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RELATIONSHIP AMONG BODY HEIGHT, SOCIO-ECONOMIC FACTORS AND MENTAL ABILITIES IN HUNGARIAN CONSCRIPTS

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Abstract: *The relationship among the body height, the neonatal development, the socio-economic factors and the mental abilities was analysed in a representative sample of Hungarian conscripts (n≥8000) surveyed in 1998. The results showed the influence of the prenatal period not only on the birth length, but on the body height and the mental abilities of the young males at the age of 18 years, too. The body height of the 18-year-old conscripts proved to increase significantly in accordance with the level of the parental education and the urbanisation level expressed by the population size of the place of residence of the subjects. The tallest conscripts grown up in better conditions had higher IQ and better school achievement than the smaller associates. The shorter stature and lower mental abilities of the offspring of the under-educated parents are attributed not only to the lower socio-economic conditions but to a health-cultural-information deficit in this social group, too.*

Keywords: *Birth length; Body height; Neonatal development; Hungarian conscripts; Socio-economic factors; Raven-scores; School achievement.*

Introduction

It has been well known for a long time that both body dimensions and mental abilities of the human populations are controlled by genetic and environmental factors (Bayley 1954, Tanner and Israelsohn 1963, Douglas 1964, Husén 1974, Susanne 1980, Bodzsár 1982, Chrzastek-Spruch 1982, Westin-Lindgren 1982, Mednick et al. 1982, Gyenis 1995, Ceci and Williams 1997, Dickens and Flynn 2001). During the twentieth century some of the biological characteristics of the human populations have changed rapidly, especially the body size, in almost all industrialized countries (Tanner 1966, van Wieringen 1986, Eveleth and Tanner 1976, Malina 1990). These changes are called as secular changes or secular trends and the most remarkable feature of them is the increase of adult height. The socio-economic factors such as parental education, income, social class, hygiene and diseases have been suggested as factors that influence adult height (Tanner 1992). Secular changes in body size have occurred simultaneously with the rise of the mean level of intelligence of the world's population, as assessed by standardized measures of mental ability (Flynn 1984, 1987). The significant impact of immediate environment on individual variation in IQ was reported by Ramey and Campbell (1984) and Ceci and Williams (1997). At the same time Martinez (2000) demonstrated that IQ and cognitive proficiencies associated with intelligence can be increased by such a direct intervention as formal schooling.

Studies of infants indicate differences in the perinatal and infant mortality risks according to the neonatal development (Battaglia 1970), and that belonging to different neonatal development groups also affects the infant and childhood growth and development differently (Pena et al. 1988; Frisancho et al. 1994, Joubert et al. 1991, 1996).

In this paper, the authors examined on a sample of the 18-year-old Hungarian conscripts the relationships among the neonatal development and the adult height of the subjects and some socioeconomic factors as well as the mental abilities of the subjects measured by school achievement and Raven-test.

Material and Methods

In Hungary, the possibility of taking national representative samples of young males was given only on the occasion of the military conscriptions, because it was obligatory for all males at the age of 18 until the end of 2004. From 2005 the military service is voluntary and the Hungarian Army will consist of only mercenary troops.

The first representative sample of Hungarian conscripts was taken by Nemeskéri et al. (1983) in 1973, and our sampling (n≥8000) was based on their methods and the data were collected from conscripts of the same populations and from the same places of the conscriptions (Joubert and Gyenis 2001, Gyenis and Joubert 2002).

During the sampling anthropometric, socio-demographic and health data were collected. The anthropometric measurements were taken by Martin (Martin and Saller 1957–1966) and by the methods and means meeting the requirements of IBP (Weiner and Lourie 1969). In the present study only body height was included of the 30 anthropometric measurements collected.

Data at birth from the so-called statistical data sheet of birth were available in the case of 95% of the subjects. Only data on the birth length and weight, on the gestational age, and on the parental education level at the time of birth were included in this study from the different body and socio-economic variables at birth of the conscripts.

