064), statistically significant ($p<0.0166$) between AH incidence and the studied group. Most of the subjects from both groups have AH borderline values. All the subjects diagnosed with AH have AH family history. 84.62% of boys in the experimental group eat daily salty foods comparing to 66.66% of the boys in the control group. There is a positive association (OR=1.6666), statistically significant ($p<0.0299$) between AH incidence and the salt consumption There is a positive association (OR=1.95), statistically insignificant ($p<0.1$) between AH incidence and the number of children per family. There is a positive association (OR=1.66), statistically significant ($p<0.0299$) between AH incidence and the presence of secondary sexual characteristics. There are no statistically significant differences ($p>0.05$) between the two groups regarding the anthropometric variables analyzed pertaining to gender.

Conclusion: According to the field scientific literature it is generally accepted that systolic and/or diastolic AH is 3-4 times more frequent among obese children and teenagers comparing to those with normal weight and 6-8 times to underweight ones (1 Gherasim 1996). Nevertheless, the findings of the research presented in this paper indicate that certain particularities of the lifestyle (increased salt consumption, overcrowded and improper dwellings) and certain genetic factors (AH family history, early adulthood) may explain a higher incidence of AH even among normal-weight and underweight children and teenagers.

Keywords: arterial hypertension, children and teenagers, anthropology.

BACKGROUND

The disease is practically absent for ages under 6 year and very rare for ages under 9 year. The incidence of AH is higher in the case of subjects over 9 year, being estimated by various statistics between 1 and 12%, depending on the epidemiological factors involved. The determination of blood pressure (BP) for large groups of children and over longer periods of time have shown that blood pressure (BP) varies according to age, sex (systolic blood pressure being high in the case of boys over 14 years of age) and growth indicators (1 Gherasim 1996). Most studies support the hypothesis that essential hypertension is caused by a combination of genetic and environmental factors, namely a multifactorial etiology (2 Philip Giampietro 2003). The current definitions of normal and high blood pressure have been derived from clinical experience as applied to largely descriptive population surveys of blood pressure and are therefore less precise than the definitions of hypertension in adults. However, a diagnosis of hypertension should be made only after elevated blood pressure is confirmed in three separate, consecutive examinations. Blood-pressure readings tend to decrease with repeated measurements because of

an accommodation by the child to the measurement procedure or relaxation and because of the statistical phenomenon of regression toward the mean (3 Sinaiko 1996).

Arterial hypertension (AH) is defined by values of the blood pressure which exceed the value of 0.5 according to age, height and weight of the child. It is agreed that a child is hypertensive when the average value of the systolic and/or diastolic pressure (for at least 3 measurements), constantly or occasionally, exceeds the 90 percentile, corresponding to the age (in the case of teenagers), or the 95 percentile with the rest of the pediatric age segments (Nelson, 16-th Edition; Second Task Force on Blood Pressure Control in Children). The normal values of blood pressure for different age segments are presented in the following table:

AGE	**Systolic blood pressure**		**Diastolic blood pressure**	
	Percentile 50 (mmHg)	**Percentile 95 (mmHg)**	**Percentile 50 (mmHg)**	**Percentile 95 (mmHg)**
0-6 months	80	110	45	60
3 years	95	112	64	80
5 years	97	115	65	84
10 years	110	130	70	92
15 years	116	138	70	95
Adult	120	140	80	90-95

Source: 4 Hipertensiunea arteriala la copil. Factori fiziologici de reglarea a presiunii arteriale. Mecanisme available at: http://www.referatele.com/referate/medicina/online7

Today, the accepted classification of AH is the one in the WHO guide (1999 World Health Organization-International Society of Hypertension Guidelines for the Management of Hypertension, Journal of Hypertension, 1999, 17: 151-183):

Category	**Systolic (mmHg)**	**Diastolic (mmHg)**
Optimum	< 120	< 80
Normal	< 130	< 85
Upper borderline of normal	130 - 139	85 – 89
Hypertension degree I (mild)	140 – 159	90 – 99
- subset of borderline Hypertension	140 – 149	90 – 94
Hypertension degree II (moderate)	160 – 179	100 – 109
Hypertension degree III (severe)	·180	·110
Hypertension isolated systolic	·140	< 90
- subset of borderline Hypertension	140 - 149	< 90

Source: 4 Hipertensiunea arteriala la copil. Factori fiziologici de reglarea a presiunii arteriale. Mecanisme available at: http://www.referatele.com/referate/medicina/online7

For a timely tracking down the AH among children and teenagers, there are necessary some preventive measures:

- determining systematic AH;
- when the blood pressure exceeds the 0.5 value, the respective child will need attentive monitoring;
- prevention of obesity as well as of massive weigh loss;

- the reduction of the sodium input in the case of an obese child, especially if there is a history of hypertension in his/her family.(5 Si copii pot avea hipertensiune arteriala available at http:// www.ifamilia.ro/boli,)

Until more prospective data become available, conventional measurements at a doctor's office remain the standard for evaluating blood pressure. Self-measurement at home and ambulatory monitoring increase the diagnostic accuracy of conventional blood pressure measurement and allow identification of patients with white-coat effect or masked hypertension. Management of hypertension exclusively based on home BP measurement cannot be recommended (6 Hilde *et al* 2005).

