

NEW ASPECTS OF THE SECULAR TREND IN JENA SCHOOLCHILDREN

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Abstract: Anthropological investigations have been performed on Jena schoolchildren since 1880. On the basis of the last examination – carried out in 1985 – the following statements can be made on the present level and the extend of secular trend: The secular trend continues into the present, if sometimes partially weakened and with differences between the sexes, for Jena schoolchildren. There are varying secular changes of individual body measurements which cause an alteration, if only slight, in body proportions. Increases in average growth rates at any particular time are indicated as a result of the secular trend during school years. Causes of secular trend must be researched now, because an explanation of causal relationships is only possible as long as the acceleration determined changes in growth and development continue.

Key words: Jena Growth Studies; Secular trend.

Anthropological examinations have been performed on Jena schoolchildren at relatively regular intervals since 1880. Thus, we have the longest existing examination series from a single town at our disposal. In the time interval between 1880 and 1985, nine representative investigations (Table 1) have been done (1880, 1921, 1932/33, 1944, 1954/55, 1964, 1975, 1980 and 1985). In most cases, the children were between the ages of 7 and 14 years. The range of the first investigations was usually limited to a few characteristics (stature and body weight were always reported). However, since 1975 the anthropological characteristic programme has been widely expanded; between 30 and 35 metric, morphological as well as physiological parameters are now included.

Table 1. Investigations of schoolchildren in Jena 1880–1985

Year of investigation	Number of probands	Number of anthropological characteristics
1880	1295	2 (+3)
1921	6186	8
1932/33	122 – 323 *	3
	104 – 205 *	
1944	4868	9
	(2259 ♂; 2609 ♀)	
1954/55	2110	6
	(1022 ♂; 1088 ♀)	
1964	2517	10
	(1269 ♂; 1248 ♀)	
1975	2115	30
	(1062 ♂; 1053 ♀)	
1980	1057	35
	(540 ♂; 517 ♀)	
1985	1621	33
	(829 ♂; 792 ♀)	

* for each semi-annual group

Our investigations have the following principal aims: (1) finding out the age- and sex-specific variability of the metric, morphological and physiological characteristics as well as of indices and proportions; (2) providing up-to-date standard values for our research area; (3) investigating of the effect of the secular trend on the body signs under investigation; (4) clarifying the present situation and dimensions of the secular trend in single signs and body proportions; (5) investigating of the influence of selected social factors on growth and development; (6) demonstrating correlations between the signs; and (7) ascertaining of the variability of the biological age.

Generally speaking the interval between two investigations amounts to 10 years. In this way we also can see short-term changes of growth and development in childhood and youth.

In the following statement we exclusively restrict ourselves to assertions about the effects of the secular trend of selected body signs as well as the description of the present position and dimensions of secular trend in Jena schoolchildren.

Some remarks about the secular trend of height and weight: The absolute mean differences in the body height of schoolboys and -girls between 1880 and 1985 (Table 2) are 15.3 cm and 14.5 cm, respectively. This results in a relative increase in the past 105 years of 11.8% for boys, and 11.2% for girls.

Table 2. Overall differences in body height and body weight in Jena schoolchildren aged between 7 and 14 years (1880–1985)

Age (years)	Boys		Girls	
	Body height (cm)	Body weight (kg)	Body height (cm)	Body weight (kg)
7	12.8	5.3	11.8	4.8
7.5	13.8	6.4	12.5	6.4
8	14.2	6.2	12.6	5.9
8.5	12.2	6.8	12.1	7.0
9	14.2	6.3	12.5	5.8
9.5	15.6	6.9	14.4	7.3
10	14.2	5.6	14.7	7.6
10.5	12.3	7.1	15.0	8.2
11	14.6	8.7	16.9	11.2
11.5	13.3	6.7	14.5	8.5
12	15.9	11.4	16.9	11.5
12.5	16.2	9.2	16.9	12.3
13	18.5	13.6	16.2	13.0
13.5	20.8	16.1	14.4	11.9
14	20.8	17.1	15.7	14.9
Overall differences	15.3	8.9	14.5	9.1

If we calculate the increase per ten years due to acceleration, the mean body height increases 1.5 cm = 1.1% (boys), and 1.4 cm = 1.1% (girls) per decade for schoolchildren aged between 7 and 14 years.

