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Pathology

Prevalence and Pattern of Anemia among Adult Population in Rural Population of Tiruchirapalli, South India

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Abstract **Original Research Article**

Clinically, anemia is the state of decreasing oxygen carrying capacity of the blood where hemoglobin concentration and packed cell volume get lowered. The aim of this study is to assess the prevalence and factors associated anemia among the subjects attended at a tertiary care teaching hospital. This is a cross sectional, prospective study by which a total of 108 anemic patients were recruited to understand their anemic state and other hematological complications. Sociodemographic and clinical data related to anemia was collected; state of anemia, morpho-physiological variations and co-clinical parameters were performed and assessed. The peripheral smear provided the informations related to types of anemia. Among the eligible 108 anemic patients aged between 18 and 65 years, females (68%) and males (32%) and it was recorded that maximum subjects were from the rural background. The dietary details were also determined by assessing the data given by the patients thereby most of them eating carbohydrate rich diet, very less protein and fatty foods. Prevalence of severe anemia was not found lowest among the younger age groups in males than females and highest in the oldest age groups in males than females. The morpho-physiological variations highlighted that severe anemia was observed among obese individuals also. Maximum cases were clinically determined as fever with 13% followed by anemia as a sole medical issue, diabetes mellitus and pancreatitis. MCHC is considered as an indicator of reduced hemoglobin but did not give as consistent a result as MCH, though overall it was just significant and was helpful in differentiating between MA and IDA. This study extensively needs more emphasis on risk groups to combat anemia, increase productivity, reduce morbidity and mortality, and improvement of overall health status of next generation.

Keywords: Anemia, adult population, morphophysiology, hematology.

INTRODUCTION

Anemia is considered as the one of the most common health issues in developing countries like India [1]. And it is also observed more among rural population while comparing with the urban peoples [2-4]. The complications related to alternations in the hemoglobin levels are largely documented to pregnant and lactating females and children (mostly female children) [1, 5-8]. Variations in the prevalence have been found between 50 and 90% in different states and regions of India [9-11].

Epidemiologically, anemia affects nearly a quarter of the total population, where low socio-economic groups and maternal anemia is strongly associated with child anemia [12]. The Government of India has been taken necessary interventional strategies to meet out this issue by increasing the provision nutritional foods for school children and pregnant ladies [13, 14]. The prevalence of anemia among other adult groups like non-pregnant women and males are not much studied and documented [15].

In general, the major causes of anemia are multifactorial in the developing countries like India are lesser iron diet [9], deficiency in vitamin C intake [16, 17], lower gastric acidity [18], repeated childbearing and lactation [3], very poor intake of nutritional supplements during and after menarche and during pregnancy [19] and parasitic infections like hookworm and malaria [18, 19]. The main reasons for the emergence of anemic state are poverty, micronutrient deficiencies, cultural and religious practices, access to health services and poor awareness of the condition and preventive measures [4, 20-22].

The national family health survey data showed that 55% of the women and 24% of the men were anemic in the state like Punjab, Manipur, Mizoram, Goa; and Kerala and other states of India had the lowest levels of anemia [23]. It was recorded that the infants whose mothers having severe anemia during the last trimester or delivery are having more risk of irreversible brain damage, lower school achievement and poor immune response [24]. Anaemia in childbearing women increases the maternal mortality, pre-natal and peri-natal infant loss and prematurity [25, 26].

Impaired cognitive performance, behavioral and motor development, lack of co-ordination, language development and scholastic achievement, as well as an increased morbidity from infectious diseases are largely observed among young children [27]. Retardation of growth, lowered immunity and poor cognitive development and behavioral abnormalities are found among school children due to the anemic deficiencies [28]. Few studies have conclusively recorded that anemia delays the psychomotor development and impairs the cognitive performance of infants, pre-school and school-aged children [29-33].

Some studies have also revealed that anemia was found among the well-nourished school children who belonged to the upper and middle socio-economic classes also and reason may be the intake of high fats, sugars and additives diets; thus obesity is found to be the sign of poverty and malnutrition [2, 34]. To keep all these review in mind, the present study was designed to assess the prevalence and pattern of anemia among adult population who are from the rural areas of Tiruchirapalli, South India.

