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Determination of the somatotype by a method using only three indexes*

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The exact determination of somatotype, using the comprehensive method, requires special knowledge and experience. On the other hand, the visual judgment of the type is inaccurate, particularly in adolescents. In view of the above, a new method has been developed which is accurate and easy to apply. It employs three indexes only: relative body weight, sitting height to height ratio, and amount of subcutaneous adipose tissue.

These indexes are of high diagnostic value in terms of the somatotype's components. They also indicate hypersthenic or hyposthenic body structure, the degree of obesity and a possible presence of dysplasia.

The new method was applied retrospectively to 158 boys and 167 girls, age 13 to 18, whose somatotype had been determined in advance according to the comprehensive method. The comparison shows high similarity between the results of the two methods: the basic somatotype is identical in about three out of four, and comparable in the remaining cases, with conflicting results in only 1.4% of the cases.

Key words: somatotype, puberty, hypersthenia, hyposthenia, dysplasia, obesity.

Introduction

The morphological type (somatotype) is the basic human physical characteristic. It is related to some specific physiological patterns, temperamental traits and disease-predisposition. The somatotype is closely related to the onset of puberty [1]. On the basis of this finding, a method for predicting the onset of puberty has been created [4].

The basic morphological type is unchangeable. However, some modifications, with age, could occur, which usually strengthen the basic somatotype's characteristics [2].

* Due to restrictions in the number of pages acceptable for publication, this paper is a condensed version of the method description and does not present in detail all the results obtained during the study.

There are a number of different classification systems of morphological types. That of Sheldon has been used in this work. The human body consists of derivatives of three embryonic layers: endodermal, mesodermal and ectodermal. On the basis of the prevailing presence of one or another constituent, Sheldon [8] describes three basic morphological types: endomorphic, mesomorphic and ectomorphic, and two mixed types; endo-mesomorphic and ecto-mesomorphic. The mesomorphic type, in its pure form, cannot be seen as often as the remaining two basic types. A balanced type can be observed, as well, in which neither of the basic types prevail.

Objectives

The exact determination of somatotype, using the comprehensive method of investigation, requires 15-20 measurements, calculation of about 10-12 indexes and interpretation of the typological profile. That method is time consuming and requires special knowledge and experience. On the other hand, the visual judgment of somatotype, applied by school physicians, pediatricians, sport instructors, etc. is inaccurate, particularly in adolescents because of age-differences in the onset of puberty, as well as the dramatic changes in height, relative body weight and amount of subcutaneous adipose tissue during puberty [3, 5].

In view of the above, a new method for determining the somatotype has been developed. The method is accurate and easy to apply. It employs three indexes only:

— Relative body weight (Weight to Height ratio)
— Sitting height to Height ratio
— Amount of subcutaneous adipose tissue.

The new method was applied retrospectively to 158 boys and 167 girls from Sofia, Bulgaria, whose somatotype had been determined with the comprehensive method as a base line. The type of each individual was confirmed with the same method several years later.

It was found that the above indexes are of high diagnostic value in determining somatotype. They also indicate hypersthenic or hyposthenic body structure, the degree of obesity and a possible presence of dysplasia.

Description of the Method

There are four consecutive steps in evaluation of the somatotype of each individual:

1. Obtaining four anthropometric measures;
2. Calculating three indexes;
3. Determining the class of of each index;
4. Comparing the classes of two pairs of indexes.

First step: The anthropometric measurements are: height, sitting height, body weight, and skin fold thickness. A caliper, preferably with constant pressure, is used for measuring the skin folds. There are different methods of skin measurement. G. Baumann's method [6] was applied in our work since the other methods [7, 9] use skin folds, which are strongly related to the sexual differentiation and the latter method has a poor correlation to relative body weight index. Baumann measures three thoracic folds, two of them located mid-way between the spine and the scapula (right and left sides) and one — in the axillary line unilateral.

Second step: The following three indexes are calculated:

— Relative body weight;

— Sitting height / Height;
— Arithmetic mean of the three skin folds.

