Screening for severe anaemia in pregnancy in Kenya, using pallor examination and self-reported morbidity

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**ABSTRACT**

Severe anaemia in pregnancy is an important preventable cause of maternal and perinatal morbidity and mortality. Different methods of screening for severe anaemia in pregnancy were evaluated in a 2-phased study conducted in Kilifi Kenya.

In phase 1 (1994/95), pallor testing was evaluated alone and in addition to raised respiratory / pulse rates: 1787 pregnant women were examined by one of 2 midwives. Sensitivities for detecting severe anaemia (haemoglobin < 7g/dl) were 62% and 69% and specificities 87% and 77%, respectively for each of the midwives. Addition of high pulse rate increased sensitivity to 77% and 81%, but specificity reduced to 60% and 51%, respectively.

In phase 2, following qualitative in-depth work, a screening questionnaire was developed. An algorithm based on screening questions had 80% sensitivity and 40% specificity. Midwife pallor assessment was conducted following the screening questionnaire. In this phase (conducted in 1997), the midwife performed very highly in detecting severe anaemia, achieving sensitivity of 84% and specificity of 92%. Spending a few minutes asking women questions may have improved the ability to interpret pallor findings.

This study demonstrates the value of pallor testing and raises alternative approaches to improving it.
INTRODUCTION

Anaemia in pregnancy is defined as a haemoglobin (Hb) concentration <11 g/dl and severe anaemia as an Hb concentration <7 g/dl. High prevalences of anaemia have been reported for women of reproductive age in developing countries. In sub-Saharan Africa it is estimated that more than half of pregnant women are anaemic (WHO, 1992). Prevalences of severe anaemia are often not reported, and vary widely between different geographical locations. In Kilifi District, Kenya, 10% of women booking for antenatal care had severe anaemia (Hb < 7g/dl) with 76% having Hb < 11g/dl (Shulman et al., 1996).

The main causes of anaemia reported in sub-Saharan Africa are iron deficiency (often exacerbated by hookworm infestation), malaria, folate deficiency, haemoglobinopathies and HIV infection (Fleming, 1989; Hurrell, 1997). Most of these causes are preventable and treatable.

The main causes of anaemia reported in sub-Saharan Africa are iron deficiency (often exacerbated by hookworm infestation), malaria, folate deficiency, haemoglobinopathies and HIV infection (Fleming, 1989; Hurrell, 1997). Most of these causes are preventable and treatable. Anaemia is an important contributor to maternal death particularly around the time of delivery. It has been reported as the main cause of 8-20% of maternal deaths in hospital based studies in sub-Saharan Africa (Fullerton & Turner, 1962; Armon, 1979; Mtimavalye et al., 1980; Hoestermann et al., 1996) and 11-13% in community based studies (Boerma & Mati, 1989; MacLeod & Rhode, 1998). Severe anaemia is also associated with perinatal mortality (Garn et al., 1981; Brabin 1991; Dasgupta et al., 1997) and with low birth-weight (Yusufi et al., 1973; Garn et al., 1981; Scholl et al., 1992; Singla et al., 1997) the main risk factor for infant mortality (McCormick, 1985).

In many countries, although strategies exist to prevent anaemia in pregnancy, they are often not effectively implemented. In addition, severe anaemia frequently goes undetected, as routine blood tests for Hb are often not available in health facilities. While it is recommended that all pregnant women be clinically screened for anaemia (WHO, 1994a; WHO, 1994b), it is still not clear what the best way is of screening women in an area where laboratory facilities are scarce.

A number of studies have been conducted assessing the effectiveness of clinical signs of pallor in screening for anaemia within different demographic groups (reviewed in Dusch et al., 1999). There are, however, relatively few published studies reporting the usefulness of examination for pallor to screen for severe anaemia in pregnant women or women of reproductive age. In a few studies, the sensitivity for detecting severe anaemia was high (84-100%) but with sample sizes for severely anaemic women being very small (between 3 and 5 women (Dusch et al., 1999; Meda et al., 1996)). In 743 Ethiopian female refugees, pallor testing had a sensitivity of 53% and a specificity of 91% for detecting Hb < 7 g/dl (Yip, 1994). Using a colour recognition card for pallor determination in 211 pregnant women in Gujarat, sensitivity for diagnosing Hb < 8 was 67% and specificity 41% (Gujiral et al., 1989).

