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ANTHROPOLOGICAL STUDIES IN THE ŻYWIEC REGION – CHANGES IN THE HEAD PROPORTIONS

ABSTRACT: The cross-sectional studies conducted for the past 40 years by the Department of Anthropology of the Jagiellonian University on children and adolescents from southern Poland enabled the observation of changes in the values of such parameters as the length (g-op), the width (eu-eu) and the main head index in time. A comparative analysis of peer groups, examined at 10-year intervals, showed slight differences in the value of head length between those groups. However, during the last decade an increase of the head length has been observed, resulting in a decreased value of the main index. Interestingly enough, the phenomenon under study has been encountered, above all, in the youngest children, 3 and 4 years old.

KEYWORDS: Anthropometric cross-sectional studies – Main head index

INTRODUCTION

Since 1962 the Department of Anthropology of the Jagiellonian University has been carrying on systematic anthropometric studies with children and adolescents inhabiting the Żywiec region (Mayer 1981, Jasicki *et al.* 1986, Kaczanowski *et al.* 1995). The subjects are children and adolescents from Żywiec, villages and small towns of the Soła river basin and hamlets of the Koszarawa river basin (Figure 1). The investigations are conducted at 10-year intervals. The investigated group mainly comprised persons born in Żywiec District, whose both parents or either of them also came from that area (Kaczanowski *et al.* 1995). Due to the local origin of the persons examined and the absence of significant migrations in this region during the past 40 years, it seems that these groups under study may be regarded as a model example of changes in the head dimensions of children from local population, which have occurred in the past decades.

MATERIALS AND METHODS

Within the framework of the anthropological research conducted in the Żywiec region, anthropometric and anthroposcopic cross-sectional studies were carried out in the years 1962, 1972, 1982, 1992 and 2002 on children and adolescents attending kindergartens and schools at Żywiec and in the years 1970/71, 1981, 1991 and 2001 on children and adolescents attending kindergartens and schools at Węgierska Górka. In the course of studies, a standard measurement scheme, worked out in the Department of Anthropology according to Martin's method, was used (Martin, Knußmann 1988).

In the present research the selected head dimensions: length (g-op), width (eu-eu) and the main head index ($eu-eu/g-op \times 100$) were taken under consideration; afterwards, changes in head dimensions in the past 40 years were analyzed on the basis of the cross-sectional studies conducted on children and adolescents of the successive

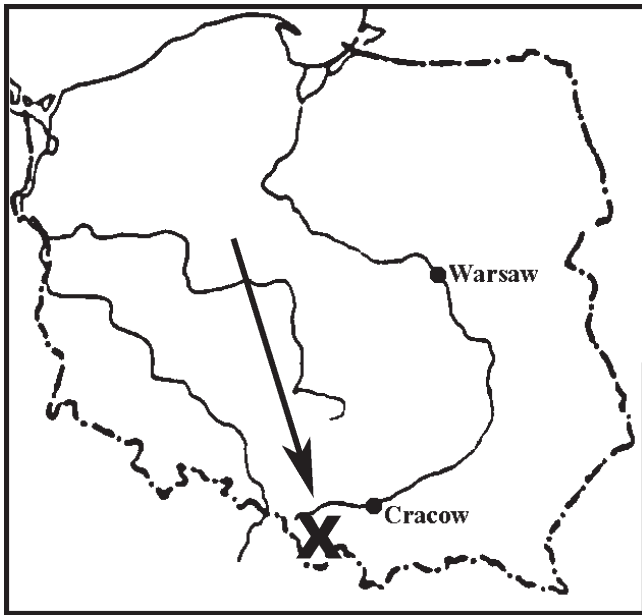


FIGURE 1. The Żywiec region – X.

age groups. Statistical evaluation was based on an analysis of variance (ANOVA), and the LSD method was used as a verifying a posteriori test. Null hypotheses were verified at the significance level $p=0.05$.

RESULTS

Mean values of the width-length head index, obtained in the cross-sectional studies of boys and girls (*Tables 1–4*) allowed to show the trend of changes in the form of a rectilinear regression (*Figures 2–5*).