It is believed that essential and secondary AH are present in almost equal proportions in the case of children. It is also to be remarked that there is a continuum between essential AH with an early debut (during childhood or teenage years) and the disease with adult individuals. This "tracking" effect was statistically proved in the case of systolic blood pressure and diastolic blood pressure, but more important correlations were made in the case of systolic blood pressure, these correlations being more correct as the first value of blood pressure was recorded at an older age. It is to be mentioned that puberty determines certain instability of blood pressure, as well as the most frequent occurrence of borderline values in AH (white coat effect).

A series of risk factors were involved in the occurrence of AH: obesity, sedentary lifestyle, high sodium contents in nutrition, potassium input, Ca+ storage in the smooth muscle tissue, the intense and prolonged stress (most often a risk factor for older children and teenagers), genetic factors (the large number of family members with AH). Primary AH is the type of disease for which it is impossible to determine only one possible cause (4 Hipertensiunea arteriala la copil… available at: http://www.referatele.com/referate/medicina/online7).

A number of factors known to be associated with hypertension in adults have also been associated with higher levels of blood pressure in children and adolescents. A direct relation between weight and blood pressure has been documented as early as five years of age (7 Gutin *et* al 1990) and is more prominent in the second decade (8, Rocchini *et al* 1998). Height is independently related to blood pressure at all ages (9 Rosner *et al* 1993). Gender and race do not have the same impact on blood pressure in children as in adults. No significant differences in blood pressure have been found in comparisons of whites, blacks, Hispanics, and Southeast Asians until adolescence. Even then, the differences are small and vary among epidemiologic studies (10 Report of the Second Task Force on Blood Pressure in Children 1987, 11 Update on the Task Force 1987).

It is clear from familial and longitudinal studies of blood pressure that there is a link between genetic and environmental influences on blood pressure during childhood and the development of essential hypertension. Systolic blood pressure correlates inversely with birth weight, beginning in the first decade of life, and the relation becomes stronger with increasing age in adulthood (12 Law *et al* 1993).

Reviews of the causes of hypertension before adulthood have tended to rely on data from medical center referrals of patients with severe elevations of blood pressure, and these patients usually have secondary causes of their hypertension. Nevertheless, it has become clear since the incorporation of blood-pressure measurement into the routine physical examination that in most cases mild-to-moderate hypertension in students in junior and senior high school is not associated with secondary disease and that essential hypertension should be an important consideration (3 Sinaiko 1996).

Although secondary causes of hypertension are more prevalent in childhood, an increasing number of children are being diagnosed with primary or essential hypertension (13 Bao *et al* 1995, 14 Rocchini 2002). Essential hypertension has been recognized as having its origins in childhood, and increasing evidence suggests that the early cardiovascular changes that occur in childhood hold the key to determining the pathophysiology of and therapy for essential hypertension (13 Bao *et al* 1995).

While it is acknowledged that control of blood pressure in primary care is of major importance for reducing the burden of cardiovascular diseases, control is suboptimal in most populations (15 Langer *et al* 2010). Health Services are providers; therefore have an important role to play in educating families and children about approaches that are useful in preventing hypertension (16 Apoorv Jain *et al* 2010). Essential hypertension not only has an impact on the single individual but also has an impact on the health care system and finances (17 Galal *et al* 2011).

The discovery of AH during childhood period raises serious diagnosis and treatment related problems, this being because untreated AH can determine serious complications. Hypertension in children is increasing. It is a predictor of cardiovascular and renal diseases (18 Falkner 2010).

While the prevalence of hypertension is far lower in children and adolescents (19 Sinaiko *et al* 1989), increasing evidence indicates that essential hypertension begins to develop during the first two decades of life. Since even small decrements in blood pressure can have substantial effects on hypertension-related morbidity and mortality (20 Stamler 1991, 21 MacMahon *et al* 1990), greater attention to blood pressure early in life may ultimately lead to considerable improvements in cardiovascular health. The general occurence of the two forms of HTA in children varies as follows: USA – 5 % (Londe), France – 4% (Aullen), Bucharest – 3% (Goldis), Iasi – 11% (Chipail), Cluj – 7,5% (Patiu) (4 Hipertensiunea arteriala la copil… available at: http://www.referatele.com/referate/medicina/online7).

AIMS & OBJECTIVES

The research was carried out during the year 2011, within the partnership educational project, *Integration through Schools and Anthropology*, No. 357/2011. The general objective stated for the anthropological study implied by this project is to examine inter- and trans-disciplinary certain aspects of the lifestyle of the children and teenagers belonging to rural Roma people communities and its impact on their health, likelihood to develop certain diseases as well as to propose prophylactic measures.

Within the general objective framework, for the purpose of this paper I isolated the findings related to the incidence of AH among children and teenagers and I explored its possible relation to the community lifestyle (eating habits, improper housing, family size) and genetic factors (AH family history, precocious appearance of secondary sexual features as a sign of early adulthood). In order to achieve the specific aims of the research were:

1. To measure the incidence of AH among children and teenagers from a rural and to compare the results to those mentioned in the literature;
2. To determine the way how the AH among children and teenagers is influenced by various factors such as: gender, height, weight, body mass index (BMI), age, AH family history, salt consumption, social status;

3. To determine if the presence of the secondary sexual traits are correlated to AH presence among the studied population;
4. To suggest some measures which could lead to the reduction in the frequency of arterial hypertension within young adult population.

