

Study of physique, body composition and motor performance characteristics

Ph.D. thesis

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Introduction

The marked and fast socio-economic changes that developed in Hungary during the past 3 decades influenced markedly the life standard and also the lifestyle. These dominantly positive changes have also been induced a great number of negative procedures. Namely: remarkably decreased the habitual physical activity in the population, the dietary habits modified in an unhealthy direction, consequently the mean relative fat content of the inhabitants increased (Gáldi 2002, Szilas 1990, Dallos et al. 1999). The decreasing habitual activity and the unhealthy dietary habits result in an increasing health risk separately, however, by their joint prevalence the possible health risks increase along a second power curve (Malina és Bouchard 1991, Bouchard 2000, Gilmore 1999, Wei et al. 1999, Blair és Brodny 1999, Flegal és Troiano 2000).

The Hungarian authors and working teams (Gyenis 1975, Eiben és Pantó 1981, Famosi és Bakonyi 1987, Mészáros et al. 2001) agree in their conclusions that the generation differences in body composition and physical performance capacity of children and adolescents are negative according to their possible consequences. These qualifications of change are identical in the slice of young adult population too. The investigators stress the significant role of unhealthy lifestyle in this respect. Many of the environmental factors (the economic status of a given family, nutrition, level of habitual physical activity, etc.) modify significantly the pattern of somatic development, the timing and tempo of biological maturation, and also the levels of physical capabilities. The majority of children and adolescents resemble their parents not only in their body proportions, or features of face etc., but their tempo of growth, development and maturation can also be similar to those of their parents. These more or less obvious similarities mirrors the similarity (but not the total identity) of inherited gene pool. The expression of inherited growth patterns is obviously under the pressure of environmental factors and effects that are mediated by the very complex effects of neuro-endocrine regulation. The effects of environment are, however, not similarly strong in the ma-

nifestation processes of various attributes and characters. Following the determination of human genome (gene map) it is also out of question that there are differences between the sensitivity of organism for the continuous effects of the environment. Some of the effects can result in retardation and some of the biological acceleration, and further the monogenic inheritances are less sensitive and the polygenic ones are more sensitive for the environmental effects. That is, the possible effects of the environment are small (or they are not measurable) in the development of colour complexity, but these can be stressed in the age related changes of body composition and also physical performance (Bouchard 2000). The marked change or changes of the human gene pool in the successive generations cannot be supposed. The majority of the developed mutations are lethal, consequently the modified attribute will not be appear in the second generation.

The aim of the study

The aim of the representative growth studies very often can be the determination of references of body dimensions (probably of other human biological characteristics) in the various age groups of a given population. The growth references can be helpful bases in the qualification of health status, individual development, nutritional status etc., or during the epidemiologic screening. Both during the health-related screening and pediatric practice the size and growth characteristics of an individual is compared to the norms that describe the age-related changes and patterns of the healthy children and adolescents. By this procedure we could quantify whether or not the individual has been reached the appropriate development, or what developmental status he or she represents. In this train of thought the calendar age is an important but not exclusively sufficient key indicator of the individual growth and development (Bodzsár 2001). The previously described fast socio-economic changes and basically the secular growth changes arise from the socio-economic changes (Tóth és Eiben 2004) give the reasons of renewal of nation-wide or regional references. Since the results of the last representative Győr-Moson-Sopron county growth study was published in 1989 by Eiben and associates, it is almost neces-

sity the introduction of the present growth status. Serves the purposes the aim of our study was to characterise the somatic and motor development, as well as the body composition attributes in the Győr elementary schoolboys.

Within the described wide range we search answers for the following questions:

1. What differences between the previously reported and present results can be evaluated as the consequences of secular growth trend?
2. Are the motor performance characteristics proportionate with the proved somatic differences?
3. What proportion of the observed population can be evaluated as critical if the joint basis of qualification is the body fat content relative to body weight and cardio-respiratory endurance?

Hypotheses

Above all we should suppose the results of a regional growth studies can be more or less different from those of the valid nationwide representative data collections, and naturally, also the differences between the results of regional growth studies cannot be excluded unambiguously. The size of the country, the similarities in geographic characteristics, the very moderate climatic differences, the distribution of the inhabitants by ethnic variations, etc., are not the real reasons for the possible differences, thus the between-group variability could be developed basically because of the differences between the life standard and lifestyle.