MATERIAL AND METHODS

Ethics and Consent

Prior to initiate the work, we obtained ethical approval from Institutional Ethics Committee of Trichy SRM Medical College Hospital and Research Centre, Tiruchirapalli and formal permission was also obtained from the higher authorities of the institution. The study was informed to all the participants verbally and written consent was obtained prior to enroll in the study.

Study Area and Population

This was a hospital based prospective observational study, which was conducted at Trichy SRM Medical College Hospital and Research Centre, Tiruchirapalli of South India from September 2015 to August 2017.

Case Definition

A total of 108 known adult patients who are clinically suspected and laboratory confirmed anemic of both moderate and severe anemia were recruited for this study. The number of patients included during the study period was determined as sample size. On enrollment, the proforma including medical and dietary history, sociodemographic data and physical examination and blood sample collection was included and collected. All the conditions were managed according to the standard protocol. The patients who had received blood transfusion during the last 12 weeks and patients who are in chemotherapy and therapy were excluded.

Classification and Criteria

The anemia was defined as the hemoglobin of less than 13g/dL in males and less than 12g/dL in females [1]; moderate anemia was define the range between 7 and 9.9 g/dL whereas severe was less than 7 g/dL. The body mass index (BMI) is considered as the very good correlating marker for determining anemic complications thereby it was calculated as weight in kilograms divided by square of height in meters. BMI was divided into three groups like low (<18.5 kg/m^2), normal (18.5-24.9 kg/m^2) and high (≥ 25 kg/m^2) according to WHO criteria. The population was graded into sedentary, moderate and heavy activity groups according to their occupation [1].

Laboratory Parameters

Initially all the blood samples were once again confirmed for the anemic state and its classifications. A complete blood count including red blood cell (RBC) count, RBC indices [mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red blood cell distribution width (RDW)], hematocrit (packed cell volume - PCV%), platelet count, total and differential leucocyte count and peripheral blood smear for determining the pattern and morphology of RBC. We used Statistical Package for the Social Sciences (SPSS), version 23 for data analysis and recorded discrete data as frequency and percentage. Differences in the type of anemia by age groups, gender and other variables were analyzed using Chi-square test. $P < 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

Baseline Analysis

In this study, a total of known and clinically eligible 108 anemic patients were enrolled who age ranged between 18 and 65 years (Table-1). The consecutive follow-up samples were not possible among 6 patients. The female patients are higher (68%) than male (32%) and it was recorded that maximum subjects were from the resident of rural background (Figure-1).

Table-1: Age and gender wise distribution

Age groups (in years)	Gender wise distribution		
	Males (n=38)	Females (n=70)	Total (n=108)
15 - 20	1 (2.6)	3 (4.3)	4 (3.7)
21 - 30	3 (7.9)	18 (25.7)	21 (19.4)
31 - 40	4 (10.5)	15 (21.4)	19 (17.6)
41 - 50	6 (15.8)	13(18.6)	19 (17.6)
51 - 60	11 (29.0)	9 (12.9)	20 (18.5)
61 - 70	13 (34.2)	12 (17.1)	25 (23.2)

[Figure in parenthesis denoted percentages]

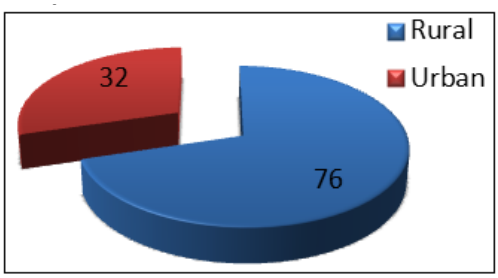

Fig-1: Residential assessment

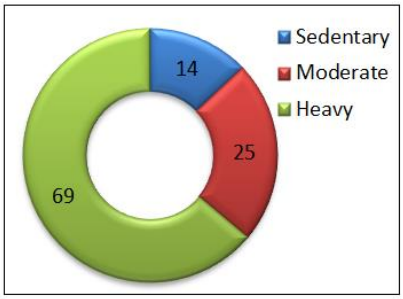

Fig-2: Activities of the patients

The present study has found high prevalence of anemia in 21 to 70 years age group of rural population. The prevalence of anemia among females was higher comparing with males. According to WHO if the prevalence of anemia at community levels is more than 40%, it is considered as problem of high magnitude [1, 35]. This study thus brings out the fact that the problem of anemia is related to wider population than the traditionally considered groups of the pregnant and lactating females and children. The adult male population is equally susceptible in this study.

