The prevalence of iron deficiency in apparently healthy Cape Coloured infants

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Summary

In order to obtain a more accurate picture of the prevalences of anaemia, iron deficiency anaemia, haematological iron deficiency and diminished iron stores, 240 Cape Coloured infants from the lower socio-economic groups were studied. Anaemia was diagnosed in 42 infants (17.5%), iron deficiency anaemia in 81 (34%), and haematological iron deficiency in 28%; 64 (27%) showed evidence of diminished iron stores. The findings indicate that iron deficiency was a common problem in the infants studied, and the same probably also applies to the community at large.

Iron deficiency in children is widespread throughout the world. It is particularly common between the ages of 6 months and 3 years, when iron stores become depleted,\(^1\),\(^2\) it usually manifests as iron deficiency anaemia, and the prevalence varies from population to population.\(^2\) In surveys conducted in the USA,\(^3\) 3-24% of infants between 6 and 24 months of age were found to have iron deficiency anaemia, while 29-68% of the same population were iron-deficient but not anaemic. These wide ranges in prevalence in the USA and indeed in many parts of the world can be explained by factors such as the age group of the population selected, ethnic background, diet, economic factors, the prevalence of intestinal parasites, and the criteria employed for the diagnosis of iron deficiency anaemia.\(^2\)

Surveys carried out on Cape Town infants by Lanzkowsky\(^4\) in 1960 showed that 34% and 55% of Cape Coloured children had iron deficiency anaemia at 4 and 12 months of age respectively. Ten years later Robertson and Sundgren\(^5\) reported 42% of Cape Coloured children between 7 and 11 months of age to be iron-deficient. In both these studies only haemoglobin concentrations were measured. In 1977 Derman et al.\(^6\) found 53% of 1-2-year-old urban Cape Coloured children to be anaemic. Causes of anaemia other than iron deficiency, such as normocytic, normochromic anaemia, also occurred in the above population group.

In order to obtain a more accurate picture of the frequency of iron deficiency 240 Cape Coloured infants were investigated to determine the prevalences of anaemia, iron deficiency anaemia, haematological iron deficiency, and diminished iron stores at varying ages during the first 12 months of life.

Subjects and methods

The study was carried out at the Heideveld Healthy Baby Clinic of the Cape Town City Health Department. This clinic serves a community consisting predominantly of Cape Coloured families from the lower socio-economic groups.

Mothers attending the clinic were asked by a nursing sister (S. de V.) if they would allow their infants to be included in the trial (the trial was carefully explained, including the fact that it would be necessary to take a venous blood specimen for testing). The selection of a particular mother depended entirely upon whether the research nursing sister was free at the time and whether the age of the infant satisfied the study protocol. The infant had to be under 12 months of age with a birth weight of over 2500 g, appear healthy and thriving, and be consuming an adequate diet for age. A clinical examination was carried out (by G. F. K.) and the infant’s length, weight and head circumference were recorded. In general mothers were very keen for their babies to participate in the study, but for logistical reasons not all could be included.

The study involved 240 infants whose ages ranged from 1 to 12 months, and it was designed so that on completion there would be 20 infants in each of 12 age groups by month. The study was approved by the Ethical and Research Committee of the Faculty of Medicine of the University of Cape Town.

Laboratory investigations included a full blood count and serum ferritin and albumin estimations. Blood samples were drawn between 09h00 and 11h00. The infant was not previously fasted. Serum ferritin values were determined by radio-immunoassay,\(^7\) and the haemoglobin concentration (Hb), mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) were measured using a model S Coulter Counter.

<p>| TABLE I. HAEMATOLOGICAL REFERENCE VALUES FOR INFANTS |</p>
<table>
<thead>
<tr>
<th>Age (mo.)</th>
<th>Hb (g/dl)</th>
<th>MCV (fl)</th>
<th>MCH (pg)</th>
<th>Ferritin (µg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11.1*</td>
<td>93*</td>
<td>27</td>
<td>150 - 215</td>
</tr>
<tr>
<td>2</td>
<td>9.5*</td>
<td>81*</td>
<td>27</td>
<td>64 - 98</td>
</tr>
<tr>
<td>3</td>
<td>10.05</td>
<td>80*</td>
<td>24*</td>
<td>21 - 36</td>
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<tr>
<td>4</td>
<td>10.05</td>
<td>74*</td>
<td>24*</td>
<td>13 - 21</td>
</tr>
<tr>
<td>5</td>
<td>10.05</td>
<td>74*</td>
<td>24*</td>
<td>8 - 12</td>
</tr>
<tr>
<td>6-12</td>
<td>10.05</td>
<td>74*</td>
<td>24*</td>
<td>8 - 12</td>
</tr>
</tbody>
</table>

*See Nathan and Oski.\(^8\)
\(^1\)See Heese.\(^9\)
\(^2\)See Oski and Stockman.\(^10\)
\(^3\)See Lanzkowsky.\(^4\)
\(^4\)See Dacie and Lewis.\(^11\)
The reference values employed for the diagnosis of anaemia, iron deficiency anaemia, haematological iron deficiency and deficient iron stores are given in Table I. Anaemia was diagnosed if the Hb was below the normal range for age. Iron deficiency anaemia was diagnosed if the Hb and MCV, Hb and MCH, or Hb, MCV and MCH were below the reference range for age. The criteria for haematological iron deficiency in an infant were an abnormal MCV and MCH, regardless of the Hb. Diminished iron stores reflected by the ferritin value were categorized as low or very low, these categories representing ferritin levels falling between the 3rd and 10th percentile and under the 3rd percentile respectively for the first 6 months in healthy Cape Coloured infants born to mothers with sufficient iron stores. Levels set for the latter half of infancy were arbitrary and based on local experience and the literature.

