# ON THE PUBERTY OF GIRLS IN SZEGED, HUNGARY

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**Abstract**

The physical development of 6–18 years old children of Szeged (Southern Hungary) was recorded with sampling in 1958/59, in 1961 and in 1966/67. In the spring of 1981, as a continuation of this work, the authors collected data concerning the puberty of schoolgirls aged 10–14 of the town, which has a population of about 200.000 inhabitants. Their experiences about the physical development of 1099 schoolgirls are summarized in this study. Their present results were compared with previous samplings. The samples ensue on single samplings each. It has been found, that in the case of girls, with the same age-groups, the arithmetic mean of body height and body weight, has increased in every sample in comparison to the preceding samples. The mean of the normal circumference of chest has decreased in the latest sample, and the median of the menarche has also decreased in every sample. Relying upon these findings, it is supposed, that the course of the secular trend continues even now, in girls of Szeged.

The authors point out, that there is not a definite body height or body weight deciding the physiological maturity. They are planning to examine about 20.000 pupils in the frame of the research work, which has been started in 1981.

## Introduction

It is obvious that the adolescence is one of the most problematical, but at the same time, one of the most beautiful period of human life. Learning about this topic is equally the task of the research workers, educators and parents. Fortunately we can consider this question from each aspect. On the present occasion, we should like to publish the results of an anthropological examination on female pupils of a Southern Hungarian city, mainly from the aspect of the research worker.

In Szeged up to the present four examinations were carried out; in 1958/59, in 1961, in 1966/67 and in spring of 1981, to state the varieties of boys and girls according to age-groups. We have reported about our previous samplings in numerous publications (FARKAS, 1961; 1962; 1963; 1964; 1966; 1967; 1969; 1970; 1972), mentioning about the establisment of the time of menarche, besides the growth examinations. Recently we have continued the research of menarche and examined relationships between the age of puberty and the natural and social factors. About this has also been reported in several articles of scientific periodicals (FARKAS, 1979; 1980).

*Table 1.* The parameters of body height of 11 to 14.5 years old girls in Szeged.—1981

| Menstruated | | | | Age (years) | Not menstruated | | | | Together | | | | Age (years) | $\bar{X}-\bar{x}_1$ | $\bar{X}-\bar{x}_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $n_1$ | $\bar{x}_1$ | $s_1$ | w | | $n_2$ | $\bar{x}_2$ | $s_2$ | w | $n_1+n_2$ | $\bar{X}$ | s | w | | | |
| 9 | 149.34 | 8.80 | 132.0–161.6 | 11 | 146 | 144.02 | 6.70 | 128.2–159.8 | 155 | 144.33 | 6.95 | 128.2–161.6 | 11 | −5.01 | 0.31 |
| 17 | 156.32 | 7.20 | 145.7–169.1 | 11.5 | 136 | 146.70 | 7.11 | 128.9–161.1 | 153 | 147.77 | 7.73 | 128.9–169.1 | 11.5 | −8.55 | 1.07 |
| 54 | 155.23 | 9.88 | 140.1–172.5 | 12 | 107 | 149.01 | 7.46 | 127.8–164.6 | 161 | 151.10 | 8.85 | 127.8–172.5 | 12 | −4.13 | 2.09 |
| 58 | 157.33 | 5.23 | 144.6–168.7 | 12.5 | 92 | 151.13 | 6.30 | 134.9–165.0 | 150 | 153.53 | 6.64 | 134.9–168.7 | 12.5 | −3.80 | 2.40 |
| 97 | 158.52 | 6.07 | 143.7–180.1 | 13 | 75 | 154.17 | 6.41 | 141.6–170.1 | 172 | 156.63 | 6.58 | 141.6–180.1 | 13 | −1.89 | 2.46 |
| 108 | 158.53 | 8.08 | 147.9–173.1 | 13.5 | 29 | 154.46 | 9.39 | 126.7–173.3 | 137 | 157.67 | 8.54 | 126.7–173.3 | 13.5 | −0.86 | 3.21 |
| 100 | 160.32 | 5.37 | 148.7–174.2 | 14 | 17 | 158.14 | 6.33 | 147.0–170.2 | 117 | 160.00 | 5.57 | 147.0–174.3 | 14 | −0.32 | 1.86 |
| 50 | 159.26 | 6.42 | 144.5–170.1 | 14.5 | 4 | 157.50 | 6.83 | 152.4–167.5 | 54 | 159.13 | 6.47 | 144.5–170.1 | 14.5 | −0.13 | 1.63 |
| 493 | | | | | 606 | | | | 1099 | | | | | | |