Parasitic infestations and other chronic illnesses were not much analyzed in this study thus concluding the etiology of anemia among males is not possible. The differential peripheral blood film count could have given an indication of the type of anemia in this population. In this study, the rural residing population is higher than urban; but some other studies suggested that residential data is not much correlated with anemia, instead of that long term exposure to air pollution also play a vital role [36].

The activity of the individuals were also analyzes thereby heavy workers were high followed by moderate and sedentary (Figure-2). The economic status was also interviewed and most of them are below middle class and working as daily wages to meet their financial commitments.

Various studies were viewed anemia as a sign of underlying disease, but in current scenario it is considered that quality of life, morbidity, very heavy physical activities and in few situation it is leads to the high risk factor for death. The sedentary and extremity of heavy works of life style and relationship between physical activity, physical performances and iron status are closely reported with iron deficiency and maximum leads to disability adjusted life years [37, 38].

The dietary details were also determined by assessing the data given by the patients thereby most of them eating carbohydrate rich diet, very less protein and fatty foods. Maximum patients are not aware about the term vitamins, amino acids, minerals etc. The frequency of the food consumption, intake of fruits and vegetables and state of diet are very important background for the state of anemia and interpreted in Table-2.

Table-2: General information about the dietary habits of the participants (n=108)

Particulars	Number of patients	Percentage
Frequency of diet consumption		
One time/ day	12	11.1
Two times/ day	39	36.1
Three times/ day	57	52.8
Intake of vegetables		
Regular	35	32.4
Rare	73	67.6
Intake of Fruits		
Regular	07	6.5
Rare	101	93.5
Diet		
Vegetarian (lacto)	24	22.2
Ova vegetarian	12	11.1
Ova-lacto vegetarian	27	25
Non-vegetarian	43	39.8
Vegans	2	1.9

Nutrition deficient anemia are most common burden globally and among them iron deficiency anemia are widespread followed by vitamin deficiency [39-41]. In this study, it was found that the maximum number of subjects was not taking their nourished foods with good nutritional value due to their poverty, unawareness and lethargies. Among them, 67.6 and 93.5% of anemic patients were rarely consuming the vegetables and fruits respectively (Table-2).

In developing countries like India, the observation of anaemia is more due to poor diet, iron and folic acid intake and poor bio-availability of iron resulting in widespread iron and folic acid deficiencies. Additionally chronic blood loss due to accidents, surgeries and infections like malaria and hook worm infestations also play vital role [35, 42, 43].

Anemic State

The hemoglobin levels of the patients included in this study were described based on their age was documented in Table 3. The prevalence of anemia was not found as "severe - <8 g/dL" among lowest in the younger age groups 15 – 30 in males and highest in the oldest age groups 61–70 (55.6%). Among females, the severe anemic state was observed higher in the age groups between 15 and 30 (50%) whereas "moderate – 9.0 – 9.9 g/dL" was observed among 31 – 40 (16.7%) and 61 – 70 years (13.6%). The mild (10 – 11.9 g/dL) state of anemic patients was observed in very low numbers (Two patients in each gender) and the same was not included in the table.

Table-3: Age and gender wise analysis of hemoglobin levels among the subjects

Age groups (in years)	Severity of anemia verses gender			
	Males (n=38)*		Females (70)*	
	Severe (n=9)	Moderate (n=27)	Severe (n=36)	Moderate (n=32)
15 - 20	-	2 (7.5)	7 (19.4)	2 (6.3)
21 - 30	-	1 (3.7)	11 (30.6)	2 (6.3)
31 - 40	1 (11.1)	4 (14.8)	6 (16.7)	11 (34.3)
41 - 50	1 (11.1)	9 (33.3)	3 (8.3)	5 (15.6)
51 - 60	2 (22.2)	4 (14.8)	4 (11.1)	2 (6.3)
61 - 70	5 (55.6)	7 (25.9)	5 (13.9)	10 (31.2)

[Figure in parenthesis denoted percentages] *Mild anemia among 2 patients in each gender

According to WHO, anemia are divided into three categories: mild (11 to 11.9g/dL), moderate (8 to 10.9g/dL) and severe (<8g/dL) anemia [44]. UNICEF classified anemia to be mild in children, adolescent girls and pregnant women if the Hb level in blood is between 8 and 10.9g/dL among children, 10 to 11.9g/dL among adolescent girls and 8 to 10.9g/dL among pregnant women. For severely anemic, the Hb level should be below 5g/dL among children, 8g/dL among adolescent girls and 5g/dL among pregnant women. Accordingly moderate anemia is denoted when the Hb level is between mild and severe anemia [45].

