COMPARISON BETWEEN RED CELL DISTRIBUTION WIDTH AND RED CELL INDICES IN PREDICTION OF ANAEMIA AMONG PREGNANT WOMEN

By

Dr. MAYANK KUMAR

Dissertation submitted to the

BLDE University, Vijayapur, Karnataka

In partial fulfillment of the requirements for the award of the degree of

DOCTOR OF MEDICINE

IN

PATHOLOGY

Under the guidance of

Dr. PRAKASH M. PATIL M.D.

Associate Professor, Department of Pathology

BLDE UNIVERSITY'S SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, VIJAYAPUR, KARNATAKA

2017

BLDE UNIVERSITY'S

SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL

AND RESEARCH CENTRE, VIJAYAPUR

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"COMPARISON BETWEEN RED CELL DISTRIBUTION WIDTH AND RED CELL INDICES IN PREDICTION OF ANAEMIA AMONG PREGNANT WOMEN"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. PRAKASH M. PATIL**$_{\text{M.D.}}$ Associate Professor, Department of Pathology, BLDE University's Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapur, Karnataka.

Date: **Dr. MAYANK KUMAR**

Place: Vijayapur

BLDE UNIVERSITY'S

SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL

AND RESEARCH CENTRE, VIJAYAPUR

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled **"COMPARISON BETWEEN RED CELL DISTRIBUTION WIDTH AND RED CELL INDICES IN PREDICTION OF ANAEMIA AMONG PREGNANT WOMEN"** is a bonafide research work done by **Dr. MAYANK KUMAR** in partial fulfillment of the requirements for the degree of **Doctor of Medicine (Pathology).**

Date:

Place: Vijayapur

Dr. PRAKASH M. PATIL

Associate Professor,

Department of Pathology,

BLDEU's Shri B.M. Patil Medical

College, Hospital and Research Centre,

Vijayapur, Karnataka

BLDE UNIVERSITY'S

SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL

AND RESEARCH CENTRE, VIJAYAPUR

ENDORSEMENT BY HEAD OF THE DEPARTMENT

This is to certify that the dissertation entitled **"COMPARISON BETWEEN RED CELL DISTRIBUTION WIDTH AND RED CELL INDICES IN PREDICTION OF ANAEMIA AMONG PREGNANT WOMEN"** is a bonafide research work done by **Dr. MAYANK KUMAR** in partial fulfillment of the requirements for the degree of **Doctor of Medicine (Pathology).**

Date:

Place: Vijayapur

Dr. B. R. YELIKAR

Professor and H.O.D,

Department of Pathology,

BLDEU's Shri B.M. Patil Medical

College, Hospital and Research Centre,

Vijayapur, Karnataka

BLDE UNIVERSITY'S

SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL

AND RESEARCH CENTRE, VIJAYAPUR

ENDORSEMENT BY PRINCIPAL / HEAD OF THE INSTITUTION

This is to certify that the dissertation entitled **"COMPARISON BETWEEN RED CELL DISTRIBUTION WIDTH AND RED CELL INDICES IN PREDICTION OF ANAEMIA AMONG PREGNANT WOMEN"** is a bonafide research work done by **Dr. MAYANK KUMAR** in partial fulfillment of the requirements for the degree of **Doctor of Medicine (Pathology).**

Date:

Place: Vijayapur

Dr. S.P. GUGGARIGOUDAR

Principal,

BLDEU's Shri B.M. Patil Medical College, Hospital and Research Centre,

Vijayapur, Karnataka

BLDE UNIVERSITY'S

SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL

AND RESEARCH CENTRE, VIJAYAPUR

COPYRIGHT

DECLARATION BY THE CANDIDATE

I hereby declare that the BLDE University, Karnataka shall have the rights to preserve, use and disseminate this dissertation / thesis in print or electronic format for academic / research purpose.

Date: **Dr. MAYANK KUMAR**

Place: Vijayapur

ACKNOWLEDGMENT

I will always be thankful to my parents, sister, wife, and my family members for molding my life in a meaningful manner.

I take this opportunity to express my heartfelt gratitude to my teacher and guide, **Dr. Prakash M. Patil**, Associate Professor, Department of Pathology, for his constant support, constructive criticism and encouragement throughout the course of this study. This study would not have been possible without his valuable guidance and meticulous supervision.

I am immensely grateful to **Dr. B.R. Yelikar**, Professor and Head of Department, Department of Pathology, for his guidance throughout the period of this study.

I am thankful to **Dr. S.U. Arakeri** Professor, **Dr. R.M. Potekar** Professor, **Dr. S.B. Hippargi** Professor, **Dr. Mahesh H. Karigoudar** Professor, **Dr. Girija S. Patil** Associate Professor, **Dr. Padmaja Kulkarni** Associate Professor, **Dr. Vijayalaxmi S. Patil** Assistant Professor, **Dr. Anita P. Javalgi** Assistant Professor, **Dr. Savitri M. Nerune** Assistant Professor, **Dr. Mamatha K.** Assistant Professor, **Dr. Sneha Jawalkar** Assistant Professor, **Dr. Yashaswini** Assistant Professor, for their supervision, concern and feedback during the study period. Their mentorship has had a profound effect on my professional outlook.

My sincere thanks to all my batch mates and colleagues who have supported and encouraged me during this work. I will cherish the work environment that I have shared with them, throughout my life.

I sincerely thank **Mr. Mohd. Shannawaz**, Lecturer in Statistics, for performing the statistical analysis of the data generated during the investigations.

I am grateful to all the technical and non-teaching staff of the Department of Pathology, who have helped and guided me in various aspects of this study.

Last but not the least**,** my sincere gratitude to all the study subjects who took part in this study. Their cooperation has contributed immensely to this study.

Date: **Dr. MAYANK KUMAR**

Place: Vijayapur

LIST OF ABBREVATIONS USED

WHO	World Health Organization
Hb	Haemoglobin
RDW	Red cell distribution width
MCV	Mean corpuscular volume
IDA	Iron deficiency anaemia
RBC	Red blood cell
G-6-PD	Glucose-6-phosphate dehydrogenase
CV	Coefficient of variation
SD	Standard deviation
Hct	Haematocrit
MCH	Mean corpuscular haemoglobin
MCHC	Mean corpuscular haemoglobin concentration
CI	Confidence interval
ROC	Receiver operating characteristic
OPD	Out patient department

ABSTRACT

BACKGROUND

Anaemia in pregnant women is an important cause for maternal mortality and is also associated with poor perinatal outcomes. Early detection and prompt management of anaemia in pregnancy can lead to substantial decrease in maternal and perinatal mortality and morbidity. Efficient diagnostic approaches are necessary in order to achieve the same.

OBJECTIVES

- To determine and compare the usefulness of red cell distribution width and red cell indices in prediction of anaemia in pregnant women
- To determine the morphological types of anaemia in pregnancy

MATERIALS AND METHODS

Pregnant women attending the out-patient department or admitted to in-patient Obstetrics and Gynecology wards who were referred to the Pathology laboratory at BLDE University's Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapur were included in this study.

The study period was from 1st December 2014 to 30th June 2016.

Two milliliters of venous blood were collected from the pregnant women in an ethylene diamine tetra acetic acid vacutainer. The various study parameters were obtained from an automated hematology analyzer. A peripheral smear was prepared from the same sample and visually examined for morphological typing of anaemia. All observations were recorded in the proforma sheet as per format.

Statistical correlation between various parameters was performed and data analyzed.

RESULTS

There was statistically significant relationship with changes in values of red cell distribution width, mean corpuscular volume, mean corpuscular haemoglobin, and mean corpuscular haemoglobin concentration with change in level of haemoglobin. This correlation was more significant with change in value of red cell distribution width compared to red cell indices.

The most common type of anaemia in pregnancy was microcytic hypochromic type, which is usually seen in iron deficiency anaemia.

CONCLUSION

Red cell distribution width and red cell indices are cost effective and simple methods which can be used as screening tools for iron deficiency anaemia in pregnancy.

KEY WORDS

Anaemia, pregnancy, red cell distribution width

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Anaemia is an important nutritional problem affecting all segments of the population in general, and children, women and pregnant women in particular. It continues to be the most important single cause of maternal mortality and also in fact for abnormalities such as premature births, still births and neonatal mortality.[1]

The importance of anaemia as a major public health problem throughout the world is widely recognized. According to the World Health Organization (WHO), in India the prevalence of anaemia among pregnant women averages 49.7%.[1] Various studies from different regions of India have reported the prevalence of anaemia among pregnant women to be around 50%.[2] The single most important cause for anaemia among pregnant women in India is iron deficiency.

Poor iron stores at birth, low iron content of breast milk, and low dietary iron intake throughout infancy and childhood result in high prevalence of anaemia in childhood. This gets aggravated by increased requirements during adolescence and during pregnancy. Anaemia in pregnancy is directly responsible for 20% of the maternal deaths in India and indirectly accounts for another 20% of the maternal deaths. There is an eight to ten-fold increase in maternal mortality rate when there is a severe reduction in the haemoglobin (Hb) level.[3]

A substantial decrease in maternal and perinatal mortality and morbidity can be achieved by early detection and effective management of anaemia in pregnancy.

Red cell distribution width (RDW), which is a quantitative measure for red cell size variation (anisocytosis) and mean corpuscular volume (MCV), which is the average volume of red cells, are predictors of iron deficiency anaemia (IDA).

In the era of rising cost consciousness, efficient diagnostic approaches, which can rule in or rule out diseases with sufficient accuracy so that testing is minimized,

are particularly welcome. Bone marrow studies are invasive methods and serum ferritin, serum transferrin, and serum iron are relatively expensive while RDW and red cell indices are part of routine blood counts in laboratories using automated haematology analyzers. The automated facility is cost effective and time saving, contrary to the tedious time consuming visual estimation of red blood cell size showing limitations of significant subjectivity associated with visual inspection.[4]

Various previous studies have debated the role of RDW and MCV in prediction of anaemia. In the present study, comparison between RDW and MCV, along with other red cell indices, has been done to determine which amongst them was a more accurate predictor of anaemia in pregnant women.

OBJECTIVES

- To determine and compare the usefulness of red cell distribution width and red cell indices in prediction of anaemia in pregnant women
- To determine the morphological types of anaemia in pregnancy

REVIEW OF LITERATURE

Definition of anaemia:

Anaemia is defined as a reduction of the total circulating red mass below normal limits.[5] Functionally, it is a decrease in the competence of blood to carry oxygen to the tissues, leading to tissue hypoxia.[6]

It should be recognized that anaemia is not a disease per se but the expression of an underlying disorder.

A Hb level of less than 11.0 g/dl is considered as the cut-off for diagnosis of anaemia in pregnant women, as per the WHO[1].

Classification of anaemia:

The classification of anaemia on the basis of the underlying mechanism is as follows:[5]

(Table 1)

Mechanism	**Examples**
BLOOD LOSS	
- Acute blood loss	Trauma
- Chronic blood loss	Gastrointestinal tract lesions Gynaecologic disturbances
INCREASED RED CELL DESTRUCTION	
- Inherited genetic defects	
- Red cell membrane disorders	Hereditary spherocytosis Hereditary elliptocytosis
- Enzyme deficiencies	G-6-PD deficiency Pyruvate kinase deficiency
- Haemoglobin abnormalities	Thalassaemia syndromes Sickle cell disease Unstable haemoglobins
- Acquired genetic defects	Paroxysmal nocturnal haemoglobinuria
- Antibody-mediated destruction	Haemolytic disease of the new born Transfusion reactions Drug-induced
- Mechanical trauma	Haemolytic uremic syndrome Disseminated intravascular coagulation Thrombotic thrombocytopenic purpura Defective cardiac valves Marathon running Karate chopping

- Infections of red cells	Malaria Babesiosis
- Toxic or chemical injury	Clostridial sepsis Snake venom Lead poisoning
- Membrane lipid abnormalities	Abetalipoproteinemia Severe hepatocellular liver disease
- Sequestration	Hypersplenism
DECREASED RED CELL PRODUCTION	
- Inherited genetic defects	Fanconi anaemia Thalassaemia defects
- Nutritional deficiencies	B12 and folate deficiencies Iron deficiency anaemia
- Erythropoietin deficiency	Renal failure Anaemia of chronic disease
- Immune-mediated injury of progenitors	Aplastic anaemia Pure red cell aplasia
- Inflammation-mediated iron sequestration	Anaemia of chronic disease
- Primary haematopoietic neoplasms	Acute leukemia Myelodysplasia Myeloproliferative disorders
- Space-occupying marrow lesions	Metastatic neoplasms Granulomatous disease
- Infections of red cell progenitors	Parvovirus B19 infection
- Unknown mechanisms	Endocrine disorders Hepatocellular liver disease

Anaemia in Pregnancy:

Anaemia in pregnancy is a common and serious problem in developing countries. Prevalence of anaemia in India is among the highest in the world.

There are many factors that are responsible for high prevalence of anaemia among pregnant women in India, the main being:[3]

1. Low dietary intake of iron (less than 20 mg/day) and folic acid (less than 70 µg/day)
2. Poor bioavailability of iron (only 3-4%) in phytate and fibre-rich Indian diet
3. Chronic blood loss due to infection such as malaria and hookworm infestations.

There is a self-perpetuating vicious cycle of anaemia in the Indian population. The presence of iron deficiency in the pregnant woman predisposes the infant to iron deficiency and anaemia right from birth itself. Poor iron content in routine diet consumed by the young child contributes further to the prevalence of anaemia in childhood. With the onset of menstruation and accompanying blood loss, there is a further rise in the prevalence and severity of anaemia among adolescent girls. The practice of early marriage and pregnancy at a very young age aggravates the problem, resulting in poor iron stores in the pregnant woman, and subsequently in the infant.

Anaemia causes changes in the immune status of the pregnant women. Hb levels below 11 g/dl are associated with a fall in the T and B lymphocyte count. This immunodepression in anaemic women renders them more susceptible to infection, leading to increased morbidity.[3]

The maternal consequences of anaemia are manifold. Women with mild anaemia in pregnancy have decreased work capacity, but may go through pregnancy without any adverse consequences. However, women with moderate and severe degrees of anaemia are at risk of several complications.

Women with moderate degree of anaemia in pregnancy have substantial reduction in work capacity. These women are more susceptible to infections. Premature births are common, contributing to perinatal morbidity and mortality. Deaths due to antepartum and postpartum haemorrhage, pregnancy induced hypertension and sepsis can occur in such women.[3]

Cardiac decompensation usually occurs in cases of severe anaemia. In such cases, compensatory mechanisms are not able to deal with the decrease in Hb levels. There is ensuing anaerobic metabolism leading to accumulation of lactic acid. Circulatory failure may occur and if untreated, results in pulmonary oedema and death.[3]

The foetal consequences of anaemia in pregnant women are well documented. A significant rise in perinatal mortality rate occurs when maternal haemoglobin levels fall below 11 gm/dl.[3] This is due to intrauterine growth retardation and premature births.

Thus, keeping in mind the adverse maternal and foetal consequences of anaemia in pregnancy, anaemic women are treated as a high risk obstetric group.

The main aim of screening for anaemia in pregnancy is to avoid the adverse effects that are associated with it. Apart from this, screening for anaemia in pregnancy is useful for a variety of other reasons. It may be helpful to collect baseline data on prevalence and severity of anaemia in a given population, and to assess the effects of supplementation with iron tablets, anti-malarial prophylactics, or oral anti-helminthic treatment. At primary care level, diagnosis of anaemia can help decide whether referral is necessary for more detailed investigation and treatment.[7]

The consequences of the adverse effects of anaemia in pregnancy may be highly risky for both the mother and her child.[8]

Red cell distribution width (RDW):

RDW is a measure of variation in the size of red blood cells. It indicates the difference in size between the smallest and largest red blood cell. An increase in RDW corresponds to an increase in anisocytosis on peripheral blood smears.[9,10]

RDW, a relatively new red cell measurement parameter, along with a histogram of red cell heterogeneity, is provided by almost all of the automated haematology analyzers. The measurement reflects the range of red blood cell size measured in a given blood sample.[9,10]

The first attempts to record the mean red blood cell size and the variation in red blood cell size were based on careful measurements of diameters of red blood cells. Price-Jones curves, showing the frequency distribution of cell diameter, were used. However, the time and expertise required in their preparation limited their practical application.

In the present era, this examination and calculation can be done easily and accurately by the automated haematology analyzers. Inspection of these red blood cell histograms makes it possible to evaluate the mean red blood cell size, variation in sizes of red blood cells, and the existence of bimodal cell populations.

RDW has been proposed to be useful in early detection and classification of anaemia because it becomes abnormal earlier in nutritional anemias than any of the other red cell parameters.

In addition to providing information about the etiology of anaemia, RDW is also useful in identifying dimorphic red blood cell population, agglutination, and red blood cell fragmentation. Blood from individuals with cold agglutinin disease shows increased RDW and MCV values, and the red cell histogram shows bimodal population of cells, in which one population of cells is in normal size range while

other population has an apparent size that is approximately double that of a single red cell. Bimodal red cell population may also be seen in individuals who have been treated for nutritional deficiency anaemias or have undergone a blood transfusion recently.

