AN INDEX FOR THE EVALUATION OF GROWTH IN CHILDREN*
A.R. Chaursia and J. Pattankar
Gwalior

The relationship of rate of growth and adequacy of the body development to physical fitness has been widely recognised. The comparison of physical measurements of a given child with those of other healthy children has been a standard way of measuring and evaluating the growth of the child. However, it has been found difficult to select truly representative figures of measurements in children because generally the standards become out of date very soon. What is needed, therefore, is the construction of some type of index which remain independent of time. In other words, a quantity giving the measurement of growth in absolute terms should be used. Many such types of indices have been suggested previously. These include width-length index, trunk extremity index and a number of height weight indices. While the first two are subjective in nature, the height weight Indices though most widely used, are open to a number of criticisms, the most important being that the growth of the human body is not linear and therefore height alone is not a suitable measure for the relative increase in the size of the body. In fact with age the body develops in all the three dimensions and hence length alone cannot be used for the purpose.

The most important fact in the study of the growth of the child is that the child like others has its own growth pattern. Its growth will resemble that of other children but its timetable is strictly its own. For this reason, mean or average values of physical measurements should not be considered more than the point of reference. And it is more important to know that a child is consistently maintaining a given relationship to other children of its age and sex than to know that it is tall or short.

There are two aspects of studies on growth pattern, the cross-sectional one and the longitudinal one. It is always advantageous to evaluate the same child over a period of time. This is actually the study of growth pattern means. Since the standards of physical measurements become out of date very soon, these measurements are of practically little help in longitudinal studies. In the absence of any reliable index for the measurement of growth it is desirable to go deeper into the different aspects of growth and to try to construct a reliable index for the measurement. This in summary is what this paper aims at.

A suitable criterion for the measurement of growth is the body build of the child. Naturally, an underdeveloped child will have a poor body build as compared to a well grown up one. Retardation in the growth of the child will automatically be represented by the deterioration in the body build. A similar interpretation can be drawn in the case of accelerated growth.
The best measure for body build is the weight per unit volume of the body as it gives an idea regarding the body composition. But the major problem in using the above weight per unit volume criterion is the measurement of the volume of the body. One method suggested is the water replaced by the body while floating. Incidentally, this is the most accurate method for the measurement of volume but on the other hand it is too much subjective in nature and therefore cannot be used in large scale surveys and in field trials. We now give a method for determining the volume of the body on the basis of some physical measurements and then use it to obtain an index for the measurement of growth.

Mathematical theory

Basically the human body can be regarded as a cylinder with an elliptical base (Figs. 1 and 2), the length of which is equal to the height of the body. The ellipse at the base of the cylinder is characterized by a smaller minor axis and a more prominent major axis so that the focii of the ellipse are near its vertex and so the eccentricity is approximately equal to one. The volume of the cylinder is given by the formula

\[ V = \text{area at the base} \times \text{length of the cylinder} \]  

If \( a \) is the length of the major axis and \( b \) that of the minor axis then

area at the base = area of the ellipse = \( \pi a b \) where \( \pi \) is a constant. Substituting this value in (1) we get

\[ V = \pi a b \times \text{length of the cylinder} \]

since \( \pi \) is a constant

\[ V \propto a b \times \text{length of cylinder} \]  

If \( e \) is the eccentricity of the ellipse then is known that

\[ e = \sqrt{a^2 - b^2} \]

or

\[ b = a \sqrt{1 - e^2} \]