

## Growth and very low birth weight

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**SUMMARY** Information on the likelihood of catch up growth in poorly grown very low birthweight children is sparse. The centiles for weight, height, and head circumference were recorded at both 2 and 5 years of age for 135 very low birthweight children and 42 normal birthweight children. At both ages significantly more children of very low birth weight were under the 10th centile for weight and height. Children of birth weight under 1000 g were more often under the 10th centile for weight at 5 years compared with those of birth weight 1000-1500 g. Mean incremental weight gain between 2 and 5 years was significantly less for very low birthweight children. Mean increment in weight from 2 to 5 years was less for very low birthweight children who had been under the 10th centile for weight at 2 years; children who had been under the 10th centile for height also had lower mean height increments. The growth centiles achieved by 2 years of age were useful predictors of poor growth at 5 years, with perinatal data of marginal importance. Only six of 43 (14%) children with a weight at 5 years of age under the 10th centile were small for gestational age at birth. Very low birthweight children who had a weight or height under the 10th centile at 2 years of age usually remained in this category at 5 years with no evidence of catch up growth.

In early childhood, many very low birthweight survivors (birth weight under 1501 g) are reported to grow poorly.<sup>1 2</sup> Parents of such children often ask whether catch up growth will occur but there is little information available on this subject for children born in the era of sophisticated neonatal intensive care.

To assist in counselling parents of poorly growing children of very low birth weight, we assessed the physical growth of a cohort of these children and a comparison group of normal birthweight children when aged 2 years and again at 5 years. The growth centile attained and incremental growth over this period were examined for evidence of catch up growth; we also looked for possible early predictors of poor growth at 5 years of age.

### Patients and methods

The cohort of very low birthweight children comprised 154 consecutive survivors of birth weight under 1501 g born in The Royal Women's Hospital, Melbourne between 1 October 1980 and 31 March 1982. Anthropometric data were available at both 2 and 5 years for 135 children (87%), but for one of these children the height at 2 years was not available. Of the 19 children not included in the

study, two were too disabled to measure weight and height accurately, six were untraced or the parents refused assessment, and 11 had growth data at 2 or 5 years only. The mean birth weight of children was 1183 g and mean gestational age was 29.3 weeks. Very low birthweight children with paired growth data were seen at the mean ages of 2.2 and 5.2 years, corrected for prematurity.

Sixty children of normal birth weight (birth weight over 2500 g) were selected for longitudinal study in a quasirandom fashion, using the terminal digits of the mother's unit record number. These normal birthweight children were born in the same hospital during the same years as the very low birthweight children. Growth data were available for 42 (70%) children at mean ages of 2.0 years and 5.1 years. One child of normal birth weight was too disabled to measure accurately, two had growth data at one age only, and 15 were untraced or the assessment was refused.

Weight, standing height, and occipitofrontal head circumference were measured in a standard fashion.<sup>3</sup> Centile positions for weight and height were derived from standards for an urban multiracial Australian community.<sup>4 5</sup> Centiles for head circumference were obtained from the composite charts of Nellhaus.<sup>6</sup> The increments in weight, height, and head circum-

ference between the ages of 2 and 5 were computed.<sup>7</sup> Because the interval between assessments was not exactly three years in every child, the increments in growth between 2 and 5 years of age were divided by the time between assessments to calculate the average annual growth increment.

Data were analysed by computer using SPSSX package programs. Differences in proportions were analysed by corrected  $\chi^2$  tests; differences in normally distributed continuous data were compared by *t* tests. To compare data not normally distributed, Mann-Whitney U tests were used. McNemar tests were used to determine whether significant proportions of children changed from 2 to 5 years relative to the 10th centile for growth. Discriminant analysis was used to obtain predictors of growth measurements under the 10th centile at 5 years of age. In the three discriminant analyses the dichotomous dependent variables were weight, height, and head circumference at 5 years, respectively above or below the 10th centile. Perinatal independent variables included growth centiles at birth, birth weight, gestational age, use of mechanical ventilation, necrotising enterocolitis, recurrent apnoea, duration of ventilation and of oxygen treatment, bronchopulmonary dysplasia, day of lowest postnatal weight, social status, duration of maternal education, and immigrant status. Mothers were designated as immigrants if they were born in a country where English was not the first language. The additional independent variables available at 2 years of age included growth centiles at 2 years, the number of days of hospital readmission, number of hospital readmissions, and number of episodes of wheezing. A *p* value less than 0.05 on any statistical test was regarded as significant.