The normal red cell distribution width (RDW-CV) is 12.8 + 1.2%.[11]

The total number of red blood cells counted are classified by size. This classification based on size is done by an automatic, continuously variable threshold circuit. The threshold begins at a level equivalent to 360 femtolitres and moves progressively lower until 20% of all red blood cells present have a size greater than the threshold. The cell size at which this occurs is recorded as the 20^{th} percentile value (A). The threshold continues downward until 80% of all red blood cells have a size greater than the threshold. The cell size at which this occurs is recorded as the 80^{th} percentile vale (B). The final value of RDW is computed by the formula RDW = [(A-B)/(A+B)] K, where K is a constant.

The RDW values calculated and reported by the automated haematology analyzers are of two types – 1) the coefficient of variation (RDW-CV), and 2) the standard deviation (RDW-SD), or both. The present study utilizes the coefficient of variation, RDW-CV, obtained from the automated haematology analyzer Sysmex XN-1000.

Two different mechanisms can be used to count and measure the red blood cells, which has an effect on the appearance and visual accuracy of the red blood cell distribution curves. The various automated haematology analyzers use either the aperture impedance technology or the light scatter technology, the differences among which are tabulated below:

(Table 2)

	Aperture impedance counter	**Light scatter counter**
First described by	Coulter	Crosland-Taylor
Mechanism of delivery of cells to sensing zone	By passage through a narrow orifice	By passage in a narrow stream created by sheath-flow
Delineation of sensing zone	By measuring impedance across the orifice	By a light beam crossing the stream of cells
Impulses used for counting as cells traverse sensing zone	Changes in impedance counted electronically	Changes in output from a photometer counted electronically

The automated haematology analyzer Sysmex XN-1000 used in the present study employs the principle of aperture-impedance for counting and measuring the cells.

An increase in the value of RDW, indicating an increase in the heterogeneity of red blood cell population, suggests an abnormal condition or disease state. A decrease in value of RDW is of no clinical significance, since little or no variability in size of red blood cells is considered normal.[11]

The RDW-SD is defined as the distribution width of the red blood cell population, and correlates with the width of the red blood cell distribution. In iron deficiency anaemia, the distribution is broad-based and thus, the RDW-SD is increased.[12] RDW-SD is determined by measuring the actual distribution width (standard deviation) of the red blood cell population at 20% above the base line. It can be used to detect red blood cell heterogeneity or anisocytosis. [10]

A red cell histogram is a graphical representation of different red blood cell type populations. It is obtained by differentiating each particle by size and frequency.

The red cell histogram is obtained by plotting the relative number of counts on the Y-axis and the cell size (in femtolitres) on the X-axis. The relative number (frequency) refers to the number of cells of a particular size, visualized at the height of a peak or the depth of a valley between two peaks.

Interpretation of red cell histograms and their analyzed parameters has added a new dimension to the routine complete blood count. Automated haematology analyzers count numerous cells to produce histograms, providing a much more accurate haematological evaluation than that obtained by visual examination of hundred cells in a peripheral blood smear. This allows detection of abnormalities or changes in a blood sample even before the same can be detected on a peripheral blood smear.

As RDW is a reflection of the ratio of the standard deviation of red blood cell size and the mean MCV, caution must be used in its interpretation. An increased standard deviation with a high MCV may give a normal RDW. Conversely, a normal standard deviation with a low MCV may give an increased RDW. The examination of red blood cell volume histogram and peripheral blood smear should be done in these ambiguous cases. Increase in the standard deviation, which indicates a true variability in red blood cell size, is accompanied by the red cell histogram showing broader base on the X-axis.[11]

An artefactual increase in RDW, where the value of RDW is far out of the proportion of the red cell count or MCV, is seen in the following conditions:[13]

1. In individuals with chronic lymphocytic leukaemia, having a lymphocyte count exceeding 150,000/µL, an artefactually high RDW is produced by the lymphocytes due to their large volume.

2. After red blood cell transfusion, an elevated RDW reflects the heterogeneity of the red blood cell population, i.e., the recipient and donor cells.
3. Cardiac valve prosthesis that produce significant red blood cell fragmentation will markedly elevate RDW.
4. In individuals with cold agglutinin disease, the red blood cell agglutinates will be counted as single cells with large volumes, resulting in a high RDW.

Red cell indices:

Mean corpuscular volume (MCV) - It is the average volume of red blood cells and is measured in femtolitres (fl). In automated haematology analyzers, the passage of a red cell through the aperture of an impedance counter or through the beam of light of a light-scattering instrument leads to the generation of an electrical pulse. The value can be obtained by two methods. Directly, the average pulse height is indicative of MCV, or, the summation of pulse heights is indicative of haemaocrit (Hct) and the MCV can be calculated by dividing the Hct by the RBC count.[11]

The coefficient of variation in automated haematology analyzers is approximately 1%, compared with approximately 10% for the manual method.[9]

The normal value of MCV in adults is 92 ± 9 fl.[11]

Mean corpuscular haemoglobin (MCH) – It is the average mass of haemoglobin per red blood cell and is measured in picogram (pg).

It is calculated by the formula: $MCH = \frac{Hb\ (g/dL) \times 10}{RBC\ (x10^6/mcL)}$

The normal value of MCH in adults is 29.5 ± 2.5 pg.[11]

Mean corpuscular haemoglobin concentration (MCHC) – It is a measure of the concentration of haemoglobin in a given volume of packed red blood cells and is reported in g/dL.

It is calculated by the formula: MCHC = $\frac{\text{Hb (g/dL) x 100}}{\text{Hct (\%)}}$

The normal value of MCHC in adults is 33 $\pm$ 1.5 g/dL.[11]

Classification of anaemias based on analyzer parameters (Table 3):[14]

Microcytic	Low MCV and normal RDW	Heterozygous thalassaemia Anaemia of chronic disease
	Low MCV and high RDW	Iron deficiency anaemia Homozygous thalassaemia Haemoglobin H disease Red cell fragmentation
Normocytic	Normal MCV and normal RDW	Normal individuals Haemorrhage Blood transfusion Non-anaemic haemoglobinopathies Chronic liver disease Chronic leukemias Hereditary spherocytosis
	Normal MCV and high RDW	Mixed deficiency Early iron or folate deficiency Anaemic haemoglobinopathies Myelofibrosis Sideroblastic anaemia
Macrocytic	High MCV and normal RDW	Aplastic anaemia Preleukemia
	High MCV and high RDW	Folate deficiency Vitamin B12 deficiency Immune haemolytic anaemia Cold agglutinins Chronic lymphocytic leukemia

Review of other studies:

Historically, one of the earliest studies to analyze the size distribution of erythrocytes was done by Brecher et al[15] in 1962.

The role of RDW and red cell indices in iron deficiency anaemia was first studied by England et al[16] in 1976. They found that anisocytosis and an increased percentage of microcytic cells were the first haematological abnormalities to occur in the early stages of iron deficiency anaemia, when the haemoglobin concentration was within normal range.

The first classification of anaemia based on MCV and RDW was reported by Bessman et al[14], using Coulter Model S plus II haematology analyzer. They found that for normal individuals, RDW was 13.4±1.2% and MCV was 90±10 fl, whereas in cases of iron deficiency anaemia, RDW was 16.3±1.8% and MCV was 74.6±20.3 fl. In β-thalassaemia cases, RDW was 13.7±1.6% and MCV was 70.4±9.2 fl. They concluded that when used separately, MCV and RDW, were less than 90% sensitive in establishing an etiological diagnosis of anaemia. They also stated that both MCV and RDW accurately predicted normal subjects and that distribution of the red cell volume was more homogenous in heterogenous thalassaemia or anaemias in chronic disease as compared to those in iron deficiency anaemia.

Bessman[17] emphasized the importance of using RDW values calculated by the same instrument for the purposes of comparison to avoid inaccuracies in interpretation, because the normal range depended on the mechanism of the instrument.

McClure et al[18] found that RDW was the first haematological parameter to become abnormal in cases of early iron deficiency, in absence of changes in MCV,

MCHC, or Hb. This early change in RDW can be used to diagnose an early stage of iron deficiency, earlier than was previously possible.

Marsh et al[13] evaluated RDW in the differential diagnosis of patients with iron deficiency anaemia, anaemia of chronic disease, and thalassaemia trait. They concluded that RDW, like other red cell indices, was not sufficiently specific or sensitive and it was necessary to confirm the diagnosis by other laboratory tests.

Simel et al[19] compared the visual inspection of peripheral blood smears with automated analysis of RDW and strongly recommended use of RDW because of its precision and reproducibility.

Mehta[20] highlighted the pitfalls of MCV in iron deficiency anaemia. Microcytosis, assessed by decrease in MCV, is used as a screening tool for IDA. He found that low MCV was also encountered in β-thalassaemia trait and also that reduction in MCV was not an early finding in cases of iron deficiency anaemia. Some cases of iron deficiency anaemia were likely to have MCV value within normal limits. Thus, he concluded that MCV gave both false negative and false positive results in the diagnosis of iron deficiency anaemia, and was not a good indicator because of its low sensitivity and specificity.

Shehata et al[21] studied the changes in RDW between and within women with progression of pregnancy. They found that there was increase in the RDW during the last four to six weeks of pregnancy. This increase, leading up to the onset of labour, was attributed to increased bone marrow activity.

Lin et al[22] recommended the use of RDW and MCV in the initial classification of anaemia in pregnancy on the basis of their study on the role of MCV and RDW in the diagnosis of iron deficiency anaemia in pregnancy. They found that there was

significant increase in RDW and decrease in MCV and concluded that high RDW and low MCV were characteristic changes of IDA in pregnancy.

In an attempt to define reference values for Hb and RBC indices, among other parameters, Milman et al[23] studied these parameters in 206 women. They suggested 11 g/dl as the lowest critical value for diagnosis of anaemia in iron-treated pregnant women.

Viswanath et al[24] studied the usefulness of RDW in the diagnosis of IDA in various grades. They found that RDW was suggestive of IDA in 100%, 82.05% and 100% of mild, moderate and severe anaemia cases, respectively.

Casanova et al[25] studied the prediction of anaemia in pregnancy by parameters obtained on a complete blood count (CBC) and found that these parameters were of significance compared to ferritin as the gold standard. These can be used especially in areas with limited resources and a high prevalence of anaemia.

Buch et al[26] evaluated the role of RDW in classifying microcytic hypochromic anaemias and concluded that it provided useful but limited information in this regard. The use of RDW as a screening tool for IDA had sensitivity of 67.9% and specificity of 25%.

Abdelrahman et al[27] conducted a cross-sectional study to evaluate the use of RDW in the diagnosis of IDA in pregnant women. With a sample size of 194, they determined that RDW had sensitivity, specificity, positive predictive value, and negative predictive value of 43.8% (95% CI: 31.4–57.0%), 73.7% (95% CI: 65.8–80.5%), 41.0% (95% CI: 29.2–53.6%), and 76.0% (95% CI: 68.1–82.6%), respectively. They concluded that RDW had a poor performance in diagnosing IDA among pregnant women, probably because of use of serum ferritin as the gold standard.

AlQuaiz et al[28] studied the accuracy of various iron parameters in the prediction of IDA among healthy women of child bearing age, using receiver operating characteristic (ROC) curves, and concluded that CBC indices were good alternate predictors for the same. They found that MCV was the best marker for detecting iron deficiency anaemia, followed by MCH and then RDW, and that MCHC was not significant in this regard.

Tiwari et al[29] correlated Hb and RBC indices with serum ferritin in Indian women in second and third trimesters of pregnancy. With a sample size of 100 pregnant women, they determined the prevalence of IDA in pregnancy as 34% and found significant correlation between serum ferritin and RDW and total red cell count.

Sultana et al[30] evaluated the role of RDW and RBC indices in early detection of IDA in 190 pregnant women. They found that higher value of RDW was more significant than changes in MCV, MCH and MCHC in the latent stage of iron deficiency. Increase in RDW had the highest sensitivity (82.3%), followed by MCV (29.2%), MCH (68.1%) and MCHC (15%). They concluded that increased RDW can be used for early detection of IDA even when the RBC indices were normal, provided there was no accompanying disease.

Sazawal et al[31] studied the role of RDW as a screening tool for IDA and concluded that RDW value of more than 15% along with Hb value equal to or less than 10.0 g/dl identified iron deficiency as the cause for anaemia. This can avoid further laboratory work-up, leading to cost reduction in management of these cases.

Khan et al[32] studied the importance of the RDW and other red cell indices in the prediction of iron deficiency anaemia in the third trimester of pregnancy in a tertiary care hospital, with a sample size of 152 pregnant women. They found that

increased RDW was the best indicator for the detection of iron deficiency anaemia. Increased RDW, even in the presence of normal MCV, was an early signal for IDA in pregnancy. In their study, the change in value of RDW was statistically more significant than changes in values of other red cell indices.

Schoorl et al[33] studied the application of innovative hemocytometric parameters and algorithms for improvement of microcytic anaemia discrimination. They concluded that the use of discriminating algorithms was helpful in reducing the diagnostic testing for confirmation in order to diagnose the underlying cause for anaemia.

In an accuracy study conducted by Bresani et al[34] in the first half of 2016, it was found that RBC indices had low ability to predict the iron needs in pregnant women having mild to moderate anaemia in the last two trimesters of pregnancy.

In 2016, Buttarello[35] studied the usefulness of old and new red cell parameters in classification and treatment of anaemia. He found that red cell parameters play an essential role in differential diagnosis of anaemia but efforts were needed in harmonizing varying results produced by different analyzers.

Role of RDW in other conditions:

Apart from its usefulness in diagnosing and determining the level of IDA in pregnancy, RDW has been studied in relation to other conditions also.

Tanindi et al[36] found that higher values of RDW strongly correlated with higher systolic and diastolic blood pressures in hypertensive individuals.

Kurt et al[37] studied the relationship of RDW with the presence and severity of preeclampsia. They found that RDW was significantly increased in pregnant women with preeclampsia and it also correlated with the severity of preeclampsia. Avcıoğlu et al[38], in a similar study, found that RDW correlated with the presence and severity

of preeclampsia in pregnant women and that it could be used as a prognostic indicator in such cases.

Danese et al[39] studied the role of RDW in cardiovascular diseases. They found that an increased RDW value was associated with ischemic cerebrovascular disease, acute coronary syndrome, peripheral artery disease, atrial fibrillation, heart failure and hypertension. Higher anisocytosis also significantly predicted adverse outcomes in patients with these conditions.

Jo et al[40] studied the role of RDW as a prognostic factor in severe sepsis and septic shock. They concluded that RDW was associated with 28-day mortality in patients with severe sepsis and septic shock.

A study to determine the prognostic significance of RDW in a medicine ward was carried out by Shteinshnaider et al[41], who concluded that a high value RDW on admission and at the time of discharge predicted poor prognosis in patients. A rise in value of RDW throughout hospitalization was associated with higher in-hospital mortality. They suggested the use of repeated RDW measurements for risk stratification.

MATERIAL AND METHODS

Source of data:

Pregnant women attending the out-patient department (OPD) or admitted to in-patient Obstetrics and Gynecology wards who were referred to the Pathology laboratory at B.L.D.E. University's Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapur were included in this study.

The study period was from 1st December 2014 to 30th June 2016.

Method of collection of data:

Under aseptic precautions, venous blood samples were collected from pregnant women who fulfilled the eligibility criteria, after taking informed consent. A detailed history of the included pregnant women was elicited. A complete general physical examination and systemic examination of the pregnant women was undertaken.

Two milliliters of blood were taken in an ethylene diamine tetra acetic acid vacutainer and immediately analyzed for a complete haemogram, including hemoglobin, RBC count, and RDW, and red cell indices, using an automated hematology analyzer (Sysmex XN-1000). A peripheral smear was prepared from the same sample and visually examined for morphological typing of anaemia.

Haemoglobin level of less than 11.0 g/dl was considered for diagnosis of anaemia in pregnant women.[1]

Sample Size:

Considering the prevalence of anaemia in pregnant women in India as 49%[2] and taking 95% confidence interval, at 15% allowable error, the calculated sample size was 180, using the following statistical formula:

$$n = \frac{Z\alpha^2 \times p \times q}{L^2}$$

The calculated sample size was 180.

Hence, 180 pregnant women with anaemia were included in the study.

Statistical Analysis:

All characteristics were summarized descriptively. For continuous variables, the summary statistics of number of cases, mean, and standard deviation were used. For categorical data, the number and percentage were used in the data summaries. ANOVA was used for multi group comparison of means. Bivariate correlation analysis using Pearson's correlation coefficient (r) was used to test the strength and direction of relationships between the levels of variables. If the p-value was < 0.05, then the results were considered to be significant. Data were analyzed using SPSS software v.24.0.

Inclusion Criteria:

All pregnant women attending the antenatal OPD or admitted to in-patient Obstetrics and Gynecology ward and referred to the Pathology laboratory at B.L.D.E. University's Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapur, irrespective of parity and previous obstetric history, were included in this study.

Exclusion Criteria:

The following pregnant women were not included in the study:

1. Pregnant women with gynecological disorders like tumours of the female genital tract, fibroids, or other associated disorders.
2. Pregnant women who had received parenteral iron supplementation.
3. Pregnant women who had received blood transfusion within the last 3 months.
4. Pregnant women with bleeding disorders.

