

## DEVELOPMENTAL RATE IN DEBRECEN GIRLS FROM THE AGE OF 7 TO 22 YEARS

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*Abstract: 100 girls were randomly selected from those involved in Debrecen Longitudinal Studies. From their developmental data ranging from the age of 7 to 22 years the authors calculated the annual growth of the parameters consecutively measured (height, weight, chest circumference, lean body mass and vital capacity) and determined the average age of peak velocities and the percentage of those developing earlier or later than the average. It was found, that about the half of the sample belong to the middle groups with average age of the peak velocities.*

*Key words: Debrecen Longitudinal Growth Study; Girls 7-22 years of age; Peak velocities of growth and development; Early and late development*

### Introduction

Only the pure longitudinal studies are suitable for determination the real annual growth and development of the children and adolescents. This sort of studies especially which continuously observed the subjects studied to their adulthood, are limited owing to the long-continued researches. In addition to the increase of the anthropometric characteristics, vital capacity is of great importance, which indicates the development of the lung and the respiratory muscles. This points out whether development and physiological function of the lung are accompanied by changes in size or not (Szöllősi, 1982). We reported on the partial results of the Debrecen Growth Study in several papers (Szöllősi – Jókay 1986, 1988). Now our 2nd longitudinal study is in the process of completion. Out of school children born between 1965 and 1968, the girls' longitudinal study was finished at the age of 22. During this long period of time, personal contacts became well-established dropping out of subjects was minimal. Thus, after calculating the usual developmental parameters, determination of the real annual growth as well as the term of the peak velocities of growth and rate of earlier or later developing girls seemed to be reasonable.

### Material and Methods

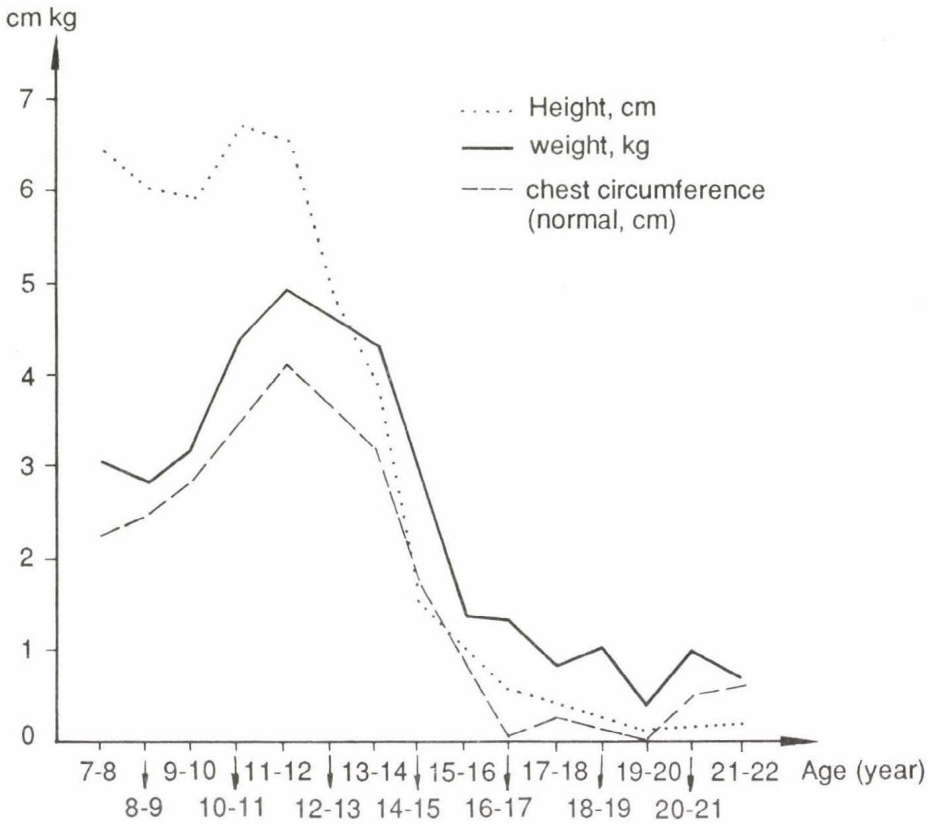
The first step was the random selection of 100 girls from the original sample. Their development was evaluated by means of an American computer program modified by us. The parameters elaborated were as follows: body height, weight, chest circumference in normal position, in maximal inhalation and in maximum expiration, lean body mass and vital capacity.

