required on the part of health professionals in identifying and dealing with this problem. Health professionals' attitudes to dieting and weight control are of great importance as well, given that the distinction between 'normal' dieting and an eating problem is a tenuous one.

The author thanks Leslie Swartz for his important contribution to the preparation of this article.

REFERENCES


Low-birth-weight infants in the Cape Peninsula

A follow-up study at the age of 3 years

J. E. DEENY, C. D. MOLTENO, D. L. WESTCOTT, H. DE V. HEESE, D. EVANS

Summary

A sample of coloured children from the Cape Town City Council area who had been of low birth weight, although a weight appropriate for gestational age, was examined at the age of approximately 3 years. The children were compared with a control group of similar social background who had been of normal birth weight. Growth parameters were compared with the National Center for Health Statistics centiles. The low-birth-weight infants had compensated well. Although they were lighter, shorter in stature and had lower intelligence quotient scores than their normal-birth-weight contemporaries, when corrected for prematurity the growth parameters and IQ did not differ significantly from those of the controls. Six per cent of the preterm infants had major and 15% minor handicaps. Infants with very low birth weights (< 1500 g) had no more handicaps than those with low birth weights. Iron deficiency was detected in 18% of the children overall but all those who were anaemic were from the low-birth-weight groups. Between 1 and 3 years of age the low-birth-weight infants had more illnesses but no more hospital admissions than the controls.

Infants of low birth weight (LBW) (< 2500 g) are at risk for defective development and are more susceptible to infection during early life than those of normal birth weight. The prevalence of LBW infants is therefore of importance to paediatricians as well as to the planners of health care services, and is generally accepted as reflecting the health status of the community. In Britain the percentage of LBW infants is approximately 7% of all births.2 The US Collaborative Perinatal Study3 reported between 6% and 16% for the various communities studied. In 1982, in 13% of the live births in the hospitals of the Peninsula Maternity and Neonatal Services of the

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University of Cape Town the infants weighed less than 2500 g. These services are responsible for approximately 80% of all deliveries for the coloured population in the Cape Peninsula. The Peninsula Maternity and Neonatal Services provide primarily for low-income mothers who have no medical aid cover.

The spectrum of LBW includes infants who are small for gestational age (SGA) and those who are appropriate for gestational age (AGA). Local studies have followed the progress of infants of very low birth weight (VLBW) (500 - 1499 g) who were managed during the early neonatal period with intravenous alimentation, and also a group of full-term SGA infants. In addition, a sample drawn from a cohort of 1000 babies of all birth weights born during May 1976, were followed up for 5 years. To extend these studies the health and well-being of a group of VLBW and LBW coloured infants resident in the Cape Peninsula, and a control group of normal-birth-weight (NBW) infants were evaluated at the age of approximately 3 years.

**Subjects and methods**

A group of 59 LBW infants were selected soon after birth according to a quota-sampling method from the neonatal units of the Peninsula Maternity and Neonatal Services. Three groups were identified by birth-weight category: 1000 - 1499 g (VLBW); 1500 - 2500 g (LBW); and more than 2500 g (NBW). All were AGA as determined by the Dubowitz scoring method and thrived during the neonatal period. Neonates with congenital abnormalities, severe neonatal disease requiring intensive care, and twins were excluded. The ages of the children ranged from 2 years 9 months to 3 years 7 months at the time of examination. The children were all urban coloured families in the lower socio-economic groups as determined by occupation and income. Approximately half of the mothers of infants in both the LBW and control groups were not educated beyond Standard 5.

During the first year of life contact with the mother and her infant was maintained by a research social worker (D. L. W.). Three of the children died during infancy. The birth weights of these children were 1200 g, 1480 g and 1750 g and the respective causes of death were sudden infant death syndrome, pneumonia and viral myocarditis. There were no further deaths between 1 and 3 years. Five of the original children were not seen at 3 years — 3 had moved away from Cape Town and 2 apparently healthy children were still living locally but the parents refused to participate further in the study. Thus the progress and health status of 51 children were measured: 16 VLBW, 17 LBW and 18 NBW.