OBSERVATIONS AND RESULTS

The study "Comparison Between Red Cell Distribution Width and Red Cell Indices in Prediction of Anaemia among Pregnant Women" was undertaken at B.L.D.E. University's Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapur during the period 1st December 2014 to 30th June 2016.

A total of 180 pregnant women with anaemia were included in this study. The observations and results of the study are as follows.

Apart from the abbreviations listed earlier, the following abbreviations are used in this section:

Dimorphic	Dimorphic anaemia
Macro	Macrocytic anaemia
MCHC	Microcytic hypochromic anaemia
NCHC	Normocytic hypochromic anaemia
NCNC	Normocytic normochromic anaemia

Table 4: Distribution of cases according to age (years)

Age (years)	No. of cases	Percent (%)
≤20	44	24.4
21-25	88	48.9
26-30	38	21.1
>30	10	5.6
Total	180	100

The majority of the pregnant women, 88 (48.9%), in the study were in the age group of 21-25 years. 44 (24.4%) were less than 20 years of age, 38 (21.1%) were in the age group of 26-30 years, and 10 (5.6%) were older than 30 years of age.

Figure 1: Distribution of cases according to age (years)

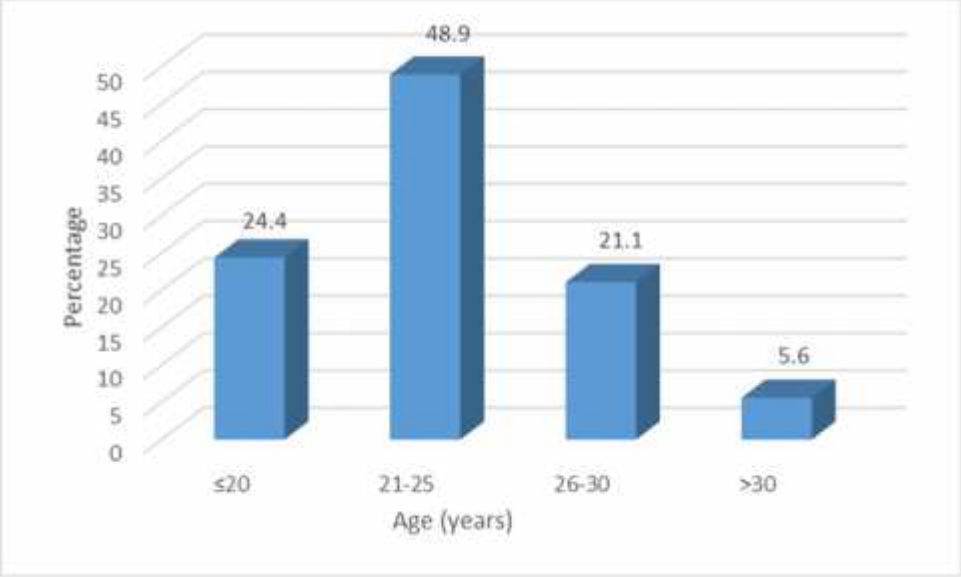


Table 5: Distribution of cases by gravida

Gravida	No. of cases	Percent (%)
1	70	38.9
2	67	37.2
3	29	16.1
4	12	6.7
>4	2	1.1
Total	180	100

70 (38.9%) women were primigravida. 67 (37.2%) women were gravida two, 29 (16.1%) were gravida three, 12 (6.7%) were gravida four, and 2 (1.1%) were gravida five or more.

Figure 2: Distribution of cases by gravida

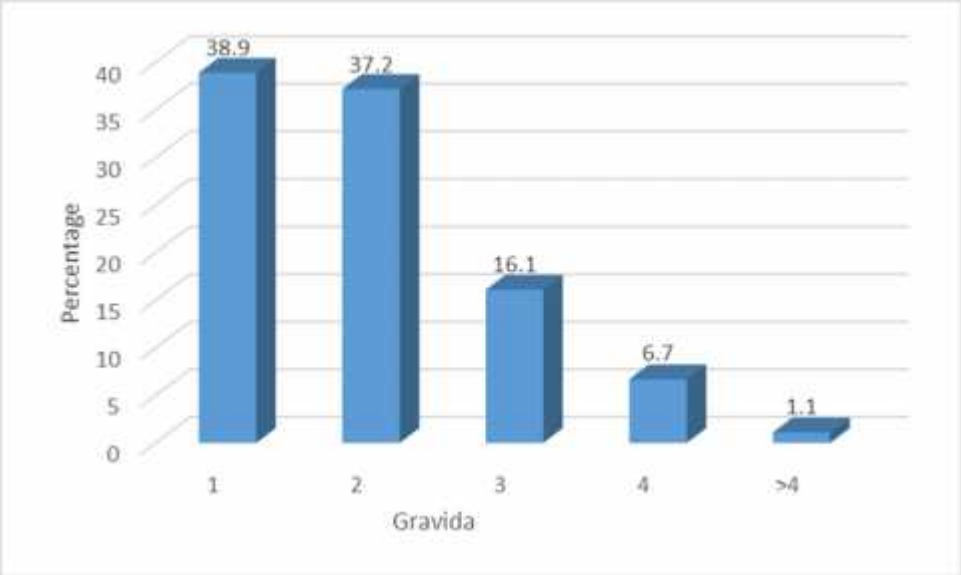


Table 6: Distribution of cases by gestation period (weeks)

Gestation Period (weeks)	No. of cases	Percent (%)
1st Trimester	7	3.9
2nd Trimester	15	8.3
3rd Trimester	158	87.8
Total	180	100

Among the pregnant women include in this study, the majority (158, 87.8%) were in the third trimester of pregnancy. 15 (8.3%) were in the second trimester of pregnancy and 7 (3.9%) were in the first trimester of pregnancy.

Figure 3: Distribution of cases by gestation period (weeks)

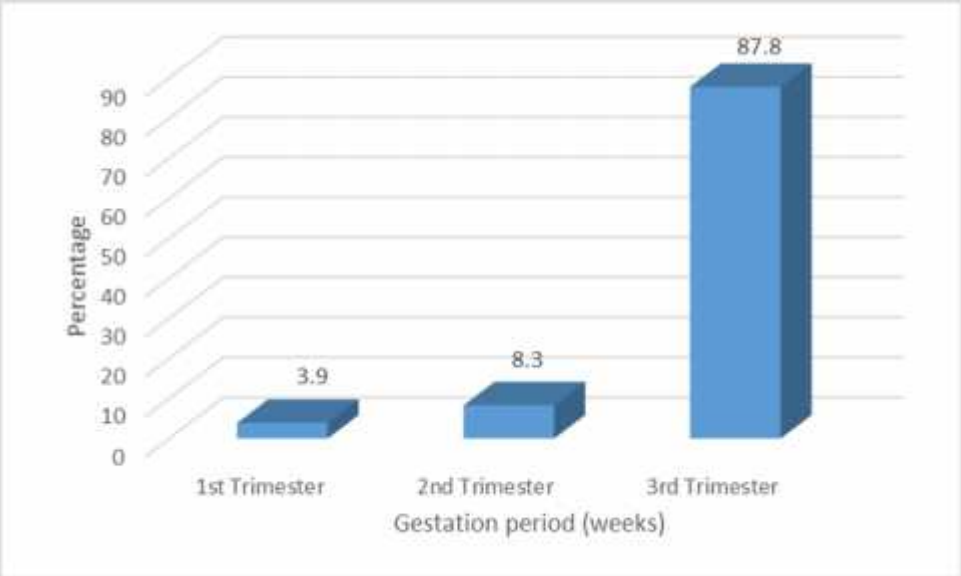


Table 7: Distribution of cases by parity

Parity	No. of cases	Percent (%)
Nulliparous	70	38.9
1	67	37.2
2	31	17.2
3	10	5.6
4	2	1.1
Total	180	100

70 (38.9%) of the pregnant women in this study were nulliparous. 67 (37.2%) were para one, 31 (17.2%) were para two, 10 (5.6%) were para three and 2 (1.1%) were para four.

Figure 4: Distribution of cases by parity

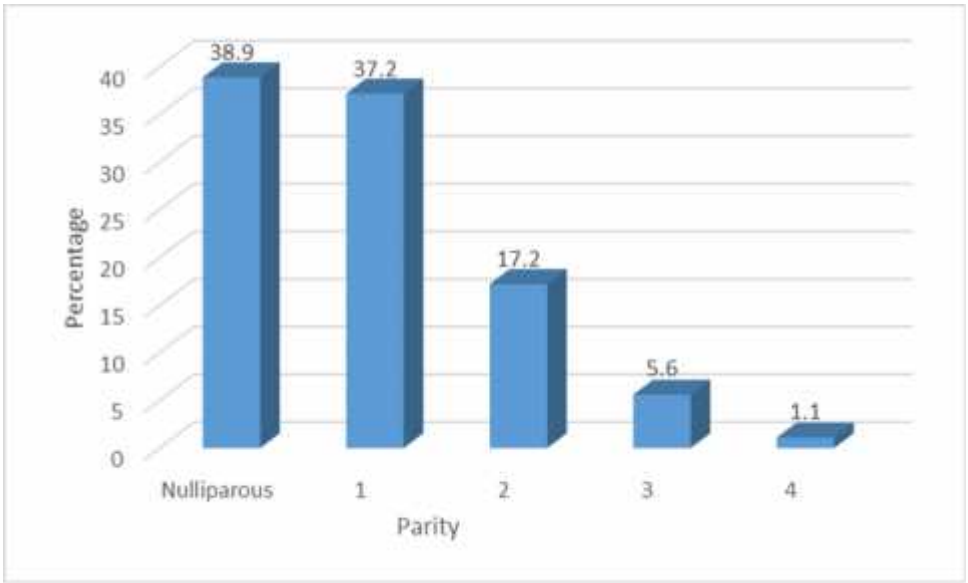


Table 8: Distribution of cases by degree of anaemia

Degree of anaemia	No. of cases	Percent (%)
Severe	26	14.4
Moderate	84	46.7
Mild	70	38.9
Total	180	100

70 (38.9%) pregnant women had mild anaemia, 84 (46.7%) had moderate anaemia, and 26 (14.4%) had severe anaemia.

Figure 5: Distribution of cases by degree of anaemia

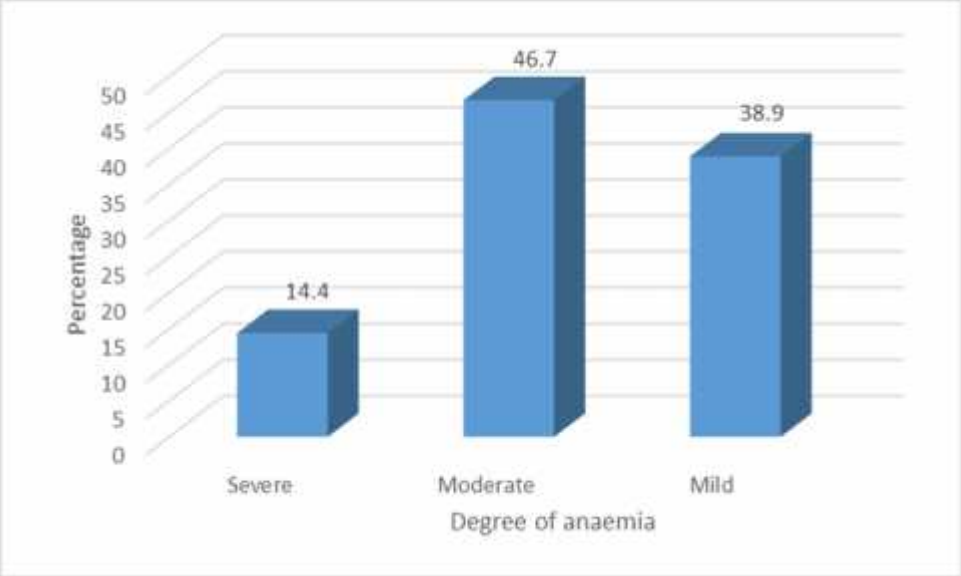


Table 9: Distribution of cases by type of anaemia

Type of anaemia	No. of cases	Percent (%)
Dimorphic	27	15
Macro	5	2.8
MCHC	95	52.8
NCHC	21	11.7
NCNC	32	17.8
Total	180	100

The morphological type of anaemia was determined on the basis of the peripheral smear examination. 95 cases (52.8%) had microcytic hypochromic type of anaemia, 32 cases (17.8%) had normocytic normochromic anaemia, 27 cases (15%) had dimorphic anaemia, 21 cases (11.7%) had normocytic hypochromic anaemia, and 5 cases (2.8%) had macrocytic anaemia.

Figure 6: Distribution of cases by type of anaemia

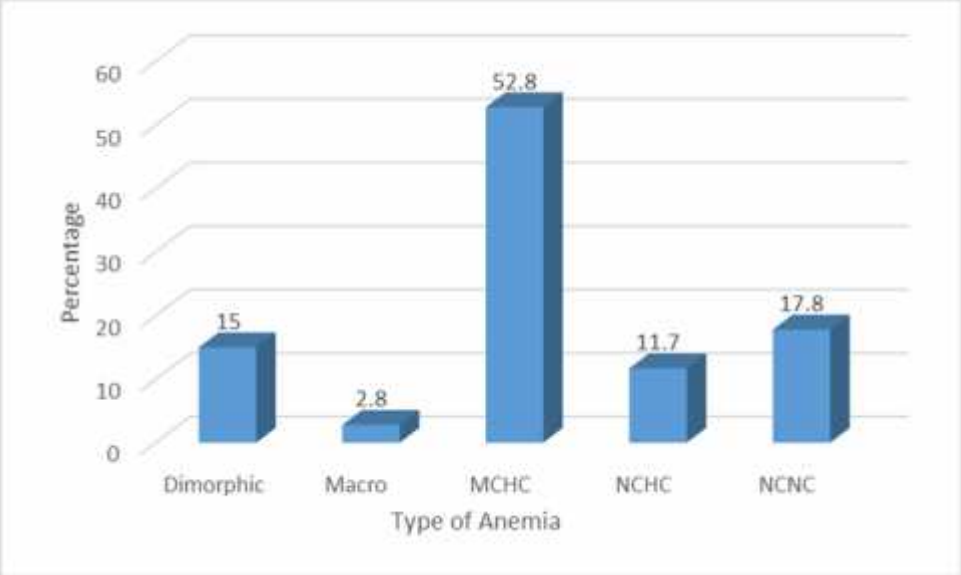


Table 10: Descriptive statistics of selected parameters of cases

Parameters	Minimum	Maximum	Range	Mean	SD
Age	16	36	20	23.8	4.1
Hb	4.4	10.9	6.5	9.0	1.6
RDW	12.3	31.4	19.1	18.0	3.6
MCV	53	113	60	77.1	9.7
MCH	14.8	40.2	25.4	24.8	4.3
MCHC	26.5	36.9	10.4	32.0	1.9
RBC Count	1.57	5.85	4.28	3.7	0.8
Hct	15.3	35.4	20.1	28.2	4.8
Gravida	1	5	4	1.9	1.0
Parity	0	4	4	0.9	0.9
Gestation Period (weeks)	8	37	29	32.8	6.7

In the present study, the age of the study population ranged from 16 years to 36 years with a mean of 23.8 years (SD = 4.1). The Hb level ranged from 4.4 g/dl to 10.9 g/dl, with a mean value of 9.0 g/dl (SD = 1.6).

The RDW ranged from 12.3% to 31.4%. The mean value of RDW was 18.0% (SD = 3.6). The MCV ranged from 53 fl to 113 fl, with a mean value of 77.1 fl (SD = 9.7). The MCH ranged from 14.8 pg to 40.2 pg, with a mean value of 24.8 pg (SD = 4.3). The MCHC ranged from 26.5 g/dL to 36.9 g/dL, with a mean value of 32.0 g/dL (SD = 1.9).

The RBC count ranged from 1.57 million/cu mm to 5.85 million/cu mm. The mean value of RBC count was 3.7 million/cu mm (SD = 0.8).

The value of Hct ranged from 15.3% to 35.4%, with a mean value of 28.2% (SD = 4.8).

The gravida status ranged from 1 to 5, with a mean value of 1.9 (SD = 1.0). The parity status ranged from 0 to 4, with a mean value of 0.9 (SD = 0.9). The gestation period ranged from 8 weeks to 37 weeks, with a mean value of 32.8 weeks (SD = 6.7).

Table 11: Comparison of mean values of selected parameters of cases by degree of anaemia

Parameters	Degree of anaemia	No. of cases	Minimum	Maximum	Range	Mean	SD	ANOVA p value
RDW	Severe	26	12.9	25.3	12.4	19.3	3.3	<0.001*
	Moderate	84	12.6	31.4	18.8	18.6	3.9	
	Mild	70	12.3	25.2	12.9	16.7	2.8	
MCV	Severe	26	53.6	113	59.4	76.4	15.0	0.112
	Moderate	84	53	101.7	48.7	75.8	9.2	
	Mild	70	58.6	93.3	34.7	79.0	7.3	
MCH	Severe	26	14.9	40.2	25.3	24.1	7.0	0.021*
	Moderate	84	14.8	34.2	19.4	24.0	3.9	
	Mild	70	17.6	32.2	14.6	25.9	3.3	
MCHC	Severe	26	26.5	36.9	10.4	31.1	3.1	<0.001*
	Moderate	84	27.8	35.7	7.9	31.6	1.7	
	Mild	70	30	35.8	5.8	32.7	1.4	

Note: *significant at 5% level of significance

Comparison of the mean values of study parameters with the degree of anaemia was done to determine their significance. It was found that there was significant correlation between changes in RDW (p value <0.001), MCH (p value 0.021), and MCHC (p value <0.001) with the degree of anaemia. The change in MCV (p value 0.112) did not correlate with the degree of anaemia.

