



**Research Article**

**EFFICACY OF ASSESSING CLINICAL PALLOR AT MORE THAN ONE PLACES AND IT'S CORRELATION WITH THE LAB PARAMETERS**

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**ARTICLE INFO**

**Article History:**

Received 15<sup>th</sup> February, 2019

Received in revised form 7<sup>th</sup>

March, 2019

Accepted 13<sup>th</sup> April, 2019

Published online 28<sup>th</sup> May, 2019

**Key words:**

Pallor, Anaemia, Palmer crease pallor, Conjunctiva Pallor, Screening for anaemia.

**ABSTRACT**

**Background:** It is important for health-care workers to know the accuracy of pallor in detecting anaemia, and if positive what level of anaemia clinical pallor can detect with confidence. Thus, this study was planned to assess the accuracy of clinical pallor compared to haemoglobin measured by automated analyzer for detecting severity of anaemia. **Methodology:** This cross sectional observational study was conducted in total 315 children. Conjunctival pallor, palmer crease pallor, tongue pallor was noted clinically as per standardised criteria. Hemoglobin was level were assessed using automated hematology analyser.

**Results:** Strong uphill correlation was detected between haemoglobin measurement observed by Sahli's Hb method and lab Hb test method. Pallor at all sites of clinical examination showed significant association with severe anaemia. Pallor at all sites of clinical examination except palm pallor showed significant association with moderate anaemia. Maximum sensitivity for diagnosing severe anaemia (99.3%) as well as moderate anaemia (92.7%) was shown by Palm pallor while maximum specificity for diagnosing severe anaemia (64.6%) as well as moderate anaemia (84.2%) was shown by tongue pallor.

**Conclusion:** Diagnosis by palm pallor followed by confirmation by conjunctival pallor can be best possible approach. Sahli's haemoglobinometer though useful and corresponding to laboratory haemoglobin must be only used in peripheral field and confirmation of Hb must be done by standardised laboratory method at the earliest possible opportunity.

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**INTRODUCTION**

Anaemia is defined as a reduction of the red blood cell volume or haemoglobin concentration and haematocrit below the range of values occurring in healthy persons or two standard deviation below the mean for the normal population, age as well as gender. In India according to NFHS-4, 2016 prevalence of anaemia was 58.4% in males and in females 58.7%, according to age groupwise distribution, anaemia prevalence in <5yrs 60.0%, in 5-7yrs 58.7%, in 8-9yrs 56.6% in 10 to 11yrs 55.1% and in ≥12 yrs 51.7%. In Chhattisgarh prevalence of anaemia was 41.6% among which mild (10-10.9 gm/dl) was 24%, moderate (7-9.9gm/dl) was 17% and severe (<7gm/dl) was 0.6%. (Kumar V et al 2010). With frequency of sickle cell trait being around 10% and that of thalassemia gene being 8.17-12.48%, Chhattisgarh shares high load of anaemia. (Kumar V et al 2010) Although anemia is diagnosed by taking various instruments like Sahli's, electronic cell counter and automated haematology analyzers, Often physicians use clinical assessment of pallor as a screening test, and order haemoglobin test if one or more sites suggest presence of pallor.

The physical signs to diagnose anaemia include conjunctival, tongue, palmer, and nailbed pallor.

Diagnostic studies assessing the accuracy of pallor for detection of anaemia have largely focused paediatric population. According to a systematic review on the accuracy of clinical signs of anaemia (Chalco JP et al 2005) which included 11 studies (8726 children), mostly performed in Africa, the rates of false positive and false negative results were unacceptably high for the clinical diagnosis of anaemia. In the four diagnostic studies that evaluated the accuracy of pallor in the conjunctivae, face, palms and nail beds to detect anaemia in adult inpatients, the sensitivity and specificity of pallor ranged from 19 to 70 per cent and 70 to 100 per cent respectively. (Sheth TN et al 1997, Gjorup T et al 1986, Hung OL et al, Nardone DA et al 1990)

It is important for health-care workers to know the accuracy of pallor in detecting anaemia, and if positive what level of anaemia clinical pallor can detect with confidence. Thus, this study was planned to assess the accuracy of clinical pallor compared to haemoglobin measured by automated analyzer for detecting severity of anaemia.

