"An Epidemiological Study of Iron Deficiency Anemia and it's Impact on the Health Status of the Reproductive Age Women"

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CERTIFICATE

Under rule 6.2 (ii) of Doctor of Philosophy (Ph.D.) Regulation 1999 as amended in 2010, this is to certify that the thesis entitled **"An Epidemiological Study of Iron Deficiency Anemia and it's Impact on the Health Status of the Reproductive Age Women"** submitted by **Miss. Swati Rai,** carried out by her is an original work and has not been previously submitted in part or full for the award of any other degree or diploma to this or any other university.

The thesis submitted to Babasaheb Bhimrao Ambedkar University (A Central University) Lucknow is fulfillment of the requirements fit for submission and evaluation for the award of the degree of Doctor of Philosophy in Department of Human Development and Family Studies, School of Home Science.

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Abbreviations:

BMI: Body Mass Index

CBC: Complete Blood Count

CDC: Centre For Disease control and prevention

CHC: Community Health Centre

CI: Confidence Interval

DMT1: Divalent Metal Transporter 1

EDTA: Ethylene Diamine Tetra Acetic Acid

GIT: Gastro Intestinal Tract

GLV: Green Leafy Vegetables

Hb: Hemoglobin

ICMR: Indian Council of Medical Research

ID: Iron Deficiency

IDA: Iron Deficiency Anemia

KAP: Knowledge, Attitude and practice

Kg: Kilogram

NFHS: National Family Health Survey

MCH: Mean Corpuscular Hemoglobin

MCHC: Mean Corpuscular Hemoglobin Concentration

MCV: Mean Corpuscular Value

NIN: National Institute of Nutrition

OR: Odds Ratio

PCV: Packed Cell Volume

PHC: Primary Health Centre

QOL: Quality of Life

RAW: Reproductive Age Women

RBC: Red Blood Count

RDA: Recommended Dietary Allowances

RR: Relative Risk

SD: Standard Deviation

TIBC: Total Iron-Binding Capacity

TLC: Total Leucocytes Count

UNICEF: United Nations Children's Fund

UNU: United Nations University

USAID: United States Agency of Development

WBC: White Blood Cells

WHO: World Health Organization

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Abstract

1	**Name of the author:**	**Swati Rai**
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INTRODUCTION

Health and individuals well-being is a fundamental human right and central to the concept of quality of life. Women's health is vital to the survival of the society. They are the pivot of the family, they nurture the next generation and give care to the elderly. Reproductive health majorly affects the lives of women from adolescence to old age, through conception to giving birth and includes the attainment and maintenance of good health as well as the prevention and treatment of ill health. The health of women of respective age groups have high risk of morbidity and mortality due to nutritional deficiencies.

Anemia is the decreased ability of the RBCs to provide adequate oxygen to body tissues. It may be due to a decreased number of RBCs, a decreased amount of substance in RBCs, which transports oxygen (hemoglobin), or a decreased volume of RBCs ***(Balducci, et al., 2007; Bridges & Pearson, 2008)*** Erythrocyte is size-measured as mean corpuscular volume (MCV). Hemoglobin concentration reduced as consequence of significant iron deficiency ***(Lewis et al., 2001; Balducci, et al., 2007).*** Measurements of hemoglobin, serum ferritin, serum iron, and transferring (total iron-

binding capacity, TIBC) capacitate iron status to be characterized in detail of anemia ***(Dallman et al., 1992).***

This study helps to identify the important risk factors that have a direct effect on an individual's thought process to adapt any behavioral change. The information gained from this present study will help to further implement policies to combat the health of women who are at the risk of developing IDA or are already suffering from. In fact, this study provides a broader perspective on how much knowledge they have and follow and in what way they relate it to their daily living. Thus, the study was undertaken with the following objectives:

1. To estimate the prevalence of anemia among reproductive age women of rural and urban areas.
2. To determine association of anemia with its pre-disposing factors in rural and urban areas.
3. To associate IDA with food consumption pattern and BMI
4. To evaluate the knowledge about anemia and its consequences among respondents.
5. To evaluate the effectiveness of intervention and associate with pre and post phase of the study.
6. To create awareness among rural women through camp and exhibition.

MATERIALS & METHODS

The cross sectional study was conducted followed by non-experimental pre-test/post-test design in which, evaluator surveyed the two groups of reproductive age women categorized under rural and urban areas. As the choice of the participants for this study included only reproductive age women (15-49 years), and their blood samples had to be collected for checking their hemoglobin level and iron status in the body, thus the availability of such participants played a very important role in deciding the sample size.

Total sample taken for the study is 400, which is slightly more than the minimum sample size requirement. Equal number of subjects from rural and urban has been taken in the study i.e. two hundred from urban population and two hundred from rural

population. The target population for this study included reproductive age women. The subjects selected for this study belonged to the age group of 15-49 years irrespective of their menarche status.

Before initiating the actual research, a pilot study was conducted on 30 study subjects from Community Health Center in rural area. The questions were personally asked to the respondents along with collecting their blood samples for checking their hemoglobin levels. The study was conducted into three phases; for each phase a different approach of sampling was used, Multi-stage Random Sampling was followed in the present study at the preliminary phase followed by non – probability sampling and purposive sampling.

The data was coded, tabulated and analyzed using appropriate statistical techniques i.e. Mean, SD, Frequency tabulation, Chi- square test, Logistic Regression, Paired t test**,** Wilcoxon signed rank test, Correlation was administered to analyze the data accordingly.

RESULTS

From the present study, it was marked that most of the women were literate but ironically unemployed. It was observed that most of the women belonged to the Class II strata and only eight percent belonged to Class V strata of socio-economic class. Over two-third of the participants had three to five days of menses. The gravida status of the women reveals that 55% of them had more than two pregnancies that is multigravida followed by primi-gravida and nulli-gravida.

Most of the reproductive age women were vegetarian 212 (53%). It can be seen that most of the women 162 (40.50%) had their meals three times a day followed by two times a day. The majority of the respondents were found to consume tea/coffee 2-3 times a day followed by once in a day. The majority of the respondents kept on munching in between meals. The majority of women agreed to have fulfilling meals in last 15 days when they did not lack appetite. About half of the total respondents had no preferences of food they eat. On the other hand, it was obtained from result that women relied upon fried and spicy food and very few women were dependent on partially boiled food. It is revealed that the level of awareness change from pre to post- intervention in the context of knowledge was observed as Low- 66.3%, average-

6.3%, High- 27.5% during pre-intervention having a total Mean 2.65 ±3.13 SD, which subsequently changed to Low- 17.5%, average-21.3%, High- 61.3%.

CONCLUSION

The present study revealed that a very high prevalence of IDA among reproductive-age women (66.5%) is an alarming sign and indicator of socioeconomic status and illiteracy. Women who were under peak childbearing age, as well as low-income groups, have more chances to experience IDA because there is a definite role of nutritional deprivation in the development of anemia and lack of balanced diet especially deficient in iron and folic acid. It has seen that the educational level of women and the standard of living of households play a considerable role in determining the degree of anemia in women. Reproductive age women are susceptible to iron deficiency anemia due to below par socioeconomic status along with literacy status. Large family size in rural areas keeps women busy in fostering others and disregarding their own health. Ignorance and lack of affordability to nutritious diet especially rich in iron makes women anemic. High prevalence of anemia and association with predisposing factors indicating the necessity of improvement of socio-demographic and dietary practices to tackle this alarming condition. Efforts must be taken to enhance the level of education and the economic status of all women. Addressing determinants, there is a scope to improve anemia in this area.

Keywords: *iron deficiency anemia, prevalence, women of reproductive age, hemoglobin, socioeconomic status*

CHAPTER - I

INTRODUCTION

Health and individuals well-being is a fundamental human right and central to the concept of quality of life. Women's health is vital to the survival of the society. They are the pivot of the family, they nurture the next generation and give care to the elderly. Apart from their family duties, they have the primary responsibility towards their own health and happiness. It is also time to take stock of how women's rights are fulfilled in the world, especially the right to health. In a report of ***Beijing Declaration and Platform of action (1995)***, pledges were signed by many countries regarding women facing many health problems and we must re-commit to addressing them.

Reproductive health majorly affects the lives of women from adolescence to old age, through conception to giving birth and includes the attainment and maintenance of good health as well as the prevention and treatment of ill health. The health of women of respective age groups have high risk of morbidity and mortality due to nutritional deficiencies. Despite of many global health issues affecting both developing and developed countries with major consequences on human health as well as social and economic development. For that reason, awareness creation towards nutritional supplementation, birth spacing, counseling regarding dietary habits respective of age with special emphasis on those women who has low income and large family size.

According to **W.H.O**, Women of reproductive age refer to all women ages from 15–49 year. Although estimates from some censuses and surveys, the upper age was taken as 44 years and the last age group is thus 40–44 years. Recently, it has been recommended especially when survey data are used, that total fertility rates be shown both by age 15–44 and by age 15–49 years. It is communal to give births to girls under 15 years of age to the 15–19 year age group and those to women over 49 years to the 45–49-year age group.

The most common nutritional deficient issues among women of reproductive age are 'Anemia'. It is most evident at all stages of the life cycle but more prevalent during adolescent, pregnancy and post pregnancy days. The major contributing factors for anemia are nutritional, genetic and infectious diseases. Although, iron deficiency is the main cause of at least 75% of anemia cases worldwide. Iron deficiency is linked

with serious health provoking problems such as impaired working capacity, weakness, malaise, headaches, cognitive impairment, decreased concentration or attention etc. The lack of iron in the body can be due to inadequate intake, impaired absorption, increased needs and excessive losses. Inadequate intake of iron is often associated with a vegetarian (or vegan) diet, malnutrition or lack of iron in the diet. Same food with a predominant fat and sugar content, fast food, various diets used to maintain low body weight eventually lead to iron deficiency and/or anemia. The prevailing iron deficiency is somehow based on dietary habits, for example, in India about 30% of people are vegan; in Russia, this indicator is more modest—about 3–4%, as in most countries of Europe (Switzerland, Spain, Portugal, Poland, etc.).

Sometimes, absorption of iron diminishing in the gastrointestinal tract (GIT) plays an important role in the development of iron deficiency and/or anemia. Diseases of the GIT found in 20–24% of women of reproductive age. Increased iron needs arise in childhood is associated with their active growth. In adolescents, this is also related to rise within an increase in the total mass of red blood cells and muscle mass. In young men, however, iron deficiency is less common than in women, although their growth and growth rate are higher. In women the high incidence of iron deficiency anemia is associated with the additional factor of blood losing during menstruation. If there is any disturbance of the development of menstrual function, it may result in chronic blood loss and iron deficiencies which initiate in puberty and they occur in a quarter of girls and adolescents. Chronic repeated blood loss is the most common cause of iron deficiency anemia. The highest rates of iron deficiency are distinctive for women of childbearing age is, associated with monthly blood loss, pregnancy, parturition and lactation. A study conducted in by ***(S. Kagamimori et al., 1998)*** has shown that 78% of Japanese schoolgirls have iron deficiency anemia (IDA) of varying severity 3 years after the onset of menstruation. Women of childbearing age are at high risk of developing IDA.

According, to **CDC** (centre for disease control and prevention) report, “IDA is a condition resulting from too little iron concentration in our body.” Iron (as a part of hemoglobin) is one of the minerals required by our body to carry out essential function, which is to transport oxygen from lungs to cells within our body. Iron is essential for the production of hemoglobin by erythroblasts. If it is not in adequate,

the hemoglobin production does not succeed and red blood cells decreases. This condition is prevalent as 'anemia'. According to W.H.O, the recommended hemoglobin level, for reproductive women (age 15 and over) is 120gm/L.

Many of them have chronic latent iron deficiency remains undiagnosed for a long time as there are no expressed clinical symptoms and the body is well adapted to it. The content of iron and ferritin in the serum during pregnancy decreases resulting as an increase in the volume of plasma and an increase in total iron-binding capacity (TIBC), the percentage of transferrin is also reduced. Increased needs are only partially counter balanced by increased absorption in the intestine and mobilization of iron stores. If iron stores are partially or completely depleted at the beginning of pregnancy; which is observed with frequent and/or profuse menstruation, iron deficiency can be relative or absolute by the time of delivery. Up to 50–60% of women do not have enough iron reserves during pregnancy which is associated with adverse perinatal outcomes.

1.1 THEORETICAL BACKGROUND

1.1.1 Elemental Iron

Iron, one of the most abundant metals on Earth, is essential to most life forms including humans. It is an integral part of proteins and enzymes that maintain good health. Iron has the longest and best-described history among all the micronutrients and it's a key element within the metabolism of almost all living creatures. In humans, iron is an important component of proteins involved in oxygen transport. It is also essential for the regulation of cell growth and differentiation. A deficiency of iron limits oxygen delivery to cells, leading to fatigue, poor work performance, and decreased immunity. Sometimes, excess amounts of iron can result in toxicity and even death. ***(Andrews, 1999)*** reported iron is also found in proteins such as ferritin that store iron for future needs and that transport iron in blood.

1.1.2 Metabolism of Iron

A well-balanced diet contains sufficient iron to satisfy body requirements. A human body requires iron for the synthesis of the oxygen transport proteins, hemoglobin and myoglobin, and other iron-dependent enzymes that participate in electron oxidation-reduction reaction. The total amount of iron present within the body varies with

weight, gender and long-term nutrition. It is also affected by the condition of health, growth and pregnancy. ***(Gibney et al., 2007)*** reported the total body iron averages approximately 3.8 g in men and 2.3 g in women. ***(Mann & Truswell, 2007; Geissler et al., 2005)*** added a fact that approximately 75% of iron is in the hemoglobin of red blood cells and about 25% is present in body which gets stores in the liver.

Several investigations such as ***(Shayeghi et al., 2005)*** has shown two transporters appear to mediate the entry of most if not all dietary iron into mucosal cells; one transfers intact haem molecules derived from hemoglobin or myoglobin in meal (haem carrier protein, HCP 1) ***;(Anderson & Frazer, 2005)*** showed the other (divalent metal transporter, DMT 1) transfers all other iron that is rendered soluble in the gastric juice and remains in solution in the small intestine (non-haem iron)**.**

1.1.3 Iron Bioavailability

There are two distinct types of dietary iron that are available in nature haem and non-haem iron. Haem iron is a constituent of hemoglobin and myoglobin in animal origin foods and therefore is present in meat, fish and poultry, as well as in blood products (haem, 40%). Haem iron accounts for a relatively small fraction of total iron intake-usually less than 1-2 mg of iron per day, or approximately 10-15% of the dietary iron consumed in industrialized countries. In many developing countries, haem iron intake is lower or maybe negligible. The second type of dietary iron, non-haem iron, are combined from of iron salts and iron in other proteins such as ferritin, which is important source, present in both foods of plant origin (non-haem, 100%) and foods of animal origin (non-haem, 60%). Besides the iron derived from food, the diet may also contain exogenous iron originating from the soil, dust, and water or cooking vessels. This is more frequently the case in developing countries, where the quantity of such contamination iron during a meal could also be several times greater than the quantity of food iron. The cooking of foods in iron pots may increase the iron content of a meal several fold. This is especially true for soups containing vegetables of low pH which are etiology and epidemiology simmered for a long time. Frying in iron pans does not generally increase the iron content in food. Any iron released during cooking is integrates into the non-haem iron pool and make it available for absorption.

(Hurrell, 1997) showed another form of exogenous iron is that present in foods such as flour, sugar and salt which are deliberately fortified with iron or iron salts. In plant

foods, iron exists in the less bioavailable non-haem form. Compared with absorption of haem- and non-haem iron is less influenced by the iron status of individuals, therefore the bioavailability of food iron is strongly influenced by enhancers and inhibitors in the diet shown in report of ***(WHO, UNICEF & UNU, 2001; Geissler & Powers, 2005).*** Iron absorption can change from 1% to 40%, relying on the mix of enhancers and inhibitors in the meal. As thus, the sufficiency - i.e. bioavailability - of iron in common diets can be meliorated by varying meal patterns to improve enhancers, lower inhibitors, or both considered in report of ***(WHO, UNICEF & UNU, 2001)***.

1.1.4 Iron Absorption

Iron absorption refers to the quantity of dietary iron that your body obtains from food. Healthy adults absorb about 15% of the iron in their diet. The chief influence on iron absorption is that the amount stored in your body. Iron absorption significantly increases when body stores are low. When iron stores are high, absorption decreases to assist against iron overload. Iron is mainly absorbed in the duodenum and upper jejunum which is regulated by three mechanisms:

(i) Dietary regulator: a short-term increase in dietary iron is not absorbed because the mucosal cells have accumulated iron and "block" additional uptake.

(ii) Stores regulator: as body iron stores fall, the mucosa is signaled to moderately increase absorption.

(iii) Erythropoietic regulator: in response to anemia the erythroid cells will signal the mucosa to extend iron absorption more significantly.

The absorption of iron may be a complex process influenced by the intestinal mucosa and therefore the amount of iron present within the diet. Vitamin C (ascorbic acid) enhances the absorption of iron while iron binding phenol compounds in beverages inhibits its absorption. Not all forms of iron are available for absorption. Generally, the animal sources appear superior to those of plant sources. Some researchers reported that since the average diet of a young woman seldom provide more than 6 mg-10 mg of iron daily and absorption is not more than (10-20) % of the food iron, many women enter pregnancies with inadequate stores.

To be absorbed, dietary iron must be in its ferrous (Fe^{2+}) form. A ferric reductase enzyme on the enterocytes reduces ferric Fe^{3+} to Fe^{2+}. A protein called divalent metal transporter 1 (DMT1), which transports all types of divalent metals into the body, then transports the iron across the enterocyte's cell membrane and inside the cell. These intestinal lining cells can then either store the iron as ferritin or the cell can move it into the body, employing a protein called ferroportin. The body regulates iron levels by regulating each of those steps. Recent discoveries demonstrate that hepcidin regulation of ferroportin is liable for the syndrome of anemia of chronic disease. While DMT1 is exclusive to iron transport across the duodenum, ferroportin is distributed throughout the body on all cells which store iron. Thus, regulation of ferroportin is that the body's main way of regulating the amount of iron in circulation. Hephaestin, a ferroxidase that which can oxidize Fe^{2+} to Fe^{3+} and is found mainly within the small intestine, helps ferroportin transfer iron across the basolateral end of the intestine cells.

Our bodies' rates of iron absorption appear to react to a variety of interdependent factors, including total iron stores, the extent to which the bone marrow is producing new red blood cells, the concentration of hemoglobin in the blood, and the oxygen content of the blood. We also absorb less iron during times of inflammation.

The composition of the diet may also influence iron absorption. Citrate and ascorbate (in citrus fruits, for example) can form complexes with iron that increase absorption, while tannates in tea can decrease absorption. The iron in haem found in meat is more readily absorbed than inorganic iron by an unknown mechanism. The ferrous kind of iron is more readily absorbed than ferric iron. Duodenal microvilli contain ferric reductase to promote absorption of ferrous iron. Only a little fraction of the body's iron is gained or lost each day. Some researchers explained that majority of the iron within the body is recycled when old red blood cells are taken out of circulation and destroyed, with their iron scavenged by macrophages within the mononuclear phagocyte system, and returned to the storage pool for re-use. Iron homeostasis is closely regulated via intestinal absorption. Increased absorption is signaled by decreasing iron stores, hypoxia, and erythropoietic activity.

1.1.5 Enhancement of Iron Absorption

(Geissler & Powers, 2005; Barasi, 2007) reported that ascorbic acid, citric acid, lactic acid, fructose and peptider from protein sources enhance the solubility of the iron, facilitating absorption. ***(Gibney et al., 2007; Mann & Truswell, 2007)*** reported that the absorption of non-haem iron can be improved when a source of haem iron is consumed in the same meal. The previous studies results shown by the different researchers that the most important enhances of non-haem iron absorption are ascorbic acid (vitamin C) by ***(Hurrell et al., 2004; Teucher et al., 2004; Geissler & Powers, 2005)***, meat by ***(Hurrell et al, 2006; Tetens et al., 2007)*** and fish by ***(Thuy et al., 2003; Thuy et al., 2005; Geissler & Powers, 2005)***. There are several foods such as amla, guava and citrus fruits, which promote iron absorption from plant foods was reported by ***(Gibney et al., 2007)***. Evidence also exists that the promotion of iron absorption of vitamin C mainly from fruits, juices, potatoes and some other tubers, and other vegetables such as green leaves, cauliflower, and cabbage is enlisted in report of **(WHO, UNICEF & UNU, 2001).** Factors promoting iron absorption was summarized in table 1.1.

1.1.6 Inhibition of Iron Absorption

(Geissler & Powers, 2005; Barasi, 2007) reported that phytate, polyphenols, oxalate, phosphates, calcium and zinc either bind with iron, making it less soluble, or compete for binding sites. Phytates, polyphenols, oxalate and phosphate block iron absorption such as in whole cereal grains; tea, coffee, nuts; spinach and egg yolk; respectively. ***(Mennen et al., 2007)*** reported a fact that Iron-binding phenolic compounds (tannins) present in black, green and herbal tea are not at risk of iron owing to any kind of tea drinking for healthy adults. ***(Gibney et al., 2007)*** showed dairy products rich in calcium such as milk or cheese can inhibit iron absorption. Calcium, particularly from milk and milk products inhibits iron absorption, while a milk glycoprotein, lactoferrin present in breast milk is a better source of iron than either cow's milk or non-fortified milk substitutes reported by ***(WHO, UNICEF & UNU, 2001; Geissler & Powers, 2005; Gibney et al., 2007).*** Factors inhibiting iron absorption was also summarized in table 1.1.

Table 1.1 Main factors affecting the bioavailability of dietary iron (Geissler & Powers, 2005, Barasi, 2007).

Factors enhancing absorption	Factors inhibiting absorption
Ascorbic acid (vitamin C)	Phytate (in whole cereal grains)
Citric acid	Polyphenols (in tea, coffee and nuts)
Lactic acid	Oxalate (in tea, spinach)
Fructose	Phosphates (in egg yolk)
Peptides from protein sources, especially meat, fish and poultry	Calcium and Zinc

Note: Calcium inhibits both haem and non-haem iron absorption. All other factors affect only non-haem iron.

1.1.6 Iron Storage and Losses

1.1.6.1 Iron Storage

Several researchers reported storage of iron in different parts of body. ***(Gibney et al., 2007)*** reported iron is stored as ferritin or hemosiderin, which is found primarily in the liver, spleen, reticulo-endothelial cells and bone marrow. They also proclaimed that in men, about one-third of the total body iron is storage iron, but in women only about one-eighth is storage iron. ***(Gibney et al, 2007; Semba & Ramakrishnan, 2008)*** clearly signified that in the liver, iron is stored mainly in parenchymal cells or hepatocytes, while in the bone marrow and spleen iron is stored in reticulo-endothelial cells. ***(Semba & Ramakrishnan, 2008)*** explained that the stored iron is chiefly a reservoir of iron to supply cellular needs for hemoglobin production.

1.1.6.2 Iron Losses

Similarly, the same researchers diagnosed the iron losses occur due to varies reasons. ***(Gibney et al., 2007; Semba & Ramakrishnan, 2008)*** reported that iron losses occurred in normal individuals mainly in faces (0.6 mg/day), bile and desquamated mucosal cells, and in minute quantities of blood. Other ways of iron loss include desquamated skin and sweat (0.2-0.3 mg/day), urine (<0.1 mg/day). They also proclaimed that greater iron utilization via growth in childhood, greater iron loss with minor hemorrhages, menstruation (0.4-0.5 mg/day) in women, and greater need for iron in pregnancy will increase 1.3-1.4 mg of absorbed dietary iron. ***(Gibney et al., 2007)*** compared iron losses with women that of men require about 1 mg (range 0.5-2.0 mg/day) iron daily each day, and this is sufficient to balance the daily losses from desquamation of epithelia. ***(Mann & Truswell, 2007)*** explained that iron supplied in the diet is balanced by iron losses and requirements for growth, pregnancy and lactation.

1.1.6.3 Iron Overload

Sometimes, excessive intake of iron can lead to several other disorders, which directly or indirectly affects the cells and tissues of body. ***(Mann & Truswell, 2007)*** explained that iron overload has been associated with damage of the liver and other organs of people with primary or secondary increased iron overload which can lead to hereditary hemochromatosis. The other non-genetic causes may occur such as complications from other blood disorders, chronic transfusion therapy, chronic hepatitis, and excessive iron intake. In fact, symptoms or early symptoms of iron overload or hemochromatosis include fatigue, weakness, abdominal pain, vomiting, liver cirrhosis, liver cancer, heart failure, arthritis and endocrine disease.