Similar results exist for example for pupils from Belgium, Hungary and Czechoslovakia (Vercauteren and Susanne 1985, Eiben 1987, Procopec 1987, Hajniš et al. 1985).

Table 3. Mean differences in body height (cm) and weight (kg) in Jena schoolchildren aged between 7 and 14 years

Year of investigation	1880–1921	1921–1932	1932–1944	1944–1954	1954–1964	1964–1975	1975–1985
Boys	4.7 cm	3.0 cm	0.6 cm	1.2 cm	1.1 cm	2.8 cm	0.9 cm
	2.2 kg	2.3 kg	-0.7 kg	1.1 kg	0.7 kg	1.9 kg	0.5 kg
Girls	3.9 cm	2.9 cm	-0.6 cm	2.4 cm	1.0 cm	2.7 cm	1.3 cm
	2.6 kg	2.1 kg	-1.3 kg	2.4 kg	0.7 kg	1.0 kg	0.7 kg

The differences of body height between 1880 and 1985 partly reach considerable values. Thus for instance 14-year-old boys of 1985 are 20.8 cm (= 14.5%) taller than the boys of the same age in 1880. It is also striking that the boys of the same age in 1880. It is also striking that the mean value for body height of 14-year-old boys of 1880, which was 143.6 cm, today will be reached in the age between 10.5 and 11 years.

The secular trend in the 105 years under investigation was not regular (Table 3), but there were phases of higher and smaller increases, in some cases there were even decreases of the mean values. Especially accentuated is the war-conditioned stagnation of acceleration in the interval between 1932 and 1944. This reflects (as in all of our investigations) the greater environmental-dependence of growth in female individuals.

Starting from these results we can establish that the secular trend in our research-area is not yet completed, though between 1975 and 1985 in some age-classes we can find (probable) random sample-conditioned decreases of the mean values.

Perhaps at the present time we have approached a point of exhaustion of the given genetic potential of information with the present environmental factors. Under these environmental conditions the secular trend would come to a temporary standstill. Only if decisive developmental-biological changes of the situation of our environment appear, we might see a continuation of acceleration. So it is periodically provable in skeletal material from the past more than 1000 years (compare Wurm, H. 1982; Zellner, K. 1984; Bach, A. 1986 and others).

We have already mentioned that the schoolchildren today reach the values of body height and body weight essentially earlier than the pupils of 1880 (Table 4). This developmental acceleration of the "body height-age" and the "body weight-age" amounts to about 3 years on an average in all age classes. The variation range of this developmental acceleration ranges for single age classes between 2 years and 4 months and 4 years and 2 months for body height and between 1 year and 5 months and 5 years and 4 months for body weight.

We have also examined whether the absolute and relative increases of body dimensions in children aged between 7 and 14 years have changed under the influence of acceleration (Fig. 1 and 2). In this case the semi-annual (and the annual) growth rates must also have changed. Fig. 1 and 2 show that this comes true for example of the absolute and relative differences of body height and body weight. But the differences in the relative increase of the body height of the girls are minimal. However, we can say (looking at the extreme age classes 7 years on the one side and 14 years on the other side) that a slight increase in the mean semi-annual growth rates can be seen in nearly all body dimensions investigated.

Table 4. Acceleration of "Body weight- and Body height-age"

Years	Ø Differences		Acceleration of "Body weight- and Body height-age"	
	♂	♀	♂	♀
1. Body height				
1880 – 1985	15.3 cm	14.5 cm	abt. 3 years 1 month	abt. 2 years 10 months
1964 – 1975	2.8 cm	2.7 cm	abt. – 6 months	abt. – 6 months
1975 – 1985	0.9 cm	1.3 cm	abt. – 2 months	abt. – 3 months
2. Body weight				
1880 – 1985	8.9 kg	9.1 kg	abt. 2 years 10 months	abt. 2 years 8 months
1964 – 1975	1.9 kg	1.0 kg	abt. – 7 months	abt. – 3 months
1975 – 1985	0.5 kg	0.7 kg	abt. – 2 months	abt. – 2 months