MATERIALS AND METHODS

This research represents the first stage of a more complex, longitudinal research, carried out within the educational project *Integration through School and Anthropology*, No. 357/2011, which was designed as a partnership. During the year 2011, two groups of students from the rural environment, aged between 10 and 16 years, have been studied. One of the groups, the control group, was formed of 100 Romanian students (30% boys and 70% girls), while the other, the experimental group, was formed of 100 Romanian students of Roma people (26% boys and 74% girls). Roma people communities preserve cultural traditions, including eating habits that may have an impact on the blood pressure. The subjects were both medically and anthropometrically examined. The blood pressure was determined from both sitting and horizontal positions, at regular time intervals, for creating a tension free environment and for eliminating the "white coat effect". The measurements of the blood pressure were repeated twice for each determination and the tool used was a mercury manometer. For completing data regarding lifestyle, questionnaires comprising 63 questions of ordinal, nominal, binary and scale type, were administered.

The statistical tools used, such as various tests of significance and exploratory analyses depend on the nature of the data studied. The types of tests and analyses used were thus adapted to the nature of the data collected with the help of the questionnaires.

The characteristics of this study are:

- Is a study that attempts to verify certain known information regarding AH among children and teenagers;
- The main criterion of data aggregation was first based on the disease (AH) and then based on the epidemiological factors that influence the blood pressure within children and teenagers;
- It has been preceded by an anamnesis and descriptive analysis of the subjects;
- Age, gender, height, weight, body mass index (BMI), economic-social status, AH family history, salt consumption by the participating subjects were considered in order to establish how these factors may influence the AH at children and teenagers;
- The presence of the secondary sexual traits were analyzed in order to determine if their presence in any way correlated with AH at children and teenagers.

The statistical analysis relied on the calculation of the Odds Ratio (OR) using CHI Square test with Yates' correction. For the characterization of the anthropometric variables, the variance analysis (ANOVA) was employed.

The *p* result of the test, has the same interpretation as the other statistical tests:

- $p>0.05$, difference is statistically insignificant;
- $p\leq0.05$ (statistically significant difference);
- $p\leq0.01$ (statistically very significant difference);
- $p\leq0.001$ (statistically highly significant difference).

Inclusion criteria: Following criteria were used to involve subjects in the present research:

- Students, aged between 10 and 16 years, from the same rural community;
- Subjects with no mental retardation.

Exclusion criteria: Following criteria were used to exclude the subjects from the present research:

- Children with kidney, cardiovascular and endocrine diseases, affections which can accompany secondary AH;
- Children whose parents hadn't expressed their written consent with regards to their children's participation in the research.

Study Design: Prospective case control. .

The participants became a part of the research only after their parents had freely given their informed ***consent*** in written form. The ethical values of the scientific research as well as the principles of anonymity and confidentiality were respected throughout the research.

RESULTS AND DISCUSSION

It is to be noticed from Table 1 that in the analyzed segment the percentage of girls is higher, the result reflecting the demographic structure of Romanian population.

As shown in Table 2, the distribution by age segment of the students is similar, children aged between 13 and 14 years prevailing in both groups. The distribution by age segment follows the secondary school classes in the Romanian educational system.

The tables 4 and 5 show that between the two groups there are no statistically significant ($p>0.05$) differences regarding anthropometric variables analyzed by gender.

Subjects were grouped into categories by body mass index (BMI): underweight, normal weight, overweight and obese - using the BMI as a measure of corporeality.

Table 5 shows that the most of the students from both groups (both girls and boys) have normal weight. It is well known that obesity is one of the risk factors involved in the occurrence of AH, the increase of the body mass index being often associated with the increase of blood pressure values, while the reduction of body weight improves BP (1 Gherasim 1996, 4, 5). The children involved in this research were neither overweight nor obese, therefore we inferred that there are other factors causing increased values of blood pressure.

The statistical analysis of the data regarding weight-BMI status of the participants to the study from the two groups reveals that there are no statistically significant differences neither in girls population ($p=0.9025$) nor in boys population ($p=0.1$). However we notice an increased chance that a girl would be underweighted (OR=1.1363) rather than a boy (OR= 0.777), tendency confirmed by numerous other studies.

By analyzing Table 8 it can be observed that higher values of the hypertension occur especially in the case of the boys of studied group. Blood pressure is slightly higher in boys than in girls during the first decade of life. This difference begins to widen around the onset of puberty and blood pressure is significantly higher in young men by the end of the teenage years (10 Report of the Second Task Force on Blood Pressure in Children 1987). There is only one case of high blood pressure among the girls of experimental group. This is the reason why we will further analyze only the differences that occur in the case of boys from both groups. The prevalence of hypertension was encountered mainly in the adolescent age segment, therefore targeted screening in this group would be beneficial (22 Veena *et al* 2010). Several studies indicate that hypertension is the result of a process that starts early in life (23 Luma *et al* 2006). In the case of boys of experimental group there was one case diagnosed with AH within the age segment 10-12 years, representing 3.85% of the boys in the experimental group.

We notice a positive association (OR=1.8064), statistically significant ($p<0.0166$) between AH incidence and the studied groups.

It can be concluded from Table 10 that most subjects from both groups have borderline AH with values of the systolic blood pressure between 140–149 mm Hg and of the diastolic blood pressure between 90–94 mm Hg. One case from each group has AH of first degree, while in the experimental group there is one subject with AH of second degree (mild) with a known family history of AH. The reference standards for blood pressure in children do not distinguish between racial or ethnic groups because the differences are not clinically relevant (10 Report of the Second Task Force on Blood Pressure in Children 1987, 11 Update on the Task Force 1987).

All the participating children and teenagers that diagnosed with AH from both groups have AH family history. A familial influence on blood pressure can be identified early in life. Children from families with hypertension tend to have higher blood pressures than children from normotensive families (24 Munger *et al* 1988). There are significant correlations in blood pressure and cardiovascular risk factors between parents and their children (25 Lauer *et al* 1991, 26 Burns *et al* 1992).

