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Basic Dimensions and Proportions of the Head between 7 to 17 Years of Age

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The presented results are a part of a large anthropological study on schoolchildren aged 7-17 from Sofia. The age-dependent of five basic dimensions and four indices characterizing the cerebral part of the head have been followed up. 3640 individual measurements — 1787 for the boys and 1853 for the girls have been taken. A differing type of growth of the basic head sizes in both sexes has been recorded. Even as early as the age of 7 years the sexual differences are clearly expressed in all head features. A tendency towards debrachycephalization has been detected.

Key words: cerebral part of the head, growth velocity, sexual differences, secular changes, debrachycephalization.

Introduction

Head size growth is closely linked to brain development. Human brain starting from its embryonic development surpasses the development of the other organs. In newborns the human brain represents 25% of its weight in adults, while in children at 10 years of age it is 95% [4]. Due to this fact the skull reaches final values much earlier than the other parts of the skeleton. The brain part is thus formed earlier than the facial one. In accordance with that the cerebral part sizes of the head as opposed to that of the facial cranium are expected to reach the values of the adult individuals earlier. The **aim** of the present study is to trace the dynamics of the changes in the basic dimensions and proportions of the cerebral part of the head between ages 7 and 17, to register the growth velocity of the features under study, to asses the sexual differences and to look for secular changes in the studied features at the end of the past century and at the beginning of the present century.

Material and Methods

Schoolchildren from 5 Sofia schools aged from 7 to 17 years were the subject of an in-detail anthropological study. A total of 3640 individual measurements — 1787 for the boys and 1853 for the girls during the period from 1993 to 2001 were carried out

after the classical method [1]. The changes in five basic sizes and four indices of the head combined in the age groups 7-9, 9-11, 11-13, 13-15 and 15-17 years were followed up and analyzed (Tables 1, 2). The growth velocity of the features under study is calculated after the formula (X2—X1)*100/(X2+X1), where X1 is the mean value from the preceding year and X2 — that from the next year of the study. The statistical significance of the sexual differences is checked by the Student's-criterion ($P<0.05$). They are quantitatively estimated by the help of the relative index of sexual differences (ISD) expressed in index units (IU) and is calculated after the formula $2*(X_3-X_Д)*100/(X_3+X_Д)$ [5].

Results and Discussion

The boys at the age between 7 and 13 years and only the 7-year-old girls are with a medium length of the head. After this age the heads are long. Between the ages of 7 through 17 both sexes display narrow heads (Table 1). According to the data on the head index both sexes are mesocephal. The transversal fronto-parietal index defines the boys in all age groups as mesometop. Only the girls between the 7 and 13 years of age belong to that category. After that age they are hypermesometop. According to the long-height index of the head both sexes in all age groups are hypsicephal. The wide-height index defines both sexes between the ages of 7 to 17 as metriocephal. Between the ages 15 and 17 years the boys are akrocephal and the girls remain at the metriocephal-acrocephal border (Table 2). The sexual differences are most clearly expressed in all head features studied as early as the age of 7 years ($P<0.05$). It has

