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HAEMATOLOGICAL PROFILE IN PAEDIATRIC AGE GROUP (0 - 12 YEARS) WITH TYPE 1 DIABETES MELLITUS WITH A SPECIAL REFERENCE TO ANAEMIA – A PILOT STUDY

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ABSTRACT: It has been demonstrated that industrialization and modernization lead to sedentary lifestyle, obesity and higher risk of metabolic disorders, of which Diabetes and Anemia are common problems encountered in clinical medicine. In the present study the prevalence of anemia and its sex predilection among pediatric age group from 0 - 12 years with Type 1 diabetes mellitus hailing from rural areas, in and around Chidambaram, District - Cuddalore, Tamilnadu, India. A total of randomly selected 50 Type 1 Diabetes Mellitus children aging 0-12 years, attending the diabetic clinic of Rajah Muthiah Medical College and Hospital, during the period of January 2012 to May 2012 were included in the study. 66% of the subjects were anemic with female preponderance. Microcytic hypochromic anemia was the most common type observed.

KEY WORDS: Anemia, Type 1 Diabetes Mellitus, Pediatric age group (0 to 12 years).

INTRODUCTION: Anemia is functionally defined as a "decrease in the competence of blood to carry oxygen to tissues, thereby causing tissue hypoxia"¹. As many as 80% of children in developing countries and 20% in US will be anemic at some point by 18 years of age². Anemia is widely prevalent in India and affects both sexes and all ages³. In infancy and childhood, anemia is associated with behavioral and cognitive delays, including impaired learning, decreased school achievement, and low score on tests of mental and motor development. An estimated 30 percent of world's population is anemic, with the global prevalence of anemia among 0-12 years old children to be 36 percent^{6,7} and 77 percent in developing regions respectively^{8,9}.

Statistical projection about India suggests that the number of diabetics will rise from 15 million in 1995 to 57 million in 2025 making it the country with the highest number of diabetic patients in the world (King et al., 1998). Asian Indians have a racial predisposition to develop diabetes (Zimmet, 1999). Anemia may occur with diabetes because the hormone that regulates red blood cell production, erythropoietin (EPO), is produced by the kidneys. Kidney damage at several levels is a complication of diabetes, and one problem often leads to the other. A simple blood test, the complete blood count or CBC, is used to check for anemia. The two elements of the test that reveal anemia are hemoglobin and hematocrit. Hemoglobin is the part of red blood cells that carries oxygen to the cells. Hematocrit indicates the percentage of red blood cells in the blood. 33% of type 1 diabetics develop chronic kidney disease after fifteen years¹⁰.

AIMS AND OBJECTIVES: The present study is undertaken to evaluate:

1. The prevalence of anemia among pediatric age group of 0 to 12 years with type 1 diabetes mellitus.
2. Sex predilection among the study group.

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MATERIALS AND METHODS:

Instruments used are:-

- AUTOMATED CELL COUNTER (MODEL & COMPANY: MYTHIC 18, ORPHEE SA, C2 DIAGNOSTICS, FRANCE).
- AUTOMATED CLINICAL CHEMISTRY-COLORIMETRIC-IMOLA, Rx Series, RANDOX, UK.)
- IMMULITE 1006 Systems, DIAGNOSTIC PRODUCT CORPORATION, USA)

Fifty Type 1 diabetic children aged from 0 to 12 years attending the diabetic clinic of Rajah Muthiah Medical College and Hospital, between January 2012 and June 2012. The children were divided into 6 groups

Group I	:	0-2 years
Group II	:	2 - 4 years
Group III	:	4 - 6 years
Group IV	:	6 - 8 years
Group V	:	8 - 10 years
Group VI	:	10 - 12 years

- Blood samples were collected by venipuncture into containers with di-potassium EDTA. All samples were analyzed for hematological parameters using automated cell counter. Iron profile studies were conducted on 18 randomly selected blood samples.
- Informed written consent from the parents was taken.

Inclusion Criteria: 0-12 years paediatric patients with Type 1 diabetes mellitus.

Exclusion Criteria: Children with:-

- Acute infections
- Communicable diseases like Tuberculosis, Hepatitis
- On iron supplements
- History of recent blood transfusion
- Known cases of hemoglobinopathies

Anemia Criteria for Diagnosis: Anemia was defined using WHO criteria for different age groups. With these criteria, the hemoglobin cut off used to define anemia in children between age groups 0 to 12 years is < 12 gm/dl. Anemia was further graded as mild (Hb 9.0 - 11.9 g/dl), moderate (Hb = 6.0 - 8.9 g/dl) and severe (Hb< 6.0 g/dl) based on hemoglobin values. Anaemia can be initially classified morphologically according to the erythrocyte indices like Mean Corpuscular Volume (MCV). The general categories of the morphological classification includes: 1. Macrocytic Normochromic; 2. Normocytic Normochromic and 3. Microcytic Hypochromic.

Sample Collection for Hematological Parameters and Iron Profile Studies: Under aseptic precautions blood collected from antecubital vein and immediately transferred into two sterile glass bottles, one with di-potassium EDTA as anticoagulant and was analyzed in the automated cell counter and the other without EDTA for Iron Profile Studies.

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RESULTS: Hematological parameters in 50 pediatric patients with Type 1 diabetes mellitus between 0-12 years were evaluated in the present study. The school children were categorized into six groups. [Table 1/Chart 1]

- **Sex Distribution:** Among the study group, 26(52%) were found to be girls and 24(48%) were found to be boys. Overall male to female ratio in the present study was found to be 1:1.1. Group III, Group IV and Group VI showed male predominance while female predominance was seen in Group I, Group V. [Table 2/Chart 2]
- **RBC Count:** 28% of patients showed RBC count less than normal limit, while majority of school going children aged between 0-12 years had RBC counts within normal range. [Table 3/Chart 3]
- **Hematocrit (HCT):** 48% of patients had hematocrit less than 33.0% and 52% of patients had hematocrit more than 33.0%. [Table 4/Chart 4]
- **Hemoglobin:** 66% of patients had hemoglobin <12.0 g/dl, among which, mild degree of anemia was most common followed by moderate degree. 34% of patients had hemoglobin greater than or equal to 12.0 g/dl. [Table 5/Chart 5]
- **Mean Corpuscular Volume (MCV):** 52% had MCV below 80fl (n=26); 40% had MCV within the normal range, (n=20) and 8% had MCV more than 100 fl. (n=4) [Table 6/Chart 6]
- **Mean Corpuscular Hemoglobin (MCH):** 44% of patients had MCH below 25.9 pg, (n=22); 38% had MCH within normal range (26.0 – 34.9pg); (n=19) and 18% had MCH more than 35.0 pg, (n=9). [Table 7/Chart 7]
- **Mean Corpuscular Hemoglobin Concentration (MCHC):** 40% had MCHC below 30.9 g/dl, (n=20). 36% had MCHC within normal range (31.0 – 36g/dl), (n=18) and 24% had MCHC more than 35.0 g/dl, (n=12). [Table 8/Chart 8]
- **Red Cell Distribution width (RDW):** 48% had RDW within the range (10.0 – 16.0%), (n=24). 52% had RDW >16.0%, (n=26). [Table 9/Chart 9]
- **Morphologic Classification of Anaemia:** In the present study, according to the above classifications following three types of anemia are seen: 29 school going children had Microcytic Hypochromic type, due to iron deficiency anemia, 13 children had Normocytic Normochromic type of anemia & 8 children had Macrocytic Normochromic type of anemia. [Table 16].