*Table 2.* The parameters of the body weight of the 11 to 14.5 years old girls in Szeged. — 1981

| Menstruated | | | | Age (years) | Not menstruated | | | | Together | | | | Age (years) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $n_1$ | $\bar{x}_1$ | $s_1$ | w | | $n_2$ | $\bar{x}_2$ | $s_2$ | w | $n_1+n_2$ | $\bar{X}$ | s | w | | $\bar{X}-\bar{x}_1$ | $\bar{X}-\bar{x}_2$ |
| 9 | 44.44 | 12.01 | 35.7–68.5 | 11 | 146 | 37.10 | 9.41 | 23.1–82.9 | 155 | 37.53 | 9.82 | 23.1–82.9 | 11 | −8.91 | 0.43 |
| 17 | 45.47 | 6.91 | 37.2–63.0 | 11.5 | 136 | 37.57 | 8.44 | 23.7–70.7 | 153 | 38.45 | 8.64 | 23.7–70.7 | 11.5 | −7.02 | 0.88 |
| 54 | 49.23 | 9.25 | 31.2–68.9 | 12 | 107 | 39.45 | 7.79 | 28.2–63.3 | 161 | 42.73 | 9.50 | 28.2–68.9 | 12 | −6.50 | 3.28 |
| 58 | 49.43 | 8.75 | 36.8–84.8 | 12.5 | 92 | 41.50 | 8.43 | 24.3–66.9 | 150 | 44.57 | 9.38 | 24.3–84.8 | 12.5 | −4.86 | 3.07 |
| 97 | 50.93 | 8.68 | 37.7–90.3 | 13 | 75 | 44.16 | 10.19 | 31.9–80.9 | 172 | 47.98 | 9.95 | 31.9–90.3 | 13 | −2.95 | 3.82 |
| 108 | 50.06 | 9.79 | 34.0–81.0 | 13.5 | 29 | 43.86 | 11.30 | 39.5–87.2 | 137 | 48.75 | 10.43 | 34.0–87.2 | 13.5 | −1.31 | 4.89 |
| 100 | 51.62 | 8.74 | 40.0–84.7 | 14 | 17 | 50.43 | 7.52 | 40.0–67.9 | 117 | 51.45 | 8.58 | 40.0–67.9 | 14 | −0.17 | 1.02 |
| 50 | 53.00 | 10.67 | 40.0–88.9 | 14.5 | 4 | 43.33 | 8.50 | 31.8–52.2 | 54 | 52.28 | 10.82 | 31.8–88.9 | 14.5 | −0.72 | 8.95 |
| 493 | | | | | 606 | | | | 1099 | | | | | | |

*Table 3.* The parameters of normal chest circumference of 11 to 14.5 years old girls in Szeged. — 1981

