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DEVELOPMENT OF HEIGHT AND WEIGHT OF CZECH CHILDREN SINCE 1951 UP TO 1981

ABSTRACT — In September 1981 already the 4th national cross sectional anthropological research among children and adolescents from 0 up to 18 years of life had been realized. Just as the foregoing researches in 1951, 1961 and 1971 the 4th NCSAR included a representative sample of children selected through random sampling. The processing of data took place separately in Slovakia and in the Czech Provinces under observance, however, of the same procedure.

The aim of the research was to acquire new representative growth standards and to evaluate growth changes in children in Czechoslovakia in the course of the 30 postwar years. In order to determine the influence of environment upon their growth and development a series of socio-economic data concerning children and their family environment were followed. The results obtained would be useful for both public health and pedagogical practice and moreover would find their application in the industry.

The present report summarizes the results concerning height and weight data in 4 tables and 12 graphs.

KEY WORDS: Czech Children 0 to 18 years old — Weight — Height — Growth acceleration — Secular Trend.

MATERIAL AND METHODS

The investigated sample from the Czech Provinces included 4 % of children i.e. 120 000 individuals. It has been obtained by three-phase random sampling in proportion to numbers of children in the individual regions, districts and localities. In consideration of a greater number of age groups of children in the period of maximum growth at the preschool age a total of 60 000 children aged 0 till 6 years and the same number of children and adolescents from 6 till 18 years were examined.

The children were divided into age groups by monthly intervals up to the first year of age, by three-month intervals up to 2 years, by half-year intervals up to 4 years and further on by one-year intervals. Each sex was processed separately. Preschool children were examined by pediatrists and nurses in public health facilities, school children and adolescents were measured by pedagogues with qualification in physical exercise and biology in schools of all types and training centres for aprentices as well.

All research workers were acquainted with a uniform methodology in advance and in detail at regional briefing courses where they were given uniform measuring devices (Fetter—Krajník's band measure and tape measure, letters for the parents, instructions in filling in questionnaires). In the course of measuring several random tests were effected to ensure the observance of the uniformity of the method.

The children were measured in standing position (heels and toes together) and active erect posture, the position of head being as if looking in distance (in the Frankfurt horizontal plane) and weighed on a medical lever balance without shoes and in gym suit only.

After finishing the data collection, the material obtained was concentrated at the computer centre and after logical revision control of punched on data and elimination of errors the material was processed in

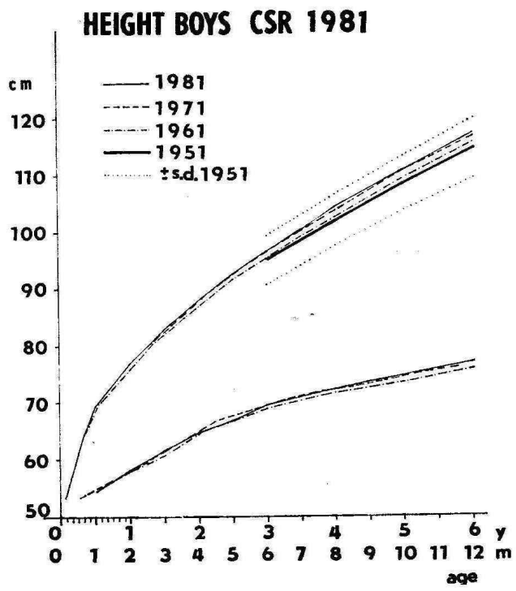
its first phase at the Computer Centre in Beroun and in its second phase at the Centre of Mathematical Statistics and Programming of the Institute of Hygiene and Epidemiology in Prague.

