Anaemia in young children of Cape York Results of a chart audit

March 2016
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Introduction

When families bring their babies and young children for a Well Child Health Check, the child health team does a series of checks, including a measurement of haemoglobin on a HemoCue to tell if the child is anaemic (has weak blood). This is the report of an audit of haemoglobin measurements for 155 babies and young children aged from 6 months up to 24 months from eight of the eleven remote communities in Cape York, where child health services were provided by Apunipima at the time of the audit. Only the most recent result for each child was included in the audit, measured at some time between February 2014 and October 2015. This audit was conducted to provide information on anaemia among young children in Cape York, as this information is needed for planning and evaluation of health services. This is the first time an audit like this has been done.

Anaemia has various causes (nutrition-related, infection related, genetic) (1, 2). However the most common cause of anaemia among pregnant mothers, babies and young children is iron deficiency (2, 3). This is because of rapid growth, including increased blood supply of the mum and the baby, and rapid brain growth of the baby before and after birth (4). This rapid growth means that mothers, babies and young children have high requirements of the key nutrients for healthy growth and development, such as iron, folate, B12, iodine and essential fatty acids (5). Good nutrition in ‘the first thousand days’ - through pregnancy up to around age two years - is important for healthy growth and development in early life, with long term benefits in school years and adult life (4, 6). One example of the relationship between a mother’s health and nutrition, and her child’s health and development, is iron deficiency anaemia. The strongest predictor of early childhood anaemia is anaemia of the mother during pregnancy (2).

Iron deficiency and iron deficiency anaemia impairs cognitive, motor and social development in babies and children, resulting in developmental impairment and delay. This can have a significant impact on learning and development in early childhood, and later during school years. Anaemia due to iron deficiency can be treated, but the treatment does not appear to reverse the negative effects of anaemia on early childhood development and education outcomes, even if the anaemia is successfully treated. For this reason, prevention of iron deficiency and anaemia is essential, not only screening and treatment (5, 7).

Previous reports have indicated that there is widespread early childhood anaemia among young Aboriginal children in remote communities in northern Australia (8-10) and health service providers report that anaemia in young children is widespread in the Cape York communities. This is consistent with previous reports of generally poor health and nutrition among young Cape York women (11, 12).

The main factors leading to iron deficiency and anaemia among babies and young children include (2, 3, 13-15):

- The child’s mother has low iron stores before and/or during pregnancy
- The child’s mother is low in other important nutrients such as folate or vitamin B\textsubscript{12}
- The child is born preterm and/or low birth weight
- Maternity ward practices – early cord clamping can reduce iron stores of new born babies
- Rapid growth – for example, the usual rate of growth of boys is higher than the usual rate of growth of girls or catch-up growth in babies who were small at birth
- The child’s mother has diabetes in pregnancy, which is associated with rapid growth of her child before and after birth
- Cow’s milk used as the main milk for babies under the age of 12 months
• The solid food given to a child after six months of age to complement breast milk or infant formula, does not include enough iron/nutrient rich foods.

It is possible for several of these factors to occur together.

Among Aboriginal and Torres Strait Islander mothers and babies, factors such as low birth weight of babies and diabetes in pregnancy are more common than for non-Indigenous mothers in Queensland generally and in Cape York (16, 17).

Iron deficiency anaemia, like other nutrition-related conditions is often associated with low income. The recent national health survey for Australia showed more iron deficiency anaemia among low income Australians compared to those with a higher income (18).

Many of the traditional foods of Aboriginal and Torres Straits people in Australia are very good sources of iron and other nutrients. Some store foods are also nutrient rich but these tend to be expensive. Many families in Cape York, as in other Australian remote settings, have low incomes and may not be able to buy the foods that provide enough iron and other nutrients that mothers and their young children need for good health and early childhood development (19, 20).

Overweight and obesity are also associated with low income (21) and more ‘visible’ conditions but iron deficiency and iron deficiency anaemia are not ‘visible’ and not easy to diagnose (22-24) so have been referred to as ‘hidden hunger’.

http://www.unicef.org/republicadominicana/english/survival_development_12473.htm
Methods

This report is based on routine Well Child Health Checks (WCHC) for young children in the Cape York communities serviced by Apunipima. Haemoglobin is routinely measured as a point of care process, during a Well Child Health Check. A child’s haemoglobin is measured on a sample of capillary blood, taken by finger prick or heel prick. This audit is based on results of haemoglobin measured at point of service, using a device called a HemoCue. This audit is based on the recent haemoglobin result for each child.

