

NATURE/NURTURE IN GROWTH STUDIES

O. G. EIBEN

Department of Biological Anthropology, Eötvös Loránd University, H-1088 Budapest, Puskin u. 3. Hungary

(Received: December 10, 1996)

Abstract

The nature/nurture problem in human growth is outlined. The factors influencing growth and maturation are enumerated, and some results of the Hungarian National Growth Study are presented. The educational level of the parents is demonstrated to be one of the most efficacious factors influencing the growth and maturation process of children.

Key words: growth and maturation, Hungarian National Growth Study, educational level.

Introduction

At the end of the 20th century, scientists are increasingly turning to the problem of the growth and maturation of children. The complexity of this biological process is well known; it is influenced by internal and external factors. The favourable factors promote this process, while the unfavourable ones slow it down. It has long been known and is readily understandable that the growth and maturation of groups of children living under better socio-economic conditions outstrip those of their counterparts living under poorer circumstances (phenomenon of "hysteroplasia"; RIETZ, 1906).

The importance of this increased in the second half of the 20th century, when the distance between the various social classes/strata has markedly widened. This is true in different regions of the world, but especially in the developing countries and in the Eastern and Central European (ex-socialist) countries (EIBEN, 1996).

It is a scientifically proved fact that the somatic developmental status of children is an indicator of the nutritional and health status of the population (TANNER, 1986). Worldwide, scientists are carrying careful growth studies to establish the above-mentioned characteristics of their populations. Auxologists attempt to take into consideration all possible factors which can influence the growth and maturation process.

Factors influencing growth and maturation

The internal and external factors influencing the growth and maturation process can be classified as follows:

(1) The internal factors are inherited characters: the sex, the race of the child, his/her physique, and connected with this, the function of the endocrine system.

VERSCHUER (1934) described growth genes of first, second and third order. The growth genes of first order control the process of zygote division and then the beginning of cell differentiation. Those of second order regulate growth during embryologic and fetal life, and those of third order have a role in postnatal growth. As concerns the growth genes of first order, there is no difference within the human species. The growth genes of second order are racespecific. Beginning from the 4th fetal month, differences in race can be demonstrated. Individual differences can be observed in the effects of the growth genes of third order.

For a gross assessment of the degree of heritability, LERNER (1958) states that the phenotypic variation of a character consists of four components: the genotypic and peristatic (environmental) variation, the correlation between the two, and the interaction of the two. THOMA (1960) gives the following limiting values for the heritability of, for instance, menarcheal age: $88.2\% > H > 72.2\%$. Taking into consideration the inaccuracy factors and amplifying the estimation for the growth process generally, one can merely state that heritability cannot be lower than 70% (EIBEN, 1977).

The child's physique (constitution) consists of the manifested part of the genotype and of that part of the paratype (i.e. acquired characteristics) which is a result of permanent adaptation to the external effects (and which also depends on genetic factors). The temporary status, i.e. condition, does not belong to the constitution. There are lasting characteristics that have only local importance and the genetic endowments have no role in their development, e.g. marks of injuries, passing children's diseases, etc. (see SZABÓ, 1938). Obviously, growth and somatic development is a phenotypically highly variable and genetically controlled process.

(2) The external factors influencing the growth and maturation process are of two kinds: (a) natural/physical or geographic factors, and (b) social factors.

(2a) The natural/physical or geographic factors include the climate determined by the geographic situation, the local geomorphological conditions: highland or lowland, exposure to radiation, the soil with its mineral salts dissolved in the drinking water (cf. iodine and thyroxine production), etc.

(2b) The social factors influencing the growth and maturation process deserve special attention: the economic welfare and social position of a given family, and the education level and profession of the parents determine the nutritional customs and hygienic circumstances of the family. At the same time, however, the social/political system in which the population lives determines the medical care (prevention of diseases and epidemics, and treatment) and the level of the physical activity and sports, too. It is also important to take into account the early or late setting out of the children to work, the early or late consumption of alcohol, drugs, smoking, early or later started

sexual life, etc. One must also consider the environmental effects of the scientific-technical revolution. As a consequence of industrialization, the environment is adversely affected by artificial light, which transforms the human biorhythm. Noise and other pollutants, an intensified tempo of life with psychological stimuli in the cities and nowadays also in the villages, and several other well-known factors included can be characterized overall by the expression: mode of life (EIBEN, 1988).

On the other hand, the cultural level of the family likewise is a meaningful factor. The educational level of the parents and their professions determine their position and possibilities in the society (BODZSÁR, 1975, 1991; FARKAS, 1986; EIBEN, 1989, 1994; EIBEN and PANTÓ, 1988). In this sense, it is easy to understand that nature, i.e. the genetic endowments, in this case the growth pattern, can be manifested inasmuch as the family environment (including nurture) promotes this.