RESULTS

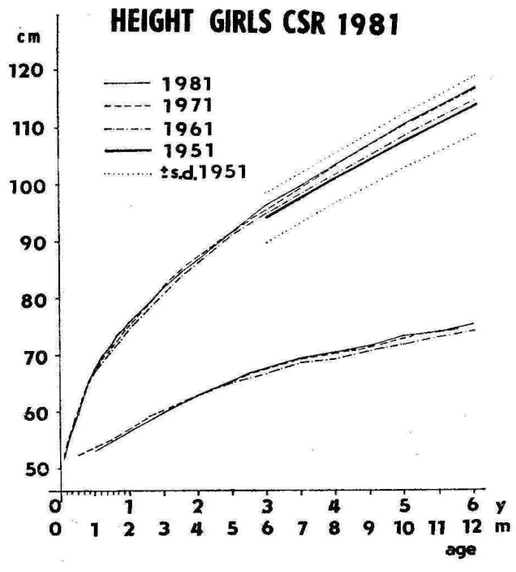
Height of boys and girls from 0 to 6 years of age (Graphs Nrs. 1, 2 and 3)

There are two charts in the graphs for the period from 0 to 6 years. The lower one for the age period of children up to 1 year and the upper one for the age bracket up to 6 years.

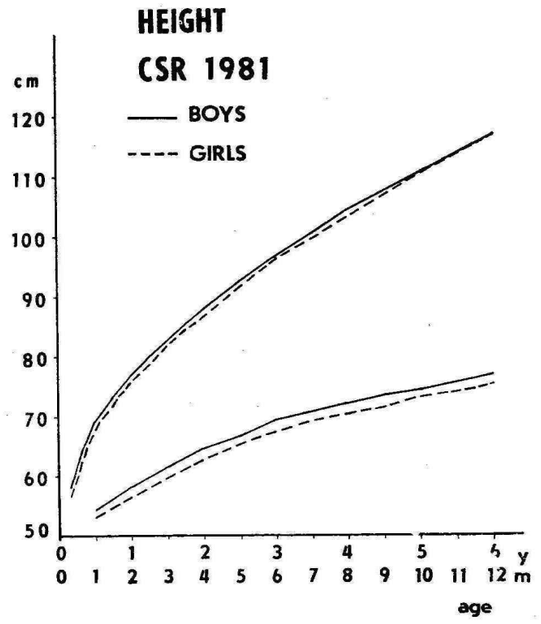
The height of boys is ascending steeply from 0 to 1 year in the form of a convex curve starting from values of about 53 cm just after birth and reaching 77 cm at the first year of life, 97 cm at the age of 3 years and 117 cm at the age of 6 years. At the beginning the values of individual research results (from the years 1961, 1971 and 1981) coincide, yet from the age of 6 months on the average heights (lengths) from the year 1961 remain lower.



GRAPH 1. *Height of Czech boys from 0 to 6 years.*



GRAPH 2. *Height of Czech girls from 0 to 6 years.*



GRAPH 3. *Height of Czech boys and girls from 0 to 6 years — comparison.*

TABLE 1. *Height of Czech Boys*

Age	N	M	S.D.
1 Month	730	54.31	2.94
2 Months	579	58.31	3.32
3 Months	605	61.58	3.33
4 Months	583	64.65	3.27
5 Months	612	66.92	3.21
6 Months	574	69.39	3.37
7 Months	597	70.70	3.18
8 Months	612	72.15	3.17
9 Months	555	73.46	3.23
10 Months	578	74.46	3.06
11 Months	545	75.85	3.23
1 Year	1,661	76.97	3.56
1.25 Years	1,844	80.02	3.60
1.50 Years	1,784	82.96	3.60
1.75 Years	1,688	85.75	3.78
2 Years	2,770	88.07	4.10
2.50 Years	2,531	92.85	4.10
3 Years	2,214	96.87	4.14
3.50 Years	2,441	100.67	4.34
4 Years	3,972	103.51	4.95
5 Years	2,885	110.97	5.22
6 Years	2,339	117.28	5.59
7 Years	2,349	123.30	5.46
8 Years	2,351	129.22	5.87
9 Years	2,341	134.56	6.24
10 Years	2,257	139.88	6.45
11 Years	2,225	144.97	6.89
12 Years	2,289	150.50	7.27
13 Years	2,435	157.17	8.57
14 Years	2,243	164.60	8.81
15 Years	2,301	171.28	7.93
16 Years	2,543	175.21	7.16
17 Years	2,413	177.20	6.71
18 Years	2,006	178.26	6.83

Since the age of 3 years the heights can be compared with the standard values of the year 1951. The last research values differ from those of the year 1951 by +0.4 of the standard deviation at the age of 3 years and by +0.6 at the age of 4 till 6 years. In girls the course of curves is similar, at the age of 3 till 6 years the values from the year 1981 as compared with those from the year 1951 are higher by +0.6 till +0.7 of the standard deviation.

