

Comparison of Growth, Maturation, and Physical Fitness of Hungarian Urban and Rural Boys and Girls

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ABSTRACT The authors present a comparison between urban and rural boys and girls, based on their Hungarian National Growth and Physical Fitness Study, carried out in the whole territory of Hungary. The sample investigated (N=39,035) contained 1.5% of the 3-18 year-old healthy boys and girls in Hungary. The anthropometric programme included 18 body measurements, the physical fitness investigation used a battery of seven tests. Data were collected also about the family background. Urban boys and girls are taller, more robust, and stronger than their rural counterparts. Pubertal growth spurt in urban boys and girls appears about one-and-a-half year earlier, than in rural ones. In width measurements, urban boys and girls usually have higher means than the rural ones. Based on their skinfolds, however, urban boys and rural girls usually have more subcutaneous fat. These differences are the most pronounced during or at the end of puberty. The authors surveyed the different urban and rural socio-economic environmental factors influencing children's growth and physical fitness and they discuss the possible reasons of these differences.

INTRODUCTION

Urbanisation is inseparable from our age. Urban and rural environmental differences in growth, sexual maturation of children have come into the focus of interest in the last decades. Today it is a statement in handbooks, based on experimental investigations, that "children in urban areas are usually larger and have a more rapid tempo of growth than children in the villages of the surrounding countryside" (Tanner, 1989). This observation, however, is not unprecedented.

There are several studies in the human biological, especially in auxological literature dealing with differences, which occurred also in anthropometric traits in different social strata and/or in urban and rural people. Differences in mean height and weight (and also other characteristics) in children belonging to different socio-economic strata and/or living in towns or villages occur in almost all developed as well as in developing countries, and also in Hungary. Genetic endowments influencing the growth and maturation process can better manifest themselves under better environmental circumstances. The two points of view in growth studies, mentioned here, namely socio-economic factors and/or urban and

rural environment overlap. In other words, it is not easy to separate their effects on the growth process. On the other hand, in many countries, including Hungary, living conditions in towns tend to be more advantageous than those in villages.

Already in the 1820s, Villermé (1828) stated that children's mortality in France was much higher in poor social strata than in the upper classes. He very early described the effects of social factors on the rate of the growth process as well as on the final stature.

Galton (1873-74) pointed out that children in a factory in England were smaller by about 3 cm than their counterparts who did not work in a factory although originated from worker families. The difference increased with age in both sexes.

Bowditch (1891) studied comparative effects of city and country life on the growth process. He demonstrated that the boys of the labouring classes in England were shorter than those of the non-labouring classes throughout all ages. Pagliani (1879) has published same data in Italy (see Boyd, 1980; Tanner, 1981; Eiben, 1989).

Rietz (1906) illustrated the socio-economic differences in Berlin school children. Height curves of children from the upper classes run at least 4-5 cm above those for the lower classes. He determined this phenomenon *hysteroptasy*, i.e. children of rich families grow faster, are taller,

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and mature earlier than children in poor families.

Ten years later, Pfaundler (1916) described the phenomenon *proteroplasy*, i.e. urban children are taller, grow faster, and mature earlier than their rural counterparts.

In Hungary, Eiben (1956) was one of the firsts who investigated growth of secondary school boys originated from the city Debrecen (Eastern Hungary) comparing with boys from the surrounding villages. Urban boys were taller and heavier than their rural counterparts. The same differences were found in other body measurements as well as in physical power. The rural boys surpassed their urban counterparts in age of 18-19 years.

The Hungarian National Growth (and Physical Fitness) Study (hereafter HNGS) organised and carried out in the 1980s by the senior author (O.G.E.) and his colleagues, offers good occasion to analyse the differences in growth and physical fitness of boys and girls according to the size of their dwelling place, or in general, whether they live under urban or rural circumstances (Eiben and Pantó, 1985; Eiben et al., 1991).