COMPARISON OF HEMATOLOGICAL AND BIOCHEMICAL PARAMETERS: Out of 50 randomly selected paediatric age Type 1 Diabetic children aged between 0-12 years, iron profile studies were carried out in 18 children.

IRON PROFILE STUDY IN 18 PATIENTS

- **Serum Iron:** In 18 patients, 12 of them had serum iron < 60µg/dl, 6 had serum iron within normal range (60 – 180 µg/dl). [Table 10, Chart 10]
- ** (Equipment: AUTOMATED CLINICAL CHEMISTRY-COLORIMETRIC-IMOLA, Rx Series, RANDOX, UK)
- **Total Iron Binding Capacity (TIBC):** In 18 patients, 12 of them had increase in TIBC (>440µg/dl), 6 were within normal range (240 – 440 µg/dl) [Table 11/Chart 11]

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- ** (Equipment: AUTOMATED CLINICAL CHEMISTRY-COLORIMETRIC-IMOLA, Rx Series, RANDOX ,UK)
- **PERCENT SATURATION:-** In 18 patients, 12 of them had percent saturation < 30% and 6 of them > 30% [Table 12/Chart 12]
- ** Calculated manually by using the formula: (% Saturation=Serum Iron x 100/ TIBC)
- **Serum Ferritin:** In 18 patients, 12 of them had serum ferritin <20µg/l, 6 of them had serum ferritin in within normal range 20-25 µg/l[Table 13/Chart 13]
- ** (Equipment: IMMULITE 1006 systems, DIAGNOSTIC PRODUCT CORPORATION, USA)

DISCUSSION: The present study is undertaken to study the prevalence of anemia and its sex predilection among pediatric age group with Type 1 Diabetes Mellitus. Anaemia in these children was defined and classified using WHO criteria (Hb <12g/dl)¹¹. An estimated 30 percent of world's population is anemia, with the global prevalence of anemia among 0-12 years old children to be 36 percent^{7,8} and 77 percent in developing regions respectively^{9,10}. In earlier studies prevalence of anemia among 5-14 years old urban and rural Indian children was found to be in the range of 66.7 – 77 percent^{8, 12}. Recent studies on prevalence of anemia have been among pre-school children only^{13, 14}. The prevalence was as high as 93 percent in children from Varanasi¹⁶. The recent NFHS-2 survey¹⁷ estimated prevalence of anemia among children of Delhi to be 69 percent. The higher prevalence of anemia could be due to inclusion of younger children (6-35 months) in the study group¹⁶. In the present study, prevalence of anemia was 66% which correlated with the above mentioned studies [Tables 14/Chart 14].

According to the study conducted by Gomber et al (1998) the male female ratio was 1.4:118. There was no difference in sex distribution in the study conducted by Kapur et al¹⁴ (2002) and Halileh et al¹⁹ (2005) and the study conducted by Sunil Gomber et al¹⁵ (2003), male female ratio was 1:1.2. In the present study, girls are found to be more anemic when compared to boys. The male female ratio is (1:1.1). [Table 15/Chart 15].

Iron deficiency was found to be the commonest cause in the present study and was demonstrated in 29 children out of 50 in the study group (58%) [Table 16]. Also iron deficiency was demonstrated in 91% of the 18 children randomly selected for iron profile studies.

CONCLUSION: In the present study among the pediatric age group with Type 1 Diabetes Mellitus (0 to 12 years), the prevalence of anemia is 66 % (as per WHO criteria of anemia). Microcytic hypochromic anemia is found in 58 % of the children in the study group and iron deficiency was demonstrated in 91% of the 18 children randomly selected for iron profile studies. Female preponderance is noted in the study group pointing to the prevalence of neglect of female child in the community even in this era of 22nd century.

The principal target of nutritional improvement in the community is the family. The mother needs to be educated on the selection of right kind of local food within the level of their purchasing power²⁰.

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Table - 1: Groups in present study

Groups	Group I 0 - 2years	Group II 2 - 4years	Group III 4 - 6 years	Group IV 6 - 8years	Group V 8 - 10years	Group VI 10 - 12years
Number of Cases	4 Cases	6 Cases	11 Cases	5 Cases	9 Cases	15 Cases