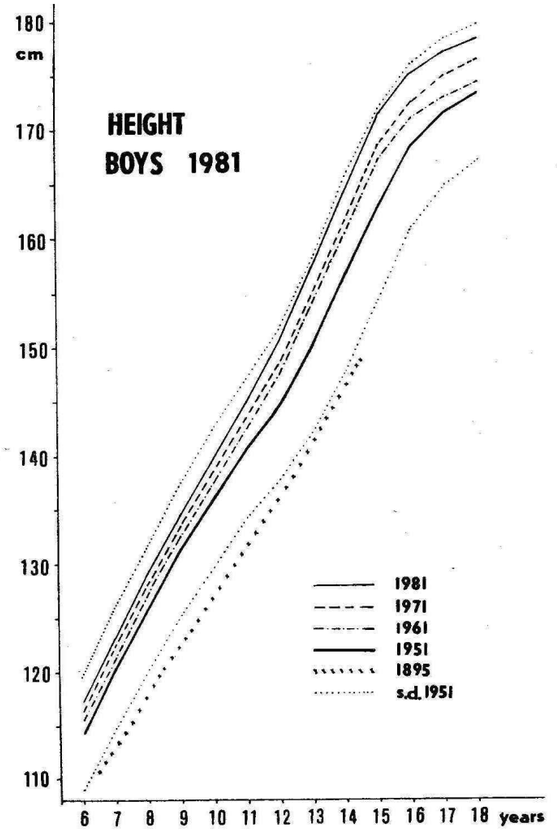
With regard to sex the difference in height is small from birth up to 6 years of age, yet at the same time constant, oscillating between 0.5 and 2.0 cm.

Height of boys and girls from 6 to 18 years (Graphs Nrs. 4, 5 and 6)

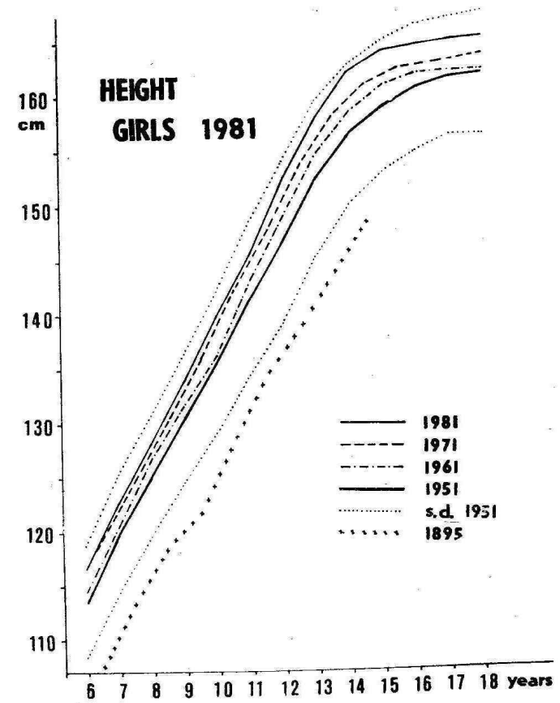
The height curve of boys from 6 to 18 years in the year 1981 indicates retardation between their 11th and 12th years of age, then accelerated growth up to 15 years with subsequent diminishing of the yearly increase. In comparison with the curve of the year 1951 the curve from the year 1981 recedes gradually more and more from the original difference of +0.5

