

COMPARISON OF CYNMETHEMOGLOBIN METHOD AND DIGITAL HAEMOMETER IN MEASURING HAEMOGLOBIN

P Rajalakshmy¹, A Lokeshmaran^{2*}

¹Lecturer in Nutrition, Kasturba Gandhi Nursing College, Puducherry.

²Assistant Professor of Bio-statistics, Department of Community Medicine, Mahatma Gandhi Medical College and Research Institute, Puducherry.

Article Info: Received 20 April 2019; Accepted 8 May, 2019

Cite this article as: P, R., & A, L. (2019). COMPARISON OF CYNMETHEMOGLOBIN METHOD AND DIGITAL HAEMOMETER IN MEASURING HAEMOGLOBIN. *International Journal of Medical and Biomedical Studies*, 3(5).

DOI: <https://doi.org/10.32553/ijmbs.v3i5.234>

Corresponding Author: Dr. Lokeshmaran. A, Assistant Professor of Bio-statistics, Department of Community Medicine, Mahatma Gandhi Medical College and Research Institute, Puducherry.

Conflict of interest: No conflict of interest.

Abstract:

Background: Anaemia is a global public health problem which affects both the developing and the developed countries, World-wide, more individuals have iron-deficiency anemia than any other health problem. The present study is to find the prevalence of anemia and to compare the effectiveness of two haemoglobin meter, Cynmethemoglobin and Digital Haemometer (Mission).

Methods: For this 60 public people from Puducherry Population, were their blood pressure, lifestyle practise was analysed, haemoglobin was tested in both Cynmethemoglobin Method and Digital Haemometer for all 60 population. Venous blood was collected to test Cynmethemoglobin method and capillary blood was taken to test in Digital Haemometer and the effectiveness was compared.

Results: In average 60 adult samples the median haemoglobin concentration using the Digital Haemometer was 12.8 g/dl and 12.0 g/dl with Cynmethemoglobin method. The prevalence of anemia was slightly higher when using Cynmethemoglobin method 73.3% (44) were 58.3 % (35) was seen in Digital Haemometer. Haemoglobin was analysed in both the method were the prevalence anemia the cynmethemoglobin method has higher prevalence of anaemia than the Digital haemometer method.

Key words: Anemia, Cynmethemoglobin Method and Digital Haemometer

Introduction

Anaemia is a global public health problem which affects both the developing and the developed countries, World-wide, more individuals have iron-deficiency anemia than any other health problem [1]. Globally, anemia affects 1.62 billion people, which corresponds to 24.8% of the population [2]. Later in 1993-2005, WHO database on global prevalence of anemia reported an overall prevalence of 25% where 65.5% of pre-school children, 48.2% of pregnant women and 45.7% of non-pregnant women were estimated to have anemia [3]. Anemia is characterized by a decrease in the normal number of red blood cells or less than the normal quantity of hemoglobin in the blood. Iron deficiency anemia (IDA)

is classified as Mild- Hemoglobin of 11.0-11.9 gm/dl, Moderate- Hemoglobin 8.0-10.9 gm/dl and Severe- Hemoglobin of <8.0 gm/dl in a non pregnant [4]. Anaemia is one of the most common health problems in India which is much more prevalent in the rural than in the urban areas [5]. India is facing a grave public health problem, with the prevalence of anaemia in India being > 40%. Nutritional anemia as a result of iron deficiency is the most common cause of anemia worldwide: approximately 50- 60% of all cases of anemia are attributed to a lack of iron in the diet. [6]. Anaemia in the school age children is associated with the retardation of growth, decreased immunity and a poor cognitive development which results in a lower Intelligence Quotient (IQ) and behavioural abnormalities [7]. Moreover, studies

from Egypt [8], India [9] and USA [10,11] have conclusively shown that anaemia delays the psychomotor development and impairs the cognitive performance of infants, pre-school and school-aged children. Anaemia in childbearing women increases the maternal mortality [12], Mild to moderate anemia leads to weakened immunity, reduced work capacity, reduced cognitive ability and an overall decreased quality of life.