There is also very little data on the usefulness of adding clinical history to pallor screening. Jackson (1992) reports that certain symptoms, particularly headache, were associated with lower Hb < 10 g/dl amongst pregnant women. In screening for anaemia, the presence of a headache had a sensitivity of 83% and specificity of 27%.

We investigated whether examinations for pallor and self-reported morbidity are effective techniques, used independently of each other or in combination, for screening pregnant women for severe anaemia (Hb < 7 g/dl). The development of a screening tool,
which could be used at health facilities that lack adequate or reliable blood-testing facilities, would be extremely useful in resource-poor settings.

**MATERIALS AND METHODS**

The study was carried out in two hospitals in Kilifi District situated north of Mombasa on the Kenya Coast. The population of Kilifi District is made up of Mijikenda people of whom 90% are the Wagiriana (Mwesesi et al., 1995). It is estimated that at least 90% of women attend for antenatal care at least once during their pregnancy in Kilifi district (Kirumi et al., 1996).

Ethical clearance was gained from the Kenya National Ethical Committee and the London School of Hygiene & Tropical Medicine (LSHTM). Informed consent in the women's first language was obtained.

**Phase 1: Examination alone**

Between October 1994 and December 1995, 1787 women of all parities attending for antenatal care at Kilifi District Hospital were examined for pallor prior to undergoing a blood test. The women had been recruited into a study assessing the effectiveness of insecticide-treated bednets (ITBN) in preventing anaemia in pregnancy (Shulman et al., 1998). A venous blood sample was taken for full blood count in the third trimester of pregnancy or at any time that a woman was suspected of being severely anaemic. Hb concentration was estimated using a coulter counter. Before the blood test, one or both of two study midwives made an assessment of pallor, based on examination of conjunctiva, nailbeds and tongue, estimating Hb to the nearest gram per decilitre (g/dl). Pulse and respiratory rates were also recorded at this time. The study midwives were just asked to assess Hb by just examining for pallor. This is something that they have been trained to do routinely and there was no additional training as part of this study.

Following the blood test results, women were re-assessed by the mid-wife and given treatment or referred to the clinical officer as indicated.

**Phase 2: Symptoms in conjunction with pallor examination**

A brief “screening” questionnaire was developed following a period of in-depth qualitative work, which included 12 focus group discussions and 25 in-depth interviews with pregnant women at Kilifi District Hospital. The questionnaire asked about recent health experiences and the ability to perform everyday tasks. Only those questions that appeared likely, from the in-depth work, to be good differentiators of severely anaemic and non-anaemic women were included in this questionnaire. The in-depth work has been reported elsewhere (chapter 6, submitted).

In this phase of the study, 198 women attending Vipingo health centre for antenatal care were recruited between October and December 1997. Most of the primigravidae had previously been recruited into a trial of antimalarials in pregnancy (Shulman et al., 1999). The remaining primigravidae and all of the multigravidae were recruited from the antenatal clinic queue at random.

A midwife (midwife 2 from the previous phase) administered the “screening” questionnaire in the local language. This took approximately 2 minutes to complete. The midwife then examined the women for pallor and categorised the findings from the pallor examination as in phase I.
Hb concentration was then assessed by venepuncture using a HemoCue haemoglobinometer. As in phase I, following the blood test results, women were re-assessed and given treatment or referred to the clinical officer as indicated.

**Statistical Analysis**

Women were categorised according to laboratory findings into two groups: cases of severe anaemia, defined as Hb < 7g/dl, or non-severe anaemia cases (Hb ≥ 7 g/dl). For phase 1 and phase 2, the sensitivity, specificity and positive predictive values of each clinical sign and symptom in predicting a diagnosis of severe anaemia were calculated.

In phase 1, where pulse and respiratory rate were also available, sensitivity and specificity were calculated for combinations of pallor with the addition of increased pulse rate, increased respiratory rate or both. Inter-observer variability was also determined for the two midwives, using the Kappa statistic. To determine whether the accuracy of the midwives' assessments changed over the 16-month study period, sensitivity and specificity were calculated for 4-month periods and compared across time using a chi-squared test.