TABLE 2. *Height of Czech Girls*

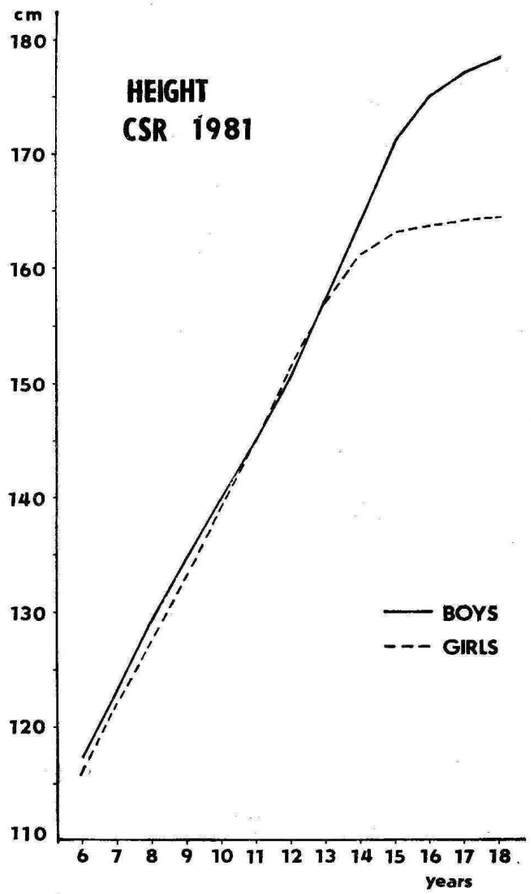
Age	N	M	S.D.
1 Month	724	53.14	2.63
2 Months	563	56.73	3.21
3 Months	624	59.85	3.15
4 Months	567	62.70	3.14
5 Months	600	65.46	3.15
6 Months	609	67.40	3.17
7 Months	567	69.13	3.18
8 Months	616	70.30	3.20
9 Months	531	71.72	3.35
10 Months	600	73.12	3.23
11 Months	575	74.12	3.49
1 Year	1,668	75.28	3.47
1.25 Years	1,811	78.52	3.44
1.50 Years	1,872	81.67	3.79
1.75 Years	1,712	84.26	3.86
2 Years	2,822	86.74	4.14
2.50 Years	2,523	91.79	4.39
3 Years	2,203	96.13	4.25
3.50 Years	2,451	99.76	4.37
4 Years	3,975	103.09	4.93
5 Years	2,876	110.44	5.36
6 Years	2,474	116.74	5.51
7 Years	2,266	120.78	5.45
8 Years	2,437	128.34	5.88
9 Years	2,341	133.91	6.20
10 Years	2,269	139,47	6.58
11 Years	2,280	145.71	7.43
12 Years	2,330	152.28	7.60
13 Years	2,485	158.03	6.96
14 Years	2,233	162.10	6.51
15 Years	2,486	164.13	5.87
16 Years	2,832	164.69	5.95
17 Years	2,884	165.07	5.78
18 Years	2,418	165.35	5.83



GRAPH 4. *Height of Czech boys from 6 to 18 years.*



GRAPH 5. *Height of Czech girls from 6 to 18 years.*



GRAPH 6. *Height of Czech boys and girls from 6 to 18 years — comparison.*

of the standard deviation at the 6th year of age to +0.55 in 9 years, to +0.85 in 12 years and to +0.9 in 16 years. In subsequent years both curves again approach each other moderately up to +0.6 of the standard deviation in 18 years. The mean height of boys at 6 years of age is about 117 cm, at 12 years 150 cm, at 16 years 175 and at 18 years 178 cm.

The curve of the mean height of girls does not show any pre-pubertal retardation, presenting otherwise similar course in relation to the 1951 curve as that of the boys. Gradual increase of the difference may be, however, followed up between the years 1951 and 1981 namely up to 14 years from +0.6 of the *SD* at 9 years to +0.7 at 12 years and to +0.9 at 14 years. Thereupon both curves approach each other again, the difference of the SD being +0.7 at 16 years and +0.6 in 18 years of age. In girls the mean height at 6 years is less than 117 cm, at 12 years 153 cm reaching about 165 cm at 16 till 18 years.