There are several methods for calculating relative body weight. Presenting the weight as a percentage of the stature (weight / height or weight / height ^{2}) is inappropriate because a length (height) or an area (height ^{2}) are incomparable with a volume (weight). The best equation is that of Hooton: height (cm) / $\sqrt[3]{\text{weight(kg)}}$ which eliminates the heterogenity of the components. Lower number of Hooton index indicates higher relative body weight and vice versa.

Third step: The classes of each index is determined by comparison with the standards for the respective population. If appropriate standards do not exist, the limit of the classes can be established on the basis of the group under investigation, providing that the group consists of a statistically acceptable number of people. Standard deviation (SD) is used to determine the limits of the classes as follows: Class —3 = below —2.5 SD; Class —2 = from —2.5 to —1.5 SD; Class —1 = from —1.5 to —0.5 SD; Class 0 (Zero) = from —0.5 to +0.5 SD, etc. Since the adipose tissue does not have a normal Gauss-Laplace distribution, the classes of this index are based on the percentiles as follows: 38% of all classes are included in Class Zero, 24% - in each of Class —1 and Class +1. 5 - 6% - in each of Class —2 and +2, and the remaining 2 — 3% - in Class —3 or +3.

Fourth Step: The classes of the following two pairs of indexes are compared:

-First pair: Relative body weight vs. Sitting height;

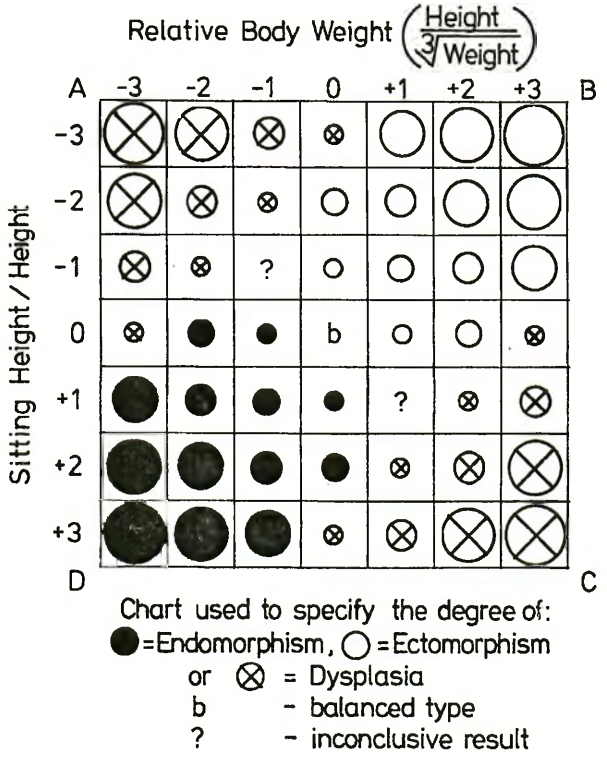

Fig. 1. Chart showing the type and the degree of endomorphism or ectomorphism (First Pair of indexes)

-*Second pair:* Relative body weight vs. Adipose tissue.

A co-ordinate chart serves as a tool of comparison (one chart for each pair). Classes of one of the indexes are plotted along the x-axis and the classes of the other one — along the y-axis. The crossing point of classes of the two indexes is employed to determine the somatotype constituents.

The chart of the *First Pair* of indexes (Fig. 1) graphically shows the type and the degree of endomorphism (direction toward Point *D*), or ectomorphism (direction Point *B*). Position in the middle square (*b*) indicates a balanced type, i.e. neither endomorphic nor ectomorphic derivatives prevail. The closer the position is to point *D* or *B*, the stronger is the degree of the respective somatotype component. Position in the squareslabelled with a question-mark indicate inconclusive results, i.e. one of the indexes is slightly on the endomorphic side, while the other one is on the ectomorphic side. Practically, individuals in such a position could be classified as belonging to the balanced type.