The measurement of Haemoglobin has traditionally relied on the services of a well-equipped clinical laboratory. Cyanmethemoglobin method has been the gold standard for hemoglobin estimation and is cheap but time consuming. A number of other methods are available such as hemoglobin color scale, Sahli technique, Lovibond-Drabkin technique, Tallqvist technique, copper-sulfate method, HemoCue and automated haematology analyzers (digital method). Each method has a different working principle and its own advantages and disadvantages[13]. The aim of the present study is to compare the effectiveness of Cynmethemoglobin method and Digital Haemometer in measuring haemoglobin.

METHOD AND MATERIALS

The present study was carried out with total 60 public at Puducherry, the Anthropometric Measurement was taken height scale and weight machine, Life Style practise was collected using questionnaire to estimate the haemoglobin two methods was carried out in this study the Cynmethemoglobin and Digital Haemometer.

The Digital Haemometer, the tip of the middle finger was cleaned using ethanol using cotton, it was pricked with sterile lancet at 4 mm depth, the first two to three drops of blood were wiped away to remove the tissue fluid. The next drop of blood was placed on the disposable firm plastic strip where it contains dry reagent is affixed and are intended to read on haemoglobin meter. The test strip by lysing erythrocytes and converting the released haemoglobin into methemoglobin. It is a quantitative determination of haemoglobin and calculate the hematocrit (Hct) in capillary blood.

The Cynmethemoglobin method was carried out for the same participant where 2ml of venous blood was taken in the aseptic condition in EDTA vial to carry out cynmethemoglobin method which works on the principle of conversion of haemoglobin to cynmethemoglobin by the addition of potassium cyanide and ferricyanide whose absorbance is measured at 540 nm in a photoelectric calorimeter against a standard solution [14]. Data were collected and recorded in MS excel spreadsheet (2007) and analysed by JASP (version 0.8.4). Wilcoxon test was admitted to find the significance between Hb levels of the two methods. Assessment of agreement between the two methods we used kappa statistics value. Also we used diagnostics test to predict sensitivity and specificity.

RESULTS

In the present study of 60 population of 53 males and 7 females; the average age between 19 – 72 years was taken.

Table1: Comparison between Cynmethemoglobin and Digital Haemometer methods regarding their prediction of Hb% values

Method	Mean	Median	IQR	Wilcoxon test
Digital Haemometer	12.35	12.8	11.8 – 13.3	p = 0.004
Cynmethemoglobin	11.88	12.0	11.0 – 12.8	

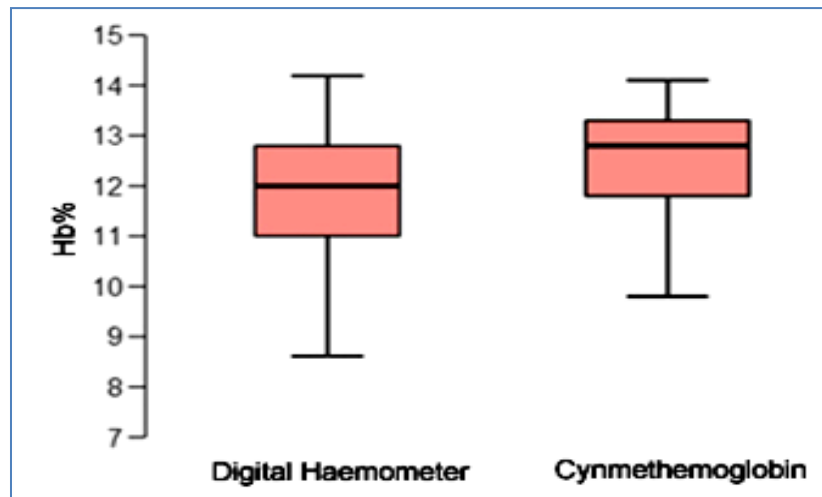


Figure 1: Comparison between Cynmethemoglobin and Digital Haemometer methods

Table 2: Agreement between Cynmethemoglobin and Digital Haemometer methods

		Cynmethemoglobin			Kappa statistics 95% CI
		Anemic	Non-anemic	Total	
Digital Haemometer	Anemic	26	9	35	0.024 (-0.216 to 0.264)
	Non-anemic	18	7	25	
	Total	44	16	60	