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**MATERIAL AND METHODS**

This cross sectional observational study was conducted in department of Paediatrics Dr. B R A M hospital, Raipur Chhattisgarh. Total 315 children amongst those admitted to Paediatrics wards and Patients attending in Paediatrics OPD, Pt J N M Medical College and Dr BRAM Hospital Raipur ; aged between 6 months to 14 years of age over a period of 2 year from February 2016 to February 2018 with clinical pallor were included in the study. Patients presenting with shock, congestive cardiac failure, generalised oedema and signs of poor perfusion and hypothermia were excluded from the study. Written informed consent of the child/parent or legally accepted representative was obtained. A detailed history elicited and physical examination was done and data was tabulated according to a predesigned pro-forma to detect various nutritional and socioeconomic factors. Conjunctiva was considered pale if the colour of the anterior rim was same as that of posterior pale rim. Palmer pallor was assessed by comparing the colour of palmer creases with that of adjacent skin. Nail bed pallor was assessed by pressing the nail and noting the colour of nail bed after releasing digital pressure. Tongue pallor was assessed by paleness colour of tongue as compared to surrounding tissues. Age of the child was recorded in completed years. Two ml of blood was drawn from anterior cubital fossa by a Paediatrician and haemoglobin was estimated by automated analyzer BC 3000 plus (Mindray® Bio-Medical Electronics Co., Ltd (Shenzhen, China). Samples were subjected to HPLC using Hb Variant® (Bio-Rad laboratories, Hercules USA). Severity of anaemia was diagnosed according to the WHO criteria i.e. Mild anaemia-9.5 to 11gm/dl, Moderate anaemia-8 to 9.5gm/dl, Severe anaemia-less than 8gm/dl.

**Statistical Analysis:** Data was expressed as percentage. Chi square test and fisher's exact test were used to assess the significance of difference between distribution of data. Pearson's correlation was used to assess the relativity between two observations. Sensitivity and specificity was calculated for diagnostic techniques. Statistical significance was assumed at p<0.05. SPSS© for windows™ Vs 17, IBM™ Corp NY and Microsoft excel™ 2007, Microsoft® Inc USA was used perform the statistical analysis.

**OBSERVATIONS AND RESULTS**

Distribution of age in study subjects was assessed. Maximum subjects (34.6%) were under the age 6-10 years.. 145 (46%) were female child(FCH) and 170 (54%) were male child(MCH) and female to male ratio was 1:0.8 .Clinical jaundice was present in 52 subjects (16.5%) and in 263 (83.5%) subjects CCF was present. (Table 1)

Using Sahli's Haemoglobin meter, 175 (55.6%) subjects showed <8.0 gm% Hb, 74 (23.5%) subjects had Hb value 8.0-9.49 and 55 (17.5%) subjects had Hb value ranging from 9.5 to 11.0 gm%. while, 11 (3.5%) subjects had Hb>11 gm%. Using haematology analyser 176 (55.9%) subjects had Hb<8.0 gm, 57 (18.1%) subjects were found to be having Hb as 8.0-9.49 gm% and 52 (16.5%) subjects had Hb 9.5-11.0 gm%. 30 (9.5%) subjects showed Hb as >11. (Table 2) Sever pallor was observed in 151 (47.9%) subjects and 110 (34.9%) subjects showed moderate pallor. While 54 (17.1%) subjects showed mild pallor.(Fig 1) Strong uphill correlation was detected between haemoglobin measurement observed by Sahli's Hb

method and lab Hb test method. This correlation was found to be statistically significant. (Fig 2) Pallor at all sites of clinical examination showed significant association with severe anaemia.(Table 4) Pallor at all sites of clinical examination except palm pallor showed significant association with moderate anaemia.(Table 5) Maximum sensitivity for diagnosing severe anaemia (99.3%) as well as moderate anaemia (92.7%) was shown by Palm pallor while maximum specificity for diagnosing severe anaemia (64.6%) as well as moderate anaemia (84.2%) was shown by tongue pallor. (Table 6)

**Table 1** General characteristics of study subjects

Characteristics	Subjects (n=315)	Percentage	
Age	<=5	96	30.5
	6-10	109	34.6
	11-15	106	33.7
	>15	4	1.3
Gender	FCH	145	46.0
	MCH	170	54.0
General examination findings	Clinical jaundice	52	16.5
	CCF	52	16.5

**Table 2** Haemoglobin measurements using different techniques

Hb (gm%)	Sahli's Haemoglobinometer		Hematology analyzer	
	N	%	N	%
<8.0	175	55.6	176	55.9
8.0-9.49	74	23.5	57	18.1
9.5-11.0	55	17.5	52	16.5
>11	11	3.5	30	9.5