There is a positive association (OR=1.6666), statistically significant ($p<0.029$), between AH incidence and salt consumption.

As shown in Table 8 most subjects from the control group (52 girls, 28 boys) come from families in which there are a maximum of four children, unlike the students in the experimental group, who are part in a high number (54 girls, 18 boys) of families with over five children. Living conditions are a very important aspect which reflect and structure the lives of individuals and communities. The average number of people/room in the case of Romanian people is of 0.8 while for the Roma people it is of 1.98. The number of children from Roma households is generally higher than the number of children in Romanian households. Even within the poorest households the birth of a child, especially of a boy is a reason of pride and happiness (27 Gabor *et al* 2011). Family planning is a delicate and controversial subject when it comes to Roma people (28 Prejbeanu *et al* 2010, 29 Rada 2009).

Most of the boys in the experimental group diagnosed with AH are from families with over 9 child births, while those in control group are from family with less than 8 children. The improper life conditions as well as extreme poverty are encountered in several cases of families

of participants to this research. These social and economical factors can be one of the main causes determining the AH incidence in children and teenagers.

There is a positive association (OR=1.95), statistically insignificant ($p<0.1$) between AH incidence and the number children per family.

Children with a predisposition to developing AH are generally obese, have got a family history of AH and are more mature than the age they have, reflected in re an androgynous hypersecretion (1 Gherasim 1996, 30 Groza 1991). For this reason we analyzed the presence of certain secondary sexual traits among the participating subjects.

Tables 17-19 and Figures 2-4 show that boys of experimental group display secondary sex characteristics in greater number than in the case of boys of control group, as it also results from other researches (31 Tarcea *et al* 2007).

We observe a positive association (OR=1.66), statistically significant ($p<0.029$) between the incidence of AH and the presence of secondary sexual characteristics.

The main findings of this phase of the study can be summarized as follows:

- The incidence of AH among the children and teenagers participating in the study, 4% for the control group and 7% for the experimental group are within the limits mentions in the scientific literature;
- There is a positive association (OR=1.8064), statistically significant ($p<0.0166$) between the AH incidence and the experimental group. This can be explained by more precarious living standards and the more frequent eating of salty foods (the most accessible preservation method);
- Most of the subjects from both groups show borderline AH values;
- All the subjects diagnosed with AH have AH family history;
- There is a positive association (OR=1.6666), statistically significant ($p<0.0299$) between AH incidence and the salt consumption;
- There is a positive association (OR=1.95), statistically insignificant ($p<0.1$) between AH incidence and the number of children per family;
- There is a positive association (OR=1.66), statistically significant ($p<0.0299$) between AH incidence and the presence of secondary sexual characteristics.
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Study Limitations

- The analyzed groups consist in a relatively small number of subjects.
- In order to verify the preliminary results presented in this paper and to draw clear conclusion further research on AH incidence should be conducted on an increased number of subjects.

The objectives of the next phases of the longitudinal study, which initial findings are presented here, are:

- Systematic blood pressure measurements on extended groups in order to capture the potential relation between the AH incidence among children and teenagers and age, gender and growth indicators;
- To determine the role of genetic and environmental factors in the AH incidence among children and teenagers.
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CONCLUSIONS

According to the field scientific literature it is generally accepted that systolic and/or diastolic AH is 3-4 times more frequent among obese children and teenagers comparing to those with normal weight and 6-8 times to underweight ones (1 Gherasim 1996). Nevertheless, the findings of the research presented in this paper indicate that certain particularities of the lifestyle (increased salt consumption, overcrowded and improper dwellings) and certain genetic factors (AH family history, early adulthood) may explain a higher incidence of AH even among normal-weight and underweight children and teenagers. Therefore, although it is rather difficult to identify the exact causes of increased blood pressure, it is likely that certain environmental and genetic factors may be responsible for AH debut relatively early in life.

To verify these preliminary findings further research should be conducted on larger groups from various communities situated in different geographical zones.

In order to prevent severe cardiovascular complications which are generated by juvenile AH, we consider useful to measure systematically the blood pressure of children during schooling, as well as to investigate children and teenagers with higher values of blood pressure within special services.

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Table 1: The characteristics of groups by gender

Gender/ Groups	Experimental group		Control group		Total	
	N	%	N	%	N	%
Girls	74	74.00	70	70.00	144	72.00
Boys	26	26.00	30	30.00	56	28.00
Total	***100***	***100***	***100***	***100***	***200***	***100***

Table 2: The characteristics of groups by age segment

Age segment (years)	Experimental group				Control group			
	Girls		Boys		Girls		Boys	
	N	%	N	%	N	%	N	%
10-12	4	32.43		15.38	22	31.43	0	0.00
13-14	42	56.76	18	69.24	38	54.29	26	86.67
15-16	8	10.81	4	15.38	10	14.28	4	13.33
Total	***74***	***100.0***	***26***	***100.0***	***70***	***100.0***	***30***	***100.0***

Table 3: The analysis of anthropometrical variables for boys in the experimental and the control group

a. Report

Group		Weight (kg)	B.M.I.	Height (cm)
Control	Average	51.80	19.22	163.67
	N	30	30	30
	Std. Deviation	8.992	2.10	80.85
	Median	50.00	19.05	165.00
Experimental	Average	51.77	19.07	164.54
	N	26	26	26
	Std. Deviation	7.078	1.99	7.27
	Median	51.00	19.19	164.00

Total	Average	51.79	19.15	164.71
	N	56	56	56
	Std. Deviation	8.08	2.03	78.16
	Median	50.00	19.12	164.75

b. ANOVA Table

		Sum of Squares	df	Average Square	F	Sig.
Weight * Group	Between Groups (Combined)	0.01	1	0.01	0.00	0.98
	Within Groups	3597.41	54	66.61		
	Total	3597.42	55			
B.M.I. * Group	Between Groups (Combined)	0.29	1	0.29	0.06	0.79
	Within Groups	228.11	54	4.22		
	Total	228.40	55			
Height * Group	Between Groups (Combined)	105.86	1	105.86	0.17	0.68
	Within Groups	3350.12	54	62.03		
	Total	3360.71	55			

BMI = body mass index.

