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A NEW METHOD FOR EVALUATING CHILD'S GROWTH

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Abstract: *Growth-standards are based on the pinciple that the growth of a child may be considered as "healthy" if the child fully realizes his genetically determined potential of growth. A child's height is therefore evaluated against the height expected for his sex, age, parent's height, and his developmental advancement. Standards for body height are constructed as ($M \pm 1.65\ S_g$), where M means the respective group-mean, and S_g is the genetical variance, estimated by the Twin Method. Body weight is evaluated on the basis of a physical fitness criterion. Standards of weight, for a given height and body build, are the same form except that M then means optimal weight, i.e. weight associated with greatest physical fitness. Growth standards of this sort should be constructed on the basis of anthropological parameters of children growing in favorable living conditions.*

Key words: *Growth standards; Method; Body build.*

Introduction

Physical development of an individual is a process throughout which one's genetic potential fulfills and undergoes modification in a particular environment. Growth-standards are based on the principle that growth of the child may be considered as "healthy" if the child fully realizes his genetically determined potential for growth. Conditioned standards which describe physical development of children according to their predispositions, can be estabilished in various ways: (1) for all the children in the country, (2) for the children reared up in the optimum conditions, (3) for the children originating from a given region or a social group. Unfortunately, each of those attitudes is lame and inconsistent. Let us apply a two-step evaluation in which a growth-standard, i.e. with a hypothetic phenotype of a child brought up in the optimum conditions and sharing the same genetic developmental pattern with the examined subject. This evaluation is crucial, because it reveals deficient living conditions of the subject and shows a correct and desired development pattern of the child. Next, the child's development should be evaluated by a subpattern, i.e. a pattern with somewhat reduced parameters, that is such ones which are accesible for a given child in a particular environment. Genetic load of body size in a child is predictable from his parent's height. Since children of the same couple are not genetically alike, variability of children's body height can be evaluated from genetic variance, calculated from body height differences in twin pairs. Because reconstruction of growth-standards for all the individuals within the population is impossible, therefore for the sake of convenience, common standards are required for groups of individuals sharing similar genetic potentias, regarding, for instance a particular trait like tempo of growth or body size.

The aim of this paper is to propose a new method for constructing growth-standards and a two-step system of evaluating child's growth.

Growth-standards – A method

Physical development of the child is judged by his actual body height and weight. Body height of the examined subject is evaluated in comparison with the conditioned parent-allowed-for standards. Generally those standards are based on regression equations with the values of mid-parent-child correlations coefficients which are assumed as r=0.5. Because the process of development is usually stimulatled by two groups of genes (Tanner 1962), one responsible for body size and the other for the tempo of growth, therefore, body height of the examined individual should be compared to tempo-conditioned standards. Those standards are constructed from the child's position in puberty standards or from skeletal age standards. Growth-standards considering main genetic aspects of maturation can be evaluated from the multitrait equation.

$$H_{exp} = a_1 \cdot X_1 + a_2 \cdot X_2 + a_3$$

where X_1 is the average height of the child's parents and X_2 is the child's maturity level. The range of normal development of the child is evaluated from genetic variance, obtained in twin studies:

$$V_g = V_{DZ} - V_{MZ}$$

The development of the child is considered normal if the value of his height for age falls within the bracket of 90 per cent of genetic variability of his actual body height.

$$(H_{exp} \pm 1.65 \cdot S_g), \text{ where } S_g = \sqrt{V_g}$$

Example: A boy, aged 14 years, is 140 cm tall, his mid-parent stature being 160 cm. He is delayed in maturation, and his score on the scale of sexual maturation is only 4 points (the scale used was based on the sum of scores describing development of pubic hair (1–5 pts), arm-pits (1–5 pts), and penis (1–5 pts). Expected body height is thus 144 cm. Because the assumed genetic variance is 11.5 cm (Wrocław Longitudinal Twin Study; Bergman 1987), the 5–95 centile range of the expected values for this boy equals 138.4–149.6 cm. This example shows that the boy, albeit fairly short among his peers in the population, grows correctly in respect to his predispositions. To a final evaluation of his body height we need a standard based on the data on children brought up in the optimum conditions.

