SEMMELWEIS UNIVERSITY
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CHANGES OF SOMATIC DEVELOPMENT, BODY COMPOSITION AND MOTOR PERFORMANCE IN LOWER ELEMENATARY SCHOOLBOYS

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Introduction

Poor families estimated by the low monthly income per capita represent a relatively wide slice of the Hungarian society nowadays. This population increase year by year. Official statistics are available for the determination of monthly income categories and unemployment rate (KSH, 2005; 2006, 2007). These material could be useful background bases for various scientific analyses, nevertheless, most estimations of real poverty are unreliable or these are not useful in scientific relations because those were collected by unofficial techniques. Many of them are simple oral information without the definition of appropriate authority. The electronic media publishes data almost week by week about the proportions of schoolchildren suffering from the consequences of real poverty. These estimations ranges between 15 and 30% of the population. These information are rather unreliable, since they are not independent of the aims of estimation and above all the reasons of publications. One of the clear samples refers to the plenary session of Hungarian Parliament. The following discussion was shown on television in a spring of 2006.

- “250 thousand Hungarian children suffer from starvation” (estimation of government party);

- “350 thousand Hungarian children suffer from starvation” (the estimation of the opposition). There were only less than six minutes between the two information.

The 100 thousand difference, is very large one, consequently results of the two estimations cannot be true in a given short period of time. If the real prevalence is between the two estimates the testimonial of society is obviously insufficient as since the mentioned mean prevalence indicates that every 5th or 6th elementary schol-children is referred to this serious social problem. It is a little wonder that the mentioned frightening proportions were not officially published by the persons provided information.

About the serious growth and developmental consequences of long-lasting poverty the paediatricians gave more and more “hard” information (Gács, 1984; de Onis és Blossner, 1997). It is widely proved thus out of questions that owing to permanent malnutrition measurably change:

a/ the age-related speed, pattern and timing of many body dimensions and proportions,

b/ the processes of bone development and mineralisation, and

c/ the time and course of biological maturation.

The above mentioned facts and consequences were supplemented by the human biologists. They stressed: the permanent malnutrition decreases the physiological speed of motor development and also the level of habitual physical activity (Spurr, 1990; Popkin et al., 1996; Malina et al., 1998). What is more data are available that paediatric malnutrition often means a risk for the development of young adult obesity.

The aim of the study

The aim of this longitudinal analysis was to compare such effects of regular physical activity and long-lasting malnutrition which can be described accurately and expressed numerically by the characteristics of somatic development and motor performance scores.

We wish to realise our aim by the separate and joint answers of the following questions:

1. Are there human biological differences among the subsequent means in body dimensions, body composition attributes and motor characteristics of the three samples (children studying in normal classes, taking part in special physical education program, and pupils with governmental social support)?

2. Are there human biological and statistical differences among the age-related patterns and speeds in the development of the observed kinanthropometric characteristics?

3. By what means changes the pattern of differences of the somatic and motor developmental processes are described by joint indices (measurements)?

Material and methods

The anthropometric data and motor performance scores were collected between 2005 and 2008 in Budapest, Győr, Miskolc, Nyíregyháza and Szigetszentmiklós. During the time of first investigation the kinanthropometric measures of 652 pupils were recorded. This number of participants changed by investigations only moderately, but the final subject number decreased remarkably. The main reasons of decrease were: the children were absent, moved from the settlement, non Caucasian anthropologic origin, older calendar age at the

time of first data collection etc. The sample (available for the final statistical analysis in every respect) following the 8th observation (in 2008) contained only 400 children.

The respective paragraphs of declaration of Helsinki were consistently observed in the organisation and arrangement of the study (participation in voluntary manner, written consent of the parent, anonymity, explanation of results according to the individual claim, etc). This prescription was modified in part during the past decades WMA, 1996). Since our investigation was declared as a non-invasive one, to pick up the agreement of regional or institutional Scientific Ethical Committee was not necessary.

In creation of subgroups in addition to the child' calendar age (CA < 7.51 years at the time of first investigation) the total independence of the samples was the determinative condition.

The final 400 children were ordered into three subgroups, but one child was classified only into one subgroup.

1. Those boys were ordered into the normal subgroup (in what follows: G1) who did not take part in the elevated level physical education and their family did not get regular governmental social support (n = 175). The organised physical activity in this sample was the curricular school physical education exclusively. Their prevalence in out of school physical activity was out of range of interpretation. The name normal subgroup can be misleading, because they were definitely hypoactive.