Morpho-Physiological Variations [43]

The morphological and physiological variations were well analyzed between the genders and also between the severities of anemia cases. The data in table 4 highlighted that even severe anemia was observed among obese individuals. There is a myth of determining the thin and general paleness individuals have moderate to severe anemia but in this study relatively substantial data was observed.

Table-4: Morpho-physiological variations of the cases

Parameters	Morpho-physiology ranges verses severity of anemia verses gender			
	Males (n=38)*		Females (70)*	
	Severe (n=9)	Moderate (n=27)	Severe (n=36)	Moderate (n=32)
Weight (kg)	56.3±9.86	64.8±12.1	55.6±8.32	61.87±10.32
Height (cms)	152.3±5.88	156.8±7.9	149.7±4.67	153.4±5.79
Waist circumference (mm)	54.3±8.5	64.6±12.6	78.6±6.82	81.4±7.86
Hip circumference (mm)	82.3±7.6	93.7±10.5	89.6±8.72	93.4±8.63
Appearance	**Number of cases (Percentages)**			
Skin dryness	4 (44.4)	12 (44.4)	14 (38.9)	11 (34.4)
General weakness	8 (88.8)	10 (37)	31 (86.1)	12 (37.5)
General paleness	7 (77.7)	12 (44.4)	29 (80.6)	11 (34.4)
Raynaud's phenomena	-	-	1 (2.8)	-
BMI (kg/m^2)	**Number of cases (Percentages)**			
Underweight (<18.5)	1 (11.1)	2 (7.4)	3 (8.3)	8 (25)
Normal weight (>18.5 – <24.9)	3 (33.3)	19 (70.4)	11 (30.6)	4 (12.5)
Over weight (>25 – <29.9)	2 (22.3)	3 (11.1)	17 (47.2)	11 (34.4)
Obese (≥30)	3 (33.3)	3 (11.1)	5 (13.9)	9 (28.1)

The impact of anemia with different morpho-physiological variables including height, weight, waist circumference, hip circumference, systolic blood pressure, diastolic blood pressure, pulse rate were done in various studies that revealed that non-anemia individuals showed better physical performance compared to anemia; non-anemia persons were taller and significantly heavier than anemia [47, 48]. This study also have the same type of data as reported in the above citations.

Clinical Parameters

Out of 108 cases studied in this analysis, maximum cases were clinically determined as fever with 13% followed by anemia as a sole medical issue (13%), diabetes mellitus (11%), pancreatitis (7%). The detailed descriptions of various clinical parameters while comparing with the stages of anemia were collected and analyzed (Table-5).

Table-5: Analysis of Clinical symptoms

No.	Clinical parameters	No. of cases (108)	Stage of anemia		
			Severe (45)	Moderate (59)	Mild (4)
1	Adreno-cortical hormone deficiency (ACH)	1 (0.9)	1 (2.2)	-	-
2	Adrenoleukodystrophy (ALD)	5 (4.6)	2 (4.5)	3 (5.1)	-
4	Anemia	13 (12)	6 (13.3)	7 (11.8)	-
5	Auditory processing disorder (APD)	6 (5.6)	2 (4.5)	4 (6.8)	-
6	Aortic regurgitation (AR)	3 (2.8)	1 (2.2)	2 (3.4)	-
7	Cervical cancer (CA CX)	2 (1.8)	2 (4.5)	-	-
8	Chronic kidney disease (CKD)	7 (6.5)	4 (8.9)	3 (5.1)	-
9	Chronic myelogenous leukemia (CML)	1 (0.9)	-	1 (1.7)	-
10	Diabetes mellitus (DM)	13 (12.1)	5 (11.1)	7 (11.8)	1 (25)
12	Fever	15 (13.9)	7 (15.5)	7 (11.8)	1 (25)
13	Head ache	3 (2.8)	-	3 (5.1)	-
14	Hypertension	4 (3.8)	1 (2.2)	2 (3.4)	1 (25)
15	Myocardial infarction (MI)	4 (3.8)	1 (2.2)	3 (5.1)	-
16	MP	1 (0.9)	-	1 (1.7)	-
17	Obstetrics and Gynecology cases	6 (5.6)	2 (4.5)	4 (6.8)	-
18	Pancreatitis (PA)	7 (6.5)	4 (8.9)	3 (5.1)	-
19	Pneumonia	1 (0.9)	-	1 (1.7)	-
20	Prolapse	2 (1.8)	1 (2.2)	1 (1.7)	-
21	PUO	6 (5.6)	2 (4.5)	3 (5.1)	1 (25)
22	Renal tubular acidosis (RTA)	3 (2.8)	1 (2.2)	2 (3.4)	-
23	Tuberculosis	2 (1.8)	1 (2.2)	1 (1.7)	-
24	Vertigo	2 (1.8)	1 (2.2)	1 (1.7)	-

