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Standards from Birth to Maturity for Height, Weight, Height Velocity, and Weight Velocity: British Children, 1965

Part II*

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(C) Whole-year Velocity Standards: Chronological Age-based and Individual Type

We now consider how to construct velocity standards, to answer our second question 'Has this child's rate of growth been within normal limits?' We are again confronted with the alternatives of plotting against chronological or developmental age at adolescence and we have adopted the same solution as before. First we give, in the conventional manner, centiles plotted against chronological age, over the whole age span. These are calculated simply from two measurements a year apart, without using further longitudinal data. They depend on a two-occasion longitudinal study, nothing further. At adolescence these standards are greatly scattered by the phase-difference effect. If we know nothing about a boy except that he is 12 years old and grew 3 cm. during the last year, we must plot 3 cm. at 11·5 years and interpret this according to the chronological age centiles. If, however, we know that he is mid-pubescent, or that his skeletal age is 14·0 years, then in theory we could make a more effective interpretation if we had the appropriate standards.

We have to remember, however, that in one important respect velocity standards differ from distance ones. In velocity standards a child does not have the same strong tendency to stay in the same centile position from one age to another; there is always a contrary tendency to a move from the outer centile positions towards a more central position in the subsequent year. Though a child can follow the 60th or even 70th centile of velocity from the pre-school years till maturity and end up a large but normal adult, a child who follows the 97th centile for very long would become pathologically enormous. Another way of saying the same thing is to note that while in general the correlations of height at age 5, say, with height at the subsequent age, i.e. 6, is of the order of 0·9, the correlation of height gain from 5 to 6 with gain from 6 to 7 is only around 0·3. This is not to say that patterns of continuously increasing or decreasing velocities do not occur, particularly in pathological cases; but velocity plots must be regarded in a more episodic way than plots of distance.

Chronological age velocity standards of whole-year velocity. To obtain the conventional centiles we began by plotting the yearly increments of height and weight of the Child Study Centre series and the six-monthly increments of the Harpenden Growth Study on probability paper to see whether or not the increments were Normally distributed. Up to adolescence all the height increments were closely fitted by straight lines, but during adolescence considerable curvature occurred, indicating the presence of fairly complex deviations from Normality in the distributions, as indeed would be expected, particularly at ages when some children have actually stopped growing.

The standard deviations of the height increments of these two sets of data from birth to age 8 are plotted on the left hand side of Fig. 16. The lower line represents the smoothed curve of the whole-year SDs from the Child Study Centre, together with similar values from Heierli (1960), which are consistently a little lower, and from Deming and Washburn (1963). The sexes are averaged in all instances. The upper line gives the smoothed curve of six-monthly SDs from the Harpenden Growth Study, with earlier points from the Child Study Centre, Heierli, and Deming data. The six-monthly increments have a consistently higher variability than the yearly increments (when both are converted to cm./yr.). This is so even in the same children. It occurs because the season of the year exerts a considerable effect on the growth of some, though not all, children; in the extreme case a child may grow in height during the spring at one and a half times its rate of growth during the autumn

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