**Table 3** Pallor at different sites

Location	Pallor	Percentage
Nail bed	225	71.4
Palm	292	92.7
Tongue	206	65.4
Conjunctiva	209	66.3

Pallor was observed in nail bed in 225 subjects (71.4%), Palm in 292 (92.7%), tongue in 206 (65.4%) and conjunctiva in 209 (66.3%). (Table 3)

**Table 4** Association between clinical pallor at various sites and severe anaemia

Site	Severe anaemia N (%)N=151	Chi sq	P value
Nail bed pallor	149 (98.7)	105.5	<0.0001
Palm pallor	150 (99.3)	18.89	<0.0001
Tongue pallor	148 (98.0)	136.3	<0.0001
Conjunctival pallor	149 (98.7)	135.7	<0.0001

**Table 5** Association between clinical pallor at various sites and moderate anaemia

Site	Severe anaemia N (%)N=261	Chi sq.	P value
Nail bed pallor	214 (82.0)	83.25	<0.0001
Palm pallor	242 (92.7)	0.001	0.579
Tongue pallor	198 (75.9)	73.68	<0.0001
Conjunctival pallor	201 (77.0)	77.22	<0.0001

**Table 6** Diagnostic significance of various clinical pallor in diagnosis of moderate or severe anaemia.

Anaemia grade	Location	Sensitivity	Specificity	PPV	NPV	P value
Severe anaemia	Nail bed pallor	98.7	53.7	66.2	97.8	<0.0001
	Palm pallor	99.3	13.4	51.4	95.7	<0.0001
	Tongue pallor	98.0	64.6	71.8	97.2	<0.0001

	Conjunctiva pallor	98.7	63.4	71.3	98.1	<0.0001
	Nail bed pallor	82.0	79.6	95.1	47.8	<0.0001
Moderate anaemia	Palm pallor	92.7	7.4	82.9	17.4	0.579
	Tongue pallor	75.9	85.2	96.1	42.2	<0.0001
	Conjunctiva pallor	77.0	85.2	96.2	42.4	<0.0001

minimum age of 12 year 52% subjects were male.(Kalantri A *et al* 2010)

**Anaemia and Pallor observed in study subjects**

In study by Desai *et al* prevalence of ‘pale-skin’ was 33.3%, and of any-pallor was 37.4%; 17.5% were reported to have palmer pallor, 17.1% to have nail bed pallor, and 22.3% and 26.2% to have eyelid and tongue pallor, respectively. (Desai MR *et al* 2002) Pallor findings in our set up are quite higher compared to Desai *et al* study. Possible reason may be due to fact that Desai *et al* carried out their study in Kenya and skin colour may be a factor influencing pallor detection.(Desai MR *et al* 2002)Strobach *et al* detected conjunctival pallor in 22%, nail bed pallor in 32 % and palmar crease pallor in 20% subjects.(Strobach RS1988) Leal LP *et al* noted presence of palmar pallor (39.3% and 26.5%), of conjunctival pallor (19.7% and 22.9%), and the combination of palmar pallor and conjunctival pallor, individually or together (47% and 30.9%) which was also significantly lower compared to our study. prevalence of anaemia in the children of this sample was 92.7%.whereas that of our study was tongue 65.4%, conjunctiva 66.3% , nail bed 71.4% and palm 92.7% which is comparatively not comparative to CG study . (Leal LP 2006) Muhe *et al* observed anaemia in 61% subjects in their study out of which moderate anaemia was detected in 19% subjects and severe anaemia in 4% subjects. (Muhe L *et al* 2000) Kalantri *et al* observed anaemia in 62% subjects. (Kalantri A *et al*) Luby SP *et al* noted prevalence of anaemia to be 82% amongst which 31% were having haemoglobin 5-8 g%, 35% were <8 g/dl and 5 % were <5 g/dl.