[Figure in parenthesis denoted percentages]

Among the clinical manifestation in anemic patients, heart failure, retinal exudates and hemorrhages, Arrhythmias, myocardial infarction and ECG abnormalities [49]; renal tubulointerstitial lesions, chronic kidney diseases and nephropathy [50, 51]; thalassemia and siderblastic anemia [52]; Diabetes mellitus [53] and chronic myeloid leukemia [54].

Differential Hematological Diagnosis

After the clinical correlation, the blood parameters were analyzed thereby mild anemia was observed among the normal and acute state of diseases. This study indicated the maximum severe anemic state was observed with the RBC count range between 3.1 and 4.0 million cells micro liter. The mild anemic cases showed moderate to high range of RBC compared to sever and moderate cases. The PCV range was observed in low level in all study groups and found higher in the age group of 30 to 30 years.

Besides, this study showed 60 (55.6%) of the study subjects had microcytic anemia and also 69 (63.9%) and 74 (68.5%) of the study subjects had lower MCH and MCHC values which further demonstrated the second most common type of anemia in the study population was hypochromic microcytic. On the other hand, the macrocytic anemia took a lesser proportion among the study group. It showed 9 (8.3%) of the study subjects reported as more MCV value. The other details of differential hematological analysis of the anemic cases were impregnated in Table-6.

Table-6: Differential hematological analysis of anemia cases

No.	Laboratory parameters	No. of cases (108)	Stage of anemia		
			Severe (45)	Moderate (59)	Mild (4)
1	***RBC count (normal range – 4.7 to 6.1 million cells per µl)***				
a	<2.0	11 (10.2)	9 (20.0)	2 (3.4)	-
b	2.1 – 3.0	37 (34.3)	13 (28.9)	24 (40.7)	-
c	3.1 – 4.0	40 (37.0)	20 (44.4)	19 (32.2)	1 (25)
d	>4.0	20 (18.5)	3 (6.7)	14 (23.7)	3 (75)
2	***PCV (normal range - 35 to 52%)***				
a	<10	6 (5.6)	4 (8.9)	2 (3.4)	-
b	10.1 – 20.0	31 (28.7)	14 (31.1)	16 (27.1)	1 (25)
c	20.1 – 30.0	68 (62.9)	27 (60.0)	40 (67.8)	1 (25)
d	>30	3 (2.8)	-	1 (1.7)	2 (50)
3	***MCV (normal range - 80 to 95 fL/ red cell)***				
a	<75	60 (55.6)	36 (80)	24 (40.7)	-
b	75.1 - 100	39 (36.1)	3 (6.7)	32 (54.2)	4 (100)
c	100.1 – 125	6 (5.5)	4 (8.9)	2 (3.4)	-
d	>125	3 (2.8)	2 (4.4)	1 (1.7)	-
4	***MCH (normal range 27 to 33pg/ cell)***				
a	<15.0	12 (11.1)	8 (17.8)	4 (6.8)	-
b	15.1 – 25.0	57 (52.8)	24 (53.3)	33 (55.9)	-
c	25.1 – 35.0	31 (28.7)	8 (17.8)	20 (33.9)	3 (75)
d	>35.0	8 (7.4)	5 (11.1)	2 (3.4)	1 (25)
5	***MCHC (normal range – 30 to 34gHb/100)***				
a	<32	74 (68.5)	32 (71.1)	42 (71.2)	-
b	32.1 – 36	30 (27.8)	13 (28.9)	17 (28.8)	-
c	>36	4 (3.7)	-	-	4 (100)
6	***Platelet (normal range – 1.5 to 4.5 lakhs cells/ µl)***				
a	<3	59 (54.6)	31 (68.9)	25 (42.4)	3 (75)
b	>3	49 (45.4)	14 (31.1)	34 (57.6)	1 (25)
7	***TC (normal range – 4300 to 10800 x 10^9 cells/ L)***				
a	≤7000	52 (48.1)	28 (62.2)	23 (39.0)	1 (25)
b	>7000	56 (51.9)	17 (37.8)	36 (61.0)	3 (75)

