



ASSESSING RELIABILITY OF WHO HAEMOGLOBIN COLOUR SCALE AND ITS COMPARISON WITH OTHER SCREENING METHODS FOR ANAEMIA DETECTION

Pathology

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ABSTRACT

Background-The World Health Organisation (WHO) haemoglobin colour scale is an inexpensive, simple method for diagnosing anaemia.

Methods-The haemoglobin of 1400 patients attending a tertiary care hospital was estimated by WHO haemoglobin colour scale (HCS) which were later compared with measurements of haemoglobin by the standard laboratory methods to determine its reliability and to determine interobserver variation.

Results-In present study, comparison of HCS with coulter counter ERBA HAEMOLAB-8 in 500 blood samples showed sensitivity of 90.48%, specificity of 98.88%, false positive rate 1.12%, false negative rate 9.52% and reliability coefficient of 0.94%. In comparison of HCS with cyanmethaemoglobin method in 500 blood samples, results showed sensitivity of 69.84%, specificity of 77.15%, false positive rate 22.85%, false negative rate 30.16% and reliability coefficient of 0.76%. In contrast, comparison of HCS with Sahli's method in 200 blood samples of ANC patients showed sensitivity of 90.83%, specificity of 30.00%, false positive rate 70.00%, and false negative rate 9.10% and reliability coefficient of 0.72%. While doing comparison of HCS with copper sulphate specific gravity method in 200 blood samples, we noticed sensitivity of 90.48%, specificity of 98.88%, false positive rate 1.12%, and false negative rate 9.52% and reliability coefficient of 0.94%. Reliability of the HCS in detecting anaemia and assessing its severity was 55.67% non anaemic cases (more than 12gm% haemoglobin), 87.67% in mild anaemia (8-12gm% Hb), 100% in cases of moderate anaemia (6-8gm%) and critical anaemia (less than 4 gm %) and 91% in severe anaemia (4-6gm% Hb). 20% of samples showed interobserver variation within the range of 1 gm/dl.

Conclusion:- The present study concluded that WHO scale is a useful, quick, easy and reliable method of detecting anaemia in areas where proper laboratory setup is not there.

KEYWORDS

Anaemia, Comparative study, Haemoglobinometry, Reliability, Standard laboratory methods, WHO haemoglobin colour scale.

Introduction:-

Anaemia is one of the most common health problems leading to morbidity and mortality especially in developing and under developed countries¹. Among various causes of anaemia, Iron deficiency anaemia is the most common micronutrient deficiency in the world, affecting 2 billion people². Other causes of anaemia are parasitic infections, malnutrition, micronutrient deficiencies, chronic inflammatory diseases, or hereditary haemoglobinopathies³. In order to control anaemia and abnormal haemoglobin conditions, an accurate diagnosis and detecting its severity at community and clinical settings is needed³. Commonly-used methods to detect anaemia are clinical examination for pallor, Sahli method, copper sulphate method, and coulter counter ERBA HAEMOLAB-8^{1,2}.

In order to overcome several limitations of these methods, ranging from lack of accuracy to complexity to high cost, Haemoglobin Colour Scale (HCS) was introduced by the World Health Organization (WHO) for use in rural settings and resource poor settings for haemoglobin estimation where laboratory based Haemoglobinometry is not available. The WHO scale was initially used for screening of anaemia in paediatric and antenatal clinics, malaria and hookworm control programs, blood donor selection⁴. HCS has many advantages of being cheaper; quick to give readings, portable, easy to use, and it does not require any maintenance, battery or electricity^{4,5}. But previous studies varied much in their results in assessing the diagnostic accuracy of HCS. In the present study, in order to determine the reliability of WHO scale and to check inter observer variation, WHO scale readings were compared with measurements of haemoglobin by the standard laboratory methods.

Material and Methods:-

The present study was done after taking approval from ethics committee. The haemoglobin of total 1400 patients attending a tertiary care hospital was estimated by HCS. Then, in order to check reliability of WHO haemoglobin colour scale in comparison with other standard laboratory methods of haemoglobin estimation, 1400 samples were subdivided. 500 venous blood samples of ward patients taken in EDTA bulb were compared with ERBA Haemolab-8. Venous blood samples

of 500 OPD patients taken in EDTA bulb were compared with Cyanmethaemoglobin method. Capillary blood samples of 200 ANC patients were compared with Sahli's acid haematin method. 200 capillary blood samples of donors were compared with copper sulphate specific gravity method.