DISCUSSION

Having analyzed the results of cross-sectional studies conducted on children and adolescents throughout the past 40 years, differences in values of the main head index were found in the peer groups under comparison. The analysis of variance (ANOVA), as well as the results of a posteriori test show that some of the observed differences are statistically significant (*Tables 5, 6*).

Statistically significant changes in values of the main head index have occurred in both boys and girls. Only in the case of groups examined in Żywiec in the years 1962, 1972 and 1982 and in Węgierska Górká in the years 1971 and 1981, the differences in the index values were statistically insignificant.

The observed changes in head proportions have made us search for the cause of such differences and, above all, for the factors influencing its shape already at early stages of ontogenesis. In Sikora's study (1964), an analysis of the development of the main head index during intrauterine

life and in the first three years of extrauterine life shows that in short-headed populations (to which – on the basis of the main head index values in adolescents – the analyzed series from Żywiec and Węgierska Górká apparently belong) the most pronounced changes in this index occur in the first years of life. In line with the latter paper, in the short-headed groups up to 6 months of age, a very rapid increase in the head index is observed, which testifies to a considerably bigger increase in head's width than in its length. Afterwards, when the maximum is reached, the index values gradually decline. An analysis of the index changes in groups with its lower values at an early stage of ontogenesis shows a growing tendency; however, this increase is not so high as in the short-headed groups. In effect, the ultimate head proportions, characteristic for the population studied and being within an average range of intragroup variation, are achieved. Parallel to Sikora's observations (1964), it seemed of utmost interest to compare changes in the main head index values in groups of boys and girls from the Żywiec region. The highest index values were found for a group of the youngest girls, examined in Żywiec in the years 1962, 1972, 1982 and in Węgierska Górká in 1970/71 and 1981. For the group of boys, the highest index values were found in Żywiec in the years 1962, 1972, 1982, 1992 and in Węgierska Górká in 1970/71, 1981, 1991. Heads of these girls and boys became longer in the process of ontogenesis. Hence the group tested behaved in a manner typical of the short-headed individuals described by Sikora. The lowest index values were obtained for the youngest group measured in Żywiec in the year 2002 and in Węgierska Górká in the year 2001, whose index value gradually increased in the course of progressive ontogenesis. The process of becoming long-headed, described in the children and adolescents examined in the sixties, seventies, eighties and nineties, as well as that of becoming short-headed in the case of subjects examined in the years 2001 and 2002 yielded a mean value, characteristic of the adult population tested, amounting to 85.4 index units for men and 85.7 for women (Sikora 1986). This value can be regarded as a genetically determined trait whose final development was not significantly affected by external factors. On the other hand, those factors probably acted with the utmost potency in the first months and years of life. The available literature on the topic points to a relationship between head dimensions and economic conditions (Mayer 1981), as well as between head proportions and the environmental conditions under which an organism develops in the first years of life (Boas 1912, Bogin 2001). The cross-sectional studies repeated every ten years, conducted with series of individuals of local origin, allowed to assess the influence of the economic factor on developmental processes, the more so as – due to numerous data (Wolański 1987) and our own observations made in the last thirty years – we are now able to determine precisely enough the changes in economic situation occurring in a given region. In the case of studies carried out in the Żywiec region, the

TABLE 1. Żywiec – mean main head index – boys.

Age	1962		1972		1982		1992		2002	
	N	x	N	x	N	x	N	x	N	x
3.5			70	86.76						
4.5			69	87.55					4	82.65
5.5			77	88.17					11	82.18
6.5	7	84.08	63	86.51					24	82.45
7.5	19	86.59	45	87.46	49	88.11	20	85.83	42	81.49
8.5	38	86.35	45	86.52	42	86.38	29	86.03	54	81.95
9.5	31	86.11	49	86.74	50	87.71	15	84.80	52	81.48
10.5	23	86.43	56	87.69	38	86.19	29	85.73	46	80.78
11.5	37	86.62	41	86.60	53	86.76	46	85.21	49	81.08
12.5	24	86.93	43	86.45	57	86.75	57	85.25	57	82.56
13.5	45	86.58	37	87.11	59	86.52	52	86.53	90	84.56
14.5	89	86.74	53	85.60	38	85.85	48	85.26	86	83.59
15.5	80	86.05	60	84.91	63	85.23	52	84.98	89	82.83
16.5	60	86.07	53	85.84	59	86.17	38	83.80	72	83.18
17.5	23	85.47	36	85.35	60	84.89	37	83.72	79	83.05
18.5	6	83.96	29	84.72	67	85.31	18	83.04	62	83.00