Table 1. Age changes in the basic head measurements

Feature	Age (years)	Boys			Girls			t-test	ISD
		n	*X*	SD	*n*	*X*	SD		
Head length	7	182	179.01	6.13	178	174.93	5.87	6.45	2.30
	9	189	181.78	6.16	182	177.30	5.65	7.30	2.50
	11	183	182.60	6.20	205	178.49	5.83	6.70	2.28
	13	166	183.92	6.03	186	180.64	5.36	5.37	1.80
	15	124	187.38	6.62	138	181.70	6.03	7.23	3.08
	17	118	189.75	6.46	138	180.67	6.53	11.15	4.90
Head breadth	7	182	141.78	5.38	178	137.06	4.44	9.09	3.38
	9	189	144.40	5.06	182	140.09	4.56	8.62	3.03
	11	183	144.91	4.92	205	140.42	4.76	9.11	3.15
	13	166	145.43	5.10	186	141.59	4.76	7.28	2.68
	15	124	145.96	5.41	138	141.33	5.15	7.08	3.22
	17	118	147.48	5.25	138	141.74	4.66	9.18	3.97
Frontal breadth	7	182	100.68	3.67	178	98.65	3.38	5.46	2.04
	9	189	103.37	3.76	182	101.28	3.38	5.64	2.04
	11	183	104.39	3.89	205	102.83	3.51	4.13	1.51
	13	166	106.22	3.90	186	105.08	3.68	2.81	1.08
	15	124	108.07	4.18	138	106.14	3.72	3.93	1.80
	17	118	109.71	3.88	138	106.29	3.60	7.27	3.17
Auricular head height	7	182	118.29	6.39	178	113.58	6.70	6.82	4.06
	9	189	121.18	6.93	183	115.35	7.08	8.02	4.93
	11	183	120.03	9.13	205	115.05	6.86	6.02	4.24
	13	166	118.87	8.28	184	113.71	7.48	6.09	4.44
	15	124	126.32	10.49	138	120.15	8.34	5.23	5.01
	17	118	129.43	8.95	136	120.15	7.00	9.10	7.44
Head circumference	7	182	526.25	14.82	178	516.65	12.89	6.56	1.84
	9	189	536.40	14.02	182	528.25	12.77	5.86	1.53
	11	183	541.82	14.44	205	538.09	15.18	2.48	0.69
	13	166	549.02	15.62	186	549.03	14.97	0.01	0.00
	15	124	562.01	17.71	138	553.15	15.30	4.30	1.59
	17	118	571.03	15.91	138	554.30	15.87	8.33	2.97

T a b l e 2. Age changes in the basic head indices

Feature	Age (years)	Boys			Girls		
		n	*X*	SD	*n*	*X*	SD
Head index	7	182	79.29	4.01	178	78.43	3.53
	9	189	79.52	3.89	182	79.09	3.56
	11	183	79.46	3.92	205	78.75	3.62
	13	166	79.16	3.75	186	78.44	3.31
	15	124	77.98	3.76	138	77.87	3.84
	17	118	77.81	3.72	138	78.54	3.70
Transversal fronto-parietal index	7	182	71.07	2.84	178	72.02	2.47
	9	189	71.63	2.63	182	72.34	2.62
	11	183	72.07	2.55	205	73.28	2.62
	13	166	73.07	2.50	186	74.26	2.58
	15	124	74.10	2.91	138	75.16	2.80
	17	118	74.44	2.69	138	75.03	2.61
Long-height index of the head	7	182	66.14	3.91	178	64.97	3.83
	9	189	66.72	4.22	182	65.12	4.04
	11	183	65.90	5.04	205	64.48	3.73
	13	166	64.68	4.70	184	62.96	4.10
	15	124	67.47	5.78	138	66.20	5.09
	17	118	68.23	4.36	136	66.52	3.87
Wide-height index of the head	7	182	83.50	4.66	178	82.92	5.08
	9	189	83.99	5.16	182	82.42	5.18
	11	183	83.03	6.20	205	81.99	5.07
	13	166	81.77	5.50	184	80.38	5.67
	15	124	86.63	7.51	138	85.08	6.14
	17	118	87.83	6.14	136	84.82	5.54

