Nutrition Research

Protein Energy Malnutrition in Coloured Children in Western Township, Johannesburg

Part II. Prevalence and Severity

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SUMMARY

Anthropometric measures of growth and serum albumin and transferrin concentrations were assessed in 344 Coloured children aged from 1 to 16 years living in Western Township, Johannesburg. About one third of children were diagnosed as suffering from protein energy malnutrition (PEM) on the basis of weight-for-age below the 3rd percentile. The prevalence varied in different age groups, and was highest in the group aged from 5 to 8 years. A high prevalence of abnormally low head circumference measurements was found in the 1-year-old children (41.2%). The severity of PEM was relatively mild, as reflected by the serum albumin and transferrin concentrations, and the almost total absence of oedema among the children. A positive association of breast feeding and income with growth was noted.


There is a recent and growing awareness of the importance of malnutrition, not just as a medical problem, but as an economic and developmental problem on a national level. Many formulations for analysing and proposing solutions to this problem have been put forward, but the first step towards realistic planning is an appraisal of the nutritional status of the target population. An important feature of such an appraisal is that the data collected should reflect community patterns, rather than concentrate on groups, e.g. those who attend schools, clinics or hospitals, which are easily studied, but which may introduce severe bias into the sample.

The objectives of this study were to provide a clear indication of the prevalence and degree of protein energy malnutrition (PEM) in a random sample of Coloured children aged from 1 to 16 years living in Western Township, Johannesburg. In addition, these children were examined in their social and ecological context. The association between nutritional status and various social factors can be an important indication of areas suitable for intervention by community health workers, and some pointers in this direction were noted.

SUBJECTS AND METHODS

The random selection of 100 families with children aged 1-16 years has been described. The children of these families were seen by appointment at the City Health Clinic in Western Township, where they were measured and venous blood was obtained. Informed consent was obtained from a parent, usually the mother, in all cases.

After the initial analysis of the data derived from the original 100 families, a further random sample of 59 1-year-old children was drawn from birth records. This was done to corroborate the findings of decreased weight and head circumference attainment in this important year of development. The relevant data on the 85 1-year-olds was pooled. There were 36 boys and 49 girls in this group.

Anthropometric Assessment of Protein Energy Malnutrition

Weight. Children were weighed on an accurate beam scale. Older children were allowed to wear underpants and brassieres. Weights were recorded to the nearest 100 g.

Height. Children under 2 years of age were measured while recumbent on a measuring board. Older children were measured while standing, by means of an anthropometer. Measurements were recorded to the nearest 0.1 cm.

Circumferences. Left mid-arm, head and chest circumferences were measured, the latter two only on children aged up to 36 and 60 months respectively. The arm circumference was measured when the child was standing, whenever possible. Measurements were made with a steel tape to the nearest 0.1 cm.

Skinfolds. Left triceps and subscapular skinfolds were measured with a Harpenden skinfold caliper, and recorded to the nearest 0.1 mm.

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from the Harvard and Iowa studies. The skinfold standards were based on measurements of English children by Tanner and Whitehouse. Mid-arm circumference standards were those suggested by Jelliffe.

**Biochemical Assessment of Protein Energy Malnutrition**

Serum, separated on the day the blood was drawn, was stored for up to 3 months at -20°C. Serum albumin and transferrin were measured by the technique of radial immunodiffusion, for which commercially-available plates (Behringwerke AG) were used.

**RESULTS**

**Original Group**

In the original group 285 children (96.6% of the eligible children from the 100 families) were studied. Distribution according to the area of residence and the age and sex of these children is shown in Table I. The distribution of children through the age groups was fairly even in the old area of the township, but in the new area there was a decline in the numbers of children in the older age groups. This reflects the age-sex distribution in the community.

| TABLE I. AGE-SEX DISTRIBUTION OF CHILDREN FROM 100 FAMILIES |
|-----------------|--|---|---|---|---|---|---|
| Age group (years) Boys | Girls | Boys | Girls | Boys | Girls | Boys | Girls |
| 1 - 4 | 25 | 23 | 25 | 17 | | | |
| 5 - 8 | 22 | 18 | 8 | 11 | | | |
| 9 - 12 | 30 | 33 | 7 | 9 | | | |
| 13 - 16 | 20 | 23 | 5 | 9 | | | |
| Total | 97 | 97 | 45 | 46 | | | |

Anthropometric measurements were considered to be 'abnormally low' if they fell below the third percentile value of the standards used, except in the case of mid-arm circumference, where 85% of the standard was the designated cut-off level.