One of the most important biological effects of the social changes is a consequence of the urbanization: the migration of peoples from different regions (representing different populations) into the major industrial centres. As a consequence of these migrations, the (relative) equilibrium in the population in question changes, resulting in the "heterosis effect": children are taller than their parents. This also happened in Hungary, in such a small country.

An interrelationship can be seen between the hardly measurable social effects or changes and the population genetic changes manifested in such objectively measurable characters as the body measurements, primarily stature.

Some results of the Hungarian National Growth Study

In the early 1980s, the author organized and with his team carried out the first Hungarian national growth study. Their representative sample was regionally stratified and involved 41 000 healthy, 3-18-year-old boys and girls (the cleaned sample $N=39.035$), 1.5% of the overall Hungarian youth in question (EIBEN et al., 1991).

A detailed anthropometric programme (18 body measurements) was carried out and menarche/oigarche data were collected with the status quo method. Hand and wrist radiographs (on 16% of the sample), head and face measurements and sociodemographic data on the children's family were collected.

The Hungarian national growth study provided information about children's growth status and age differences, proportional changes, changes in body composition, changes in physique (somatotype components), and the maturation status of boys and girls (for further details, see EIBEN, 1989; EIBEN and PANTÓ, 1986, 1988; EIBEN et al., 1991). That survey led to the publication of the first Hungarian national growth standards (EIBEN and PANTÓ, 1986), the basic anthropometric growth data on the current Hungarian youth (EIBEN and PANTÓ, 1988) and a monographic report (EIBEN et al., 1991).

In the 6-18 year-old sample, physical fitness was also investigated, with seven motoric tests (BARABÁS, 1986; EIBEN et al., 1991).

As regards the sociodemographic data, the paternal/maternal age, the child's place in the sibling sequence, the number of brothers and sisters (measure of the family), and the professions of the parents (in this increasing order) influence the growth process of children, but differences in height according to these aspects were small. The educational level of the fathers and/or mothers, however, displayed a remarkable dissociation within the sample and proved to be the most important factor.

In the Hungarian national growth study, there were five categories of educational level, ranging from uncompleted primary school, through completed primary school, vocational training school (without a school-leaving certificate), specialized school and grammar school (both with a certificate), to a high school and/or university degree. It is worthy of mention that the educational level of the parents in the recent sample investigated was slightly higher than that of the economically active Hungarian population (EIBEN, 1994).

The means of height and other length measurements in the upper categories were above the national means and/or the 50th percentiles, and in the lower categories below them. Sons of fathers with an uncompleted primary school education were the shortest, sons of fathers with a completed primary school level were taller, sons of fathers with a vocational training school level were taller again, sons of fathers with a secondary school level were still taller, and sons of fathers with a high school or university level were the tallest. The higher the fathers' educational level, the taller their sons. In this group, the pubertal growth spurt also occurred earlier than in other groups of boys.

As concerns the educational level of the mothers, the boys exhibited a similar picture; indeed, in sons of mothers with a low educational level, backwardness in growth and maturation was more evident.

This phenomenon was even more expressed in girls, and especially in daughters of fathers and mothers with a low educational level, who were the shortest, and in daughters of fathers and mothers with a university degree, who were the tallest, particularly after puberty (for further details, see EIBEN, 1989).

Thus, the higher the educational level of the parents, the taller their sons and daughters. These differences between the two extreme social groups (6-7 cm) are significant in both sexes. The mothers' educational level seems to be more of a determinative factor in this respect than that of the fathers.

In the width and girth measurements of the trunk and the extremities and in the skinfolds there were only small differences, but a definitive tendency was observed: children of less educated parents displayed unfavourable biological (anthropometric) values in growth. This was especially the case for the means of the bicondylar width of the humerus, in particular in early childhood and prepuberty.

The onset of puberty in girls revealed the same tendency: the age at menarche in the lower categories was later by 4-7 months than in the upper categories (Table 1). This trend in Hungary was already known (EIBEN, 1972; BODZSÁR, 1975; 1991).

Based on her Bakony Growth Study, BODZSÁR (1991) qualified the parents' educational level as the most important indicator of the sociodemographic status of the family influencing the growth of children.

In the early 1980s, FARKAS investigated a large Hungarian sample (the majority of it originating from Southern Hungary) and analysed his material from many aspects. Among others, he observed that in daughters of mothers with a low educational level the menarche appeared later than in daughters of highly educated mothers: $m=12.88$ vs. 12.69 y. The corresponding analysis concerning the educational level of the fathers yielded similar results (FARKAS, 1986). These differences amount to about 2 months.