Anaemia is defined by applying the following cut-offs for haemoglobin readings as specified on page 345 of the Chronic Conditions Manual, 2015 (25)

Haemoglobin < 105 g/L for children aged >= 6 months to < 12 months

Haemoglobin < 110 g/L for children aged >= 12 months up to 12 years.

There is no currently allocated field in which haemoglobin measured at point of care, can be entered into Best Practice. Instead, clinical staff currently enter point of care haemoglobin results in the visit notes section of Best Practice. This report is based on an audit of that information, using the process described below. Best Practice have advised Apunipima that a haemoglobin result field is being added to the system, and will be available in the next release, from late 2015.

A clinician may request a pathology laboratory measurement of haemoglobin, but a search of Best Practice records showed that laboratory measurements of haemoglobin are available for only a small proportion of children (~ 3%) and consequently this report is based on measurements by HemoCue only.

Data extraction

A list of children meeting the following criteria was first extracted from Best Practice:

- aged 0 - 36 months as of 19/10/2015
- registered in a community where Apunipima provides child health services – eight communities out of the eleven remote Cape York communities at the time of this audit
- had at least one contact from an Apunipima member of staff in the last 12 month period.

This yielded a total of 351 children aged from birth up to 36 months, across the 8 communities. Next, records for 93 children were checked manually on Best Practice to determine the frequency of recording of haemoglobin results in the visit notes, compared with the recording of haemoglobin results in investigations or correspondence sections. Note that health checks, if attached to Best Practice, are attached to the correspondence section. Of these 93 records, none contained a haemoglobin result anywhere other than the visit notes.

Based on this initial audit, and in order to increase the efficiency of the chart audit, a report was produced to extract relevant notes from Best Practice. This report returned all visit notes for children in the sample that contained the words “Hb” or “Hae”. All notes in the report were then manually assessed to determine each child’s most recent haemoglobin value and haemoglobin test date, where one was available. Of the 351 children, 184 had at least one haemoglobin result recorded in their visit notes. The age of each child at the most recent haemoglobin measurement was calculated, and records were then excluded for 29 children who were aged either less than 6 months or more than 24 months at their most recent haemoglobin test. This report is based on information recorded for the remaining 155 children. A flow chart of this process is shown below.
Information extracted for each child including location, gender, date of birth, date of measurement of haemoglobin and measurement result, was imported into Excel (Microsoft Office 2013) and into SPSS (IBM SPSS Statistics 22) for statistical analysis.

Flow Chart: Record Selection Process

351 children aged from birth up to 36 months in eight Cape York communities had a record on Apunipima BP system on 19 October 2015

181 of these 351 children had record of ‘hb’ or ‘hae’ in visit notes

29 children excluded (less than 6 months of age OR more than 24 months of age) at their most recent haemoglobin test

155 children aged 6m up to 24m identified with haemoglobin result recorded
Results

Coverage and ethnicity

The number of children aged 6 months to 24 months varies considerably by community, ranging from 9 children up to 40 children. On an overall population basis, the estimated number of children in this age group - 6 months up to 24 months – in the eight communities in October 2015, ranged from 147 (Queensland Health Ferret data collection) to 164 (Apunipima Best Practice data collection). Haemoglobin results recorded from February 2014 up to October 2015, were available for 155 children.

Estimates of coverage by community ranged from 63.6% one community to more than 100% in several communities, depending on the population estimate used. Three of these 155 children identified as non-Indigenous while ethnicity was not recorded for an additional three children. The remaining 149 children (96%) were identified as Aboriginal and/or Torres Strait Islander.

This high coverage means that the results reported here are probably representative of the situation in respect of anaemia, though there are other possible sources of error such as measurement and/or recording errors, which cannot be identified by an audit.

Results – anaemia

Prevalence of Anaemia by age

Overall among children aged 6 months up to 24 months, about one in three children were anaemic (32.3% (95%CI 24.8%,39.7%)). There was a trend for anaemia prevalence to be higher among children who were over 12 months of age (34.9% (95%CI 25.6%,44.3%)) compared to babies aged 6 months up to 12 months of age (26.9% (95%CI 14.4%,39.4%)) but the difference was not statistically significant (p = 0.313).

Prevalence of anaemia by age group

![Figure 1. Prevalence of anaemia by age group](image-url)
Prevalence of Anaemia by gender

Among the 155 children, 82 (53%) were boys. There are differences in the prevalence of anaemia between boys and girls, with more anaemia among boys (37.8% (95% CI 27.1%, 48.5%)) - compared to girls (26.0% (95% CI 15.7%, 36.3%)) - in the 6 month to 24 month age group. This was true also when results were compared for children under 12 months and for children aged 12 months up to 24 months. However, this difference in prevalence of anaemia between boys and girls was not statistically significant at any age.