The body weight at birth and the gestational age essentially determine the viability and life expectancy of the newborn infants. The percentile method, worked out for neonates by Battaglia and Lubchenco (1967) defines the condition and nutrition of the infant by taking the 10^{th} and 90^{th} percentiles of the body weight at birth by gestational age as limit values.

According to body weight at birth and gestational age, the conscripts were classified into three groups, small for gestational age (SGA: undernourished), appropriate for gestational age (AGA: normal fed), and large for gestational age (LGA: overfed), corresponding respectively to birth weight less then the 10^{th} percentile, between the 10^{th} and 90^{th} percentiles, and above the 90^{th} percentile of gestational age.

In this study Hungarian data at birth of 1973–1978 (Joubert 1983) were used, because the method is most appropriate if each country and larger region works out the reference values built on its data of birth (Pérez et al. 2001).

Among the several socio-economic factors collected in the survey only the place of residence of the conscripts and the parental educational level were taken into consideration.

The place of residence at the time of birth of the conscripts was classified into 5 categories: 1. Budapest (population about 2 millions), 2. large cities (city 1: population over 100,000), 3. medium cities (city 2: population between 100,000–25,000), 4. small towns (urban administrative status, population between 25,000 and about 5000), 5. rural settlements (village: villages, farms, population less than 5000).

For the classification of the educational level of the parents we used the following scale: 1/ 0–7 classes: unfinished primary school, 2/ 8 classes: primary school, 3/ 8 classes + vocational school: primary school + vocational school, 4/ 9–12 classes: secondary school, 5/ 13–18 classes: university or college education.

For measuring the mental abilities of the conscripts Raven-test (SPM: Standard Progressive Matrices, Raven et al. 1998) and the school achievement in the last accomplished school class were applied.

Statistical analyses were made by ANOVA, post hoc test (Scheffé-test) and Pearson's correlation coefficient.

Results

The basic statistical parameters of the body height, school achievement and the Raven-scores according to the neonatal development groups are presented in Table 1. In all variables the values in the LGA group were the highest and all the differences were significant ($p<0.05$).

Table 1. Body height, school achievement and Raven-scores according to the neonatal developmental groups.

	SGA			AGA			LGA			Altogether		
	n	M	SD	n	M	SD	n	M	SD	n	M	SD
Height	1076	172.9	7.4	6347	175.8	6.9	665	179.4	7.2	8088	175.7	7.1
School achievement*	818	3.2	0.7	5020	3.3	0.7	530	3.4	0.7	6368	3.3	0.7
Raven-score*	884	35.1	8.2	5407	36.9	7.8	567	37.5	7.4	6858	36.7	7.9

*Statistical significance at $p<0.05$ level.

Figure 1 shows the means of birth length of the conscripts developed in each neonatal development group according to the place of residence at birth. The highest value of the birth length was found in the LGA group of Budapest and in all categories according to the place of residence the conscripts in the LGA groups had higher values, than in the AGA and SGA groups. The differences were highly significant (by ANOVA) in comparison of the AGA and LGA groups ($p<0.0001$ and <0.001), but they were non significant in comparison of the SGA groups. The multiple comparisons by Scheffé-test remained statistically also highly significant ($p<0.007$) in each case when Budapest and the large cities (city 1) were compared with the other places. In cases of the medium cities (city 2), small towns and villages statistically significant differences ($p<0.001$) were found only in the comparisons with Budapest and the large cities (city 1).

The values of body height of the conscripts at the age of 18 years developed in each neonatal developmental group according to the place of residence at birth are presented in the Figure 2. Body height of the conscripts was the highest in the LGA group in all places of residence, while it was the shortest in the SGA groups of the conscripts in all places of residence. Significant differences were found by ANOVA in the comparison of the AGA groups ($p<0.0001$) and the multiple comparison by Scheffé-test remained highly significant in each case when Budapest was compared with the other places ($p<0.008$ and $p<0.0001$). In the other settlements statistically significant differences were found only in the cases of comparison with Budapest and the large cities ($p<0.027$ and $p<0.0001$).