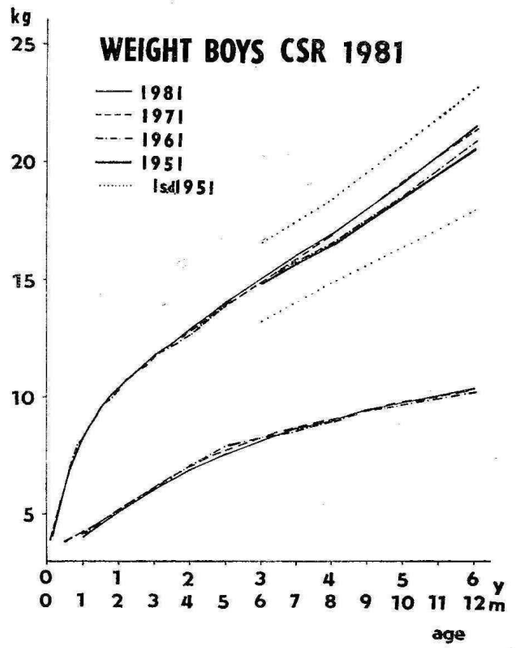
In comparison with Matiegka's results from the year 1895 (6) the mean height of Czech boys increased up to the year 1981 at 6 years of age by about 10 cm, at 12 years by about 14 cm and at 14 years by about as much as 18 cm. This means that present-day boys have reached the same height by about 2 to 2.75 years earlier than 86 years ago. In girls the difference in height between 6 and 14 years of their age is 12—16 cm. This means that present-day girls attain the same mean height by about 2 to 3 years earlier than girls in the year 1895.

The curve of girls intersects the boys'curve at 11 years and then at less than 13 years. At that age period the girls' height surpasses in average that of boys.

Weight of boys and girls from 0 to 6 years (Graphs Nrs 7, 8 and 9)

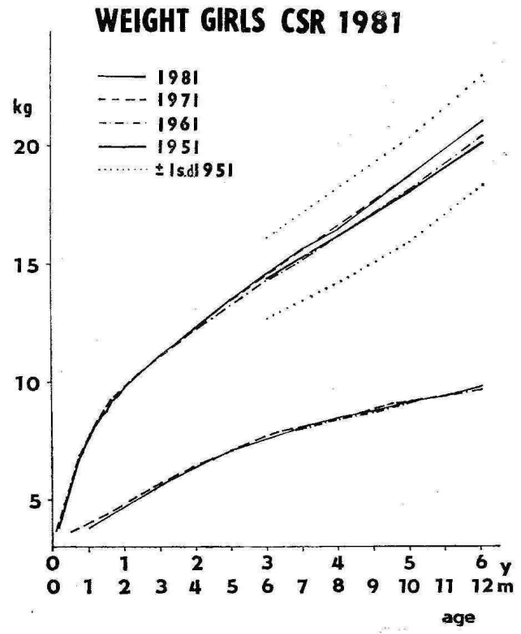
The weight curve of boys from 0 to 6 years shows a rapidly increasing trend to the point of inflection at about the 9th month of their life. From the 18th month on the course of the curve remains almost linear with moderate increase up to 6 years. In girls the point of inflection is to be found at about 7 years. Up to 3 years of their age the curves of research results obtained in 1961 and 1971 practically do not deviate from those of the year 1981. From 2 to 3 years the results from the year 1981 and 1971 are higher than those found in 1961 and from 3 years on their discrepancy is steadily growing in both sexes, with final difference of about 0.6 kg as compared with the year 1961 and 1 kg with 1951.

From the age of 3 years it is possible to compare the results with those from the year 1951; at the age of 3 years and even at the age of 4 and 5 years they



GRAPH 7. *Weight of Czech boys from 0 to 6 years.*

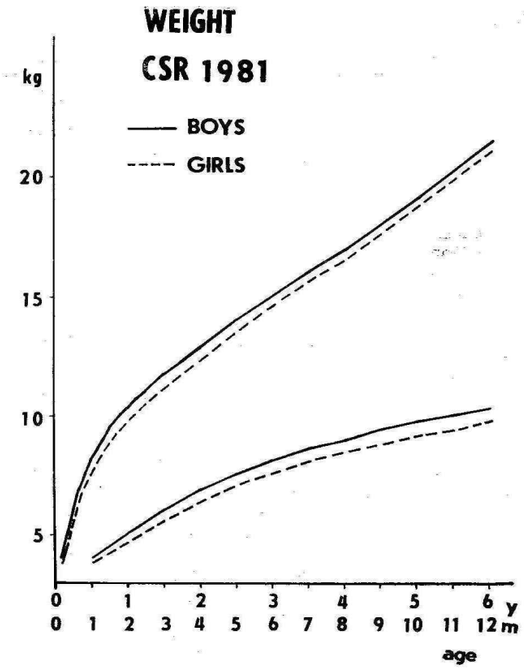
practically coincide with those of the year 1961. At the age of 6 years only the corresponding data from the year 1961 are higher by about +0.2 of *SD*.