MATERIAL AND METHODS

The material and methods of this research project were described in detail in the first monographic publication on the HNGS (Eiben et al., 1991). The authors sum here up the most important information.

The *nation-wide sample* was based on the 1980 Hungarian national census. All geographical regions, all the 19 counties of Hungary and its capital, Budapest, were visited in order to gain a *proportional representations* of the geo-graphical regions as well as duly-proportioned representations for each. The industrial and/or agricultural character of the country was taken into consideration. Data on subjects/individuals collected in various settlements exhibited the differences between urban and rural environment.

In designing the sampling, distribution of the Hungarian population (10.6 million in time of the study) according to settlement size was consequently followed. By and large, one may state that in 1980, more than a half of the Hungarian population (66.6%) lives in towns.

One percent of all cohorts of children and youngsters was planned for investigation. Only *healthy children* were investigated. The (cleaned)

sample comprised 39.035 boys and girls, over the age range from 3 to 18 years. This represents 1.5 percent of the Hungarian children and youth in the mentioned age groups. Physical fitness was not investigated in nurseries, but only in primary and secondary school boys and girls. The overall sample included Budapest and 113 settlements in Hungary: 37 towns and 76 villages, where 326 schools and nurseries were visited.

Human biological, physical educational, and socio-demographic *methods* were used.

The *anthropometric programme* was detailed and produces information about the children's growth status and age differences, proportions, body composition, physique (somatotype), and maturation status: age at either menarche or oigarche; and about skeletal age (in about 16% of the sample). The basic anthropometric list contained 18 body measurements. Internationally standardised instruments were used. Investigation methods and *techniques* were in accordance with internationally accepted standards, described by Martin and Saller (1957). The recommendations of the IBP HA section (Tanner et al., 1969) were also taken into consideration (Pantó and Eiben, 1984).

For the *physical fitness investigation*, a battery of seven tests was established from internationally accepted and recommended tests (Aahper, 1965; Haag and Dassel, 1975; Simons and Renson, 1982; Barabás, 1989). These test were easily applied at all scenes of the investigation, even under simply conditions. The tests were selected in order to represent the most important and measurable factors such as general strength (hand grip strength), explosive arm strength (two hands medicine ball push), explosive leg strength (standing broad jump), muscular endurance of the whole body (Burpee test), muscular endurance of the trunk (sit-up test), running speed (60-m dash), and aerobic performance (12-min endurance run).

The *field study team* was directed by the senior author and consisted in two groups. Four persons were involved in *anthropometry*. All measurements were obtained by highly-experienced investigators, so, there were no systematic differences between investigators.

The *motor tests* were carried out by one of the authors (A.B.) and her two co-workers, both permanent participants in this project.

The usual mathematic-statistical parameters were calculated using statistical software, both