Chart - 1: Age Distribution

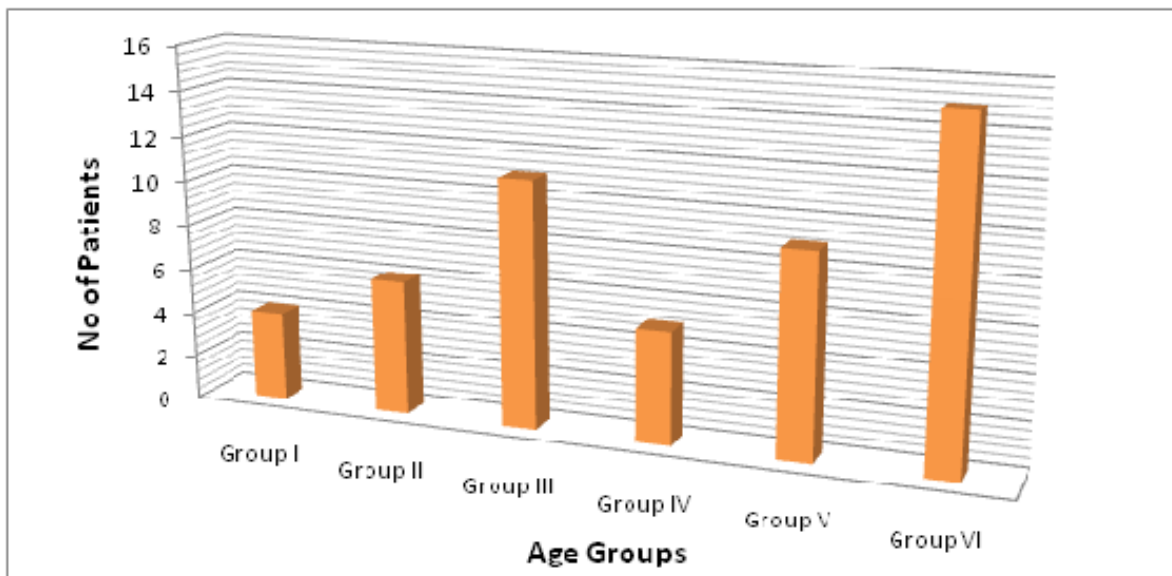


Table - 2: Sex Distribution

AGE GROUP	GIRLS	PERCENTAGE	BOYS	PERCENTAGE
Group I	1	2	3	6
Group II	3	6	3	6
Group III	7	14	4	8
Group IV	3	6	2	4
Group V	3	6	6	12
Group VI	9	18	6	12
Total	26	52	24	48

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Chart 2: Sex Distribution

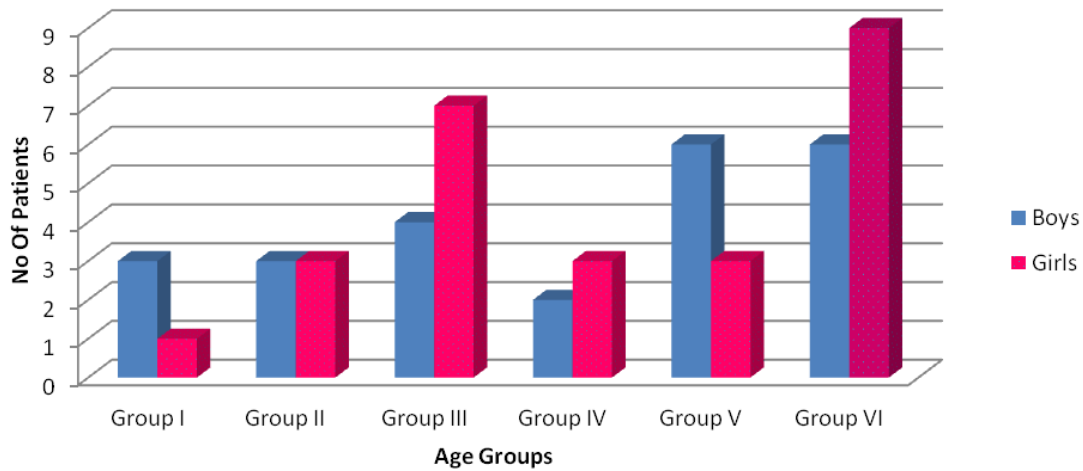


Table - 3: RBC Count in the study groups

Groups	Group I	Group II	Group III	Group IV	Group V	Group VI	Total	
RBC COUNTS (x10 ¹² /L)	< 3.6	1 (25%)	2(33.33%)	3(27.27%)	1(20%)	3(33.33%)	4(26.66%)	14(28%)
	3.6 - 5.5	3(75%)	4(66.66%)	8(72.72%)	4(80%)	6(66.66%)	11(73.33%)	36(72%)

Chart 3: RBC count

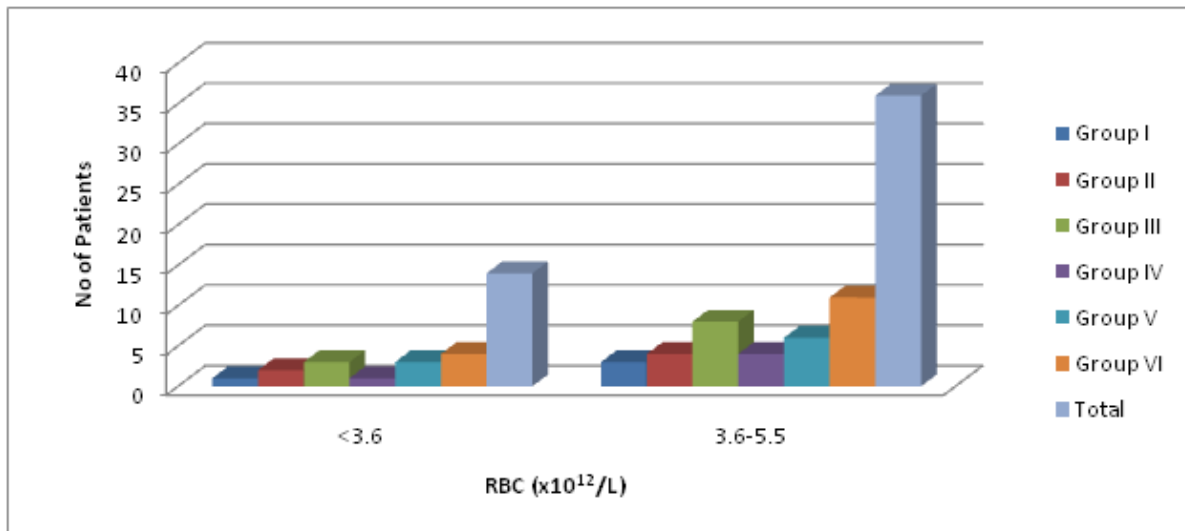


Table - 4: HCT values in the study groups

Groups	Group I	Group II	Group III	Group IV	Group V	Group VI	Total	
HEMATOCRIT	< 33	2 (50%)	4(66.66%)	7(63.63%)	2(40%)	3(33.33%)	6(40%)	24(48%)
	> 33	2(50%)	2(33.33%)	4(36.36%)	3(60%)	6(66.66%)	9(60%)	26(52%)