| Menstruated | | | | Age (years) | Not menstruated | | | | Together | | | | Age (years) | $\bar{X}-\bar{x}_1$ | $\bar{X}-\bar{x}_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $n_1$ | $\bar{x}_1$ | $s_1$ | w | | $n_2$ | $\bar{x}_2$ | $s_2$ | w | $n_1+n_2$ | $\bar{X}$ | s | w | | | |
| 9 | 74.11 | 9.84 | 64–95 | 11 | 146 | 68.68 | 8.42 | 56–103 | 155 | 69.00 | 8.60 | 56–103 | 11 | −5.11 | 0.32 |
| 17 | 74.35 | 5.06 | 62–85 | 11.5 | 136 | 68.65 | 7.49 | 56–94 | 153 | 69.28 | 7.48 | 56–94 | 11.5 | −5.07 | 0.63 |
| 54 | 79.20 | 7.16 | 63–95 | 12 | 107 | 70.63 | 6.55 | 59–93 | 161 | 73.50 | 7.88 | 59–95 | 12 | −5.70 | 2.87 |
| 58 | 79.34 | 6.88 | 68–99 | 12.5 | 92 | 72.71 | 7.30 | 57–101 | 150 | 75.25 | 7.84 | 57–101 | 12.5 | −4.09 | 2.54 |
| 97 | 80.75 | 7.36 | 69–108 | 13 | 75 | 74.31 | 8.42 | 63–102 | 172 | 77.94 | 8.46 | 63–108 | 13 | −2.81 | 3.63 |
| 108 | 79.52 | 8.80 | 61–107 | 13.5 | 29 | 74.72 | 8.86 | 63–106 | 137 | 78.50 | 9.02 | 61–107 | 13.5 | −1.02 | 3.78 |
| 100 | 80.98 | 7.00 | 67–105 | 14 | 17 | 79.94 | 6.39 | 71–93 | 117 | 80.83 | 6.92 | 67–105 | 14 | −0.15 | 0.89 |
| 50 | 82.58 | 8.89 | 69–111 | 14.5 | 4 | 69.25 | 9.18 | 59–80 | 54 | 81.59 | 9.57 | 59–111 | 14.5 | −0.99 | 12.34 |
| 492 | | | | | 606 | | | | 1099 | | | | | | |

*Table 4.* The parameters of bicristal breadth of 11 to 14.5 years old girls in Szeged. — 1981

| Menstruated | | | | Age (years) | Not menstruated | | | | Together | | | | Age (years) | $\bar{X}-\bar{x}_1$ | $\bar{X}-\bar{x}_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $n_1$ | $\bar{x}_1$ | $s_1$ | w | | $n_2$ | $\bar{x}_2$ | $s_2$ | w | $n_1+n_2$ | $\bar{X}$ | s | w | | | |
| 9 | 24.24 | 3.00 | 21.6–31.2 | 11 | 146 | 22.77 | 2.08 | 18.0–31.2 | 155 | 22.85 | 2.17 | 18,0–31.2 | 11 | −1.39 | 0.08 |
| 17 | 25.08 | 1.40 | 22.8–27.7 | 11.5 | 136 | 22.97 | 1.93 | 18.2–29.5 | 153 | 23.20 | 1.99 | 18.2–29.5 | 11.5 | −1.88 | 0.23 |
| 54 | 25.32 | 2.00 | 21.3–30.0 | 12 | 107 | 23.51 | 1.75 | 19.2–27.6 | 161 | 24.12 | 2.02 | 19.2–30.0 | 12 | −1.20 | 0.61 |
| 58 | 25.69 | 1.55 | 22.6–28.8 | 12.5 | 92 | 23.92 | 1.90 | 18.8–29.8 | 150 | 24.60 | 1.96 | 18.8–29.8 | 12.5 | −1.09 | 0.68 |
| 97 | 25.96 | 1.68 | 22.7–32.4 | 13 | 75 | 24.76 | 1.95 | 21.8–30.0 | 172 | 25.44 | 1.89 | 21.8–32.4 | 13 | −0.52 | 0.68 |
| 108 | 25.72 | 1.67 | 21.9–30.5 | 13.5 | 29 | 24.66 | 2.38 | 19.1–33.0 | 137 | 25.50 | 1.89 | 19.1–33.0 | 13.5 | −0.22 | 0.84 |
| 100 | 25.95 | 1.80 | 20.0–32.0 | 14 | 17 | 25.64 | 1.55 | 24.0–28.3 | 117 | 25.90 | 1.76 | 20.0–32.0 | 14 | −0.01 | 0.26 |
| 50 | 26.71 | 2.59 | 21.1–36.7 | 14.5 | 4 | 24.40 | 2.40 | 21.3–27.10 | 54 | 26.54 | 2.65 | 21.1–36.7 | 14.5 | −0.17 | 2.14 |
| 493 | | | | | 606 | | | | 1099 | | | | | | |