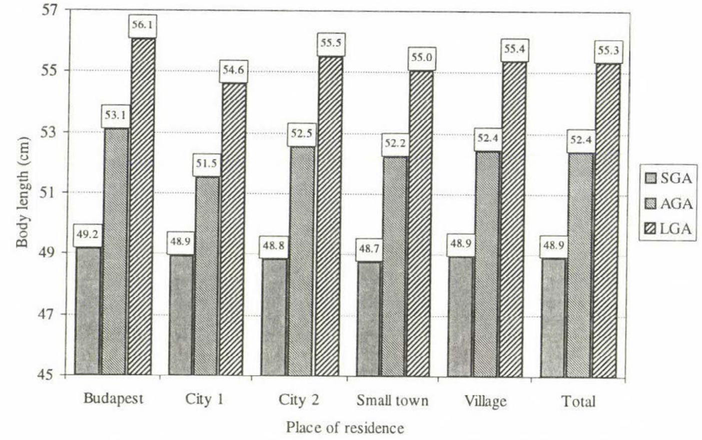

Figure 1: Birth length of the conscripts according to the neonatal developmental groups and the place of residence.

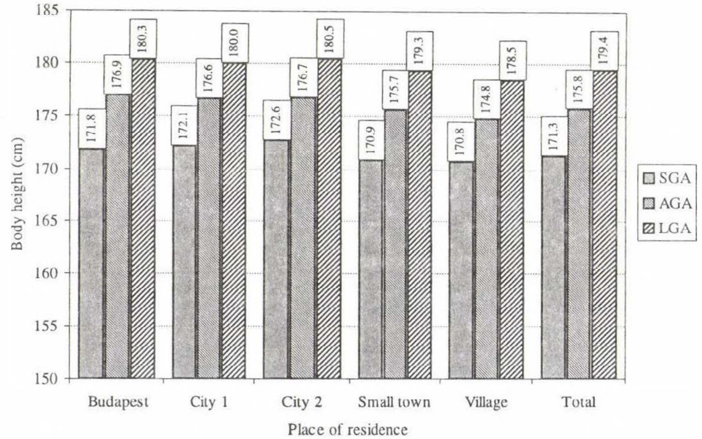

Figure 2: Body height of the conscripts at the age of 18 years according to the neonatal developmental groups and the place of residence.

Figure 3 shows the body length at birth of the conscripts according to the educational level of the parents. With the increase in the education level of parents the difference between the birth length averages of the conscripts belonging to the given group decreases. The differences by ANOVA were highly significant ($p<0.0001$) and the multiple comparisons by Scheffé-test were also statistically highly significant ($p<0.0001$) in each case, with one exception, when the parents with secondary (9–12 classes) and university education (13–18 classes) were compared with each other.

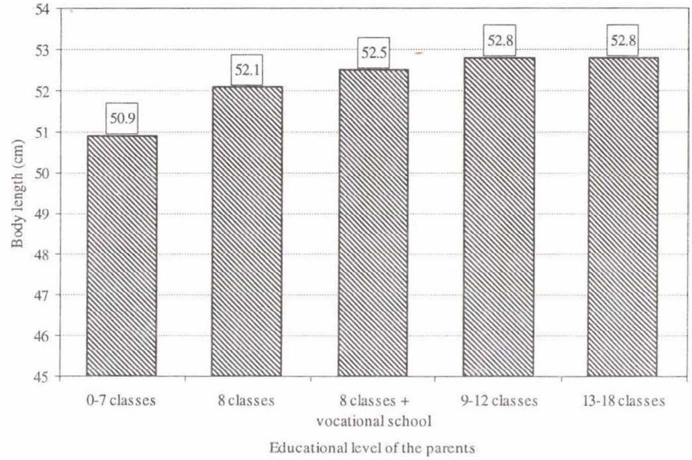

Figure 3: Body length at birth of the conscripts according to the educational level of the parents.

The body height of the conscripts at the age of 18 according to the educational level of the parents is shown on the Figure 4. The lower the educational level of the parents was, the shorter the mean body height of the conscripts was at the age of 18 years. The differences by ANOVA and the multiple comparisons by Scheffé-test remained statistically highly significant ($p<0.0001$ and $p<0.0001$) in each case, when the parents with uncompleted and completed primary education were compared with the higher educated parents (vocational school, secondary school and college or university education). But there were no significant differences, when the two groups of the higher educated parents were taken into comparison (9–12 classes versus 13–18 classes).

