Infant growth charts

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Abstract

Detection and monitoring childhood growth disorders requires the correct use of growth charts. A check on the accuracy of every point plotted on Gairdner-Pearson growth charts of premature infants in a hospital paediatric department was carried out. Errors beyond set limits were recorded. Of 611 points plotted on the growth charts of 50 premature infants who were at least 1 year of age at the time of the study, there were 173 (28.5%) points plotted in error. Altogether 94.7% of the errors occurred when plotting the age along the horizontal (X) axis of the growth chart, irrespective of whether weight, length, or head circumference was being measured. There was no evidence that the errors caused appreciable changes in clinical management.

Potential sources of error identified were failure to adjust for prematurity correctly, inaccuracy in calculating age, and the use of the logarithmic scale. These errors could be serious and it is important that there should be greater vigilance in using growth charts. The use of age calculators or improved chart design is recommended. Assessment of the use of other growth charts in different settings is also suggested.

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Growth charts for weight, head circumference, and length have become an essential tool in the surveillance of childhood growth. Specific charts exist for males and females from 24 weeks gestational age up to 19 years. Growth charts for infants are valuable in monitoring early health and in the detection and monitoring of infants who fail to thrive or have abnormal head growth.

Growth charts are widely used by various

professional health workers and are incorporated in parent held records. Growth charts serve only as an aid to overall clinical management but errors in plotting points may result in inappropriate responses from health care workers. These may lead to unnecessary referral and investigation, or misplaced reassurance. The medicolegal consequences are potentially serious.

There is scant literature on the skills of health workers in the clinical use of growth charts.¹ This study was designed to assess the degree of accuracy in plotting points on infant growth charts in a hospital paediatric department.

Methods

The hospital case notes of 50 infants, born less than 37 weeks' gestation, and who were at least 1 year old at the time of the study, were randomly selected. Gairdner-Pearson growth charts are used in our department for all children less than 2 years of age.²

Every point that the original health professional plotted on each growth chart was rechecked by two of the authors (KC and UP) using information from the case notes. Measurements documented in the case notes were replotted on the growth charts after cross checking, and then compared with the original entry. Errors equal to or beyond the set limits (table 1) were recorded. These limits were arbitrary but were chosen after consideration of the reasonable level of accuracy expected in normal everyday practice and with reference to the grid markings on the growth chart.

Results and discussion

Tables 2 and 3 show the number of plots and errors made for weight, head circumference, and length. There are fewer recordings for length reflecting current practice in our department of not measuring infants' length in the first few months of life. Weight and head circumference measurements are obtained routinely at follow up clinic appointments and usually recorded together on the growth charts.

There was a wide variation of the number of points plotted on each growth chart reflecting the diverse clinical needs of the patients assessed. Although all of the infants in the study were premature and at least 1 year of age, many required little follow up or monitoring after the initial perinatal period and hence had fewer points recorded on their growth charts.

Of 611 points plotted on the 50 growth charts used in this study, 173 (28.5%) were plotted outside the set error limits. There may

Table 1 Error limits

	Growth chart axis	Error limit
Age	X	1 week
Weight	Y	500 g
Length	Y	1 cm
Head circumference	Y	1 cm

Table 2 Total numbers of points plotted and total errors detected

	Total No of points plotted (mean, SD)	Total No of errors (mean, SD)	Error rate (%)
Weight	273 (5.46, 2.78)	70 (1.48, 2.82)	28.6
Length	88 (1.76, 1.83)	33 (0.78, 1.88)	35.2
Head circumference	250 (5.0, 3.0)	70 (3.66, 2.48)	25.3
Total	611 (12.12, 6.99)	173 (3.66, 4.34)	28.5

Table 3 Maximum degree of error plotted and mean error margin

	No of errors	Maximum degree of error	Mean (SD) error margin
Weight			
X axis (weeks)	67	9	2.33 (1.59)
Y axis (kg)	3	1.4	0.8 (0.52)
Total	70	—	—
Length			
X axis (weeks)	29	6	2.43 (1.69)
Y axis (cm)	3	9	4.5 (3.42)
Total	32	—	—
Head circumference			
X axis (weeks)	65	9	2.29 (1.51)
Y axis (cm)	5	3	1.5 (0.87)
Total	70	—	—

be a number of reasons why growth recording is inaccurate including the accuracy of the measurements themselves. The accuracy depends upon individual skill and care of the operator as well as correct operation and use of appropriate equipment. In this study we assumed that the measurements were accurate.

The majority of errors detected in this study (94.7%) occurred when plotting the age of the child along the horizontal (X) axis of the chart irrespective of whether weight, length, or head circumference was being measured (table 3). These errors occur as a result of miscalculation of the age of the child by failure to correct for prematurity when plotting chronological age or by simple misreading of calendar dates. A correctly calculated age could be plotted incorrectly because of an error in reading the scale along the appropriate axis and may occur more readily when using a logarithmic scale as used on Gairdner-Pearson charts in this study. Some mistakes occur along the horizontal axis, propagated by using the initial misplotted value as a reference point from which subsequent values were calculated and then incorrectly plotted.

There were few errors made in plotting values along the vertical (Y) axis of the chart (table 3). This probably reflects the fact that

no mental calculations or correction factors are required, and the graph is linear in this axis.

Error rates of up to 35.2% (table 2) are indeed alarming but what is the clinical relevance of such a finding? The maximum degree of error of points plotted for length, head circumference, and weight on the horizontal and vertical axis shown in table 3 is clearly not acceptable. Although a number of children did attain new centile lines on correction of some of the misplotted points, we were reassured that in no child was clinical outcome or management significantly altered by the erroneous plotting. We are, however, concerned by the results. Our set standards for plotting centile charts are not restrictive and should be easily attained in clinical practice. This study has highlighted the need for greater vigilance in using centile charts, especially when estimating and plotting age and where correction for prematurity is necessary. Points plotted should be dated and double checked, particular attention being made to gestational age at birth which should be clearly indicated on the chart as a point of reference. Aids such as an age calculator and improved chart design may reduce errors further.

Assessment of the use of other charts in different settings is warranted and all health care workers involved in monitoring children's growth and development should be aware of the potential sources of errors in plotting centile charts highlighted in this study and strive to ensure accurate and clear records at all times.

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- 2 Gairdner V, Pearson J. Revised Gairdner-Pearson growth charts. *Arch Dis Child* 1985; **60**: 1202.