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# ON THE INTERPRETATION OF THE CURVES OF MENARCHE/OIGARCHE

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Abstract: *With respect to the advantages of the widespread computer technique, the authors propose to calculate the percentile values of menarche and oigarche data. They interpret their percentile values based on their "Hungarian National Growth Study" (Eiben — Pantó 1881, 1986, 1987/88), by comparing them with those of other studies. Thereafter they give a transformed formula of the curve's equation which makes possible the obtaining of the same result by a very simple graphical technique.*

Key words: *Menarche/oigarche curves; Percentiles, Corresponding "weight" of the relative rate of the cohort; Hungarian National Growth Study.*

## Introduction

The earliest investigations of girls' puberty were based on the retrospective method. The adult women were asked about the date of their menarche, and the mathematic average of the given ages was calculated. Using the *status quo* method for data-collection, the above-mentioned way is unfeasible. To evaluate data, the regression method of probit analysis was recommended (Weber 1957, Finney 1962) which was elaborated for the investigation of quantifiable effects. This was based on the realization that time can function as a dose. As "an answer" for the increasing doses, i.e. for the effect of advanced time, onset of puberty (menarche/oigarche) in pubertal-aged individuals of the population appears at increasingly larger rates.

In the age of computers, there is no problem to using this method and to calculate not only the median (the 50th percentile value) but all the other percentiles which provide us with some important information about the S-shaped curve.

## Material and Methods

The mathematical process was carried out on the basis of the explicit form of the curve:

$$Y = \frac{100}{1 + e^{-A\,(x + C)}}$$

From the form of the function it can be seen that the numeric value of the constant C gives the value of the median immediatly and the constant A characterizes the hollowness/roundedness of the S-shaped curve (c. f. Burrel et al. 1961).

## Results and Discussion

With the help of the above-given function the authors carried out calculations on several samples. Their percentile values are given in *Table 1.* As it can be seen, not only the median value but also the *percentiles* were determined: One can determine any age belonging to any optional *yes-percent.* The authors recommend for practical purposes the 3rd, 10th, 25th, 50th, 75th, 90th, and 97th percentiles.

*Table 1.* **Menarche median and percentile values of different samples**

| Author / Sample | Percentiles 3 | 10 | 25 | 50 | 75 | 90 | 97 |
|---|---|---|---|---|---|---|---|
| Van Wieringen et al. 1971<br>The Netherlands<br>N = 2079 | 11.17 | 11.86 | 12.52 | 13.33 | 14.11 | 14.72 | 15.38 |
| Eiben 1972<br>Western Hungary<br>N = 15229 | 10.53 | 11.48 | 12.29 | 13.09 | 13.90 | 14.71 | 15.66 |
| Łaska-Mierzejewska et al. 1982<br>Poland<br>Urban (Warsaw) N = 5546 | 10.47 | 11.31 | 12.04 | 12.76 | 13.48 | 14.20 | 15.04 |
| Rural N = 7771 | 10.96 | 11.85 | 12.61 | 13.96 | 14.14 | 14.91 | 15.80 |
| Bodzsár 1991<br>Bakony (Western Hungary)<br>N = 1319 | 10.59 | 11.36 | 12.03 | 12.69 | 13.36 | 14.02 | 14.79 |
| Farkas 1986<br>Southern Hungary<br>N = 24478 | 10.50 | 11.33 | 12.04 | 12.76 | 13.47 | 14.18 | 15.01 |
| Eiben — Pantó 1986, 1987/88<br>Hungary (HNGS)<br>N = 12702 | 10.65 | 11.43 | 12.11 | 12.78 | 13.46 | 14.14 | 14.92 |

With this computer-oriented elaboration each point was taken into account with a corresponding *weight* of the relative rate of the given age-group. (This had to be a natural requirement in all exact regression studies!)

The *median* (or any other age corresponding to any other percent values) can be *determined also in that case,* even if there are no applicable data in the vicinity of the percent value in question (e.g. because of some *practical insufficiency*). It is mathematically evident that the total curve in question (including the diverging sides of the S-shaped curve) can be determined by its minimum two, arbitrary points. Knowledge of more points means a greater accuracy, of course.

A further possibility arises from the above mentioned considerations, i.e. one can get a linear form by a simple mathematical transformation of the function of the curve:

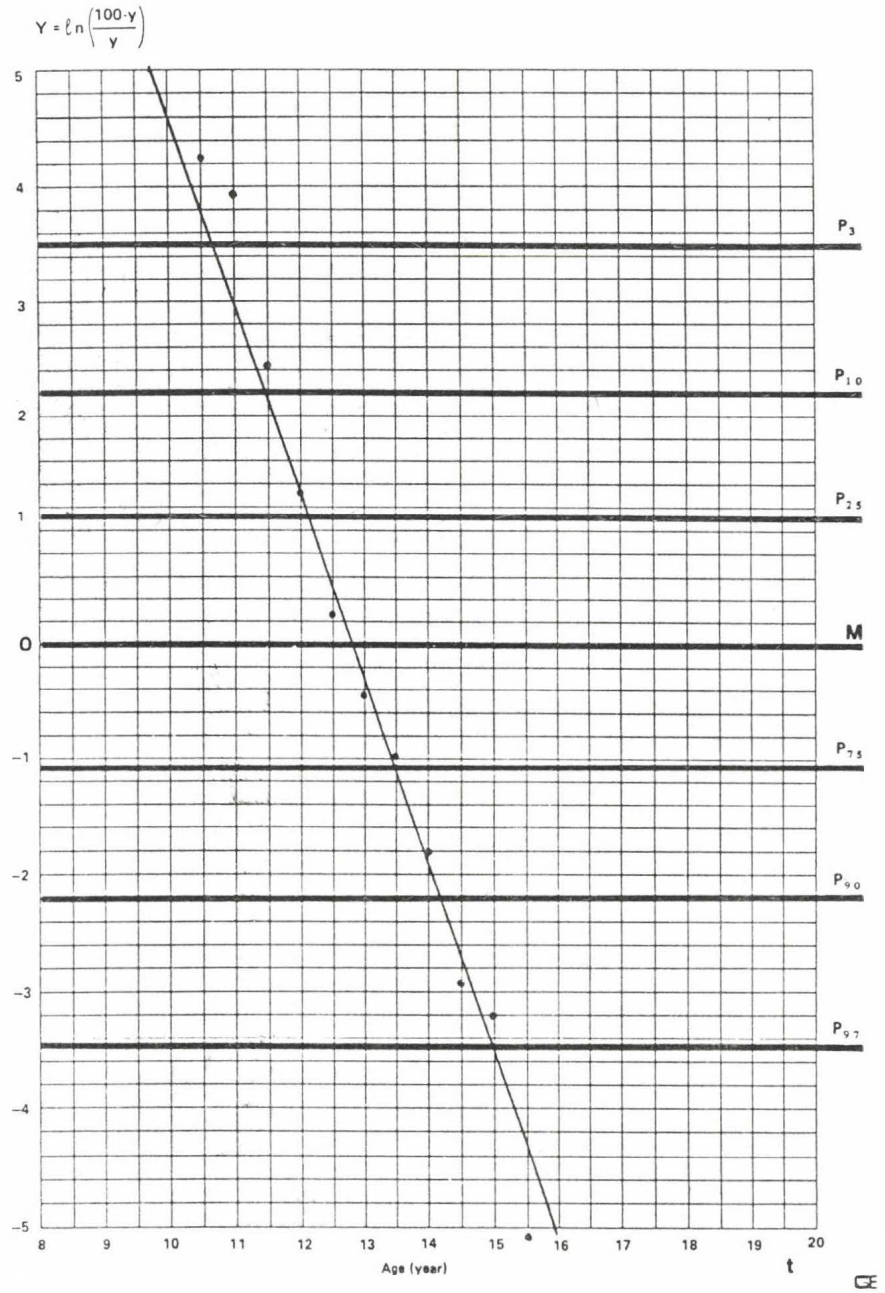


*Fig. 1:* Median and percentile values of menarcheal age in Hungarian girls in the 1980s, based on the Hungarian National Growth Study (Eiben — Pantó 1986, 1987/88).

$$\ln \frac{100 - Y}{Y} = -Ax - AC$$

If one plots the expression $\ln \frac{100 - Y}{Y}$ as a function of age (x), one gets a heap of points spread around a straight line. Now, one can use a linear method (which is more simple mathematically, of course). An obvious advantage of a linear description is that in an expediently designed evaluation diagram one can easily get the median (50th percentile) and the percentile values (*Fig. 1*).

A quick and simple evaluation can be performed even by a ruler. In this case, however, one has to give up exactness of *weighting*.

Herewith we publish the basic data of the Hungarian National Growth Study's sample (Eiben – Pantó 1981, 1986, 1987/88) of which the number of elements was N = 39035. The number of girls in question between the ages 9 and 18.5 years was N = 12719. Out of this number 7232 gave the answer *yes* and 5487 the answer *no* (*Table 2*).

*Table 2.* **Number of girls investigated and percent values of menstruating girls ("yes%") of the Hungarian National Growth Study (Eiben — Pantó 1986, 1987/88) and the percentile values of age at menarche (N = 12702)**

| Age (year) | N | "Yes%" |
|---|---|---|
| 9.0 | 704 | 0.14 |
| 9.5 | 621 | — |
| 10.0 | 638 | 0.15 |
| 10.5 | 653 | 1.37 |
| 11.0 | 701 | 1.84 |
| 11.5 | 669 | 7.92 |
| 12.0 | 689 | 21.19 |
| 12.5 | 701 | 42.79 |
| 13.0 | 689 | 60.08 |
| 13.5 | 659 | 72.98 |
| 14.0 | 658 | 85.86 |
| 14.5 | 751 | 94.94 |
| 15.0 | 792 | 96.08 |
| 15.5 | 655 | 99.38 |
| 16.0 | 737 | 99.05 |
| 16.5 | 672 | 99.55 |
| 17.0 | 626 | 99.68 |
| 17.5 | 508 | 100.00 |
| 18.0 | 420 | 99.52 |
| 18.5 | 159 | 99.37 |

| Percentile | Age | −3 SD | +3 SD |
|---|---|---|---|
| 3 | 10.6460 | 10.6431 | 10.6488 |
| 10 | 11.4329 | 11.4295 | 11.4362 |
| 25 | 12.1089 | 12.1051 | 12.1127 |
| 50 | 12.7849 | 12.7807 | 12.7891 |
| 75 | 13.4609 | 13.4563 | 13.4655 |
| 90 | 14.1369 | 14.1319 | 14.1420 |
| 97 | 14.9238 | 14.9183 | 14.9294 |
| A = | 1.62518 | 1.62615 | 1.62409 |
| B = | 12.7849 | 12.7807 | 12.7891 |

These data were elaborated with the above-described (computer oriented) regression analysis. This gave a median m = 12.78 year (*Fig. 1*).

The next step in elaborating the menarcheal/oigarcheal data seems to be the investigation of the question: how the median (C) and the other percentile values and how the hollowness (A) of the curve changes with the different biological and/or socioeconomical endowments.

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