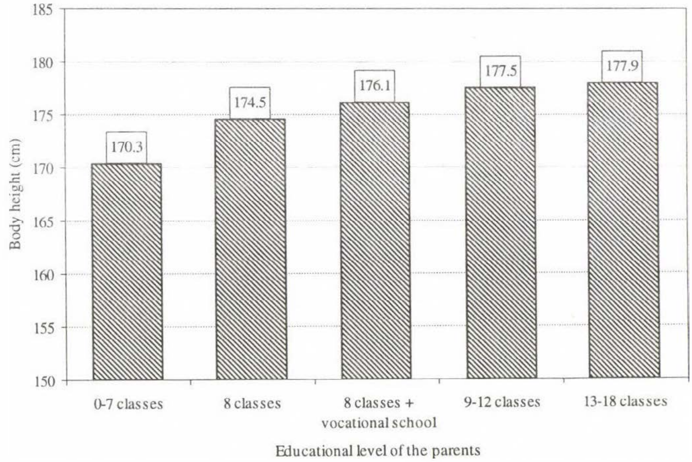

Figure 4: Body height of the conscripts at the age of 18 years according to the educational level of the parents.

The relationship between the Raven SPM scores and the body height of the conscripts is shown on the Figure 5. The distribution of the Raven scores and the values of the body height showed a close connection between these two variables of the conscripts. The higher the Raven-score was, the higher the height was (Raven F=0.236*body height-4.582; r=0.217, significant at the 0.01 level).

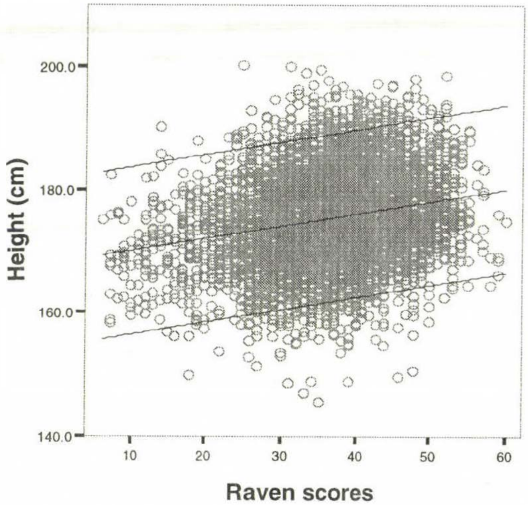

Figure 5: Distribution of the Raven SPM+ scores and the body height of the conscripts.

Interpretation and conclusions

It is well known that children and youth of the same society but of different socio-economic level differ in stature and other body dimensions at all ages, the children of the higher educated parents being taller and having larger body dimensions (Eveleth and Tanner 1976, Susanne 1985, Tanner 1990, Eiben 2001).

Similar to the body characteristics the mental abilities expressed by the IQ and the school achievement are influenced not only by genetic factors, but by different environmental factors such as formal schooling and family background (Ramey and Campbell 1984, Bodzsár 1991, Gyenis 1995, Ceci and Williams 1997, Martinez 2000).

In our study we presented data about the influence of the prenatal period not only to the birth length, but to the body height and the mental abilities of the young males at age 18 years, too.

However, the process of growth and maturation and the body development at all ages of childhood and adolescence are influenced by several socio-economic factors. In our sample both the effect of urbanisation level expressed by the population size of the place of residence, and the parental educational level had significant influence on the body height and mental abilities of the conscripts. The body height of the 18-year-old conscripts increased significantly with the level of the urbanisation of the place of residence and the parental education. The tallest conscripts grown up in better conditions had higher IQ and better school achievement than the smaller associates.

The results provide further confirmation of the positive association between the socio-economic conditions, the body height and the mental abilities of the young males in Hungary. The shorter stature and lower mental abilities of the offspring of under-educated parents is attributed not only to the lower socio-economic conditions but to a health-cultural-information deficit in this group, too.

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