For phase 2, which contained both reported health experiences from the screening questionnaire and the midwife’s assessment for pallor, logistic regression was used to model the probability of severe anaemia. Predictors of severe anaemia (p<0.10) from univariate analysis were included in the models. Two logistic regression models were estimated: (i) women’s answers in the screening questionnaire alone (ii) combination of women’s answers and the midwife’s assessment for pallor. Backward elimination was used for each model to achieve a subset of “symptoms” from the questionnaire that were independent predictors of severe anaemia (p<0.05). The coefficients for these variables were then used to calculate “anaemia scores” such that a higher score represented a higher probability of being severely anaemic. Three methods of calculating the scores were used so that the algorithms that would be of more practical use in the field could be compared with the most precise algorithm based on exact predicted values. The three methods were: (i) counting the number of symptoms present, (ii) predicted values (excluding the constant) based on regression coefficients rounded to the nearest whole number (iii) predicted values (excluding the constant) based on exact regression coefficients. Sensitivity, specificity and positive predictive values (PPVs) were calculated using different cut-off points to define severe anaemia.

**RESULTS**

**Phase 1: Examination alone**

The mean Hb concentration (SD) of the 1787 recruited women was 8.6 g/dl (1.77), range 2.2-15.4; 312 (17%) were severely anaemic (Hb < 7 g/dl), 1079 (60%) were moderately anaemic (Hb 7-9.9 g/dl), and 396 (22%) were mildly anaemic / non-anaemic (Hb ≥ 10 g/dl). There were 13 multiple pregnancies. Mean gestation (SD) at the time of the assessment and blood test was 31 completed weeks (3.27), range 12 – 40. Both midwives examined 946 of the women.

Using pallor examination alone to estimate a Hb < 7g/dl, sensitivities for detecting true cases (i.e. women with a measured Hb of < 7g/dl) were 62% and 69% for midwives 1 and 2, respectively (Table 1). In the 946 women examined by both midwives, there was agreement in 77% (KAPPA= 0.42, indicating “good agreement” (Fleiss, 1981)).
Table 1 Predicting severe anaemia (Hb < 7g/dl) on the basis of midwives examination for pallor and clinical signs (phase 1)

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Sensitivity %</th>
<th>Specificity %</th>
<th>PPV %</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW1 pallor test +ve</td>
<td>62 (135/218)</td>
<td>87 (963/1108)</td>
<td>48 (135/280)</td>
</tr>
<tr>
<td>MW2 pallor test +ve</td>
<td>69 (170/246)</td>
<td>77 (893/1161)</td>
<td>39 (170/438)</td>
</tr>
<tr>
<td>RR &gt; 22</td>
<td>13 (40/308)</td>
<td>90 (1321/1463)</td>
<td>22 (40/182)</td>
</tr>
<tr>
<td>PR &gt; 99</td>
<td>34 (106/309)</td>
<td>73 (1074/1466)</td>
<td>21 (106/498)</td>
</tr>
<tr>
<td>MW1 pallor test +ve or PR&gt;99 or RR &gt; 22</td>
<td>79 (210/267)</td>
<td>56 (730/1310)</td>
<td>27 (210/790)</td>
</tr>
<tr>
<td>MW2 pallor test +ve or PR&gt;99 or RR &gt; 22</td>
<td>84 (216/258)</td>
<td>46 (551/1189)</td>
<td>25 (216/854)</td>
</tr>
<tr>
<td>MW1 pallor test +ve or PR&gt;99</td>
<td>77 (204/265)</td>
<td>60 (783/1299)</td>
<td>28 (204/720)</td>
</tr>
<tr>
<td>MW2 pallor test +ve or PR &gt; 99</td>
<td>81 (205/253)</td>
<td>51 (592/1168)</td>
<td>26 (205/781)</td>
</tr>
<tr>
<td>MW1 pallor test +ve or RR &gt; 22</td>
<td>66 (150/227)</td>
<td>77 (887/1156)</td>
<td>36 (150/419)</td>
</tr>
<tr>
<td>MW2 pallor test +ve or RR &gt; 22</td>
<td>74 (190/258)</td>
<td>68 (800/1184)</td>
<td>33 (190/574)</td>
</tr>
</tbody>
</table>

MW pallor test +ve = midwife predicted Hb as being less than 7g/dl by pallor examination
RR > 22 = respiratory rate greater than 22 respiration per minute
PR > 99 = pulse rate greater than 99 beats per minute
All the above were statistically significantly associated with severe anaemia (p < 0.05) except for respiratory rate alone.