Body weight of the individual is mostly related to body height and body build, thus the expected body weight must be determined by the combination of those two factors. The impact of body height may be replaced, if necessary, by the relative body weight index which is weakly correlated with body height (Billewicz 1962), and facilitates determination of body mass for subjects of various body build. Somatotype method, conveyed by Parnell's analysis, can be applied to the evaluation of development of children with different body build (Welon 1984), but this method is rather complicated. Instead, we may employ a single index based on a few simple measurements and in this way describe massiveness of body build. The proposed T index has the following advantages:

$$T = \frac{(tl-tl) . (xi-ts) . 10^2}{(B-v)^2}$$

(1) It changes slightly at school age, 7 to 18 years; (2) Body build type, determined by the T index is relatively constant in youth; (3) The index T is strongly correlated with relative body mass. All these statements had been evidenced by the longitudinal data (Welon 1990a). Due to its advantages, the index is convenient for the description of body build type. By the application of the index, we may compute the expected body mass value and determine the range of its variability, similarly as we have already calculated the range of the standards for body height. It must be noted that those walues refer only to children brought up in the optimum conditions, because exclusively in this instant body mass is correct. Since the data indispensible for the construction of optimum standards are unavailable, we may employ standards for suboptimum conditions in which the correct body mass of an individual is determined by a functional criterion, where the correct body weight is described as the range of relative body mass values of physically fit individuals.

An example of the evaluation of correct relative body mass in the 13-year-old girls, which belong to two different body types: T_1 – slim, and T_3 – strong, definied by the T index, is at fig. 1. Correct body weight was determined by physical fitness criterion, being the sum of cathegorized (1–3) values of 6 tests: shuttle run, 60 m dash, high jump, long jump, baseball throw andd 2 kg ball throw. Brackets of correct relative body mass, determined by usig the values of average fitness, are for the slim-build girls 165–192 and for strong-build girlsl 185–203 (Welon 1990b).

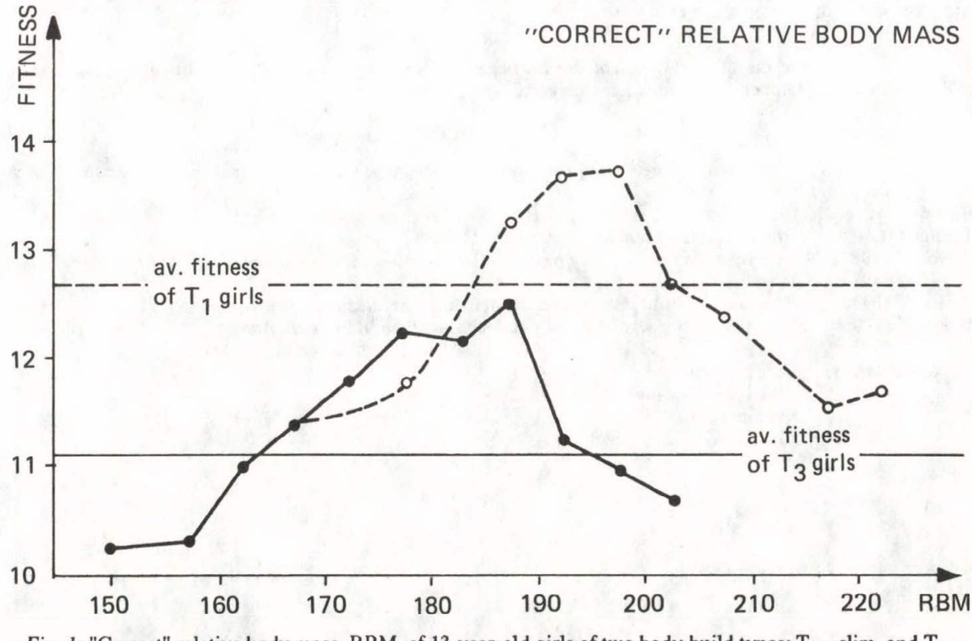

Fig. 1: "Correct" relative body mass, RBM, of 13-year-old girls of two body build types: T_1 – slim, and T_3 – strong, determined by physical fitness criterion, being the sum of 6 nomelized tests. RBM = (weight) : (height)^2.

System of evaluation of child's physical development

The system of evaluation of physical development of a child is two-step: in reference to a correct growth-standard and in reference to a suboptimum growth standard in which actual living conditions of the family considered.

(1) If the child falls within the range of expected for height values along with its genetic variability, then he fulfills his growth potential and develops correctly. If the child, with a given body mass and height and body build type falls within the range of the values for the correct body mass, it is evident that the ratio of body mass and body height is proper, for physically fit individuals.

(2) The child may not fit in growth-standards because of poor health or impaired living conditions. If the child's body height and body mass falls within the range of appropriate suboptimum growth standard we may assume that in this environment the whole genetic potential is fullfilled to the maximum. The development of such a child may be then considered correct, in respect to his environment. Suboptimum growth standards may be constructed for main social groups significantly differing in children developmental level. Thus substandards for such groups should have adequately reduced parameters. For example, if village boys are on the average 4 cm lower then appropriate correct growth standard, then this difference marks the substandard diminished value for height.

Growth standards assessing "correctness" of physical development in children provide also the explanation why the given child has that particular body height or weight and not the other (tall or short parents, early or late maturation, slim or strong body build of the child). Besides these standards evaluate the child's body mass by means of a functional criterion.

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