GRAPH 8. *Weight of Czech girls from 0 to 6 years.*

TABLE 3. *Weight of Czech Boys*

Age	*N*	*M*	*S.D.*
1 Month	730	4.14	0.64
2 Months	579	5.19	0.76
3 Months	605	6.14	0.86
4 Months	583	6.98	0.82
5 Months	612	7.66	0.88
6 Months	574	8.22	0.92
7 Months	597	8.72	0.91
8 Months	612	9.05	1.00
9 Months	555	9.52	1.09
10 Months	578	9.84	1.06
11 Months	545	10.16	1.17
1 Year	1,661	10.42	1.26
1.25 Years	1,844	11.11	1.22
1.50 Years	1,784	11.82	1.35
1.75 Years	1,688	12.34	1.41
2 Years	2,770	12.90	1.49
2.50 Years	2,531	14.02	1.60
3 Years	2,214	15.04	1.73
3.50 Years	2,441	16.14	1.89
4 Years	3,972	17.02	2.07
5 Years	2,885	19.21	2.45
6 Years	2,334	21.64	3.15
7 Years	2,349	24.09	3.64
8 Years	2,351	27.07	4.40
9 Years	2,341	30.23	5.36
10 Years	2,257	33.65	6.19
11 Years	2,225	37.23	7.13
12 Years	2,289	41.09	7.89
13 Years	2,435	46.79	9.57
14 Years	2,243	52.71	10.14
15 Years	2,301	58.96	9.59
16 Years	2,543	63.97	9.33
17 Years	2,413	67.29	8.98
18 Years	2,006	69.74	8.48



GRAPH 9. *Weight of Czech boys and girls from 0 to 6 years — comparison.*

Weight of boys and girls in the 6 to 18 years age bracket (Graphs Nrs. 10, 11 and 12)

The course of the weight curve of boys shows a concave form from 6 up to 15 years of their age with inflection point at 12 years and subsequent steeper course of the curve. A retardation of increments takes place after the age of 16. From 6 years on the weight is increasing from about 21.5 kg to 41 kg at 12 years and roughly to 70 kg at 18 years. As compared with the year 1951 the values from the year 1981 are at the age of 6 years higher by about +0.3 kg of *SD*, at 8 years by +0.5, at 10 years by +0.6 and at 11,16 and 18 years by +0.7 of the *SD*.

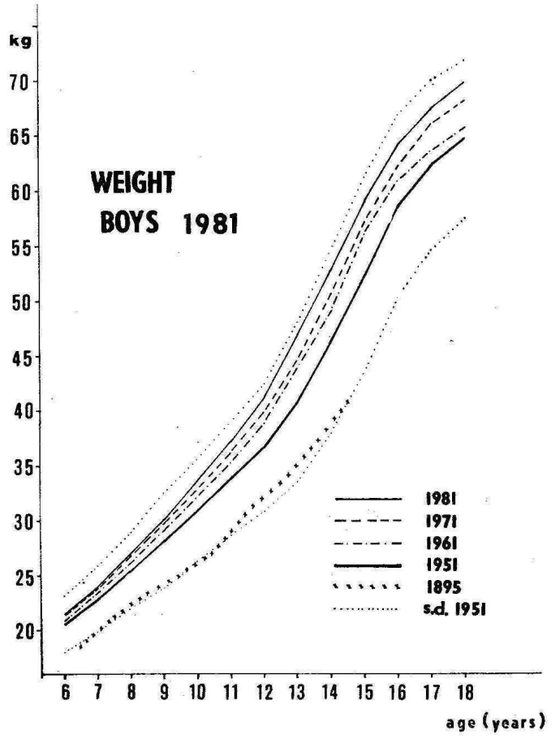
The weight curve of girls from 6 to 18 years presents a concave course up to 13 years, from 14 years on a retardation of increments takes place up to 17 years without practically any change in the mean values up to 18 years.

At 6 years of age the mean weight is about 21 kg, at 12 years 43 kg and at 18 years about 59 kg. Up to 11 years the weight from the year 1981 is in substance conformable to that from the year 1971, being up to 18 years a little higher only with maximum difference of about 1 kg at 13 years. As compared with the year 1951 the difference at the age of 6 years is roughly 1 kg, at 12 and 13 years over 4 kg. At the age of 18 years the weight from the year 1981 is in average lower than it was in the year 1951 by about 0.3 kg.