Table 4: The analysis of anthropometrical variables for girls in the experimental group and control group

a. Report

Group		Weight (kg)	B.M.I.	Height (cm)
Control	Average	48.23	19.13	158.21
	N	70	70	70
	Std. Deviation	8.860	2.262	72.08
	Median	48.00	19.22	157.00
Experimental	Average	45.95	18.17	159.81

	N	74	74	74
	Std. Deviation	6.316	2.28	86.52
	Median	48.00	18.59	158.00
Total	Average	47.06	18.63	158.60
	N	144	144	144
	Std. Deviation	7.71	2.315	79.67
	Median	48.00	18.78	158.00

b. ANOVA Table

		Sum of Squares	df	Average Square	F	Sig.
Weight * Group	Between Groups (Combined)	187.42	1	187.42	3.19	0.07
	Within Groups	8328.12	142	58.64		
	Total	8515.55	143			
B.M.I. * Group	Between Groups (Combined)	33.19	1	33.19	6.42	0.01
	Within Groups	733.69	142	5.16		
	Total	766.88	143			
Height * Group Report	Between Groups (Combined)	270.27	1	270.27	0.42	0.51
	Within Groups	9050.79	142	63.73		
	Total	9077.82	143			

BMI = body mass index.

Table 5: The characteristics of groups by gender and weight-BMI categories

Weight status/ Groups		Experimental group				Control group			
		Girls		Boys		Girls		Boys	
		N	%	N	%	N	%	N	%
underweight	< 16	18	24.32	0	0.00	2	2.86	2	6.67
	16-16.99	4	5.41	4	15.38	18	25.71	0	0.00

	17-18.49	12	16.22	8	30.77	10	14.29	10	33.33
Total		34	45.95	12	46.15	30	42.86	12	40.00
normal weight	**18.50-24.99**	**40**	**54.05**	**14**	**53.85**	**40**	**57.14**	**18**	**60.00**
overweight	25-29.99	0	0.00	0	0.00	0	0.00	0	0.00
Obese	>30	0	0.00	0	0.00	0	0.00	0	0.00
General total		***74***	***100***	***26***	***100***	***70***	***100***	***30***	***100***

Table 6: The statistical analysis of girls according to weight status-BMI categories

Girls	**Normal weight**	**Underweight**
Experimental Group	40	34
Control Group	40	30
Results of statistical analysis		
Odds Ratio (OR)	**P**	
1.1363	0.9025	

Table 7: The statistical analysis of boys according to weight status-BMI categories

Boys	**Normal weight**	**Underweight**
Experimental Group	14	12
Control Group	18	12
Results of statistical analysis		
Odds Ratio (OR)	**P**	
0.777	0.1	

Table 8: The characteristics of groups by AH (Arterial Hypertension)

Age segment (years)	**Control group**				**Experimental group**			
	Girls		**Boys**		**Girls**		**Boys**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
10-12	0	0.00	0	0.00	0	0.00	1	**3.85**
13-14	0	0.00	1	**3.33**	0	0.00	2	**7.69**
15-16	0	0.00	3	**10.00**	1	**1.35**	3	**11.53**
Absence of AH	70	100	26	86.67	73	98.65	20	77.44
Total	***70***	***100***	***30***	***100***	***74***	***100***	***26***	***100***

Table 9: The statistical analysis of groups according blood pressure values

Total	**AH**	**Absence of AH**
Experimental Group	7	93
Control Group	4	96
Results of statistical analysis		
Odds Ratio (OR)	**P**	
1.8064	0.0166	

Table 10: The values of the blood pressure in groups by the age segments

Age segment (years)	**Control group**				**Experimental group**			
	Boys		**Blood pressure (mm Hg)**		**Boys**		**Blood pressure (mm Hg)**	
	N	**%**	**Systolic**	**Diastolic**	**N**	**%**	**Systolic**	**Diastolic**
10-12	0	0.00			1	3.85	140	90
13-14	1	3.33	141	90	2	7.69	141 145	91 93
15-16	3	10.00	142 144 **150**	92 93 **95**	4	15.03	148 **153** **162**	93 **95** **101**
Absence of AH	26	86.67	<130	<85	19	73.43	<130	<85
Total	***30***	***100***			***26***	***100***		

Table 11: The characteristics of AH cases in the two groups according AH family history

Family history of AH	**Experimental group**				**Control group**			
	Girls		**Boys**		**Girls**		**Boys**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
With family history of AH	1	100.0	6	100.0	0	0.00	4	100.0
Without family history of AH	0	0.00	0	0.00	0	0.00	0	0.00
Total	***1***	***100.0***	***6***	***100.0***	***0***	***100.0***	***4***	***100.0***