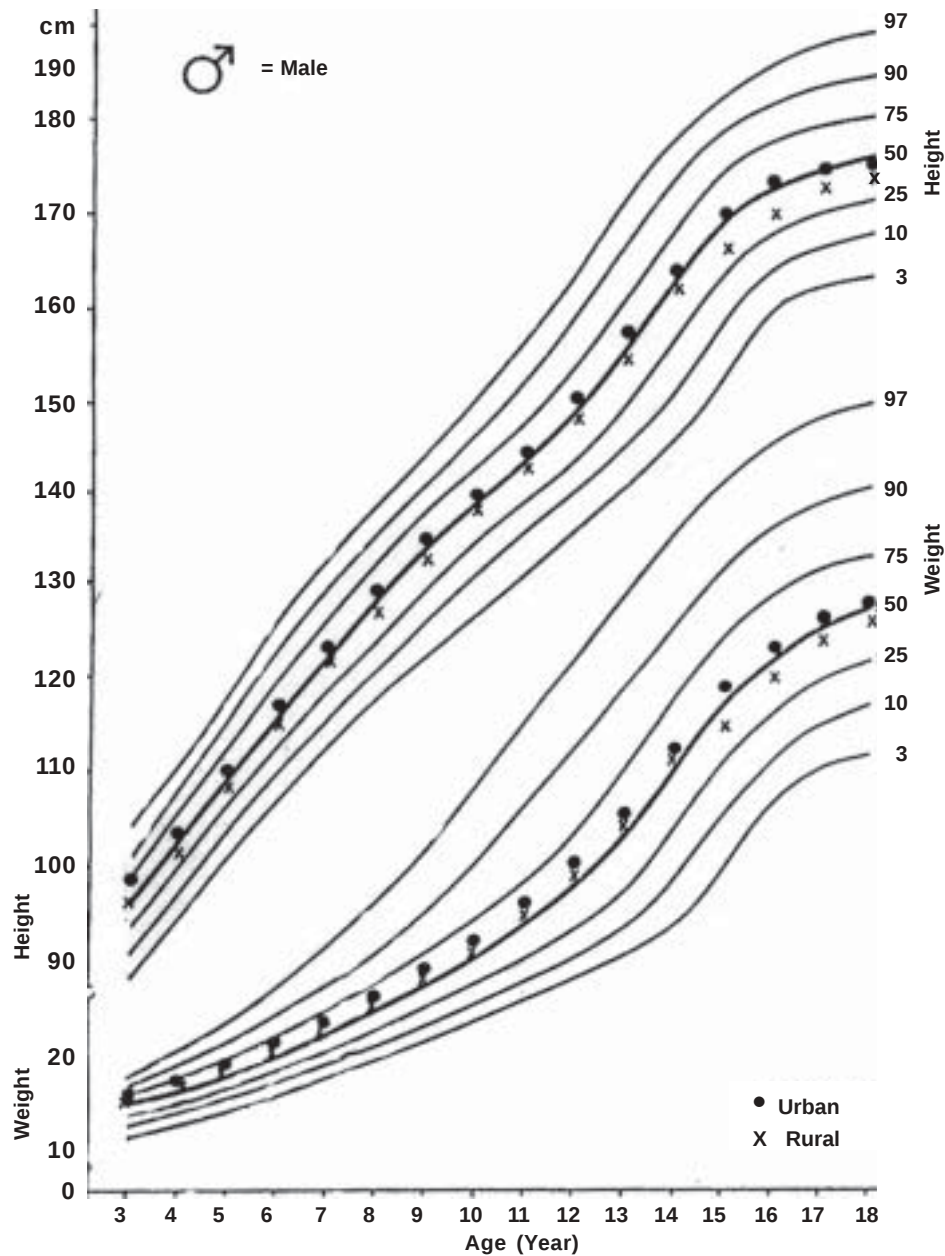


Fig.1. Mean values of height (cm) and weight (kg) of urban and rural boys investigated within the Hungarian National Growth Study (Eiben et al., 1991).

BMDP and the SPSS-X. For calculating population percentiles of the body measurements subjects for growth status and physical fitness, and smoothing the percentile curves, the authors followed the methods proposed by Goldstein (1972) (see Eiben and Pantó, 1986). For analysing

proportional changes related to age, the unisex human phantom (Ross and Wilson 1974) was used. To estimate somatotype, the Heath—Carter anthropometric somatotyping method was used (Carter and Heath, 1990). For estimating skeletal age, the TW2-method was followed (Tanner et