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Chart 4: Hematocrit Values

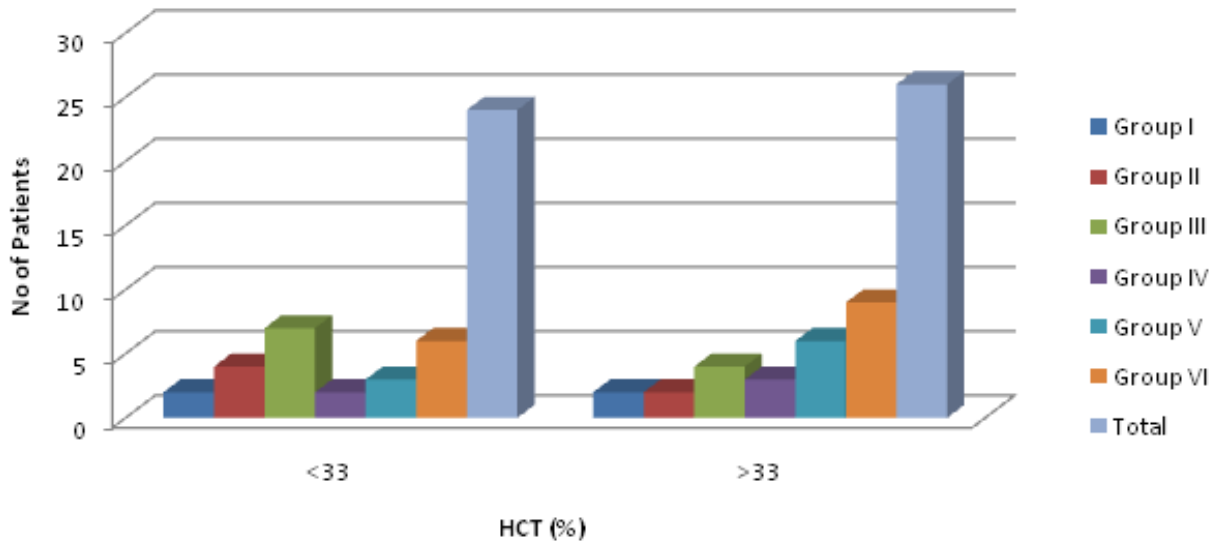
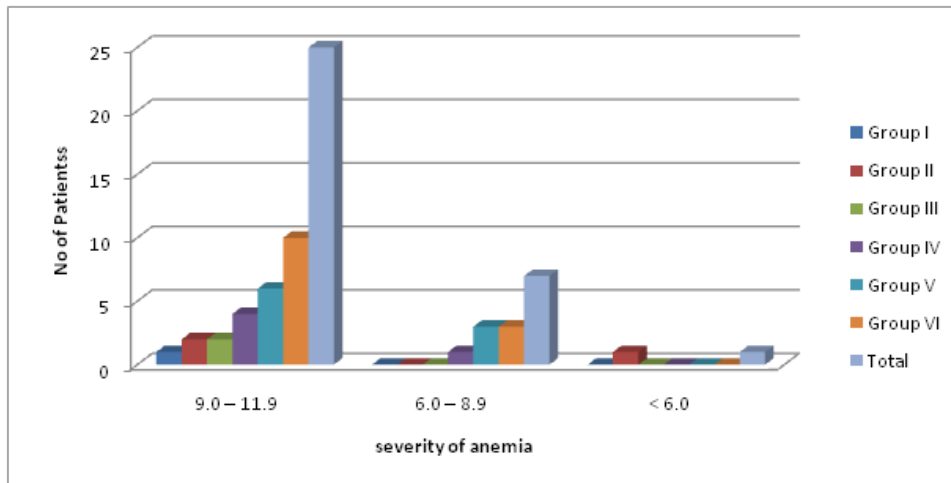


Table - 5: Hb values in the study groups

Groups		Group I	Group II	Group III	Group IV	Group V	Group VI	Total
HEMOGLOBIN (g/dl)	9.0 - 11.9 (mild)	1 (50%)	2(33%)	2(18%)	4(80%)	6(66.66%)	10(67%)	25(50%)
	6.0-8.9 (moderate)	-	-	-	1(20%)	3(33.33%)	3(20%)	7(14%)
	<6.0 (Severe)	-	1(17%)	-	-	-	-	1(2%)

Chart 5: Hemoglobin values



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Table - 6: MCV values in the study groups

Groups	Group I	Group II	Group III	Group IV	Group V	Group VI	Total	
MCV(fl)	< 80.00	3(75%)	4(66.67%)	6(54.54%)	3(60%)	6(66.67%)	4(26.67%)	26(52%)
	80.0 - 100.0	1(25%)	1(16.67%)	3(27.28%)	2(40%)	2(22.22%)	11(73.33%)	20(40%)
	>100.0	-	1(16.67%)	2(18.18%)	-	1(11.11%)	-	4(8%)

Chart 6: MCV VALUES

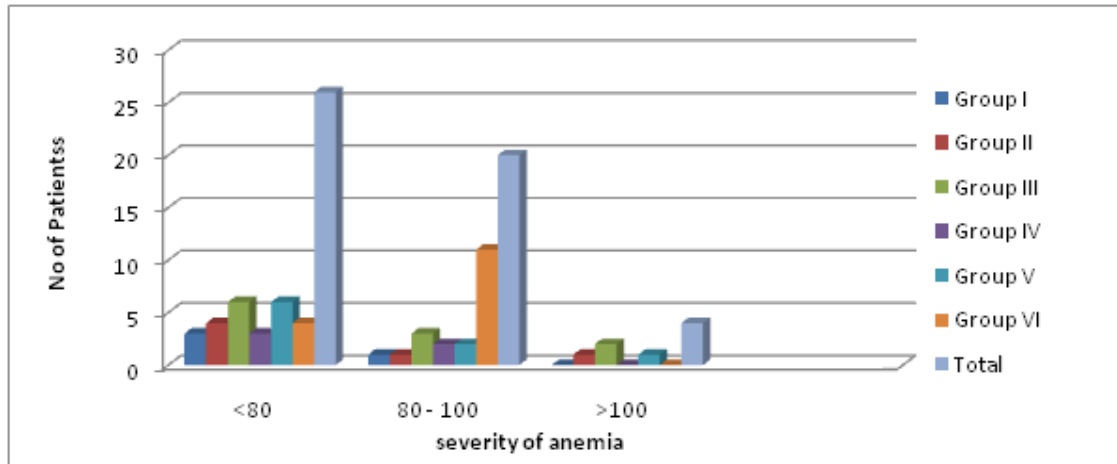
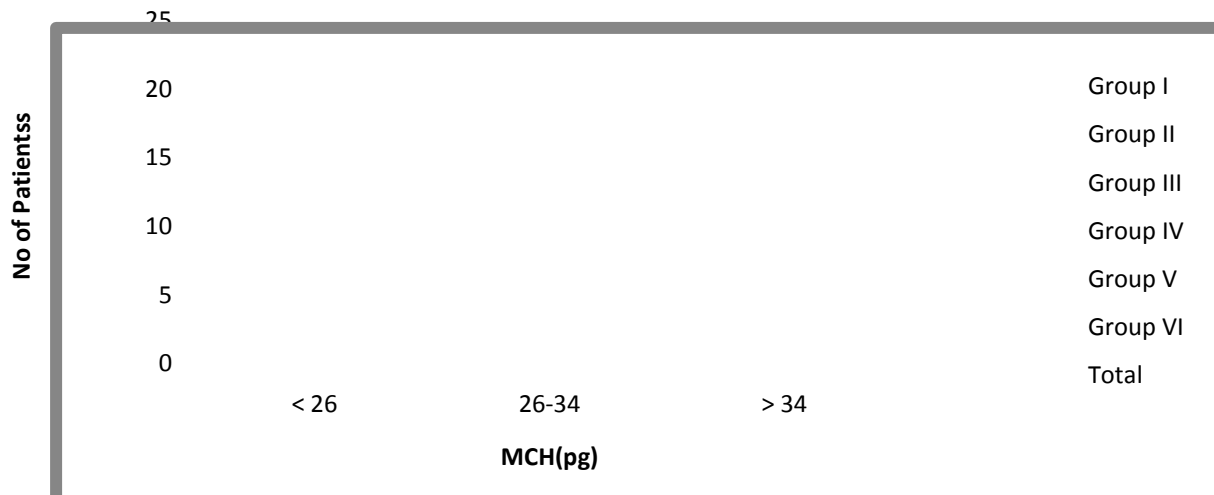