(Semba & Ramakrishnan, 2008) reported hereditary hemochromatosis is an autosomal recessive disorder, and a study has found a homozygote frequency of 100-500 per 100,000 in North America and Europe**.** People of northern European decent are most likely to have the gene mutation that causes iron overload which can lead to hemochromatosis, but in developing countries, such as Indian sub-continent, incidence of hemochromatosis is lower than northern European. The prevalence of severe hereditary anemia such as thalassemia major is more usual because of repeated transfusion in Asia and Africa.

(Allen et al., 2008) reported that iron-overload related disease in hereditary hemochromatosis commonly develops in men, but not in women. ***(Mann & Truswell, 2007; Semba & Ramakrishnan, 2008)*** the preferred treatment for reducing iron levels in hemochromatosis patients is called therapeutic phlebotomy.

1.2 ANEMIA

1.2.1 Definitions of Anemia

Erythrocyte is size-measured as mean corpuscular volume (MCV). Hemoglobin concentration reduced as consequence of significant iron deficiency ***(Lewis et al., 2001; Balducci, et al., 2007)*** Anemia is the decreased ability of the RBCs to provide adequate oxygen to body tissues. It may be due to a decreased number of RBCs, a decreased amount of substance in RBCs, which transports oxygen (hemoglobin), or a decreased volume of RBCs ***(Balducci, et al., 2007; Bridges & Pearson, 2008).*** Measurements of hemoglobin, serum ferritin, serum iron, and transferring (total iron-binding capacity, TIBC) capacitate iron status to be characterized in detail of anemia ***(Dallman et al., 1992).***

Anemia is defined that in clinical terms as an insufficient mass of RBCs circulating in the blood; in public health terms anemia is defined as a hemoglobin concentration below the thresholds given by ***WHO, UNICEF & UNU (2001).***

Anemia affects roughly one third of the world's population and over 800 million women and children. Anemia is associated with poor cognitive and motor development outcomes in children, can cause fatigue and low productivity, and, when it occurs in pregnancy, is associated with poor birth outcomes (including low birth weight and prematurity) as well as maternal and perinatal mortality. In 2010, anemia estimated to account for more than 68 million years lived with disability, more than the estimate for major depression, chronic respiratory diseases and injuries combined. As such, anemia has significant consequences for global health as well as social and economic development in low, middle and high-income countries.

The Indian council of medical research (ICMR) categorizes anemia into four categories on the basis of hemoglobin level in blood shown in table 1.2:

Table 1.2: Categorization of anemia according to hemoglobin concentration

Category	Haemoglobin concentration (gm/dl)	Anemic level
I	11.0-11.90	Mild
II	8.0-10.9	Moderate
III	<8.0	Severe
IV	<4.0	Very Severe

1.2.2 Prevalence of Anemia

The prevalence of ID and IDA varies greatly from population to population according to a variety of host and environmental factors. The etiology of anemia is multifaceted and often several factors are at play in an anemic individual. Nutritional anemia as a result of iron deficiency is the most common cause of anemia worldwide, with approximately 50% of all cases attributed to a lack of iron in the diet. A number of host and environmental factors are associated with iron deficiency, and in more severe forms contribute to IDA as well. These include:

1. ***Inadequate dietary iron intake*: *(Clark, 2008; Fiatarone-Singh et al., 2000)*** showed diets low in iron or diets low in adequate amounts of bio-available iron are a major cause of IDA, particularly in non-industrialized countries. Typically, high levels of IDA are also observed in old age when dietary quality and quantity deteriorates.

2. ***Menstruation and pregnancy*: *(Bothwell, 1995)*** showed specification in blood losses associated with menstruation and pregnancy are common causes of ID and IDA. Typically non-menstruating women lose about 1 mg of iron per day, while menstruating women lose an additional 10 mg of iron per day during menses. Pregnancy is associated with an iron loss of approximately 1000 mg in a 55kg woman.

3. ***Infectious disease: (Oppenheimer, 2001)*** reported that in the developing world common infections which may be both chronic and recurrent are associated with blood loss leading to iron deficiency, and ultimately to IDA. Hemolytic malaria and parasitic infections such as hookworm, trichuriasis,

amoebiasis, and schistosomiasis are particularly common diseases that contribute to the depletion of iron stores and often result in IDA.

4. ***Interactions with medication: (Rockey & Cello, 1993)*** **s**everal pharmacological agents can interfere with iron uptake and/or transport leading to iron loss or defective absorption. These include H2 blockers, proton pump inhibitors, aspirin or non-steroidal anti-inflammatory drug use.

5. ***Gastrointestinal conditions*****:** ***(Rockey & Cello, 1993)*** both acute and chronic gastrointestinal illness is associated with IDA and is an important consideration in clinical diagnosis of the condition. ***(Clark, 2008)*** Duodenal or gastric ulcers, carcinoma, polyps, irritable bowel disease, erosive gastritis, celiac disease, altered hepatic function for any number of reasons, and/or compromised protein status may lead to IDA.

6. ***Periods of growth*****:** ***(McLean et al., 1995; Tolentino & Friedman 2007; Turner et al., 2003)*** iron deficiency and IDA are particularly prevalent during peak periods of growth. Though full-term infants are normally born with adequate iron stores, if complementary foods containing iron are not introduced to the diet after six months of age then an infant is at risk of developing ID, and ultimately IDA. Iron requirements on a body weight basis are proportional to growth velocity, thus iron deficiency and IDA are common in preschool years and during puberty.

7. ***Socioeconomic status*****:** Iron deficiency and IDA are most common among groups of low socioeconomic status for a number of reasons, including but not limited to ***(Bhargava et al., 2001; Thankachan et al., 2007)*** reported malnutrition, poor education regarding health and hygiene, and greater presence of concomitant disease when compared to populations of higher socioeconomic status.

1.2.3 Classification and Etiology of Anemia

Anemia diagnosed when the concentration of hemoglobin falls below established cut-off values. When the hemoglobin concentration decreases, the capacity of the blood to carry oxygen to tissues compromised, resulting in symptoms such as fatigue reduced physical work capacity, and shortness of breath.

Anemia develops through three main mechanisms: ineffective erythropoiesis (when the body makes too few red blood cells), hemolysis (when red blood cells are destroyed) and blood loss. Nutritional deficiencies, diseases and genetic hemoglobin disorders are the most common contributors to anemia. Iron deficiency, hemoglobinopathies and malaria considered as the three top causes of anemia globally and discussed broadly below. Anemia are frequently classified by their cause (e.g. nutritional anemia or hemolytic anemia), but can also be distinguished by the size, shape and color of the red blood cells. For example, in *microcytic* anemia like iron-deficiency anemia, the amount of hemoglobin in each red blood cell reduced and the cells are smaller than normal. Iron-deficiency anemia also classified as *hypochromic*, since the red blood cells are less red in colour. *Megaloblastic* anemia (red cells are larger than normal) is characteristic of folate or vitamin B12 deficiencies.

1.2.4 Contributors to IDA

I. Nutrient Deficiencies

"Nutritional anemia" result when the intake of certain nutrients is insufficient to meet the demands for synthesis of hemoglobin and erythrocytes. Iron deficiency is the most common cause (nutritional or otherwise) of anemia and is estimated to contribute to approximately 50% of all cases of anemia among non-pregnant and pregnant women, and 42% of cases in children under 5 years of age worldwide. However, the proportion of anemia due to iron deficiency will vary, depending on the age and sex of the group being studied, the region of the world in which they live and the prevalence of other causes of anemia in that particular area. Deficiencies of vitamins A, B2 (riboflavin), B6 (pyridoxine), B12 (cobalamin), C, D and E, folate and copper can also result in anemia, owing to their specific roles in production of hemoglobin or erythrocytes.

II. Disease

Infectious diseases can cause anemia through multiple mechanisms, including impaired nutrient absorption and metabolism, ineffective erythropoiesis, or increased nutrient losses. Acute and chronic infections can also contribute to what commonly called "anemia of chronic disease" or "anemia of chronic inflammation", whereby pro-inflammatory cytokines alter iron metabolism so that iron is sequestered in stores as ferritin, and the production and lifespan of red blood cells are reduced. Anemia of

chronic disease/inflammation are characterized by a normochromic, normocytic anemia with low red blood cell counts and is the second most prevalent anemia after iron-deficiency anemia.

III. Genetic Hemoglobin Disorders

Structural variation or reduced production of the globin chains of hemoglobin can also result in anemia. Globally, more than 300 000 children estimated to be born each year with a serious inherited hemoglobin disorder, and approximately 80% of these births occur in low- or middle income countries . Sickle cell disorders, which are associated with chronic hemolytic anemia, are the most common genetic hemoglobin disorder, found predominantly in sub-Saharan Africa, followed by β- and α-thalassemia, which are primarily concentrated in Southeast Asia *(9)*. Roughly, 5% of the global population estimated to carry a significant hemoglobin variant; the percentage is much higher in Africa (18%) and Asia (7%).

1.3 VULNERABLE GROUP

The population groups most vulnerable to anemia include children less than 5 years of age, particularly infants and children under 2 years of age, adolescents, women of reproductive age (15–49 years), and pregnant women. Other at-risk groups include the elderly, though the prevalence and etiology of anemia among older adults not as well characterized.

(a) Infants and Young Children under 2 years of Age

This age group is particularly vulnerable to developing anemia. Iron-deficiency anemia is common in infants and young children, owing to the high iron requirements needed for their rapid growth and development, particularly during the first 2 years of life. In addition, typical complementary foods fed to children are frequently low in iron content (in quantity and bioavailability) and have high contents of inhibitors of iron absorption. Low birth weight and prematurity also negatively impact the iron stores present at birth, thus further compromising the iron status of very young children, particularly in countries where intrauterine growth restriction is common.

(b) Children under 5 years of Age

However, children over 2 years of age generally have a lower prevalence of anemia than the youngest children, as a group, children aged less than 5 years bear the largest burden of anemia globally.

(c) Adolescents and Women of Reproductive Age (non-pregnant and pregnant)

This group is also at increased risk of developing iron deficiency and anemia, for several reasons. Regular blood loss that occurs with menstruation increases iron losses and thus iron requirements. Periods of high growth and development during adolescence and pregnancy incur significant additional iron needs (e.g. for the fetus, placenta and expanded maternal blood volume in pregnancy).

Women may also experience significant iron loss from bleeding in childbirth, and diets that are low in bio-available iron are common among women and adolescents in many low- and middle-income countries. In some settings, intra-household food allocation may be based on differential valuation of household members; women, girls and the elderly are more likely to be negatively affected by this unequal distribution. Pregnant adolescents are at particular risk of developing anemia, not only because of their dual iron requirements (for their own growth and for the growth of the fetus), but because they are also less likely to access antenatal care.

(d) Older Adults

Individuals over 65 years of age (or 60 years in some national and international classifications) considered older adults. Anemia in this group may represent a substantial burden in the future, owing to the increasing size of the elderly population globally, as well as increasing lifespans. Global data on the prevalence and causes of anemia among the elderly are limited, but it is known that the prevalence of anemia increases with age, starting at the age of 50 years, and that anemia affects men in this age group more commonly than women . Roughly one third of anemia cases in the elderly in the United States of America (USA) are due to nutritional deficiencies, primarily iron (but also folate and vitamin B12); one third are due to chronic inflammation or chronic kidney disease; and one third are considered “unexplained anemia of the elderly”, a form of hypo proliferative normocytic anemia not due to nutritional deficiency, chronic kidney disease or inflammatory disease, in which the erythropoietin response to anemia is compromised.

1.4 TYPES OF ANEMIA

1.4.1 Iron Deficiency Anemia

Iron deficiency anemia is a condition where there is a reduced amount of hemoglobin and decreased number of red blood cells in the body. ***WHO (2015)***defined Iron-deficiency anemia (IDA) as the most common type of nutritional anemia which results from long-term negative iron balance and is responsible for approximately 50% of all anemia. It is a severe stage of iron shortage in which hemoglobin falls below the normal range (Hb 12.0 mg/dL or hematocrit below 36%).***(Lanerolle and Atukorala, 2006; WHO, 2015)*** showed Anemia leads to less oxygen getting to the cells and tissues affecting their function. About 3.3 million women of child bearing age have iron deficiency anemia. ***(WHO, 2015)***publishedIron deficiency with or without anemia reduces work productivity in adults and limits cognitive development in children, thus limiting their achievement in school and ultimately reducing investment benefits in education. It is estimated that about 2,150 million people are iron deficient and that this deficiency is severe enough to cause anemia in 1,200 million people globally. ***(WHO, 2015; Fleming, 1970)*** reported in the developing world nearly half of the population is iron deficient. However, the industrial world is not free from it: 11 % of its population has iron deficiency. Roughly 47% of non-pregnant women and 60% of pregnant women have anemia worldwide, and including iron deficiency without anemia the figures may approach 60 and 90% respectively. In the industrial world as a whole, anemia prevalence during pregnancy averages 18%, and over 30% of these populations suffer from iron deficiency.

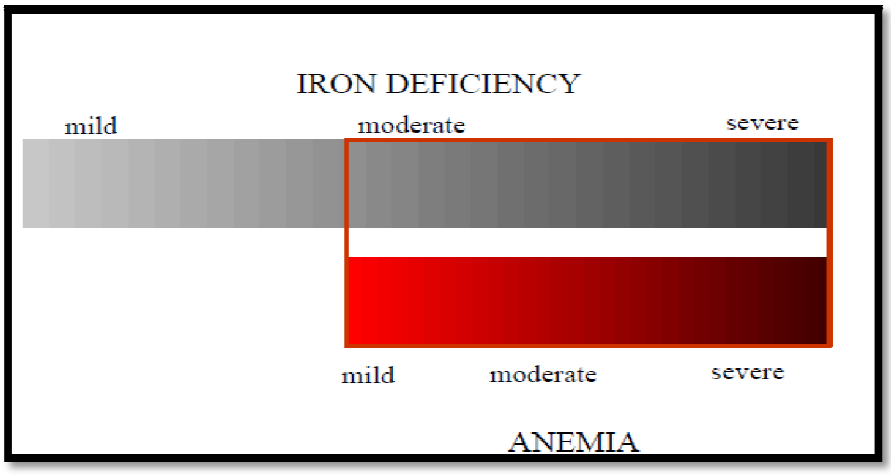
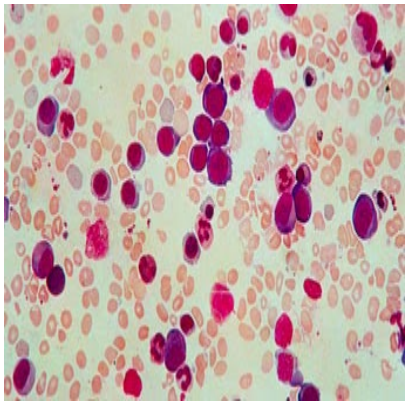


Figure 1.1 Spectrum of Iron Deficiency and Anemia

1.4.2 Iron Deficiency in Pregnancy

The high risk of women of fertile age and pregnant women for incurring negative balance and iron deficiency is due to their increased iron needs because of menstruation and the substantial iron demands of pregnancy. Median requirements of absorbed iron are estimated to be 1.36 and 1.73 mg per day among adult and teen-age menstruating females. However, 15% of adult menstruating women require more than 2.0 mg per day, and 5% require as much as 2.84 mg per day. The superimposition of menstrual losses and growth in menstruating teenage girls increases the demands for absorbed iron; 30% need to absorb more than 2.0 mg of iron per day; 10% as much as 2.65 mg, and 5% 3.21 mg. These requirements are very difficult, if not impossible to satisfy even with good quality, iron-fortified diets.

1.4.3 Folic Acid Deficiency Anemia



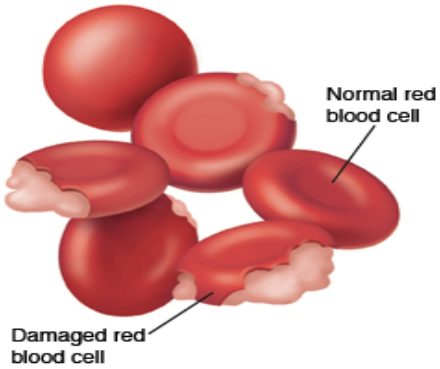
Folic acid is a member of the vitamin B family; it is used in the production of new red blood cells. Some people do not have enough folic acid in their normal diet, so their bodies are unable to produce enough red blood cells. In other cases, the body may not be able to properly use the folic acid ingested. Folic acid deficiency anaemia occurs most often in infants and teenagers. Some important sources of folic acid are cheese, eggs, fish, green vegetables, meat, milk, and yeast. Smoking can also interfere with the body's ability to use folic acid.

1.4.4 Pernicious Anemia

The most common form of vitamin B12 deficiency anaemia is called pernicious anaemia. People between the ages of fifty and sixty are at highest risk for pernicious anaemia, which is a form of anaemia in which the body is unable to absorbed vitamin B12, Pernicious anaemia is characterized by decrease gastric production of hydrochloric acid and deficiency of intrinsic factor, a substance normally secreted by the parietal cell of the gastric mucosa that’s essential for vitamin B12 absorption.

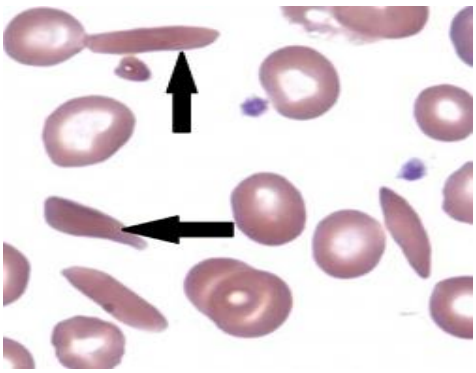
Some conditions that can lead to pernicious anaemia are eating disorders, anorexia nervosa and bulimia entries, poor nutrition, diabetes mellitus stomach problems, and thyroid disease.

1.2.5 Hemolytic Anemia



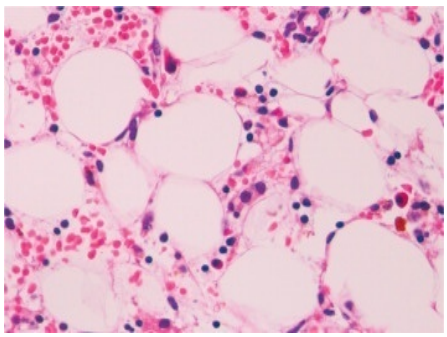
Hemolytic anaemia occurs when red blood cells are destroyed faster than they are made. In some cases, an infection can cause this problem. In other cases, the body's own immune system destroys the red blood cells. Some symptoms of hemolytic anemia include pain, shock, gallstones, an enlarged spleen, and other serious health problems.

1.2.6 Sickle Cell Anemia

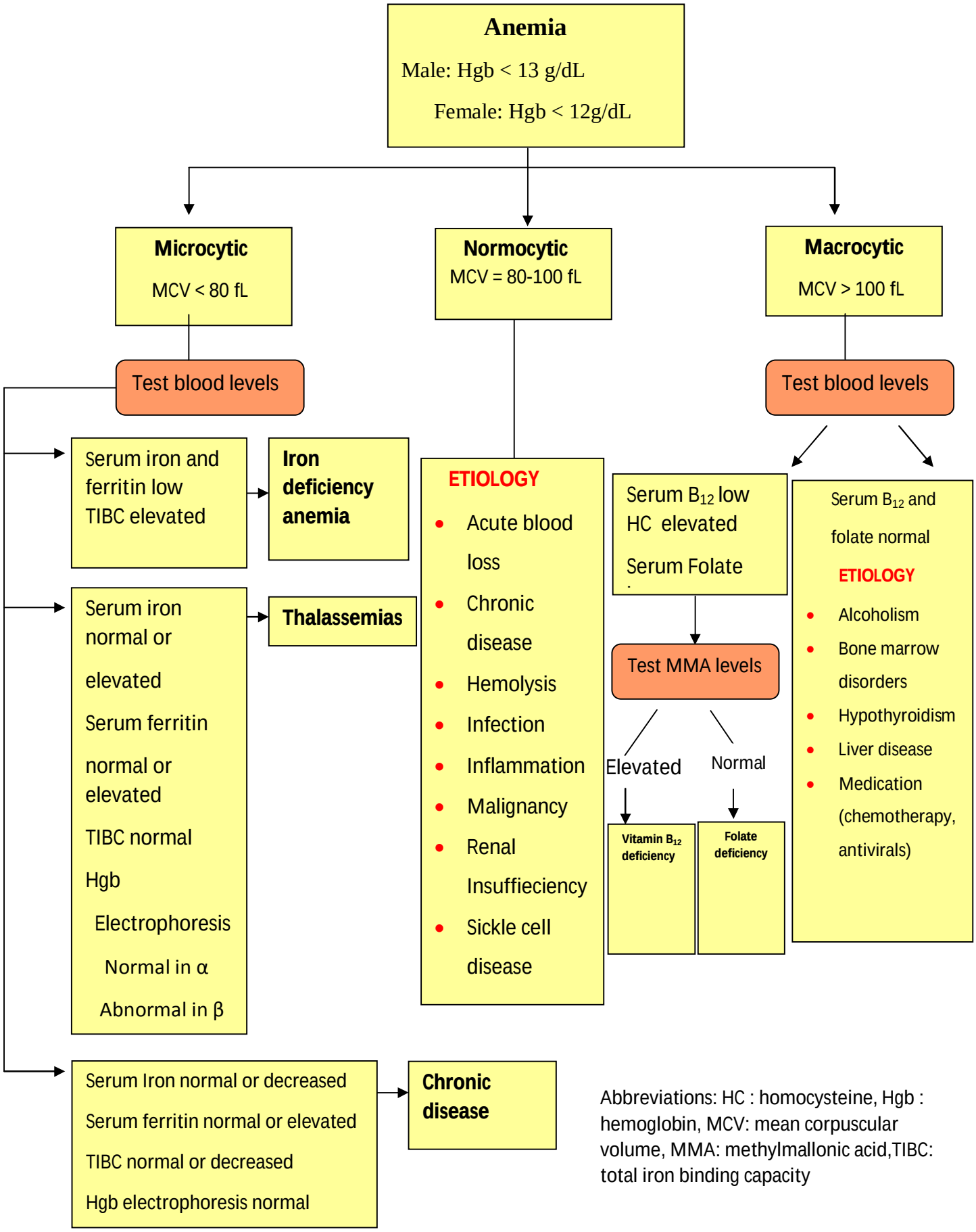


Sickle cell anemia is a genetic disorder. Cells receive genes that give them the wrong instructions for making red blood cells. When sickle haemoglobin gives up its oxygen to the tissues, it sticks together to form long rods inside the red blood cells making these cells rigid and sickle-shaped whiles the normal red blood cells are flexible. This can lead to this small blood vessel getting blocked which then stops the oxygen from getting through to where it is needed. This in turn can lead to severe pain and damage to organs. This condition can cause pain, weakness, and, in extreme cases, death.

1.2.7 Aplastic Anemia



Aplastic anaemia is a serious form of anaemia that can lead to death. The body makes too few of all kinds of blood cells: red blood cells, white blood cells, and platelets, because the bone marrow fails to produce them. One well known cause is the white cell attacking the bone marrow (autoimmune). Platelets are blood cells that help blood to clot.



Abbreviations: HC : homocysteine, Hgb : hemoglobin, MCV: mean corpuscular volume, MMA: methylmallonic acid,TIBC: total iron binding capacity

1.5 Stages of Development of Iron Deficiency Anemia

Iron deficiency develops in stages, but blood symptoms do not develop until iron deficiency has progressed quite far to the point where brain and muscular activity may already be impaired. Unfortunately, low hemoglobin and hematocrit test results are often relied upon as the first indicators of iron deficiency.

The three overlapping stages of iron deficiency are as follows:

• ***Stage One*:** The body's iron stores for erythropoiesis are depleted; but, at this stage, erythropoiesis remains normal as does the hemoglobin content of the maturing erythrocytes.

• ***Stage Two*:** Not enough iron is transported to the marrow, and iron-deficient erythropoiesis begins.

• ***Stage Three*:** This stage begins when the small, hemoglobin-deficient cells enter the circulation in increasing numbers, replacing normal erythrocytes that have grown old and have been removed from the circulation. By this time, the development of iron deficiency anemia is associated with the depleted transport of iron stores and diminished hemoglobin production.