Height, weight and mid-arm circumference are plotted against age, for boys and girls separately, in Figs 1 - 6. The prevalence of abnormally low anthropometric measurements is analysed in Table II. In this Table the results for boys and girls and for the two areas are combined. There were only two instances in which differences occurred between children of opposite sex and from different areas. There was a greater prevalence of low stature among children in the 5-8-year-old group in the old area (36.7%) than among those from the new area (0%) ($\chi^2 = 4.7373$, $P<0.05$), and 9-15-year-old boys had a higher prevalence of low stature (27.4%) than

![Fig. 1. Height plotted against age for boys of the original group. Upper line — 50th percentile; lower line — 3rd percentile.](image)

![Fig. 2. Height plotted against age for girls of the original group. Upper line — 50th percentile; lower line — 3rd percentile.](image)

**TABLE II. PREVALENCE OF ABNORMALLY LOW ANTHROPOMETRIC MEASUREMENTS IN ORIGINAL GROUP**

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Height (%)</th>
<th>Weight (%)</th>
<th>Mid-arm circumference (%)</th>
<th>Head circumference (%)</th>
<th>Chest circumference (%)</th>
<th>Triceps skinfold (%)</th>
<th>Subcapsular skinfold (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 4</td>
<td>11.2</td>
<td>22.2</td>
<td>13.3</td>
<td>36.2</td>
<td>16.7</td>
<td>1.1</td>
<td>0</td>
</tr>
<tr>
<td>5 - 8</td>
<td>18.6</td>
<td>52.2</td>
<td>8.5</td>
<td>36.2</td>
<td>16.7</td>
<td>15.3</td>
<td>1.7</td>
</tr>
<tr>
<td>9 - 12</td>
<td>22.8</td>
<td>48.1</td>
<td>26.6</td>
<td>13.9</td>
<td>7.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 - 16</td>
<td>12.3</td>
<td>28.1</td>
<td>22.8</td>
<td>10.5</td>
<td>8.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over-all</td>
<td>16.1</td>
<td>36.5</td>
<td>14.4</td>
<td>36.2</td>
<td>16.7</td>
<td>9.5</td>
<td>4.2</td>
</tr>
</tbody>
</table>
did the girls (10.8%) \( (\chi^2 = 5.1448, P<0.05) \). The data in Table II are presented in 4-year age groups. In most cases, the prevalence of abnormally low measurements did not change significantly with age, but 5-12-year-old children had a higher prevalence (49.3%) of low weight compared with the other children (24.5%) \( (\chi^2 = 1.8137, P<0.0005) \) and 9-12-year-old children had a higher prevalence (26.6%) of low mid-arm circumference compared with the others (14.6%) \( (\chi^2 = 4.8251, P<0.05) \).

Particular attention has been paid to the relationship between mid-arm circumference-for-age and weight-for-age, since the mid-arm circumference is easier to measure, is less dependent on accurate ages in the group under 5 years old and is said to be as useful as weight measurements in the detection of undernourished children. In Fig. 7 the percentage of standard of mid-arm circumference \( (y) \) is plotted against the percentage of standard weight \( (x) \) for each child. Although there is a strong linear relationship between these two variables \( (y = 0.44x + 54.58, r = 0.747, P<0.0001) \), when the abnormally low results are demarcated from the normals, it can be seen that 56.4% of the children whose weights were below standard had normal mid-arm circumference measurements, and that just over a fifth of the children who had abnormally low mid-arm circumferences were of normal weight. The same pattern held true when the data from the children under 5 years old were examined alone.

For epidemiological purposes, protein energy malnutrition may be considered present when weight-for-age falls below the third percentile (or 80% of standard weight).
In the absence of oedema or severe reduction in weight (less than 60% of standard weight) this form of PEM is called 'undernutrition' or nutritional dwarfing. By this criterion, 36.5% of all children were suffering from PEM, and it was most prevalent in the 5-8-year-old age group (Table II). Only 1 child had kwashiorkor (undernutrition, with oedema) and a further 3 were marasmic (their weight was less than 60% of standard weight).