Table 12: The characteristics of boys according to salt consumption

Frequency of consumption of salted foods	**Control Group**		**Experimental Group**	
	Boys			
	N	%	N	%
Daily	20	66.66	22	84.62
Once a week	2	6.67	0	0.00
Two to three times a week	8	26.67	2	7.69
Several times a week	0	0.00	0	0.00
Two to three times per mouth	0	0.00	2	7.69
TOTAL	*30*	*100*	*26*	*100*

Table 13: The statistical analysis of boys with AH according to the daily consumption of salty foods

Total	**AH**	**Absence of AH**
Experimental Group	5	17
Control Group	3	17
Results of statistical analysis		
Odds Ratio (OR)	**P**	
1.6666	0.029	

Table 14: The characteristics of groups by the number of children in the family

Children/ No	**Experimental group**				**Control group**			
	Girls		**Boys**		**Girls**		**Boys**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
≤ 4	20	27.03	8	30.77	52	**74.29**	28	**93.33**
5-8	36	**48.65**	8	30.77	12	17.14	2	6.67
9-12	14	18.92	8	**30.77**	6	8.57	0	0.00
> 12	*4*	5.4	2	**7.69**	0	0.00	0	0.00
Total	***74***	***100***	***26***	***100***	***70***	***100***	***30***	***100***

Table 15: The characteristics of cases with AH by the number of children in the family

Boys/No	**Experimental group**				**Control group**			
	With AH		**Without AH**		**With AH**		**Without AH**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
≤ 4	1	16.66	7	35.00	2	**50.00**	26	100.00
5-8	1	16.66	7	35.00	2	**50.00**	0	0.00
9-12	2	**33.33**	6	30.00	0	0.00	0	0.00
> 12	2	**33.33**	0	0.00	0	0.00	0	0.00
Total	***6***	***100***	***20***	***100***	***4***	***100***	***26***	***100***

Table 16: The statistical analysis of boys with AH according to the number of children per family

Total	**AH**	**Absence of AH**
Experimental Group	6	20
Control Group	4	26
Results of statistical analysis		
Odds Ratio (OR)	**P**	
1.95	0.1	

Table 17: The characteristics of the groups of boys by the presence of facial hair

Age segment (years)	Control group -Boys		Experimental group – Boys	
	N	%	N	%
10-12	0	0.00	2	**7.69**
13-14	4	13.33	5	**19.23**
15-16	15	50	17	**65.39**
Absence of facial hair	11	36.67	2	7.69
Total	***30***	***100***	***26***	***100***

Table 18: The characteristics of the groups of boys by voice change

Age segment (years)	Control group –Boys		Experimental group - Boys	
	N	%	N	%
10-12	0	0.00	3	**11.54**
13-14	3	10.00	5	**19.23**
15-16	16	53.33	17	**65.38**
Unchanged voice	11	36.67	1	3.85
Total	***30***	***100***	***26***	***100***

Table 19: The characteristics of the groups of boys by presence of juvenile acne

Age segment (years)	Control group -Boys		Experimental group – Boys	
	N	%	N	%
10-12	2	6.67	4	**15.38**
13-14	4	13.33	7	**26.92**
15-16	9	30.00	13	**50.00**
Without acne	15	50.00	2	7.70
Total	***30***	***100***	***26***	***100***

Table 20: The statistical analysis of lots of boys with AH according to the secondary sex characteristics

Total	**Present of secondary sex characteristics**	**Absence of secondary sex characteristics**
Experimental group	5	1
Control group	3	1
Results of statistical analysis		
Odds Ratio (OR)	**P**	
1.66	0.029	