The mean respiratory rate (SD) was 20.4 intakes per minute (2.10), range 12-52, n=1771: and the mean pulse rate (SD) was 90.2 beats per minute (10.41), range 60-126, n=1775. Raised respiratory rates (> 22 respiration per minute) and raised pulse rates (> 99 beats per minute) individually were not good predictors of low Hb (Table 1). However, the sensitivity, specificity and PPV for increased pulse rate in combination with pallor resulted in sensitivities of 79% and 81% and specificities of 60% and 51% for midwives 1 and 2, respectively (Table 1). The inclusion of raised respiratory rate made very little improvement to either sensitivity or specificity.

Comparing sensitivity and specificity over time for the 2 midwives showed no significant change for midwife 1 but an improvement in specificity for midwife 2. Her specificity increased from 71% to 83% between the first and last 4 month periods (p=0.004).

Phase 2: Symptoms in conjunction with pallor examination
The mean Hb concentration (SD) of the 198 recruited women was 8.6 g/dl (1.70), range 3.8-13.1. 32 (16%) were severely anaemic (Hb < 7 g/dl), 126 (64%) were moderately anaemic (Hb 7-9.9 g/dl), and 40 (20%) were mildly anaemic / non-anaemic (Hb ≥ 10 g/dl). Mean gestation (SD) at the time of the assessment and blood test was 32 completed weeks (3.9), range 16-40.

Table 2 illustrates how the screening questionnaire, asking about symptoms, signs, recent functional activities and self-perceived paleness or colour change, and the ensuing midwife’s final assessment of Hb predict severe anaemia (Hb < 7 g/dl). Two useful questions appear to be whether the woman reports that her colour has changed (sensitivity 69%, specificity 67%), and whether her legs felt heavy or lifeless (sensitivity 39%, specificity 69%). When the pallor test was performed after the questionnaire had been completed, the midwife's assessment of pallor was associated with high sensitivities and specificities of 84% and 92% respectively (Table 2).
To create possible algorithms to diagnose severe anaemia, two logistic regression models were fitted. Model 1, based on reported “symptoms” alone, found the best independent predictors to be: needing to rest on the way from the bus stop, having “heavy or lifeless” legs, and the woman reporting that she is pale or that her colour has changed. Model 2 was based on “symptoms” and also the midwife’s pallor assessment after delivering the “screening” questionnaire. The second model consisted of only midwives pallor assessment and having heavy or lifeless legs, as no other symptoms contributed significantly to the model. Table 3 shows the regression coefficients for the final logistic regression equations obtained for both Model 1 and Model 2.

Table 3  Regression coefficients for the two models for predicting severe anaemia (phase 2)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Model 1: Symptoms &amp; signs alone (R^2=0.17)</th>
<th>Model 2: Symptoms, signs &amp; midwife assessment (R^2=0.49)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rested when walking from bus stop</td>
<td>1.38</td>
<td>1.38</td>
</tr>
<tr>
<td>Legs feel heavy or lifeless</td>
<td>0.90</td>
<td>1.69</td>
</tr>
<tr>
<td>Thinks she is pale or that her colour has changed</td>
<td>1.24</td>
<td>4.31</td>
</tr>
<tr>
<td>Midwife assesses Hb&lt;7g/dl</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 P-value from chi-squared test of association with severe anaemia (Hb < 7g/dl)
2 Risk ratio: risk of having Hb<7 g/dl if sign present vs. sign absent
3 Distance from bus stop to health centre is approximately 500m
Table 4  The sensitivities and specificities of different cut off scores using two models (phase 2)