## Results

Table 1 shows the number of children with size

indices below the 10th centile. There were significantly more children of very low birth weight with weights and heights under the 10th centile at both 2 and 5 years but not for head circumference. For these children the proportion with a head circumference under the 10th centile increased significantly from 2 to 5 years ( $p=0.0002$ ); over this period, children of birth weight 1000–1500 g deteriorated significantly ( $p=0.008$ ) with a similar but non-significant trend for those of birth weight under 1000 g. A significant deterioration in head growth was not observed in the normal birthweight children; the proportions relative to the 10th centile did not change significantly for any other growth measurement between 2 and 5 years, either for the children of normal or very low birth weight.

Significantly more children of birth weight under 1000 g were below the 10th centile for weight and height at 2 years compared with children of birth weight 1000 to 1500 g; however, this difference persisted at 5 years only for weight.

Using the 3rd centile as a more stringent criterion for poor growth, at 5 years of age 27 out of 135 (20%) of the very low birthweight children were below this point for weight, 14 out of 135 (10%) for height, and 11 out of 135 (8%) for head circumference; 12 out of 135 (9%) of the very low birthweight children were under the 3rd centile for both weight and height. No child of normal birth weight was under the 3rd centile for any of these measurements.

We next investigated the centile ranking, rather than the percentage of children under the 10th centile (as was shown in table 1); children in both groups were compared using Mann-Whitney U tests. The very low birthweight children had significantly lower centiles for weight at 2 years ( $z=-5.90$ ,  $p<0.0001$ ), and at 5 years ( $z=-4.69$ ,  $p<0.0001$ ), for height at 2 years ( $z=-5.44$ ,  $p<0.0001$ ) and at 5 years ( $z=-3.57$ ,  $p=0.004$ ), but for head circumference only at 5 years ( $z=-2.85$ ,  $p=0.004$ ).

Table 1 No (%) of children with size indices under the 10th centile at 2 and 5 years of age

Group	Weight		Height		Head circumference	
	2 years	5 years	2 years	5 years	2 years	5 years
Normal birth weight (n=42)	0	2 (5)	0	2 (5)	0	3 (7)
Very low birth weight (n=135)	35 (26) $p=0.005\ddagger$	43 (32) $p=0.009\ddagger$	34 (25)* $p=0.007\ddagger$	31 (23) $p=0.02\ddagger$	4 (3) NS	17 (13) NS
Very low birth weight:						
Birth weight 500–999 g (n=28)	16 (57)	16 (57)	13 (46)	9 (32)	0	5 (18)
Birth weight 1000–1500 g (n=107)	19 (18) $p=0.001\ddagger$	27 (25) $p=0.003\ddagger$	21 (20)* $p=0.008\ddagger$	22 (21) NS	4 (4) NS	12 (11) NS

\*No height at 2 years for one child, birth weight >1000 g, normal height at 5.

†Normal birth weight compared with very low birthweight children.

‡Infants of birth weight 500 to 999 g compared with those of birth weight 1000 to 1500 g.

The mean incremental growth between the assessments at 2 and 5 years of age is shown in table 2. Increments in weight were significantly less in children of very low birth weight compared with those of normal birth weight, but were similar for height and head circumference, indicating no evidence of catch up in height or head growth and a significant deterioration in weight gain. Children of birth weight under 1000 g had similar growth increments compared with those of birth weight 1000 to 1500 g (table 2). Those children of very low birth weight who had weighed under the 10th centile at 2 years had significantly lower weight increments compared with the remainder; those who had been under the 10th centile for height at 2 years had significantly lower height increments (table 2).

Possible predictors of growth that was under the 10th centile at 5 years of age were determined using discriminant analyses. The corresponding growth centile achieved by 2 years was the most important clinical and statistical predictor; a few perinatal variables and one health variable accounted for a small percentage of the variance, which was of statistical rather than clinical significance. Predictors of a 5 year weight under the 10th centile were weight centile at 2 years (29.2% of variance,  $p=0.0001$ ), birthweight centile (2.3% additional variance,  $p=0.007$ ), immigrant status (2.4% additional variance,  $p=0.02$ ), and the use of mechanical ventilation (2.9% additional variance,  $p=0.007$ ).