Data obtained were divided in order of magnitude into 5 groups according to each parameter and age, so, that the middle group should consist of the average value  $\pm$  a half standard deviation. Thus, the average rate and (taking into consideration the extreme groups) the percentual rate of the parameters could be determined with a much lower or higher value than the average. Then, it was found out at which age to which group the

parameters of each girl belong. Based on the above calculations we determined the rate of girls developing later or earlier than the average.

### Results

The average increase of *body height* between 7 and 8 years of age is 6.4 cm with a standard deviation of 1.19 cm. The tempo of growth decreases till the age of 10 and then the peak velocity appears with an average value of 6.7 cm from the age of 10 to 11, as we mentioned in our earlier paper (Szöllősi 1981a, b, Szöllősi and Jókay 1985). Then, growth rate gradually diminishes again and it does not even reach 1 cm from the age of 15 to 16 and it is 0.1 cm a year at the ages of 19 and 20. Girls' body height increases 0.6 cm altogether from 18 to 22 (*Fig. 1*). The standard deviation of the annual growth gradually increases and reaches its maximum between the ages of 12–14: 2.047 and 2.025 cm, respectively. Thereafter it decreases step by step and after 16 its amount can be measured only in decimals.



*Fig. 1:* The annual increments of height (cm), weight (kg), and chest circumference (normal, cm) in Debrecen girls

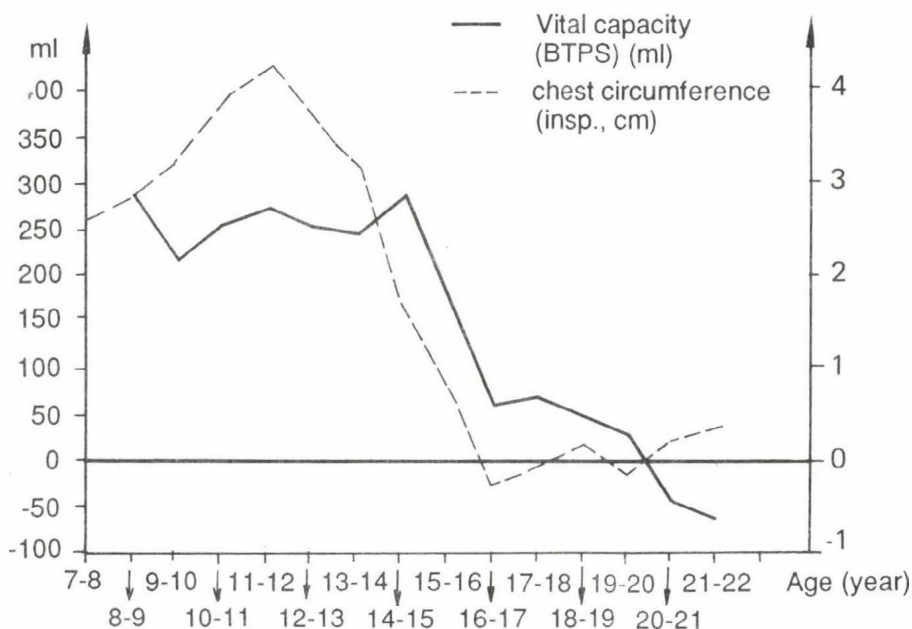


Fig. 2: The annual increments of vital capacity (ml), and chest circumference (maximal inspiration, cm) in Debrecen girls

As far as *body weight* is concerned peak velocity occurs one year later (Szöllősi 1981a, b, Szöllősi and Jókay 1985, 1988): it is almost 5 kgs from the age of 11 to 12, then its rate decreases gradually and it is not as much as 1 kg after 17 year of age.

The increase in *chest circumference* follows that of body weight. The increment in lean body mass is similar, however, while lean body mass constitutes the majority of gain in weight between 12 and 13, the increase in body fat percent will predominate at a later age (Szöllősi and Jókay 1988).

The increase in *vital capacity* varies between 220 and 290 mls between the ages of 8 and 15, then its rate gradually decreases, its increase, however, continues till the age of 20. From this age onward we get negative values only. It is a well-know fact that the vital capacity of grown-ups decreases parallel with age. Earlier this phenomenon was observed to begin at the age of 16 (Anthony and Venrath 1962), it seems to start somewhat later in the generation growing up now (Fig. 2).

The standard deviations of the weight, chest circumferences and vital capacity reach the highest degree between the ages of 14–16 (weight: 2.793 and 2.890 kg, chest circumference in normal position: 2.552 and 2.832 cm, VC: 0.331 and 0.301 lit.). The highest standard deviation are caused by rate of individual increment that is more variable in puberty.