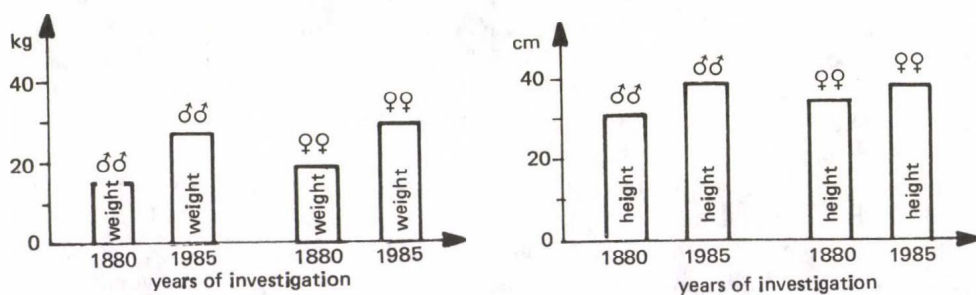


Fig. 1: Mean differences in weight (kg) and height (cm) in Jena schoolchildren aged 7 and 14 years

A different picture arises from considering the increases between the single age classes in 1880 and 1985 (represented as moving averages which smooth the time series; Fig. 3 and 4). On this occasion there exists no homogeneous trend but in most cases in both sexes in 1985 there are greater semi-annual increases than in 1880.

In this analysis it was found (similar to other analyses) that the variation range and also the variability of many morphological and metric characteristics in the female sex is not so extreme as in the male sex.

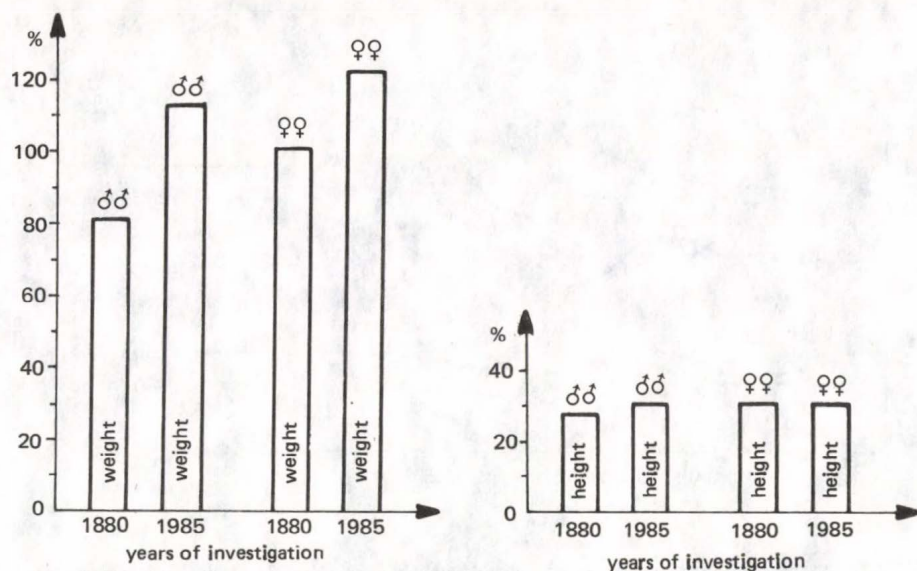


Fig. 2: Mean differences in percent in weight and height in Jena schoolchildren aged 7 and 14 years

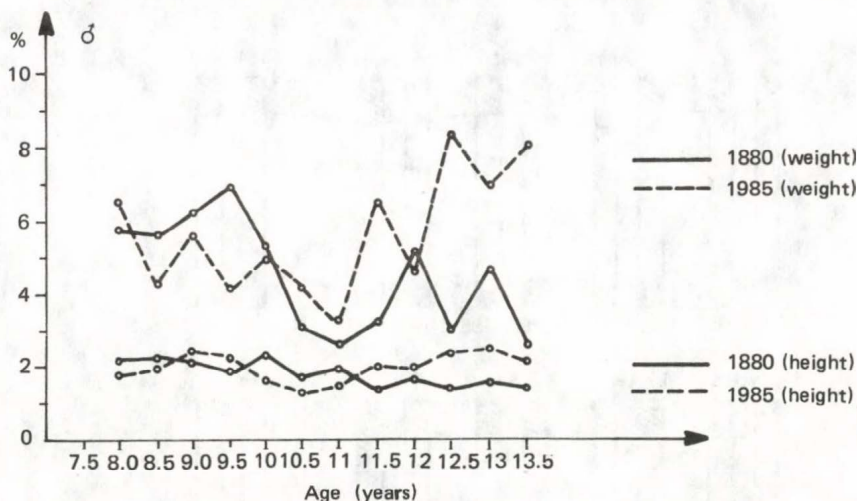


Fig. 3: Moving averages for the increases of weight and height in Jena boys in 1880 and 1985 (in percent per six months)