For 5 year old height under the 10th centile, predictors were the 2 year height centile (19.3% of variance,  $p=0.001$ ) and immigrant status (2.4% additional variance,  $p=0.025$ ). For the 5 year head circumference under the 10th centile, significant predictors were head centile at 2 years (28.3% of variance,  $p=0.0001$ ) and the number of wheezing episodes in the first 2 years of life (2.6% additional variance,  $p=0.021$ ).

Only six out of 43 (14%) children with a weight at 5 years under the 10th centile were also under the 10th centile for birth weight. There were 12 children who had birth weights under the 10th centile and by 5 years six remained in this category, four had grown normally, and two were untraced.

### Discussion

Children of very low birth weight, judged by the centile attained in early childhood, have been reported to grow poorly in weight and height, with fewer problems with head growth.<sup>1 8-12</sup> Those of birth weight under 1000 g are even more likely to grow poorly in weight and height.<sup>13 14</sup> These reports, however, do not provide the data on incremental growth or growth velocity that are needed to assess whether poorly growing survivors of very low birth weight catch up in later childhood.

In our study, very low birthweight children at 2 and 5 years of age were significantly lighter and

Table 2 Mean annual growth increments between 2 and 5 years

Group	Mean (SD) weight (kg/year)	Mean (SD) height (cm/year)	Mean (SD) head circumference (cm/year)
Normal birth weight (n=42)	2.29 (0.84)	7.58 (1.21)	0.70 (0.33)
Very low birth weight (n=134)	2.00 (0.67)	7.55 (1.02)	0.69 (0.23)
	t=2.02 p=0.048	NS	NS
Very low birth weight:			
Birth weight <1000 g (n=28)	1.97 (0.74)	7.64 (0.96)	0.73 (0.23)
Birth weight 1000-1500 g (n=106)	2.02 (0.66)	7.52 (1.04)	0.68 (0.22)
	NS	NS	NS
Very low birth weight:			
Weight <10th centile at 2 years (n=35)	1.75 (0.49)		
Weight >10th centile at 2 years (n=100)	2.09 (0.70)		
	t=-2.56 p=0.012		
Height <10th centile at 2 years (n=34)		7.13 (0.62)	
Height >10th centile at 2 years (n=100)		7.68 (1.09)	
		t=-2.96 p=0.007	
Head circumference <10th centile at 2 years (n=4)			Insufficient for analysis

shorter than their normal birthweight controls. Moreover, compared with our own normal birthweight population, standards for a multiracial Australian urban population,<sup>4</sup> and the charts of Tanner *et al*,<sup>3</sup> those under the 10th and 3rd centiles for weight and height were substantially over represented. Children of birth weight under 1000 g were significantly lighter at 5 years compared with those of birth weight 1000 to 1500 g.

There was no convincing evidence of catch up growth for very low birthweight children between 2 and 5 years. Parents of these children who are growing poorly at 2 years may ask for reassurance that catch up growth will occur; rather than provide this reassurance, our data show that weight or height increments between 2 and 5 years are likely to remain below average, perpetuating poor growth.

We previously reported that very low birthweight children, born in the era when mechanical ventilation was not utilised and when survival prospects were lower (1966–70), attained near normal growth centiles at 14 years of age.<sup>15</sup> These children are not comparable with survivors of the intensive care era; consequently, the current cohort should be followed up to determine what changes in growth occur during puberty.

Significantly more children of very low birth weight had a head circumference under the 10th centile at 5 years compared with 2 years. We speculate that the decrease in centiles of these children may relate to their skulls assuming a less dolicocephalic shape from 2 to 5 years and are not necessarily a reflection of decreased brain growth.

Being under the 10th centile for any of the three size indices at 5 years was not dominantly determined by being under the 10th centile for that index at birth. The 43 children with weights under the 10th centile at 5 years included only six who were small for gestational age at birth. The centile attained for weight at 2 years was the predominant 'predictor' of poor weight gain over the next three years, with other factors of only marginal clinical importance.

With the increasing availability of synthetic growth hormone, it is likely that this treatment will be evaluated in children who do not have demonstrable growth hormone deficiency. Our study indicates that, without intervention, children of very low birth weight who are small at 2 years will generally remain so at 5 years. If a trial of growth hormone is contemplated these children provide a readily identified risk group for poor growth; they can usually be identified by 2 years of age and they

are unlikely to exhibit spontaneous catch up in weight or height over the next three years.

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