### Statistical methods

Analysis of the results was carried out on a Univac computer employing Transi (part of a statistical package, Statjob) for the creation of subsidiary files from the master file. A 'skip command' permitted the specification of the range of values allowed for a variable, i.e. Hb, MCV, MCH and ferritin, before a record was accepted for the subsidiary file.

### Results

Forty-two (17.5%) infants had a low Hb, 131 (54.6%) a low MCV and 67 (27.9%) a low MCH, while 28 (11.6%) and 36 (15%) were categorized as having low or very low serum ferritin values respectively. The means, standard deviations and ranges obtained for Hb, MCV, MCH and ferritin in the different age groups are given in Table II. Mean Hb values were greater than the reference value at all ages, but low values are evident from the age of 2 months. Borderline and low mean MCVs and MCHs occurred from 5 to 7 months of age, while low MCVs and MCHs varied between 37.5% and 52.5%.

In a further analysis infants were grouped by age in six age categories (Table III). The percentages of infants categorized as suffering from anaemia, iron deficiency anaemia and haematological iron deficiency and having diminished iron stores are shown in this table.

#### Anaemia

Forty-two infants (17.5%) had low Hb values for age. The prevalence varied between 20% and 25%, except for the age groups 7-8 months and 9-10 months, in which lower prevalences were found (Table III).

#### Iron deficiency anaemia

There were 81 infants (33.7%) in this group, the percentage increasing progressively with age; after 7 months 40-50% were affected.

#### Iron stores

Sixty-four infants (26.7%) showed evidence of diminished iron stores. The number with low iron stores was highest at 1-2 months, and there was a progressive increase with age in the number of infants with very low iron stores.

### Discussion

Prevalence rates given for iron deficiency during infancy and early childhood are largely influenced by the criteria and
reference values for the various tests employed in a particular survey. The reference values in the present study are lower than those usually used in Western countries, so that the prevalence rates for anaemia, iron deficiency anaemia and haematological iron deficiency may well be underestimated. The findings may also not reflect the actual rates at present in the community at large, since the infants studied attended a healthy baby clinic, which had weighed more than 2500 g at birth, were thriving, and showed no evidence of undernutrition or deviations from normality on clinical examination. Selection for inclusion in the study may also be criticized in that bias cannot be excluded, but practical considerations necessitated the methods employed.

In the present study 17.5\% of the infants had Hb levels below the reference values for age and were classified as being anaemic. By raising the reference Hb level by 1 g/dl, i.e. to 12.1 g/dl at 1 month, 10.5 g/dl at 2 months and 11.0 g/dl at 3 - 12 months, 57.5\% or 138 of the infants would have been classified as being anaemic. These are the reference values often used in Western countries. The large overlap of Hb values between normal and iron-deficient populations limits its use as a screening test for iron deficiency anaemia. For this reason measurements of the MCV and MCH are used in conjunction with Hb measurements for confirming the presence of hypochromic microcytic anaemia in infants and the diagnosis of iron deficiency anaemia. The number of infants with diminished iron stores is greatest during late infancy. The fact that so many infants were classified as suffering from haematological iron deficiency, i.e. as having a hypochromic microcytic red blood cell profile without anaemia, possibly indicates that the Hb reference values for the various age groups were set too low. The latter would also explain the low percentage (17.5\%) of infants classified as anaemic.

The percentages of infants with diminished iron stores were highest during early infancy and the later 2 months of infancy at 40\% and 37.5\% respectively. This pattern can be explained on the basis that a large number of infants must have been born with diminished iron stores which were further reduced by growth, as indicated by the proportionately larger percentages of older infants with low iron stores. Evidence of normal growth was substantiated by measurements of weight, length and head circumference, which were all above the National Center for Health Statistics 3rd percentiles for age. All infants aged under 3 months were found to have a serum albumin level of over 30 g/l, and in all aged over 3 months the figure was over 35 g/l. Very few infants were breast-fed after the age of 6 weeks. Had it not been for the distribution of iron-fortified milk by the City Health Department and the early introduction of solids (at a median age of 3 months), the number of infants with diminished iron stores would probably have been higher.

These findings indicate that a large number of infants show evidence of diminished iron stores and that iron deficiency anaemia is common in Cape Coloured babies during late infancy. It appears that there has been no improvement in the infants of the Heideveld community (and probably also none in similar communities in the Western Cape) over the last 20 years. Iron deficiency is presumably even more common in toddlers and young children up to the age of 36 months.

The importance of the non-haematological effects of iron deficiency on the growth and development of the infant and young child have been stressed. These include effects on growth, the gastro-intestinal tract, muscle function, behaviour and, more important, mental and intellectual development. If these observations are correct and if they are especially applicable to infants from lower socio-economic groups and disadvantaged families in the Western Cape, a concerted effort to eradicate iron deficiency is mandatory.

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REFERENCES


### TABLE III. PERCENTAGES OF INFANTS WITH ANAEMIA, IRON DEFICIENCY ANAEMIA AND DIMINISHED IRON STORES AT DIFFERENT AGES

<table>
<thead>
<tr>
<th>Age (mo.)</th>
<th>Anaemia</th>
<th>Iron deficiency anaemia</th>
<th>Diminished iron stores Low</th>
<th>Diminished iron stores Very low</th>
<th>Haematological iron deficiency</th>
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<td>1 - 2</td>
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<td>12.5</td>
<td>37.5</td>
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