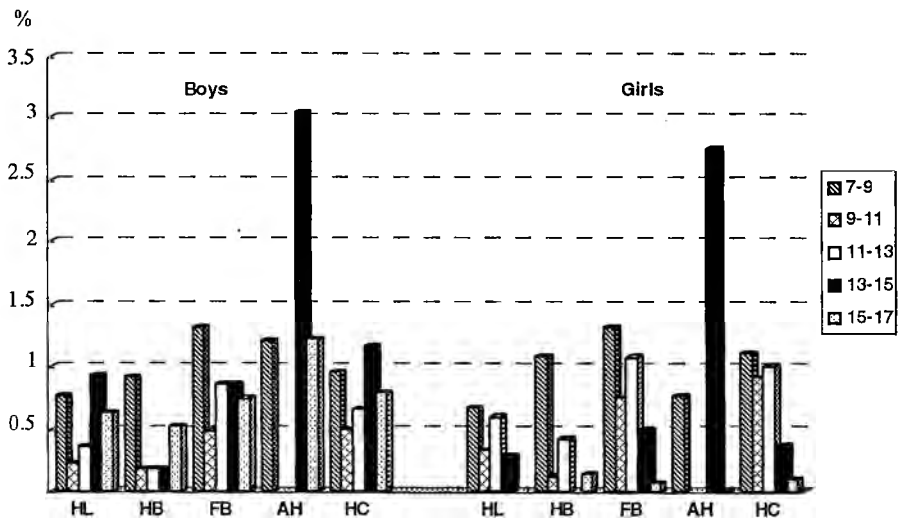

Fig. 1. Growth velocity in the basic head measurement

been established by the help of (ISD) that they are greatest in the auricular head height and smallest in the head circumference. Growth velocity in the boys for most of the features is most intense between ages 13 and 15. In the case of the girls the growth between 7 and 9 years is most accelerated for all features excepting for the auricular head height. In them a second peak of growth — between the years of 11 to13 is observed (Fig. 1). At the age of 7 years the head sizes in both sexes represent

between 87.9% and 93.8% of the values for adult individuals from Sofia while in the case of the 17-years old these are already between 94% and 100% (National programme "Anthropological characteristics of the Bulgarian people", 1989/1999, unpublished data).

The secular changes of the basic head sizes and the head index compared to data from anthropological studies at the beginning and the 1970-ies of the past century have been traced [8, 9]. A tendency to brachycephalization expressed in the head length growth and diminution of the head breadth has been established. R. Stoev and Y. Yordanov [3] have observed a decrease of the head index in adult Bulgarians born after 1950. The tendency to debrachycephalization has been established by foreign authors as well [2, 6, 7]. The changes in the head circumference are most weakly pronounced as compared to 1970 [9]. Its mean values in the 17-year old persons are quite close to those from the present study. St. Vatev [8] has found a significantly smaller head circumference.

Conclusion

During the period between 7 and 17 years of age heads of medium length to long ones, narrow, of medium height to high with a forehead of medium breadth and mesocephalic shape are typical for both sexes. In the boys for the most of the features the growth velocity is highest between the ages of 13 and 15 years and in the girls it is highest between the years of 7 to 9. The sexual differences in all features of the head under study are clearly outlined as early as 7 years of age. A tendency towards debrachycephalization is registered.

References

1. Martin, R., K. Saller. Lehrbuch der Anthropologie in sistematischer Darstellung, Bd. I. Stuttgart, Gustav Fischer Verlag, 1957, 363-371, 385-429.
2. Štefančič, M., P. Leben-Seljak. Growth of head and face in children from Ljubljana during adolescence: mixed longitudinal study. — Antropološki zvezki, 4, 1996, 73-85.
3. Stoev, R., Y. Yordanov. Secular trend in Bulgaria — In: Secular Growth Changes in Europe, Budapest, Eötvös Univ. Press, 1998, 65-73.
4. Tanner, J., M. Growth at adolescence. Oxford, Blackwell Scientific Publications, 1962.
5. Wolanski, N. Function of the extremities and other influence on the asymmetric structure of body in children and young persons from different environmental conditions. — Acta Med. Auxologica, IV-1, 1972, 3-11.
6. Zellner, K., U. Jaeger, K. Kromeyer-Hauschild. Das Phänomen der Debrachykephalisation bei Jenaer Schulkindern. — Anthrop. Anz., 56, 1998, No4, 301— 312.
7. Zellner, K., K. Kromeyer-Hauschild, J. Stadler, U. Yaeger. Ergebnisse der Untersuchung ausgewhlt Kopfmaße bei Jenaer Kindern. — Anthrop. Anz., 57, 1999, No2, 147-163.
8. Ватев, Ст. Антропология на българите. С., 1939, 38—49.
9. Янев, Б., П. Щерев, П. Боев, Ф. Генов, Д. Сепетлиев, И. Попов, Б. Захариев. Физическо развитие, физическа дееспособност и нервно-психическа реактивност на населението. С., Медицина и физкултура, 1982.