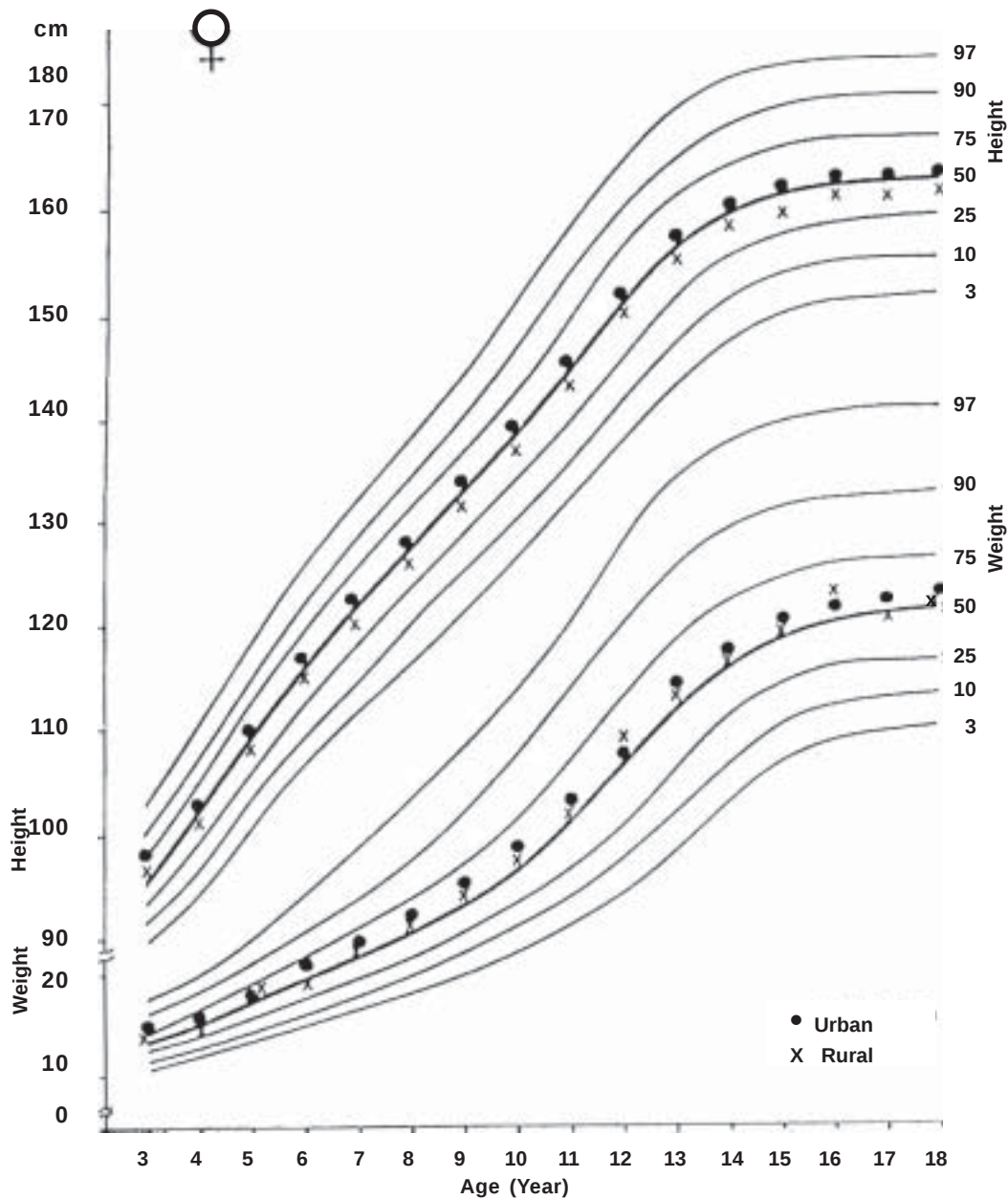


Fig. 2. Mean values of height (cm) and weight (kg) of urban and rural girls investigated within the Hungarian National Growth Study (Eiben et al., 1991).