WHO colour scale kit was consisted of a booklet with a set of 6 shades of red with haemoglobin range of 4-14 gm/dl and a dispenser with special absorbent test strips having property of rapid absorbance and uniform colour spread. Drop of blood was taken on one end of test strip so that it formed a stain of 8-9 mm in diameter, wait at least 30 seconds and then reading was completed within 2 minutes. Blood stain was compared with colour scale in good light, avoiding direct sunlight or shadow. The booklet was held open at an angle that allowed you to distinguish the different shades easily. The blood stain was slid up and down behind the apertures in the scale until the best match was found. The test strips were kept close to the back of the scale to prevent the entry of any stray light. Starting from the lightest shade (4gm/dl), if the blood stain matched one of the shades of red exactly, its haemoglobin value was recorded. If the colour of the stain lied between two shades, the mid value was recorded. In cases of any doubt between two shades, the lower value was recorded. In 500 samples, two observers took the WHO haemoglobin reading on WHO haemoglobin colour scale individually. This was done to detect any inter-observer variation.

Results:-

Table 1: Reliability of WHO haemoglobin colour scale in comparison with standard laboratory methods of haemoglobin estimation.

Results	Coultercounter ERBAHAEM OLAB-8 (Sample size - 500)	Cyanmethae moglobin Method (Sample size -500)	Sahli's acid haematine- Method (Sample size -200)	Copper sulphate specific gravity method (Sample size -200)
	Percentage			
Sensitivity	90.48%	69.84%	90.83%	90.48%
Specificity	98.88%	77.15%	30.00%	98.88%

False positive rate	1.12%	22.85%	70.00%	1.12%
False negative Rate	9.52%	30.16%	9.10%	9.52%
Reliability coefficient	0.94%	0.76%	0.72%	0.94%

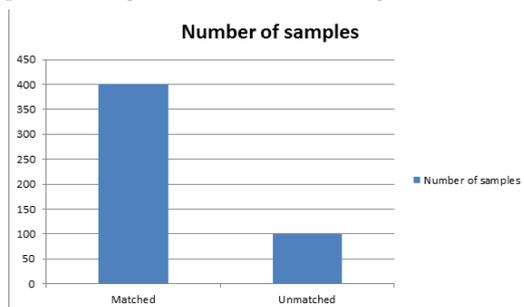
Table 2: Reliability of WHO haemoglobin colour scale in comparison with copper sulphate method

Haemoglobin	copper sulphate method	WHO haemoglobin colour scale
Less than 12.5 gm	18	17
More than 12.5 gm	182	183

Table 3: Reliability of WHO haemoglobin colour scale in detecting anaemia and assessing its severity.

Hb scale with severity of anaemia	No. of cases	No. of cases matched in WHO Hb colour scale	% of cases matched
Not anaemic (12gm/dl or more)	307	206	55.67%
Mild to moderate (8-12gm/dl)	503	440	87.67%
Marked (6-8gm/dl)	75	75	100%
Severe (4-6gm/dl)	44	40	91%
Critical (less than 4gm/dl)	08	08	100%

Graph 4 – showing Inter observer variation (1gm% variation)



Discussion

One of the most commonly-used methods for diagnosis of anaemia in rural settings is clinical examination. However inaccurate results of clinical examinations for detection of anaemia, especially non-severe anaemia leads to development of WHO colour scale.

WHO colour scale was developed as a clinical device to provide a means for identifying whether an individual is anaemic and in a broad classification, the severity of anaemia. It does not aim to compete with a haemoglobinometer but is intended to be used when the latter is not available or practical.