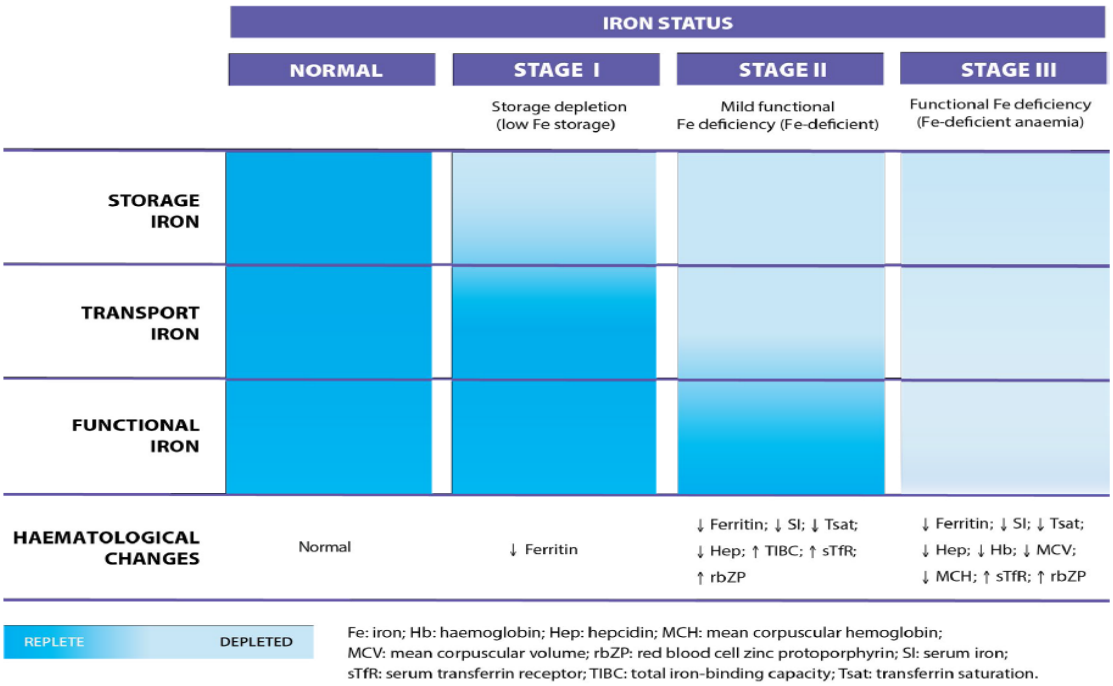


Figure 1.2 Three different stages showing the iron status.

Iron is found in all plants foods but is more plentiful and bio-available in meat. Deficiency results from ineffective absorption of iron excess loss. Absorption is

tightly regulated in the intestines depending on the iron status of the individual, the type of iron and other nutritional requirements. Once iron is absorbed it is well conserved. Iron is depleted primary through blood loss, including from parasitic infections such as schistosomiasis and hookworm.

Iron deficiency is the most principal source of anemia worldwide. The principal cause is dietary iron deficiency (due to low iron intake or poor bioavailability caused by high intake of iron binders such as phytate or tannins common to cereal based diets). Physiological increases in iron losses (e.g. menstrual losses, iron losses to the fetus during pregnancy, iron lost in the milk during lactation), or pathological iron losses (e.g. gastrointestinal hemorrhage), increased tissue iron requirements (e.g. during periods of rapid growth in infants, children and adolescents) or, more rarely, malabsorption of iron due to intrinsic gastrointestinal disease, are all contributors to iron deficiency anemia. The decline in body iron is first marked by the depletion of iron stores, which indicates the onset of iron deficient erythropoiesis.

Hemoglobin synthesis starts to become impaired and hemoglobin concentration falls. Iron deficiency anemia is characterized by microcytic-hypochromia red blood cells. Because of the gradual progression of the disorder, many patients are initially without symptoms and tend not to seek medical help until the anemia becomes severe, that is, when hemoglobin levels have dropped to a certain level (about 7 or 8 g/dl). Long before the mass of the red blood cells is affected and anemia is diagnosed, a developing iron deficiency affects behavior. Even at slightly lowered iron levels, the complete oxidation of pyruvate is impaired, reducing physical work capacity and productivity, resulting in common symptoms of fatigue, weakness, and shortness of breath.

In advanced stages, decreased hemoglobin and the consequent decrease in the blood's oxygen-carrying capacity cause the patient to develop dyspnea on exertion, fatigue, dizziness, listlessness, pale ear lobes, palms, conjunctiva, and mucous membranes, inability to concentrate, irritability, headaches, susceptibility to infection, and a tingling sensation in the fingers and toes. Decreased oxygen perfusion causes the heart to compensate with increased cardiac output and tachycardia. Other, less common manifestations of iron deficiency include glossitis (inflammation of the tongue), angular stomatitis (fissuring at the corners of the mouth), and koilonychia

(concave or "spoon" fingernails). Structurally or functionally altered epithelial tissue is often found in individuals with iron deficiency anemia. The nails become brittle, thin, and "spoon-shaped" or concave as a result of impaired capillary circulation. The tongue may be sore, with redness and burning, caused by atrophy of the papillae. However, these changes can be reversed.

1.6 Causes of Iron Deficiency Anemia

(WHO, UNICEF & UNU, 2001) reported Iron deficiency is the most common known from of nutritional deficiency. ***(Bridges & Pearson, 2008; Semba & Ramakrishnan, 2008)*** reported Iron-deficiency anemia, often caused by insufficient iron intake such as special diets low i.e. low consumption of meat and special diets high i.e. high consumption of phytates in dietary iron; poor absorption of iron by the body; and almost invariably reflects chronic bleeding such as excessive menstrual bleeding, non-menstrual bleeding, bleeding from gastrointestinal tract and blood loss from reproductive system. ***(Loukas et al., 2005; Pasricha et al., 2008)*** indicated that the high prevalence of iron deficiency in the developing world where hookworm infestation, causing owing to blood loss. ***(Brabin, 1983; Brabin et al., 2001)*** reported that in some low-income countries, malaria was an important factor related to maternal mortality in pregnancy. (***WHO, UNICEF & UNU, 2001; Semba & Ramakrishnan, 2008)*** it is now apparent that the poor bioavailability of iron in largely unprocessed cereal-based diets is the major cause of iron deficiency in the developing countries.

There are many causes for iron deficiency anemia of which the major causes are as follows:

i. An inadequate dietary intake of iron (less than 1 to 2 mg/day) as a result of a poor diet; prolonged, unsupplemented breast- or bottle-feeding of infants; or during such periods of stress as rapid growth in children and adolescents. The elderly often develop anemia as their interest in food wanes. Dieters are another group that can become anemic because they do not meet their iron need.

ii. Iron mal-absorption which prevents iron from being used and may occur because of chronic diarrhea, partial or total gastro-ectomy, or such other mal-absorption syndromes as celiac disease (where the lining of the small

intestine is damaged by the effects of gluten - the protein found in wheat and other cereal grains of the grass family)

iii. Secondary blood loss resulting from drug-induced gastrointestinal bleeding (usually from anticoagulants, aspirin, or steroids); heavy menses; or hemorrhage from trauma, gastrointestinal ulcers, malignancy, or varices (enlarged veins, arteries, or lymphatic vessel)

iv. Pregnancy, which diverts maternal iron to the fetus for erythropoiesis and then Mechanical erythrocyte trauma, caused by a prosthetic heart valve or vena cava filters.

Such diseases as rheumatoid arthritis, connective tissue disorders, chronic infection, trauma or malignancy are commonly confused with mild iron deficiency anemia. Instead, they are related to anemia of chronic disease. Such diseases as rheumatoid arthritis, connective tissue disorders, chronic infection, trauma or malignancy are commonly confused with mild iron deficiency anemia. Instead, they are related to anemia of chronic disease.

In India, iron deficiency anemia is mostly influenced by poverty, illiteracy, ignorance and lack of knowledge regarding iron deficiency anemia and dietary requirements and nutritive value of different vegetables. Iron-deficiency anemia (IDA) is often caused by insufficient iron intake. Iron-deficiency anemia doesn't develop immediately. Instead, a person progresses through stages of iron deficiency, beginning with iron depletion, in which the amount of iron in the body is reduced while the iron in RBCs remains constant. If iron depletion isn't corrected, it progresses to iron deficiency, eventually leading to IDA. Not having enough iron in our body causes iron-deficiency anemia. Lack of iron usually is due to blood loss, poor diet, or an inability to absorb enough iron from the foods that we eat.

(a) Blood loss

When one loses blood, one loses iron. If enough iron is not stored in one's body to make up for the iron loss, the person develops iron-deficiency anemia. In women, low iron levels may be due to blood loss from long or heavy menstrual periods or bleeding fibroids in the uterus. Blood loss that occurs during childbirth is another cause for low iron levels in women. Internal bleeding (bleeding inside the body) also may lead to

iron-deficiency anemia. This type of blood loss isn't always obvious, and it may occur slowly. Some causes of internal bleeding are:

- A bleeding ulcer, colon polyp, or colon cancer.
- Regular use of aspirin or other pain medicines, such as no steroidal anti-inflammatory drugs (for example, ibuprofen and naproxen).
- Urinary tract bleeding.

(b) Poor diet

The best sources of iron are meat, poultry, fish, eggs, and iron-fortified foods (foods that have iron added). If a person doesn't eat these foods regularly, or if he/she doesn't take an iron supplement, he/she is more likely to get iron-deficiency anemia. Insufficient intake of iron enhancers in the diet (foods rich in vitamin C such as citrus fruits) will lead to iron deficiency anemia. Vegetarian diets can provide enough iron if the right foods are eaten. For example, good non-meat sources of iron include spinach and other dark green leafy vegetables, certain types of beans, dried fruits, and iron-fortified breads and cereals. Inability to absorb enough iron Even if there's enough iron in our diet, our body may not be able to absorb it. This may be due to intestinal surgery or diseases of the intestine, such as Crohn's disease or celiac disease. Prescribed medicines that reduce acid in the stomach also can interfere with iron absorption.

(c) Pregnancy

During some stages of life, such as pregnancy and childhood, it may be hard to get enough iron in diet. This is because the need for iron increases during these times of growth and development. Women of child bearing age are at increased risk for iron-deficiency anemia because of blood loss during their monthly periods. About 1 in 5 women of child bearing age has iron-deficiency anemia. Pregnant women also are at higher risk for the condition because they need twice as much iron as usual. The extra iron is needed for increased blood volume and for the fetus growth. About half of all pregnant women develop iron-deficiency anemia which may be the cause for a premature or low-birth-weight baby.

(d) Infectious disease

In the developing world common infections which may be both chronic and recurrent are associated with blood loss leading to iron deficiency, and ultimately to IDA. Hemolytic malaria and parasitic infections such as hookworm, amoebiasis, and schistosomiasis are particularly common diseases that contribute to the depletion of iron stores and often result in IDA.

(e) Interactions with medication

Several pharmacological agents can interfere with iron uptake and/or transport leading to iron loss or defective absorption, including non-steroidal anti-inflammatory drugs, H2 blockers, proton pump inhibitors, and aspirin.

(f) Socioeconomic status

Iron deficiency and IDA are most prevalent among women of low socioeconomic status for a number of reasons, including malnutrition, poor knowledge regarding prevention of anemia and worm infestation, and presence of concomitant disease when compared to populations of higher socioeconomic status.

(g) Other risk groups

People who get kidney dialysis treatment may develop iron deficiency anemia. This is because blood is lost during dialysis. Also the kidneys are no longer able to make enough of a hormone needed to make red blood cells.

1.5 SYMPTOMS and CONSEQUENCE OF IRON DEFICIENCY

The value of fall in hemoglobin may bind to symptoms. ***(Mason, 2007)*** concluded symptoms of iron deficiency include fatigue, weakness, pallor, dyspnoea on exertion and palpitations. Although, symptoms of iron deficiency can occur even before the condition has progressed to IDA; therefore this is why it is important to screen hemoglobin for too little iron among high risk groups.

(Mason, 2007; Mann & Truswell, 2007) showed the impact of non-hematological includes damage in work capacity, intellectual performance, neurological function and impaired immune function and, in children, psychomotor disturbances. Symptoms of gastrointestinal tract are painful atrophy of the mucosa membrane covering the tongue, the esophagus and the stomach; and brittle, grooved fingernails and spoon-shaped nails. ***(Bridges & Pearson, 2008)*** reported people with severe, long-standing

iron deficiency and folate deficiency have a same symptom. ***(WHO, UNICEF, UNU, 2001; Nacher et al., 2002; Yazdani et al., 2004)*** showed specifically, prevalence of IDA among pregnant women increases perinatal risks for mothers and neonates, meanwhile increases overall infant mortality .

Figure 1.3 Atrophic glossitis and angular stomatitis due to iron deficiency (Bridges &Pearson, 2008, p. 101).

A mild case usually causes no symptoms or problems. However, a severe case can cause extreme fatigue (tiredness) and weakness. Severe iron-deficiency anemia can lead to serious problems for young children and pregnant women, and it can affect the heart. This type produces red blood cells (RBCs) that are smaller than usual, and hence, the term microcytic is used when referring to them. RBCs are not only reduced in size and number, but contain a subnormal amount of hemoglobin, which causes cells to become pale. The term hypochromia describes cells that are pale in color because they do not contain their full complement of hemoglobin.

1.5.1 Common signs and symptoms

- Lethargy
- Slow development
- Difficulty in maintaining body temperature
- Decreased immune function
- Inflamed tongue
- Headaches
- Palpitations
- Dizziness
- Emotional instability
- Depression and restlessness
- Stress fractures (rarely)

1.6 MAGNITUDE OF THE PROBLEM

A Systematic Analysis of Global Anemia Burden (1990 to 2010) aimed to produce the first complete account of global anemia burden. Prevalence was higher in most of the regions among females. South Asia and Central, West, and East sub-Saharan Africa had the highest burden, while East, Southeast Asia saw the greatest reductions.

WHO database (1995-2005) Micronutrient Deficiency Information System (MDIS) estimated the prevalence of iron deficiency anemia among the industrialized and non-industrialized countries. In non-industrialized countries, 30% to 60% of non-pregnant women were anemic with the highest rates in Asia and Africa. Iron deficiency was the main cause of anemia in industrialized countries, whereas in the non-industrialized countries the other factors such as malaria and parasitic infections (hookworm) played a role. According to the WHO database, in the industrialized countries, the most affected groups were pregnant women (18% anemic), school children (17 % anemic), non-pregnant women and the elderly, (both 12% anemic). In the non-industrialized countries, the most affected population groups were pregnant women and school-aged children (both 53% anemic), non-pregnant women (44% anemic), preschool children (42% anemic) and the elderly (51% anemic). The prevalence of anemia was low among the adult males in industrialized countries (4.7% anemic), but in non-industrialized countries, not less than 1/3 of the adult males were anemic.

National Family Health Survey (NFHS) (2011) estimated that about 20%-40% of maternal deaths in India are due to anemia. India contributed to about 50% of global maternal deaths due to anemia. Iron is used for formation of hemoglobin, oxygen transportation, brain development, regulation of body temperature and muscle activity. When the hemoglobin level is decreased in human body, it is called as iron deficiency anemia. Iron deficiency is the most common etiological factor in causing anemia**.**

Anemia is a serious public health problem, which affects the mental and physical development, as well as health maintenance and work performance. Iron deficiency is by far the most common cause of anemia worldwide. About 2 billion people suffer from varying degrees of anemia in developing countries. Iron deficiency occurs when

insufficient iron is absorbed to meet the body's needs. This may be due to inadequate iron intake, poor iron absorption, increased iron need or chronic blood loss. Prolonged iron deficiency leads to iron deficiency anemia (IDA).

1.7 ASSESMENT OF ANEMIA

Anemia is most frequently assessed at a population level through measurement of blood hemoglobin concentration. Anemia can also be diagnosed, though less frequently, using hematocrit (packed cell volume), mean cell volume, blood reticulocyte count, and blood film analysis or hemoglobin electrophoresis. Hemoglobin is known to naturally vary by age, sex, elevation and smoking status, as well as physiological status (e.g. pregnancy). Thus, a hemoglobin concentration below established sex-, age-, and pregnancy specific cut-off values is indicative of anemia as shown in (table 1.3):

Table 1.3: Hemoglobin levels (g/L) to diagnose anemia at sea level

		ANEMIA		
Population, age	**No anemia**	**Mild**	**Moderate**	**Severe**
Children, 6-59 months	**≥110**	**100-109**	**70-99**	**<70**
Children, 5-11 years	**≥115**	**110-114**	**80-109**	**<80**
Children, 12-14 years	**≥120**	**110-119**	**80-109**	**<80**
Non-pregnant women, 15 years and above	**≥120**	**110-109**	**80-109**	**<80**
Pregnant women	**≥110**	**100-109**	**70-99**	**<70**

Source: ***WHO (2011). Haemoglobin concentrations for the diagnosis of anemia and assessment of severity***

Hemoglobin concentration is relatively easy to measure in the field, using relatively inexpensive equipment, and can be done on either capillary or venous blood. It also does not require highly skilled individuals to perform the measurement. However, while essential to diagnose anemia, hemoglobin measurement cannot alone determine the cause of the anemia. For example, hemoglobin concentration is frequently used as a proxy indicator of iron deficiency and iron-deficiency anemia, and the terms "anemia" and "iron-deficiency anemia" are frequently and incorrectly used

interchangeably. Hemoglobin concentration alone is not a suitable indicator for assessing iron status or diagnosing iron-deficiency anemia because of the overlap of hemoglobin concentrations in normal and iron-deficient individuals, and the high prevalence of anemia of chronic disease (or inflammation) in areas where poverty, malnutrition and disease are prevalent.

In order to determine whether anemia is caused by iron deficiency, additional measurements of iron status are needed, such as serum ferritin or serum transferrin receptors, which are the most commonly, used indicators. Serum ferritin is a measure of the amount of iron in body stores; when infection is not present, ferritin increases when iron stores are present, and falls as they are depleted. The level of transferrin receptor in serum reflects the intensity of erythropoiesis and demand for iron; levels of transferrin receptor rise after iron stores have been depleted .Serum ferritin concentrations below 15 μg/L for individuals over 5 years of age, and below 12 μg/L for children aged under 5 years, are generally considered to be indicative of depleted iron stores. Iron status can also be assessed through measurements of total iron-binding capacity, transferrin saturation, zinc protoporphyrin concentration, erythrocyte protoporphyrin concentration, or bone marrow biopsy.

1.8 PHYSIOLOGIC IRON REQUIREMENTS

To better understand why iron deficiency anemia is more prevalent among children and women, especially pregnant women, it is important to discuss iron requirements during different periods of life.

Iron is essential for life. As a constituent of hemoglobin and other proteins, called enzymes, iron participates in many important processes that facilitate oxygen transport and supply to the tissues and organs. In a healthy, well-nourished individual, iron balance occurs when the quantity of iron absorbed from the diet is sufficient to compensate daily iron loss, and to maintain adequate body iron stores. The iron balance can be disturbed by a variety of factors, such as low dietary iron intake, increased iron losses and increased iron requirements.

(INACG, 1989) reported the amount of iron in the human body is approximately 2,500 mg. More than half of this amount, approximately 1,700 mgs, is present in the hemoglobin of red blood cells. Menstrual blood flow is increased by approximately 100 percent in women using intrauterine devices and reduced by about 50 percent in

women using oral contraceptives. A certain amount of iron is lost daily due to basal iron losses with epithelial cells from internal and external surfaces. About one-third is lost from the gastrointestinal tract. A tiny fraction of iron is lost in urine or sweat. ***(Lee, 1999)*** reported significant iron loss occurs in women during menstruation. Median monthly loss of blood during menstruation has been estimated at 35 ml (the upper limit of normal is about 80 ml), which is equivalent to more than 12 mg of iron. ***(Sharmanov, 1996)*** conducted the DHS survey conducted in Kazakhstan in 1995 showed that among women who were using intrauterine devices, the rate of moderate-to-severe anemia was approximately 1.5 times higher than among those who were not using them. This may be related to the observation that chronic use of intrauterine devices can lead to iron depletion and iron deficiency anemia. Thus, taking into account their greater physiologic iron losses, menstruating women, especially those using intrauterine devices, are at a greater risk of iron deficiency than men.

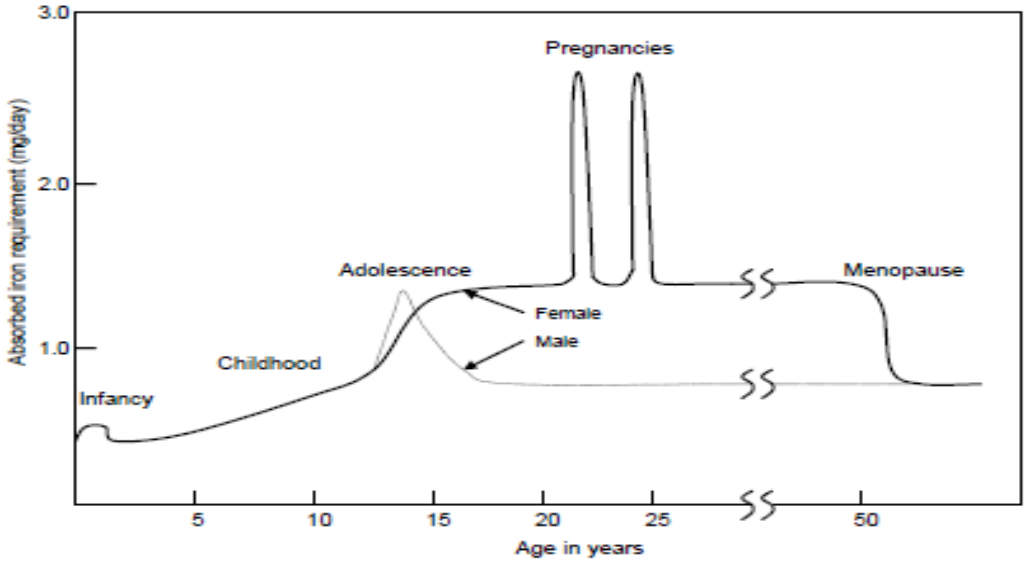


Figure 1.4: Requirements of Iron on the basis of gender and age (Source: *Lee, 1999*)

1.7.1 Iron Losses in Pregnancy and Lactation

(Lee, 1999) reported the second and third trimesters of pregnancy constitute a major drain on the iron reserves of women of reproductive age. During these periods, the requirements of the growing fetus (about 270 mg), umbilical cord and placenta (90 mg) are especially great. There is also an expansion of maternal red-blood-cell mass (about 450 mg), which raises the iron requirements even more. Expressed in terms of need for iron, these changes along with blood loss during delivery (150 mg) and basal

iron losses (170 mg) are equivalent to about an additional 1,130 mg of iron. This amount is greater than that which can be absorbed from diet; hence iron supplementation is necessary during pregnancy. After delivery, expanded red cell mass contracts and some iron returns to reserve sites. However, despite such return, the average cost of each pregnancy in terms of iron loss is still high, approximately 680 mg.

The size of iron stores at the beginning of pregnancy plays an important role. Iron requirements are higher in mothers who begin pregnancy with depleted or low iron stores. Such situation is common in developing countries. Low birth intervals may negatively affect initial iron stores and increase the chance of iron deficiency during pregnancy.

During lactation a woman loses about 0.5 to 1 mg of iron per day. However, because of amenorrhea, the iron requirements of lactating women are approximately the same as those of menstruating.

1.9 Risk Factors for Anemia

Anemia is the most common cause of maternal deaths, accounting at number fifth of all maternal deaths (more than one lakh women in India die of pregnancy-related deaths, out of which 22,000 are related to nutritional anemia). Severe anemia accounts for 20.3% of maternal deaths. The risk of dying from hemorrhage and infection is five to ten times greater among anemic women compared with non-anemic women.

Anemia among women also contributes to infant health by intra-uterine growth retardation, low birth weight and ultimately 8 perineal mortality, and a higher risk of irreversible brain damage in infants. Anemia is more likely to occur during:

- Preschool age when growth is rapid.
- Adolescence when there is rapid growth and menstrual loss of iron.
- Pregnancy, when there is rapid growth of fetus and maternal tissues.