The factors chosen for assessment of health and well-being for each birth-weight category were growth, development, iron status and morbidity since the age of 1 year. The anthropometric data obtained were weight, height and head circumference. The children were weighed on a calibrated Seca scale and all measurements were made according to standard methods. The data were expressed as percentages of the expected values based on the 50th centile of the National Center for Health Statistics figures. Statistical testing using independent t-tests was performed.

Development was assessed by the administration of the Merrill-Palmer test by a clinical psychologist (D. E.) the day before the physical examination and blood collection for the haematological studies. The indices of iron status were haemoglobin, mean corpuscular volume (MCV), serum ferritin and protoporphyrin. Levels of normality for this age group as quoted by Sadowitz and Oski, and Nathan and Oski were used to determine iron deficiency.

Morbidity was assessed by recording: (i) hospital admissions and non-hospitalised illness from 1 year of age; (ii) findings on examination of the child (carried out by J. E. D.); and (iii) further investigations where indicated.

**Results**

The birth-weight categories of the 51 children studied and their ages and sex ratios are given in Table I. Percentage of expected weight and height for actual age and age corrected for prematurity, and the weight for height ratio were calculated for each child. The VLBW children were lighter and shorter and the LBW children were shorter than those in the control group (P < 0.05 in both cases). However, these differences did not remain statistically significant when the age was corrected for prematurity (Table II). The catch-up in weight in preterm infants (uncorrected for gestational age) is shown in Fig. 1. Even when no correction was made for gestational age, most of the infants were well within the normal percentiles. The head circumferences were compared for each weight group. There were no significant differences between the groups.

An IQ score was obtained on the Merrill-Palmer test for each child. The differences between the IQs of the VLBW and LBW groups and the NBW group were statistically significant (P < 0.01 and P < 0.05 respectively) (Table III). There were 7 children with IQs less than 80, and they were all in the premature groups. None of the infants born at full term had IQs below 80. However, when

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**Fig. 1. Weight catch-up of preterm infants.**

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**TABLE I. STUDY SAMPLE**

<table>
<thead>
<tr>
<th>Category</th>
<th>VLBW</th>
<th>LBW</th>
<th>NBW</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight at birth (g)</td>
<td>1000-1499</td>
<td>1500-2500</td>
<td>&gt;2500</td>
<td>—</td>
</tr>
<tr>
<td>No. at hospital discharge</td>
<td>19</td>
<td>20</td>
<td>20</td>
<td>59</td>
</tr>
<tr>
<td>No. at 1 year</td>
<td>17</td>
<td>19</td>
<td>20</td>
<td>56</td>
</tr>
<tr>
<td>No. studied at 3 yrs</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>51</td>
</tr>
<tr>
<td>Girls</td>
<td>6</td>
<td>7</td>
<td>9</td>
<td>22</td>
</tr>
<tr>
<td>Boys</td>
<td>10</td>
<td>10</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td>Age (mo.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>38.1 ± 2.9</td>
<td>39.3 ± 2.5</td>
<td>38.0 ± 2.5</td>
<td>38.5 ± 2.6</td>
</tr>
<tr>
<td>Range</td>
<td>33-43</td>
<td>34-42</td>
<td>34-43</td>
<td>33-43</td>
</tr>
</tbody>
</table>
TABLE II. GROWTH PARAMETERS OF CHILDREN BY BIRTH WEIGHT

<table>
<thead>
<tr>
<th>Weight</th>
<th>Height</th>
<th>Weight/height ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% for correct age</td>
<td>% for actual age</td>
<td>% for correct age</td>
</tr>
<tr>
<td>VLBW</td>
<td>89.6±5.8</td>
<td>87.4±6.3</td>
</tr>
<tr>
<td>LBW</td>
<td>94.3±12.3</td>
<td>91.3±10.8</td>
</tr>
<tr>
<td>NBW</td>
<td>95.9±13.2</td>
<td>96.1±13.0</td>
</tr>
</tbody>
</table>