## Materials and Methods

Latest researches made the authors project to collect data of 20 thousand girls. This work started in February 1981 in Szeged. Untill now we managed to collect the samples of about 3500 adolescent girls, whose age-groups range from 11 to 14.5 years. The research aims an examination into the agents, influencing the appearance of menarche. According to this questions were raised about the family circumstances (e.g. the number of siblings), parents (e.g. their occupation, educational level), and the date of the menarche of the girls. Altogether 34 different informations were collected this way partly from the parents and partly from the pupils. Within the frames of this work has been performed the measuring of body height, body weight, the normal circumference of chest and the bicristal breadth. Due to shortage of both material and personal conditions, we could not establish the similar body measurements of boys, however it should also be necessary, thus we can report here only on our observations dealing with girls alone.

At present, the four body measurements are analyzed in case of 1099 girls of 11 to 14.5 years. The most important parameters are stated (arithmetic mean, standard deviation, range in groups of menstruating and not menstruating girls separately as well as of all girls together (Tables 1–4).

## Results

In every age-group was observed that in case of all the four groups, the mean values of the girls, already menstruating, were higher than those of not menstruating (Tables 1–4). Experiments, like this are mentioned by other authors as well (CSÓKA–PHILIPPNÉ JUNG and EIBEN, 1981) in case of Hungarian girls. It is generally mentioned, that the menarche of girls occurs either at reaching a higher arithmetic mean of body weight and stature, or at reaching a certain arithmetic mean of body weight and stature. The works of BODZSÁR (1977), HAMMAR et al. (1972), RICHTER (1973), ROBERTO-GLORIA (1974), WINICK (1975) refer to the first variation. Other authors consider the appearance of menarche to be dependent of 45.8 kg arithmetic mean of body weight, and 153.6 cm arithmetic mean of body height, for Hungarian girls (BORSOS, TAKÁCS and SMID, 1977). HOFMEIER, SCHWIDDER and MÜLLER (1964) connect the menarche with achieving a certain physical development. In Marshall's opinion the menarche appears after achieving a certain height velocity peak.

According to FRISCH (1976) the absolute and relative increase of the adipose tissue can be proved at girls both of early and late maturation. The arithmetic mean of body weight of girls with a median of 14.5 years, was as much as 47.2 kg; but those with 12.4 years showed an arithmetic mean of body weight of 48.7 kg (FRISCH, REVELLE and COOK, 1973). ŠKERLJ, BROŽEK and HUNT (1953) stated, that the median of obese girls was 12.99 years, that of thin ones 13.5 years, whereas of the so-called normaly developed girls was 13.66 years.

So even the thin girls become earlier mature with less body weight, than those who have a higher body weight and are normaly developed physicaly.

KANTERO, WIDHOLM and WIDHOLM (1970) clearly reject the correlation between the stature and the date of appearance of menarche. They mention that the date of the median of menarche diverged at girls whose body weight exceeded, fell behind or neared the arithmetic mean. Girls of lower weight matured later, than those of higher weight. According to our first four tables the data of menstruating girls, namely the arithmetic mean of body weight, the normal circumference of chest, and the bicristal breadth is in every case higher, than at the girls still before menstruation. At the same time, however, it can be stated, that in the case of the body measure-