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 1: Symptoms / signs alone</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of symptoms/signs present</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 1</td>
<td>84% (27/32)</td>
<td>40% (66/165)</td>
<td>21% (27/126)</td>
</tr>
<tr>
<td>≥ 2</td>
<td>63% (20/32)</td>
<td>82% (135/165)</td>
<td>40% (20/50)</td>
</tr>
<tr>
<td>≥ 3</td>
<td>31% (10/32)</td>
<td>98% (161/165)</td>
<td>71% (10/14)</td>
</tr>
<tr>
<td>Sum of exact regression coefficients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 1</td>
<td>75% (24/32)</td>
<td>56% (92/165)</td>
<td>25% (24/97)</td>
</tr>
<tr>
<td>≥ 2</td>
<td>63% (20/32)</td>
<td>82% (135/165)</td>
<td>40% (20/50)</td>
</tr>
<tr>
<td>≥ 3</td>
<td>31% (10/32)</td>
<td>98% (161/165)</td>
<td>71% (10/14)</td>
</tr>
<tr>
<td><strong>Model 2: Symptoms / signs &amp; midwife assessment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of symptoms/signs present</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 1</td>
<td>94% (29/31)</td>
<td>62% (103/166)</td>
<td>32% (29/92)</td>
</tr>
<tr>
<td>≥ 2</td>
<td>48% (15/31)</td>
<td>99% (164/166)</td>
<td>88% (15/17)</td>
</tr>
<tr>
<td>Sum of exact regression coefficients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 2</td>
<td>94% (19/31)</td>
<td>62% (103/166)</td>
<td>32% (29/92)</td>
</tr>
<tr>
<td>≥ 4</td>
<td>84% (26/31)</td>
<td>92% (152/166)</td>
<td>65% (26/40)</td>
</tr>
<tr>
<td>≥ 6</td>
<td>48% (15/31)</td>
<td>99% (164/166)</td>
<td>88% (15/17)</td>
</tr>
</tbody>
</table>

4  Model 1 symptoms / signs included: “do your legs feel heavy or lifeless?” “do you think you are pale or that your colour has changed?” and “did you need to rest when you walked here from the bus stage?”
5  Model 2 symptoms included: “do your legs feel heavy or lifeless?”

Table 4 shows the sensitivities, specificities and PPVs for diagnosing severe anaemia by using different cut-off scores based on counting the number of symptoms present and on the exact regression coefficients. There was little difference between these scoring methods. Results for predicted values based on rounded regression coefficients were identical to Model 1 for counting the number of symptoms present and very similar for Model 2, so we have not included them in the Table. In Model 1, if the presence of any one of the 3 symptoms were used to define a diagnosis of severe anaemia then a sensitivity of 84% and specificity of 40% could be obtained. Although this had the same sensitivity as from the midwife’s assessment alone in this phase, the specificity was lower. Model 2 indicates that an algorithm based on diagnosing anaemia if either the midwife assessed the woman as severely anaemic, or the woman reported that her legs felt “heavy or lifeless”, resulted in a sensitivity of 94% and a specificity of 62%. The inclusion of “heavy or lifeless” legs increased the sensitivity compared to the midwife assessment alone, but reduced specificity.

**DISCUSSION**

Severe anaemia in pregnancy is an important public health problem that often remains neglected in areas with limited laboratory facilities where routine testing of Hb is not performed.

We explored a number of alternatives for non-invasive screening for severe anaemia in pregnancy, in an area with a high prevalence of severe anaemia. In the first phase of
In this study, we demonstrated with a large sample size, that midwives, who received virtually no additional training, were able to detect 62-69% of pregnant women with severe anaemia (Hb < 7g/dl) by using pallor testing alone. The sensitivity of screening could be increased to 77-81%, by including raised pulse rate as a positive test result, but at the expense of a lower specificity.

In the second phase of this study we investigated the ability of specific “screening” questions when used alone and in combination with pallor testing to detect women with severe anaemia in pregnancy. The screening questions were derived from a period of in-depth work and only those questions that appeared likely to be good differentiators of severely anaemic and non-anaemic women were included. Specific questions relating to known risk factors for anaemia such as recent malaria and helminth infections were not included in this brief questionnaire as infection is usually asymptomatic in this population and the in-depth work suggested that such questions were unlikely to contribute useful information.

**Individual questions**

Individual questions relating to physical health and ability to work had varying sensitivities and specificities. Questions that appeared to work best, in terms of sensitivity and specificity, were: “do your legs feel heavy or lifeless” and “do you think you are pale or that your colour has changed”.