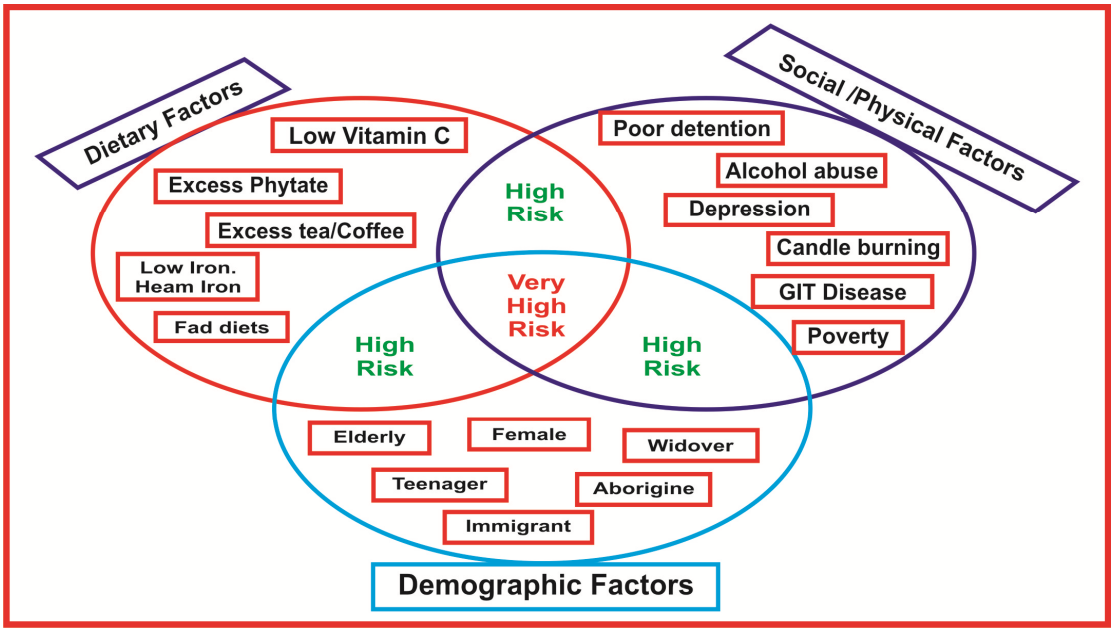


Figure 1.5 Risk factors of Anemia (Source: Redrawn from *PV Ingle et al., 2011*)

(PV Ingle et al., 2011) concluded some other risk factors on the basis of knowledge, practice and attitude towards anemia and anemia in pregnancy, those are:

i. Socio demographic factors (age, level of formal education, marital status, areas and cities of residence).
ii. Obstetrical factors (gravidity, parity, history of previous preterm or Small-for gestational- age deliveries, plurality of pregnancy multiple or singleton).
iii. Behavioral factors (smoking or tobacco usage, alcohol usage, utilization of prenatal care services).
iv. Medical conditions (diabetes, renal or cardio-respiratory diseases, chronic hypertension AIP- anemia in pregnancy.

1.10 EPIDEMIOLOGY

The World Health Organization (WHO) estimates that anemia affects between one-quarter to one-third of the world's population or up to 2 billion people. Iron deficiency affects many more people. Most of the anemic population lives in developing countries, where high anemia prevalence is seen, particularly in pregnant women, young children, female adolescents, and women of childbearing age.

Overall, anemia contributes to about 20 percent of maternal and perinatal deaths in developing countries. A recent WHO World Health Report noted that the risks of both

maternal and perinatal mortality were reduced by 25% and 28%, respectively, for each gram increase in hemoglobin level between 50 and 120 g/L. This is contrary to the previous generally accepted understanding women and children with mild and moderate anemia are vastly greater than the number with severe anemia. It follows then that the great majority of anemia-related maternal and perinatal deaths are due to mild and moderate anemia rather than severe anemia. Anemia's other serious negative consequences include poor pregnancy out comes such as low birth weight and premature birth. Anemia also has adverse implications for social and economic development. There is now strong evidence that anemia can reduce cognitive development and limit a child's learning in schools. This will lower the effectiveness of investments in education. Anemia's role in reducing physical capacity and work productivity in adults has been long established. Nevertheless, anemia continues to have a relatively low priority in health policies and programs, compared to other nutrition-related health problems with more obvious life-threatening implications. Difficulties are posed by Anemia multiple causes and by the still-limited programmatic experience in and insufficient evidence on effective intervention approaches and best practices to control anemia.

These are major constraints for policy formulation and program development. A better understanding of the etiology or causes of anemia and the identification of critical issues related to effective anemia program design and implementation are key to developing more successful actions. Recent progress in understanding the nature of the problem and the achievements and limitations of existing programs provides a firm basis for designing effective Strategies and interventions. Most, the USAID (*United States Agency for International Development)* previous generally accepted understanding that only severe anemia resulted in death. This finding is very important because the numbers of women and children with mild and moderate anemia are vastly greater than the number with severe anemia.

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Anemia may result from defects at any stage of red cell and hemoglobin production or when an increased rate of red cell destruction (hemolysis) exceeds the capacity of the bone marrow to mount a compensatory increase in production. Changes in the relationships between red cell and plasma volumes may also result in a reduced hemoglobin concentration: such changes occur physiologically in pregnancy where red cell volume is increased less markedly than plasma volume. All anemia sufferers manifest signs and symptoms attributable to tissue and organ hypoxia and the ensuing reduced metabolism.

1.11 OVERVIEW- GLOBAL and INDIAN SCENARIO

1.11.1 Global Prevalence of Anemia

Anemia is the most common nutritional deficiency disorder in the world. It is a condition that occurs when the red blood cells do not carry enough oxygen to the tissues of the body. ***(WHO, 1989)***defines anemia as a condition in which the hemoglobin (Hb) content of blood is lower than normal as a result of deficiency of one or more essential nutrients, regardless of the cause of such deficiencies. Most of the anemias are due to inadequate supply of nutrients like iron, folic acid and vitamin B12, proteins, amino acids, vitamins A, C, and other vitamins of B-complex group i.e., niacin and pantothenic acid are also involved in the maintenance of hemoglobin level .

According to WHO, anemia and iron deficiency is used synonymously, that is they co-exist more often. The major risk factors for IDA include poor absorption of micronutrients from diets high in phytate or phenolic compounds, a low intake of iron, and period of life when iron requirements are especially high. IDA is an indicator of both poor nutrition and poor health.

Table 1.4: Prevalence of anemia globally, according to W.H.O

POPULATION GROUP	PREVALENCE OF ANEMIA (PERCENT)	POPULATIONS AFFECTED (NUMBERS IN MILLIONS)
Preschool Children	**47.4**	**293**
Adolescents	**25.4**	**305**
Pregnant women	**41.8**	**56**
Non pregnant women	**30.2**	**468**
Men	**12.7**	**260**
Elderly	**23.9**	**164**
TOTAL	**24.8**	**1620**

The WHO Global Database on Anemia for 1993–2005, covering almost half the world's population, estimated the prevalence of anemia worldwide at 25 per cent. Although the prevalence of anemia is estimated at 9 per cent in countries with high development, in countries with low development the prevalence is 43 per cent. In absolute numbers anemia affects approximately 2 billion people globally, which corresponds to 24.8% of the population with about 293 million children of preschool age, 56 million pregnant women, and 468 million non-pregnant women estimated to be anemic. The highest prevalence is in preschool-age children (47.4%), and the lowest prevalence is in men (12.7%). Children and women of reproductive age are most at risk, with global anemia prevalence estimates of 47 per cent in children younger than 5 years, 42 per cent in pregnant women, and 30 per cent in non-pregnant women aged 15–49 years. However, the population group with the greatest number of individuals affected is pregnant women (41.8%) However, in women, anemia may

become the underlying cause of maternal mortality and perinatal mortality. Nearly 50 per cent of women of reproductive age group of 15-49 years are anemic.

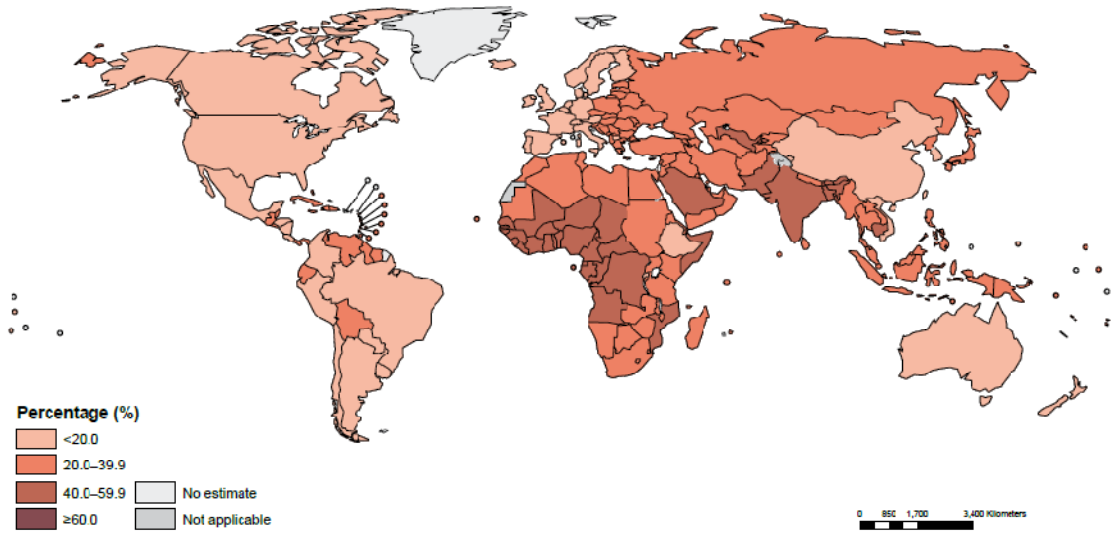


Figure 1.6 Global estimates of the prevalence of anaemia in women of reproductive age, 15–49 years, 2011

Africa and Asia account for more than 85 per cent of the absolute anemia burden in high-risk groups and India is the worst hit. Anemia is estimated to contribute to more than 115,000 maternal deaths and 591,000 perinatal deaths globally per year. Analysis of data on global prevalence shows that anemia is disproportionately concentrated in low socioeconomic groups, and that maternal anemia is strongly associated with child anemia.

According to W.H.O regional report estimates generates for adolescents, pregnant and non-pregnant women that the highest proportion of individuals affected are in African countries and South-Asian countries. An alarming 600 million people in South-East Asia are suffering from iron deficiency anemia, predominantly affecting adolescent girls, women of reproductive age and young children. The condition has a prevalence rate of 74 percent among pregnant women in the region ranging from 13.4 percent in Thailand to 87 percent in India. About 74 percent of pregnant women in Bangladesh, 63 percent in Nepal, 58 percent in Sri Lanka and Myanmar, and 51 percent in Indonesia suffer from anemia.

1.11.2 INDIAN SCENARIO

In India, anemia affects an estimated 50% of the population. Prevalence of anemia in all the groups is higher in India as compared to other developing countries. ***(Malhotra, et al., 2004)*** said that the problem becomes more severe as more women are affected with it as compared to men. It is estimated that about 20%-40% of maternal deaths in India are due to anemia and one in every two Indian women (56%) suffers from some form of anemia. **(District Level Household Survey, DLHS (2008)** surveys have shown that prevalence of anemia is very high (ranging between 80->90%) in preschool children, pregnant and lactating women and adolescent girls. Low birth weight infants, young children and women of childbearing age are particularly at risk of anemia. That way Anemia begins in childhood, worsens during adolescence in girls and gets aggravated during pregnancy. In recent decades, important changes in lifestyle habits and dietary patterns occurred among the Inuit population, contributing to the decreased consumption of country foods that are good sources of iron. Poverty in India is widespread.

Among the nations, India is estimated to have one third of the world's poor people. In 2010, the World Bank reported that 32.7% of the totals Indian people fall below the international poverty line of US $1.25 per day (PPP), while 68.7% live on less than US $2 per day. Most of them belong to low socio-economic class with lack of proper education, employment and a low quality lifestyle and diet. In such conditions it is very difficult for them to fulfill their daily iron/nutritional requirements.

According to the National Family Health Survey (NFHS)-(III), more than half of women in India (55%) have anemia, including 39 % with mild anemia, 15 % with moderate anemia and 2% with severe anemia. WHO has estimated that prevalence of anemia in developed and developing countries in pregnant women is 14 per cent in developed and 51 per cent in developing countries and 65-75 percent in India alone. Prevalence of anemia in South Asian countries is among the highest in the world. It is estimated that about half of the global maternal deaths due to anemia occur in South Asian countries and India alone contributes to 50% of global maternal deaths and about 80 per cent of the maternal deaths due to anemia in South Asia.

India has among the highest number of cases of anemia in the world, according to the NFHS-III undertaken in 2005-2006. The reasons range from high cost of healthcare

facilities, poor food quality and the low status of women. The survey further revealed that among the states, Assam is the worst affected with 72% of married women being anemic, followed by Haryana (69.7%) and Jharkhand (68.4%). The prevalence of malaria in states like Assam was cited as one of the chief reasons for this sorry state of affairs. Anemia remains to be major cause of maternal mortality and low birth weight in India. Moderate and severe anemia is seen even among educated families and the higher income group. Pregnant women with Hb less than 8 g/dl constitute a high risk group. Seven states, Himachal Pradesh and Haryana in the North; Tamil Nadu and Kerala in the South; Assam and Orissa in the East and Madhya Pradesh in Central India were investigated. A total of 84 per cent pregnant and 92.2 per cent lactating women were anemic with severe anemia in 9.2 and 7.3 per cent respectively; 39.2 and 27.3 per cent in Madhya Pradesh, 14.4 and 8.6 per cent in Assam and 8.5 and 13.4 per cent in Haryana had severe anemia in pregnancy and lactation, respectively.

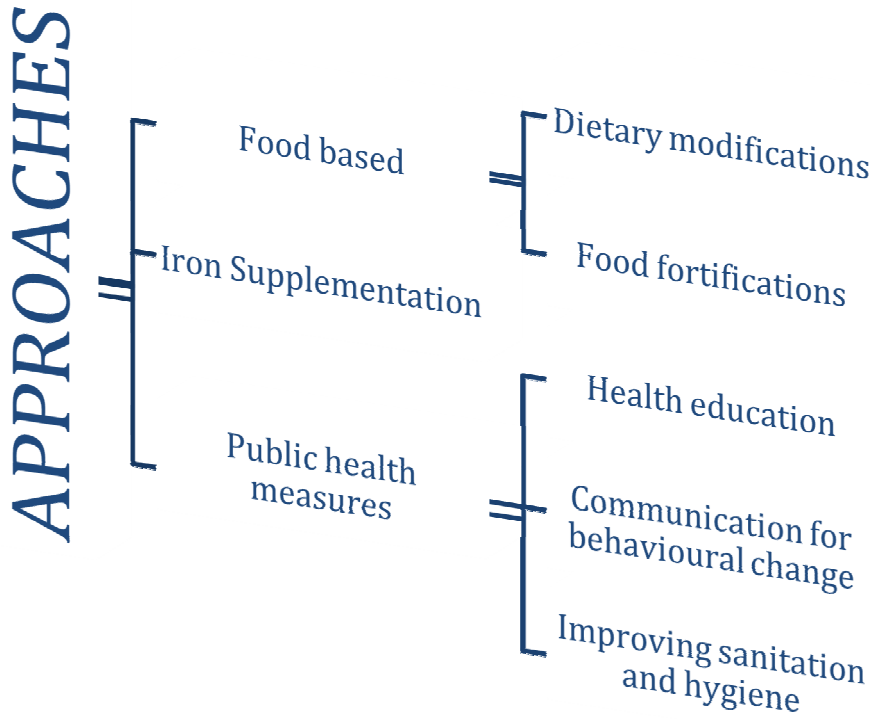
ICMR data in the same districts also reported 90.1 per cent adolescent girls with anemia (7.3% having severe anemia). ICMR district nutrition survey (1999-2000) reported prevalence of anemia as 84.2 per cent with 13.1 per cent with severe anemia in pregnancy. So, these findings suggest continuation of anemia throughout life in women. Studying the data of NFHS-(III), 65.6 % women of Kolkata were observed as suffering from anemia, whereas, 45.2% young girls of Karnataka and 34.82% young girls and women of Kannada were reported as anemic in two recent studies.

1.12 OUTCOMES OF ANEMIA

The reason why iron deficiency is a matter of concern is that it cause fatigue, decreased motor abilities, impaired memory and can also cause delays in mental development. In addition to this, anemia in pregnancy can increase the risk of having a preterm delivery and preterm babies have other health concerns ranging from low birth weight and neural tube defects to death. The reduction of risk having preterm birth during pregnancy can only resolve through iron supplementation. **(*Milman et al., 2011)*** reported “Infants and children born to iron-deficient mothers have a poor cognitive development of the brain functions and a lower intelligence quotient than infants and children born to iron-replete mothers.”

The trend in low-income community and developing countries is that adolescent girls achieve menarche being iron deficient and since it is not treated with proper diet due lack of resources as well as awareness. In case of pregnant women (pre or post) the deficiency is carried on with multiple pregnancies and hence compromises health and increases risk of complications.

1.13 EFFECTIVE APPROACHES TO RDUCE THE PROBLMEN



About 1–2 mg of iron is lost every day, through skin and enteric desquamation and minor blood losses. This loss is balanced by intestinal absorption. Therefore, iron recycling accounts for most of the iron homeostasis in human. The situation is different in menstruating women where there are controversial discussions about iron stores, ferritin, and Hb levels. It appears that lower Hb and ferritin values in menstruating women have been accepted as normal rather than possibly representing widespread iron deficiency. The situation is even more complex in pregnant women; nevertheless, iron substitution has been shown to be beneficial for them. Similarly, increased iron demand occurs during infancy and childhood due to growth and development demands.

All-encompassing scientific agreement exists on how to prevent and treat the major causes of anemia in reproductive age women, however the challenge remains in identifying how to incorporate and translate effective intervention programs at large-scale. When applied effectively to large populations of reproductive age women with known causes of anemia, these interventions have been shown to reduce the burden of iron deficiency and other major causes of anemia:

I. ***Dietary modifications:*** The primary prevention in interventions range is focused on healthy diet and sources of iron. The main area of focus for interventions in groups like young children, adolescent girls, women of reproductive age, pregnant and lactating women. The interventions must be start from early stage of life by providing iron rich source foods like fruits, vegetables, whole grains, and meat, beans, nuts, milk and milk products.

II. ***Iron supplementations:*** Treatment of anemia or iron deficiency depends on age, health and cause of deficiency. If the problem is because of dietary intake then iron rich sources of food can help to overcome. Additionally, with the varying age and cause iron supplements are also prescribed.

(a) Daily Supplementation during Pregnancy: No doubt exists that iron supplementation during pregnancy prevents maternal iron deficiency and anemia, and increases hemoglobin concentrations. Recently, WHO recommends universal daily iron (60 mg) and folic acid (400 μg) supplementation for pregnant women for six months where anemia is widespread.

(b) Weekly Supplementation for Women of Reproductive Age: This intervention involves providing a weekly dose of iron and folic acid to non-pregnant women of reproductive age and aims to improve the iron status of women prior to conception, as well as to provide folic acid in the peri-conceptional period when it is most efficacious to prevent neural tube defects in the developing fetus. A recent WHO position statement advocates for weekly supplementation. This approach needs more programmatic experience because it requires creating both an effective supply chain (through the private sector or public-private partnerships) and a demand for supplements amongst women.

According to WHO recommendation populations having high risk, iron supplements should be given to adolescents and women after pre and post pregnancy days for 2-4 months per year to ensure that women have reasonable iron stores in their life cycle. It is important to check hemoglobin level atleast in a month after the initial doses. If any women been suffering from severe iron deficiency anemia, the doses must be continued for at least 6 months until hemoglobin concentrations have reached to normal levels in order to build iron stores. Sometimes intravenous iron supplementation is also required in Hb levels less than 90 g/L.

III. **Iron in food fortification:** Iron is the one most abundant element on earth, with potential of high toxicity to living cells. Nevertheless, it has poor bioavailability, and efforts have been made to provide iron as well as micronutrients (vitamin A, C, B-12, and Zinc) for everybody, notably by food fortification within rice, because it represents one of the most essential nutrients for women. Rice and most staple cereals contain low iron levels, since most iron-containing components are lost during grain processing. According to CDC, populations with monotonous diets consisting mainly of cereals are especially prone to iron deficiency, which affects about two billion people. Hence, it has been recommended for intake of Vitamin B-12 rich sources to enhance iron absorption.

Food fortification programs to supplement nutrition with iron have not been very successful. One alternative solution is iron biofortification. Different approaches have been studied, including conventional breeding and directed genetic modification, which offer the most rapid way to develop iron-rich rice plants. Biofortification of crops is also an interesting approach, and at least two complementary approaches have been successfully adopted to increase the concentrations of bioavailable mineral elements in food crops. First, application of mineral fertilizers and/or improving the solubilization and mobilization of mineral elements in the soil has been implemented. Secondly, crops have been developed with increased abilities to acquire mineral elements and accumulate them in edible tissues. This is why the knowledge of the iron content of various aliments as well as of the factors influencing its absorption should be improved.

IV. **Antihelminthic treatment:** *Presumptive treatment of hookworms in areas where hookworms are known to be endemic.* Data from the 1990's suggest that 44 million of 124 million pregnant women in the developing world (more than 1/3) harbor hookworm infection. Hookworm can lead to gastrointestinal blood loss, poor nutrient absorption, and inhibition/suppression of appetite—which can aggravate iron deficiency and anemia in pregnancy. Where hookworm prevalence is greater than 20 percent, providing de-worming medications such as albendazole and mebendazole is recommended beginning in the second trimester of pregnancy as a routine part of ANC.

V. **Other Interventions:** These include control of malaria and other infectious diseases. Monitoring programs should be developed with the help of governmental and non-governmental institutions. Women do not have access to all health care resources so it is important to identify and treat cases of iron deficiencies, malaria, helminths and focus on high-risk women of reproductive age group.

1.14 CONFERRED TEST CONDUCTED

1.14.1 Anemia Screening Tests

The best laboratory tests for the diagnosis of anemia involve measuring the packed volume of red cells (hematocrit) or the concentration of hemoglobin in circulating blood. Both determinations can be made on either capillary blood obtained by skin puncture or venous blood obtained by venipuncture. Skin puncture is easier to perform under field conditions, especially in developing countries, but the use of capillary blood substantially decreases diagnostic reliability. In the case of venous blood, sequential values in the same individual usually remain within 0.6 g of hemoglobin per dl. The discrepancy between capillary and venous values ranges between 0.5 and 1.0 g of hemoglobin per dl. In general, however, carefully collected capillary samples provide acceptable results.

1.14.1.1 Capillary blood. A specimen of capillary blood is obtained from the fingertip (or the heel, for an infant). To obtain the best possible sample, warm the fingertip (or

heel) first to promote blood flow. After sterilizing the area, make a clean puncture with a sterile lancet to obtain a free flow of blood. Avoid squeezing the extremity so as minimize the contamination of blood with tissue fluid. Depending on the procedure to be followed, the blood is taken into a pipette, heparinized tube or glass cell, or else dropped on to filter paper.

1.14.1.2 Venous blood. Venous blood is generally taken from the antecubital vein with a sterile 20 or 21 SWG needle and a dry sterile syringe. Smaller gauge needles are not suitable for obtaining free blood flow. Alternatively, a vacuum tube (for example, a Vacutainer) may be used. In persons whose veins are not easily seen or felt, the skin area may be warmed and a tourniquet or sphygmomanometer cuff applied. Clean the area of venipuncture with 70% alcohol and allow it to dry before inserting the sterile needle into the vein. Draw blood into the syringe, remove the tourniquet or sphygmomanometer cuff and withdraw the needle, keeping the swab in place for a few minutes to ensure that any leaking is staunched.

1.14.1.3 Safety precautions. It is very important in both laboratory and field to avoid the transmission through blood of infection with hepatitis B virus or the human immunodeficiency virus (HIV) which causes acquired immunodeficiency syndrome (AIDS). Blood lancets, needles and syringes should ideally be disposed of after a single use. However, this is not always practicable. Sterilizing in a hot air oven or in a pressure cooker (autoclave), or disinfecting by thorough boiling (20 minutes), is sufficient. It is not adequate to leave such equipment in an alcohol bath. Procedures should always be established to prevent any risk of transmission from subject to subject or from subject to technician.