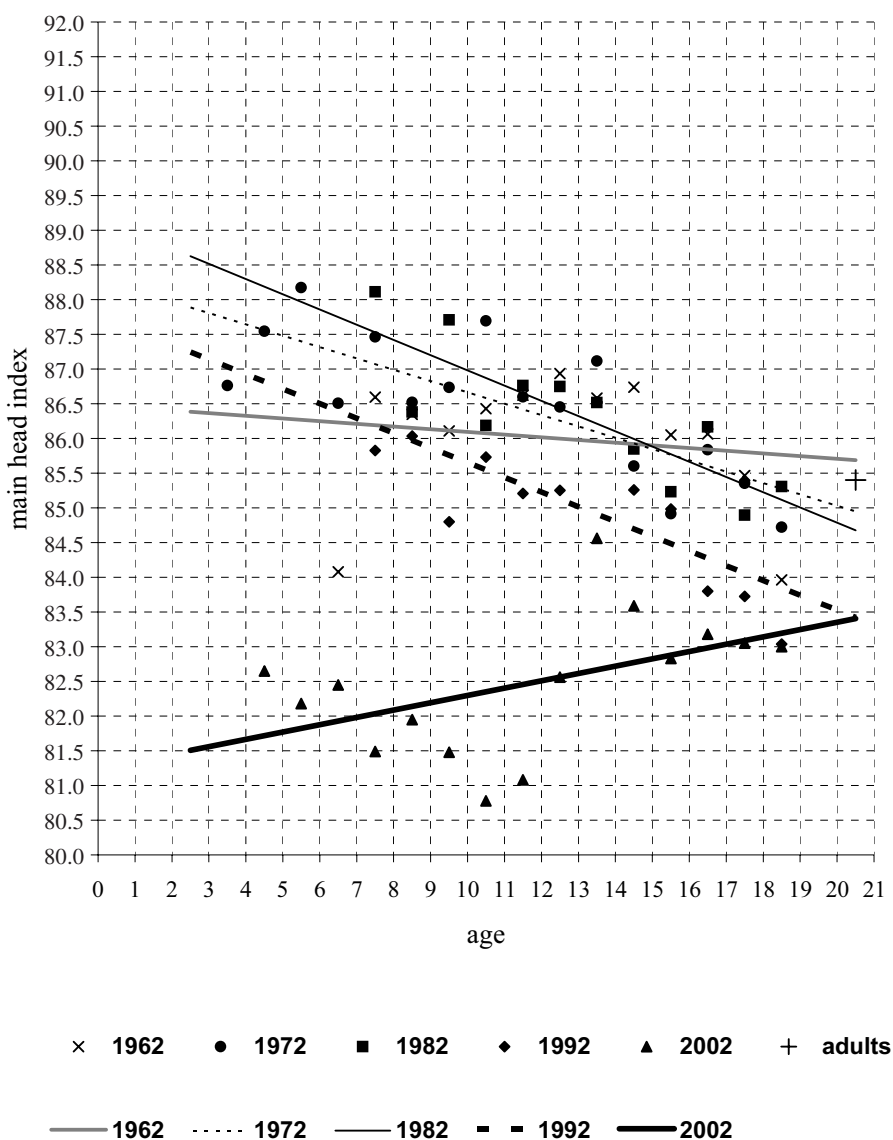


FIGURE 2. Żywiec – mean main head index – boys.

TABLE 2. Żywiec – mean main head index – girls.