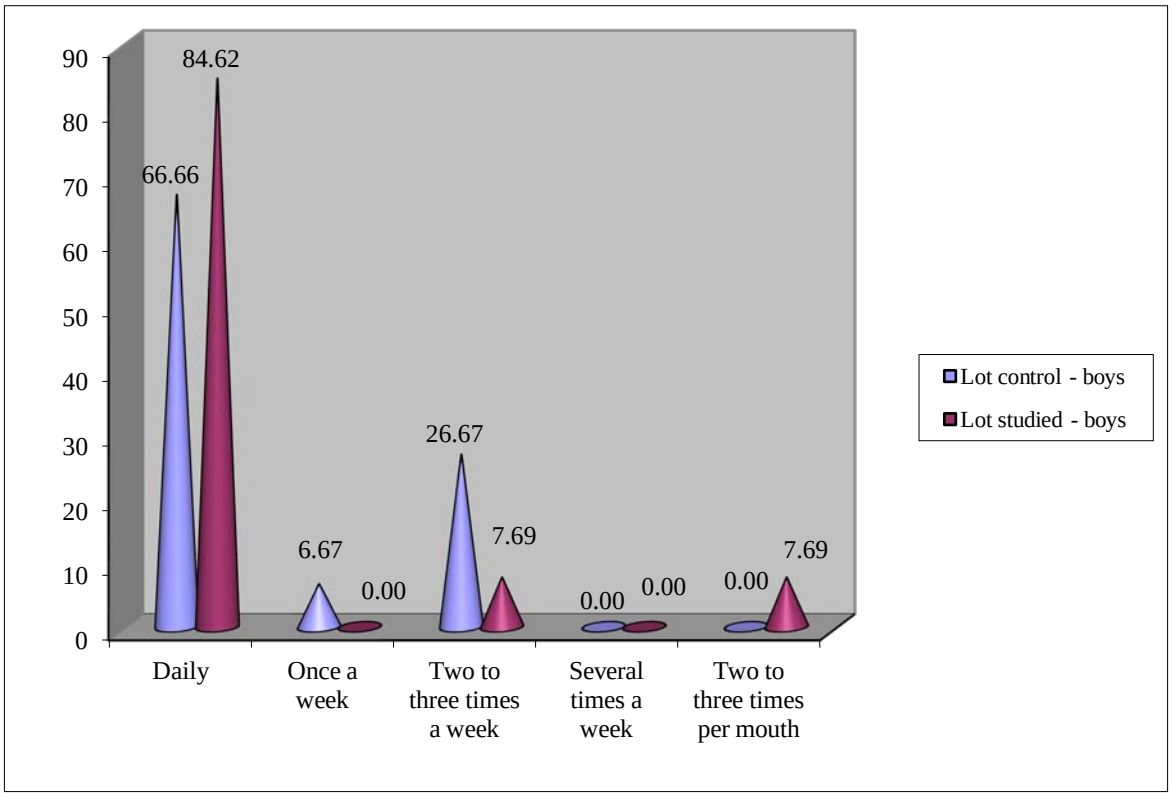

Figure 1: The percentage distribution of boys according to salt consumption

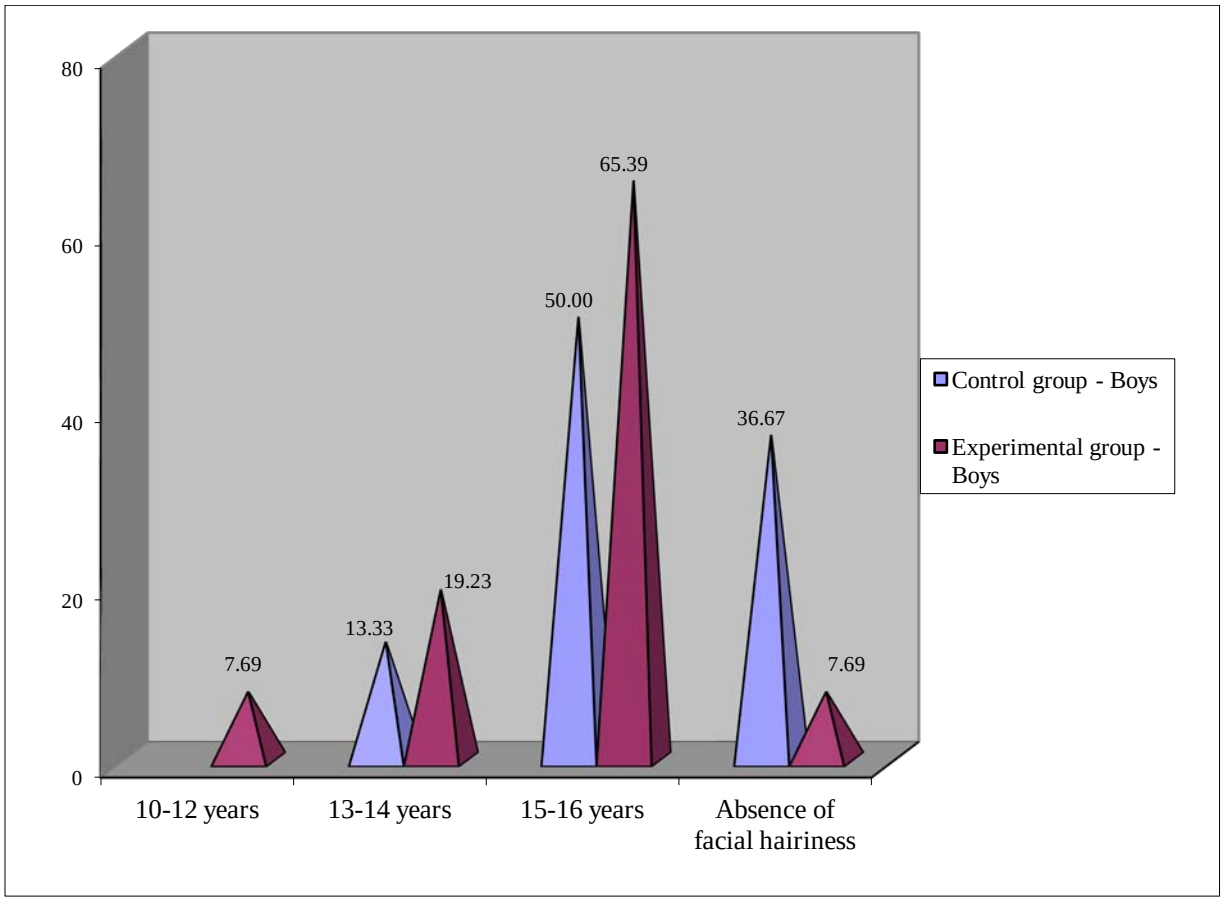

Figure 2: The percentage distribution of boys from both groups by presence of facial hair

