Screening for anemia in infants: evidence in favor of using identical hemoglobin criteria for blacks and Caucasians 1, 2

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ABSTRACT The purpose of this study was to evaluate the need for separate Hb screening criteria according to race by evaluating the Hb response to a therapeutic trial of iron in 1-yr-old infants. Among the 1128 infants who were screened, a significantly larger percentage of blacks (37%) than Caucasians (22%) had a Hb <11.5 g/dl. However, when these screen-positive infants were treated with oral iron for 3 months, the percentage who had a ≥1 g/dl response was similar in blacks (38%) and Caucasians (35%). Our results indicated that a slight but significant inherent tendency to lower Hb values among the black infants was counter-balanced by a substantially higher prevalence of iron deficiency anemia. These findings are in favor of using uniform Hb screening criteria in similar populations. Am. J. Clin. Nutr. 34: 2154–2157, 1981.

KEY WORDS Hemoglobin, iron deficiency, screening, blacks, Caucasians

During the past decade, evidence from several surveys has suggested that blacks normally have a lower Hb concentration than caucasians (1–8). This difference in Hb persisted even when populations were matched for income (1, 2, 5, 6) and when an effort was made to exclude known causes of anemia (5, 6, 8). For this reason it has been proposed that different criteria for anemia in blacks and Caucasians might be justified in order to avoid unnecessary further workup and/or treatment of inappropriately large numbers of blacks whose Hb values might be low on genetic basis (4–8). In order to evaluate the need for separate screening criteria according to race, we determined whether the rate of therapeutic response to iron was similar in the two races in our program of screening for anemia and iron deficiency in 1-yr-old infants (9).

Methods

Hb concentration was determined on capillary finger stick blood between March 1978 and June 1980 in 1128 infants between the ages of 11.5 and 14 months who were dependents of US Air Force Personnel. The 278 infants (25%) who had a Hb <11.5 g/dl were considered screen positive and were asked to return for a second visit. The value of 11.5 g/dl, which corresponds to an estimate of the 10th percentile in a normal Caucasian population (10) was selected as a cutoff value because we anticipated that it would include much of the zone of overlap between iron-deficient and iron-sufficient infants; yet we did not believe that we could justify a higher cutoff value within the context of current screening practices. On the second visit, venous blood was drawn on the screen positive infants, and a 3-month course of oral ferrous sulfate (Fer-in-sol, Mead Johnson, Evansville, IN) was initiated at a dose of 3 mg iron/kg/day in a single dose 30 min before breakfast. Repeat venous blood studies were obtained after 3 months. The regimen was satisfactorily completed by 188 infants, with both venipuncture blood samples obtained and with better than 50% compliance (more than one of the two bottles of medication that were supplied was used). Average compliance approximated 75%. The Hb response was calculated using the first venous Hb rather than the capillary Hb as a baseline in order to minimize errors due to a statistical phenomenon termed regression to the mean. That is to say, if any population is singled out because of a low or high laboratory value, simply repeating the laboratory test will result in an average...
value that is closer to the normal mean for that test. This is due to a composite of random factors such as sampling error, laboratory error, and biological variations that could have been partly responsible for the initial outlying value. Thus, in our design, the pretreatment venous Hb represents a more reliable base-line than the prior capillary Hb for estimating a real change in Hb concentration, even though the capillary value was the basis for treatment. A rise in venous Hb ≥1.0 g/dl was arbitrarily defined as a therapeutic response. Hb and red cell indices were measured by Coulter Model S electronic counter. Transferrin saturation, serum ferritin, and erythrocyte protoporphyrin were measured as previously described (9). A more detailed description of the clinical setting, the experimental design, the basis for the criterion for response, and the methods are included in another paper that is focused primarily on the evaluation of laboratory tests in the screening for iron deficiency (9).

Results and discussion

The total number of infants screened, those who were screen positive, those who completed the regimen, and those with a ≥1.0 g/dl rise in venous Hb with treatment are categorized according to racial group in Table 1. Of the total population, 14% of the infants were black and 71% Caucasian. In the screen positive group, the corresponding values were 21% for blacks and 63% for Caucasians. Thus blacks were substantially overrepresented in the screen positive group (p < 0.005). Figure 1 also allows one to calculate that a much higher percentage of blacks than Caucasians had a capillary Hb <11.5 g/dl, 37% compared to 22% (p < 0.005). This difference could reflect either an inherently lower Hb concentration in blacks, and/or a higher prevalence of potentially correctable causes of anemia such as iron deficiency. If only an inherently lower Hb concentration in blacks accounted for the overrepresentation of black infants in the screen positive group, we would anticipate a lower rate of response to iron therapy than among Caucasian infants.