Table3: Diagnostic test between Cynmethemoglobin and Digital Haemometer methods

Statistic	Digital Haemometer vs Cynmethemoglobin		Cynmethemoglobin vs Digital Haemometer	
	Value	95% CI	Value	95% CI
Sensitivity	59.09%	43.25% to 73.66%	59.09%	43.25% to 73.66%
Specificity	43.75 %	19.75% to 70.12%	43.75 %	19.75% to 70.12%
Positive Likelihood Ratio	1.05	0.64 to 1.73	1.05	0.64 to 1.73
Negative Likelihood Ratio	0.94	0.48 to 1.81	0.94	0.48 to 1.81
Disease prevalence	73.33%	60.34% to 83.93%	73.33%	60.34% to 83.93%
Positive Predictive Value	74.29%	63.73% to 82.61%	74.29%	63.73% to 82.61%
Negative Predictive Value	28.00 %	16.74% to 42.92%	28.00 %	16.74% to 42.92%
Accuracy	55.00%	41.61% to 67.88%	55.00%	41.61% to 67.88%

As show in the table1 this stated that there is significant difference between cynmethemoglobin method and digital method with the p-value of 0.004 (wilcoxon test was applied). The median value with inter-quartile range of haemoglobin concentration using Digital Haemometer was 12.8 g/dl (IQR - 11.8 – 13.3) and 12.0 g/dl (IQR – 11.0 – 12.8) was seen in Cynmethemoglobin method. Also the kappa statistics value 0.024 stated that there is poor agreement between these two methods shown in table2. The

prevalence of anaemia are considerably different by these two methods, the Cynmethemoglobin method shows 73.3% (44) as compared to Digital Haemometer it shows 58.3 % (35), but it was not statistically significant.

The diagnostic test results shows the sensitivity and specificity was 59.09% and 43.75 % in Digital haemometer(test) vs Cynmethemoglobin(gold standard) and 74.29 % and 28 % for the

cynmethemoglobin method(test) vs Digital haemometer(gold standard) shown in the table3.

DISCUSSION

Determination of haemoglobin is a method to confirm the iron deficiency anemia worldwide. Haemoglobin (Hb) estimation is used to diagnose anaemia. Any intervention to treat anaemia is largely based on the level of Hb. [15] Most reliable methods for Hb estimation require the presence of an equipped laboratory. The cyanmethemoglobin method has become the most generally used means of assaying the hemoglobin content of blood. In 1967, the American Society of Clinical Pathologists recommended it. This method is used in 70 % of labs [16].

Many study suggested that cynmethemoglobin method is a gold standard method used to analyse the haemoglobin since, it is a traditional method it is time consuming but less expensive, this can be applicable only with the help of laboratories, the venous blood need to collect for this method which cannot be accepted by all catagories of people but this method has high accuracy when compared with other method.

In case of Digital Haemometer there is very less study based on this since its evaluated in the later period. This method single drop of blood was placed on the disposable strip. The blood dispersed within the hydrophilic mesh, Hb was extracted out from the red blood cell and with the help of reagents present in the strip, was converted into a complex. The optical reflectance, which is inversely proportional to the concentration of Hb in the sample, was measured and Hb levels read within a minute it is time saving method but expensive when compared with cymethemoglobin method, this can be done in the remote areas where the laboratory facility is not available but the sensitivity and specificity is less when compared with the standard method the major advantage of this method is only few drops of capillary blood is enough to show the result.