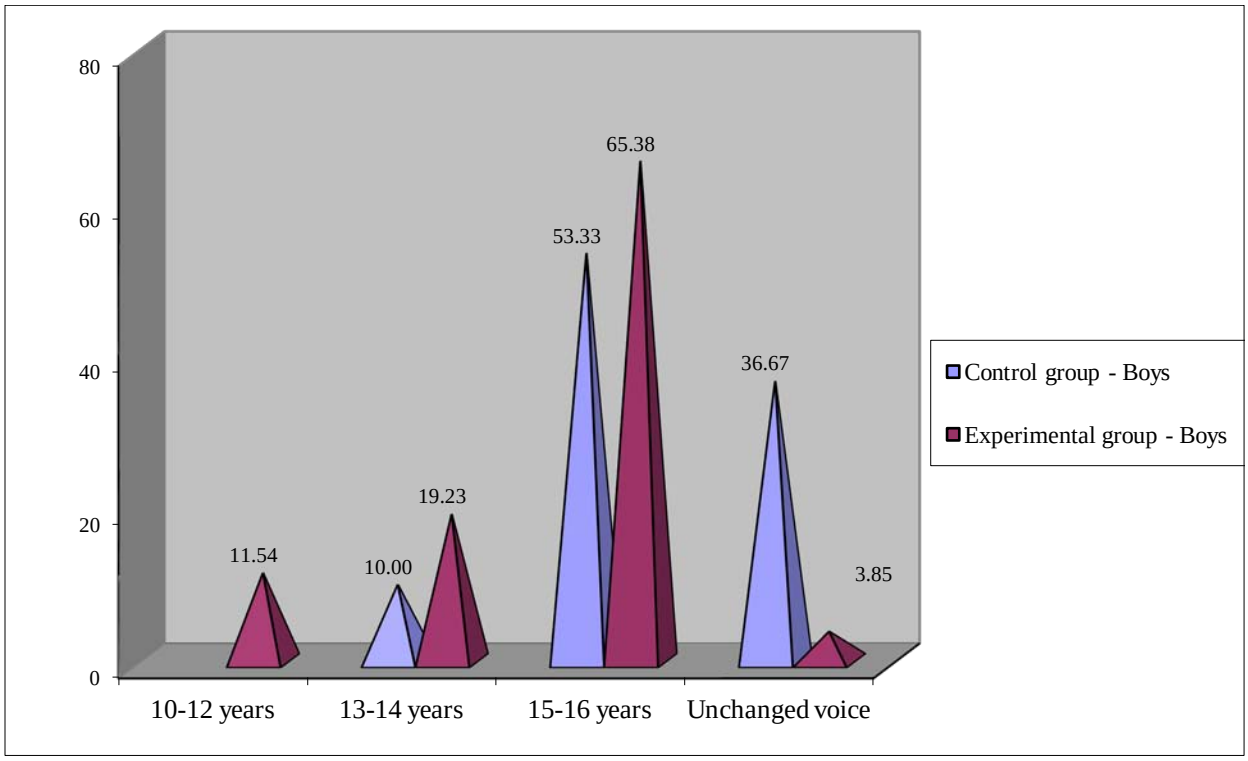

Figure 3: The percentage distribution of boys from both groups by voice change

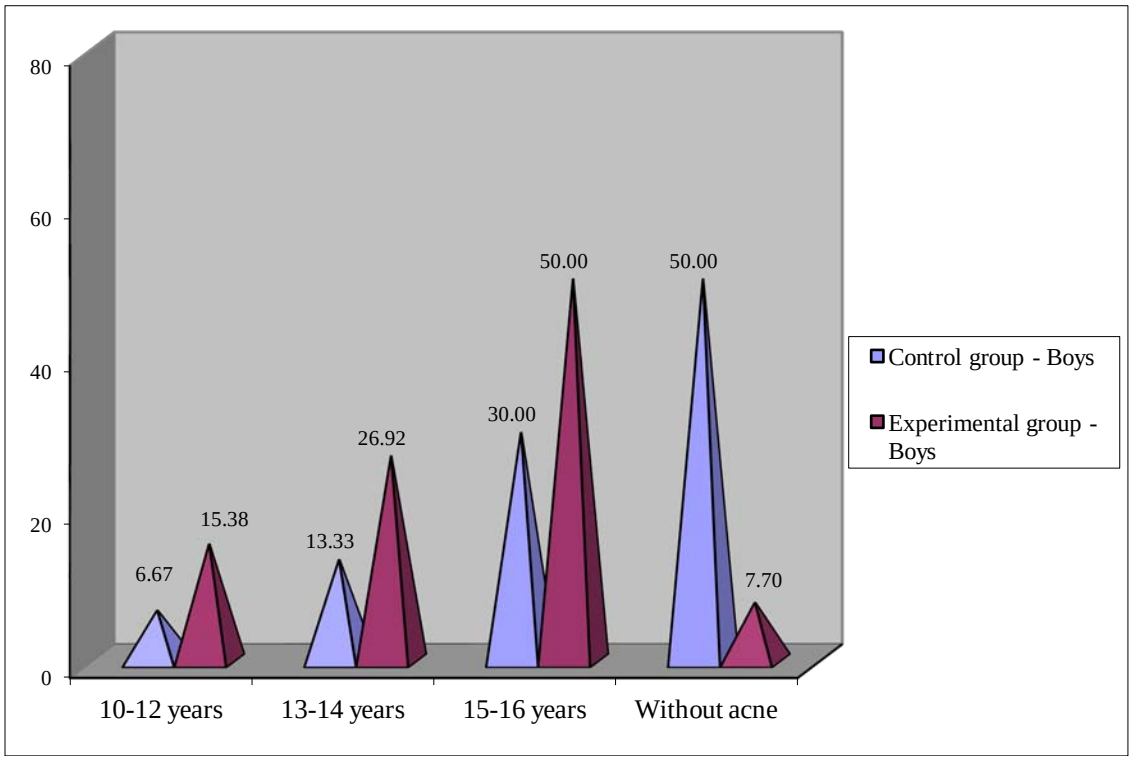

Figure 4: The percentage distribution of boys from both groups by presence of juvenile acne