Despite the higher prevalence of low Hb values in blacks, we found that the rate of Hb response to iron therapy was essentially the same as in Caucasians. Sixteen of the 41 screen positive black infants who completed the regimen (38%) had a ≥1 g/dl Hb response. The corresponding values for Caucasian infants were 43 with a response out of 122 screen positive infants completing the regimen (35%). The proportion of screen positive infants that failed to complete the regimen was similar among the two racial groups.

The finding that black infants more often had a capillary Hb <11.5 g/dl than Caucasian infants but that they had a similar rate of Hb response certainly indicates a higher prevalence of iron deficiency but does not exclude the possibility that there is also a lower Hb in blacks on a genetic basis. Figure 2 shows the cumulative distribution of capillary Hb values in blacks and Caucasians on a probability plot that results in linearity when values show a Gaussian distribution. Values for Caucasian infants distributed in a linear fashion and values for blacks were parallel in the middle and upper parts of the Hb distribution, with a median value that was 0.3 g/dl lower than Caucasians. The identical difference of 0.3 g/dl was found when the groups were matched socioeconomically by comparing values from only those infants whose paternal military rank was in the same middle range, E4 to E7. The Hb difference in the middle and upper portions of the distribution (Fig. 2) is in accord with an inherently slightly lower Hb concentration between blacks and Caucasians, but was of smaller magnitude than the 0.5 to 1.0 g/dl in previous reports (1-8).

The other point illustrated by Figure 2 is that Hb values in blacks showed a substantial skew from a normal, Gaussian distribution in the lower portion of the Hb range, a finding that was not evident in the data for Caucasians. This marked deviation from linearity at the lower end of the curve in blacks indi-

Table 1

Screening and treatment of anemia in 1-yr-old infants by race

<table>
<thead>
<tr>
<th>No. of subjects</th>
<th>All races</th>
<th>Caucasians</th>
<th>Black</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total infants screened</td>
<td>1128</td>
<td>800</td>
<td>159</td>
<td>169</td>
</tr>
<tr>
<td>2. Those with Hb &lt;11.5 g/dl</td>
<td>278</td>
<td>174</td>
<td>59*</td>
<td>45</td>
</tr>
<tr>
<td>3. Total with Hb &lt;11.5 g/dl who completed the treatment regimen</td>
<td>188</td>
<td>122</td>
<td>41</td>
<td>25</td>
</tr>
<tr>
<td>4. Infants with ≥1.0 g/dl Hb response</td>
<td>66</td>
<td>43</td>
<td>16</td>
<td>7</td>
</tr>
</tbody>
</table>

* p < 0.005: blacks were significantly overrepresented in the screen positive group.
cates a higher prevalence of anemia, probably attributable primarily to iron deficiency.

Another approach to estimating the relative prevalence of iron-responsive anemia according to race is to weight the data from infants with a \( \geq 1.0 \text{ g/dl Hb} \) response to correct for the number of subjects who did not complete the regimen. If we assume that the rate of response would have been the same among screen positive infants who did not complete the regimen, we can then calculate for blacks and Caucasians what percentage of the total screened group would have had a \( \geq 1 \text{ g/dl Hb} \) response. By this calculation, 8% of Caucasian and 14% of black infants would have had an iron-responsive anemia. Thus, two lines of evidence indicated a higher prevalence of iron deficiency among the black infants.

In conclusion, our results are in accord with an inherently lower Hb concentration in blacks than Caucasians. However, when a low Hb is being used as a screening criterion to identify a population at high risk for iron deficiency, the best cutoff value for further tests and/or treatment is determined both by the normal range of values and the prevalence of iron deficiency anemia (11). In our population, the influence of an inherent difference in Hb concentration appeared to be counterbalanced by a higher prevalence of iron deficiency anemia among blacks to result in a similar rate of response to a therapeutic trial of iron in the two races. These findings are in favor of using uniform Hb criteria for both races when screening for anemia in similar high risk populations. On the other hand, among populations in which iron deficiency and other causes of anemia are rare, such as adult men and more affluent groups, the case for using separate Hb criteria may be stronger.

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