Table 1. Onset of puberty in Hungarian girls according to educational level of the parents based on the Hungarian national growth study (EIBEN, 1989).

Educational level of the parents	Age at menarche (medians in years)
Father	
Uncompleted primary school	13.07
Completed primary school	13.09
Vocational training school	12.99
Secondary school	12.61
High school/University	12.44
Mother	
Uncompleted primary school	12.93
Completed primary school	12.99
Vocational training school	12.83
Secondary school	12.86
High school/University	12.67
The whole Hungarian sample	12.79

Most factors causing differences in socio-economic groups more or less correlate with each other, e.g. the educational level and profession, since the earlier one partly determines the latter one. This is the reason why it is so difficult to separate the effects of certain ecological factors. A higher educational level is usually associated with a better nutrition, and better care of the infants and children. Additionally, these parents usually use social services better than others. For Hungarian children, the educational level of the parents is a determinant. The author is convinced that the cultural niveau is the most important social factor influencing the growth and maturation of the young. It seems important to point out the determining role of the mothers in creating a better cultural background for the family (EIBEN, 1989, 1996).

References

- BARABÁS, A. (1986): Selected factors of physical performance in the Hungarian youth. - *Anthropologiai Közlemények* 30, 233-242.
- BODZSÁR, É. B. (1975): Data to Puberty of Girls. - *Humanbiologia Budapestinensis* 3, 174.
- BODZSÁR, É. B. (1991): The Bakony Growth Study. - *Humanbiologia Budapestinensis* 22, 210.
- EIBEN, O. G. (1972): Genetische und demographische Faktoren und Menarchealter. - *Anthropologischer Anzeiger* 33, 205-212.
- EIBEN, O. G. (1977): Some genetic aspects of human growth. In: SZABÓ, G. and PAPP, Z. (eds): *Medical Genetics*. - Excerpta Medica, Amsterdam-Oxford, Akadémiai Kiadó, Budapest 615-620 pp.
- EIBEN, O. G. (1988): Secular Growth Changes in Hungary (in Hungarian). - *Humanbiologia Budapestinensis*, Suppl. 6, 133.

- EIBEN, O. G. (1989): Educational level of parents as a factor influencing growth and maturation. In TANNER, J. M. (ed.): *Auxology 88. Perspectives in the Science of Growth and Development*. - Smith-Gordon and Nishimura, London 227-234 pp.
- EIBEN, O. G. (1994): Genetic aspects and/or effects of the environmental factors in human growth. In: JAI RUP SINGH (ed.): *Human Genetics. Health and Disease Perspectives*. - Ess Ess Publications, Delhi 253-258 pp.
- EIBEN, O. G. (1996): Growth and maturation problems of children and social inequality over economic liberalisation in Central and Eastern Europe. - Cambridge University Press (in press).
- EIBEN, O. G. and PANTÓ, E. (1986): The Hungarian national growth standards. - *Anthropologiai Közlemények 30*, 5-23.
- EIBEN, O. G. and PANTÓ, E. (1987/88): Body measurements in the Hungarian youth at the 1980s, based on the Hungarian national growth study. - *Anthropologiai Közlemények 31*, 49-68.
- EIBEN, O. G., BARABÁS, A. and PANTÓ, E. (1991): The Hungarian National Growth Study, I. Reference Data on the Biological Developmental Status and Physical Fitness of 3-18 Year-old Hungarian Youth in the 1980s. - *Humanbiologia Budapestinensis 21*, 123.
- FARKAS, Gy. L. (1986): Relationships between the different factors and the age at menarche in Hungary. - *Anthropologiai Közlemények 30*, 117-123.
- LERNER, I. M. (1958): *The Genetic Basis of Selection*. - W. Sonn, New York.
- RIETZ, E. (1906): Körperentwicklung und geistige Begabung. - *Zeitschrift für Schulgesundheitspflege 19*, 65-98.
- SZABÓ, Z. (1938): Physique and heredity. In: GERGELY, L. (ed.): *New Data of Research on Physique (in Hungarian)*. - Budapest.
- TANNER, J. M. (1986): Growth as a mirror of the condition of society: Secular trends and class distinctions. In: DEMIRJIAN, A. and BRAULT DUBUC, M. (eds): *Human Growth: A multidisciplinary Review*.
- THOMA, A. (1960): Age at menarche, acceleration and heritability. - *Acta Biologia Academiae Scientiarum Hungariae 11*, 241-254.
- VERSCHUER, V. O. (1934): Die Erbbedingtheit des Körperwachstums. - *Zeitschrift für Morphologie und Anthropologie 34*, 398-412.