*Table 5.* The comparison of arithmetic means of body height, body weight and normal chest circumference at 11 to 14.5 years old girls from Szeged

| Age (years) | Body height | | | | Body weight | | | | Normal chest circumference | | | | n | n | n |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I. 1958–59 | II. 1966 | III. 1981 | III.–I. | I. 1958–59 | II. 1966 | III. 1981 | III.–I. | I. 1958–59 | II. 1966 | III.. 1981 | III.—I. | I. 1958–59 | II. 1966 | III. 1981. |
| 11 | 139.4 | 144.0 | 144.3 | 4.9 | 33.9 | 36.6 | 37.5 | 3.6 | 64.3 | 71.1 | 69.0 | 4.7 | 74 | 72 | 155 |
| 11.5 | 141.7 | 146.1 | 147.8 | 7.1 | 35.1 | 38.5 | 38.5 | 3.4 | 65.1 | 72.4 | 69.3 | 4.2 | 87 | 113 | 153 |
| 12 | 145.7 | 148.4 | 151.1 | 5.4 | 38.1 | 40.0 | 42.7 | 4.6 | 67.9 | 74.2 | 73.5 | 5.6 | 75 | 119 | 161 |
| 12.5 | 149.0 | 152.0 | 153.5 | 4.5 | 40.1 | 44.1 | 44.6 | 4.5 | 68.5 | 77.6 | 75.3 | 6.8 | 77 | 112 | 150 |
| 13 | 152.7 | 153.7 | 156.6 | 3.9 | 43.5 | 46.3 | 48.0 | 4.5 | 70.7 | 80.2 | 78.0 | 7.3 | 69 | 120 | 172 |
| 13.5 | 154.3 | 156.2 | 157.7 | 3.4 | 46.0 | 49.0 | 48.8 | 2.8 | 74.4 | 81.2 | 78.5 | 4.1 | 68 | 89 | 137 |
| 14 | 156.9 | 156.1 | 160.0 | 3.1 | 47.6 | 49.8 | 51.5 | 3.9 | 76.1 | 82.1 | 80.8 | 4.7 | 106 | 57 | 117 |
| 14.5 | 157.6 | 156.4 | 159.1 | 1.5 | 49.9 | 51.9 | 52.3 | 2.4 | 78.6 | 84.2 | 81.6 | 3.0 | 146 | 23 | 54 |
| | | | | | | | | | | | | Together: | 702 | 705 | 1099 |

ments of menstruating girls mentioned above, and girls of the similar age-group still not mentruating there is a certain coincidence among the lower values of range. At 13.5 and 14 years old girls, in case of the lower values of the normal circumference of chest, at 13.5, 14 and 14.5 years old girls in case of bicristal breadth, the lower values of range are, in case of menstruating ones lower than at those who are still before the menstruation. In consequence, it is perceivable, that the occurrence of menarche at the girls of the same population cannot be connected exclusively to a definite body weight or stature value as their attainment is related to other factors as well, e.g. race, the level of nutrition, etc. Moreover, only, data derived from longitudinal sampling are worth considering. Finally referring to SCHWENK's note (1965), can be mentioned that the sexual hormones restrain the production of somatotropic hormones. In compliance with it, the menarche heavily depends on the fluctuation of the concentration of oestrogens. We may agree with GRIMM's conception (1966) who claimed that the early-maturing children achieve a higher body development and at the late maturing ones, a so-called leptomorphic tendency of growth can be demonstrated. The estimation of this question requires, certainly, a more detailed analysis in the future. Comparing the arithmetic mean of body height, body weight and normal circumference of chest of all the girls of corresponding age-groups with the similar arithmetic means, from 1958/59 and 1966/67, appears that, the arithmetic mean of 1981 is in every case considerably higher. It occurs only in case of 11.5 years old girls, that the arithmetic means obtained in 1966 and 1981 coincide totally (Table 5). On the contrary according to our experiences at the normal circumference of chest the mean of 1966 is higher than those of 1958/59; on the other hand, the mean values obtained in 1981 did not exceed the results of 1966 either, but they are 1–3 cm below. Considering all these values we must take into consideration that the sample sizes are wery similar (in 1958/59: 702, in 1966: 705 and in 1981: 1099). Therefore the decrease of the mean values of the normal circumference of chest is not connected with the essential difference in sample sizes. The differences cannot be regarded as a methodical error either, as the samplings were carried out by the same person. So, it is indisputable that the process of accelerated growing is in progress even today, as it could be established unambiguously from the comparison of data from 1958/59 and 1966/67, in Szeged. Anyway this was not observed in case of nursery-school children, whose earlier data (FARKAS, IZSÁK and NAGY, 1965) were revised in spring of 1981. The mentioned change of somatic characteristics was followed by the change in the puberty time of girls. While the value of the median of menarche of the girls in Szeged was 13.2 years in 1958/59, 13.02 years in 1961, at the same time it was 12.75 years in 1966/67. The question raises spontaneously, if we can expect a further change of the median size in 1981, too.