![Prevalence of anaemia (%) by gender and age group](image)

**Figure 2. Prevalence of anaemia by gender and age group**

Prevalence of Anaemia by community

There are eleven remote communities on Cape York. For this audit, no results were available for communities 1, 7 and 8. The results shown here are for communities 2 to 6 and communities 9 to 11. There was considerable difference in the results for prevalence of anaemia for the different communities, but these results need to be interpreted with caution, given the small numbers of children in the different communities. This is the reason for the very wide confidence intervals for these results. The lowest prevalence of anaemia was seen in Communities 6 and 11, where one out of eleven children (9.1%) had anaemia in both communities. The highest prevalence was seen in Community 5, where 14 out of 17 children (82.4%) had anaemia.

The small numbers of children and relatively large numbers of communities limit the statistical analysis that can be done, however comparison of results for Community 5 with the combined results for all the other communities showed that the higher prevalence of anaemia among young children in Community 5 (82.4% (95%CI 62.1%,100%)) is statistically significant compared with the other
seven communities combined (26.1%, (95%CI 18.7%, 33.5%)) (Chi2 = 21.928, df=1, p<0.001). The high result found for Community 5 could be a reflection of the true situation in respect of anaemia in that community. However, there are other possible reasons which need to be excluded, in Community 5 and in the other communities also, such as systematic measurement error.

Table 3: Prevalence of anaemia among children aged 6m up to 24m by community

<table>
<thead>
<tr>
<th>Anaemic</th>
<th>Total Sample</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community 5</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td>Community 4</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Community 2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Community 3</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>Community 9</td>
<td>8</td>
<td>29</td>
</tr>
<tr>
<td>Community 10</td>
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<td>28</td>
</tr>
<tr>
<td>Community 6</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Community 11</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
<td><strong>155</strong></td>
</tr>
</tbody>
</table>

Figure 3. Prevalence of anaemia (%) by community
The overall prevalence of anaemia (32.3%) among young children across the Cape York communities is much higher than reported rates of anaemia among young children elsewhere in Australia (about 2% to up about 6%) (24, 26). However the rates reported here for the Cape York communities are very similar to the prevalence of anaemia among young children from remote Aboriginal communities in the Northern Territory (~21% children aged 6 months up to five years, ~30% children aged 6 months to 18 months) (27).

The results found in respect of Community 5 are particularly high but even if the results for that community are excluded, the prevalence of anaemia among young children of the other seven communities (26%) is still unacceptably high.
Results – haemoglobin

Haemoglobin by gender and age

Among the 155 children, haemoglobin results ranged from 80g/L to 141 g/L. At six months up to 12 months of age, haemoglobin of less than 105 g/L is classified as ‘anaemia’. The mean haemoglobin for boys at 6 months up to 12 months (107.5 g/L (95%CI 103.6, 111.4)) is close to this cut-off and significantly lower than mean haemoglobin of girls at the same age (113.0 g/L (95%CI 109.2,116.8)) (t= -2.061, df50, p<0.05).

Over one year of age, haemoglobin of less than 110 g/L is classified as ‘anaemia’. The mean haemoglobin for both boys - 112.7 g/L (95%CI 109.9, 116.1) - and girls - 112.2 g/L (95%CI 109.3, 115.2) is close to this cut-off. There was no significant difference in mean haemoglobin for boys and girls over 12 months of age.

Figure 4. Mean haemoglobin boys and girls from 6 months up to 12 months and 12 months up to 24 months (n=155)
Comparison of the distribution of haemoglobin readings for boys and girls shows that boy babies, from 6 months up to 12 months, tended to have lower haemoglobin readings than girl babies but there was little difference after 12 months of age. The median haemoglobin for boys from 6 up to 12 months is 109 g/L, whereas the median haemoglobin value for girls from 6 up to 12 months was 113 g/L. After the age of 12 months, the median haemoglobin value for boys (111 g/L) was nearly the same as the median value for girls (113 g/L).

Figure 5. Distribution of haemoglobin results (%le) for boys and girls from 6 months up to 12 months

Figure 6. Distribution of haemoglobin results (%le) for boys and girls from 12 months up to 24 months
Discussion

This audit showed that in the eight Cape York remote communities serviced by Apunipima, about one in three young children aged between 6 months and 24 months were anaemic at their most recent haemoglobin count. The rates of anaemia in one Community 5 were especially high but even in the seven other communities, more than one in four young children were anaemic.