**Pallor examination, performed after asking the questions**

The midwife in this phase of the study was “midwife 2” from phase 1. The sensitivity of pallor examination in predicting severe anaemia was much higher than in phase 1, being 84% with a specificity of 92%. In this phase of the study, the midwife examined each woman for pallor after having asked her the “screening” questionnaire. This increase in sensitivity and specificity was an unexpected finding, for which there are several possible explanations. It is possible that the difference is due to chance (p = 0.09 for difference in sensitivity between phases 1 and 2). An alternative explanation may be that the midwife’s assessment abilities improved with time and experience. However, this is unlikely because in phase 1, which lasted for 14 months, this midwife showed an improvement in specificity only. Another possibility is that examination for the second phase was in a different site, possibly with better lighting, although this was not apparent at the time of the study. We suggest that the midwife was able to form more accurate assessments of the patients’ Hb levels by spending time with the women, observing them, talking to them and discussing their health. In other words although the midwife was meant to be assessing for pallor as before, the accuracy of the pallor test improved with background knowledge about the women’s health. This hypothesis needs to be tested in a different setting, as it is a potentially important finding.

**Development of an algorithm – using pallor examination and / or questions**

When combinations of “symptoms” were used to predict severe anaemia, the three best independent predictors were “do your legs feel heavy or lifeless?” “do you think you are pale or that your colour has changed?” and “did you need to rest when you walked here from the bus stage?”. When the presence of any one of the three symptoms was used to define a diagnosis of severe anaemia then a sensitivity of 84% and specificity of 40% could be obtained. These scores were lower than those for the midwife assessment of pal-
lor in this phase 2. Combining symptoms with pallor testing in an algorithm, increased sensitivity but decreased specificity relative to pallor testing alone, probably because the sensitivity and specificity of pallor testing alone was so high in this phase of the study. Combining questions about symptoms with pallor testing may be useful in an area with less experienced health professionals.

The sensitivities and specificities for the different algorithms derived in this study need to be treated with caution as the algorithms were derived and then validated using the same data. This is likely to result in a higher diagnostic accuracy than would be obtained if a new data-set were used to validate the algorithms.

The questions asked in phase 2 were based on previous qualitative work in the study area and may not be generalisable to other populations. One example of the importance of this qualitative phase was that asking about self-reported pallor needed to be worded as “do you think you are pale or that your colour has changed?”. A number of women reported that their skin had become darker, because the contrast between their pale palms and the backs of their hands had increased. There were a number of interesting and unexpected “symptoms” that arose during the qualitative work, that are not classically described as being symptoms of severe anaemia, such as having legs that feel heavy or lifeless and buzzing in ears. An explanation may be that there has been little previous work on describing the symptoms of severe anaemia in populations with such low Hb levels.

If screening for severe anaemia is used to decide who should be referred for further investigation and treatment, then it is important that the screening tool has a high sensitivity. However, increasing sensitivity usually results in a reduction in specificity, with more women being referred unnecessarily for investigation, so adding to the cost of the health service. The trade-off between sensitivity and specificity desired from a screening test will depend on the cost of performing the screening test and the capacity of resources available for further investigations subsequent to positive test results. This type of priority setting is better decided at the national or regional level.

Our investigation of some alternative methods for low cost clinical assessment of severe anaemia, demonstrates that pallor testing has a reasonable sensitivity and that pulse measurement and “screening” questions about symptoms, signs and recent activities are likely to be useful in refining pallor assessments.

Further studies are needed to evaluate algorithms based on these approaches prospectively (possibly with health workers of different cadres), to determine whether they can help health providers to diagnose severe anaemia more accurately. In addition, it is important that further studies are performed to test the unexpected hypothesis raised here that spending a few minutes observing a woman and asking questions related to her health prior to performing a pallor examination can improve the sensitivity of this non-invasive, simple screening tool. In the meantime, in view of the seriousness of severe anaemia in pregnancy, the simplicity of pallor testing, and its relatively high sensitivity for detecting women with severe anaemia, mean it should continue to be encouraged in areas where there are limited facilities to test the Hb of pregnant women.

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