Figure 7: Comparison of mean values of selected parameters of cases by degree of anaemia

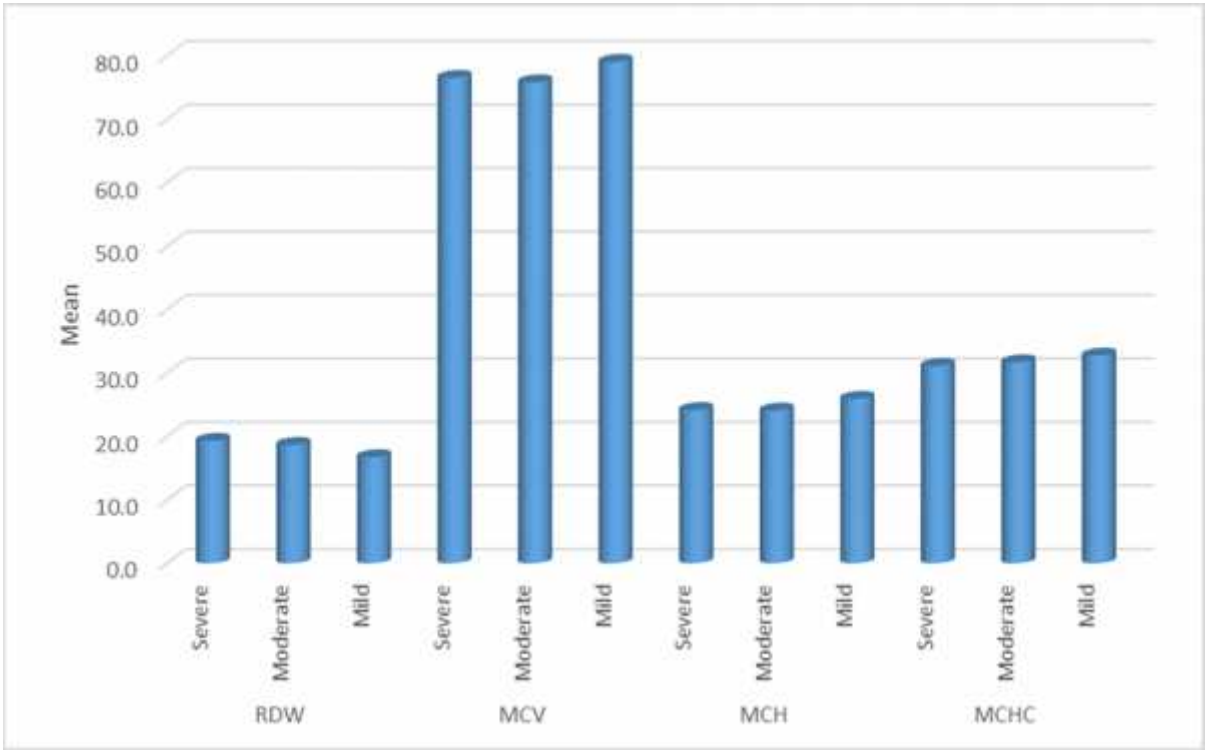


Table 12: Comparison of mean values of selected parameters of cases by type of anaemia

Parameters	Type of anaemia	No. of cases	Minimum	Maximum	Range	Mean	SD	ANOVA p value
RDW	Dimorphic	27	17.4	31.4	14	21.8	3.9	<0.001*
	Macro	5	12.6	16.7	4.1	14.7	1.9	
	MCHC	95	12.6	26.9	14.3	18.6	3.0	
	NCHC	21	12.8	19.9	7.1	15.7	2.0	
	NCNC	32	12.3	18.9	6.6	14.9	1.5	
MCV	Dimorphic	27	60.6	93.2	32.6	80.2	9.0	<0.001*
	Macro	5	98.4	113	14.6	103.5	5.5	
	MCHC	95	53	87.8	34.8	70.8	6.2	
	NCHC	21	78.8	86.4	7.6	81.6	2.0	
	NCNC	32	79.1	93.3	14.2	86.0	3.4	
MCH	Dimorphic	27	16.9	31.8	14.9	25.5	3.8	<0.001*
	Macro	5	30.4	40.2	9.8	36.0	3.8	
	MCHC	95	14.8	30.4	15.6	22.1	2.8	
	NCHC	21	24.2	28.5	4.3	26.4	1.0	
	NCNC	32	27	32.2	5.2	29.4	1.5	
MCHC	Dimorphic	27	27.7	34.8	7.1	31.7	2.0	<0.001*
	Macro	5	30.9	36.9	6	34.7	2.5	
	MCHC	95	26.5	34.7	8.2	31.1	1.6	
	NCHC	21	30.5	33.8	3.3	32.4	0.8	
	NCNC	32	32.2	35.8	3.6	34.1	0.9	

Note: *significant at 5% level of significance

Comparison of the mean values of study parameters with the morphological type of anaemia was done to determine their significance. Changes in RDW (p value <0.001), MCV (p value <0.001), MCH (p value <0.001), and MCHC (p value <0.001) correlated significantly with the morphological type of anaemia.

Figure 8: Comparison of mean values of selected parameters of cases by type of anaemia

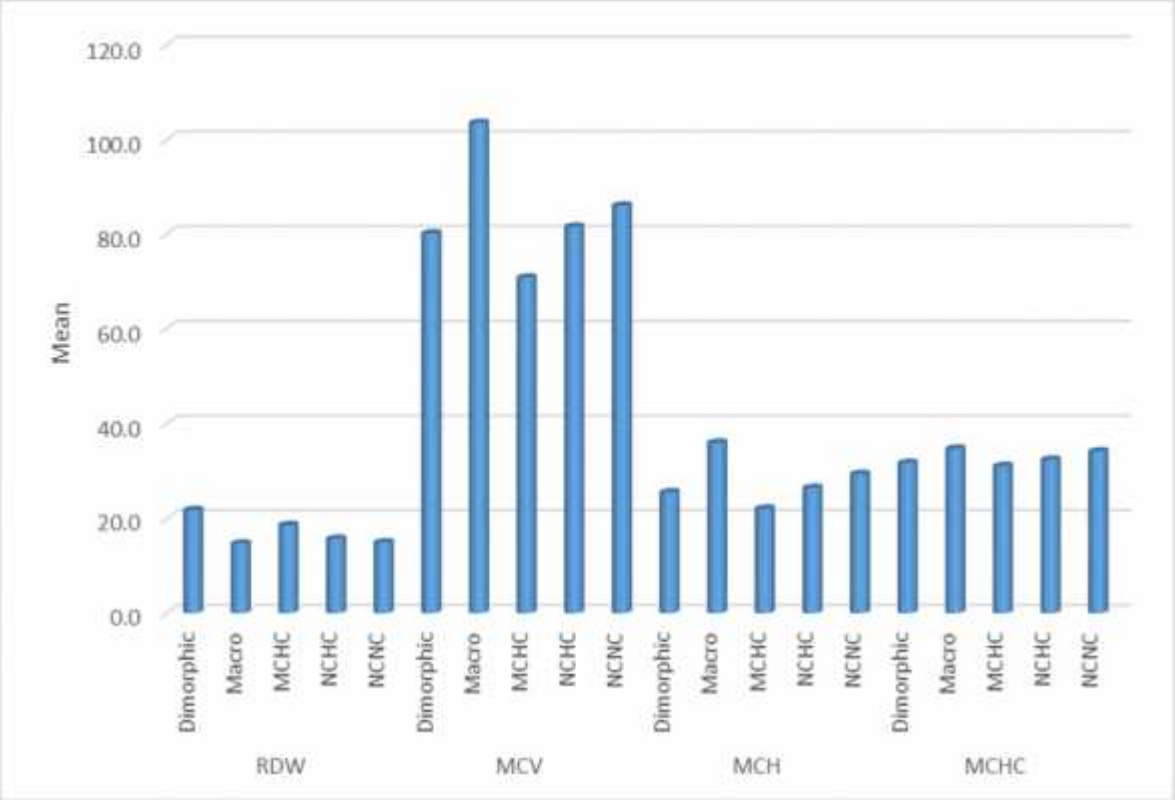


Table 13: Comparison of mean values of selected parameters of cases by age group (years)

Parameters	Age group (years)	No. of cases	Minimum	Maximum	Range	Mean	SD	ANOVA p value
RDW	<=20	44	12.3	31.4	19.1	18.3	3.6	0.796
	21-25	88	12.6	26.9	14.3	17.8	3.4	
	26-30	38	12.6	28.4	15.8	17.7	3.6	
	>30	10	14.0	30.8	16.8	18.6	4.8	
MCV	<=20	44	54.1	93.2	39.1	77.3	9.4	0.732
	21-25	88	53.0	102.5	49.5	77.2	9.3	
	26-30	38	58.6	113.0	54.4	77.4	11.0	
	>30	10	53.6	87.2	33.6	73.7	9.4	
MCH	<=20	44	16.1	31.8	15.7	24.5	4.0	0.727
	21-25	88	14.8	37.6	22.8	25.0	4.3	
	26-30	38	16.6	40.2	23.6	24.8	4.9	
	>30	10	14.9	30.9	16.0	23.5	4.5	
MCHC	<=20	44	26.5	35.2	8.7	31.6	2.0	0.315
	21-25	88	27.8	36.9	9.1	32.2	1.8	
	26-30	38	28.8	35.6	6.8	31.9	1.9	
	>30	10	27.8	35.5	7.7	31.7	2.3	

Comparison of the mean values of study parameters with the age groups was done to determine their significance. Changes in RDW (p value = 0.796), MCV (p value = 0.732), MCH (p value = 0.727), and MCHC (p value = 0.315) did not correlate significantly with the age of the pregnant women.

Figure 9: Comparison of mean values of selected parameters of cases by age group (years)

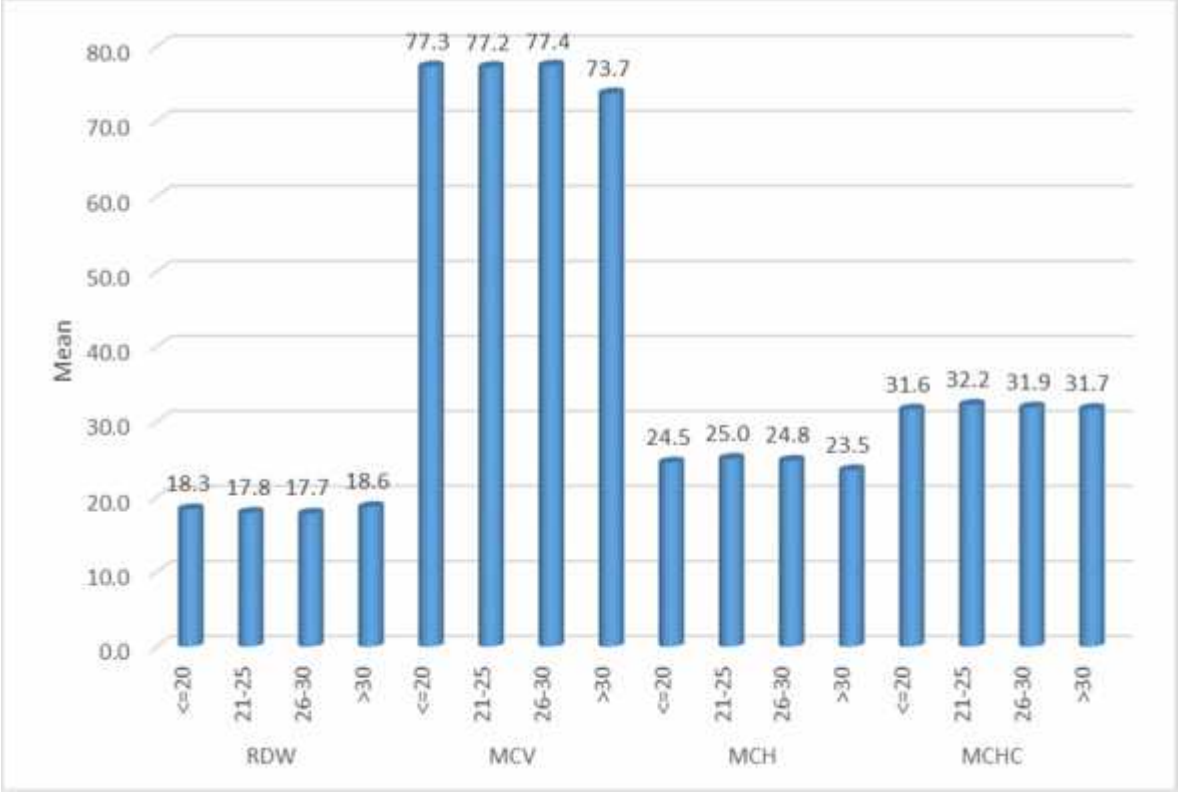
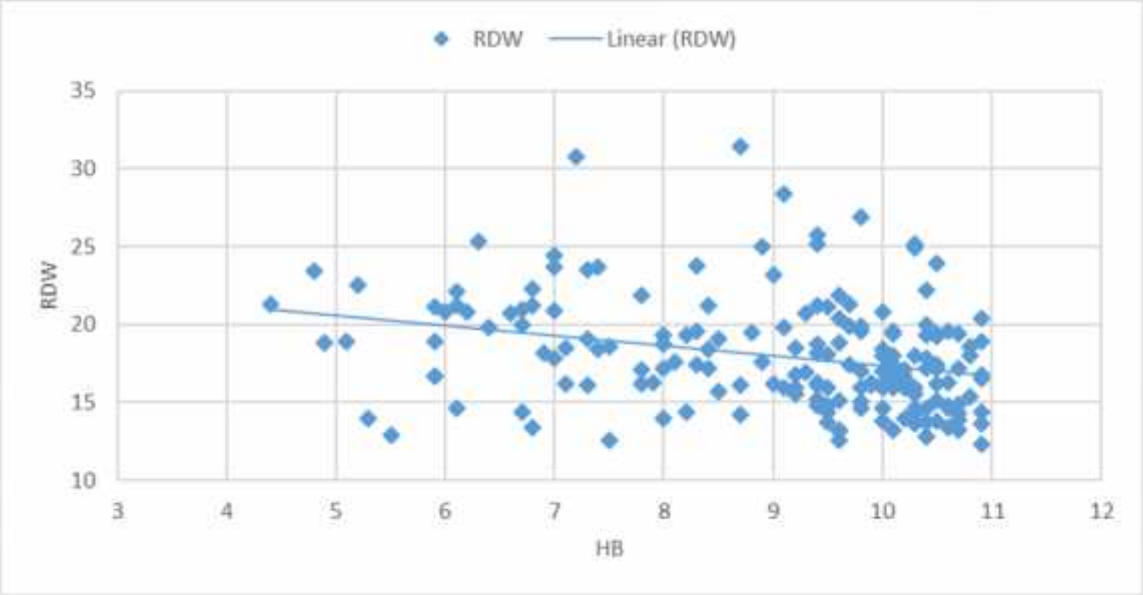


Table 14: Correlation and scatter plot between Hb and RDW

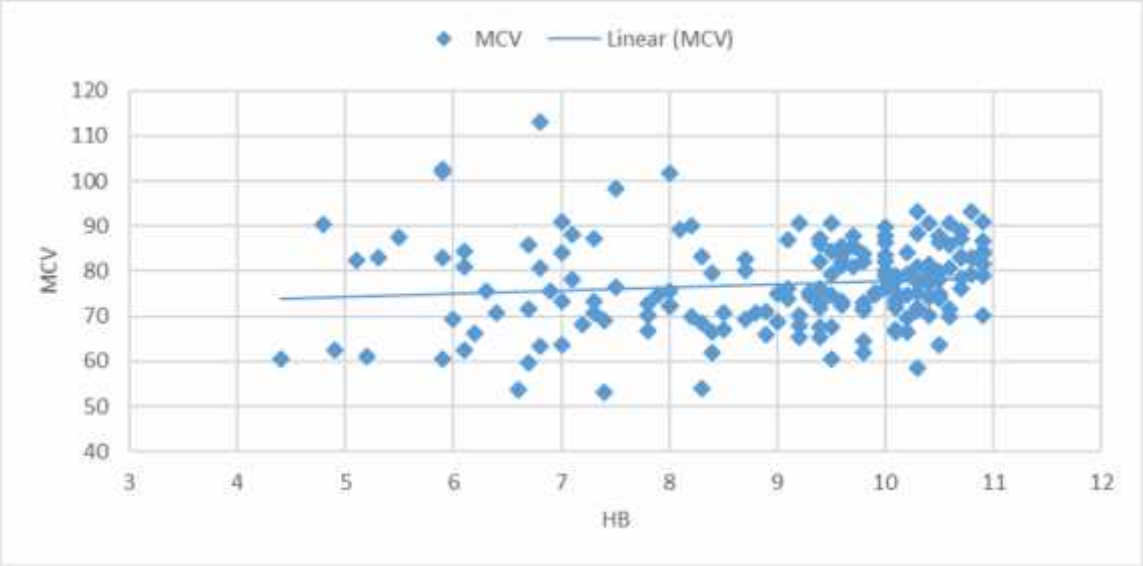


	RDW	
Hb	r value	p value
	-0.296	<0.001*

Note: *significant at 5% level of significance

There is significant inverse correlation (r = -0.296) between change in the value of RDW and Hb level.