The biochemical findings confirmed the mild degree of PEM. The mean (± SD) serum albumin concentration was 4.28 (± 0.40) g/100 ml and only 4 children had serum albumin concentrations under 3.5 g/100 ml. The mean (± SD) transferrin concentration was 287 (±46) mg/100 ml and only 2 children had levels below 200 mg/100 ml. Neither serum albumin nor transferrin concentrations showed a significant variation with either sex or age.

**Group Aged 1 Year**

Weight, mid-arm circumference and head circumference were measured in the enlarged group of 85 1-year-old children. The results are shown in Table III. There were no statistically significant differences between boys and girls. The means for each measurement were slightly higher for children from the new area compared with those from the old area, but the differences were not significant. In Fig. 8 head circumference is plotted against age for this group.

**Fig. 7. Weight plotted against mid-arm circumference (both expressed as percentage of standard). Horizontal line — 85% mid-arm circumference standard; vertical line — 3rd percentile for weight. See text for discussion.**

**Fig. 8. Head circumferences of girls (above) and boys (below), plotted against age for the 1-year-olds. In each plot, upper line — 50th percentile; lower line — 3rd percentile.**

The biochemical findings confirmed the mild degree of PEM. The mean (± SD) serum albumin concentration was 4.28 (± 0.40) g/100 ml and only 4 children had serum albumin concentrations under 3.5 g/100 ml. The mean (± SD) transferrin concentration was 287 (±46) mg/100 ml and only 2 children had levels below 200 mg/100 ml. Neither serum albumin nor transferrin concentrations showed a significant variation with either sex or age.

**Relationships between Ecological and Anthropometric Variables**

Relationships between ecological and anthropometric variables were examined in the original 100 families and standard correlation and partial correlation techniques were used for children aged 60 months and younger. The duration of breast feeding was the single most important variable for predicting weight-for-age ($r = 0.3446; P<0.001$) and mid-arm circumference-for-age ($r = 0.2055; P<0.05$). Total income per person per week correlated with weight-for-age ($r = 0.2718; P<0.005$), height-for-age ($r = 0.2456; P<0.01$) and mid-arm circumference-for-age

**TABLE III. ANTHROPOMETRIC DATA (1-YEAR-OLD CHILDREN)**

<table>
<thead>
<tr>
<th></th>
<th>Mean (kg)</th>
<th>SD (kg)</th>
<th>Abnormally low (%)</th>
<th>Mean (cm)</th>
<th>SD (cm)</th>
<th>Abnormally low (%)</th>
<th>Mean (cm)</th>
<th>SD (cm)</th>
<th>Abnormally low (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>9.94</td>
<td>1.41</td>
<td>25.0</td>
<td>15.2</td>
<td>1.0</td>
<td>11.1</td>
<td>47.4</td>
<td>1.8</td>
<td>44.4</td>
</tr>
<tr>
<td>Girls</td>
<td>9.97</td>
<td>1.51</td>
<td>22.4</td>
<td>15.2</td>
<td>1.3</td>
<td>10.2</td>
<td>46.8</td>
<td>1.6</td>
<td>38.8</td>
</tr>
</tbody>
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The high prevalence of abnormally low weight in the 1-year-old group is supported by the lower prevalence of children of abnormally low weight in the 1-year-old group (23.5%) than in older age groups (Table II).

The high prevalence of children of abnormally low weight in the early school-going age groups was associated with a parallel increase in the prevalence of abnormally low triceps skinfold thickness, indicating that a dietary energy deficit, and not simply a lack of protein, must be contributing significantly to the PEM picture. This is in keeping with observations made in several other countries. A school feeding-scheme which provides a balanced meal, rather than a concentrated protein supplement, at least to primary schoolchildren, would appear to be indicated. Such a scheme might ameliorate the poor educational attainment of these children.

The importance of breast feeding for a longer period and an adequate income level in preventing PEM has been demonstrated. These two factors, however, often work against each other. Mothers may stop breast feeding in order to work to increase the family income. A compromise is to advise mothers in this situation to continue partial breast feeding, before and after work, until the child reaches 1 year of age.

This study has indicated an unacceptable prevalence of PEM in a community with a high childhood death rate, poor physical amenities and disturbed family and community patterns of living. Solutions are more difficult to find, but further studies of the 'disrupted ecology' that produces the problem are required.

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REFERENCES