Age	1962		1972		1982		1992		2002	
	N	x	N	x	N	x	N	x	N	x
3.5			44	86.96					4	80.56
4.5			80	86.52					4	79.92
5.5			76	87.56					5	85.2
6.5	13	84.51	66	86.53	5	87.10			22	81.77
7.5	29	86.91	61	87.50	29	86.70	27	81.67	49	82.49
8.5	46	86.94	41	87.30	27	86.75	27	85.07	36	82.56
9.5	39	87.82	49	85.33	51	86.35	28	85.32	39	81.39
10.5	38	86.75	52	86.03	39	85.80	33	84.52	60	81.59
11.5	28	86.56	50	85.46	41	86.51	29	83.84	65	82.7
12.5	38	86.08	54	85.34	44	85.80	59	85.46	64	83.46
13.5	55	86.08	56	85.61	45	86.60	65	84.71	74	83.1
14.5	167	86.98	89	85.61	73	85.08	77	84.13	84	83.32
15.5	109	86.82	156	85.89	145	86.31	152	84.87	90	84.67
16.5	74	86.97	191	85.91	133	86.08	116	84.94	174	84.39
17.5	32	85.59	124	85.79	113	85.87	110	84.96	134	84.02
18.5	4	87.67	105	86.67	88	86.75	70	85.20	65	84.4

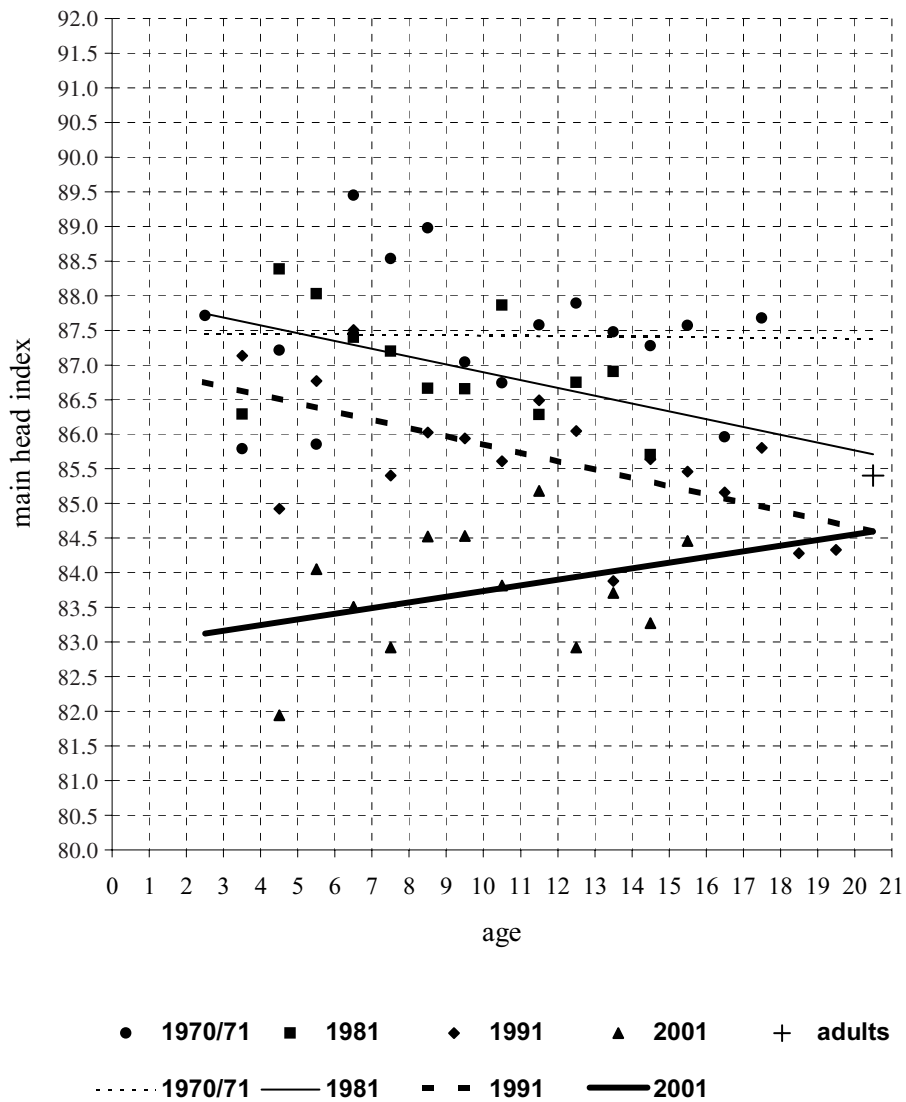


FIGURE 3. Żywiec – mean main head index – girls.