The classification of the individual annual growth parameters according to the order of magnitude suggest that there are cases where annual increase cannot be measured. There is even a reduction of body weight which is accompanied by that of chest circumference and lean body mass, too. This can be observed especially in patients

inclined to getting fat. Similar values can be obtained concerning body height if there is no change or, if there is some, but within the limit of measurement error.

If this was the fact, the first group consisted of these cases. Such values were found in the case of body height from the age of 13 (*Table 1*). While the rate of non-growing girls was 1 to 8% from the age of 13 to 15, their rate gradually increased up to 26–27% after 15. The rate was about 50%, varying between 29 and 53%, in the middle group, with  $\bar{x} \pm$  a half SD. Group 5 comprises girls with an extremely high growth rate. Their rate varied between 1–12%.

*Table 1. The percentual rate of stature's growth velocity in the Debrecen girls in the middle ( $\bar{x} \pm 0.5$  SD) and the extreme groups*

Group:	1.	3.	5.
Age (years)	percentage		
13 – 14	1	32	9
14 – 15	8	49	3
15 – 16	11	53	1
16 – 17	17	29	1
17 – 18	19	37	12
18 – 19	26	41	10
19 – 20	21	47	6
20 – 21	27	53	2
21 – 22	26	48	9

As we have already mentioned it is a common phenomenon in girls that there is a year when their body weight does not grow or it even decreases. After the age of 15 this rate increases from the earlier 1 to 11% to 17 to 38%. The rate of girls belonging to the middle group is about 50% varying between 37 to 61%. An extreme gain in weight was observed at a rate of 2 to 13% (*Table 2*).

*Table 2. The percentual rate of gain of weight in the Debrecen girls in the middle ( $\bar{x} \pm 0.5$  SD) and the extreme groups*

Group:	1.	3.	5.
Age (years)	percentage		
7 – 8	7	51	9
8 – 9	5	55	7
9 – 10	3	50	8
10 – 11	2	43	5
11 – 12	1	61	4
12 – 13	2	40	9
13 – 14	2	45	5
14 – 15	11	40	7
15 – 16	22	47	3
16 – 17	17	37	5
17 – 18	26	49	6
18 – 19	26	53	2
19 – 20	38	37	5
20 – 21	23	52	5
21 – 22	26	48	13

The annual increase in chest circumference and LBM gave practically similar results. As far as vital capacity is concerned the rate of slowly developing girls was 4 to 10% till the age of 8 to 14, then it gradually increased to 19–52%. In the middle group the rate varied between 28 to 48%, and was 1 to 9% in the group with an extremely high annual increase (Tables 3, 4, and 5).

**Table 3. The percentual rate of increase of chest circumference in the Debrecen girls in the middle ( $\bar{x} \pm 0.5$  SD) and the extreme groups**

Group:	1.	3.	5.
Age (years)	percentage		
7–8	1	37	7
8–9	1	45	5
9–10	2	50	2
10–11	1	45	4
11–12	8	43	6
12–13	3	40	2
13–14	3	52	4
14–15	19	39	7
15–16	29	44	2
16–17	23	43	7
17–18	33	39	4
18–19	31	32	19
19–20	33	37	6
20–21	20	64	3
21–22	22	56	13