RESULTS AND DISCUSSION

Based on a „pilot study” (Eiben and Pantó, 1985) carried out on about one-third of the HNGS, it was clear that growth and maturation of the Hungarian boys and girls in the 1980s were

much more influenced by socio-demographic status, the mode of life, or in other words, by the “cultural background” of the family (e.g. educational level of the parents, see Eiben, 1989) than by the other factors, e.g. genetic endowments. Urban boys and girls were taller, heavier,

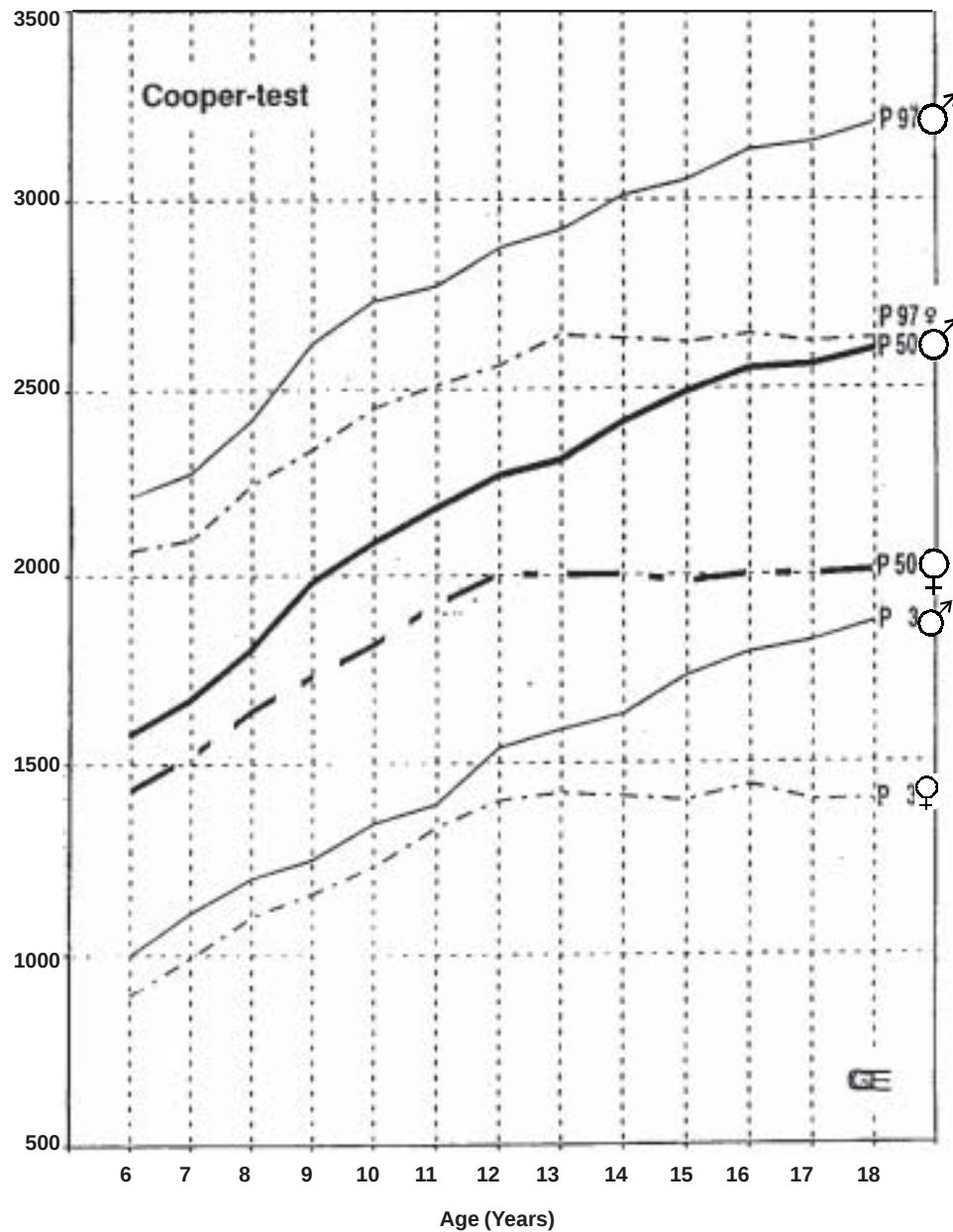


Fig. 3. Performance of boys and girls in cardio-vascular endurance run (Cooper test) investigated within the Hungarian National Growth study (Eiben et al.).

their rate of growth was faster than their rural counterparts. Breaking down the sample according to *settlement size* brought to light further differences: means of height, body mass, and other length, widths, and girth measurements were

invariably greater with increasing settlement size. Further analysis revealed with additional *urban—rural differences* worthy to deal with.