We also tried to get an impression of the changes of the percentage of given classes of body height and body weight by acceleration (Fig. 5 and 6). Unfortunately this comparison has only been possible since 1975 because we do not have the primary material of the previous investigations. We divided our probands into 3 classes:

- individuals with body dimensions below the -1 SD limit
- individuals with body dimensions above the $+1$ SD limit
- individuals with body dimensions within the ± 1 SD limit.

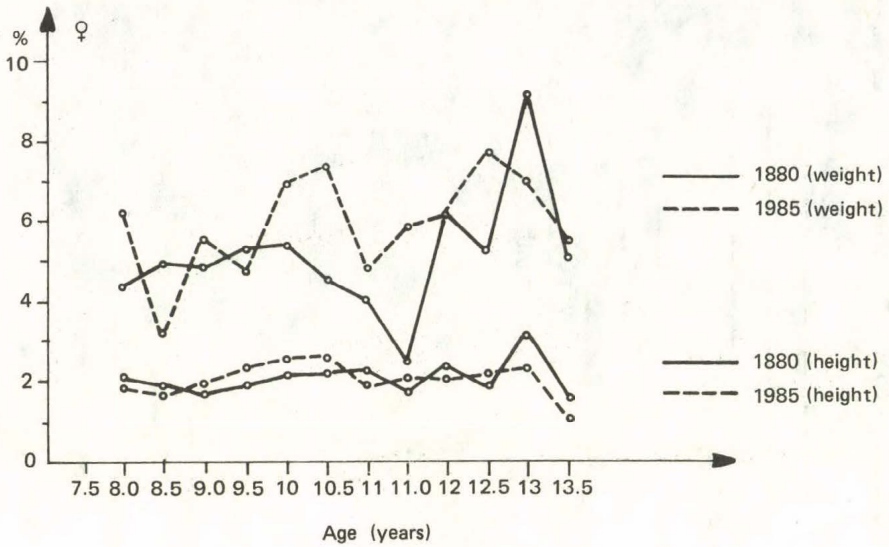


Fig. 4: Moving averages for the increases of weight and height in Jena girls in 1880 and 1985 (in percent per six months)