By one the recent publications of the Central Office of Statistics (KSH, 2007) the rate of unemployment is smaller, and the life standard is higher in North-West-Hungary than in the other regions of the country. If this condition is a long-lasting one (we have a real basis to suppose it) and it is biologically strong enough the secular trend-related differences are more moderate than in the other parts of the country.

Nevertheless, we do not suppose differences between the statistical means of estimated relative fat content of children and adoles-

cents, investigated before and after the turn of millennium. By our premise the general hypoactivity is also characteristic at the schoolage generation of Győr.

In agreement with the available recent Hungarian data we evaluate only the taller height means for the positive consequence of secular growth trend. The significantly heavier body mass, the greater depot fat content, the more linear physique, as well as the more moderate physical performance are evaluated as negative consequences of the trend. We have to note these consequences do not develop in every population.

By the previously shown lifestyle changes we can suppose the weaker physical capabilities in our Győr boys. We can also suppose further, than in physical performance scores where the linear correlations with height and body mass were positive in the former samples investigated decades ago (Mészáros et al. 1979, 1986), the level of linear correlation will decrease.

The significant relationship between the greater body fat content and lower physical or physiological performance was found in many investigations (Prókai et al. 2005, Rowland, 2005, Photiou et al. 2008). In the health-related approach, for instance, if the amount of depot fat and the level of cardio-respiratory endurance are the joint basis of qualification the consequences of the two unfavourable attributes are summarised, in some cases the pattern of effects is exponential (Bouchard 2000, Reusz et al. 2001). It is an additional question in the health-related approaches, what level of depot fat and cardio-respiratory endurance should take as critical, along which the various patho-physiological states develop with a great level of probability. We suppose that by the two mentioned risk conditions about 28% and 30% of children and adolescents can be estimated. This prevalence is greater than those of the recent Hungarian assessments (Frenkl és Mészáros 2002, Prókai et al. 2007, Zsákai és Bodzsár 2007).

Subjects

The subjects were recruited from the 31 eight-grade elementary and 1 eight-grade high school of city Győr. In choosing the pos-

sible sample we endeavoured to give the same chance for all the possible subjects. Taking into account the respective prescription of Helsinki Declaration that determine the volunteer participation (and also the written consent of one parent), and the definite space requirements of motor testing our endeavour was limited in some cases. The investigated subjects (the overweight and obese too) took part in the curricular PE classes delivered dominantly by PE teachers. The kinanthropometric data collection was carried out in 2006 and 2007. The final sample contains 3,621 children and adolescents. By the evidence of the statistics of Győr-Moson-Sopron County Statistical Office this investigated sample represents the 7 to 14-year-old boys in 59% and 88 %.

Methods

For the estimations of physique and body composition standard anthropometric techniques (accepted by the international literature) were used. In taking the required body dimensions the prescriptions of the International Biological Program (Weiner and Lourie, 1969) were followed. Official and authenticated anthropological equipment (Sieber-Hegner-type, made in Zürich) were used.

a/ The growth type of the children and adolescents were characterised by the anthropometric technique of Conrad (1963). This procedure describes the physique by the metric index between the leptomorph and picnomorph extremes and additionally gives numeric information (plastic index) about the actual level of bone-muscle development.

b/ For the qualification of nutritional status we determined:

- the depot fat content relative to body mass according to the suggestions of Parízková (1961),
- the body mass index (BMI), this index is the ratio of body mass and body height,
- the lean body mass (LBM), that contains only the essential fat compartment within the body.

The critical body fat content was determined by the BMI cut-off points suggested by Cole and associates (2000), and by the depot

fat percentage described by Lohman (1992). In the determination of overweight and obesity both categorisation were observed. The critical body composition was one of the grouping bases.

Physical performance capacity was assessed by the train of thought of Szabó (1977), and the following motor tests were executed: 30m dash, standing long jump, fist-ball throw, and 1200m run.

For the statistical analysis of the measured and calculated variables Statistica for Windows program (version 7.1, StatSoft Inc., Tulsa, OK 74104, USA, 2006) was used. As the first step of the analysis the conventional descriptive statistics (mean, standard deviation, minimum and maximum) were calculated in every age group. The differences between the successive means were analysed by *F*-test following one-way ANOVA. In case of significant *F*, the Scheffé's critical differences were calculated.

Differences between the respective standard deviations were analysed by *Levene*-tests.

Age dependency and the within pair relationships of the studied variables were determined by linear correlation coefficients.