TABLE 3. Węgierska Górka – mean main head index – boys.

Age	1970/71		1981		1991		2001	
	N	x	N	x	N	x	N	x
2.5	5	87.7						
3.5	8	85.7	20	86.2	4	87.1	1	93.4
4.5	11	87.2	22	88.3	10	84.9	6	81.9
5.5	9	85.8	23	88.0	8	86.7	18	84.0
6.5	10	89.4	59	87.3	22	87.5	19	83.5
7.5	29	88.5	30	87.2	36	85.4	20	82.9
8.5	25	88.9	33	86.6	37	86.0	37	84.5
9.5	44	87.0	35	86.6	53	85.9	24	84.5
10.5	23	86.7	43	87.8	37	85.6	28	83.8
11.5	39	87.5	38	86.2	41	86.4	32	85.1
12.5	32	87.8	27	86.7	33	86.0	31	82.9
13.5	35	87.4	39	86.9	37	83.8	32	83.7
14.5	37	87.2	28	85.7	30	85.6	42	83.2
15.5	44	87.5	1	87.5	54	85.4	21	84.4
16.5	23	85.9	1	83.5	81	85.1	1	81.8
17.5	5	87.6			47	85.8		
18.5	1	86.6			21	84.2		
19.5					8	84.3		

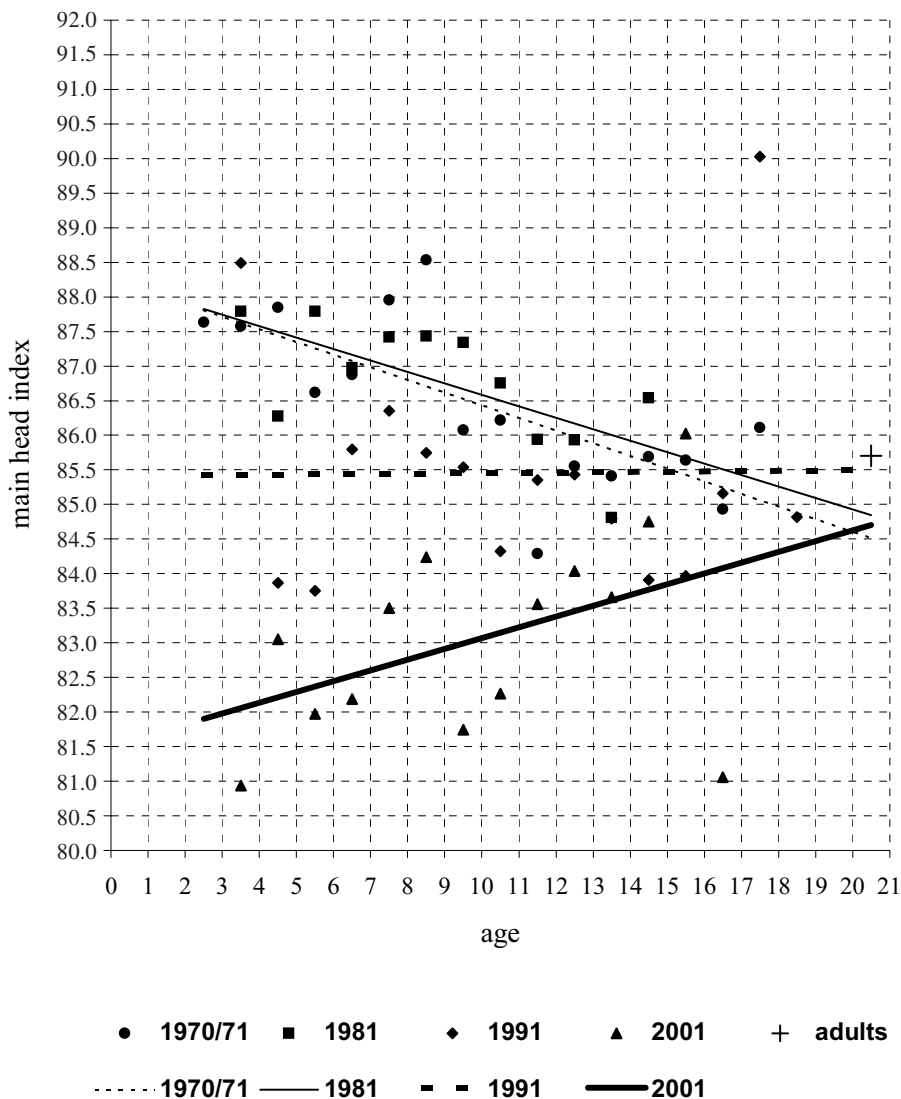


FIGURE 4. Węgierska Górka – mean main head index – boys.

TABLE 4. Węgierska Górka – mean main head index – girls.

Age	1970/71		1981		1991		2001	
	N	x	N	x	N	x	N	x
2.5	3	87.6						
3.5	10	87.5	6	87.7	4	88.4	6	80.9
4.5	10	87.8	18	86.2	9	83.8	8	83.0
5.5	17	86.6	20	87.7	4	83.7	13	81.9
6.5	12	86.8	35	86.9	19	85.8	13	82.1
7.5	27	87.9	36	87.4	23	86.3	22	83.5
8.5	34	88.5	44	87.4	25	85.7	30	84.2
9.5	43	86.0	34	87.3	34	85.5	28	81.7
10.5	45	86.2	46	86.7	38	84.3	28	82.2
11.5	22	84.2	39	85.9	38	85.3	29	83.5
12.5	39	85.5	38	85.9	35	85.4	33	84.0
13.5	32	85.4	36	84.8	36	84.7	24	83.6
14.5	33	85.6	30	86.5	37	83.9	28	84.7
15.5	35	85.6			16	83.9	22	86.0
16.5	13	84.9			4	85.1	2	81.0
17.5	3	86.1			3	90.0		
18.5					5	84.8		