Table - 7: MCH values in the study groups

Groups	Group I	Group II	Group III	Group IV	Group V	Group VI	Total	
MCH(pg)	< 26	2(50%)	3(50%)	7(63.64%)	2(40%)	3(33.33%)	5(33.33%)	22(44%)
	26 - 34	1(25%)	2(33.33%)	3(27.27%)	3(60%)	4(44.44%)	6(40%)	19(38%)
	> 34	1(25%)	1(16.67%)	1(9.09%)	-	2(22.22%)	4(26.67%)	9(18%)

Chart 7: MCH VALUES



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Table - 8: MCHC values in the study groups

Groups		Group I	Group II	Group III	Group IV	Group V	Group VI	Total
MCHC (g/dl)	< 31	2(50%)	3(50%)	5(45.45%)	2(40%)	3(33.33%)	5(33.33%)	20(40%)
	31 - 37	-	2(33.33%)	4(36.36%)	3(60%)	5(55.56%)	4(26.67%)	18(36%)
	> 37	2(50%)	1(16.67%)	2(18.18%)	-	1(11.11%)	6(40)	12(24%)

Chart 8: MCHC VALUES

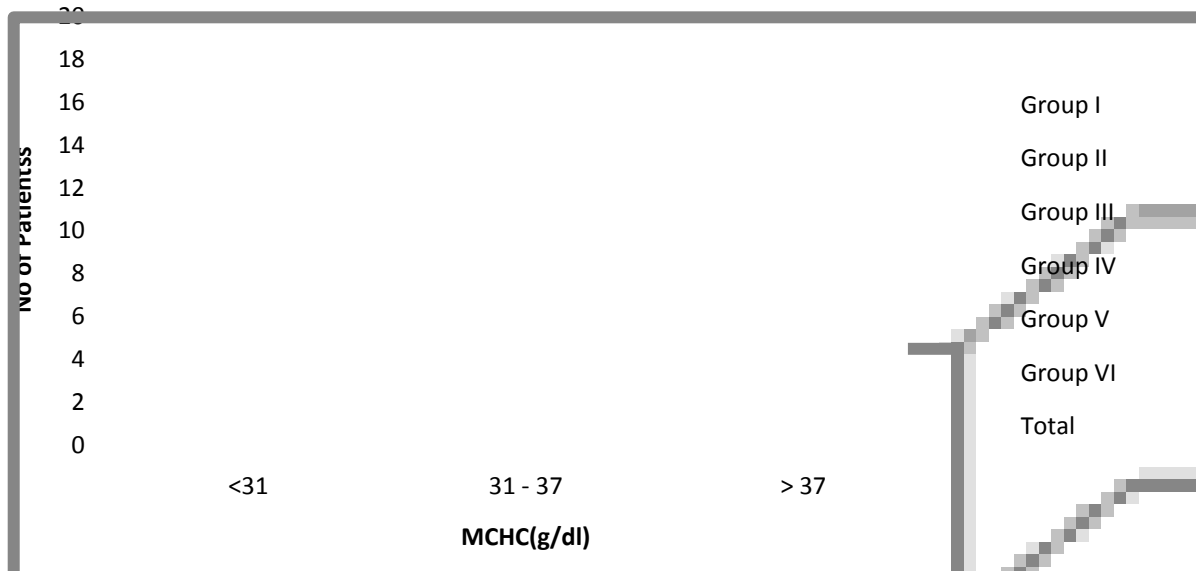


TABLE - 9: RDW values in the study groups

Groups		Group I	Group II	Group III	Group IV	Group V	Group VI	Total
RDW (%)	10.0 < 16.0	2(50%)	2(33.33%)	4(36.36%)	3(60%)	5(55.56%)	8(53.33%)	24(48%)
	> 16.0	2(50%)	4(66.67%)	7(63.63%)	2(40%)	4(44.44%)	7(46.67%)	26(52%)