In our study percentage of mild anemia was found in 17.14% , moderate 34.92% and severe 47.94% subjects .(Luby SP *et al* 1995)Chalco JP *et al* noted in metaanalysis that prevalence of anaemia in children can be as high as 87%.(Chalco JP 2005)Getaneh *et al* noted that younger children were having sever and more prevalence of anaemia compare to older children.(Gatenah *et al* 2000) In a study from India, Regina *et al* noted that Anaemia was more prevalent in girls compared to boys even before menarche.but in our study anemia was more prevalent in boys(54%) compared to girls(46%). (Regina D *et al* 2016)Mohapatra *et al*, in a study from Bhubaneswar, Odisha, in the age group of less than 12 years, found a prevalence of anaemia of 79%. (Mohapatra S *et al* 2014) Jain N *et al*, in a study from Rishikesh, in the age group of 5 years to 16 years, found a prevalence of anaemia of 56.5%.(Jain N *et al* 2012) Gupta S *et al*, in a study from West Bengal, in the age group of 6 years to 16 years, found a prevalence of anaemia of 80.2%.(Gupta S *et al* 2012)Bhoite *et al*, in a study from Vadodara, Gujarat, in the age group of 5 years to 12 years, found a prevalence of anaemia of 73%.(Bhoite R *et al* 2011). In our study in age group  $\leq$  5yr prevalence of anemia was 30.5% ,in 6-10yrs 34.6% , in 11-15yrs 33.7% and in >15yrs 1.3% .

Clinical pallor in conjunctiva, palm, nail bed as well as tongue were found to be having significant association with moderate as well as severe anaemia. Further palm pallor was found to have maximum sensitivity (99.3%) followed by conjunctival pallor and nail bed (98.7%) which was followed by tongue pallor (98.0%) to detect severe anaemia . Similarly in moderate anaemia snstivity is maximum in palm pallor(92.7%) followed by nail bed pallor (82.0%) followed by conjunctiva pallor (77.0%.) and minimum in tongue pallor

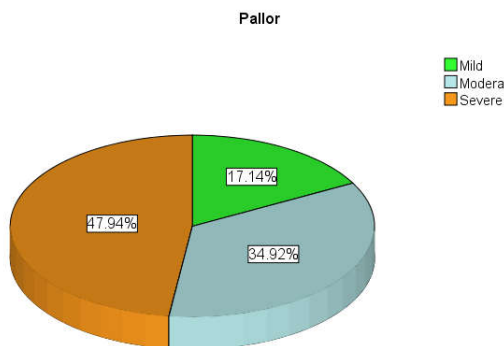


Fig 1 Pallor observations in the study subjects

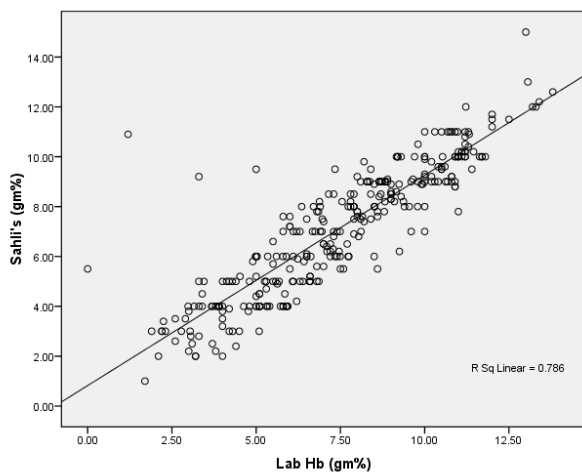


Fig 2 Correlation analysis between Heamoglobin measurement using Sahli'sHaemoglobinometer and Heamtologyanalyzer.

**DISCUSSION**

We recruited total 315 subjects and analyzed them for clinical presence of pallor in nail bed, tongue, conjunctiva and palmer crease. Further laboratory estimation of haemoglobin was done using hematology analyzer and Sahli'shaemoglobinometer was used for estimating Hb. The interpretation was then compared to assess the diagnostic significance.

**General Characteristics**

Luby *et al* in similar study conducted in African patients in year 1995 recruited 1225 subjects and enrolled 1104 subjects. Median age of subjects was 13 months (<1 month to 60 months) and 53% were male. Thus gender distribution was similar to our study.(Luby SP *et al* 1995)Gatenah *et a*; also enrolled 574 subjects with age groups 2-60 months and analysed pallor at four different sites. (Gatenah *et al* 2000) Muhe *et al* evaluated clinical pallor in 2540 subjects with 2months to 5 years of age.(Muhe L *et al* 2000) Desai *et al* also studies the same age group with 3782 subjects.(Desai MR *et al* 2002)Kalantri *et al* performed similar study in subjects with

(75.9%) Specificity in severe anaemia was found to be highest in tongue pallor (64.6%) followed by conjunctiva (63.4%) followed by nail bed (53.5%) followed by palm pallor (13.4%). Similarly in moderate anaemia specificity is highest in tongue pallor and conjunctiva pallor (85.2%), followed by nail bed (79.6%) and minimum in palm pallor (7.4%).