The authors summarize here the results of an analysis of urban and rural boys and girls whose

somatic development is characterised by height, weight data and physical fitness measured in seven motor tests. Figures 1 and 2 show the means plotted against the national growth curves (the first Hungarian "growth standards", Eiben and Pantó, 1986).

Height. The urban boys and girls are higher than the rural ones. Urban means in both sexes are above the 50th percentiles. Rural boys and girls, especially during the years of puberty, fall behind the 50th percentiles. In 15 year-old boys and girls, the difference is about 3-4 cm. Practically, in all age groups, there is a significant difference between urban and rural boys and girls. The pubertal growth spurt in urban boys and girls occurs about one-and-a-half year earlier than in their rural counterparts (Fig. 1 and 2).

Body mass. The same trend can be observed in body mass. The urban boys and girls are heavier in almost all age groups than the rural ones. Mean values of urban boys and girls are above the 50th percentiles, while the rural ones hardly reach the 50th percentiles, in the 15-18 year-old boys, they do not even reach the median. Most differences are significant (Fig. 1 and 2).

In width and girth measurements one can observe the same phenomenon: means of urban boys and girls usually are greater than their rural counterparts. In skinfold thickness, interestingly, urban boys and rural girls have greater means. (More detailed see Eiben et al., 1996).

Physical fitness. In all strength tests boys usually performed better than girls. As far as muscular endurance was concerned, performances of the boys and girls were nearly the same, especially in early childhood. Thereafter, performance of boys increased gradually with age. In girls, however, it increased slower and at a decreasing tempo and became stable at a low level (Barabás, 1989) at age 13, a relatively early age, coinciding with the age at menarche (Eiben and Pantó, 1985). This phenomenon is characterised to all motor tests, so, as an example, the percentile curves of Cooper test (which gives information about the cardiovascular endurance) are shown in Figure 3. (A more detailed description about the physical performance of Hungarian boys and girls, one can find at Barabás, 1989; and Eiben, 1996.)

Although there are slight discrepancies between urban and rural children's performance, the general picture is more or less the same: urban boys and girls produced a better physical performance than their rural counterparts. The urban

boys and girls can be characterised by a larger body and a more linear structure. One would expect increased levels of performance in tests of strength with greater body size, but the shorter rural children surpassed urban ones in hand grips strength scores, and moreover, they had even similar results in the standing broad jump (Barabás, 1989).

Obviously, in the last decades there has been a certain difference in mode of life in towns and villages in Hungary. In the 1950s, there was a political will to eliminate the disadvantageous difference prevailing in rural areas. Forced urbanisation proved to be unfounded, the political ambition got into a tangle. Even today, there are differences in urban and rural modes of life, affecting also childhood. Today, 62.8 % of the Hungarian population lives in towns. Life expectancy also differs: it was 66.8 years in towns, and 64.6 years in villages (Demographic Yearbook 1998).

Add to these, parents with higher educational levels tend to live in towns. Although the majority of these people in Hungary live from a modest salary, they better exploit the possibilities. There is true for nutrition, medical care and treatment, physical education and sports or even extra activities, e.g. music or languages, etc. offered to the children. The highly educated parents motivate their children to participate at these regular activities (Eiben et al., 1996; Eiben and Mascie-Taylor, 2004). This was demonstrated also in the Budapest Growth Study, which was a repetition in the Hungarian capital of the HNGS (Eiben et al., 1999; Németh, 1996/97, 1999; Eiben and Németh, 2001). The Budapest boys and girls in the middle 1990s were higher and heavier than the HNGS means (standards).