SM Lewis, GJ Stott and K J Wynn⁶ had used this haemoglobin scale method to measure haemoglobin in 1213 random venous blood samples from routine work in four laboratories one each in the UK, South Africa, Thailand and Switzerland. Limited field trials of the method for assessing clinical usefulness were done in rural hospitals of South Africa. Two batches of blood samples were provided, one with stated haemoglobin value for a training session and a second batch of 20 test samples with haemoglobin concentration from 2-17g/dl as determined by a reference laboratory with the haemiglobocyanide method. Two blood sessions one each in South Africa and Thailand were also done. In the laboratory based comparative study the presence of anaemia was reliably detected using the new method with sensitivity of 91% and specificity of 86%. In our study we compared the haemoglobin of 500 samples by WHO scale and cyanmethaemoglobin method. The sensitivity was 69.84% and specificity was 77.15%. S M

Lewis et al⁶ did not find any discrepancies between colour scale and copper sulphate specific gravity method. In our study on blood donors, the sensitivity was 90.48% and specificity was 98.88% when compared with copper sulphate specific gravity method. Sahli's and copper sulphate method had similar sensitivity and specificity as HCS in other previous studies^{7,8,9}. So present study concluded that blood donor trials by HCS were as reliable as copper sulphate method with the advantage of being more convenient and simple.

C F Ingram and S M Lewis¹⁰ carried out the project with colour scale method on a total of 548 patients who presented in general medicine and antenatal clinics at three hospitals in the neighbourhood of Johannesburg. Venous blood samples were first used to check haemoglobin with the WHO scale independently and then sample was immediately sent to laboratory to check haemoglobin by standardised automated blood counters. In Ingram et al study¹⁰, anaemia screening showed sensitivity of 96% and specificity of 86%. However, in our present study haemoglobin of 500 samples were compared by colour scale and coulter counter method where presence of anaemia was detected with sensitivity of 90.48% and specificity of 98.88%.

Sensitivity and specificity of HCS were very high in laboratory based studies but reduced considerably in field studies¹¹. Sensitivity of HCS for anaemia detection varied from 50% to 86% in previous studies done under real-life condition^{11,12}. Present study had much better sensitivity for severe anaemia than another real-life study which reported sensitivity of 50%¹².

In S. Gies et al study done in Ethiopia, HCS showed a very low sensitivity in detecting anaemia among pregnant mothers³. Sensitivity for the hemoglobin values <9g/dL was 42.9% and for values <10g/dL was 33.3% whereas sensitivity for the hemoglobin values <11g/dL was 43.5%. However in all three categories, specificity remained relatively high¹¹. In Montresor et al. study conducted to detect the anaemia among preschool children in Zanzibar, under estimation of the high hemoglobin levels was reported¹³.

Present study indicated its clinical reliability in general medical and antenatal clinics for detecting anaemia and discriminating between moderate, severe and critical anaemia. Out of 1400 samples, 500 samples were subjected for inter observer variation in WHO scale kit. In 400 samples readings were matched between the two observers but in 100 samples, there were variation in reading of 1gm/dl of haemoglobin i.e. in present study, 20% samples showed inter observer variation.

Several factors contributed to the incorrect readings like not following the guidelines of waiting period of 30 seconds and completing test within two minutes because the blood stain changes colour after this time. The size of drop was also important. In a small number of cases, the initial reading was made on a test strip with too little blood, leading to inadequate spread, with a white periphery at the adjacent matching area. Conversely too much blood led to a thick spread and insufficient drying in the prescribed time. The solution to this problem was to take up blood to a distance of about 3 cm in a capillary tube for delivery on the test strip. It is essential to have good light (day light or artificial light). Our present study was also carried out in day light and artificial light was used in close ventilated rooms.

Some training was also required like careful understanding of instructions and practice with some blood samples of known haemoglobin content. Without exception the scale was well received. Most participants found the scale and test strips easy to perform and handle. The accuracy improved when the tests were repeated under supervision and these faults were taken care off. Confidence in selecting the correct shade increased with experience and we had no difficulty in judging intermediate values.

There was a health check up drive in thane district at sakwar in state of Maharashtra in India where 600 patients haemoglobin was determined by this HCS. The technicians who used the HCS found it very simple, convenient and rapid method of haemoglobin estimation. Present study confirmed the usefulness and reliability of HCS and its great advantage of providing a reliable near patient method for screening anaemia in the absence of laboratory. We wish to donate these kits to the gynaecology department where haemoglobin estimation of ANC patients is done using Sahli's method.

Conclusion

Haemoglobin Colour Scale is a reliable, useful, quick and easy method in detecting anaemia and assessing its severity after a brief training in rural and community setups where proper laboratory facilities are not available. However more studies are needed for examining the utility of HCS in assessing response to the treatment for anaemia and whether improved diagnosis of anaemia, using HCS, ultimately improves treatment and outcomes of anaemic patients remains to be further explored.

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