A study by Neufeld L, et, al shows timeliness of the readings and method of holding the scale properly were some of the operational challenges. TrueHb and TouchHb could overcome the limitations related to subjectivity since the readings are generated automatically.

The findings suggest higher sensitivity for capillary sample as compared with venous samples, which is not in concordance with documented literature. [17]

CONCLUSION

In conclusion, Cyanmethaemoglobin Method is less expensive this can be done in the area where the lab facilities are not too far, and this is a standard method worldwide. In case of digital haemometer method eventhough it is expensive this method is useful in the remote area where the lab facilities in not available and this can be done without the help of lab technicians.

REFERENCE

1. World Health Organization. Global Burden of Diseases 2004 update, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland: WHO; 2008.
2. Worldwide prevalence of anaemia 1993–2005: WHO global database on anaemia / Edited by Bruno de Benoist, Erin McLean, Ines Egli and Mary Cogswell.
3. WHO. Worldwide prevalence of anemia 1993–2005: WHO global database on anemia. Geneva, Switzerland: World Health Organization. 2008
4. Demaeyer EM. Preventing and Controlling Iron Deficiency Anemia through Primary Health Care. Geneva, World Health Organization, 1998-99.
5. National Consultation on the Control of Nutritional Anaemia in India. Department of Family Welfare (Maternal Health Division), Ministry of Health and Family Welfare, Nirman Bhawan, New Delhi, 1998.
6. Seshadri S. A database on iron deficiency anaemia (IDA) in India: prevalence, causes, consequences and strategies for prevention. Department of Foods and Nutrition. WHO Collaborating Centre for Nutrition Research. The Maharaja Sayajirao University of Baroda, Vadodara, India, 1999.
7. DeMaeyer E, Adiels-Tegman M. The prevalence of anaemia in the world. Bull World Health Organ. 1985;3:302-16
8. Johnston R, Conkle J. Micronutrient deficiencies and interventions in Cambodia: information for improved programming. Phnom Penh, Cambodia: A2Z – The USAID Micronutrient
9. Gowri A.R, 14.Sangunam H.J.. Assessment of the mental and motor abilities of school going children with anaemia. *Ind. J. Nutr. Dietet* 2005;42: 99-105

10. Lozoff B, Jimenez E, Wolf AW. Long term developmental outcome of infants with iron deficiency. *New England Journal of Medicine* 1991; 325:687-95.
11. Seshadri S, Gopaldas T. Impact of iron supplementation on cognitive functions in pre-school and school-aged children: The Indian experience. *American Journal of Clinical Nutrition* 1989; 50:675-86.
12. Webb T, Oski F. Iron deficiency anaemia and scholastic achievement in young adolescents. *Journal of Pediatrics* 1973; 82:827-30
13. Clegg JW, King EJ. Estimation of Haemoglobin by the Alkaline Haematin Method. *Br Med J.* 1942; 2: 329-333.
14. Nkrumah B, Nguah SB, Sarpong N, Dekker D, Idriss A, May J, Adu- Sarkodie Y. Hemoglobin estimation by the HemoCue® portable hemoglobin photometer in a resource poor setting. *BMC Clin Pathol.* 2011; 11: 5.
15. Guidelines for Control of Iron Deficiency Anaemia: Adolescent Division, Ministry of Health and Family Welfare. Government of India, 2013. Hemoglobin color scale a diagnostic dilemma. *Indian J Pathol Microbiol* 2009;52:360–2.
16. Eilers, R. J., Notification of final adoption of an international method and standard solution for hemoglobinometry specifications for preparation of standard solution. *Amer. J. Clin. Pathol.* 47,212(1967).
17. Neufeld L, Garcia-Guerra A, Sanchez-Francia D, et al. Hemoglobin measured by Hemocue and a reference method in venous and capillary blood: a validation study. *Salud Publica Mex* 2002; n44:219–27.