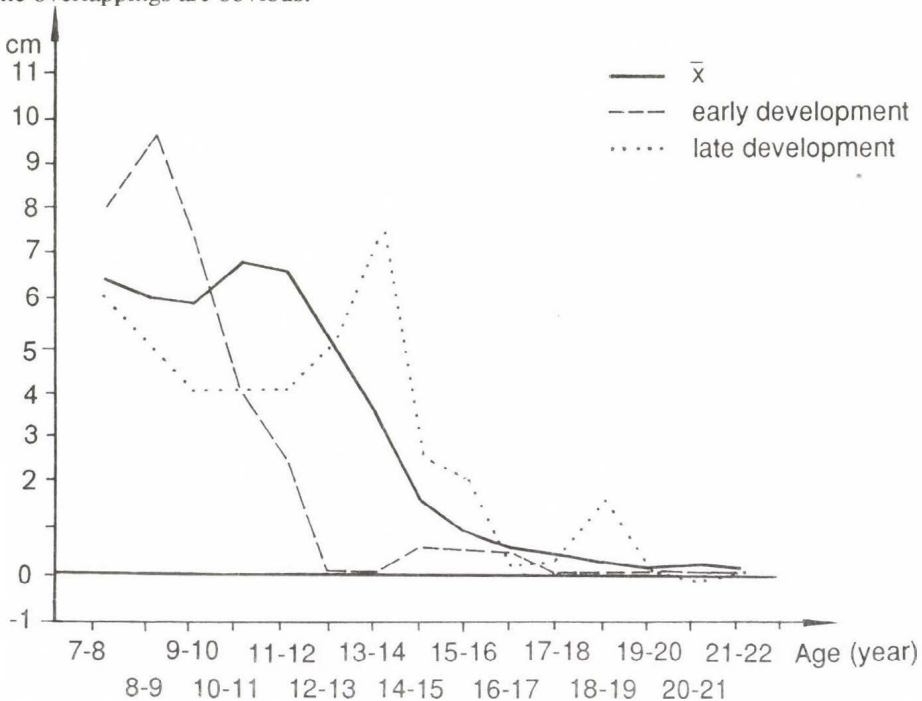
**Table 4. The percentual rate of increment of LBM in the Debrecen girls in the middle ( $\bar{x} \pm 0.5$  SD) and the extreme groups**

Group:	1.	3.	5.
Age (years)	percentage		
10–11	17	50	33
11–12	17	50	33
12–13	–	34	13
13–14	4	46	3
14–15	21	41	5
15–16	30	39	3
16–17	29	43	5
17–18	32	40	12
18–19	28	50	2
19–20	27	52	3
20–21	28	52	3
21–22	30	44	9

**Table 5. The percentual rate of increment of vital capacity in the Debrecen girls in the middle ( $\bar{x} \pm 0.5$  SD) and the extreme groups**

Group:	1.	3.	5.
Age (years)	percentage		
8 – 9	5	38	9
9 – 10	4	28	5
10 – 11	4	49	6
11 – 12	6	44	3
12 – 13	9	46	5
13 – 14	10	52	4
14 – 15	19	39	7
15 – 16	22	50	5
16 – 17	27	45	1
17 – 18	22	53	4
18 – 19	23	53	6
19 – 20	23	48	1
20 – 21	20	48	2
21 – 22	48	48	4

Evaluating individual worksheets we observed in the case of some girls that growth – especially in body height – stopped entirely following peak velocity and then it started again at a low rate. This phenomenon cannot be observed in the average values because it is covered by the values of girls with an earlier and later development, respectively. This is demonstrated on *figure 3*, where the average annual growth of body height is illustrated compared with the velocity curves of an earlier and a later developing girl. The overlappings are obvious.



*Fig. 3: Velocity curves of stature in early, middle, and late development in Debrecen girls*

Furtheron, is it conspicuous that peak velocity occurs at the time corresponding to mean age only in 43% of girls, while it occurs at a later date in 34% of them and at an earlier date in 23% of them. The time span is 1 year in some of them, however, it can last as long as 2 years.

On evaluating the individual worksheets it was also found that development finished at the age of 18 in some girls, however, it could be over at the age of 22 in others. The rate of these data and their further detailed evaluation is in progress.

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## References

- Anthony AJ, Venrath H (1962) *Funktionsprüfung der Atmung*. (2. Aufl.) — J. A. Barth, Leipzig.
- Szöllősi E (1981a) Growth and development of pupils in Debrecen, based on semilongitudinal observation from their age of 7 to 18 Years. — *EUSUHM Congress on Prevention and Health Care throughout Childhood and Adolescence*. — Amsterdam; 62—64.
- Szöllősi E (1981b) Velocity Curves of Pupils' Growth in 7—18 of Age. — *Collegium Antropol.* (Zagreb) Suppl. to Vol. 5; 137—140.
- Szöllősi E (1982) Relations between the Childrens' Body Development and Their Vital Capacity — III. *International Congress of Auxology*. — Abstracts No. 029. Brussels.
- Szöllősi E, Jókay M (1985) Posters Presented at the Symposium of the EUSUHM, 9th — 11th July, Budapest
- Szöllősi E, Jókay M (1986) Growth and Development of Pupils in Debrecen (East Hungary) Based on Cross-sectional and Longitudinal Studies. : *Anthrop. Közl.*, 30; 169—175.
- Szöllősi E, Jókay M (1988) Body Sizes and Functional Characteristics of Adolescents in Debrecen, Hungary. — *Int. J. Adol. Med. Hlth.*, 3; 239—257.

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