Table 15: Correlation and scatter plot between Hb and MCV



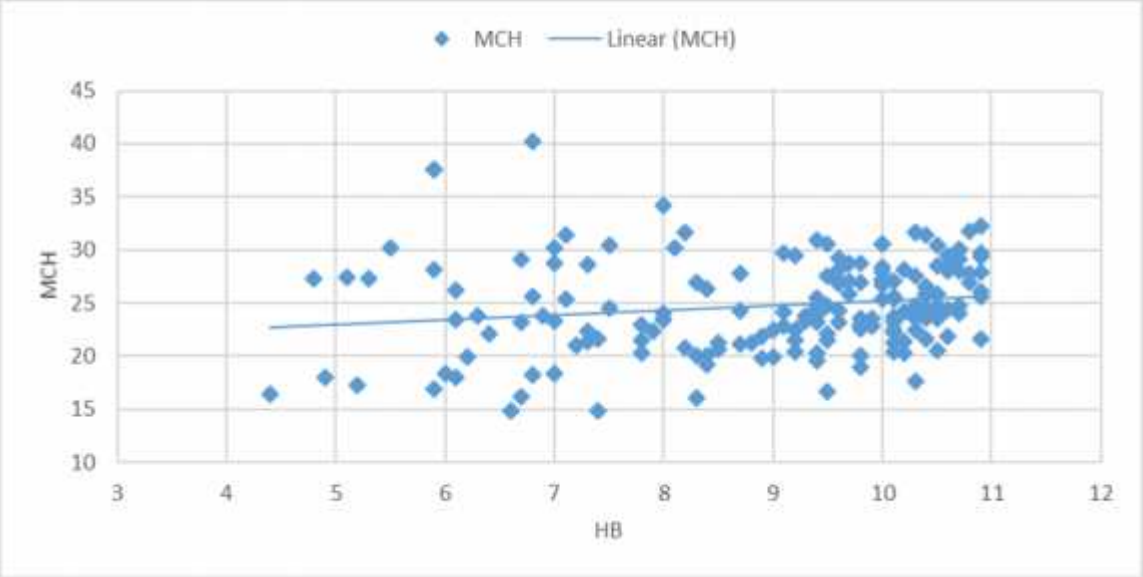
	MCV	
Hb	r value	p value
	0.115	0.124

Note: *significant at 5% level of significance

The change in value of MCV did not significantly correlate with the Hb level ($r = 0.115$).

Also, out of RDW and MCV, the correlation with Hb level is more with change in RDW than that with change in MCV ($0.296 > 0.115$).

Table 16: Correlation and scatter plot between Hb and MCH

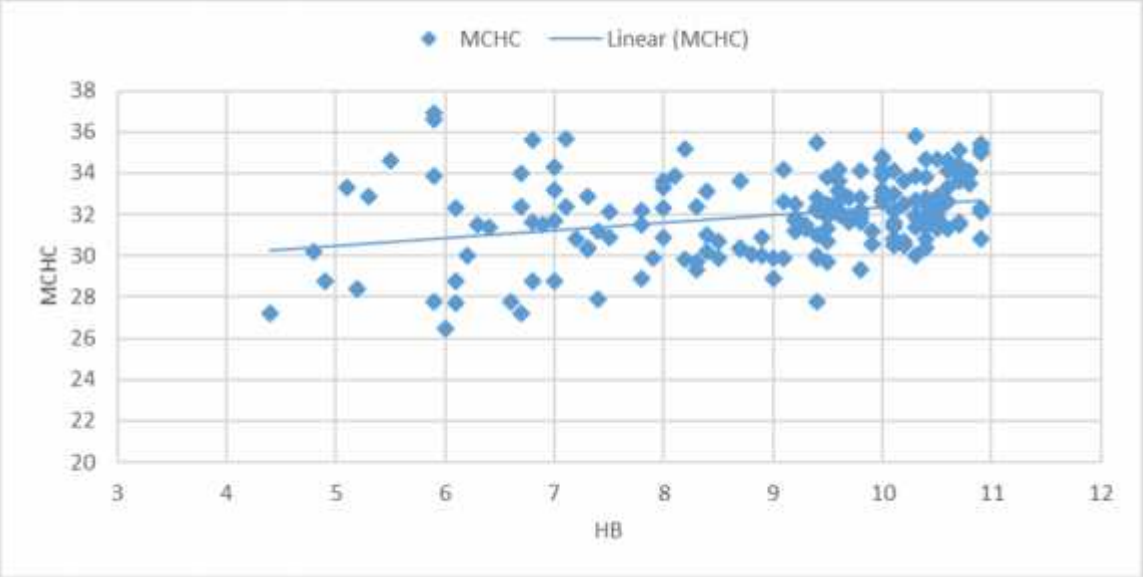


	MCH	
Hb	r value	p value
	0.166	0.026*

Note: *significant at 5% level of significance

There is significant correlation (r = 0.166) between change in the value of MCH and Hb level.

Table 17: Correlation and scatter plot between Hb and MCHC

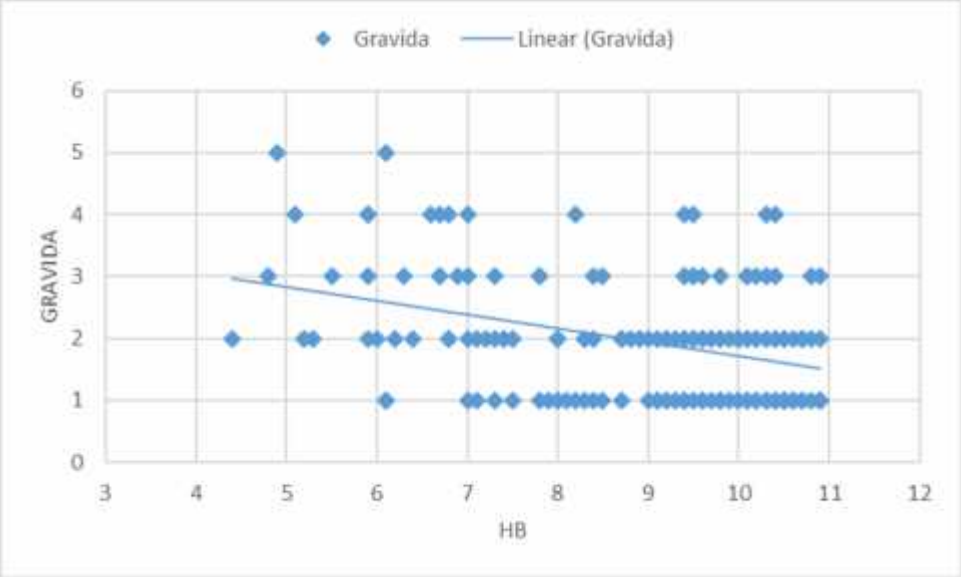


	MCHC	
Hb	r value	p value
	0.303	<0.001*

Note: *significant at 5% level of significance

There is significant correlation (r = 0.303) between change in the value of MCHC and Hb level.

Table 18: Correlation and scatter plot between Hb and Gravida

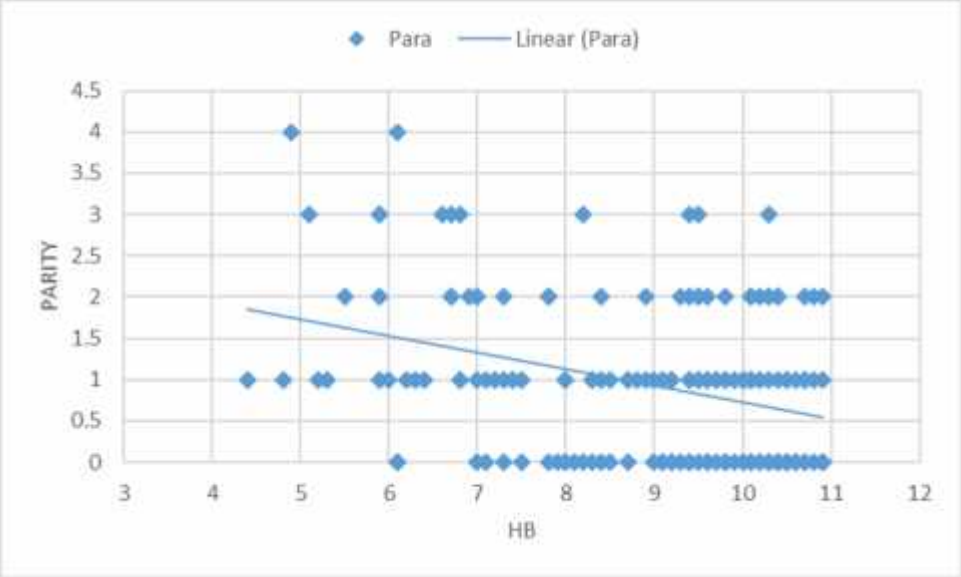


	Gravida	
Hb	r value	p value
	-0.373	<0.001*

Note: *significant at 5% level of significance

There is significant inverse correlation (r = -0.373) between Hb level and the gravida status.

Table 19: Correlation and scatter plot between Hb and Parity



Hb	**Para**	
	r value	p value
	-0.342	<0.001*

Note: *significant at 5% level of significance

There is significant inverse correlation (r = -0.342) between Hb level and the parity.

Figure 10: Automated haematology analyzer (Sysmex XN-1000)

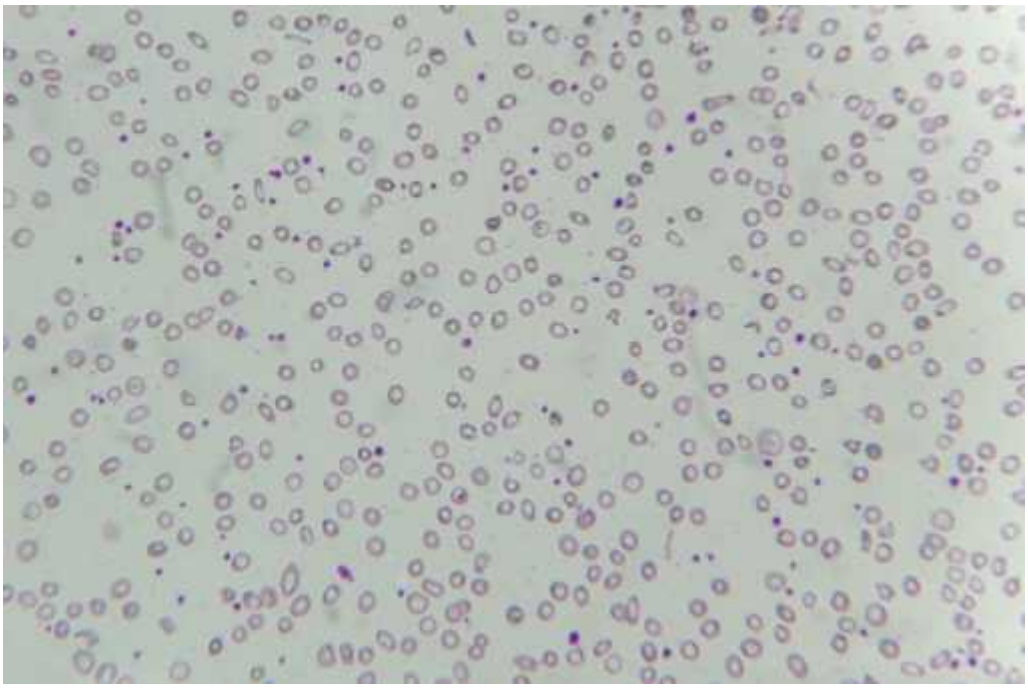


Figure 11: Photomicrograph of peripheral smear showing microcytic hypochromic type of anaemia (40x)

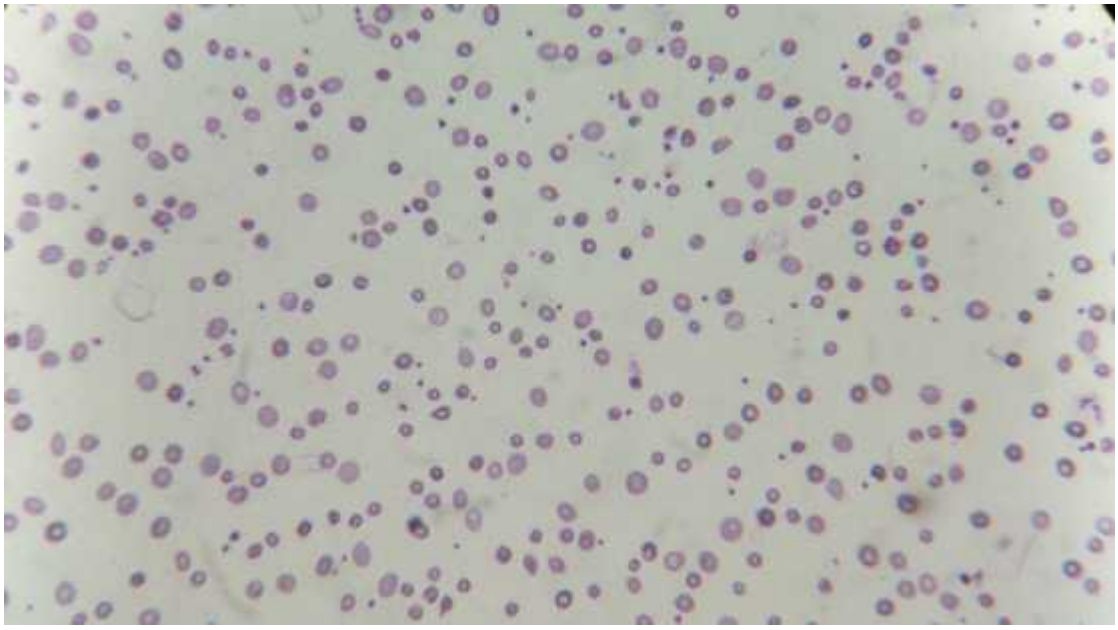


Figure 12: Photomicrograph of peripheral smear showing dimorphic type of anaemia (40x)

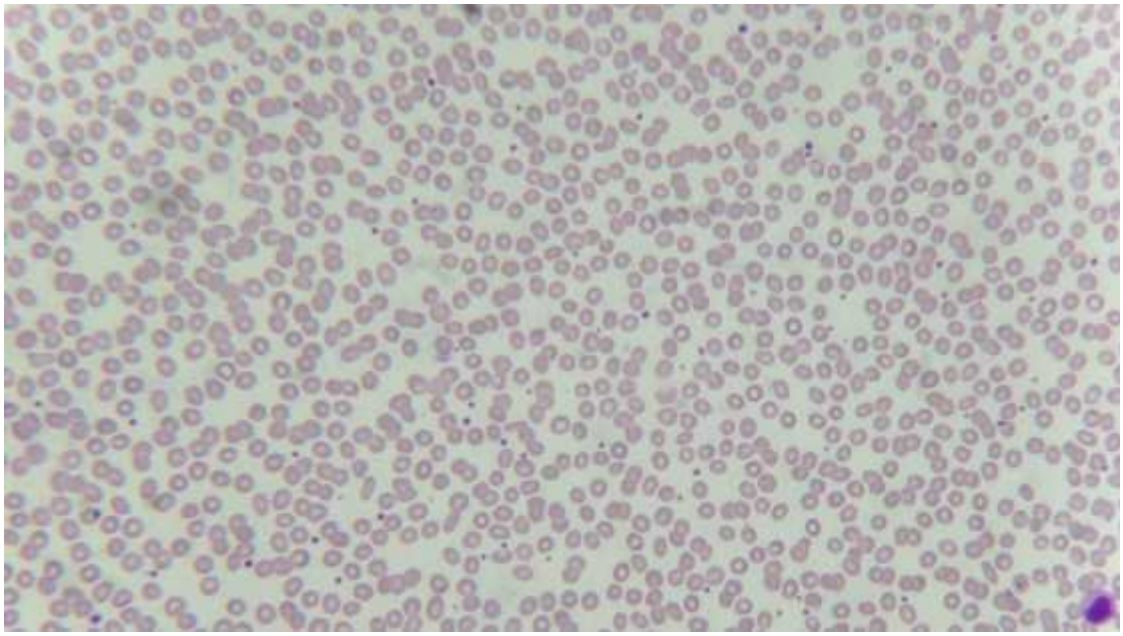


Figure 13: Photomicrograph of peripheral smear showing normocytic normochromic type of anaemia (40x)

DISCUSSION

The study "Comparison Between Red Cell Distribution Width and Red Cell Indices in Prediction of Anaemia among Pregnant Women" involving 180 patients was undertaken at B.L.D.E. University's Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapur during the period 1st December 2014 to 30th June 2016. The observations were compiled, results statistically analysed, and discussed in comparison with previous studies.

