Archives of Disease in Childhood, 1988, **63,** 1179–1180

Annotations

Special growth charts

The use of a reference chart for plotting sequential changes in height and weight is now a familiar routine for most health professionals involved in the care of children and increasingly for many parents as well. The idea of 'following a curve' is widely understood and a child who is 'falling off the chart' becomes the source of many an anxious consultation. In the Third World this idea has been exploited in a dramatic way by presenting the centile chart as a 'road to health'. There are many children in the United Kingdom, however, for whom the Tanner and Whitehouse charts are not necessarily ideal.[1]

A special problem exists for children who have an intrinsic growth disorder making the standard height and weight ('distance') charts inappropriate as reference material. Many of these conditions are so rare that to construct a growth chart of 'normal' growth would be a major, although not impossible, task. Others are so variable in their clinical expression that the population is insufficiently homogeneous for this kind of approach. There remain a number of conditions, however, where clinical management of individual children is greatly helped by appropriate reference growth charts.

Down's syndrome

The growth of children with Down's syndrome has now been systematically studied for more than 60 years. Three studies by Brousseau (1928), Benda (1949), and Øster (1953) were analysed by Roche and appeared to show an improvement in stature of about 1 SD over this time period.[2] All these studies, together with that by Rarick and Seefeldt,[3] were of institutionalised children who all showed considerably poorer growth than the home reared group studied by Cronk.[4] The recently published growth charts by Cronk *et al* undoubtedly provide the best reference data available.[5] The centile charts are sex specific and cover the periods 1 to 36 months and 2 to 18 years. Growth rates were slowest in infancy and again at adolescence compared with normal children. At birth lengths and weights are reduced by about 0·5 SDs but by 3 years are down by 2 SDs for length and 1·5 SDs for weight. This tendency to be overweight compared with normals continues throughout childhood. The adolescent growth spurt is also less and is mostly accounted for by reduced leg growth. Children with Down's syndrome who have congenital heart disease tend to be 1·5 to 2·0 cm shorter and about 1 kg lighter. In general, all children with Down's syndrome appear to show greater variation in growth rates than normal children, so they may not remain on the same centile.[2 6] This may arise from the effects of congenital heart disease, recurrent infection, or chronic upper airways obstruction.

Turner's syndrome

Growth studies in Turner's syndrome are complicated by the fact that many patients will have had treatment with anabolic or sex steroids (and recently growth hormone) and that only about 65% of patients with Turner's syndrome have the chromosome constitution 45,XO. Ranke *et al* have analysed the growth data from 150 untreated children and could find no difference between cases with 45,XO and other karyotypes,[7] and this finding is supported by another study of the growth of 45,XO and 45,XO/46,XX subjects.[8] Children with Turner's syndrome show a reduction in birth weight and length of around 540 g and 2·8 cm respectively. Height velocity in the first three years is close to normal but from then on there is a progressive decline in height velocity up to the age of about 14 years. Although only a minority of patients with Turner's syndrome show any significant pubertal growth spurt, they continue growing for longer so height gain in the second decade is only a little below normal. The growth data of untreated girls from four European studies have been combined with some British data to produce a growth chart showing mean (2SD) compared with normal girls.[9]

Other sex chromosome abnormalities

The growth of boys with Klinefelter's syndrome (47,XXY) is the best documented of the other sex chromosome abnormalities. The mixed longitudinal study by Schibler *et al* gives individual growth data, the mean height curve, mean height velocities, and upper/lower segment ratios in 54 boys.[10] In the prepubertal period the mean height follows closely

to the 75th centile of the standard chart and this increased height is due to increased leg growth from infancy. Similar findings are reported by others who have also noted a reduced head circumference.[11 12] Pubertal progression is slower but prolonged compared with controls. The Edinburgh cytogenetic study reported the growth of 14 boys with 47,XYY and found it similar to that of the boys with Klinefelter's syndrome, although the head circumferences did not differ from controls.[12] Girls with 47,XXX on the other hand appeared to have normal growth.

Skeletal dysplasias

A comprehensive study of height, height velocity, upper/lower segments, and head circumference in 403 individuals with classical achondroplasia has been published by Horton *et al.*[13] Height velocity rapidly declines during the first two years of life to reach and stay at about the third centile resulting in a progressive loss of height compared with normals. This is almost entirely due to growth failure in the lower segments in the first five years though subsequently growth of the trunk is subnormal as well, especially in girls. It was not possible in this study to assess the extent of the pubertal growth spurt. The head circumference charts are very useful for determining the onset of hydrocephalus, which may be difficult to diagnose in achondroplasia. The same group have also published growth curves for the rarer skeletal dysplasias including diastrophic dysplasia, spondyloepiphyseal dysplasia congenita, and pseudoachondroplasia.[14] These data are based on a limited number of observations from a small number of patients and so are presented as mean (SD).

Using special growth charts

Clinically the most useful form of reference growth chart is the centile chart. While not all the data in these studies have been presented in this form, provided means and SDs are available for different ages, it is possible to construct similar growth curves using appropriate statistical smoothing techniques.[9] The cross sectional data that have been reported in most of these studies will usually be adequate for the prepubertal period though additional longitudinal data may be needed during puberty. Examples of the uses of these special growth charts include adult height prediction and assessing the effects of various forms of treatment in Turner's syndrome,[9] and the detection of growth failure in Down's syndrome. A novel approach to the use of special growth charts are the theoretical weight control charts constructed by Griffiths and Edwards for boys with Duchenne muscular dystrophy.[15] With disease progression and declining activity, muscle tends to be replaced by fat so that increased weight places an extra strain on already weakened muscles. Their charts have been designed as a guide to dieting. There is still a considerable need for improvement in presentation and accessibility of existing data and for further studies especially of growth velocities and of growth during puberty in many of these conditions.

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