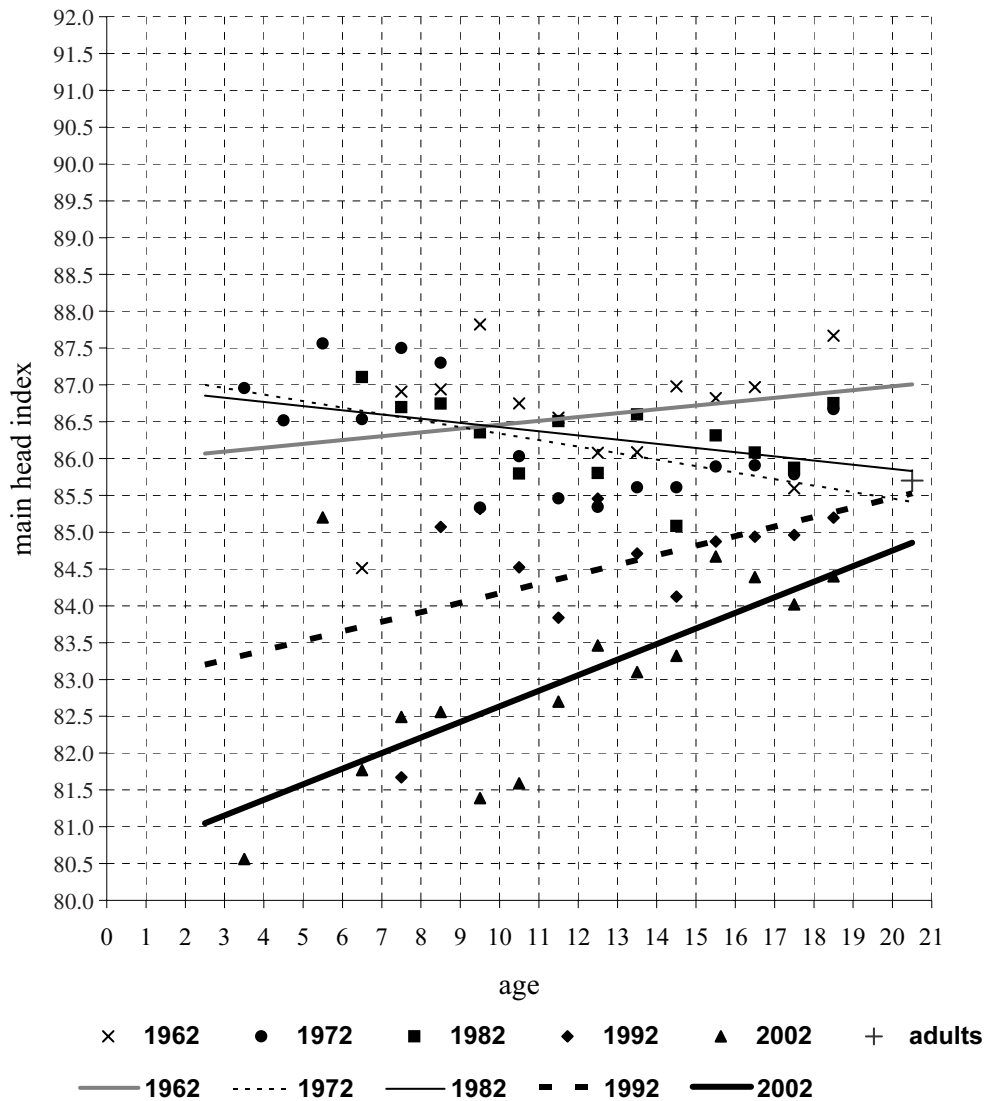


Figure 5. Węgierska Górka – mean main head index – girls.

TABLE 5. Statistically significant differences between the groups studied (main head index) – Żywiec.

	Boys					Girls				
	1962	1972	1982	1992	2002	1962	1972	1982	1992	2002
1962										
1972										
1982										
1992	X	X	X			X	X	X		
2002	X	X	X	X		X	X	X	X	

X – statistically significant difference (the LSD test).

TABLE 6. Statistically significant differences between the groups studied (main head index) – Węgierska Górka.

	Boys				Girls			
	1971	1981	1991	2001	1971	1981	1991	2001
1971								
1981								
1991	X	X			X	X		
2001	X	X	X		X	X	X	

X – statistically significant difference (the LSD test).

ameliorated living conditions of the population studied in the last ten years can in all probability be regarded as a factor that plays a substantial role in the observed process. Hence the beneficial extragenetic factors have influenced the changes in the development of phenotypes of the children under survey at the time of their early childhood, including the genetically determined dimensions of head length and width (Szopa 1977, Sparks, Jantz 2002). In an attempt to determine the cause of the phenomenon studied, changes in the mode of handling infants whose head proportions partly depend – according to some studies (Walcher 1905) – on the manner of body placement, should also be taken into account. It so happened that the longest heads were found in the case of infants positioned on their bellies, and the shortest – for babies placed on their backs. The use of baby carriers and bouncers by mothers also seems to have an additional effect on children's head shape.