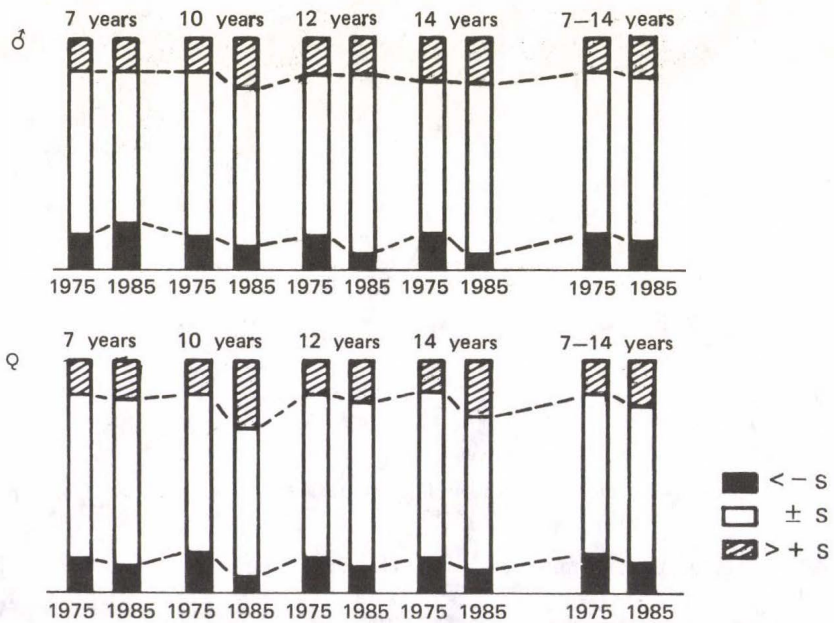


Fig. 5: Classes of body height in Jena schoolchildren in 1975 and 1985

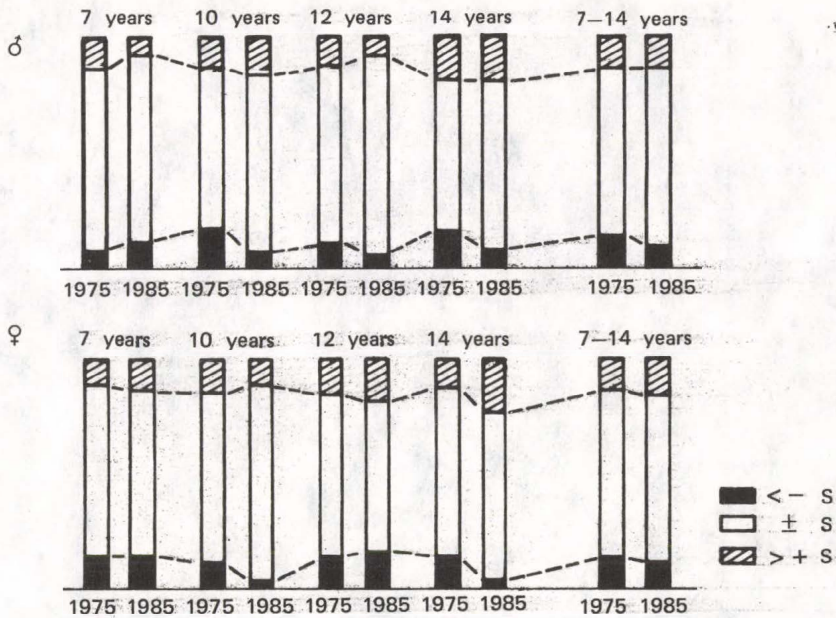


Fig. 6: Classes of body weight in Jena schoolchildren in 1975 and 1985

No homogeneous developmental trend was found but the percentage of the 3 formed classes shows age-dependent variations.

But an analysis of the whole material (7-14 years) suggests that in the 10 years in question the portion of very small and light individuals decreases whereas the percentage of very tall and heavy individuals increases. The number of probands within the ± 1 SD limit is nearly constant (except the body weight of the boys).

Finally we want to make some remarks about the secular trend in choice head measurements, because they reflect very evident changes. With regard to the change in both head diameters and in the resultant head shape the following observations can be made for boys and girls (Fig. 7 and 8 show for example only the results for the male sex). Head length and head breadth have changed between 1944 and 1985 in inverse relation to each other: head length has increased in this time and head breadth has decreased in these four decades.

This inverse relation between head length and head breadth results in a progressive ovalisation of the head, a debrachycephalisation. This debrachycephalisation (Fig. 9, boys) is expressed numerically as a reduction of the average cephalic index by 6.4 units in boys and 6.9 units in girls of all age groups between 1944 and 1985, - a phenomenon which can be also observed in other parts of Europe (Susanne et al. 1988). Debrachycephalisation corresponds with the development of slimmer constitution which can be seen to be a long-term trend in the Jena schoolchildren.