The rates of anaemia shown here are higher than the rates reported for children elsewhere in Australia, apart from reports from the Northern Territory. About 2% of children aged 1 year to 4 years were found to have iron deficiency anaemia in the national survey of lead in children, conducted across Australia in 1995 (26). The recent Australian National Health Survey found less than 2% of Australians over 12 years of age had iron deficiency anaemia, though this increased to about 5% among people on lowest income (18). There are reports of higher prevalence of anaemia (up to 6%) among younger children, and higher rates (up to 14%) among young children of Asian backgrounds living in Australia (9, 24, 28).

The Northern Territory Healthy Under Five (HU5K) 2014 report shows results from child health checks for children of the NT remote communities, using a similar methodology to this audit, but for larger numbers (n=2,633, ~69% of estimated resident children) (27). In HU5K 2014, about 21% of Indigenous children aged 6 months to five years of age were anaemic, with higher rates reported for the younger children - 6 months to 11 months (31%), 12 months up to 17 months (32%) and 18 months up to 23 months (23%).

The diagnosis of anaemia is based on levels of haemoglobin, compared with the usual levels for that age/gender group or stage of pregnancy for pregnant women. The cut-offs are defined as two standard deviations below the mean for the reference population, so only about 2.5% of the reference population have haemoglobin at or below the cut-offs (23, 29). This audit showed that the average haemoglobin levels of the children between 6 months and 24 months were low and close to the cut-offs for anaemia. This was especially true for boys aged between 6 months and 12 months (mean haemoglobin 107.47 g/L (95%CI 103.6, 111.4)) compared to anaemia cut-off of 105 g/L and for both boys and girls aged from 12 months to 24 months (mean haemoglobin 112.65 g/L (95% CI 110.5, 114.8) compared to anaemia cut-off of 110 g/L.

Among the children in Cape York, more boys were found to have anaemia compared to girls. This may be because boys tend to grow faster than girls, especially before six months of age (30). The faster growth rates of boys means that their iron stores are more likely to ‘run out’.

Other children with higher than usual rates of growth include babies who were born small but then grow rapidly and ‘catch-up’. Children who are overweight or obese and/or children whose mother had diabetes in pregnancy also tend to have rapid growth, and are more likely to become anaemic than other children. Health indicators for Cape York Health for 2005 to 2009 (17) show higher rates of low birth weight (14.1%) among Indigenous babies of Cape York compared to low birth weight among all babies born in Queensland (6.9%). Similarly about 12% to 14% of Indigenous mothers in Cape York had some form of diabetes in pregnancy compared to about 6% for all pregnant women in Queensland.

This audit found that about 20% of babies are already anaemic at six months of age, which is often a consequence of low iron stores at birth associated with poor iron status of mothers (3, 14). For babies who are less than six months of age, the main source of iron is not breast milk or formula milk but the iron stores provide by their mother in the last ten weeks of pregnancy (3). Mothers who
are younger and/or have closely spaced pregnancies are more likely to have low iron stores themselves and their babies are more likely to be born with low iron stores (14, 15). As well as iron, folate is another important nutrient for the prevention of anaemia, and health information for Cape York shows that many young women have low folate levels at an age when they are usually having children (11, 12, 31).

As the recent Australian national health survey shows, iron deficiency anaemia is more common among Australians with lower income, and many mothers in Cape York communities live on low incomes, in settings where even basic food costs are much higher than elsewhere in Queensland (18, 32). These factors confirm the importance of improving food security in order to improve the health and nutrition of all young women and pregnant mothers in Cape York.

Maternity ward practices can also influence rates of anaemia among babies at around six months. After a baby is born, blood is transferred from the placenta to the baby for some minutes through the umbilical cord. Early cord clamping reduces the amount of blood transferred to the baby after delivery. Later cord clamping allows more blood to be transferred to the baby which provides an extra supply of iron to support the baby in early life (3). Early cord clamping has been practiced because of concerns about post-partum haemorrhage (PPH) among mothers. However a recent Cochrane Review has found that early cord clamping does not reduce the risk of PPH but does increase the risk of early childhood anaemia among babies (13).

From around six months of age, babies need nutrient rich solid food for nearly all their iron requirements. The higher anaemia rates in the children over one year of age in Cape York, are consistent with nutrient poor diets (33). In Australia, such diets are most common among people living on low incomes (34), including Aboriginal people living in remote community settings (35, 36). These ‘diets of poverty’ do not provide enough nutrients to meet the nutrition requirements of pregnant mothers or to support optimal growth and development of young children (21, 33). By contrast, the traditional foods of Aboriginal people were much more nutrient dense than many of the ‘western food’ available in remote community stores (19, 20). Families in Cape York need improved food security, to be able to access healthy nutritious foods at a cost they can afford, in order to ensure that mothers and young children get the nutrients they need for to prevent anaemia and for healthy growth and development.