TABLE III. IQ SCORES OF CHILDREN BY BIRTH WEIGHT

<table>
<thead>
<tr>
<th>VLBW</th>
<th>LBW</th>
<th>NBW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>85 ± 10.8</td>
<td>88 ± 10.4</td>
</tr>
<tr>
<td>Range</td>
<td>64-105</td>
<td>64-108</td>
</tr>
<tr>
<td>Corrected for age</td>
<td>90.3±11.2</td>
<td>92±10.7</td>
</tr>
<tr>
<td>Range</td>
<td>67-110</td>
<td>67-113</td>
</tr>
</tbody>
</table>

the ages were corrected for prematurity. The differences between the IQ scores were not significant.

Iron deficiency was classified according to the scheme in Table IV. Two premature and 2 full-term infants were iron-deficient but not anaemic. However, all 4 iron-deficient anaemic infants were in the premature groups. Mean IQs were calculated for these categories but the differences between the groups were not significant when tested by analysis of variance.

The illnesses experienced by the children since the age of 1 year were recorded. Of the 51 children, 2 had had 2 hospital admissions and 6 had had one hospital admission over a 2-year period. This gives an average of 4 admissions per year or an 8% hospitalisation rate. There was no over-representation of the VLBW or LBW group. There was no prolonged hospital stay, a total of 23 bed-days having been utilised by the whole group over 2 years. The problems requiring admission were both medical and surgical.

The problems requiring admission were both medical and surgical. These included elective surgery such as orchidopexy and ENT procedures, and burns, motor vehicle injury, phimosis, bronchitis and gastro-enteritis.

A broad spectrum of minor and major ailments occurred over the 2-year period. There were 30 separate problems or diagnoses identified, of which 15 were clearly primary care problems, such as feeding problems, upper respiratory tract infections, tonsillitis, dental problems, and papular urticaria. The remaining conditions, among them bronchitis, measles, anaemia, and viral hepatitis were managed on an ambulatory basis. Seventy-eight per cent of VLBW and 79% of LBW infants had two or more illnesses as opposed to 58% of controls. There were fewer illness episodes in the control group.

Family size and housing density were compared for the three groups as a factor in recurrent illness. Although there was a trend for more overcrowding in the VLBW group homes, there were no significant differences in either of these parameters.

The findings at this age showed that of the 51 children, 14 were well, 32 had a minor chronic problem, and 2 had a major chronic problem (1 cerebral palsy, 1 moderate asthma). Subjects with problems which had not been previously diagnosed or for which they were not receiving treatment were referred for appropriate treatment. Such problems included tonsillar and adenoidal hypertrophy requiring surgery (3), strabismus (1), and chronic otitis media (1).

Discussion

Developmental follow-up of at-risk neonates gives important feedback on the efficacy of perinatal care. Regional studies need to be undertaken periodically as services available and standards of care vary over time and geographical area. This study's findings refer to preterm AGA infants (with certain exclusions) born in Cape Town during 1980-1981. The social circumstances, health and utilisation of services during the first year of life have already been described. Both the VLBW and LBW infants were lighter and shorter than those in the NBW group at 3 years of age. There was, however, no difference in head circumference between the groups. These findings agree with those of Kimble et al. who reported on the growth to age 3 years of VLBW infants who were AGA. The growth of the infants in their study appeared to be roughly parallel to but below the mean growth of normal