2. The physically more active subgroup (G2) consists of those children who took part continuously in the special physical education program during the observation period (n = 115). This grouping criterion was not uniform by schools or settlements. The possible two extremes were: As first, the child should meet the some physical ability requirements. These were determined by the schools and tested in spring time before the beginning of academic year. As second, the children were accepted according the rank order of their application. Although these children were physically more active (their organised, obligatory, curricular physical activity was 14·45 minutes in a decade), but they could not be classified as being athletic ones.

3. The third subgroup contains the children with governmental social support (G3; n = 110). The official basic criteria of social support are set by the valid Hungarian low (1997/31. §). These are:

- unemployment benefit,
- regular municipal financial support,
  child welfare subsidy,
- single parent family,
- chronic child disease, or
- more than three children in the family.

For the anthropometric characterisation traditional human biological techniques (accepted by the international literature) were used. The constitution was described by the metric and plastic indices introduced by Conrad (1963). For the quantification of nutritional status the body mass index, relative body fat content and the lean body mass were calculated. The biological development of the children was classified according to the differences between the morphological and calendar ages.

The physical ability levels were assessed by the scores reached in 30m dash, standing long jump, fist-ball throw, 400m run and 12-minute-run-walk test. For the joint evaluation of motor performance the suggestions of Szabó (1977) were followed.

A s a first step of statistical analysis the conventional descriptive and comparative were calculated. For the evaluation of slopes in the age-related developments the standardised betas (transformation of linear regression coefficient) were compared.

Results and discussion

▪ The used grouping criteria had not significant or human biological effects on the slopes (speeds) of increase in height. We should note further the children with regular social support were significantly shorter in all eight observations. The genetic influence on shorter stature can be excluded on the basis of statistical probabilities. The consistent differences were evaluated as environmental effect.

▪ The G1 (normal) children represent the heaviest subgroup in this comparison. The slope of age-related body weight gain was also the fastest in this sample. We should stress, however, the yearly body mass accumulation was significantly faster in the G3, than in the physically more active children. By the between-sample differences and the various speeds of increase a well-established conclusion cannot be drawn. This requires the results of comparison of between-group characteristic nutritional status. The lower initial mean body

mass mean in the subgroups of physically active children is basically the consequence of preliminary selection procedure.

▪ The mean body mass index in the G2 samples was consistently and significantly lower than those in the hypoactive samples. The speed of increase of BMI in the normal and socially supported subgroups was statistically the same, but these calendar age-related slopes were remarkably greater than in the more active subgroup. The nutritional status of the individual can only be estimated with only a great error additionally the relative body fat content cannot be assessed by the calendar age and body mass index.

▪ The mean relative body fat content was statistically the same in the G1 and G3. These means were significantly higher than those in G2. Interestingly there were no differences among the speeds of depot fat accumulation. The prevalence of overweight and obese boys in the normal and socially supported subgroups was high by every qualification basis. The observed means and prevalence were slightly greater in these two samples than in the relevant Hungarian publications. We should note the mean body fat content of our physically more active children was significantly greater than the characteristic means 25-30 years ago. It can be qualified as positive that by the joint qualification of height, body mass and relative body fat content the lean body mass of G2 children was the greatest, and the age-related increase of this indicator was faster than in the hypoactive samples. The mean body composition of G1 and G3 boys was critical already at the time of first observation. According to the high initial fat means and the fast increase of depot fat content the hypoactive boys are living with a definite health risk. The fast rate of fat accumulation and the hypoactive lifestyle are in close relationships consequently these attributes are also the consequences of the environmental factors.

▪ Subsequent means of morphologic constitution and the age-related changes of growth type indices in the comparison of hypoactive – more active comparisons were statistically different, in spite the absolute between-group variability moderate in general. The more leptomorphic constitution of our subject coincides with the characteristic consequences of secular growth trend. The generation differences are still remarkable in Hungary during the past decades. The growth type of nowadays children is more leptomorphic than 25-30

years ago, but their bone-muscle development is only apparently similar. Following the distorting effects of depot fat the growth type of our hypoactive children is unambiguously leptomorphic and hypoplastic. The age-related speed of increase of the fat-corrected plastic index in G2 was significantly faster than in the other two groups compared. The speeds of increase in the hypoactive groups were statistically the same. The obviously negative consequences of secular growth trend were provably smaller. In contrast to the earlier observations the preliminary (above all physical performance-based) selection did not have effects on physique characteristics, but the respective effects of regular physical activity were marked. We should highlight the increase in body linearity (described by the metric index) was significantly slower and the speed of bone-muscle development was faster in G2 than in the other compared two samples.

Our hypothesis concerning to body built, body composition and also the age-related changes of these characteristics can be hold without restriction.