Leal LP *et al* noted that maximum individual sensitivity for detecting anaemia was shown by palmar pallor to be followed by conjunctival pallor, but the sensitivity was quite less (40.3% and 20.6%) compared to our study. (Leal LP 2006) Muhe *et al* noted maximum sensitivity by Palmer and nail bed pallor for moderate anaemia (95%) and maximum specificity for Conjunctival pallor (81%) for moderate anaemia and Conjunctival and mucosal pallor for severe anaemia. (Muhe L *et al* 2000) In study by Kalantri *et al* all clinical pallor parameters except nail bed were significantly different in different grades of pallor. Maximum diagnostic significance in terms of likelihood ratio was shown by tongue (LR 9.87) in all three grades of anaemia. (Kalantri A 2010) Stoltzfus RJ *et al* however noted that the prevalence of pallor at any anatomical site did not correspond to the prevalence of anaemia or severe anaemia though Haemoglobin concentration significantly lower in group with pallor compared to without pallor for conjunctiva, palm, or any site,  $P < 0.001$ ; nail bed not significant. (Stoltzfus RJ *et al* 1999)

Luby SP *et al* noted that for each site mean Hb conc was significantly different at presence and absence of pallor. Further maximum sensitivity was shown by Nail bed and specificity by palm pallor across different spectrums of anaemia. (Luby SP *et al* 1995)

In a meta-analysis by Chalco JP *et al* Sensitivity of clinical signs ranged widely from 29.2% through 80.9% at different haemoglobin thresholds. Only palmar pallor showed 80.9% of sensitivity at haemoglobin less than 8 g/dL. And only nail bed pallor reached a 90.8% of specificity at haemoglobin less than 7 g/dL. Getaneh *et al* noted that Palmar pallor, with a sensitivity of 58%, had the highest sensitivity to detect moderate anaemia as compared to other anatomic sites and the inter-observer agreement was highest for conjunctival pallor. (Chalco JP *et al* 2005) Regina L *et al* in a study in Indian population noted that sensitivity and specificity of clinical pallor in diagnosing anaemia is 94.02% and 93.71% respectively. The positive and negative likelihood ratios of clinical pallor in diagnosing anaemia are 14.94% and 0.064% respectively. (Regina D *et al* 2016)

Our study suggests that moderate anaemia is best detected by using palm pallor or pallor of the nail beds (sensitivity 95%), while conjunctival pallor was least useful (sensitivity 84%). A similar trend is also shown for severe pallor, even though the sensitivity values are low in this case. In Bangladesh, palm pallor had a lower sensitivity than conjunctival pallor for both severe and moderate anaemia probably because of the increased palm pigment (Kalter *et al* 1997). Similarly, in a study from Pakistan it was found that conjunctival pallor had the highest sensitivity of all sites for detecting anaemia with haemoglobin  $< 11$  g/dl in young children. (Thaver IH *et al* 1994) Other studies in Africa (Luby SP 1995, Zuker JR 1997) and of whites in the USA (Nardone *et al* 1990) have shown that the nail beds and palm are the best sites for assessing pallor in these settings.

Thus we conclude that anaemia prevalence is very high in our population. In addition to standard and definitive techniques used for diagnosis of anaemia, clinical diagnosis of pallor is very useful, easy and handy tool in diagnosing anaemia. Palm pallor should be most preferred screening method though additional use of other pallor site only increases the sensitivity. Diagnosis by palm pallor followed by confirmation by conjunctival pallor can be best possible approach. Sahli's haemoglobinometer though useful and corresponding to laboratory haemoglobin must be only used in peripheral field and confirmation of Hb must be done by standardised laboratory method at the earliest possible opportunity. Through training of healthcare workers as well as caretakers, parents and stakeholders to detect clinical pallor can help to find out increasing number of cases of anaemia. Thus this can be an important step in detecting anaemia and providing treatment to these subjects.

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**How to cite this article:**

Kanak Ramnani *et al* (2019) 'Efficacy of Assessing Clinical Pallor at More Than one Places and it's Correlation with the Lab Parameters', *International Journal of Current Advanced Research*, 08(05), pp. 18728-18732.  
DOI: <http://dx.doi.org/10.24327/ijcar.2019.18732.3588>

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