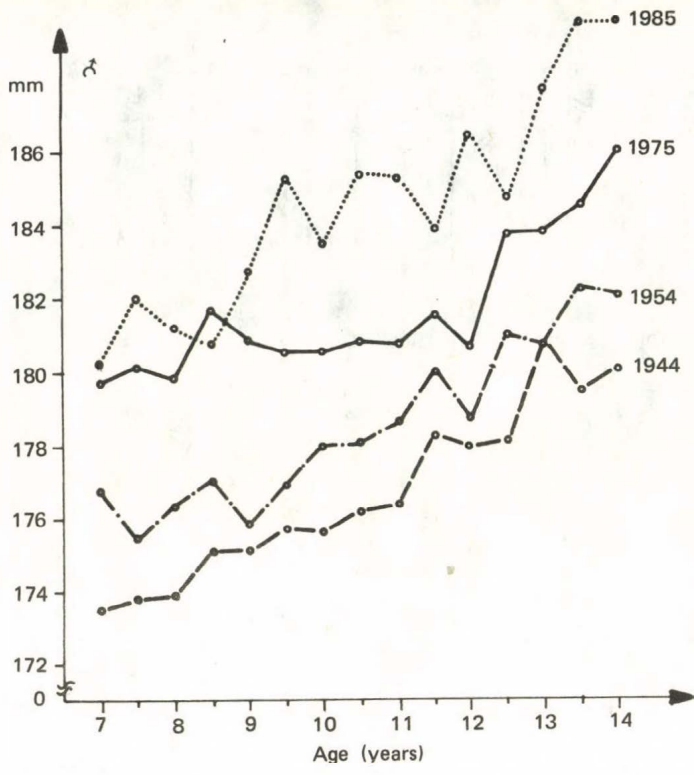


Fig. 7: Changes of the head length in Jena boys at the different investigations between 1944 and 1985

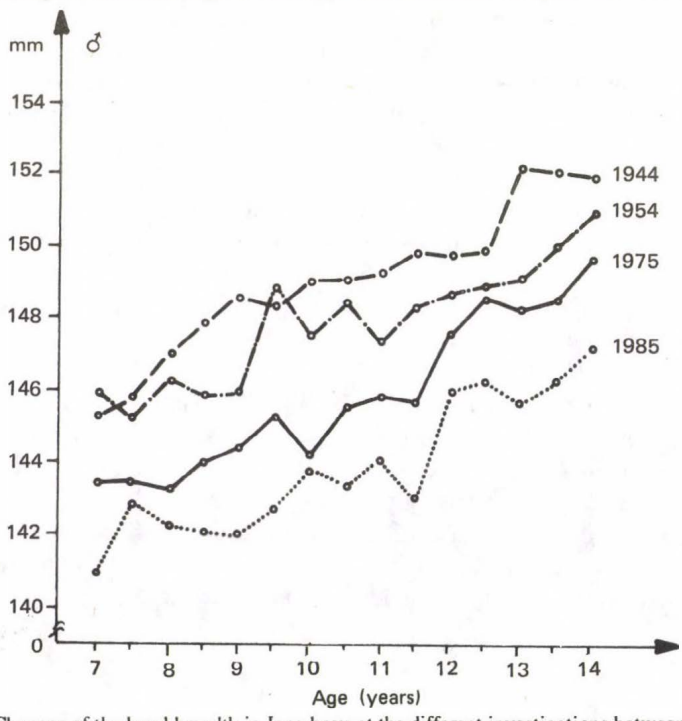


Fig. 8: Changes of the head breadth in Jena boys at the different investigations between 1944 and 1985

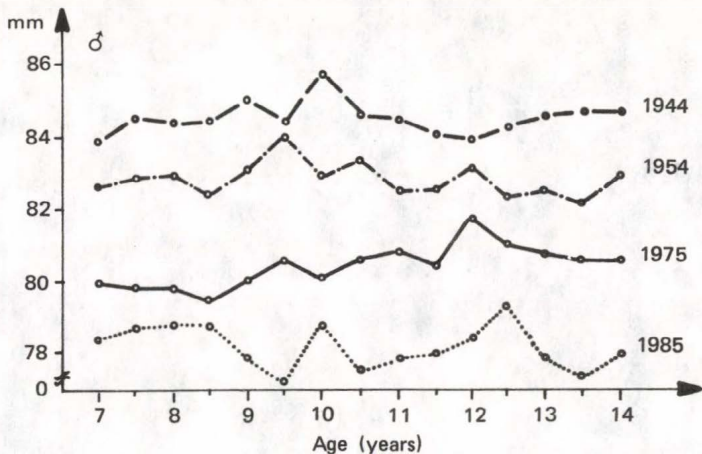


Fig. 9: Changes of cephalic index in Jena boys at the different investigations between 1944 and 1985

Generally the fact that the secular trend influences both body and head measurements again underlines the repeated demand that research into secular trend should be based on a wide range of characteristics of as many parts of the body as possible. This can not only be done by anthropologists but co-operation with other fields is also necessary and important. The secular trend is a complex event, based on a complex causal connection and therefore it should also be investigated in a complex way.

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