The means of 30m dash times were identical in the two hypoactive samples by all the possible evaluation bases. The running performance of PE children was significantly better in every observation time, but the elevated level of physical activity did not influence the age-related speed of increase. It cannot be excluded that the only the quantity (but not the quality) of physical activity was greater. Nevertheless, the judgement of performances is unambiguous. The mean performances in the two hypoactive subgroups were remarkably slower than in the reference samples. However, the mean performances in G2 were not above the respective averages o f the reference. These means basically only equals with mean performances of the normal children investigated in 1977 and 1980. Whereas the real training effect cannot be assumed in our PE children, but the increase in co-ordination resulted in significant between-group differences. Sorry to say one of our results is different from the earlier observations. Namely, the trend of increase in 30m dash was not linear in our investigation between 7 and 11 years of age. This rather exponential pattern if increase (the running scores decrease with the increasing age) mirrors obviously the lack of necessary practice in our children. To the observed between-group differences, age-related developmental patterns and speeds in the tests standing long jump and

fist-ball throw can be related a human biologically similar contents and conclusions. The similarity may arise from the fact that the good performance in the mentioned two tests requires almost identical physical capabilities. Mean performances of the PE children were better already at the beginning of the study, and also the speed of increase was faster in this subgroup. The quality of these capabilities was not valuable in the hypoactive samples.

▪ Practically similar conclusions can be drawn by the means and slopes of cardio-respiratory indicators. It is important to note that the means in Cooper test of PE boys did not represent higher quality than those in the hypoactive subsamples.

All in all the very moderate physical performances generate some additional questions. At first, the body composition and motor characteristics of G1 and G3 are not astonishing results, since they are in very close relationships, and they are the consequences of the subjects hypoactive lifestyle before the school years. These statements based on the initial means. If we compare these statistics to the characteristic means of a really normal sample, the delay of our subjects is nearly one decimal year.

▪ The motor qualification of capabilities are not more advantageous if beside the direct performance scores we take into account the overall points as a basis of evaluation. These comparisons suggest that in the two hypoactive groups merely the so called “spontaneous development” cannot be observed.

The age-related stagnation in the developmental studies always indicate definite regression (delay or retardation). By the verified and general (not only one indicator is the basis of qualification) decrease in physical performance arises the problem of necessity of the reform in the content of school physical education, and additionally the enlargement of the basic programs in the PE teacher’s curriculums.

In so far as, one of the declared aim in the preparation of lower elementary school teachers is to deliver PE, they should know the physiological effects of basic movements and also the possible PE methods and tools.

The respective null- and research hypothesis can be hold without restriction.

▪ The relationship between physical activity and biological development was described in our study by the differences between

the chronological and morphological ages, and also by the speed of changes in these age indicators.

Basically two valid references are available in this arrangement. In so far as, the observed age differences are related to the slope = unity (this value is the necessary regression constant in the increase of calendar age), the inter-sample differences are moderate, but they can be proved. The speeds of increase in biological-based age character (namely the morphological age) were different in the compared three subgroups. We should evaluate the observed results: Although the physiological level of regular physical activity really does not modify the normal pattern of somatic development, but the permanent sedentary lifestyle results in retardation of somatic growth and development. The difference developed during four years between the morphological and chronological ages, was significantly greater in the more active and hypoactive comparison, than between the slopes of the two hypoactive (G1 vs. G3) sub-samples.

The hypothesis formulated in Chapter 1 can be hold just in part.

▪ The consistent delay in the somatic and motor development of children growing in families that needed of governmental social support was not only measurable during the four-year observation period, but the retardation was proven by simple statistical techniques.

The means of recorded characteristics of G3 children were consistently in that quarter of normal distribution pattern, which should be evaluated already as warning (in some cases critical) by the basis of some kinanthropometric consideration. The differences that were small or moderate by variables (or these were not significant) has summarised in the used joint parameters. Only one environmental effect cannot be highlight in this respect, but in our opinion the consequences of relative malnutrition are out of question.

As closing remarks of this summary we cite two conclusions.

“It is testimony, that pupils should mind their health, should live hygienic manner and they should be physically active, in this manner the learning of theoretical knowledges will also be more easy.”

“One of the main reasons of very bad health conditions of Hungarian peoples (beside the disadvantageous life standard) is that the common people do not know what the hygienic lifestyle does mean. Behind this lack, however, should be mentioned the board of manage-

ment and not the peoples. The peoples needs education, but very little happened in this direction."

The similar contents of my dissertation and the above cited sentences are not disputable. It is through-provoking, however, that the cited conclusions were written by Mr. Dezső Király (PE teacher) following his anthropo-physiologic investigation in 1925 (!).

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