TABLE IV. CLASSIFICATION OF IRON STATUS

<table>
<thead>
<tr>
<th>Iron status</th>
<th>Haemoglobin (g/dl)</th>
<th>MCV (fl)</th>
<th>Protoporphyrin (µg/dl RBC)</th>
<th>Ferritin (µg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>≥ 11.5</td>
<td>≥ 75</td>
<td>&lt; 80</td>
<td>≥ 12</td>
</tr>
<tr>
<td>Depleted</td>
<td>≥ 11.5</td>
<td>≥ 75</td>
<td>&lt; 80</td>
<td>&lt; 12</td>
</tr>
<tr>
<td>Deficient</td>
<td>≥ 11.5</td>
<td>&lt; 75</td>
<td>≥ 80</td>
<td>&lt; 12</td>
</tr>
<tr>
<td>Deficient anaemic</td>
<td>&lt; 11.5</td>
<td>&lt; 75</td>
<td>≥ 80</td>
<td>&lt; 12</td>
</tr>
<tr>
<td>Probable thalassaemia trait</td>
<td>&lt; 11.5</td>
<td>&lt; 75</td>
<td>&lt; 80</td>
<td>≥ 12</td>
</tr>
<tr>
<td>Normochromic normocytic anaemia</td>
<td>&lt; 11.5</td>
<td>≥ 75</td>
<td>&lt; 80</td>
<td>≥ 12</td>
</tr>
</tbody>
</table>

*Protoporphyrin 3 µg/g Hb = 80 µg/dl RBC.
children between 1 and 3 years of age. The head circumferences were, however, closer to the normal. In contrast with our study the growth differences in Kimble et al.'s study cases remained even when the age was corrected for prematurity. Our finding that differences did not remain significant when ages were corrected is consistent with the study of Forslund and Bjerre. 

The question of whether to correct developmental test scores for the degree of prematurity remains controversial. Siegel\textsuperscript{11} claims that correction for prematurity may be appropriate in the early months but not after 1 year of age. Miller et al.\textsuperscript{12} believe otherwise. Their study supports the view that correction for prematurity may mask abnormailities and advises that both uncorrected and corrected values for the developmental quotient should be recorded. In this study IQs were significantly lower at 3 years of age in LBW infants than in controls but when corrected for prematurity the significance disappeared. This finding is therefore similar to those relating to physical growth.

Lower IQs have been consistently reported in premature infants at follow-up. In a large collaborative study of infants born in 1977 - 1978 Kitchen et al.\textsuperscript{13} found a mean IQ of 88.8 in VLBW infants as opposed to 98.8 in controls. Major handicaps (cerebral palsy, deafness, blindness, epilepsy or an IQ below 70) occurred in 18% of the children. Our infants were all AGA, weighing between 1000 and 2000 g at birth. Six per cent of them had major and 12% minor (IQ 70 - 80) handicaps. The mean IQ and rate of handicap were similar in our VLBW and LBW groups. 

Maternal need for additional iron increases dramatically during the third trimester of pregnancy and the ferritin concentration of cord blood in infants born before 32 weeks' gestation is far lower than in full-term infants.\textsuperscript{20} Mean values for haemoglobin concentration and red cell count were shown to be lower in LBW and much lower in VLBW infants than in NBW infants despite iron supplementation.\textsuperscript{21} It is not surprising therefore to find that 3 of the 4 iron deficient and anaemic infants in this study were of VLBW and the other was in the LBW group. What may be surprising is the fact that iron deficiency was still a problem at the age of 3 years. However, there was no correlation between iron depletion without anaemia and birth-weight categories. There were no significant differences in IQs but the numbers were too small in the iron deficiency groups with and without anaemia to draw conclusions.

The three deaths and highest hospital admission rate occurred during the premature infants' first year of life. This agrees with the finding reported in the literature.\textsuperscript{22} Between 1 and 3 years of age there was no difference in hospital admission rate between groups. The annual admission rate of 8% agrees with the findings of Roghmann.\textsuperscript{23} The VLBW and LBW infants did, however, have significantly more illnesses over this period than the NBW infants. Although premature infants in Cape Town were smaller, had lower IQs and more iron deficiency than the NBW controls, their growth and intelligence parameters with two exceptions were within normal limits. The VLBW had shown significant growth catch-up. In terms of handicap the VLBW were no worse off than the LBW infants. Follow-up programmes are an essential part of perinatal and infant care. Monitoring and prevention of anaemia would reduce morbidity. In addition, awareness of IQ deficiencies could pre-empt schooling difficulties. Such programmes should therefore include documentation of not only neurodevelopmental outcome but also health, socio-economic environment and utilisation of health care facilities.

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