1.14.2 Hemoglobin concentration

There are several laboratory techniques for measuring hemoglobin concentration. Most of those that have been and are still used in primary health care are inaccurate in routine practice and should be discarded.

The accurate and reliable procedures are those which convert hemoglobin to one of its compounds, the concentration of which is determined by matching the color with a known standard in a photoelectric colorimeter or by measuring absorption in a

spectrophotometer. Three such techniques in common use are the cyanmethemoglobin (HbCN), the oxyhemoglobin (HbO_2) and the alkaline hematin methods.

The cyanmethemoglobin method has become the most popular of the three because it measures practically all hemoglobins except sulfhemoglobin. Another major advantage of this method is that the standards used remain stable for a long time. In this method blood is mixed with Drabkin's solution in order to convert hemoglobin into cyanmethemoglobin, the absorbance of which is then measured at 540 nm in a photoelectric colorimeter or in a spectrophotometer. An absolute prerequisite for using cyanmethaemoglobin to determine haemoglobin concentration is to dilute the blood in 250 times its volume of Drabkin's solution. Adding an exact amount of blood to a measured amount of diluent is simple to do in an established laboratory where the blood can be drawn and measurements made them very same day. However, if blood is collected in the field, it will have to be transported to a laboratory for the determination.

However, the transport of blood samples presents serious problems in developing countries. In warm, humid climates, unrefrigerated blood quickly becomes unsuitable for haemoglobin determination because of evaporation or contamination. A possible alternative is to carry a quantity of stoppered test tubes each containing an accurately measured 5-m1 volume of diluent (Drabkin's solution). The blood is collected and 20 p1 is immediately added to the diluent, the tube is once again stoppered, and the blood-reagent mixture is transported to a laboratory where measurements can be made.

1.14.3 lron Deficiency Tests

Several laboratory tests can confirm the presence of iron deficiency. The most commonly used are those that measure serum ferritin, transferrin saturation, and erythrocyte protoporphyrin.

1.14.3.1 Serum Ferritin

Ferritin is normally present in serum, but in such small quantities that until recently it remained undetected. It is measured by radio-immuno screening assay or by enzyme-linked immunoassay. An advantage of measuring the serum ferritin level is that it

permits an evaluation of iron status not only in persons with iron deficiency but also in those with an excess. At all ages a serum ferritin value of less than 10-12 pg/l (or ng/ml) indicates a depletion of iron stores. The assay, which until recently was expensive and time-consuming, has been simplified and can now be used as a routine laboratory procedure.

1.14.3.2 Transferrin Saturation

Almost all of the iron in the serum is bound to the iron-binding protein, transferrin. Transferrin saturation is calculated by measuring both serum iron and total iron-binding capacity using spectrophotometric techniques, dividing the iron concentration by the iron-binding capacity, and multiplying by 100 to express the result as a percentage. Values below 16% in adults are considered indicative of iron deficiency. The corresponding cut-off values for infants and children are 12% and 14%, respectively.

1.14.3.3 Erythrocyte Protoporphyrin

Protoporphyrin accumulates in red blood cells when it has insufficient iron to combine with to form haem. Erythrocyte protoporphyrin can be measured rapidly by a simple fluorescence assay performed directly on a thin film of blood. The instrument specifically designed for the assay requires little operator time or training, although it needs frequent recalibration by the manufacturer. Erythrocyte protoporphyrin is elevated (i.e., higher than 80 pg per dl of red blood cells below the age of four years and 70 pg per dl above that age) in cases of iron deficiency; values are also high when there is lead poisoning. This test is therefore useful for screening infants and young children in low-income urban areas where both conditions are common.

1.15 TREATMENT OF IRON DEFICIENCY ANEMIA

In clinical practice, any patient suspected of being anemic is tested and, if the anemia is confirmed, treated with medicinal iron supplements. The situation is very different in large-scale public health programmes, particularly in developing countries, where systematic laboratory testing is organizationally and financially impossible. In these settings, the approach that is most cost-effective is to give iron supplements to entire high-risk groups, particularly pregnant women. With this approach the distinction

between treatment and prevention is blurred, as supplementation will act to reverse anemia in some individuals and prevent it from developing in others. Therapy as such must rely on medicinal iron, since dietary changes alone cannot correct iron deficiency anemia, especially when severe. The treatment of choice is the oral administration of ferrous fumarate, gluconate or sulfate, parenteral administration being reserved for patients who are completely intolerant of oral iron. Only the most severe cases (hemoglobin concentration less than 3 g/dl) call for a blood transfusion.

1.15.1 Oral Iron Therapy

1.15.1.1 Iron tablets

(Blaud, 1832) introduced iron therapy in the form of what came to be called "Blaud's pill": a tablet containing ferric carbonate as its main constituent. Effective in correcting iron deficiency anemia, it remained the mainstay of treatment until other iron preparations were introduced and it became obvious that ferrous iron was better absorbed than ferric iron. To this day practically all medicinal iron preparations contain ferrous compounds. Ferrous fumarate, gluconate and sulfate are commonly used. Other ferrous compounds previously or still in use include ferrous succinate, lactate, glycine sulfate, glutarnate, citrate, tartrate and pyrophosphate.

Iron tablets contain a percentage of elemental iron that varies with the molecular weight of the iron compounds. Uncoated (compressed) tablets and sugar-coated tablets are the least expensive formulations and disintegrate well in the stomach. However, they become oxidized over time and hence less effective, especially in humid climates. Enteric-coated tablets are somewhat more expensive. They have the added drawback that they disintegrate only partially when exposed to gastric juices. All coated preparations and batches therefore need to be subjected to an ***in vitro*** hydrochloric acid disintegration test; those that do not disintegrate in 0.1 mol/litre HCl within two hours should be rejected.

1.15.1.2 Liquid Preparations

There are many iron-containing syrups and liquid preparations (drops) available. Usually they are expensive, deteriorate in storage, and contain minerals and vitamins that are unnecessary for most patients. However, liquid preparations are useful for

administration to infants and children, who often reject solid preparations or are unable to swallow them.

1.15.1.3 Combinations with Other Nutrients

For infants and children the recommended dose is 3 mg of iron per kg of body weight per day. Higher doses have been used, e.g., twice this amount, but they are probably unnecessary. They also increase the risk of accidental overdose, especially in children between one and five years of age. During pregnancy, women tend to become deficient in both iron and folate. It is therefore desirable to combine both hematinics in one tablet. Therefore, for pregnant women the daily administration of folate (500 pg) with iron (120 mg) is beneficial since anemia during pregnancy is usually caused by a deficiency of both nutrients. A suitable combination tablet, to be taken twice a day, would contain 250 pg of folate and 60 mg of iron.

The oral administration of iron can cause gastrointestinal side-effects in some individuals such as epigastric discomfort, nausea, vomiting, constipation, and diarrhoea. The frequency of these side-effects is directly related to the dose of iron. In addition, iron consumed with a meal is better tolerated than when it is taken on an empty stomach**,** although the amount of iron absorbed is reduced.

The major reason for the failure of iron therapy is non-compliance due to the side-effects caused by an excessively high initial dose of iron. The patient typically takes the pills for a few days and bears with the discomfort, but stops taking the medication as soon as he or she experiences an increased sense of well-being from the rise in hemoglobin; unfortunately, this occurs long before the hemoglobin has reached a normal level.

1.15.2 Parenteral Iron Therapy

There is little justification for giving parenteral iron when oral therapy is possible. The parenteral route is indicated only when oral administration causes severe vomiting that cannot be stopped by lowering the dose of iron, or in cases of persistent non-compliance.

The most commonly used preparation for intramuscular or intravenous administration is **Imferon R** (iron dextran). The advantage of the intravenous method is that the complete iron requirement can be supplied in a single dose. This technique, known as total dose infusion, has been used especially in obstetric practice,where it solves the problem of non-compliance and permits the increased requirement during pregnancy to be met in full. The recommended intravenous dose for adults (including pregnant women) is 500 mg of iron in 10 m1 of saline solution given over a period of 10 minutes following a test dose of 1-2 drops. Intravenous infusion must be done only in a hospital. The recommended intramuscular dose is 100 mg of iron in 2 m1 of saline solution. Intramuscular administration should be used only when there are no adequate facilities available for intravenous administration.

Parenteral iron therapy is not more effective than oral. In addition, it is expensive and can be dangerous. It should never be prescribed routinely without one or more definite indications as enlisted below:

- Poor compliance to oral therapy in spite of repeated counselling.
- Intolerance to oral iron.
- Rapid blood loss which is difficult for oral iron to compensate.
- Gastrointestinal disorders where oral iron may exacerbate the symptoms i.e. peptic ulcer, ulcerative colitis.
- Mal-absorption syndromes.
- Inability to maintain iron balance as seen in patients on haemodialysis.
- Pregnant women with severe IDA, presenting late in pregnancy.
- Patient donating large amount of blood for auto-transfusion programme

1.15.3 Public Education

With the possible exception of food fortification, the success of all four technical approaches to anemia control depends on the active participation of the population. Hence the need for a public education support strategy based on careful analysis of the behavioral changes required. The major changes in behavior that are needed center on compliance with supplementation regimens, changes in cooking and eating habits, and measures for infection control, including better personal hygiene and more rational feeding of sick children-responsibilities that in many societies are assigned primarily to women.

In devising effective messages, educational planners should bear in mind the older lessons learnt from community development and borrow freely from the newer methods of social marketing adapted from advertising. Many past efforts at anemia control failed in part because their educational strategies ignored these insights and techniques. There is also a growing body of educational experience relating to nutrition and health in general that needs to be tapped. Community development groups, where they exist, can help draw up the anemia control strategy, including the health and nutrition promotion that they themselves can carry out with support from service providers.

1.16 Monitoring and Evaluation

A continuing monitoring and evaluation strategy is best incorporated into the country's existing health information system, so that it becomes part of the established routine. Measuring the prevalence and severity of iron deficiency anemia is essential, although there are still many technical obstacles to screening for anemia in the community. Monitoring and evaluation should also look at how the anemia control strategy is progressing technically and managerially. The supply of hematinics, for example, needs to be watched carefully. This is often best done through the monitoring and evaluation system developed for the country's essential drugs programme. Potential problems such as noncompliance need to be monitored so that serious failures can be anticipated and preventive or remedial measures taken in good time. All monitoring and evaluation data should be used to improve and adjust programme operations.

1.17 PROGRAMS IMPLEMENTED

The Government of India has initiated several supplementary nutrition programmes at the central and state level, to improve the nutritional status of the people and eradicate anemia. But these programmes made very little impact because of they did not take into account the socio-economic and political reasons of anemia among women. For example, most of the programmes address nutrition during the first six years of life, and then skip directly to pregnancy and lactation. Adolescence, which is the period of additional nutritional requirement, is not addressed through these programs. Very

little space is available to create awareness on the importance of understanding women's nutritional needs throughout various stages of her life, and to ensure that women eat the food that reaches the household.

OBJECTIVES

1. To estimate the prevalence of anemia among reproductive age women of rural and urban areas.
2. To determine association of anemia with its pre-disposing factors in rural and urban areas.
3. To associate iron deficiency anemia with dietary habits and BMI.
4. To evaluate the knowledge about anemia and its consequences among respondents.
5. To create awareness among rural women through camp and exhibition.
6. To evaluate the effectiveness of intervention and associate with pre and post phase of the study.

LIMITATIONS OF THE STUDY

1. Due to resource constraints non-experimental design was used, thus the changes that could have been in the control group because of other factors could not be assessed.
2. The method used does not call for generalized information and the sample provides only limited understanding of the phenomenon and should not necessarily be applied to other populations.

CHAPTER - II

REVIEW OF LITERATURE

The comprehensive review of literature is an essential part of any scientific investigation. The review of literature leads the researcher to conclude the findings with references to past studies. The review gives a clear perspective of the overall field of research and allows comparing the results of the past studies in the particular field with the present research. It also provides the investigator with an opportunity to gain insight into the methods and approaches employed by other researchers and helping in formulating the research design.

Further literature having direct bearing on different aspect of the present study is limited. Hence, references having indirect bearing are also reviewed. A brief account of such literature reviewed has been presented under the following headings:

Section I: Prevalence of Anemia

Section II: Iron Deficiency Anemia

Section III: Socio-demographic Profile

Section IV: Reproductive Health

Section V: Dietary Habits

Section VI: Anthropometric

Section VII: Menstrual Health

Section VIII: Medical Status

Section IX: Knowledge regarding Anemia

Section X: Iron Rich Foods

Section XI: Diagnosis of Anemia

Section XII: Effectiveness of Structured Teaching Programme in Prevention of Anemia

Section I. Prevalence of Anemia

(Lokare, et al, 2012) the overall prevalence of anemia among pregnant women was found to be 87.2%. The prevalence of mild, moderate, severe anemia were observed as 24.7%, 54.5%, and 7.9%, respectively. Thus the prevalence of moderate anemia was high in comparison to the other degrees of anemia.

(Marques, et al., 2015) assessed the prevalence of anemia among women attending universities. The risk of developing anemia was almost three-fold higher among the students attending the public university (OR 2.71; p = .0248). The results revealed that prevalence of anemia was much higher than in the overall female population (79%). The higher education was not a protective factor for anemia in women when analyzed separately from the total population of women.

National Family Health Survey (2005-06) reveals that the percentage of anemic ever-married women in the age group 15-49 has increased from 53.9 in 1998-99 to 58.2 in 2005-06 in rural areas and from 45.7 to 51.5 in urban area.

(Kamath, et al., 2013) investigated the prevalence of anemia among tribal women, aged 15 to 49 years in Udupitaluk, Udupi district, Karnataka. The study findings revealed that in the sample of tribal women in the age group of 15-49 years, the prevalence of anemia was 55.9%. Among the subjects, 6 (3.5%) were severely anemic, 33 (19.4%) had moderate anemia and 56 (32.9%) were mildly anemic.

(Majid Sadeghiann, et al., 2013) identified that low socioeconomic status and high parity index were associated with higher prevalence of anemia. The obtained data revealed a total response rate of 13.8% for prevalence of anemia, while 14.5% and 5.9% belonged to non-pregnant and pregnant participants, respectively.

(Sinha et al., 2013) carried a hospital based study to determine the prevalence of anemia in difference groups among women of reproductive age population. Out of 3,859 subjects, 2,597(67.3%) women amongst reproductive age group were diagnosed as anemic. The highest prevalence of anemia (13.7%) was found at the age group of

25-29 years and the second highest prevalence of anemia 13.1% was at the age of above >40 years of the study population.

(Premalatha, 2012) estimated the prevalence of iron deficiency anemia among adolescent school girls in the age group of 13-17 years in Chennai. A cross-sectional survey was executed among 400 female school students in the age group of 13-17 years in Chennai. Socio-demographic details and anthropometric measurements were obtained. The results revealed that the prevalence of anemia was 36 found to be 78.75% among school students in the age group of 13-17 years in Chennai.

(Mishra et al., 2012) reported that 96.8% of the subjects were anemic and majority of anemic women were in the category of mild to moderate anemia.

(Manmeet and Kamaljit, 2009) also conducted a similar kind of study in an urban area of Chandigarh and as per their result, the overall prevalence of anemia among reproductive age women was 73.3% .

(Panigrahi and Sahoo, 2011) correlated Nutritional anemia with epidemiological indices among women of reproductive age in an urban slum of Bhubaneswar, Orissa. The prevalence of anemia was found to be 60.8%, of which 39.6, 20.0 and 1.2% women had mild, moderate and severe anemia, respectively. Statistical analyses have shown that epidemiological factors like age, education of 37 respondents, socioeconomic status, history of excessive menstrual bleeding and inadequate intake of green leafy vegetables and pulses were found to be significantly associated with anemia.

(Ansari and Nagina, 2010) examined the frequency and nutritional risk factors of iron deficiency anemia among 200 women of reproductive age of 15-45 years in Karachi, Pakistan. The study findings indicated that 44.5% of them were found to be anemic. Community based program to monitor the severely anemic cases will help to overcome iron deficiency anemia.

(Karkada, 2010) reported that anemia is a silent emergency among the women of reproductive age group (15-45). As per, prevalence of anemia among the reproductive age group was very high (72.6%) in India. The overall prevalence of anemia in India

increased from 74.2% (1998-99) to 79.2% (2005-06). Nagaland had the lowest prevalence (44.3%), then Goa (49.3%) & Mizoram (51.7%). Bihar had the highest prevalence (87.6%) followed closely by Rajasthan (85.1%), and Karnataka (82.7%). As per statistical rate in 2006, the incidence rate of anemia among women aged 15-49 years in India was 55.3% and in Karnataka 51.5%

(Pala and Dundar, 2008) addressed the prevalence of anemia and risk factors in women of reproductive age group in Public Health Training and Research Area, Bursa, Turkey. The prevalence of anemia was 32.8 per cent (hemoglobin level < 12 g/dl). Usage of 39 Prevalence of anemia, iron deficiency, and iron deficiency anemia was highest among 31-49 years old.

(Kalaivani, 2009) found that the prevalence of anemia in India is highest in the world. Prevalence of anemia is higher among women and preschool children. Even among higher income educated segments of population, about 50% of adolescent girls and women are anemic.

(Mei Ciu Chang, et al., 2009) highlighted the prevalence of anemia in healthy adolescent girls and a reproductive-age group of adult women residing in an urban area. A total of 441 individuals comprising healthy, non-pregnant, non-lactating, reproductive-age women (aged 13 to 50 years) participated in the study. Prevalence of anemia amongst adults (41.7%) was higher than adolescents (28.3%). Nutrient intake of anemic adolescents was lower than non anemic adolescents. The results highlighted on the prevalence of anemia among the adolescent girls and reproductive-age group of women, which may be helpful in combating this common disorder in the urban population.

(Negi, et al., 2009) conducted a study to assess the prevalence of anemia among the women of reproductive age group (15-45) in Dehradun district. Two villages from each of the ten sub centres were selected for the study. From every village 10 women of reproductive age were randomly covered from different households. The results showed that the prevalence of anemia was 40 found to be 65.5% and 66.0% among the subjects respectively. Age and occupation of the women did not significantly

affect the prevalence of anemia. An inverse relation emerged between the prevalence of anemia and literacy status.

(Sanjeev, 2008) estimated the prevalence of anemia among adolescent females and studied the socio-demographic factors associated with anemia. A total of 296 adolescent females (10-19 years old) were included in this study. The prevalence of anemia was found to be 35.1%. A high prevalence of anemia among adolescent females was found, which was higher in the lower socioeconomic strata and among those whose parents were less educated. It was seen that anemia affects the overall nutritional status of adolescent females.

(Tupe, et al., 2008) explored the influence of dietary factors of iron bioavailability and socio-demographic conditions prevalence of anemia among married women. The study included 173 married women (15-39 years old) from urban slums near Pune city. Diet was assessed by two random 24-hour recalls. The age, weight, height, education, family size, income, physical work, and number of days of menstrual loss were recorded. Fasting blood was analyzed for hemoglobin and serum ferritin. The prevalence of iron deficiency was 25.1%, and anemia was seen in 46.4% among married women.

(Melaku, et al., 2005) estimated the magnitude of iron deficiency anemia among reproductive age group women. 41 A total of 22,861 women of reproductive age group (15-49 years) were examined clinically. The majority of anemia in women was in the category of mild (19.3%), moderate (10.3%) and severe (0.9%0) Most affected respondents were in the age of 36-49 years.

(Malhotra, et al., 2004) reported that the prevalence of anemia was higher among females than males. Especially the females those who were below 30 years had higher prevalence than the males who were more than 45 years.

(Jolly Rajaratnam, et al., 2000) did a survey on the prevalence of anemia among adolescent girls was conducted by the Christian Medical College and Hospital. The respondents include 155 women of reproductive age group from the K.V. Kuppam block and 161 from the Gudiyatham block. Results indicated that prevalence of

anemia among girls was 44%. Of these, 2.1% was severe, 6.3% moderate, and 36.5% mild anemia. Prevalence of anemia exists in 40.7% of pre- and 45.2% in post-menarchial girls.

Section II. Iron Deficiency Anemia

(Bermejom and Garcia, 2009) reported that the Iron deficiency anemia is characterized by microcytic, hypochromic erythrocytes and low iron stores. The mean corpuscular volume is the measure of the average red blood cell volume and mean corpuscular hemoglobin concentration is the measure of the concentration of hemoglobin in a given volume of packed red blood cells.

(Disouza and Rangarajan, 2007) reported that the occurrence of restless leg syndrome was significantly higher among those who had iron deficiency anemia. The initial symptoms of iron deficiency anemia are unnoticeable. In severe cases there will be inadequate oxygen supply to major organs in the body. This will cause various health problems such as kidney failure, lung diseases, and cardiovascular diseases and ultimately it leads to death.

(Beard, 2001) proposed that mainly found in hemoglobin, iron is essential for the binding and the transport of oxygen as well as for cell growth and differentiation.

(Grantham-McGregor and Ani, 1999) reported iron deficiency anemia results in neurological impairment which may not be fully reversible.

(Caulfield et al., 2004) Iron deficiency is also known to decrease immune factors functions, but some investigators has also hypothesized that deficiency protects against infectious diseases or that iron supplementation increases infectious diseases.

(*Stolzfus, Mullany and Black, 2004)* found that iron deficiency anemia was the underlying factors in 841,000 deaths per year resulting from maternal and perinatal causes and it directly causes the deaths of 134,000 young children.

Section III. SOCIO-DEMOGRAPHIC PROFILE

(Preeti Tiwari et al., 2015) showed majority of the study participants were in the age group of 19-22 years at the time of marriage, 21-29 years at the time of pregnancy and studied up to primary level only. The prevalence of anemia in pregnant women in her study was observed to be 41.5 %, where 48.75% were having mild grade of anemia followed by 41.25% having moderate anemia and only 10% had severe anemia.

(Ganapathi K et al., 2016) concluded in his present study that the overall prevalence of anemia among reproductive age group women (15-49 years) in this rural population (Ulundai primary health center area) is high to the extent of 53.3%. High prevalence of anemia was seen among illiterate women (65.9%) when compared to literate women (52.4%) as seen in studies in India (illiterate 56% and literate 40%)

(Priyanka Sharma et al., 2013) reported the majority of the respondents were between age 20-25 years. They showed the degree of anemia in different age groups. It was observed that 38% of women in the age group of 20-25 years were suffering from anemia. They also showed that the proportion of pregnant women suffering from anemia in class I and Class II were less (3% and 20% respectively) as compared to the lower socio-economic class (38% and 2% in Class III and IV). Risk of anemia in Class III was higher as compared to Class I. They also concluded that in pregnant women who were illiterate, the percentage of anemia was found to be 16%. The proportion of pregnant women suffering from anemia was found to be on the lower side amongst women who were highly educated. The prevalence of anemia with respect to religion. It was observed that 37% of Hindu women were suffering from Anemia as against 26% amongst muslim women.

(Berhanu Woldu et al.,2019) in his study revealed that being in the age category of 36 and above is 2.64 times more likely to be anemic as compared to the age categories of 15–24 years. The reason might be due to the economic burden of the women because most of the study participants in this age group were divorced and widowed. In his study, educational status was found to be significantly associated with the prevalence of anemia among participants. The odds of to be anemic in his study was

2.28 times higher in women with no formal education than women attending secondary and above educational status.

(Sadeghian et al., 2013) concluded that the highest prevalence of anemia was 30.5% among the age group of 40-44 years, while the lowest prevalence, practically zero, was among the age group of 15-19 years. It was interesting to know that there was approximately a linear association between increases in prevalence of anemia with individuals aged from 15 to 44 years. In the economic status, the lowest mean hemoglobin level of 12.56±1.46 g/dl belonged to the lowest economic group, and the highest mean hemoglobin level of 13.26±1.44 g/dl belonged to the highest economic group. This indicated that lowest economic group women are more anemic compared to women belonging from higher society.

(Prabhaker Mishra et al., 2012) In his study, results showed that 96.8% patients were found to have anemia and majority of the patients (63.9%) were aged 15-30 years. About 40% patients income was more than Rs10 thousand. This means that anemia was more common in low socioeconomic class, the reasons were varied but the most important was inadequate amount of food and proper nutrition.