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Chart 9: RDW VALUES

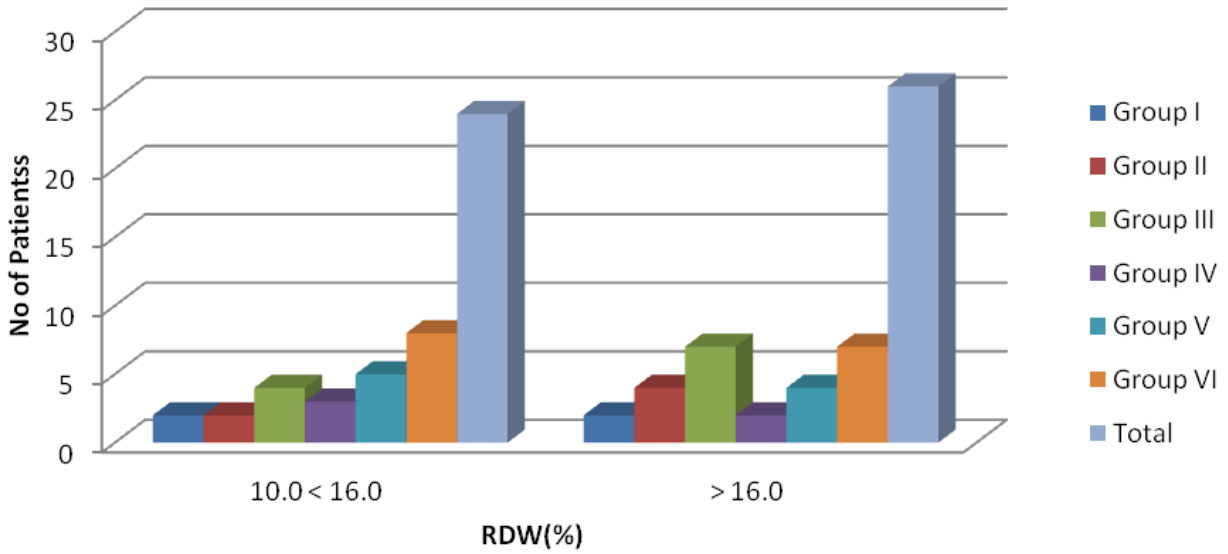


Table - 10: Serum Iron in 18 Patients

SERUM IRON ($\mu\text{g}/\text{dl}$)	PATIENTS
<60.0	12(75%)
60.0-180.0	6(25.0%)

Chart 10 - a: Serum Iron values in 18 patients



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Chart 10 - b: Serum Iron values in 18 patients

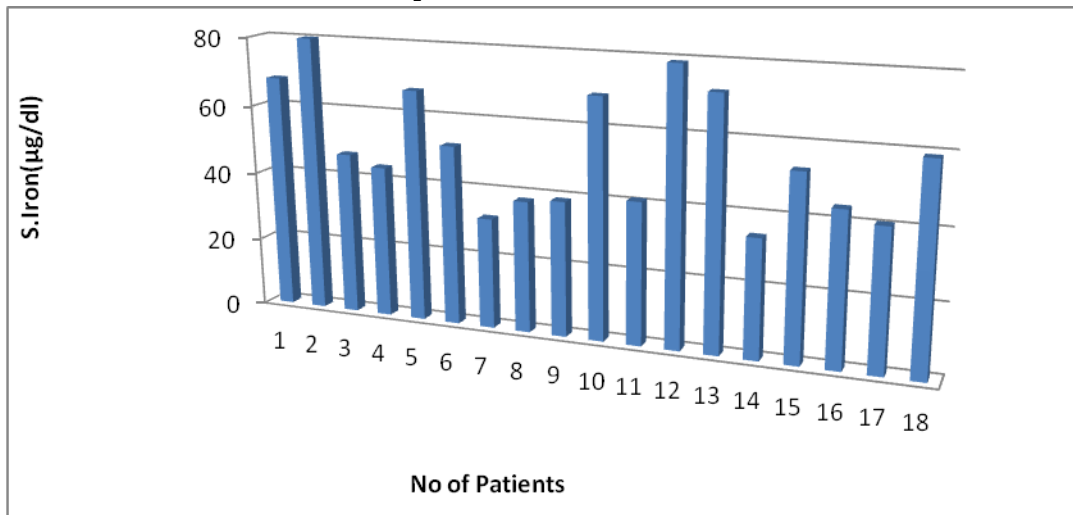
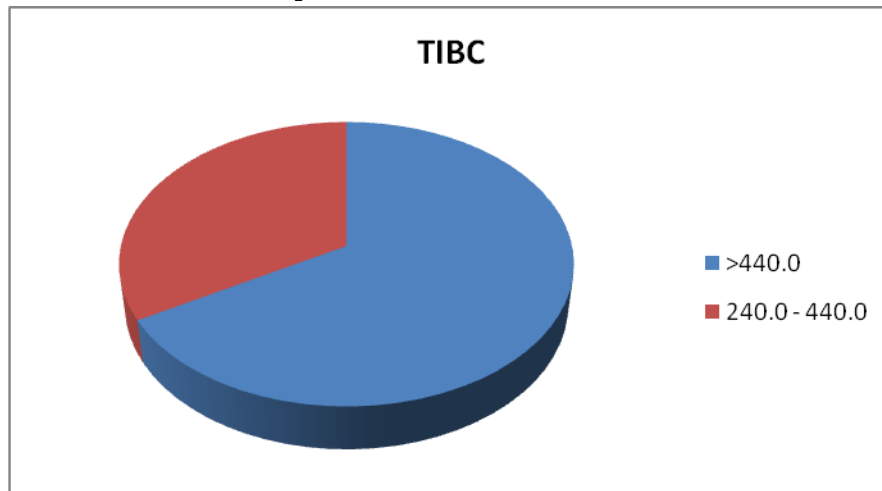


Table - 11: TIBC in 18 patients

TIBC (µg/dl)	PATIENTS
>440.0	12(66.7%)
240.0-440.0	6(33.3%)

Chart 11 - a: TIBC Iron values in 18 patients



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Chart 11 - b: TIBC iron values in 18 patients