Changes in head proportions in the age groups of children and adolescents were also reported by periodically repeated surveys of children and adolescents from Poznań (Malinowski *et al.* 1976, Cieślak *et al.* 1994, Malinowski 2002) and Nowy Sącz (Mayer, unpublished data). The common characteristic of the above-mentioned series examined cross-sectionally is a similar distribution of the main head index, resembling the parameters reported for the Żywiec region. In comparison with the cross-sectionally surveyed series from the territory of Poland, a series from Jena, tested in the years 1944, 1954, 1975, 1985 and 1995 (Jaeger 1998), looks entirely different. As it happens, the successive age groups of the Jena series are characterised by a constant value of the main head index, which gradually declines in the consecutive decades.

CONCLUSIONS

- A comparative analysis of peer groups surveyed at 10-year intervals showed that in the past decade the head length value has been distinctly increased, resulting in a decreased value of the main head index.
- The described phenomenon is, above all, characteristic for the youngest children: 3 and 4-year-old.
- An analysis of the measurements of a series composed mainly of persons of local origin has thus shown that both genetic and environmental factors influence the development of head proportions in the process of ontogenesis.
- Extragenetic factors affect head dimensions at early stages of ontogenesis, whereas the ultimate head proportions genetically determined, are characteristic of a given local population and are attained in the process of the organism's development.

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