(S. R. Kane et al., 2016) According to age, most of the anemia(56.6%) as well as non-anemic (50%) subjects were from age group of 20 – 23 years. Difference was found statistically non significant as p value was 0.553. Considering the residential area, maximum (82.5%) anemic and maximum (83.3%) non anemic subjects were belonging to rural area. This difference was also found to be non-significant. Association was also found non-significant with type of family as maximum of both anemic (72.2%) and non-anemic (83.3%) subjects were from nuclear families.
In regard to family income, association was not found to be significant as maximum of the anemic (38.7%) and non-anemic (27.7%) subjects were having family income between 10001- 20000.

(Rekha Dutt et al., 2009) showed prevalence of anemia on the basis of socio-economic factors, where girls belonging from I and II class were non-anemic while those belonged from other three classes showed high prevalence of anemia. Anemia was more common in married girls compared to unmarried.

(Saranaz Jangjoo, 2016) this study the prevalence of iron-deficiency anemia in non-pregnant women of productive age [14 to 45 years] with anemia is 6.5 percent. In this study, 38.4 percent of the individuals with iron-deficiency anemia were between 30 to 33years old and they were the highest percentage of individuals with iron-deficiency anemia. 23.07 percent of the individuals were between 42 to 45 years old, 15.3 percent of the individuals were between 26 to 29 years old, 7.6 percent were between 18 to 21 years old, 7.6 percent were between 22 to 25 years old and 7.6 percent of these individuals were between 38 to 41 years old.

Kakkar et al: Level of anemia was higher ($p<0.05$) in early adolescent (10 -13 Years) age group (81%) as compared to middle (58.3%) and late adolescent (17-19 years) age group girls (48.7%). The prevalence of anemia was more amongst Hindu (61.4%) consuming mainly vegetarian diets while Muslims (54.7%) that also consume Non veg. diet prevalence was lesser.

(Mangla M et al.,2016) majority of women in the age group 19-24 years (86.04%) and 25-30 years (93.6%) had mild to moderate anemia. Whereas in women over the age of 30 years, the prevalence was of anemia was 98.4%. Among these, 10.4% had very severe anemia. 14.5% of total illiterate pregnant females had very severe anemia whereas no case of very severe anemia was found among graduates and post graduates. Most women educated either up to primary and secondary level had mild (26.8 and 33.8%) or moderate anemia (38.1 and 52.1%) with prevalence of severe anemia being 30.3% and 11.3% respectively. Only 1.2% women educated up to primary level had very severe anemia.

(Lokare, et al, 2012)it was observed that proportion of pregnant women suffering from anemia was maximum (93.7%) in the age group 30 years and above followed by the age group below 20 years (88.3%). The observed difference was not statistically significant ($P > 0.05$). Figure 2 shows the prevalence of anemia in pregnancy with respect to religion. It was observed that 94.3% of Hindus were suffering from anemia when compared with 84.9% and 82.2% of Muslim and Buddhist women, respectively. the proportion of pregnant women suffering from anemia in classes I and II were less

(47.61% and 71.42%, respectively) as compared with the lower socioeconomic status (93.51%, 94.49%, and 94.11% in classes III–V, respectively). It was obvious that as the socioeconomic status decreased, the prevalence of anemia increased. Revealed that proportions of pregnant women suffering from anemia were 96.4%, 94.8%, 92.1%, and 91.5% among illiterates, those educated up to primary, middle school, and high school, respectively. It was found that the lower the educational level of the women, the higher the probability of suffering from anemia during pregnancy.

Section IV: REPRODUCTIVE HEALTH

(Preeti Tiwari et al., 2015) reported prevalence of anemia was directly related to number of children and inversely related to spacing between previous and present pregnancy. The prevalence of anemia was found to be significantly high in women with high parity and women with spacing of less than or equal to 1 year between two consecutive pregnancies.

(Ganapathi K et al., 2016) Women not having any live birth and more than 2 live births were at higher risk of anemia (65.9%) when compared to women having one or more live births (46.2%). High prevalence of anemia in women not having any live birth is mainly due to excessive bleeding during delivery, closely spaced pregnancies, and inadequate dietary intake of iron.

(Uche-Nwachi EO et al., 2010) conducted an initial and final hemoglobin reading among the respondents; where at the final Hb reading, it was found that women with at least one previous birth or pregnancy were more likely to have anemia than women without any. This suggests that the behaviour and attitudes of pregnant women with children may differ significantly from those of nulliparous women with respect to the current pregnancy. At the final Hb reading parous women were more likely to have anemia than nulliparous women. At both Hb readings, the grade of anemia increased with parity. An anemic woman with at least one previous birth was more likely to have Grades II to III anemia, than a nulliparous anemic woman at first and final Hb readings.

At the final Hb reading the presence of anemia increased with gravidity such that a multi-gravid or grand multi-gravid woman was more likely to be anemic than a primi-

gravid or secondi-gravid woman. However, at final Hb reading persons with 2-3 spontaneous abortions were more likely to have anemia than those who had one.

(*Sadeghian et al., 2013)* found that the prevalence of anemia is 5.9% among pregnant women in comparison with 14.5% in non-pregnant women, despite the higher risk of anemia in pregnancy. The parity had a clear effect on the prevalence of anemia, the women with more than two pregnancies had significantly higher rate of anemia.

(Asia Taha et al., 2014) it can be suggested that the prevalence of anemia in pregnant women is more than the non-pregnant women, 64.7% of anemic respondents were pregnant at the time of study. From our study it is worth noting that 64.5% of females had less than 1 year intervals between successive pregnancies.

(Mangla M et al., 2016) Similarly the parity of the pregnant female was also associated with the severity of anemia. 51.1% cases of severe anemia and 50 % cases of very severe anemia were present in multiparous women. Majority of nulliparous or primiparous women had mild to moderate anemia. The interval since the woman's last delivery or any other pregnancy outcome was another variable which showed significant correlation between the presence and severity of anemia. 72.4% of pregnant females who had their last delivery or abortion 3 years or more prior to this pregnancy had mild anemia. Majority of cases of severe and very severe anemia were again found in females with a birth interval of less than 1 year.

Section V: DIETARY HABITS

(Ganapathi K et al., 2016) Women taking vegetarian diet are at significantly higher risk of anemia (64.9%) than the women who were taking mixed diet (49.5%) that is vegetarian and non-vegetarian both.

(Vibhute et al., 2020) A nutritious breakfast that includes sugar, starch, protein, fat, fiber, vitamins, and minerals, especially iron and vitamin C, which is necessary to ensure the sustained release of energy. In our study, it was fortunate to note that 272 (90.7%) had breakfast regularly. Lack of intake of fruits and vegetables in diet are also contributing factors for poor health status.

Poor eating habits are a major public health concern among university students. In total, 52 (17.3%) of our study participants declined to consume green leafy vegetables for anemia prevention. In our study, 192 (64%) participants did not consume multivitamins. The medical student comes under the vulnerable group that suffer anemia because of their living in the hostel or outside.

(Larson- Meyer, 2007) Percentage prevalence of anemia was slightly higher (87.8%) among the vegetarians. The reason could be the consumption of foods with less absorbable iron (non heme iron) which is predominant in the vegetarian diets. All ovo-vegetarians were found to be anemic and this may be attributed to the fact that they may not be taking egg on a regular basis.

(S. R. Kane *et al,2016)* Difference was found in prevalence of anemia according to dietary habits, as anemia was found more (82.5%) among vegetarians, but this was also not statistically significant as most of the non-anemic (66.6%) subjects were also vegetarian. Association with regard to frequency of taking junk food was also found non-significant.

(*Rekha Dutt et al., 2009)* our study reveals that compared to non-vegetarians, more vegetarians were anemic which is confirmed by other studies5, 9. In India poor bioavailability of dietary iron along with low intake of heme iron from animal food is a major cause for anemia.

(Maj Sivapriya S1, 2013) Detailed analysis revealed that majority of the women followed beneficial practices such as including green leafy vegetables and jaggery in diet, using iron utensils, hand washing before meals and after defecation, following regular antenatal visits and drug compliance

(Yishu Sun, 2010) According to the intake of various food groups such as cereal, vegetable, lentils, fats, tea and coffee have been consumed by the absolute majority of women; food groups such as dairy products, other fruits and meat have consumed by fewer; and food groups such as liver and egg have been consumed by the absolute minority. These foods have a good effect on anemia among women of reproductive

age. Therefore, increasing of food intake in different categories is an important tool in the prevention and treatment of anemia.

Section VI: ANTHROPOMETRIC

(Shekhar, 2005) The mean height was found to be 156.6 cm, and mean weight was 51.5 kg. The mean BMI of the subjects ranged from 16.8 to 20.8. Out of 150 subjects, 68 students were found to be normal, although none were observed to be severely anemic (Hb < 7 g/dl); 12.6 % and 46 % subjects were moderately and mildly anemic, respectively.

(Hanan et al. 2010) conducted a study on anemia in adolescent college girls. The mean haemoglobin (Hb) in non-anemic girls was 13.04 ± 0.013 g/dl and in anemic girls it was 10.2±0.45 g/dl. 38% girls were underweight having body mass index (BMI > 18.5) out of which 42.07% were anemic.

(Shah et al., 2011) Study shows that the prevalence of mild anemia was (34.65 %), moderate anemia (36.85%) and severe anemia (8.55%). 18.42% of girls were underweight, 20.11% were overweight and obese.

(Ganapathi K, 2016) Height: Standing height was measured to the nearest centimeter using a semi-flexible measuring tape. Weight was measured to the nearest kilograms using a portable weighing machine after removing footwear and other heavy accessories. Underweight women were significantly higher risk of anemia (96.6%) when compared to women having normal weight (51.0%)

(Berhanu Woldu, 2019)In this study, prevalence of anemia among RAW was significantly associated with BMI. Being of BMI greater than 25 kg/m2 is 73.7% less likely to be anemic when compared to BMI ranges from 18.5 to 24.9 kg/m2 or normal BMI. Overweight was inversely associated with the prevalence of anemia.

(Yushi sun, 2010) Non-pregnant women with severe anemia, BMI were the lowest (23.0 kg/m2); on the contrary, non-pregnant women without anemia, BMI were the

highest (26.3 kg/m2) (see Table 16). This study found that the increasing of BMI promotes an increase in the levels of Hb among women between 15 and 49 years old.

(Bano et al., 2012) found that majority (81.8%) of anemic students were undernourished as per their BMI.

(Pandey et al., 2013) reported that the prevalence of anemia among underweight students was 60%, normal was 27.5%, and overweight was 12.5%

(Patel et al., 2018) Almost 91% of the included women were anaemic (65811/72750), over a third were underweight (25571/72750, 35.1%) and over a third were both anaemic and underweight (23867/72750, 32.8%). Anaemia was severe in less than 0.2% and moderate in nearly 48% women.

(Premalatha T, 2012) In this study 42.5% of girls with BMI<18 were found to be anemic. the prevalence of anemia is high in underweight participants, this study also shows that the prevalence of anemia in pre-obese and obese (75%) participants which stresses the focus on inbuilt absorption of micronutrients.

Section VII: MENSTRUAL HEALTH

(Ganapathi K, 2016) Women who had menstrual cycle more than 35 days and <21 days were at higher risk of anemia (72.7%) when compared to women who had normal menstrual cycle (52.4%) may be due to heavy menstrual blood loss, deficient dietary intake, and increased need of iron and lack of awareness about anemia. Women who attained menopause were significantly of lower risk for anemia (35.1%) compared to women who did not attain menopause (55.2%). This is because of no menstrual loss in menopausal women, pregnancy, and other related factors.

(Vibhute, et al., 2020) About 171 (57%) of the participants in this study had 5–7 days of menstrual cycle. Heavy menstrual blood loss is an important risk factor for anemia especially the iron deficiency anemia. The mean menstrual iron loss, averaged over the entire menstrual cycle of 28 days, is about 0.56 mg/day.

(George et al., 2013) One-third (33.5%) of adolescent girls was found to be iron depleted in the menstruating group, compared to 15.9% in the non-menstruating group. Iron-depleted girls with menses were found to have significantly lower levels of hemoglobin, haematocrit, MCHC, RBC, and serum iron.

(Bernardi, 2016) Iron deficiency was present in 68.2 % of the participants and 18.2 % were anemic. Almost half of the participants reported that their menses were heavy or very heavy, and there was a relationship between perceived heaviness of menstrual flow and anemia ($P = 0.021$). Of the individuals who reported that their menses were heavy or very heavy, 35.0 % were anemic. AAW who reported heavy or very heavy menses had significantly lower hemoglobin ($P = 0.015$), hematocrit ($P = 0.003$), and ferritin ($P = 0.012$) levels, as well as more general ($P = 0.006$) and menses-associated symptoms of anemia ($P = 0.015$) than those who reported normal or light menses.

Section VIII: MEDICAL STATUS

(Ganapathi K, 2016)Women who had passed worms in stools were at significantly higher risk of anemia (88.6%) when compared to women who were not passing worms in stools (49.9%). The higher prevalence of anemia in women who passed worms in stools can be attributed to lack of personal hygiene, irregular use of footwear, open air defecation, lack of awareness about hand washing with soap before eating, and not taking deworming tablets at regular intervals.

(Jarrah SS et al., 2007) from their study of 206 adolescent girls and 65 pregnancy women mentioned that 50% of anemic females reported daily symptoms or dizziness, fatigue, headache and depression. Women complained about extreme weakness and 14.4 percent reported dizziness and giddiness all of which can be related to symptoms of severe anemia. Many sports women also complained about frequent headache (25.3%), breathlessness (13.2%) and palpitation (14.1%)

(Rekha Dutt et al., 2009) various studies have also shown that presence of worms in adolescent population may contribute significantly to blood loss in intestine with resultant anemia. Our study shows that anemia was significantly associated with history of malaria owing to destruction of red blood cells which is in conformity.

(Saranaz Jangjoo, 2016)A series of clinical symptoms appear after anemia and some of them like feeling of weakness, tiredness, dizziness, dyspnea, palpitations, pale skin, difficulty in concentration and tingling of feet and hands are common symptoms can help in diagnosing iron-deficiency anemia. 36.5 percent of the women [73 individuals] had feeling of weakness, 41 percent [82 individuals] had the feeling of tiredness, 22.5 percent [45 individuals] had the feeling of dizziness, 18 percent [36 individuals] had dyspnea, 19 percent [38 individuals] had palpitations, 9 percent [18 individuals] had pale skin, 7 percent [14 individuals] had difficulty in concentration, 35.5 percent [71 individuals] had history of tingling of feet and hands and 14.5 percent [29 individuals] of the individuals in the study had no symptoms. Thus, the highest percentage was related to the feeling of tiredness in the individuals studied.

(Mamta et al., 2014) Sign and symptoms wise more than half of the subjects (57.5%) reported weakness, followed by fatigue (55%), lethargy (47.5%) and fainting episodes (17%). According to clinical signs of anemia 65% of respondents had pallor skin, followed by (37.5%) had pallor tongue, (35%) had CRT >3sec whereas only very small number of subjects (7.5%) had spoon shaped nail.

(Kumar et al., 2019) Weakness & easy fatigability were most common (100%) presenting symptoms and pallor was most common (98% patients) clinical sign.

(Kawaljit Kaur, 2014) conducted a study among the rural population of Patiala, one of the major cities of Punjab, and stated that there was a positive correlation that iron deficiency anemia may be due to the result of blood loss caused by parasitic infection. Hookworm intensity was significantly associated with haemoglobin level; for each 1,000 egg increase, hemoglobin was reduced by 2.4 g/L.

Section IX: KNOWLEDGE REGARDING ANEMIA

(Maj Sivapriya, 2013) 62(31%) antenatal women had average and 138 (69%) had good knowledge about prevention of anemia. Most of the antenatal women, 128 (64%) had good knowledge and 71 (35.5%) had average knowledge on disease aspect of anemia. 99% study participants had average or good knowledge on diet aspect of

anemia. All the antenatal women had average or above average knowledge regarding prophylactic treatment of anemia.

(Kakkar et al, 2011) It was observed that knowledge and awareness was responsible for status of anemia up to certain extent. Girls about (55.60%) having knowledge about sources of iron rich food and prevention of anemia were slightly less anemic than the girls about (60.20%) not having any knowledge.

(Premalatha T, 2012) 80.75% of participants were unaware of anemia. 19.25% of subjects were aware of what anemia is and how to control and prevent it.

(Raksha M et al, 2016) 64% of the women were aware of the food items which were a rich source of iron, however only 30% of them implemented these food items in their daily diet. 50% were aware of high protein diet in the correction of anemia (role in heme binding). None of the women were aware of any of the inhibitors of iron absorption. Only 25% of the women were aware of a few maternal complications of anemia like PPH, cardiac failure, failing lactation, recurrent infections and only 31% of them were aware of fetal complications like IUGR, infections leading to preterm labor. Role of deworming was known to 22 women out of the 200. Only 5 women were not compliant to the iron medication. Almost 60% of the women said that all the knowledge they had, was imparted to them by medical or para medical professionals, 22% attributed it to their family and friends while the remaining 18% acquired it via books and television.

(Nivedita K,2016)Assessment of knowledge revealed that only 39.87% of the participants were aware of and understood the term anemia. Awareness regarding the prevalence and complications of anemia was good. 53.8% of the participants accepted that pregnant women were more vulnerable to anemia and 66.1% responded correctly that the fetus will be affected by severe anemia. Only 32.6% gave the correct response that pregnant women should take iron supplementation in spite of taking a healthy diet. Awareness that tea and coffee can act as inhibitors of iron absorption was present in 33.2% of participants but only 42.08% of them were aware that consuming iron along with food will reduce side effects. More than 1/3rd of the participants were aware that iron tablets were dispensed free of cost in government hospitals. Only

44.62% of the participants were aware of their hemoglobin level in the current pregnancy. Only 23.1% of them were aware of the fact that hook worm infestation could lead to anemia.

(Shilpa Jose et al, 2016) Many of the subjects (40.5%) did not know whether they were anemic or not. Most of the total subjects (45.4%) knew that the anemia is a serious condition. Majority of them (75.1%) considered iron rich foods as important for the prevention of anemia.

(Masresha et al., 2020) Knowledge concerning symptoms associated with IDA was also found to be at high level. This is evident from the findings of 88.9%, 84.5%, 93.3%, 75.6% and 80% of the participants who reported that IDA was associated with such symptoms as fatigue, general weakness, dizziness and fainting, headaches, and pallor of face, lips and nail beds. In the case of our study, the participants knew all signs and symptoms of IDA.

(Mamta, 2014) More than half of the sample had average knowledge regarding anemia, 33% had good knowledge and about 15% had poor knowledge. There was not even a single woman with excellent knowledge regarding anemia.

(S Upadhyay et al., 2011) In present study, the mean score obtained by subjects was only 21.32 per cent, indicating low knowledge score. As high as 66.32 per cent subjects were having low knowledge scores, only 4.56 per cent were in high knowledge category, rest were having scores of medium knowledge category. Knowledge scores were computed separately for subjects on the basis of age group, occupation, education. Highest scores were obtained by women of 18-25 years. Least mean scores were obtained by women of 36-45 years. Educational qualification was found to be significantly related with knowledge scores. Knowledge scores increased with the increased educational level. So the Graduate women obtained maximum mean per cent score that is 45 ±29.15 and women having education nil to primary school obtained least score, which is 24.48 ± 16.52. Women engaged in service and household tasks scored more than women engaged in farming.

(Imunticha, 2015) correlated the relationship between knowledge and practice on prevention of Iron deficiency anemia among the women of reproductive age. Knowledge analysis revealed that 55.8% had inadequate knowledge with regard to iron deficiency anemia and its prevention.

(Mamta, 2014) evaluated the knowledge of anemia among women of reproductive age group (15-49 years) residing in rural Punjab. The result illustrated that 52.5% were having average knowledge regarding anemia (causes, sign & symptoms & treatment).The overall mean score was 6.92. Age, education and working status of the females were found to have statistically significant association with the knowledge score related to anemia.

(Ghimire, 2013) associated the knowledge and practice of women of reproductive age group (15-45yrs) regarding the prevention of anemia. The result showed that there was significant association in level of knowledge to the educational status regarding prevention of anemia. Furthermore, there was significant association between the level of knowledge and the practice of women of reproductive age group on prevention of anemia.

(Ruhi, 2013) depicted that 31.7% of the women of reproductive age group obtained information and knowledge from mass media, 21.7% from books, 18.3% of respondents from Peer Group and 28.3% of them from Health Workers.

(Ahmad, 2013) stated that adolescents are especially vulnerable to anemia because of their rapid growth. Proper nutrition, including adequate iron intake, plays an important part of growth and development. Adolescence should acquire the knowledge and skills because iron deficiency and iron deficiency anemia can affect their learning, growth and development. Therefore adequate information can help the teenagers to stay healthy and prevent iron deficiency.

(Mirzoyan, 2010) stated that most of the women residing in rural area of reproductive age had poor knowledge regarding anemia which may prevent them from seeking early treatment and adopting preventive measures.

(***Kalimbira et al., 2009)*** revealed that56.6% of the women were aware of anemia, with at least two thirds knowing its causes, ways of prevention, and treatment.

Section X: IRON RICH FOODS

(Conrad and Umbreit, 2005) stated that the following factors enhance iron absorption:

- Haem iron present in meat, poultry, fish, and seafood.
- Ascorbic acid or vitamin C, present in fruits, juices, other vegetables like cauliflower and cabbage.
- Fermented or germinated food.

(Swaminathan, 2008) Iron deficiency anemia will be prevented by adequate dietary intake or iron such as green leafy vegetables such as amaranthus, spinach, coriander leaves, drumstick leaves, cauliflower leaves, radish leaves, vegetables such as beet root, drumstick, cereals like ragi, barley, rice (raw milled), legumes like bengal gram dhal, black gram dhal, soyabean, nuts and oil seeds and fruits such as chickoo, pomegranate and jaggary.

(Park, 2015) enlisted the forms of iron, haem iron and non-haem iron. Haem iron is better absorbed than non-haem iron. Foods rich in haem iron are liver, meat, poultry and fish. They are not only important sources of readily available iron, but also promote the absorption of non-haem iron from vegetarian food eaten at the same time. Non-haem iron is of vegetable origin e.g. cereals, green leafy vegetables, legumes, nuts, oilseeds, jaggery, and dried fruits. In some areas large amount of iron may be derived from cooking in iron vessels.

(Buvaneswari and Ramya, 2014)in their study of overall acceptability of *Brassica oleracea* leaves (cauliflower leaves) incorporated food products and its impact on treating anemic college going girls. Enriching the common recipes with *Brassica oleracea* leaves will increase the hemoglobin content 22 of the anemic adolescents. Thus incorporation with *Brassica oleracea* leaves powder can be made more acceptable and if done will be an alternate for the high cost nutrient (or) therapeutic supplements.

Some researchers also revealed that cauliflower green leaves are rich source of iron and calcium along with the other micro nutrients. It contains folate which helps in making and stimulating the blood and prevents symptoms of anemia. The cauliflower green leaves are highly nutritious and a good source of J-carotene- 43.11mg, Iron-60.38mg, Copper-1.55mg, Manganese-5.86mg, Zinc- 5.10mg (values as per 100gm). Recognizing the value of *Brassica oleracea* leaves the researcher has aimed to incorporate in common recipes for increasing bioavailability of minerals like iron and calcium as it helps in alleviating nutritional deficiency disorder.

(Nambiar, Daniel and Guin, 2010) Drumstick leaves (*Moringa oleifera*) are reported to contain alkaloids, flavonoids] anthocyanins, proanthocyanidins and cinnamates, and is highly reputed in folklore and traditional system of medicine as a remedy for a variety of ailments. Drumstick leaves (*Moringa oleifera*) with a beta carotene (a precursor of vitamin A) content of 19690mcg/100gm are acceptable in traditional Indian diets both in fresh as well as dry forms and have a good] bioavailability in fresh and dry forms, thus they are useful in 24 improving utilization of iron especially from high phytate Indian diets**.**

(Indian Council of Medical Research, 1989) has recommended iron intake of 28 mg/d for adult man and 30 mg/d for adult woman while for pregnant and lactating woman the recommended dose is 38 mg/d. Plant foods which are good sources of iron are cereals and millets (Bajra, samai, rice bran & wheat germ), pulses and legumes (Soybean, chick pea, cow pea, lentil, peas, whole horse-gram), Green leafy vegetables (Amaranth, beet, cauliflower, chekkur manis, mustard, parsley, mint, radish, turnip).

(Reddy et al., 2006) reported that higher iron status associate with the consumption of an omnivorous diet is due to more to the intake of heme iron than to the enhancing effect on non-heme iron absorption.