The better life conditions in towns are positive, well-perceptible factors influencing growth and maturation of children. They promptly effect or work and the children's organism is highly susceptible to them. In the 1980s, it was repeatedly proved in Hungary that the advantageous environmental factors promoted manifestation of growth pattern while the disadvantageous ones stopped or retarded it (Eiben, 1988). It is obvious that childhood, including prepuberty and puberty, is the most sensitive life-period for environmental effects like socio-economic factors presented by the urban and/or rural mode of life. Our results once again demonstrated the significance of well-planned and systematic physical

education and sports in schools, and even in kindergartens.

The last question is, how it would be possible to create equal chances in growth and physical fitness for the urban and rural youth. It is rather an economic and socio-political than a human biological problem. Auxologists have had an ambition to call the politicians' attention to this problem, to elaborate a better and more equitable distribution, a better and well-considered health and welfare politics as well as a fair youth-politics for a long time. We can only hope that governments will take notice of this problem and will find a correct solution for it.

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NOTE

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REFERENCES

- AAHPER: *Youth Fitness Test Manual*. Washington D.C. (1965).
- Barabás, A.: Motor performance of Hungarian school children. In: S. Oseid and K. Carlsten (Eds.): *Children and Exercise XIII*. p 29-37. Human Kinetics Publishers, Champaign, Ill. (1989)
- Bowditch, H.P.: The growth of children studied by Galton's percentile grades. in the 22nd Annual Report of the State Board of Health of Massachusetts. p 479-525. Wright and Potter, Boston (1891).
- Boyd, E.: *Origins of the Study of Human Growth*. University of Oregon, Health Sciences Center Fundation, Portland (1980).
- Carter, J.E.L. and Heath, B. H.: *Somatotyping. Development and Applications*. Cambridge University Press, Cambridge (1990).
- Demographic Yearbook: KSH, Budapest (1998).
- Durnin, J.V.G.A. and Rahaman, M.N.: The assessment of the amount of fat in the human body from measurements of skinfold thickness. *Brit. J. Nutr.*, **21**: 681 (1967).
- Eiben, O.G.: Comparative study of growth and development in urban and rural youth (in Hungarian with English and Russian summaries). *Biológiai Közlemények* (Budapest), **3**: 115-134 (1956).
- Eiben, O.G.: *Secular Growth Changes* (in Hungarian). *Humanbiologia Budapestinensis*, **Suppl. Vol. 6**. pp 133 (1988).
- Eiben, O.G.: Educational level of parents as a factor influencing growth and maturation. In: J. M. Tanner (Ed.): *Auxology '88. Perspectives in the Science of Growth and Development*. p 227-234. Smith-Gordon/Nishimura, London, Niigata-Shi, Japan (1989).
- Eiben, O.G.: Selected data on growth and physical fitness of healthy Hungarian boys and girls in our changing world. *Collegium Antropologicum* (Zagreb), **20**: 73-81 (1996).
- Eiben, O.G., Barabás, A. and Pantó, E.: *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*, **Vol. 21**, pp 123 (1991).
- Eiben, O.G., Barabás, A., Kontra, G. and Pantó, E.: Differences in growth and physical fitness of Hungarian urban and rural boys and girls. – *Homo* (Stuttgart), **47**: 191-205 (1996).
- Eiben, O.G. and Mascie-Taylor: Socio-economic background of the family and growth of children. *Economic and Human Biology* (in Print) (2004)
- Eiben, O.G. and Németh, Á.: Somatotypes of Budapest children. In: P. Dasgupta and R. Hauspie (Eds.): *Perspectives in Human Growth, Development and Maturation*, p 301-312. Kluwer Academic Publ., Dordrecht, Boston, London (2001).
- Eiben, O.G., Németh, Á., Barabás, A. and Pantó, E.: *Data to Biological developmental Status and Physical Fitness of Budapest Youth* (in Hungarian). *Humanbiologia Budapestinensis*, **Suppl. Vol. 24**, pp 142 (1998).
- Eiben, O.G. and Pantó, E.: Some new data about the biological development of youth in Hungary, in function of socio-demographic factors (in Hungarian with an English summary). *Anthropologiai Közlemények* (Budapest), **29**: 45-72 (1985).
- Eiben, O.G. and Pantó, E.: The Hungarian national growth standards. *Anthropologiai Közlemények* (Budapest), **30**: 5-23 (1986).
- Galton, F.: Proposal to apply for anthropological statistics for school. *J. Anthropol. Inst.*, **3**: 308-311 (1873/74).
- Goldstein, H.: The construction of standards for measurements subjects to growth. *Human Biology*, **44**: 255-261 (1972).
- Haag, H. And Dassel, H.: *Fitness Test*. C. Hofman, Schorn-dorf bei Stuttgart. (1975).
- Martin, R. and Saller, K.: *Lehrbuch der Anthropologie I*. G. Fischer, Stuttgart (1957).
- Németh, Á.: Trends in growth of Budapest children and youth between 1929 and 1995. – *Anthropologiai Közlemények* (Budapest), **38**: 33-48 (1996/97).
- Németh, Á.: *Somatic Developmental Status of Budapest Children and Youth at the end of the XXth Century and Secular Trend in Budapest*. PhD Thesis, Budapest (1999).
- Pagliani, L.: *Lo sviluppo umano per età, sesso, condizione sociale ed etnica: studiato nel peso, statura, circonferenza toracica, capacità vitale e forza muscolare*. G. Civelli, Milano (1879).
- Pantó, E. and Eiben, O.G.: Some methodological problems of a nation-wide cross-sectional growth study in Hungary. In: J. Borms, R. Hauspie, A. Sand, C. Susanne, and M. Hebbelinck (Eds.): *Human Growth and Development*. p 789-795. Plenum Press, New York, London (1984).