In order to establish this, we also performed preliminary evaluation. We have the data of 935 girls, from the age-groups of 11.5–14.5 years, collected with the method of status quo. In 484 cases the menstruation already occured before the date of samplings. The data of observation have been established with a numerical method, applied earlier, which produced a result quite identical with the probit analysis (FARKAS, 1975). Accordingly the menarche age of girls in 1981 in Szeged was 12.72 years, i.e. 0.03 year below the median of an earlier observation. This slight decrease might not indicate a secular trend in the past 15 years; it is, however, a fact that the median didn't shift towards the higher age of life. Our aim is to realize our sampling among the 10 to 18 years age-groups. So conclusions must be drawn very carefully

*Table 6.* The important values of determination of menarche median.

| Age groups x | Total n | The number and the p.c. of menstruated r | % | The probit of p.c. of menstruated P |
|---|---|---|---|---|
| 11.5 | 153 | 17 | 11.1 | 3.78 |
| 12 | 161 | 54 | 33.5 | 4.57 |
| 12.5 | 150 | 58 | 38.7 | 4.71 |
| 13 | 172 | 97 | 56.4 | 5.16 |
| 13.5 | 128 | 108 | 84.4 | 6.01 |
| 14 | 117 | 100 | 85.5 | 6.06 |
| 14.5 | 54 | 50 | 92.6 | 6.45 |
| | 935 | 484 | | |

| The number of series i | Age-groups $x_i$ | Empirical probit $y_i$ | $x_i$ | $x_i y_i$ |
|---|---|---|---|---|
| 1 | 11.5 | 3.78 | 132.25 | 43.47 |
| 2 | 12 | 4.57 | 144.00 | 54.84 |
| 3 | 12.5 | 4.71 | 156.25 | 58.88 |
| 4 | 13 | 5.16 | 169.00 | 67.08 |
| 5 | 13.5 | 6.01 | 182.25 | 81.14 |
| 6 | 14 | 6.06 | 196.00 | 84.84 |
| 7 | 14.5 | 6.45 | 210.25 | 93.53 |
| n=7 | 91 | 36.74 | 1190.00 | 483.78 |

as the majority of our data refers to the 11 to 14.5 years age-groups. Thus alteration of this median value, can be expected. It derives from the above mentioned, that the present paper is only the previous evaluation of a large research work. The data obtained so far allow us, however, to suppose — at least in case of the girls in Szeged — that the process of accelerated growing should not yet be considered as finished; which is shown by the significant differences of the arithmetic mean values of body measurements. This fact after all is self-evident, taking into account that Szeged is the centre of a large oil-field, having attracted numerous workers mostly young people from other areas of the country in the last 10–15 years. Thus the mixing up to the population, as well as the urbanization have accelerated. According to our plans, — it should be added — we want to draw into our investigation all the 10 to 18 years old girls of Szeged. Up to the present, however, we could only examine, in the first place, children who live in the new district of about 35 000 inhabitants, whose conditions differ from those living in other areas of the town.

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