Section XI: DIAGNOSIS OF ANEMIA

(Nicolas Galan, 2002) suggested that Complete Blood Count test measures the amount of all components in the blood, including, Red Blood Cells (RBCs), White Blood Cells (WBCs), hemoglobin, hematocrit and platelets. The CBC test provides

information about your blood that is helpful in diagnosing iron deficiency anemia. In iron deficiency anemia, the hematocrit and hemoglobin levels are low. Also, RBCs are usually smaller in size than normal.

(World Health Organization, 2011) recommended that the cyanmethemoglobin method for determining hemoglobin concentration is the best laboratory method for the quantitative determination of hemoglobin. It serves as a reference for comparison and standardization of other methods. A fixed quantity of blood is diluted with a reagent (Drabkins solution) and hemoglobin concentration is determined after a fixed time interval in an accurate, well-calibrated photometer.

(Sinha, et al., 2013) reported that the Cyanmethaemoglobin method was used to determine the hemoglobin level.

(Karaoglu, et al., 2010)reported that anemia prevalence was 27.1% (Hb< 11.0 gr/dl). Having four or more living children being at 50 the third trimester and having a low family income were determined as the independent predictors of anemia in pregnancy. Anemia was also associated with soil eating (PICA) in the anemic women, 50.0% had a transferrin saturation less than 10% indicating iron deficiency, 34.5% were deficient in B12 vitamin and 71.7% were deficient in folate. Most of the anemia were normocyticnormochromic (56.5%) indicating mixed anemia.

(Gibson, 2010) accomplished that serum and erythrocyte ferritin concentrations reflect the level of storage iron. Serum measurements are simpler and are the more common of the two tests. Having been found to be directly proportional to the abundance of storage iron in normal subjects, serum ferritin concentration is used as a sensitive and specific index for ID. When used in combination with the measurement of Hb, serum ferritin distinguishes between the anemia of chronic disease and ID.

(Brady, 2007) reported that anemia is typically diagnosed on a complete blood count. Apart from the number of red blood cells and the hemoglobin level, the automatic counters also measure the size of the red blood cells by flow cytometry, which is an important tool in distinguishing between the causes of anemia. Examination of a

stained blood smear using a microscope can also be helpful, and it is sometimes a necessity in regions of the world where automated analysis is less accessible.

(Breymann, 2002) indicated that in modern counters, four parameters (RBC count, hemoglobin concentration, MCV and RDW) are measured, allowing others (hematocrit, MCH and MCHC) to be calculated, and compared to values adjusted for age and sex. Some counters estimate hematocrit from direct measurements.

(Kotech, et al., 2002)conducted a study on sample of 804 girls for serum ferritin and found a proportion of girls had serum ferritin levels less than 12 g/ml, indicative of poor iron storage.

Many authors had used cynmathemoglobin method for determining hemoglobin concentration to diagnose anemia. Also it was found to be better when compared to other methods for collecting for blood samples from the subjects.

Section XI: EFFECTIVENESS OF STRUCTURED TEACHING PROGRAM IN PREVENTION OF ANEMIA

(Kala and Christopher, 2010)implemented the structured teaching program on knowledge and attitude of post-adolescent girls in prevention of iron and folic acid deficiency anemia at a 58 selected corporation school, Coimbatore. Major findings of the study revealed that during pretest 90% of them were had inadequate knowledge and 65% of them had unfavorable attitude towards iron and folic acid deficiency anemia. After the structured teaching program, the knowledge and attitude were improved (73% had adequate knowledge and 79% of them had most favorable attitude).

(Man meet and Kamaljit, 2009) assessed the effect of health education on the KAP of women for prevention of anemia in a village of Chandigarh. Interpersonal and group communication approaches were used to communicate messages on anemia. The results revealed that 93.3% and 96.6% could specify at least one correct cause of anemia and identified a sign or symptom of anemia. The knowledge about methods of anemia prevention was significantly higher; 93% women were in favor of including green leafy vegetables in their diet. Hence, from the study it was concluded that

nutrition 59 education is one of the appropriate, effective and sustainable approaches to combat iron deficiency anemia.

(Yusoff, 2009) compared the effectiveness between multimedia nutrition education intervention and non-nutrition education intervention in improving awareness level regarding iron deficiency among anemic adolescents. The awareness components assessed include the causes, symptoms and preventive measures of iron deficiency. Both interventions were implemented for 3 months. The changes in awareness among respondents of both groups were evaluated using multi-choices questionnaire. Multimedia nutrition education program conducted at school setting was in fact practical and effective in improving awareness on iron deficiency among anemic adolescents.

(Sajjan, 2008) concentrated on the impact of nutrition education on hemoglobin status of rural adolescent girls in Dharwad. A total of 300 women of reproductive age group were selected. Specific information on the consumption pattern of green leafy vegetables indicated that the adequacy of green leafy vegetable was less than ten percent. Nutrition education intervention resulted in significant increase in the mean knowledge scores. The mean pretest knowledge score was 13.70 and was increased to 24.43 after intervention. The study concluded that nutrition education is one of the appropriate, effective and sustainable approaches to combat iron deficiency anemia.

(Minakshi, 2008) addressed the effectiveness of structured teaching program on knowledge regarding iron deficiency anemia and its prevention among early adolescent girls in selected schools of Bhavnagar District. The overall pre -test mean knowledge score of adolescent girls was 13.81±3.67 and posttest mean knowledge score of was 22.71±2.35. The posttest mean knowledge score is significantly greater than the pretest mean knowledge score. It infers that structure teaching programme was effective

(Werner and Bower, 1982) measured the impact of teaching programme on their level of knowledge of pre-university students. There was a significant improvement in the level of knowledge at the end of the program, with the greatest improvement in those who attended most sessions. The low scores recorded for questionnaire

administered before the teaching programme suggest that there is a critical need for improved in education.

(Iron Deficiency Anemia: Assessment, Prevention, and Control, 2001) A guide for program managers, World Health Organization, stated that innovative measures must be developed to improve nutritional knowledge and awareness among mothers and health workers. Finally, nutrition education and intervention programs should address anemia with a focus on both the dietary quantity. All of these interventions must be monitored for effectiveness. It suggested the health authority to incorporate nutrition education intervention along with the supplementation program since both play an important role, particularly in correcting iron status and preventing reoccurrence of iron deficiency among adolescents. The above literature has enabled the researcher to understand that structured teaching programme improve the understanding of people and meets specific learning needs of women of reproductive age group.

CHAPTER - III

MATERIALS & METHODS

Research methodology is the precise, systematic and theoretical procedural method used to study, identify, select, process, and analyze information about the research topic. It critically evaluates study's overall validity and reliability. This chapter contains relevant information concerning to the research design and methodological step used for current investigation.

3.1 The Study Area

3.2 Study Period

3.3 Study Design

3.4 The Study Sample

3.5 Sampling Methodology

3.6 Tools and Techniques of the Study

3.7 Tools and Techniques for Intervention Phase

3.8 Tools and Techniques for Post Intervention Phase

3.9 Analysis of Data

3.10 Statistical Tools

3.11 Operational Definitions

3.1 THE STUDY AREA

The study area was divided in to two districts of Uttar Pradesh i.e. Lucknow and Raebareli.

3.1.1 DISTRICT PROFILE OF LUCKNOW

Lucknow, the capital of Uttar Pradesh is situated 123 meters above sea level and it has always been a multicultural city. Courtly manners, beautiful gardens, poetry, music, and fine cuisine patronized by the Persian-loving Shia Nawabs of the city are well known amongst Indians and students of South Asian culture and history. It is situated on 26.30 & 27.10 North latitude and 80.30 & 81.13 East longitude. Lucknow covers

an area of 2528 sq.km. It is surrounded on the eastern side by District Barabanki, on the western side by district Unnao, on the southern side by Raebareli and on the northern side by Sitapur and Hardoi districts. River Gomti flows through the city. The population of district Lucknow as per census 2011 is 4,588,455. Lucknow is popularly known as The City of Nawabs. It is also known as the Golden City of the East, Shiraz-i-Hind and The Constantinople of India. Avadh is claimed to be among the most ancient of Hindu states. The general profile of the district is given below:

Table No. 3.1.1.1 General Profile of Lucknow District

Geographical Data		
S.NO	**Variables**	**Value**
	Latitude Longitude Geographical Area	26.30'-27°10'North 80. 30'- 81.13' East 2528 KM^2
	Boundaries in East West North South	 Barabanki Unnao Sitapur&Hardoi Raebareli
Climate		
	Summer -Maximum Temperature -Minimum Temperature Rainy season -Average Rainfall -Maximum Temperature -Minimum Temperature Winter -Maximum Temperature -Minimum Temperature	March to Mid June <40°C 27 °C Mid-June to September 313 mm 32 °C 25 °C October to February 23°C 7-12°C
Area and Administration Divisions		
	Tehsils Districts Sub-Tehsil Patwar Circle Panchayat Samitis Nagar nigam Nagar Palika Nagar Panchayats	Lucknow, Mohanlalganj, Malihabad, Bakshi ka Talab, Hardoi, Lakhimpur Kheri, Lucknow, Raebareli, Sitapur, Unnao 0 - - 01 - Bakshi kaTalab, Chinhat, Gosaiganj, Kakori, Mal, Malihabad, Mohanlalganj, Sarojini Nagar

	Revenue villages Assembly Area	799 09

LUCKNOW CITY

Lucknow is popularly known as The City of Nawabs. It is also known as the Golden City of the East, Shiraz-i-Hind and The Constantinople of India. Avadh is claimed to be among the most ancient of Hindu states. According to popular legend, Ramchandra of Ayodhya, the hero of the Ramayana, gifted the territory of Lucknow to his devoted brother Lakshman after he had conquered Sri Lanka and completed his term of exile in the jungle. Therefore, people say that the original name of Lucknow was Lakshmanpur, popularly known as Lakhanpur or Lachmanpur. Lucknow is accessible from every part of India through Air, Rail and Road. It is directly connected with New Delhi, Patna, and Calcutta, Mumbai, Varanasi and other major cities by Amausi airport. In fact rail link joins Lucknow to Pakistan via Amritsar in the west and to Bangladesh railways in the east. The ancient language of Lucknow is often referred to as Lucknawi Urdu. As the seat of the government of Uttar Pradesh, Lucknow is the site of Vidhan Sabha, the High Court and numerous government departments and agencies. It is also the location of many social and cultural institutions of national significance, such as the Kathak, Khayal, Nawabs and Classical music. It is also the birth place of British pop star Sir Cliff Richard and resident city of Mr. Subrata Roy, the founder and chairman of the Sahara India Pariwar. In health care area Sanjay Gandhi Post Graduate Institute at Rae Bareli road has got attraction of the U.P. State. The demographic profile, socio economic characteristics, educational facilities, health Services and others information of city are given below:

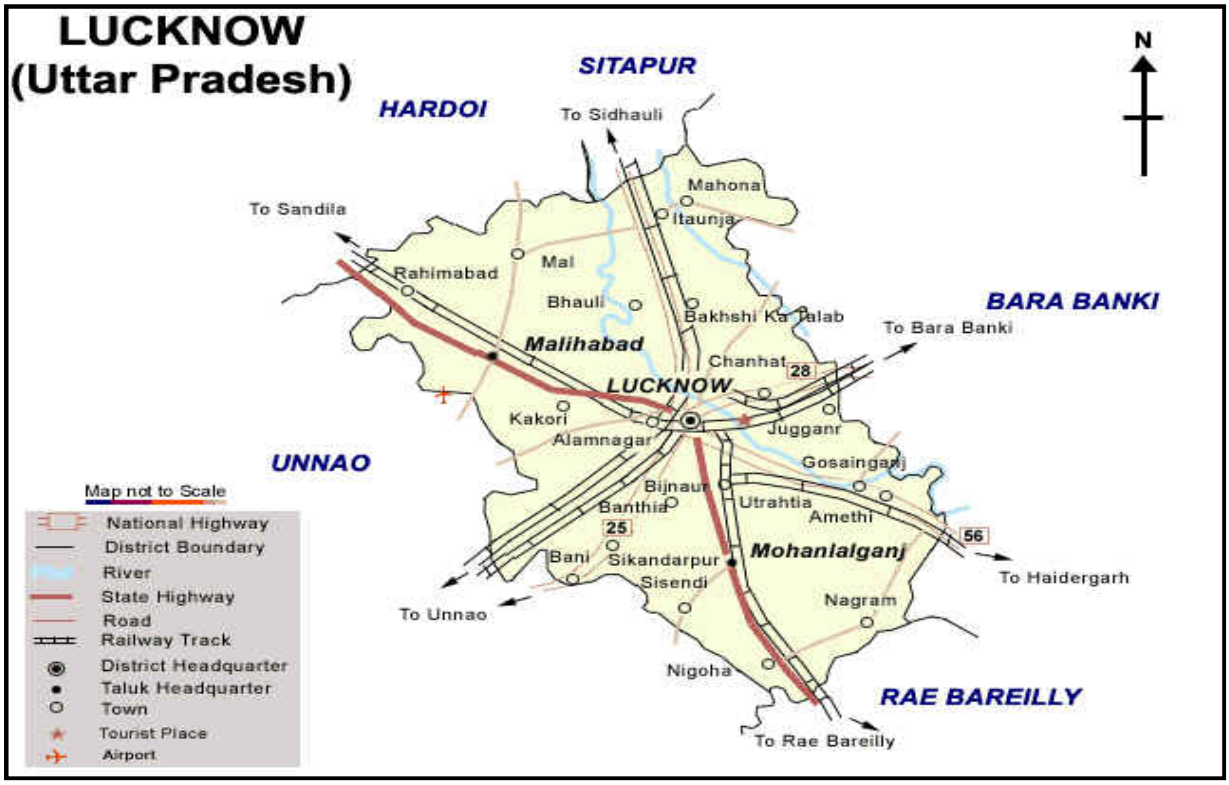


Figure 3.1.1 Map of Lucknow City

Source: Google images

Table No. 3.1.1.2: Demographic Profile of Lucknow District

Demographic Profile		
	Total Population	45,89,838
	Rural	15,50,842
	-Male	8,13,752
	-Female	7,37,090
	Urban	30,38,996
	-Male	15,80,724
	-Female	14,58,272
	Density of population (Per Sq. Km.)	1,816
	Male / Female ratio	1000 : 917
	Literacy Rate	77.29 %
	Male Literates	1,742,440 (82.56%)
	Female Literates	1,384,820 (71.04%)
	Hindu (%)	77.08
	Muslim (%)	21.46
	Christian	0.45
	Sikh	0.52
	Buddhist	0.08

	Jain	0.11
	Others (%)	0.01
	Schedule Caste (%)	21.3
Socio-Economic Characteristics		
	Total Households	8,60,703
	Rural Households	2,83,193
	Urban Households	5,77,510
Educational Facilities		
	University	7
		Integral University
		Amity University
		University of Lucknow
		Uttar Pradesh Technical University
		Dr. Ram Manohar Lohia National Lucknow University
	Medical College	Babu Banarsidas University
		3 (SGPGIMS, KGMU, Sardar
	Engineering College	Patel Post Graduate Institute of
	Polytechnic College	Dental & Medical Sciences)
	Technical Training	9
	Colleges	-
	Primary School	(Govt. Girls PTC)
	Middle Schools	55
	Senior and Senior Secondary	3050
	School	1222
		683
Public Health Facilities		
	Allopathic Hospital	38
	Beds in Allopathic hospitals	4787
	Ayurvedic Hospital	39
	Beds in Ayurvedic hospital	168
	Unani hospitals	06
	Community health centres	09
	Primary health centres	26
	Dispensaries	17
	Sub Health Centres	328
	Private hospitals	-

Source: http://dcmsme.gov.in/ (development commissioner (msme) ministry of micro, small & medium enterprises), http://www.census2011.co.in/census/district/528-lucknow.html

3.1.2 DISTRICT PROFILE OF RAE BARELI

Raebareli classified as Class I town is a statutory town and the administrative head quarters of Raebareli district falls under Lucknow division of Uttar Pradesh state. The city is a renowned educational and agriculture centre in the state. The city located 77 km southeast of Lucknow, situated on the bank of Sai River, a tribute of Gomati River passing to the west of the city. The city lies on the geographical coordinates of 26°13'North Latitude and 81°14' East Longitude. The region is under Composite Tropical climate. Its elevation varies from about 360 feet above sea level in the northwest to 258 feet above sea level in the extreme southeast, on the banks of the River Ganga. On the north, it is bounded by tehsil Mohanlal Ganj of Lucknow and Haidergarh of Barabanki, on the east, by tehsil Mussafir Khana of district Sultanpur and on the south-east, by pargana Ateha and the Kunda tehsil of district Pratapgarh. The southern boundary is formed by Ganga, which separates it from the district of Fatehpur. On the west lies the Purwa tehsil of Unnao. The general profile of the district is given below.

Table No. 3.1.2.1 General Profile of Raebareli District

Geographical Features		
	Variables	**Values**
Geographical Data	Latitude Longitude Geographical Area	25° 49' - 26° 36' North 100° 41' - 81° 34' East 3286 KM^2
	Boundaries in East West North South	 Amethi Unnao Lucknow, Barabanki Pratapgarh
Climate		
	Summer -Maximum Temperature -Minimum Temperature Rainy season -Average Rainfall -Maximum Temperature -Minimum Temperature Winter -Maximum Temperature -Minimum Temperature	March to Mid June <40°C 27 °C Mid-June to September 313 mm 32 °C 25 °C October to February 23°C 7-12°C
Area and Administration Divisions		

	Tehsils Districts Sub-Tehsil Patwar Circle Panchayat Samitis Nagar Nigam Nagar Palika Nagar Panchayats Revenue villages Assembly Area	Raebareli, Dalmau, Maharajganj, Lalganj, Unchahar, Salon 0 - - - 01 05 1317 0

RAEBARELI CITY

Raebareli pronunciation (also known as Raebareily or Rae Bareli) is a city and a municipal board in the Indian state of Uttar Pradesh. It is the administrative headquarters of Raebareli district and a part of Lucknow Division. The city is situated on the banks of the Sai River, 82 km (51 mi) southeast of Lucknow. It possesses many architectural features and sites, chief of which is a strong and spacious fort. The district is irregular in shape but compact. It forms a part of the Lucknow division and lies between Latitude 25° 49' North and 26° 36' North and Longitude 100° 41' East and 81° 34' East.

Figure 3.1.2 Map of Raebareli city
Source: Google images

Table No. 3.1.2.2 Demographic Profile of Raebareli District

Demographic Profile		
	Total Population	3,405,559
	Rural	3,097,564
	-Male	1,592,449
	-Female	1,505,115
	Urban	281,260
	-Male	160,093
	-Female	147,902
	Density of population (Per Sq. Km.)	1,965,843 (67.25%)
	Male / Female ratio	1000:943
	Literacy Rate	67.25%
	Male Literates	1,165,965
	Female Literates	799,878
	Hindu (%)	87.39 %
	Muslim (%)	12.13 %
	Christian	0.11 %
	Sikh	0.07 %
	Buddhist	0.02 %
	Jain	0.01 %
	Others (%)	0.02 %
	Schedule Caste (%)	0.25 %
Socio-Economic Characteristics		
	Total Households	8,60,703
	Rural Households	2,83,193
	Urban Households	5,77,510
Educational Facilities		
	Medical College	All India Institute of Medical Sciences (AIIMS)
	ITI	02
	Polytechnic College	9
	Technical Training Colleges	02
	Primary School	03
	Middle Schools	15
	Senior and Senior Secondary School	2306
		704
		281
Public Health Facilities		
	Allopathic Hospital	07
	Beds in Allopathic hospitals	749

	Ayurvedic Hospital	50
	Beds in Ayurvedic hospital	231
	Unani hospitals	05
	Community health centres	17
	Primary health centres	46
	Dispensaries	20
	Sub Health Centres	268
	Private hospitals	88

Source: http://dcmsme.gov.in/ (development commissioner (msme) ministry of micro, small & medium enterprises), http://www.census2011.co.in/census/district/528-raebareily.html

3.2 PERIOD of STUDY

The total period of research work was of four and half years. In the beginning, an extensive literature review of the study was done by going through various papers in journals and online publication, designing of the questionnaire cum interview schedule was done followed by testing of its validity for making it authentic to be used in the study. Simultaneously, the layout of the interventional module was being prepared and information was being gathered to be added to the module by keeping in mind to add each trivial detail in an uncomplicated manner that could be well understood by the uneducated women too. The whole period was divided into four phases;

a) Preliminary Phase:

The initial phase of the study was dedicated to in-depth understanding of the research topic. Subject experts were approached and literature review was done to prepare questionnaire cum interview schedule.

b) Interaction Phase:

In this phase, the researcher started field work (interaction with study population) to collect information. The data collection work was carried out for six months from July 2017 - December 2017.

c) Intervention Phase:

The intervention phase was of three months from March 2018 – May 2018 in which the prepared educational material using multimedia and awareness videos were shown to the interventional group. Dietary pamphlets were circulated among

all the study subjects and sufficient time was given to them so that they could well understand.

d) Post Intervention Phase:

The post interventional part was from August 2018 - October 2018 in which the interventional group was assessed. Later on, data feeding and statistical analysis part was done along with write up of the thesis.

3.3 STUDY DESIGN

The cross sectional study was conducted followed by non-experimental pre-test/post-test design in which, investigator surveyed the two groups of reproductive age women categorized under rural and urban areas. While evaluator may observe changes in outcome indicators among the intervention participants, they cannot attribute all these changes to the intervention alone using this design because there is no comparison group.

3.4 THE STUDY SAMPLE

3.4.1 Sample Size

Sample size basically constitutes the number of observation or participants that are part of that study. When doing a research it becomes impractical to study the whole population. Thus, a set of participants are selected from the population, they are less in number but are adequate for that population from which they are drawn which makes it possible to draw a true inference for the results obtained about that population.

As the choice of the participants for this study included only reproductive age women (15-49 years), and their blood samples had to be collected for checking their hemoglobin level and iron store in the body, thus the availability of such participants played a very important role in deciding the sample size.

Reviewing Number of research papers viz. **(P. Mishra, 2012; WHO Global Database on Anemia 1993-2005; WHO, UNICEF, UNU, 2001; Yishu Sun, 2010)** related to prevalence of anemia worldwide. As sample is a true representation of Universe (population) the base line data drawn by NFHS-4 was considered for determining the sample size. According to **NFHS-4** the prevalence rate of anemia

among reproductive age women (15-49 years) is 57.8% in India, according to this rate the sample size has to be deduced.

According to the NFHS - 4, the prevalence of anemia was found to be 57.8 percent. Further, the sample for the present study was calculated using the following formula:

$$\mathbf{n} = \frac{Z^2_{\alpha/2}\, pq}{d^2}$$

Where, $Z_{\alpha/2}$ is two sided value of abscissa of standard normal variate at level of significance α, p the proportion considered in percentage, and **q = 100-P**, and d is the absolute difference of the estimate.

Prevalence rate of anemia (p) = 57.8% = 0.578

q= 100-p= (100-57.8) = 0.422

d= Absolute difference of the estimate = 5%

By putting all the values in formula mentioned above, the total sample size comes to be 375.

Hence, total sample taken for the study was 500, which was slightly more than the minimum sample size requirement for determining iron deficient women. Hundred women were excluded from the study as they were not iron deficient. Hence, equal number of subjects from rural and urban population has been taken in the study i.e. two hundred from urban population and two hundred from rural population.

As the sample included in the study were from the same group (reproductive age) and the questions targeted on the study subjects included the knowledge related to anemia and selected people from that group were to be later included in the interventional phase. People belonging to age group of 15 - 49 years were selected, after explaining them the motive of the study, if they were willing to participate then only the sample was collected irrespective of their menarchial status.