- Pfaundler, M.: *Körpermass-studien an Kindern*. Springer, Berlin (1916).
- Rietz, E.: Körperentwicklung und geistige Begabung. *Z. Schulgesundheitspflege*, **19**: 65-98 (1906).
- Ross, W.D. and Wilson, N.: A stratagem for proportional growth assessment. in Borms, J. and Hebbelinck, M. (Eds) *Children and Exercise VI. Acta Paediatrica Belgica*, **Suppl.**: 169-182 (1974).
- Simons, J. and Renson, R. (Eds.): *Evaluation of Motor Fitness*. Report of the European Seminar on the Evaluation of Motor Fitness. Leuven University Press, Leuven (1982).
- Siri, E.E.: *Body Composition from Fluid Space and Density*. MS USRL 3349. Donner Laboratory, University of California (1956).
- Tanner, J.M.: *A History of the Study of Human Growth*. Cambridge University Press, Cambridge (1981).
- Tanner, J.M.: *Foetus into Man. Physical Growth from Conception to Maturity*. 2nd Ed. Castlemead Publ. Ware (1989).
- Tanner, J.M., Hiernaux, J. and Jarman, S.: Growth and physique studies. In: J. S. Weiner and J. A. Lourie (Eds.): *Human Biology. A Guide to Field Methods*. IBP Handbook No.9. p.1-76. Blackwell Scientific Publ., Oxford, Edinburgh (1969).
- Tanner, J.M., Whitehouse, R., Marshall, W.A., Healy, M.J.R. and Goldstein, H.: *Assessment of Skeletal Maturity and Prediction of Adult Height (TW2 Method)*. Academic Press, London (1975).
- Villermé, I.R.: Mémoire sur la mortalité en France dans la classe aisée et dans la classe indigente. – *Mémoire Acad. Méd.* (Paris), **1**: 51-98 (1828).