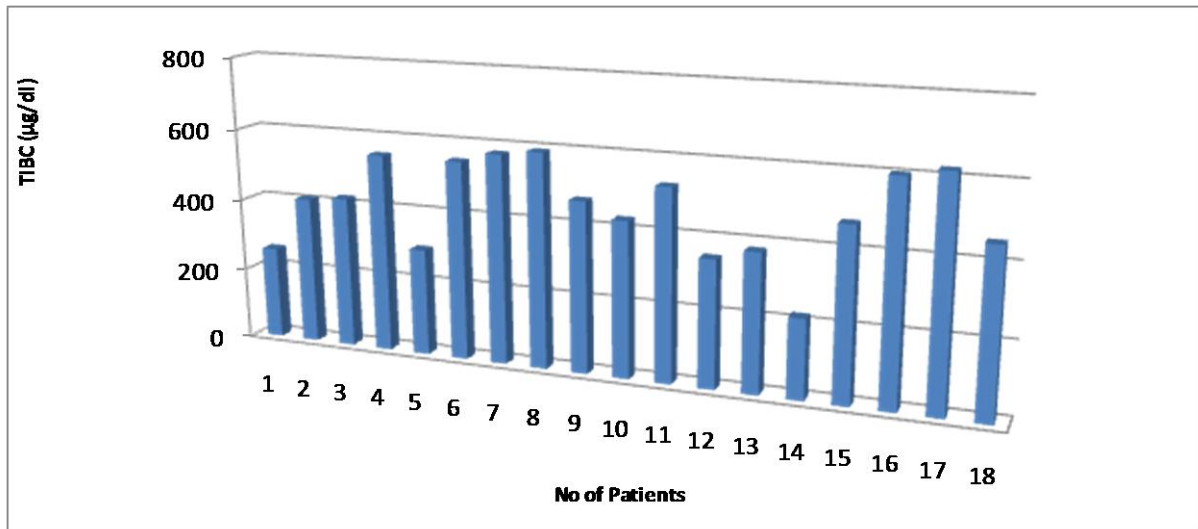
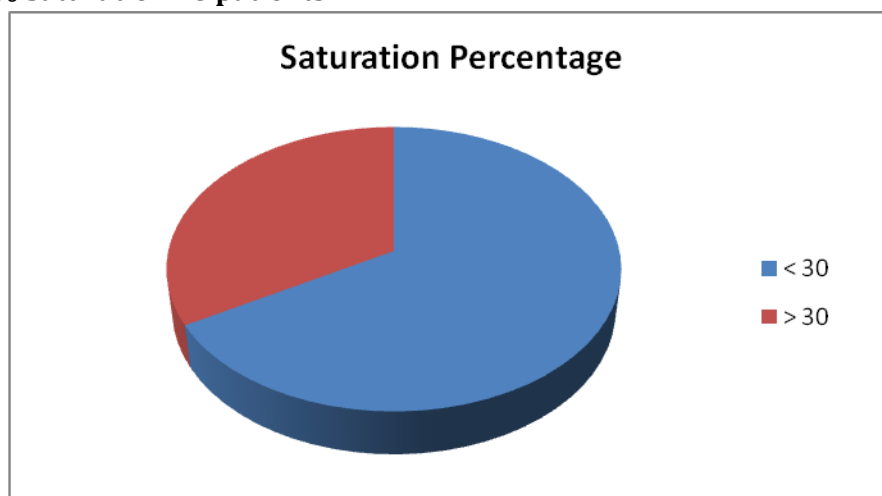


Table - 12: % Saturation In 18 Patients

PERCENT SATURATION	PATIENTS
<30	12(66.7%)
>30	6(33.3%)

Chart 12 - a: % Saturation 18 patients



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Chart 12 - b: Percent saturation values in 18 patients

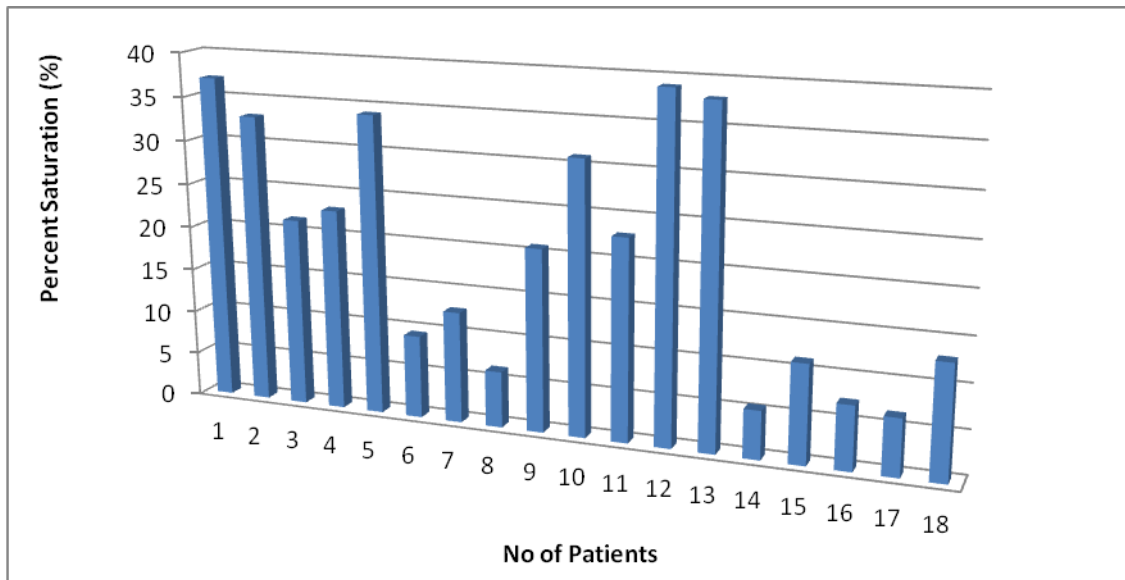
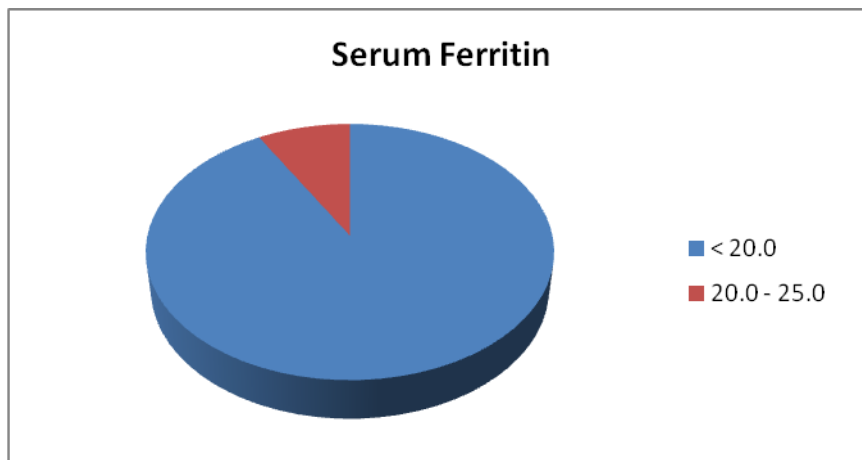


Table - 13: Serum Ferritin in 18 patients

SERUM FERRITIN (µg/l)	PATIENTS
<20.0	12(91.7%)
20.0-25.0	6(8.3%)

Chart 13 - a: % Saturation 18 patients



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Chart 13 - b: serum ferritin values in 18 patients