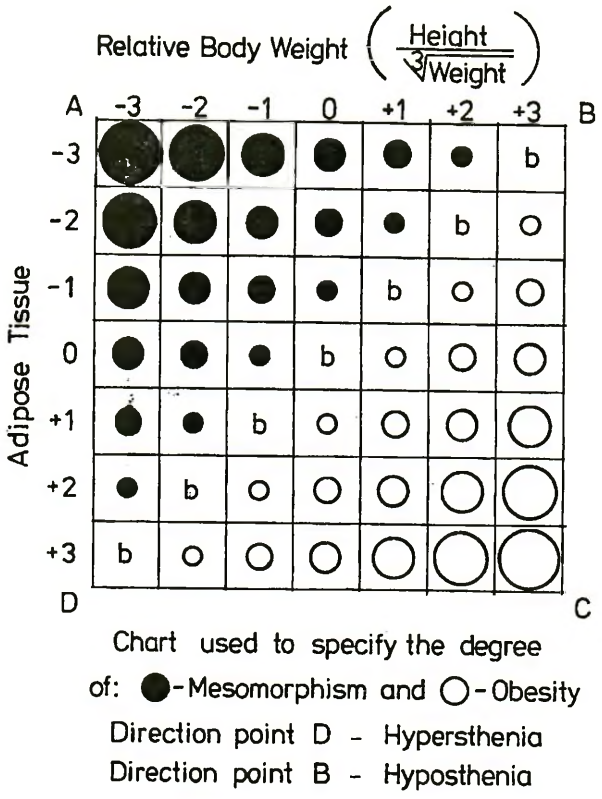

Fig. 2. Chart showing the type and the degree of mesomorphism or obesity (Second Pair of indexes)

Positions closer to Point *A* or *C* indicate dysplasia. According to the typology, dysplastic is an individual, whose signs of endomorphism and ectomorphism are simultaneously strongly expressed, for example: an individual with high relative body weight and short sitting height. Dysplasia was established, in our investigation, in 14 out of 325 youngsters.

The chart of the *Second Pair,* i.e. relative body weight vs. adipose tissue (Fig. 2) indicates the degree of mesomorphism and obesity. A position in the diagonal *B-D* squares (marked *b*) shows a good balance between the mesomorphic elements, which are basically the skeleton and muscles, and the adipose tissue. However, positions closer to Point *D* indicate corpulent, hypersthenic body build, while those in the Point *B* neighbourhood are indicative of gracile, slender, hyposthenic body structure. A position closer to Point *A* expresses a stronger presence of the mesomorphic component, while those near Point *C* indicate obesity of different degree.

For better interpretation of somatotype, the position of each individual on both charts should be compared. If the mesomorphic component is strongly expressed while the other components, i.e. endomorphic and ectomorphic (Chart 1) are bal-

anced or one of them is slightly prevailing, the type is clearly mesomorphic. The adipose tissue should be interpreted differently in endomorphes and ectomorphes. Endomorphic individuals normally have more adipose tissue, while ectomorphic individuals have less fat tissue.

Accuracy of the Method

The somatotypes determined by both methods, i.e. the described one and the comprehensive one, were compared in all 325 youngsters under examination. The comparison showed high similarity between the results obtained by the two methods. The basic somatotype was identical in about three out of four, and comparable in the remaining cases. According to our method, the latter cases belong mostly to the balanced type. The difference is due to the fact that the comprehensive method uses much more indexes (most of them of secondary importance) which could shift the basic type slightly in either direction. Overall, the difference in the type, determined by both methods, is minimal and without practical significance.

Erroneous information, i.e. endomorph presented as ectomorph or vice versa, was found in only 1.4% in the boys and 1.3% in the girls. Such low error should be considered acceptable when a method using only three indexes is applied.

Conclusion

The described method has a high diagnostic power. All the constituents of the somatotype can be assessed. The morphological diagnosis is a direct result of the position of the individual on both charts. Each square of the charts specifies the type and the degree of the morphological components. The interpretation is so easy that the determination of the somatotype may be done even by people without special knowledge in the field of morphological typology.

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