[Figure in parenthesis denoted percentages]

Further the peripheral smear was analyzed microscopically thereby the neutrophils count was observed between 51 and 75% among 75 cases followed by >75 among 25 cases and the other differential leucocytic counts among the 108 subjects were depicted in Table-7.

Table-7: Differential leucocytic analysis

Leucocytes	Normal value (%)	Range observed (%)	No. of cases	Percentage
Neutrophils	40 - 80	<50	8	7.4
		51 - 75	75	69.4
		>75	25	23.2
Lymphocytes	20 - 40	<25	48	44.4
		26 – 50	52	48.2
		>50	8	7.4
Eosinophils	1 - 5	<5	85	78.7
		>5	23	21.3
Monocytes	2 – 10	<4	77	71.3
		>4	31	28.7
Basophils	0 - 1	0	97	89.8
		1	11	10.2

Iron deficiency details, reticulocytic count, red blood cell count, distribution width index and white blood test results are used to make the diagnosis and understand the complications of anemia [55]. In this study, MCHC is considered as an indicator of reduced hemoglobin but did not give as consistent a result as MCH, though overall it was just significant and was

helpful in differentiating between MA and IDA [56, 57].

In this study, microcytic, hypochromic anemia was predominantly observed among 67 cases followed by dimorphic anemia (19 cases) and normocytic normochromic anemia with 14 cases (Figure-3). The fraction of reticulocytes were also analyzed and impregnated in Figure-4.

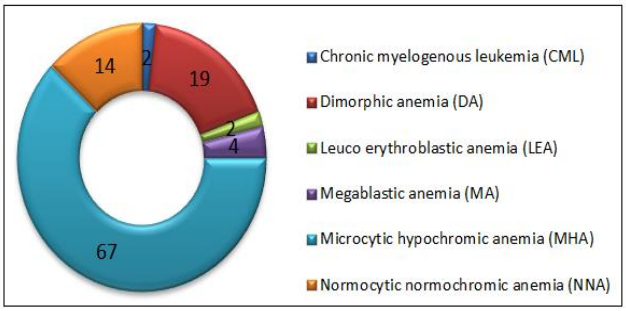

Fig-3: Analysis of types of anemia among the subjects (n=108)

The difference in the diagnosis of few cases of hemolytic anemia could be due to the presence of fragmented red cells and polychromatic red cells due to the categories of microcytic and macrocytic anemia respectively [58].

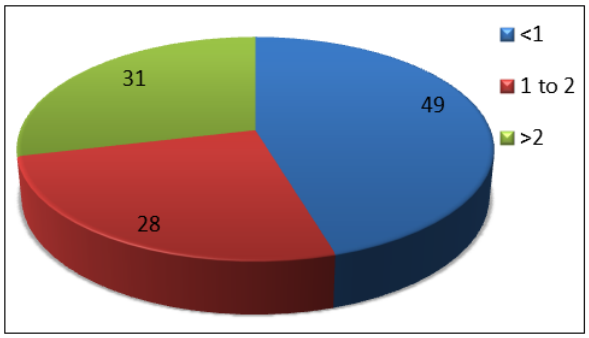

Fig-4: Reticulate count among the study subjects

CONCLUSION

From this study, we come to the conclusion that the CBC should always be the light of peripheral smear examination as this could help us in getting the correct diagnosis not only in the cases of hemolytic anemia but also macrocytic anemia. This study extensively needs more emphasis on risk groups to combat anemia, increase productivity, reduce morbidity and mortality and improvement of overall health status of next generation.

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