The relationships between body dimensions, body composition attributes and motor performance scores, and also the internal relationships between the physical performance characteristics were analysed by linear correlation coefficients. The differences between the correlation coefficients were tested following *Z*-transformation.

The maximum effect of random error was determined below 5 % consistently.

We have found

The calculated means of height and body mass of the present Győr sample were consistently and significantly taller and heavier than those of characteristic decades ago. The mean body mass differences, however, were remarkably greater than by the taller stature means could be expected. The observed differences in height and body weight can be the consequence of secular growth trend, but their human biological qualification is not positive necessarily. The linear correlation between the taller stature and greater depot fat of the child-

ren and adolescents is significant. Since the prevalence of overweight and obese subjects in our sample was higher than in the previous decades, a definite part of the significantly taller stature can be explained by the greater level of relative depot fat. The heavier body mass and the more linear physique are in general opposite human biological attributes of the individual. Nevertheless, in our sample this parallelism was the characteristic. If the possible or suggested fat-correction is made, the between-generation differences become more marked. The increase in linearity component of physique can also be evaluated as the effect of secular growth trend, but these modifications may develop not in necessarily manner. Knowing the result of the respective Hungarian longitudinal studies we should stress. In case of normal or required (for the harmonious child development) level of habitual physical activity the increase in linearity of physique cannot be observed. Although the secular growth changes in Hungary are marked yet, by the observed characteristics unambiguously positive effects of consequences cannot be mentioned.

The respective hypothesis can be hold without restrictions.

The mean motor performances of the investigated children and adolescents were very weak consistently. This qualification neither changes essentially, if we subtract the performances of the obviously overweight and obese children and adolescents. The generation differences in physical performance can also be the part of secular growth trend, but its appearance can be averted. By the kinanthropometric approach a “diabolical circle” or “circulus viciosus” can be supposed. The characteristic general hypoactivity and the more than biologically required energy intake result in an increase in body fat content, that linearly or exponentially decrease physical performance and consequently the level of habitual physical activity. The very moderate or weak physical performance capacity are characteristic along the means of the all 4 applied motor tests, but the statistical correlations between the results were moderately stronger in the group of normal body composition children and adolescents than in the endangered one. The age dependent increase in motor performance scores was

significant in both samples, but the regression coefficients (slopes) were significantly lower than those observed 2-3 decades ago. In the function of recent Hungarian data these results cannot be evaluate as being “sampling error”.

The respective hypothesis can be hold without restrictions.

The prevalence of critical body composition (overweight and obesity) was high in every age group. It was significantly greater than in the middle of 70-es and 80-es. The proportion of endangered children and adolescents increased significantly with calendar age. It was “only” 8% in the group of 7-year-old boys, but the prevalence exceeded the 25% in the 14-year-old boys. This unfavourably negative prevalence does not change significantly if the qualification basis is the body mass index instead of weight-related depot fat. It is characteristic for the change in speed increasing prevalence: in our study the successive means of depot fat was closer to the non-selected (by depot fat) means investigated in the middle of the 70-es. The depot fat influences negative the motor performances, but it appears as one of the new point of view during the evaluation of common anthropometric measures and indices too. If the conventional morphological basis of the qualification is supplemented by also the functional characteristics, the final result (the end conclusion) is more unfavourable than the originally introduced one. Gutin and Barbeau (2000) among the functional characteristics suggested the measured or estimated level of cardio-respiratory endurance as being a supplementary qualification basis. The two authors pointed out, the high relative body fat content and the weak cardio respiratory endurance together means an exponentially increased health risk for the present and especially in young adulthood. The number of such children and adolescents was much greater in our sample than the prevalence of “simply” overweight and obese ones. Unfortunately many individuals from the normal body composition sample can be ordered into the endangered group if we take into consideration their cardio-respiratory performance estimated by the results in 1200m run test.

The respective hypothesis can be hold without restrictions.

Our results cannot be evaluated as being regional standards. We can accept as reference (comparative) data only the means and variability measures of the purified sample (necessarily it does not contain the characteristics of overweight and obese subjects).

We highlighted in this thesis consistently the negative trends and possible consequences of the observed body built, body composition and motor performance of our children and adolescents, but we have to stress these children and adolescents are living also in our society. The children learn and make strong habit, probably as worthy of imitation that the adult society mediate continuously. Thus the responsibility belongs to us, but the new generation will suffer the developing consequences and they will “pay” for them. By the principle, namely “it is just the matter of habit” the possibility of amplified reproduction of the observed critical status is sure.
iztosított.

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