Age, number of pregnancies and gestation period:

The majority of the patients in the study were young females, in the age group of 21 to 25 years. Few study subjects were younger than 20 years of age. The analysis of the gravida and parity status of the young females showed that the current pregnancy was, in majority of the cases, the first, closely followed by second.

This highlights the fact that, although there is awareness about family planning in the general population, it needs to be fortified in order to avoid pregnancies at a very young age.

The fact that most of the study subjects were in the third trimester of pregnancy is due to the preference given to pregnant women who were admitted to the labour room for delivery as they were on the verge of delivery and their Hb levels would be a better reflection on the overall health condition throughout pregnancy.

Subgroup analysis revealed that values of RDW, MCV, MCH and MCHC did not change significantly among different age groups of pregnant women.

Degree of anaemia:

Analysis of the degree of anaemia among the study subjects showed that most of the pregnant women had either moderate (7.0 g/dl to 9.9 g/dl) or mild (10.0 g/dl to 10.9 g/dl) degree of anaemia, with only 26 cases (14.4%) showing severe anaemia (<

7.0 g/dl). Noronha et al[2], in their study on prevalence of anaemia in pregnant women in Udupi district, found that 63.5% pregnant women had mild degree of anaemia, 35.0% had moderate degree of anaemia, and only 1.5% had severe degree of anaemia. A study conducted by Viveki et al[42] found that majority (50.4%) of the pregnant women had moderate degree of anaemia, 42.6% had mild degree of anaemia, and 7.0% had severe degree of anaemia. In a study of similar parameters, Arifulla et al[43] found that 70% of the pregnant women had moderate degree of anaemia, 18% had mild degree of anaemia, and 12% had severe degree of anaemia. These findings are consistent with our study.

Subgroup analysis revealed that values of RDW, MCH and MCHC changed significantly in pregnant women with severe degree of anaemia when compared to the pregnant women with moderate and mild degree of anaemia. However, the change in value of MCH was not significant in this regard.

Type of anaemia:

One of the objectives of this study was to determine the morphological types of anaemia in pregnancy.

52.8% of the pregnant women in our study had microcytic hypochromic type of anaemia, which is the most common morphological form of anaemia seen in cases of iron deficiency.[3] This is consistent with the findings of Arifulla et al[43], who observed that microcytic hypochromic anaemia comprised 70% of their study cases, macrocytic anaemia were 17% and dimorphic anaemia were 13%. The occurrence of normocytic hypochromic type and normocytic normochromic types of anaemia can be attributed to oral iron supplementation prescribed to pregnant women as a part of routine antenatal care.[23] Macrocytic anaemias and dimorphic anaemias, which were seen in few study cases, are a result of combined iron and folic acid deficiencies.

Subgroup analysis revealed that there was significant change in values of RDW, MCV, MCH and MCHC with each morphological type of anaemia.

Red cell parameters:

The main objective of our study was to determine and compare the usefulness of red cell distribution width and red cell indices in prediction of anaemia in pregnant women.

The value of RDW had an inverse relationship with change in Hb level. A decrease in the Hb level was associated with a corresponding increase in the value of RDW. This had a good correlation and was found to be statistically significant.

The value of MCV showed a decrease with decrease in the Hb level. This showed a weaker correlation with the level of Hb and was found to be statistically insignificant.

The values MCH and MCHC showed correlation with change in level of Hb. There was a corresponding decrease in the values of MCH and MCHC associated with decrease in Hb level. The correlation between these two parameters and change in Hb level was found to be statistically significant.

These findings are consistent with those of Sultana et al[30], who had concluded that red cell distribution width appeared to be a reliable and useful parameter for detection of iron deficiency during pregnancy. In their study, RDW was found to be the best parameter for prediction of IDA among pregnant women.

Similar results were obtained by Lin et al[22] who found that low MCV and high RDW were the characteristic changes of IDA in pregnancy and recommended the use of RDW and MCV in the initial classification of anaemia in pregnancy.

The findings of Khan et al[32] matched with our study. They had found that increase in RDW (36.2% of cases) was more sensitive than decrease in MCV (19% of cases) for prediction of IDA.

Our findings match with those of McClure et al[18], who found than an increased RDW was 66% specific and 100% sensitive for the diagnosis of IDA. Similar results were also obtained by Casanova et al[25].

Viswanath et al[24] also found that RDW had a higher sensitivity in the diagnosis of mild and moderate IDA.

In a study by AlQuaiz et al[28], they found that RBC parameters were useful in the diagnosis of IDA, findings that are consistent with our study. However, unlike our study, where RDW was found to be the best parameter for the diagnosis of IDA, they found that MCV was better than RDW in this regard.

The findings of Tiwari et al[29] that RDW had utility in diagnosis of IDA in pregnant women ($r = -0.420$, $p = 0.013$) matched with our study. However, they also found significant correlation ($r = 0.496$, $p = 0.000$) between Hb levels and value of MCV, which was not found in our study. Also, they found that MCH ($r = 0.052$, $p = 0.605$) and MCHC ($r = 0.035$, $p = 0.728$) were not useful parameters for diagnosis of IDA.

However, a study by Aulukh et al[4] had contradictory results. They found that, with a sensitivity and specificity of 81.0% and 53.4% and a positive and negative predictive value of 63.0% and 72.2% respectively, RDW had a limited specificity in the diagnosis of IDA.

The findings of Abdelrahman et al[27] highlighted the poor performance of RDW in the diagnosis of IDA in pregnant women. The results of this study did not

match with our study, probably due to use of serum ferritin as the gold standard for diagnosis of IDA.

In our study, we found that the correlation coefficients (r) between change in level of Hb and change in values of RDW, MCV, MCH, and MCHC was -0.296 (p value <0.001), 0.115 (p value = 0.124), 0.166 (p value = 0.026), and 0.303 (p value <0.001), respectively. These correlations were statistically significant at 5% level of significance. Between RDW and MCV, the correlation with change in level of Hb was stronger with RDW than MCV.

The correlation between Hb and gravida was -0.373 (p value <0.001) while that between Hb and parity was -0.342 (p value <0.001). These correlations were also statistically significant at 5% level of significance.

Significant correlation was observed between change in values of RDW (p value <0.001), MCH (p value =0.021), and MCHC (p value <0.001) and the degree of anaemia by performing subgroup analysis. MCV (p value =0.112) did not show significant relationship with the degree of anaemia.

Change in values of RDW (p value <0.001), MCV (p value <0.001), MCH (p value <0.001), and MCHC (p value <0.001) showed significant correlation with the morphological type of anaemia.

Both of the above subgroup correlations were statistically significant at 5% level of significance.

Subgroup analysis with the age groups of the cases did not show any significant correlation with RDW (p value = 0.796), MCV (p value = 0.732), MCH (p value = 0.727), and MCHC (p value = 0.315).

Anaemia in pregnancy continues to be a common and severe problem in developing countries like India, making an important contribution to maternal

morbidity and mortality.[7] It is also associated with poor intrauterine growth and increased risk of preterm births and low birth weight rates, contributing to perinatal morbidity and mortality.[3] Thus, anaemia in pregnancy is associated with adverse consequences for the mother and the infant.

There can be significant reduction in the complications associated with anaemia in pregnancy if there is early detection and prompt management. There can be substantial reduction in undernutrition in childhood, adolescence, and improvement in adult height.

In the current scenario, with a high prevalence rate of anaemia in pregnancy and in a system where health care services are burdened with high work load, it is necessary to make the diagnosis with minimum laboratory tests. An early diagnosis will lead to formation of better management strategies, eventually reducing the burden on health care services.

RDW and red cell indices, which are part of routine haematological parameters in laboratories using automated haematology analyzers, can be helpful in early diagnosis of anaemia in pregnancy.

CONCLUSION

Red cell distribution width is the best indicator for prediction of iron deficiency anaemia in pregnancy. The rise in the value of red cell distribution width correlates more significantly than changes in mean corpuscular volume with change in level of haemoglobin in pregnancy. Red cell distribution width must be correlated with other red blood cell indices to make the findings more reliable and confirmatory. It is recommended to use red cell distribution width and mean corpuscular volume in the antenatal care centres for early diagnosis of anaemia in pregnant women.

SUMMARY

Blood samples from 180 pregnant women with anaemia were studied at the Department of Pathology, B.L.D.E. University's Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapur from December 2014 to June 2016.

These blood samples were analysed using Sysmex XN-1000 automated haematology analyzer to obtain the Hb level and various RBC parameters. A peripheral smear prepared from the same sample was visually examined for morphological typing of anaemia.

Most of the pregnant women in this study were young females, in the age group of 21 to 25 years. Majority of the pregnant women had moderate degree of anaemia.

Morphologically, more than half of the pregnant women had microcytic hypochromic type of anaemia. This type of anaemia is characteristically seen in cases of iron deficiency.

It was found that change in Hb level had statistically significant relationship with changes in values of RDW, MCV, MCH, and MCHC. This relationship had stronger correlation with changes in value of RDW, as compared to the changes in value of MCV. Out of the other two parameters, MCHC had a stronger correlation than MCH with the change in level of Hb.

Except for MCV, significant correlation was obtained between RDW, MCH and MCHC with the degree of anaemia. All study parameters showed significant correlation with the type of anaemia.

There was also significant correlation between Hb levels and the gravida status of the pregnant women, highlighting the fact that lower Hb levels are seen in successive pregnancies.

RDW and RBC indices are cost effective and simple methods for initial diagnosis of IDA in pregnancy.

The limitations of this study were that other parameters of iron status or profile such as serum iron level, total iron binding capacity and transferrin saturation were not performed.

BIBLIOGRAPHY

1. World Health Organization. Worldwide prevalence of anaemia 1993–2005: WHO global database on anaemia. Geneva: WHO, 2005.
2. Noronha JA, Bhaduri A, Bhat HV. Prevalence of anaemia among pregnant women: A community-based study in Udupi district. Heal Popul Perspect Issues 2008;31(1):31–40.
3. Kalaivani K. Prevalence & consequences of anaemia in pregnancy. Indian J Med Res 2009;130(5):627–33.
4. Aulakh R, Sohi I, Singh T, Kakkar N. Red cell distribution width (RDW) in the diagnosis of iron deficiency with microcytic hypochromic anemia. Indian J Pediatr 2009;76(3):265–8.
5. Kumar V, Abbas AK, Aster JC. Red Blood Cell and Bleeding Disorders. In: Kumar V, Abbas AK, Aster JC, editors. Pathologic Basis of Disease. 9th ed. New Delhi: Elsevier; 2014. p. 629–67.
6. McKenzie SB, Otto CN. Introduction to Anaemia. In: McKenzie SB, Williams JL, editors. Clinical Laboratory Hematology. 3rd ed. New York: Pearson; 2014. p. 178–97.
7. Raghuram V, Anil M, Jayaram S. Prevalence of Anaemia amongst women in the reproductive age group in a rural area in South India. Int J Biol Med Res 2012;3(2):1482–4.
8. Montoya Romero J de J, Castelazo Morales E, Valerio Castro E, Velázquez Cornejo G, Nava Muñoz DA, Escárcega Preciado JA, et al. Review by expert group in the diagnosis and treatment of anemia in pregnant women. Ginecol y Obstet México 2012;80(9):563–80.
9. Perkins S. Examination of the Blood and Bone Marrow. In: Greer JP, Foerster

J, Rodgers GM, Paraskevas F, Glader B, Arber DA, Means Jr RT, editors. Wintrobe's Clinical Hematology. 13th ed. Lippincott Williams & Wilkins; 2013 p9-35.

10. Lee G. Anaemia: A Diagnostic Strategy. In: Greer JP, Foerster J, Rodgers GM, Paraskevas F, Glader B, Arber DA, Means Jr RT, editors.Wintrobe's Clinical Hematology. 13th ed. Lippincott Williams & Wilkins; 2013 p908-40.
11. Briggs C, Bain BJ. Basic Haematological Techniques. In: Bain BJ, Bates I, Laffan MA, Lewis SM, editors. Practical Haematology. 12th ed. Elsevier; 2012 p23–56.
12. Lin CK, Lin JS, Chen SY, Jiang ML, Chiu CF. Comparison of hemoglobin and red blood cell distribution width in the differential diagnosis of microcytic anemia. Arch Pathol Lab Med 1992;116(10):1030–2.
13. Marsh WL, Bishop JW, Darcy TP. Evaluation of red cell volume distribution width (RDW). Hematol Pathol 1987;1(2):117–23.
14. Bessman JD, Gilmer PR, Gardner FH. Improved Classification of Anemias by MCV and RDW. Am J Clin Pathol 1983;80(3):322–6.
15. Brecher G, Jakobek EF, Schneiderman MA, Williams GZ, Schmidt PJ. Size distribution of erythrocytes. Ann N Y Acad Sci 1962;99:242–61.
16. England JM, Ward SM, Down MC. Microcytosis, anisocytosis and the red cell indices in iron deficiency. Br J Haematol 1976;34(4):589–97
17. Bessman JD. More on the RDW. Am J Clin Pathol 1985;84(6):773–9.
18. McClure S, Custer E, Bessman JD, E B, Conrad ME CW, Beutler E, Robson MJ BE, et al. Improved Detection of Early Iron Deficiency in Nonanemic Subjects. J Am Med Assoc 1985;253(7):1021–3.
19. Simel DL, DeLong ER, Feussner JR, Weinberg JB, Crawford J. Erythrocyte

anisocytosis. Visual inspection of blood films vs automated analysis of red blood cell distribution width. Arch Intern Med 1988;148(4):822–4.

20. Mehta BC. Iron deficiency - Prevalence and problems. J Assoc Physicians India 1990;38(6):421–4.

21. Shehata HA, Ali MM, Evans-Jones JC, Upton GJ, Manyonda IT. Red cell distribution width (RDW) changes in pregnancy. Int J Gynaecol Obstet 1998;62(1):43–6.

22. Lin L, Ren J, Zeng C. Mean corpuscular volume and red blood cell volume distribution width in the diagnosis of iron deficiency anemia in pregnancy. J Obstet Gynaecol Can 1997;32(2):81–3.

23. Milman N, Byg KE, Agger AO. Hemoglobin and erythrocyte indices during normal pregnancy and postpartum in 206 women with and without iron supplementation. Acta Obstet Gynecol Scand 2000;79(2):89–98.

24. Viswanath D, Hegde R, Murthy V, Nagashree S, Shah R. Red cell distribution width in the diagnosis of iron deficiency anemia. Indian J Pediatr 2001;68(12):1117–9.

25. Casanova BF, Sammel MD, Casanova GA, Sammel BF, Macones GA. Development of a clinical prediction rule for iron deficiency anemia in pregnancy. Am J Obstet Gynecol 2005;193(2):460-6.

26. Buch AC, Karve PP, Panicker NK, Singru SA, Gupta SC. Role of red cell distribution width in classifying microcytic hypochromic anaemia. J Indian Med Assoc 2011;109(5):297–9.

27. Abdelrahman EG, Musa IR, Elbashir LM, Adam I. Red blood cell distribution width and iron deficiency anemia among pregnant Sudanese women. Diagn Pathol 2012;7:2–5.

28. Alquaiz JM, Abdulghani HM, Khawaja RA, Shaffi-Ahamed S. Accuracy of Various Iron Parameters in the Prediction of Iron Deficiency Anemia among Healthy Women of Child Bearing Age. Iran Red Crescent Med J 2012;14(7):397–401.

29. Tiwari M, Kotwal J, Kotwal A, Mishra P, Dutta V, Chopra S. Correlation of haemoglobin and red cell indices with serum ferritin in Indian women in second and third trimester of pregnancy. Med J Armed Forces India 2013;69(1):31–6.

30. Sultana GS, Haque SA, Sultana T, Ahmed AN. Value of red cell distribution width (RDW) and RBC indices in the detection of iron deficiency anemia. Mymensingh Med J 2013;22(2):370–6.

31. Sazawal S, Dhingra U, Dhingra P, Dutta A, Shabir H, Menon VP, et al. Efficiency of red cell distribution width in identification of children aged 1-3 years with iron deficiency anemia against traditional hematological markers. BMC Pediatr 2014;14(1):8-15.

32. Khan H, Khan K, Raziq F, Naseem A. Iron Deficiency Anemia - Red Cell Distribution Width (RDW) and Red Cell Indices in The Prediction of Among Healthy Women in Third Trimester of Pregnancy. Prof Med J 2014;21(1):100–5.

33. Schoorl M, Schoorl M, van Pelt J, Bartels PCM. Application of Innovative Hemocytometric Parameters and Algorithms for Improvement of Microcytic Anemia Discrimination. Hematol Rep 2015;7(2):5843-49.

34. Bresani Salvi CC, Braga MC, Figueirôa JN, Batista Filho M. Could the erythrocyte indices or serum ferritin predict the therapeutic response to a trial with oral iron during pregnancy? Results from the Accuracy study for Maternal

Anaemia diagnosis (AMA). BMC Pregnancy Childbirth 2016;16(1):218–27.

35. Buttarello M. Laboratory diagnosis of anemia: are the old and new red cell parameters useful in classification and treatment? Int J Lab Hematol 2016;38:123–32.