Anaemia is not only detrimental to children’s health and immunity, but also to their development (22). As described above, the effect of early childhood anaemia on development appear to persist even after the anaemia has been treated, with reduced educational outcomes later during school age years (7, 37). There are now interventions, such as multi-micronutrient supplements like Sprinkles Plus®, which are effective in preventing early childhood anaemia (38) and research that indicates that these interventions protect and support early childhood development (39). For these reasons the recommendations below focus on initiatives to prevent anaemia in young children and their mothers, so that children in Cape York can have the opportunity to enjoy the same good health, early childhood development and future educational achievements as children elsewhere in Australia, and so their mothers can enjoy good health at least as good as the health of mothers elsewhere in Australia.
Limitations of this study

The audit methodology used for this report does have several limitations:

- **Possible measurement error** - during routine child health checks, haemoglobin is measured at ‘point of service’ using a HemoCue to assess haemoglobin of a sample of capillary blood. This technique can be subject to measurement error which can lead to under-estimates of haemoglobin and thus to over-estimates of anaemia.

- **Denominator estimates** - the denominator used in this report is the number of children tested. Coverage by routine child health checks appears high, however there is uncertainty about the number of children living in the remote communities of Cape York.

- **Recording of haemoglobin results** - as described in the Methods section, there is currently no provision in Best Practice to record the results of point–of-service haemoglobin measurements which increases the likelihood of results being missing from this audit.

- **Small numbers** - in most of the children of the Cape York communities, the numbers of young children are relatively small. These small numbers limit the comparisons that can be made between different communities.

- **Indigenous identification** – the ethnicity of a small number of children (n=3) was not clearly recorded in Best Practice.

Because of these limitations, the recommendations address the need for further investigations to clarify the situation in respect of early childhood anaemia, and the causes of anaemia, among Aboriginal and Torres Strait Islander babies and young children – and their mothers - in the remote communities of Cape York.

**Conclusion:**

This audit provides information on the prevalence of anaemia among young children of Cape York for the first time. Despite the limitations of the methodology, the results of the audit confirm anecdotal reports of service providers, and are consistent with the reports from similar settings in the Northern Territory. This audit demonstrates levels of early childhood anaemia which are unacceptable and which need to be urgently addressed. As well as the implications for child health and development, these results indicate poor health and nutrition of the mothers of these young children.

There is a need for immediate interventions to improve the nutrition of mothers and their young children, to prevent iron deficiency in early childhood and other related nutrient deficiencies. These interventions are essential for improved health of young women and mothers of Cape York and for improved health, development and educational outcomes of their children.
Recommendations

1. Develop and implement initiatives to address early childhood anaemia among young children in Cape York to focus on prevention, as well as screening, treatment and monitoring. These initiatives should be developed in partnership with the community leaders, elders and families of Cape York. Options to be considered could include:

   - Home fortification initiative to prevent anaemia in early childhood, with promotion of optimal infant and young child nutrition combined with provision of a multi-micronutrient preparation for home fortification of solid food for older babies and young children
   - Promotion of nutrient rich first foods, to complement breast feeding/formula from 6 months of age, with the development of affordable and acceptable recipes/products
   - Initiatives to improve the health and nutrition of primary school-aged and adolescent girls, before their first pregnancy
   - Continued investment in improved health and nutrition of pregnant mothers, including mothers with diabetes in pregnancy
   - Investigation of current practices in respect of cord clamping in hospitals where mothers from Cape York give birth, in Cairns and elsewhere
   - Strategies to raise awareness about anaemia and food security for mothers and their children, among the people of Cape York, as well as service providers and policy makers.

2. Develop reporting systems which utilise routine health service data to provide information for monitoring and evaluation, and the information required to secure funding for initiatives to address issues such as anaemia. Appropriate ethical approvals are needed for this.

3. Design routine reporting of anaemia to include information on key factors such as birth weight, prematurity and early childhood growth. This information should be linked with records of maternal health indicators.

4. Conduct further investigations to validate audit results and address research questions in respect of:
   - causes of anaemia, to clarify issues such as iron deficiency, other nutritional factors and non-nutritional causes of anaemia
   - prevalence of anaemia among other groups including young children, primary-school-aged children, adolescent girls, pregnant mothers and the elderly, all of whom are vulnerable to anaemia
   - determine reasons underlying the abnormally high rates of anaemia in one community
   - dietary intakes of pregnant mothers, their babies and young children.

It may be possible to address some of these research questions through the proposed longitudinal study of the Baby One Program.
References