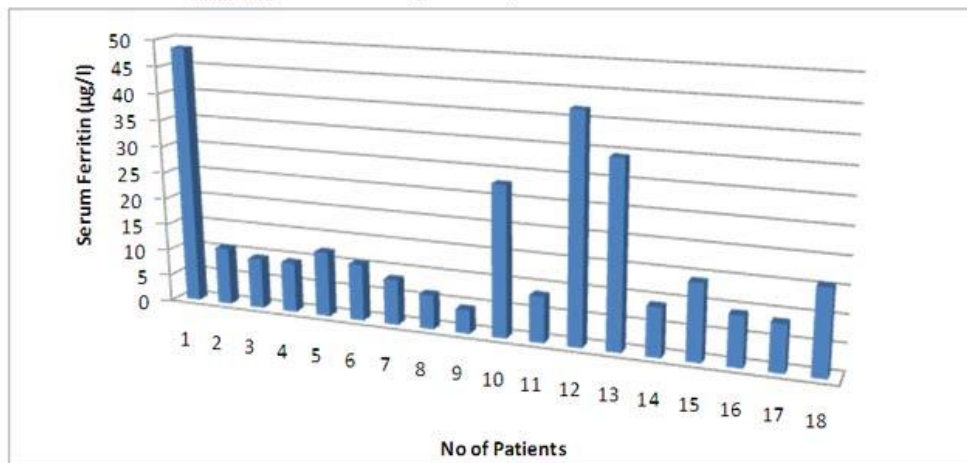
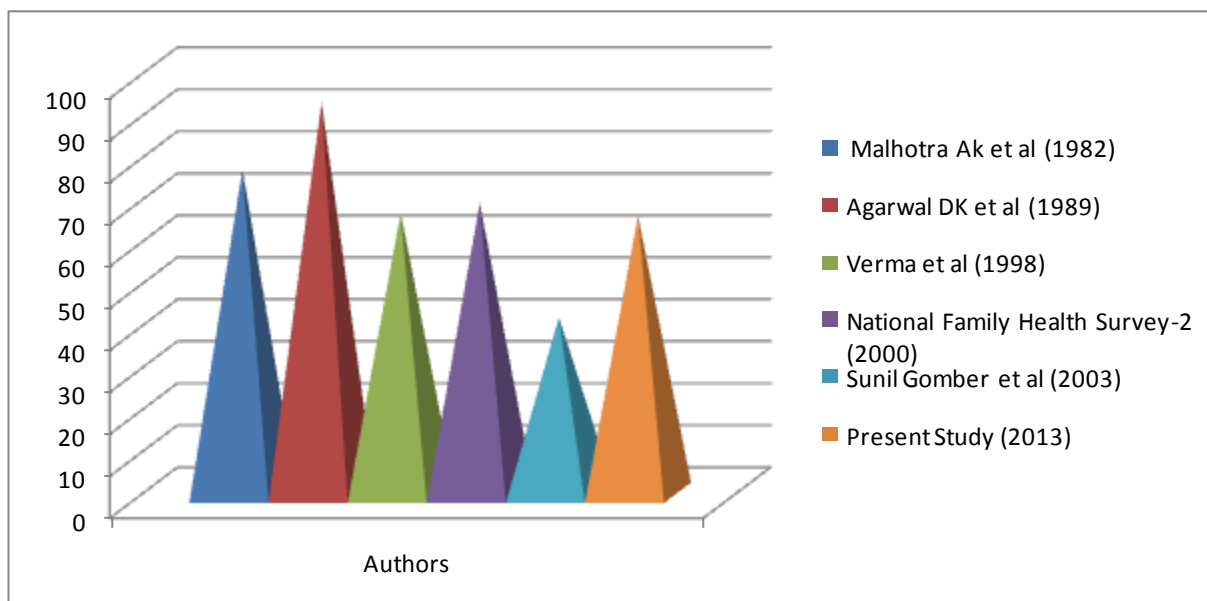


Table 14: Prevalence of Anemia

Sl. No.	AUTHORS (YEAR)	PREVALECE (%)
1.	Malhotra Ak et al ⁶¹ (1982)	77
2.	Agarwal DK et al ⁶⁵ (1989)	93
3.	Verma et al ⁵⁹ (1998)	66.7
4.	National Family Health Survey-2 ⁶⁶ (2000)	69
5.	Sunil Gomber et al ⁶⁴ (2003)	41.8
6.	Present Study (2013)	66

Chart 14: Prevalence of Anemia



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Table 15: Sex distribution of anemia

Study Group (year)	Gomber et al ¹⁸ (1998)	Kapur et al ¹⁴ (2002)	Sunil Gomber et al ¹⁵ (2003)	Halileh et al ¹⁹ (2005)	Present Study (2013)
Male: Female	1.4:1	1:1	1.2:1	1:1	1:1.1

Chart 15: Sex Distribution of Anemia

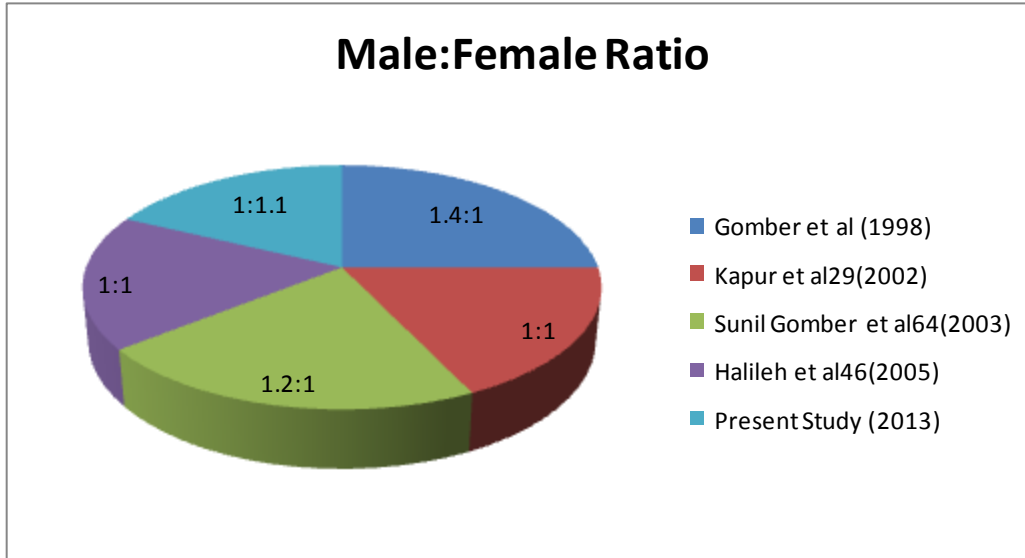


Table 16: Types of Anaemia seen in the study group.

Sl. No.	TYPES OF ANEMIA	NO. OF CHILDREN
1.	Microcytic Hypochromic	29
2.	Normocytic Normochromic	13
3.	Macrocytic Normochromic	8

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