36. Tanindi A, Topal FE, Topal F, Celik B. Red cell distribution width in patients with prehypertension and hypertension. Blood Press 2012;21(3):177–81.

37. Kurt RK, Aras Z, Silfeler DB, Kunt C, Islimye M, Kosar O. Relationship of red cell distribution width with the presence and severity of preeclampsia. Off J Int Acad Clin Appl Thromb 2015;21(2):128–31.

38. Avcıoğlu SN, Demircan Sezer S, Altınkaya SÖ, Küçük M, Kurt Ömürlü İ, Yüksel H. Erythrocyte Indices in Patients with Preeclampsia. Meandros Med Dent J 2015;16(2):35–42.

39. Danese E, Lippi G, Montagnana M. Red blood cell distribution width and cardiovascular diseases. J Thorac Dis. 2015;7(10):402–11.

40. Jo YH, Kim K, Lee JH, Kang C, Kim T, Park H-M, et al. Red cell distribution width is a prognostic factor in severe sepsis and septic shock. Am J Emerg Med 2013;31(3):545–8.

41. Shteinshnaider M, Barchel D, Almoznino-Sarafian D, Tzur I, Tsatsanashvili N, Swarka M, et al. Prognostic significance of changes in red cell distribution width in an internal medicine ward. Eur J Intern Med 2015;26(8):616–22.

42. Viveki RG, Halappanavar AB, Viveki PR, Halki SB, Maled VS. Prevalence of Anaemia and Its Epidemiological Determinants in Pregnant Women. Al Ameen J Med Sci 2012;5(3):216–23.

43. Arifulla M, Patil A, Sajjanar B, Yendigeri S, Honakeri V, Fathima N, et al. Prevalence of Anaemia in Pregnancy in Hospital Based Population in Bijapur, Karnataka. J Evol Med Dent Sci 2013;2(35):6673–81.

ANNEXURE – I

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

Institutional Ethical Committee
BIJAPUR-586 103.
OUTWARD
No. 544/14
Date. 24/11/14
S.M. Patil Medical College

B.L.D.E. UNIVERSITY'S
SHRI.B.M.PATIL MEDICAL COLLEGE, BIJAPUR-586 103
INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 22-11-2014 *at* 3-30pm. *to scrutinize the Synopsis of Postgraduate Students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected & revised version synopsis of the Thesis has been accorded Ethical Clearance.*

Title "Comparison Between Red cell Distribution coidth and Red Cell Indices in Prediction of Anaemia Among Pregnant Women"

Name of P.G. student Dr. Mayank Kumar.
Dept of Pathology

Name of Guide/Co-investigator Dr Prakash. M. Patil. Assoc Prof
Dept of Pathology

for. PP
DR.TEJASWINI. VALLABHA
CHAIRMAN
INSTITUTIONAL ETHICAL COMMITTEE
BLDEU'S, SHRI.B.M.PATIL
MEDICAL COLLEGE, BIJAPUR.

Following documents were placed before E.C. for Scrutinization
1) Copy of Synopsis/Research project.
2) Copy of informed consent form
3) Any other relevant documents.

ANNEXURE – II

BLDE UNIVERSITY'S SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTER, VIJAYAPUR - 586 103

RESEARCH INFORMED CONSENT FORM

I, the undersigned, _____, D/OW/O _____, aged _____ years, ordinarily resident of do hereby state/declare that Dr. _____ of Hospital has examined me thoroughly on _____ at (place) and it has been explained to me in my own language that I am suffering from disease (condition) _____ and this disease/condition mimic following diseases _____. Further Dr. informed me that he/she is conducting dissertation/research titled ._____, under the guidance of Dr. _____, requesting my participation in the study. Apart from routine treatment procedure of , the pre-operative, operative, post-operative and follow-up observations may be utilized for the study as reference data.

Dr. _____ has also informed me that during conduct of this procedure_____ like adverse results may be encountered. Among the above complications most of them are treatable but are not anticipated hence there is chance of aggravation of my condition and in rare circumstances it may prove fatal in spite of anticipated diagnosis and best treatment made available. Further doctor has informed me that my participation in this study help in evaluation of the results of the study which is useful reference to treatment of other similar cases in near future, and

also I may be benefited in getting relieved of suffering or cure of the disease I am suffering.

The doctor has also informed me that information given by me, observations made/ photographs/ videos taken upon me by the investigator will be kept secret and not assessed by the person other than me or my legal hirer except for academic purposes.

The doctor did inform me that though my participation is purely voluntary, based on information given by me, I can ask any clarification during the course of treatment / study related to diagnosis, procedure of treatment, result of treatment or prognosis. At the same time, I have been informed that I can withdraw from my participation in this study at any time if I want or the investigator can terminate me from the study at any time from the study but not the procedure of treatment and follow-up unless I request to be discharged.

After understanding the nature of dissertation or research, diagnosis made, mode of treatment, I the undersigned Smt. _____ under my full conscious state of mind agree to participate in the said research/dissertation.

Signature of patient:

Signature of doctor:

Witness: 1.

2.

Date:

Place:

ANNEXURE – III

PROFORMA FOR STUDY

Name: **Age: ___ years Sex: F OPD/IPD no.:**

History of present pregnancy:

Obstetric history:

Past history:

Family history:

General physical examination:

Obstetric examination:

Clinical diagnosis:

Hematological investigations:

Parameters	
RBC count	
HGB	
HCT	
MCV	
MCH	
MCHC	
RDW	

Peripheral Smear Examination:

RBCs:

WBCs:

Platelets:

IMPRESSION:

ANNEXURE – IV

MASTER CHART

S.No.	Date	Name	Age	Lab. No.	Hb	RDW	MCV	MCH	MCHC	RBC	HCT	G	P	L	A	D	POG	PS
1	12/4/2014	Savita	20	168063	8	18.7	75.7	23.4	30.9	3.42	25.9	1	0	0	0	0	37	MCHC
2	12/4/2014	Radha	25	168082	9.4	21.2	67.7	20.3	29.9	4.64	31.4	2	1	1	0	0	34	MCHC
3	12/4/2014	Chaitra	19	168107	10.6	19.6	90.5	29.5	32.6	3.59	32.5	1	0	0	0	0	37	Dimorphic
4	12/4/2014	Madeena	24	168229	10.9	16.8	81.5	26.1	32.1	4.17	34	3	2	2	0	0	32	NCHC
5	12/4/2014	Arati	20	174506	10.4	22.2	80.1	24.4	30.4	4.27	34.2	1	0	0	0	0	36	MCHC
6	12/4/2014	Rajeshree	28	173917	8.9	17.6	66	19.8	30	4.5	29.7	2	2	1	0	0	32	MCHC
7	12/4/2014	Nasima	21	173915	9.3	20.7	74.3	23.3	31.3	4	29.7	1	0	0	0	0	36	MCHC
8	12/4/2014	Lalita	27	174309	10.1	18	75.2	23.2	30.8	4.36	32.8	1	0	0	0	0	36	MCHC
9	12/5/2014	Parvati	24	174552	6.1	21.2	62.5	18	28.8	3.39	21.2	5	4	4	0	0	36	MCHC
10	12/5/2014	Boramma	22	174523	10.2	14	84	28.2	33.6	3.62	30.4	1	0	0	0	0	36	NCNC
11	12/26/2014	Neelamma	23	185786	10.1	16.7	66.4	20.4	30.8	4.94	32.8	2	1	1	0	0	37	MCHC
12	12/26/2014	Lakshmi	25	185854	10.4	13.7	77.2	24.5	31.7	4.25	32.8	4	2	2	1	0	14	MCHC
13	3/2/2015	Savita	27	32377	10.1	16.8	72.9	22.2	30.5	4.54	33.1	3	2	2	0	0	20	MCHC
14	3/6/2015	Shailabai	26	34824	5.5	12.9	87.4	30.2	34.6	1.82	15.9	3	2	1	0	1	37	NCNC
15	3/9/2015	Kamalabai	35	36079	6.6	20.7	53.6	14.9	27.8	4.42	23.7	4	3	3	0	0	32	MCHC
16	3/9/2015	Latha	23	36078	8.5	15.7	70.8	21.2	29.9	4.01	28.4	3	1	1	1	0	36	MCHC
17	3/10/2015	Raziya	25	36533	9.5	21.1	67.6	21.5	31.9	4.41	29.8	4	3	3	0	0	36	MCHC
18	3/11/2015	Roopa	20	37297	10.9	12.3	83.8	29.4	35	3.71	31.1	1	0	0	0	0	36	NCNC
19	3/12/2015	Geeta	32	37681	10.1	15.9	79.1	27	34.1	3.74	29.6	3	1	1	1	0	36	NCNC
20	3/12/2015	Vijayalaxmi	20	37473	9.2	15.9	90.7	29.5	32.5	3.12	28.3	1	0	0	0	0	36	NCNC
21	3/14/2015	Shantamma	22	38901	10.7	19.4	87.1	30	34.4	3.57	31.1	2	1	1	0	0	37	Dimorphic
22	3/14/2015	Sunanda	25	39166	9.7	21.3	85.5	27	31.6	3.59	30.7	2	1	0	0	1	37	Dimorphic

23	3/14/2015	Bashira	26	39135	9.6	15.1	85.4	29.2	34.2	3.29	28.1	3	2	2	0	0	37	NCNC
24	3/16/2015	Surekha	24	39496	6.7	20	71.6	23.2	32.4	2.89	20.7	3	2	2	0	0	16	MCHC
25	3/16/2015	Arti	30	39652	10.1	16.4	73.5	23.7	32.2	4.27	31.4	3	2	2	0	0	28	MCHC
26	3/19/2015	Laxmi	20	41641	10.7	13.2	83.2	28	33.6	3.82	31.8	2	1	0	0	1	32	NCNC
27	3/19/2015	Savita	20	41351	10.8	18.6	93.2	31.8	34.1	3.4	31.7	1	0	0	0	0	28	Dimorphic
28	3/19/2015	Rajashree	20	41450	8.2	14.4	90	31.7	35.2	2.59	23.3	1	0	0	0	0	24	NCNC
29	3/20/2015	Rajeshwari	21	42942	9.5	13.7	90.6	30.6	33.8	3.1	28.1	1	0	0	0	0	36	NCNC
30	3/22/2015	Mukta	26	43117	10.4	12.8	79.1	25.9	32.7	4.02	31.8	2	2	1	0	0	36	NCHC
31	3/23/2015	Roopa	20	43464	7.8	17.1	66.7	21.5	32.2	3.63	24.2	1	0	0	0	0	36	MCHC
32	3/23/2015	Jyoti	25	43668	9.8	15	83.9	28.7	34.1	3.42	28.7	1	0	0	0	0	20	NCNC
33	3/23/2015	Smita	20	43660	8	17.2	72.5	23.4	32.3	3.42	24.8	1	0	0	0	0	36	MCHC
34	3/23/2015	Sujata	21	43151	7.1	16.2	88.1	31.4	35.7	2.26	19.9	1	0	0	0	0	36	NCNC
35	3/23/2015	Arati	28	43381	9.3	16.9	75.4	23.8	31.5	3.91	29.5	2	2	1	0	0	28	MCHC
36	3/24/2015	Shashikala	28	44122	10.7	14.3	89	30.1	33.9	3.55	31.6	2	2	1	0	0	28	NCNC
37	3/24/2015	Indira	30	44297	8	19.3	72.1	24	33.3	3.33	24	2	1	0	0	1	36	MCHC
38	3/24/2015	Basamma	21	44155	9.6	12.6	73.4	24.3	33.1	3.95	29	1	0	0	0	0	36	MCHC
39	3/24/2015	Basamma	20	44101	9.2	15.5	70.3	22.4	31.8	4.11	28.9	1	0	0	0	0	36	MCHC
40	3/25/2015	Kamalabai	28	45767	8.1	17.6	89.2	30.2	33.9	2.68	23.9	1	0	0	0	0	20	Dimorphic
41	3/26/2015	Annapurna	20	45263	10.3	15.9	71.8	23.5	32.7	4.39	31.5	2	0	0	1	0	36	MCHC
42	3/31/2015	Shivaleela	22	47593	10.6	13.4	80.7	28	34.6	3.79	30.6	2	1	1	0	0	24	NCNC
43	4/14/2015	Geeta	19	56266	9.5	14.4	84.4	27.5	32.5	3.46	29.2	2	1	1	0	0	36	NCHC
44	4/16/2015	Ambika	21	56302	10.3	13.6	88.3	31.6	35.8	3.26	28.8	3	2	2	0	0	36	NCNC
45	4/16/2015	Shalini	26	56334	9.2	18.5	65.3	20.4	31.2	4.52	29.5	2	1	1	0	0	36	MCHC
46	4/16/2015	Savitri	22	56486	10.9	14.4	90.9	32.2	35.4	3.39	30.8	2	1	1	0	0	36	NCNC
47	4/16/2015	Heena	28	56252	9.8	17	73.1	23.5	32.1	4.17	30.5	2	1	0	0	1	36	MCHC
48	4/16/2015	Renuka	24	56211	9.4	25.2	65.3	19.6	30	4.79	31.3	3	2	2	0	0	36	MCHC
49	4/17/2015	Rekha	24	57073	10.1	13.2	77.7	25.6	33	3.94	30.6	2	1	1	0	0	34	MCHC
50	4/17/2015	Prabhavati	22	56837	10	18.4	78.9	27	34.2	3.7	29.2	1	0	0	0	0	36	MCHC

51	4/18/2015	Karishma	21	57987	8.4	18.4	62	19.2	31	4.37	27.1	1	0	0	0	0	36	Dimorphic
52	4/19/2015	Bharti	20	58000	9.4	18.7	73	23.9	32.8	3.93	28.7	1	0	0	0	0	36	Dimorphic
53	4/19/2015	Laxmi	19	58241	10.5	17.2	87.8	30.4	34.7	3.45	30.3	1	1	0	0	0	36	MCHC
54	4/19/2015	Neelamma	25	58234	7	23.7	90.9	30.2	33.2	2.32	21.1	4	2	2	1	0	36	Dimorphic
55	4/20/2015	Sara	24	58575	9.6	20.4	84.1	28.2	33.6	3.4	28.6	2	1	1	0	0	30	Dimorphic
56	4/22/2015	Shaila	22	59657	5.9	21.1	60.6	16.9	27.8	3.5	21.2	2	1	1	0	0	36	Dimorphic
57	4/25/2015	Malakawwa	32	61325	7.2	30.8	68.2	21	30.8	3.43	23.4	2	1	1	0	0	8	Dimorphic
58	4/25/2015	Rajashree	30	61314	9.8	19.9	82.1	26.9	32.8	3.64	29.9	3	2	2	0	0	36	NCHC
59	5/7/2015	Danamma	20	67520	10.4	13.7	90.6	31.4	34.7	3.31	30	1	0	0	0	0	36	NCNC
60	5/7/2015	Anupama	20	67737	10.5	17.4	63.7	20.5	32.1	5.13	32.7	2	1	1	0	0	36	MCHC
61	5/7/2015	Bouramma	26	67716	10.8	15.4	79.3	26.9	34	4.01	31.8	3	2	1	0	1	36	MCHC
62	5/7/2015	Reshma	21	67426	10	15.9	86.4	28.4	32.9	3.52	30.4	2	1	1	0	0	36	NCNC
63	5/8/2015	Hema	22	68179	9	23.2	74.9	22.4	29.9	4.02	30.1	1	0	0	0	0	36	MCHC
64	5/8/2015	Nirmala	20	67972	10.6	14.6	69.8	21.8	31.3	4.86	33.9	1	0	0	0	0	8	MCHC
65	5/8/2015	Malashree	19	67776	8.7	31.4	80.2	24.3	30.3	3.58	28.7	1	0	0	0	0	36	Dimorphic
66	5/8/2015	Renuka	26	67767	7.5	12.6	98.4	30.4	30.9	2.47	24.3	2	1	1	0	0	36	Macro
67	5/15/2015	Shobha	20	71552	9.1	15.9	86.9	29.7	34.2	3.06	26.6	1	0	0	0	0	36	NCNC
68	5/15/2015	Roopa	35	71955	9.4	18.2	71.9	23.2	32.3	4.05	29.1	1	0	0	0	0	32	MCHC
69	5/15/2015	Laxmibai	22	72040	9.4	16.1	76.2	24.6	32.3	3.82	29.1	1	0	0	0	0	36	MCHC
70	6/1/2015	Ningavva	35	81306	9.4	14.8	87.2	30.9	35.5	3.04	26.5	4	3	3	0	0	36	NCNC
71	6/1/2015	Shruti	23	81031	10.6	16.3	85.7	28.6	33.3	3.71	31.8	1	0	0	0	0	36	NCNC
72	6/1/2015	Savita	21	81361	9.6	18.8	83.5	26.9	32.2	3.57	29.8	1	0	0	0	0	32	NCHC
73	6/1/2015	Laxmi	25	81222	9.6	13.1	82.1	26.8	32.7	3.58	29.4	2	1	1	0	0	25	NCHC
74	6/1/2015	Deepa	21	81398	10.9	13.6	84.5	29.7	35.2	3.67	31	1	0	0	0	0	24	NCNC
75	6/2/2015	Kasturi	22	82011	9.8	26.9	64.5	18.9	29.3	5.18	33.4	1	0	0	0	0	36	MCHC
76	6/2/2015	Urmila	23	82013	5.9	16.7	102.5	37.6	36.6	1.57	16.1	4	3	3	0	0	32	Macro
77	6/2/2015	Savithri	29	82139	9.4	16.3	75.8	24.4	32.2	3.85	29.2	3	2	2	0	0	30	MCHC
78	6/2/2015	Gowramma	30	82099	8.7	14.2	82.7	27.8	33.6	3.13	25.9	2	1	0	0	1	36	NCHC