Since the end of the last century (1895) the mean weight of 6 year-old boys has increased by 4 kg, at 11 years by 8 kg, at 14 years by 15 kg. This difference

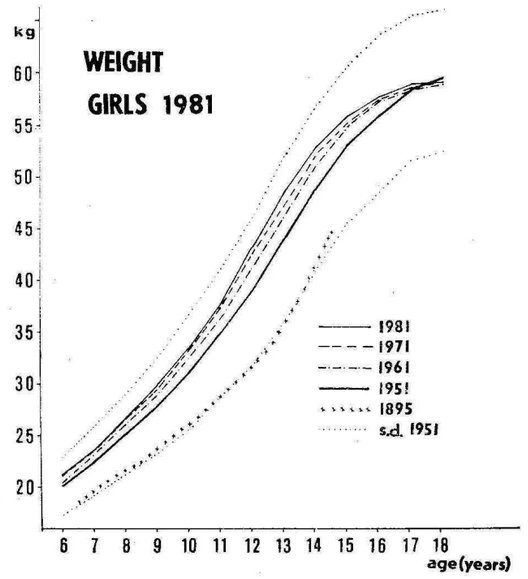
TABLE 4. *Weight of Czech Girls*

Age	N	M	S.D.
1 Months	724	3.84	0.54
2 Months	563	4.73	0.64
3 Months	624	5.59	0.70
4 Months	567	6.40	0.77
5 Months	600	7.11	0.85
6 Months	609	7.60	0.85
7 Months	567	8.08	0.87
8 Months	616	8.47	0.97
9 Months	531	8.83	1.08
10 Months	600	9.23	1.05
11 Months	575	9.39	1.11
1 Year	1,668	9.75	1.16
1.25 Years	1,811	10.48	1.19
1.50 Years	1,872	11.11	1.30
1.75 Years	1,712	11.72	1.36
2 Years	2,826	12.27	1.47
2.50 Years	2,523	13.47	1.61
3 Years	2,203	14.56	1.76
3.50. Years	2,451	15.58	1.90
4 Years	3,975	16.51	2.16
5 Years	2,876	18.77	2.78
6 Years	2,474	21.15	3.19
7 Years	2,266	23.70	3.81
8 Years	2,437	26.62	4.46
9 Years	2,341	29.85	5.46
10 Years	2,269	33.37	6.35
11 Years	2,280	37.61	7.71
12 Years	2,330	43.23	9.26
13 Years	2,485	48.25	9.21
14 Years	2,233	52.77	8.74
15 Years	2,486	55.87	8.16
16 Years	2,832	57.78	8.33
17 Years	2,884	58.87	7.71
18 Years	2,418	59.08	7.94

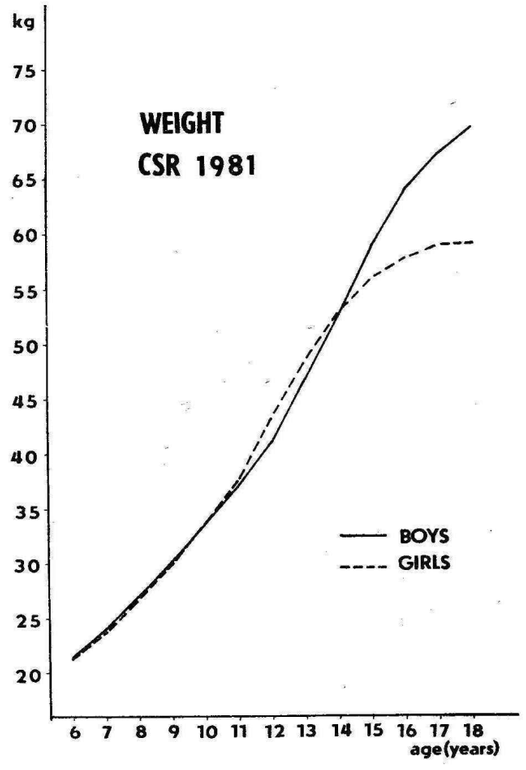


GRAPH 10. *Weight of Czech boys from 6 to 18 years.*

in the weight of boys as expressed in relation to their age is 1.5 till 2.5 years. In girls the difference in comparison with the year 1895 is 4 kg at 6 years, 11 kg at 12 years and about 10 kg at 14 years. Present-day