79	6/2/2015	Mahadevi	30	81888	10.4	17.2	78.8	26.6	33.8	3.91	30.8	2	1	1	0	0	36	NCHC
80	6/2/2015	Urmila	23	81709	5.9	16.7	101.9	37.6	36.9	1.57	16	4	3	3	0	0	36	Macro
81	6/2/2015	Kavita	23	81746	10.2	15.9	74.6	24.2	32.5	4.21	31.4	2	1	1	0	0	20	MCHC
82	6/2/2015	Yallawa	24	81718	8.4	21.2	66.5	20.1	30.2	4.18	27.8	3	2	2	0	0	36	MCHC
83	6/2/2015	Bouramma	20	81528	10.2	17.1	66.5	20.3	30.5	5.02	33.4	1	0	0	0	0	32	MCHC
84	6/3/2015	Savitri	24	82210	7	24.4	73.4	23.3	31.7	3.01	22.1	3	2	2	0	0	36	Dimorphic
85	6/3/2015	Padmavati	26	82146	10	13.8	87.8	30.5	34.7	3.28	28.8	2	1	1	0	0	36	NCNC
86	6/3/2015	Megha	25	82142	6.7	14.4	85.7	29.1	34	2.3	19.7	3	2	2	0	0	36	NCNC
87	6/3/2015	Vijaylakshmi	22	82667	9.8	14.6	71.4	22.6	31.6	4.34	31	1	0	0	0	0	36	MCHC
88	6/4/2015	Kousar	21	83248	7	17.8	84	28.8	34.3	2.43	20.4	1	0	0	0	0	36	NCNC
89	6/4/2015	Mahananda	23	82939	10.6	14.8	71.5	24.4	34.1	4.35	31.1	1	0	0	0	0	36	MCHC
90	6/4/2015	Reshma	21	82686	8.5	19.1	67.1	20.6	30.7	4.13	27.7	1	0	0	0	0	32	MCHC
91	6/4/2015	Roopa	20	82855	10.3	14.6	75.2	24.1	32	4.28	32.2	1	0	0	0	0	36	MCHC
92	6/5/2015	Laxmibai	28	83811	6.8	21.2	63.3	18.2	28.8	3.73	23.6	2	1	1	0	0	32	MCHC
93	6/5/2015	Laxmibai	26	83681	7	20.9	63.6	18.3	28.8	3.82	24.3	2	1	1	0	0	36	MCHC
94	6/5/2015	Savita	25	83773	10	18	80.2	27.9	34.8	3.58	28.7	2	1	1	0	0	28	Dimorphic
95	6/5/2015	Rukmawwa	23	83422	10.7	13.9	82.9	29.1	35.1	3.68	30.5	1	0	0	0	0	20	NCNC
96	6/5/2015	Savitri	24	83411	6.3	25.3	75.5	23.8	31.5	2.65	20	3	1	1	1	0	36	MCHC
97	1/24/2016	Savita	22	12125	6.2	20.8	66.3	19.9	30	3.12	20.7	2	1	1	0	0	12	MCHC
98	1/25/2016	Shabana	25	12235	6.9	18.2	75.5	23.8	31.5	2.9	21.9	3	2	2	0	0	20	MCHC
99	1/25/2016	Savitri	20	12263	10.1	17.4	75.2	23.7	31.5	4.27	32.1	1	0	0	0	0	37	Dimorphic
100	1/26/2016	Reshma	30	12874	10.1	19.6	79.1	25.4	32.2	3.97	31.4	3	2	2	0	0	30	MCHC
101	1/26/2016	Sunita	25	13013	7.3	19.1	73.2	22.3	30.4	3.28	24	2	1	1	0	0	28	Dimorphic
102	1/26/2016	Masabi	26	13155	8.9	25	70.9	21.9	30.9	4.06	28.8	2	1	1	0	0	12	Dimorphic
103	1/26/2016	Vhaishali	22	13206	9.1	19.8	74	24.1	32.6	3.77	27.9	1	0	0	0	0	16	MCHC
104	1/27/2016	Khadarabi	30	13389	10.2	16.6	79.3	24.2	30.5	4.21	33.4	3	2	2	0	0	28	NCHC
105	1/28/2016	Sangeeta	22	14464	8.8	19.5	70.7	21.3	30.1	4.13	29.2	2	1	1	0	0	37	MCHC
106	1/28/2016	Parvati	19	14466	10.3	18	77.5	24.7	31.9	4.17	32.3	1	0	0	0	0	37	MCHC

107	1/29/2016	Sangamma	21	15902	8	14	101.7	34.2	33.6	2.34	23.8	2	1	1	0	0	37	Macro
108	1/29/2016	Rajeshri	24	14908	10.8	18	83	27.8	33.5	3.88	32.2	2	1	1	0	0	37	NCNC
109	1/29/2016	Bagamma	36	14815	10.4	19.3	70.3	21.6	30.8	4.81	33.8	3	2	2	0	0	37	MCHC
110	1/30/2016	Kaveri	20	15046	10.5	19.4	74.9	23.5	31.3	4.47	33.5	1	0	0	0	0	37	MCHC
111	1/30/2016	Kasturi	18	15054	6.1	14.6	81.1	26.2	32.3	2.33	18.9	1	0	0	0	0	28	NCHC
112	1/30/2016	Sana	20	15073	9.4	25.7	86	23.9	27.8	3.93	33.8	1	0	0	0	0	37	Dimorphic
113	2/1/2016	Riyana	30	15948	10.3	14.3	93.3	31.6	33.9	3.26	30.4	4	3	3	0	0	37	NCNC
114	3/2/2016	Rekha	30	33530	6.8	22.3	80.8	25.6	31.6	2.66	21.5	4	3	3	0	0	36	Dimorphic
115	3/5/2016	Geeta	25	35210	10.5	15.1	79.8	25.9	32.4	4.06	32.4	1	0	0	0	0	36	NCHC
116	3/5/2016	Shivaleela	20	35223	7.3	16.1	87.1	28.6	32.9	2.55	22.2	3	2	2	0	0	34	NCNC
117	3/12/2016	Sukanya	36	38435	8.2	19.3	69.8	20.8	29.8	3.94	27.5	4	3	3	0	0	37	MCHC
118	3/12/2016	Shruti	22	38709	10	17	76.2	25.3	33.2	3.95	30.1	2	1	1	0	0	28	MCHC
119	3/12/2016	Renuka	20	38731	7.5	18.6	76.5	24.5	32.1	3.06	23.4	1	0	0	0	0	37	MCHC
120	3/12/2016	Rekha	16	38708	9.7	17.4	80.9	25.8	31.9	3.76	30.4	1	0	0	0	0	37	NCHC
121	3/14/2016	Kavita	20	39887	6.4	19.8	70.6	22.1	31.4	2.89	20.4	2	1	1	0	0	32	MCHC
122	3/14/2016	Shivalingawwa	35	39656	9.5	15.9	74.6	22.1	29.7	4.29	32	2	1	1	0	0	36	MCHC
123	3/14/2016	Anju	28	39678	8.7	16.1	69.2	21.1	30.4	4.13	28.6	2	1	1	0	0	36	MCHC
124	3/14/2016	Renuka	21	39720	10.9	16.5	86.7	27.9	32.2	3.9	33.8	1	0	0	0	0	36	NCNC
125	3/15/2016	Shivalingamma	32	40045	5.3	14	83	27.3	32.9	1.94	16.1	2	1	1	0	0	36	NCNC
126	3/15/2016	Seela	21	40243	7.1	18.5	78.2	25.4	32.4	2.8	21.9	2	1	1	0	0	32	MCHC
127	3/15/2016	Sangeeta	20	40325	6.7	21	59.6	16.2	27.2	4.13	24.6	4	3	3	0	0	36	MCHC
128	3/15/2016	Rukmini	22	40240	9.8	19.6	71.9	23	31.9	4.27	30.7	1	0	0	0	0	36	MCHC
129	3/16/2016	Manjula	28	40399	7.8	21.9	70.3	20.3	28.9	3.84	27	3	2	2	0	0	36	MCHC
130	3/16/2016	Bhimabai	23	40483	9.9	16.1	74.7	22.8	30.6	4.34	32.4	2	1	1	0	0	32	MCHC
131	3/16/2016	Saraswati	18	40537	10.2	16.3	69.7	21.4	30.7	4.76	33.2	2	1	1	0	0	36	MCHC
132	3/16/2016	Priyanka	21	40718	10.7	17.2	76.2	24	31.5	4.46	34	2	1	1	0	0	37	MCHC
133	4/4/2016	Pushpa	28	50830	9	16.2	68.7	19.9	28.9	4.53	31.1	2	1	1	0	0	36	MCHC
134	4/4/2016	Surekha	21	50864	10.1	19.4	67.1	21.2	31.6	4.77	32	1	0	0	0	0	32	MCHC

135	4/4/2016	Pooja	20	51051	10.5	16.2	78	24.8	31.8	4.23	33	1	0	0	0	0	36	MCHC
136	4/4/2016	Gangamma	30	51095	9.1	28.4	76.2	22.8	29.9	3.99	30.4	2	1	1	0	0	30	Dimorphic
137	4/4/2016	Vitabai	28	51055	5.9	18.9	82.9	28.1	33.9	2.1	17.4	3	2	2	0	0	36	Dimorphic
138	4/4/2016	Anuradha	21	51124	9.8	15.9	61.9	20	32.2	4.91	30.4	2	1	1	0	0	36	MCHC
139	4/5/2016	Rajashri	22	51642	10.9	20.4	70.2	21.6	30.8	5.04	35.4	1	0	0	0	0	37	MCHC
140	4/5/2016	Nashima	20	51602	10.9	18.9	79.1	25.6	32.3	4.26	33.7	1	0	0	0	0	36	NCHC
141	4/5/2016	Vidaya	19	51687	8.3	23.8	54.1	16.1	29.7	5.16	27.9	2	1	1	0	0	8	MCHC
142	4/5/2016	Renuka	23	51688	9.2	16.8	67.9	21.5	31.7	4.27	29	2	1	1	0	0	20	MCHC
143	4/5/2016	Gulashanbi	36	51709	8.4	17.2	79.6	26.3	33.1	3.19	25.4	2	1	1	0	0	36	MCHC
144	4/5/2016	Sujata	24	51643	10.4	14.6	81.4	26.5	32.5	3.93	32	1	0	0	0	0	36	NCHC
145	4/5/2016	Geeta	25	51669	10	14.6	82.1	26.7	32.6	3.74	30.7	2	1	1	0	0	24	NCHC
146	4/5/2016	Pallavi	24	51692	10.5	13.8	86.4	28.5	32.9	3.69	31.9	1	0	0	0	0	8	NCHC
147	4/5/2016	Vitabai	28	51699	5.1	18.9	82.3	27.4	33.3	1.86	15.3	4	3	3	0	0	36	NCNC
148	4/6/2016	Rajeshwari	25	52238	9.4	15.2	82.1	25.5	31	3.69	30.3	2	1	1	0	0	32	NCHC
149	4/6/2016	Mahananda	30	52240	4.9	18.8	62.5	18	28.8	2.72	17	5	4	4	0	0	36	MCHC
150	4/6/2016	Reshma	22	52315	9.6	13.2	81.2	27	33.2	3.56	28.9	1	0	0	0	0	36	NCHC
151	4/7/2016	Shilpa	22	52935	10	20.8	89.9	30.5	33.9	3.28	29.5	1	0	0	0	0	32	Dimorphic
152	4/11/2016	Jakkawwa	22	54648	9.9	16.3	75.3	23.5	31.2	4.21	31.7	1	0	0	0	0	37	MCHC
153	4/11/2016	Savita	22	54664	10.3	15.5	81.1	27.5	33.9	3.75	30.4	1	0	0	0	0	37	NCNC
154	4/11/2016	Shivaleela	28	54694	9.5	14.8	79.4	24.8	31.3	3.83	30.4	3	2	2	0	0	32	NCHC
155	4/12/2016	Neelamma	20	55471	4.8	23.4	90.3	27.3	30.2	1.76	15.9	3	1	1	1	0	32	Dimorphic
156	4/12/2016	Vaishali	22	55308	10.5	23.9	74.2	23.5	31.7	4.46	33.1	1	0	0	0	0	36	MCHC
157	4/12/2016	Deepa	25	55319	7.8	16.2	72.7	22.9	31.5	3.41	24.8	3	2	2	0	0	24	MCHC
158	4/12/2016	Geeta	24	55342	10.7	14.9	78.5	24.8	31.6	4.32	33.9	1	0	0	0	0	12	MCHC
159	4/12/2016	Roopa	18	55402	7.4	18.4	69.1	21.6	31.2	3.43	23.7	2	1	1	0	0	36	MCHC
160	4/12/2016	Bharati	28	55368	9.5	18.1	60.6	16.6	30.7	5.1	30.9	3	2	2	0	0	37	MCHC
161	4/13/2016	Laxmi	19	55923	4.4	21.3	60.4	16.4	27.2	2.68	16.2	2	1	1	0	0	37	MCHC
162	4/13/2016	Sangeeta	19	55946	6.1	22.1	84.3	23.4	27.7	2.61	22	1	0	0	0	0	37	Dimorphic

163	4/13/2016	Mahek	20	56144	10.4	20	77.7	24.4	31.4	4.26	33.1	1	0	0	0	0	37	MCHC
164	4/15/2016	Vijayalxmi	25	57011	10.1	16.3	71.9	22.5	31.4	4.48	32.2	2	1	1	0	0	32	MCHC
165	4/15/2016	Kavita	23	57022	9.7	19.9	87.8	28.8	32.8	3.37	29.6	2	1	1	0	0	37	Dimorphic
166	4/19/2016	Taslim	25	59474	8.3	19.6	68.5	20.1	29.3	4.13	28.3	2	1	1	0	0	37	MCHC
167	4/19/2016	Gouramma	22	59472	7.9	16.3	74.6	22.3	29.9	3.54	26.4	1	0	0	0	0	37	MCHC
168	4/19/2016	Neelamma	26	59487	6.8	13.4	113	40.2	35.6	1.69	19.1	2	1	1	0	0	32	Macro
169	4/20/2016	Kaveri	25	59531	9.6	21.9	72.5	23.2	32	4.14	30	2	1	1	0	0	37	MCHC
170	4/20/2016	Ambika	23	59364	10	16.2	83.4	27.2	32.6	3.68	30.7	2	1	0	0	1	37	NCHC
171	4/20/2016	Sangitha	27	59776	10.3	25.2	58.6	17.6	30	5.85	34.3	3	2	2	0	0	28	MCHC
172	3/8/2016	Halima	23	36513	10.3	24.9	71.3	22.4	31.4	4.6	32.8	2	1	1	0	0	37	MCHC
173	3/8/2016	Rajashree	20	36512	8.3	17.4	83.1	26.9	32.4	3.08	25.6	1	0	0	0	0	37	NCHC
174	3/9/2016	Shaila	22	37039	7.4	23.7	53	14.8	27.9	5	26.5	2	1	1	0	0	37	MCHC
175	3/16/2016	Savita	20	41023	7.3	23.5	70.7	21.4	30.3	3.41	24.1	1	0	0	0	0	37	Dimorphic
176	3/17/2016	Bharati	24	41281	10.5	19.2	73.9	23.8	32.2	4.41	32.6	2	1	1	0	0	37	MCHC
177	3/17/2016	Savita	21	41294	10.4	12.8	74.1	23.6	31.9	4.4	32.6	1	0	0	0	0	32	MCHC
178	3/30/2016	Mahadevi	23	48303	10.4	17.8	78.5	25.7	32.8	4.04	31.7	1	0	0	0	0	37	Dimorphic
179	4/17/2016	Bouramma	24	58261	5.2	22.5	61	17.3	28.4	3	18.3	2	1	1	0	0	37	MCHC
180	4/22/2016	Ashwini	20	60813	6	20.8	69.3	18.4	26.5	3.26	22.6	2	1	1	0	0	37	MCHC

KEY TO MASTER CHART

Hb	Haemoglobin (g/dL)
RDW	Red cell distribution width (%)
MCV	Mean corpuscular volume (fl)
MCH	Mean corpuscular haemoglobin (pg)
MCHC	Mean corpuscular haemoglobin concentration (g/dL)
RBC	Red cell count (million/cu mm)
HCT	%
G	Gravida
P	Para
L	Living
A	Abortions
D	Deaths
POG	Period of gestation (weeks)
PS	Peripheral smear
MCHC	Microcytic hypochromic anaemia
Dimorphic	Dimorphic anaemia
NCNC	Normocytic normochromic anaemia
NCHC	Normocytic hypochromic anaemia
Macro	Macrocytic anaemia