GRAPH 11. *Weight of Czech girls from 6 to 18 years.*



GRAPH 12. *Weight of Czech boys and girls from 6 to 18 years — comparison.*

girls attain the same average values of weight as compared with those from the year 1895 sooner by 2 till 2.6 years. The weight curve of boys and that of girls cross for the first time at 10 years and for the second time at 14 years, the girls weighing on the average within the above age bracket more than the boys.

DISCUSSION

The aim of this communication is to make available for general use the new standards of body height and weight. An adequate interpretation of changes ascertained in comparison with preceding values revealed by national and foreign researches requires evaluation of a whole series of characters of the family and social environment of the children registered to this purpose. The interpretation of the ascertained changes will be the object of a further phase of research data processing.

However we can state already at the present stage that in comparison with the year 1971 the results of the year 1981 have revealed increments during the whole course of the growth period with the only exception of the earliest age period. Thus it has been confirmed that the acceleration of height development especially in the period of school-going age and adolescence in both sexes of the Czechoslovak youth is persisting.

Increments in the first decade (1951—1961) were expressive in all age groups (in the period of the school age by about +0.3 of the *SD*) those in the second decade (1961—1971) were already lower attaining +0.2 of the *SD* yet during the whole growth period.

On the other hand, increments registered in the third decade of these cross sectional research studies (1971—1981) are not constant, being minimal in the pre-school infants and gradually increasing from the 8th year of age. At the adolescent age the increments registered in the third decade were higher than in the second one.

Similarly the final average height at 18 years has increased in both sexes.

The body weight of boys and girls up to 6 years does not show any impressive changes in the last decade. Increments are noted since about 8 years, differences increasing henceforth in boys up to 18 years, in girls up to 15 years. In girls, the differences are in comparison with the year 1971 lower than those in boys, decreasing after 15 years henceforth so that the average weight of girls at the age of 18 years is the same as in the year 1971 and lower than in the year 1951.

Curves of height and weight are without any adjustment continuous just as in the three foregoing research studies, reflecting thus the regularity of development and the correctness of random sampling and the accuracy of processing.

The collection of curves of height and weight from all four national anthropological researches reveals the dynamics of development of more than one generation in the course of the post-war period characterized by impressive social changes.

In both sexes relatively higher increments of height and weight have been registered, reflecting thus a general trend to growing slim. In girls this trend is much more impressive, especially in the higher age groups. An explanation may be found in more rational approach to nutrition and in an effort to control the body weight.

Already the second research showed in 1961 that the first national standard of height and weight for Czechoslovak youth from the year 1951 ceased to correspond to reality, as fully corroborated later by the results of the research realized in 1971. For this reason results from the year 1981 served as basis to establish a new standard for evaluating the growth development of Czech children. This standard was published in the form of tables and percentile graphs for verification and given at disposal to pediatricians.

SUMMARY

1. The four post-war national anthropological research studies of children and adolescents represent a systematic vetification of growth development for the period covering an entire generation, unique in comparsion with similar attempts made abroad. Their positive results prove with documentary evidence the good care of our society for children and adolescents.

2. The results from the year 1981 show further growth acceleration, a moderate tendency to getting slim more in girls than in boys and are presenting a new growth standard for use in public health and other spheres of national economy as well. The new standard is going to replace the still used standard from the year 1951 that is already out of date.

ACKNOWLEDGEMENT

This research has been coordinated in the State Research Programme by Professor J. Houštěk and L. Pelech. It could be realized thanks to the understanding of the Ministeries of Public Health and Education of the Czech Socialist Republic and thanks to successful cooperation of the pediatritians and

nurses in the selected public health facilities and educationalists in schools of all types as well. Our thanks are due also to the staff of the Computer Centre in Beroun and to further members of the working team with special regard to Z. Roth, J. Vignerová and M. Josífko, specialists of the Centre of Mathematical Statistics and Programming of the Institute of Hygiene and Epidemilogy, Prague.

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