3.4.2 Study Subject

The target population for this study included reproductive age women. The subjects selected for this study belonged to the age group of 15-49 years irrespective of their

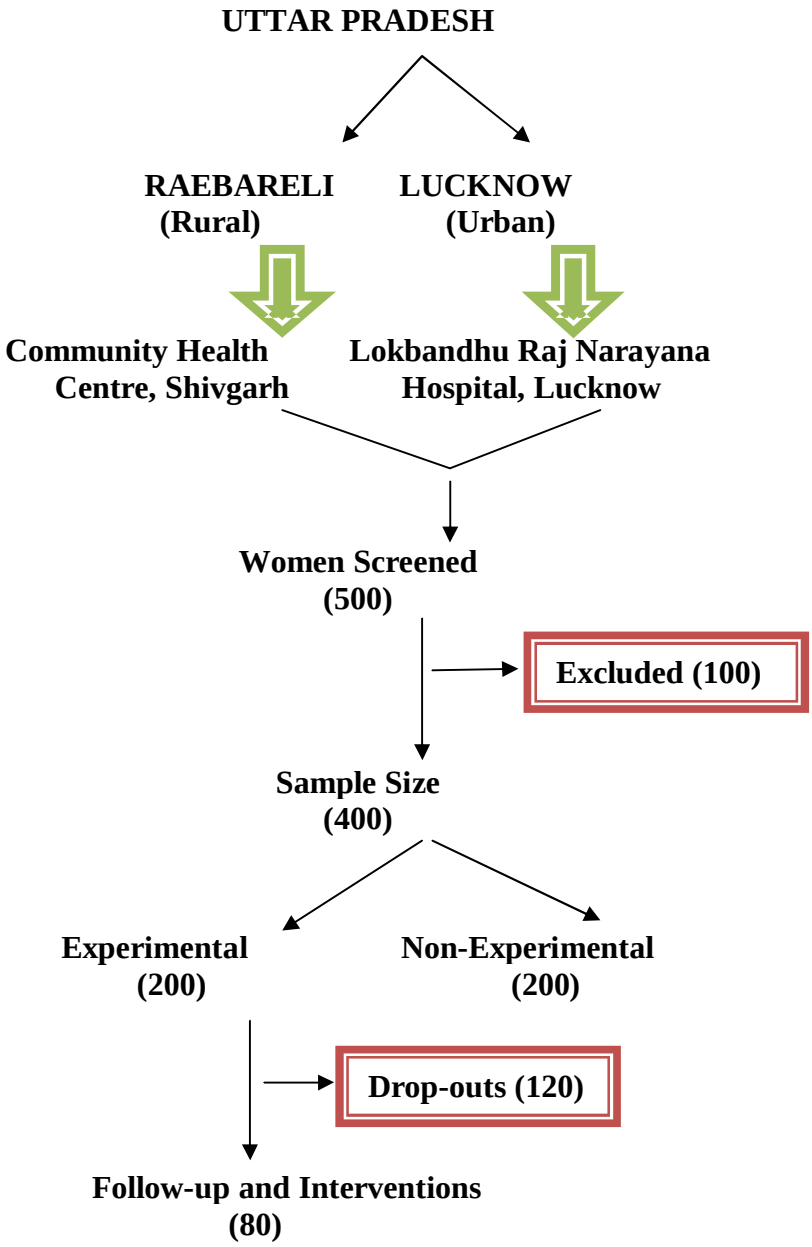
menarche status. As this age group has the most exposure to technology and are easily willing to adapt new ideas and techniques in their life. According to **WHO**, women of reproductive age refers to all women ages from 15–49 years.

***Inclusive Criteria;**

1. Selected individuals belonging to the reproductive age group of 15-49 years.
2. Subjects willing to participate in the study and ready for bio-chemical examination.

***Exclusive criteria;**

1. Patients with mental illnesses leading to confusion were excluded from participating.
2. Women who were not iron deficient.
3. Women with severe health issues due to various reasons.



3.4.3 PILOT STUDY

Before initiating the actual research, a pilot study was conducted on 30 study subjects from Community Health Center in rural area. The questions were personally asked to the respondents along with collecting their blood samples for checking their hemoglobin levels. After completing the pilot study, the minor changes had been done based on the responses of the subjects. The questionnaire was piloted for understanding and difficulty to avoid ceiling and floor effects in scoring.

3.5 SAMPLING METHODOLOGY

The study was conducted into three phases; for each phase a different approach of sampling was used, multi-stage random sampling was followed in the present study at the initial phase followed by convenience and purposive sampling in later phases of study.

3.5.1 Preliminary Phase

As recommended by ***Cochran (2009)*** multi-stage random sampling was the technique adopted for selection of sample in the present investigation. Following stages were involved in arriving at the required sample size.

Stage 1: The official websites of Lucknow Municipal Corporation and Raebareli Municipal Corporation was accessed to gather list of Community Development Blocks and Public Hospitals.

Stage 2: There were altogether 08 and 18 blocks in Lucknow and Raebareli district respectively.

Out of which, two blocks from each district were selected randomly for study.

Table No. 3.4.1 List of Blocks in Lucknow & Raebareli

S.No.	Name of Blocks in Lucknow (n=8)	Name of Blocks in Raebareli (n=18)
1	Bakshi ka Talab	Amawan
2	Chinhat	Bachhrawan*
3	Gosainganj	Chatoh
4	Kakori	Dalmau
5	Mall	Deeh
6	Malihabad	Deen Shah Gaura
7	Mohanlalganj*	Harchandpur
8	Sarojini Nagar*	Jagatpur
9	_	Kheeron
10	_	Lalganj
11	_	Maharajganj

12	_	Rahi
13	_	Rohaniya
14	_	Sareni
15	_	Salon
16	_	Sataon
17	_	Shivgarh*
18	_	Unchahar

*selected blocks

Stage 3: Out of the randomly selected four blocks (two from each district), on the basis of convenience sampling 2 blocks (one from each district) were chosen and the available public hospitals and community health centers in that area were marked down.

Stage 4: One public hospital from each block was selected based on convenience sampling; further, data was collected purposively from the people belonging to the age group of 15-49 years irrespective of their menarchial status.

Table 3.4.2 Selected Hospitals for Data Collection

S.No	Hospitals	Total Number of Respondents
1.	Community Health Centre (CHC), Shivgarh, Rae Bareli	200
2.	Lok Bandhu Rajnarayan Public Hospital, Lucknow	200
	Total	**400**

3.5.2 Interactive Phase

Stage 5: Lastly, each study subject was individually questioned for their personal information and knowledge towards the aforementioned objectives followed by collecting blood sample for assessing their hemoglobin level and iron stores in the body.

3.5.3 Intervention Phase

Purposive sampling was applied in this phase, keeping in mind the subjects who were willing to be a part of educational intervention and was ready to participate in the follow up procedure. For interventional study, rural area was preferred and all the subjects were contacted via mobile numbers that was provided by them during the primary survey. Only 80 subjects willingly participated in the interventional study, the rest 120 dropped out due to various reasons.

3.5.4 Post-interventional phase

In this phase, the study subjects were evaluated based on their responses in a pre-designed and pre-tested questionnaire. The scores were given to the respondents according to their answers.

3.6 TOOLS AND TECHNIQUES OF THE STUDY

The wording and design of a questionnaire are essential if the researcher is to obtain reliable responses. ***Polgar and Thomas (2000)*** warn of potential pitfalls, for example, the inclusion of ambiguous, biased or leading questions. Whilst open-ended and closed-response are the two major formats adopted in questionnaires, the latter format was adopted as appropriate for meeting the aims of this study. A research is only considered acceptable if the tools for that study have been accurately and suitably used. It should be noted that the tools which are being used in the study should be standardized, reliable and valid above all they should meet the requirements of the study. Various tools and techniques of applying those tools which have been used in the study according to the need of each phase have been discussed below:

3.6.1 Tools & Techniques for Phase-I & II

This phase of the study was conducted on the women of reproductive age of rural and urban areas and therefore it was highly desirable to prepare a simple but comprehensive primary survey schedule. A pre-designed and pre-tested questionnaire cum interview schedule was used as a tool to assess their general as well as specific level information. The general information broadly covers the socio-demographical information, menstrual status and medical history whereas specific information broadly covers Nutritional status through direct and indirect methods such Anthropometric measurement, Biochemical Estimation and Dietary survey. Secondly,

Knowledge regarding Anemia was also assessed using a pre-designed and pretested questionnaire. After going through extensive literature a questionnaire was administered keeping in mind the aforementioned aim, various published questionnaires were tracked down to get an in-depth knowledge on the types of questions to be enquired **(*Mangla M et al. 2016; Shilpa Jose et al. 2016*)**. The schedule to collect primary information on prevalence of anemia, developed by ***Agyiri Joseph (2011) and Pratibha Arya*** was found to be applicable in the context of present study. However, much information sought in said schedule had no relevance in context of present study. Therefore, other researchers and knowledgeable persons were consulted and schedule was reconstructed according to priorities of present study and successfully pretested for its suitability. The finally developed primary survey schedule, which has been used in present study, is enclosed in Appendix I. To evaluate the understand ability and the applicability of the instruments one week prior to the main field work, a pre-test was done on 10% of the sample size, Following the analysis of the pre-test study data, ambiguous or unclear questions was rephrased to make it more understandable.

The data was collected by the author itself by questioning the respondents personally and one assistant at each pathology and clinic was assigned to collect the blood sample for determining the full hemogram of the respondents including iron stores in the body. A brief introduction was given to the respondents by the researcher, apart from the fact that the questions were too straight forward it was kept in mind that the questions were asked in the simplest language so as to avoid any kind of uncertainty with the questions.

Plate No. 3.6.1 Data collection from respondents during preliminary phase

The primary survey schedule contained questions on following major aspects:

3.6.1.1 General Information of the Respondents

3.6.1.1.1 Socio-demographical Information

- **a. Age:** The age group selected for this study was from 15-49 years, this age group is the reproductive age group.
- **b. Religion:** It was grouped as Hindu, Muslim, and others
- **c. Marital Status:** The marital status of the individual was grouped as single and ever-married.
- **d. Residence Area:** Classification of the residence was rural and urban areas.
- **e. Type of Family:** The division of type of family was considered as Nuclear and Joint.
- **f. Family Size:** It was categorized as small (2-4 members), medium (5-8 members), and large (>8 members) according to the number of person living in a family

3.6.1.1.2 Socio-economical Information

- **a. Literacy Status:** It was grouped as illiterate, primary, secondary, higher secondary, graduate and others.
- **b. Employment:** It was quoted as working and non-working.
- **c. Monthly Income of Family:** The monthly income was categorized as <5000, 5000-8000 and >8000.
- **d. Socio-economic Strata:** The socio-economic strata was based on **B.G. Prasad's** scale which was classified as Class I, Class II, Class III, Class IV and Class V. (Scale is enclosed in Annexure III)

3.6.1.1.3 Menstrual Status

- **a. Age at Menarche:** It was divided as ≤12 years, 13-15 years and ≥16 years.
- **b. Length of a cycle:** It was categorized as <28 days, 28-30 days, >30 days and irregular.
- **c. Duration of menses:** It was categorized as ≤2 days, 3-5 days, and ≥ 6 days.
- **d. Presence of clots:** It was grouped as present and absent.
- **e. Flow during menstruation:** It was categorized as normal and excessive.
- **f. Problem of Menorrhagia**

g. Recent experience of heavy or prolonged bleeding

3.6.1.1.4 Obstetrical History: This section dealt with

a. Current menarche status: It was divided as pregnant and not pregnant

b. Gravida: It was categorized as nulli-gravida, primi-gravida and multi-gravida

c. Parity: It was categorized as nulli-parous, primi-parous, bi-parous and multi-parous.

d. Abortion history: It was grouped as none, once and multiple.

e. Interval between current and previous pregnancy: Less than 1 year, 1 – 3 years and more than 3 years.

f. Number of children: No child, 1 – 3 children, 4 – 6 children, 7 – 9 children and more than 10 children.

g. Spacing between children: 1 year, between 1 – 2 years, more than 2 years.

h. Current breastfeeding status: It was grouped as yes and no.

3.6.1.1.5 Dietary Pattern Survey: The dietary pattern was elicited by asking questions as listed below:

a. Nature of Diet: The respondent was asked whether he consumed vegetarian, non-vegetarian, eggetarian or occasional non-vegetarian diet.

b. Number of Meals per day: The respondent whether or not consumed her diet at fixed or irregular timing.

c. Food habit after conceiving: It was divided as taking the usual diet, taking the special diet and partly modified

d. Frequency of tea/coffee in a day: It was categorised as once, 2-3 times, 4-5 times, at regular intervals and whenever feel like having it.

e. Munching between meals: It was grouped as only once, whenever feel hungry and never.

f. Type of food: It was divided as fried/spicy, partially boiled, whatever being cooked for family.

g. Food Frequency Pattern: It was classified as consumption of red meat, chicken, fish, legumes, green leafy vegetables, whole grains, citrus fruits/juices, soups**.**

3.6.1.1.6 Health and Medical status:

It was categorised as past morbidity status (ever had anemia, malaria, hookworm, any infection, blood transfusion), other morbid conditions (peptic ulcer, rectal bleeding, melaenia, ulcerative colitis and cancer) pattern of common ailments in anemia (headache, dizziness, nausea, constipation, stomach ache, melaena, insomnia, and fatigue) and past history of surgery.

3.6.2.1 Anthropometric Measurements of Reproductive Age Women

As per **National Institute of Nutrition** (**NIN-2009),** nutritional anthropometry is a measurement of human body at different age levels and degrees of nutrition. Growth retardation may be the first response of the body towards nutritional deficiencies while appearance of clinical signs may be the final stage. From the public health point of view identification helps to prevent milder cases going into severe forms with consequent risk of high mortality. **Oliveira *et al*. (2004)** states that anthropometric measurements, among the most frequently applied methods for assessing nutritional status in reproductive age women esp. pregnant women, are recognized as effective tools in the prevention of peri-natal morbidity and mortality. The anthropometric measurements, namely, height and weight of all the four hundred (400) respondents were recorded for further calculation of BMI.

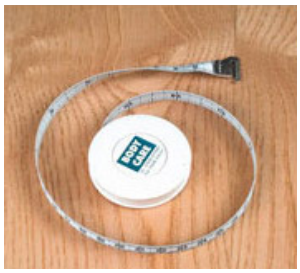
S.No	Measurement	Equipment/ Technique
1	**Weight**: Libra weighing machine was used to measure the weight of respondents	**Libra Weighing Machine**
2	**Height**- Anthropometric measuring tape was used to draw the scale on wall	 **Anthropometric measuring tape**
3	**BMI**- Standard WHO classification and formula was used to calculate the BMI.	**BMI= Weight (kg) / Height (m^2)** **Body Mass Index Formula**

Plate 3.6.2 Anthropometric measurements equipments/ formula

3.6.2.1.1 Height

The height of every human being is determined by both hereditary and environmental factors. The maximum growth potential of an individual is decided by hereditary factors. The environmental factors such as nutrition and morbidity determine the extent of exploitation of that genetic potential **(NIN, 2009)**. Heights of all the respondents were determined using a scale drawn on a vertical flat wall with the help of a fiberglass tape. The study participants were asked to stand erect near the wall with their heels together and toes apart and head upright touching the wall. The head was held comfortably high. A smooth thin ruler was kept on the centre of the head and height was recorded in centimeters.

3.6.2.1.2 Weight

The measurement of body weight is the most widely used and simplest criteria of assessment of health and nutritional status. As this study encompasses pregnant women, a routine measurement of weight was recommended in order to identify excess or inadequate weight gain. Recording of weight of all study subjects was done with the help of digital weighing machine to the nearest 0.1 kg accuracy. To obtain approximate result, it was made sure that the study participants were weighed with minimum possible clothing, footwear and accessories.

3.6.2.1.3 Body Mass Index (BMI)

Body Mass Index (BMI) is a useful assessment of body fitness in all age groups of reproductive age women. It is simple to use. BMI is defined as body weight in kilograms divided by the square of height in meters (kg/m^2), is a weight-for-height index that meets to assess the underweight, normal weight, overweight and obese.

Table No. 3.6.2.1.3 Ideal Range for Body Mass Index

Body Mass Index	Value
<18.5	Underweight
18.5-24.9	Normal
25-29.9	Overweight
30-34.9	Obese Class I
35-39.9	Obese Class II
>40	Obese Class III

Plate 3.6.2.1.2: Weight and Height Recording of Respondents

3.6.2.1.4 Biochemical Examination

Biochemical examination such as hemoglobin level (gm/dl), Packed Cell Volume (PCV) (%), Mean Corpuscular Volume (MCV) (fl), Mean Corpuscular Hemoglobin (MCH) (pg), Mean Corpuscular Hemoglobin Concentration (MCHC) (g%), Red Blood Cell count (cu.mm), Serum iron (µg/dl) and Serum ferritin (µg/dl), were done for all the subjects of both the rural and urban areas. The tests were carried out with the help of a government accredited hematological lab to know the iron status of the subjects. The biochemists came to the hospitals to collect the blood samples.

Blood samples of the subjects were collected from the vein of the forearm. The skin was cleaned by rubbing with spirit. A sterile hypodermic needle fixed to a syringe of capacity 10 ml was inserted into the vein. About 5 ml of blood was collected from each sample and poured into bottle containing anticoagulant Ethylene Diamine Tetra Acetic Acid (EDTA). The blood samples were taken to the lab by the biochemists for analysis.

Table No. 3.6.2.1.4 Normal range of Complete Blood Count

Components	Normal Range	Units
Hemoglobin	11.50 – 15.00	g/Dl
Hematocrit	35.9 – 44.6	%
Packed Cell Volume (PCV)	36.00 – 46.00	%
RBC Count	3.80 – 4.80	mill/mm3
MCV	80.00 – 100.00	Fl
MCH	27.00 – 32.00	Pg
MCHC	32.00 – 35.00	g/Dl
Red Cell Distribution Width	11.50 – 14.50	%
WBC Count	4.5 - 11	KµL
Differential Leucocytes Count		
Segmented Neutrophils	40.00 – 80.00	%
Lymphocytes	20.00 – 40.00	%
Monocytes	2.00 – 10.00	%
Eosinophils	1.00 – 6.00	%
Basophils	<2.00	%
Absolute Leucocytes Count		
Neutrophils	2.00 – 7.00	thou/mm3
Lymphocytes	1.00 – 3.00	thou/mm3
Monocytes	0.20 – 1.00	thou/mm3
Eosinophils	0.02 – 0.50	thou/mm3
Basophils	0.01 – 0.10	thou/mm3
Total Leucocytes Count (TLC)	4.00 – 10.00	thou/mm3
Platelet Count	150.00 – 450.00	thou/mm3
Serum Ferritin	12 - 270	µg/l

Plate 3.6.2.4: Blood sample collection of respondents from a pathologist

3.6.3.1 Pre and Post Knowledge Questionnaire

During development of the questionnaire, account was taken of previous KAP related surveys on IDA (**Raksha M et al., 2016; Mamta L et al., 2014; Nivedita K et al., 2016; Angadi and Ranjitha et al., 2015)**. These provide an ongoing source of information about the KAP questions to be intervened to the subjects.

This was the basic tool, which, guided the study, and therefore, to develop this tool investigator made repeated interactions with selected women in identified hospital before initiating present investigation program. These interactions involved informal discussion with a number of respondents in selected hospitals for gathering the information on their ability to what extent they can respond to the questions framed in the schedule. Later on, the format of schedule was discussed with the specialist in nutrition education. Thus, the final pre and post test schedule was formulated with inputs from the participants of present investigation and specialists from related discipline. The developed schedule was informally pre tested before initiating the study and found effectively applicable. A total of 08 questions were asked, each question has multiple choice.

3.7 Tools and Techniques for Phase III (Intervention Phase)

3.7.1 Conduct of Educational Intervention

Caballero (2001) opines that an intervention in nutrition introduced in early life has the potential to improve nutritional status and bring about major reductions in the

incidence of several diseases. Poor socio-economic status does stand in the way of improved nutrition, but ignorance regarding nutrients needed by the body and low cost foods, which can provide them better health, are partly responsible. Nutrition education has been described as the process, which assists the public in applying knowledge from the nutrition science and the relationship between diet and health to their practices ***(Barasi, 2007)***. Thus, nutrition education helps people gain knowledge of nutrition and persuades to bring about required changes in their food habits.

From among 200 reproductive age women who had visited the Community Health Center during the study period, 80 women who were willing to participate in the study were selected and considered as interventional group.

3.7.2 Preparation of Nutrition Education Module

Nutrition education may help improve household food security status and unhealthful food-related behaviors associated with household food insecurity ***(Farrell, 2014)***. A nutrition educational module was developed by the researcher and approved by the nutrition experts. The module consisted of the following information like meaning of anemia, normal hemoglobin levels, criteria for diagnosis, etiology, vulnerable groups, symptoms, prevalence, deleterious effects of anemia, Recommended Dietary Allowances (RDA) of iron, factors inhibiting and enhancing iron absorption, iron rich foods and do's and don'ts of anemia. Materials like charts, posters, booklets and a Power point presentation on nutrition education to prevent anemia were prepared.

Booklet on Anemia: To assist in counseling a booklet was prepared. Booklet was developed to assist the patients in gaining insight into the disease related aspects and in knowledge and practice regarding nutrition. Thus, keeping this perspective in mind booklet was developed in both English and Hindi so that the patients could easily understand it. Booklet is enclosed in Annexure V.

3.7.3 Imparting Nutrition Education

Nutrition education was imparted to all the 80 women who willingly participated in interventional program. The aspects covered were know how of anemia, importance and functions of iron, requirements of iron during adolescence and pregnancy, hygiene during menstruation, iron rich diets, desirable weight gain and effects of

adequate / malnutrition during pregnancy on the mother and fetus, importance of breast feeding and immunization. Education was imparted through various audio visual aids like posters, charts, and power point presentations included videos on awareness about anemia, food guide pyramid and low cost iron rich recipes.

Plate 3.7.3 Respondents during Educational Intervention

3.7.4 Awareness Camp on Prevention and Control of Anemia

An awareness campaign on prevention and control of anemia was carried out with an objective to educate rural women about the reproductive age phenomenon and complications arising due to hormonal changes during reproductive phase with special emphasis during puberty and pregnancy. It was held to make them aware about anemia and its multifactorial causative factors and how to control them and maintain the health through suitable diet, exercise and lifestyle changes. Lectures by eminent speakers revealed the importance and concept of woman's health, menopause, its effects on body, bones, metabolism and psychology of a woman.

Plate 3.7.4.1 Banner of Anemia Awareness Camp

Plate 3.7.4.2 Lectures during Awareness Camp

एक दिवसीय एनीमिया जागरूकता स्वास्थ्य शिविर संपन्न

- बाबा साहब भीमराव अंबेडकर विश्वविद्यालय की ओर से किया गया जागरूकता शिविर का आयोजन
- शोधकर्ताओं ने लिया एनीमिया मुक्त भारत बनाने का संकल्प

संवाददाता। शिवगढ़ (रायबरेली)

शिवगढ़ क्षेत्र के सामुदायिक स्वास्थ्य केंद्र शिवगढ़ प्रांगण में बाबा साहब भीमराव अम्बेडकर विश्वविद्यालय के तत्वावधान में मानव विकास एवं परिवार अध्ययन विभाग गृह विज्ञान की ओर से एनीमिया मुक्त भारत बनाने के उद्देश्य से पांच सदस्यीय प्रोफेसर दल व उनके साथ आए होम साइंस पर शोध कर रहे 55 छात्रों द्वारा एक दिवसीय एनीमिया जागरूकता स्वास्थ्य शिविर का भव्य आयोजन किया गया। इसका शुभारम्भ बाबा साहब भीमराव अम्बेडकर विश्वविद्यालय संकाय अध्ययन से मुख्य अतिथि के रूप में एडीजी पुलिस की पत्नी एवं प्रोफेसर सुनीता मिश्रा, विभागाध्यक्ष डॉ.यूवी किरन, डॉ. शर्मिला, डॉ.नीतू सिंह, डॉ. शालिनी अग्रवाल, स्वाती राय व सीएचसी अधीक्षक डॉक्टर एलपी सोनकर ने बाबा साहब भीमराव अम्बेडकर की प्रतिमा पर पुष्पमाला चढ़ाने के बाद महिलाओं एवं आशा बहुओं को फल वितरित कर किया। जागरूकता शिविर को संबोधित करते हुए प्रोफेसर डॉ. सुनीता मिश्रा ने कहा कि एनीमिया महिलाओं एवं बच्चों के लिए बहुत ही घातक है जिससे बचने के लिए हरी सब्जियों, फलों एवं पत्तियों वाली सब्जियों का ज्यादा से ज्यादा सेवन करें। गांव में निशुल्क रूप से मिलने वाली सहजन की फलियों एवं उसकी पत्तियों का प्रयोग करें। गर्भावस्था के दौरान काले अंगूर, संतरे एवं केले का नियमित सेवन करें।

डॉ. नीतू सिंह ने कहा कि हीमोग्लोबिन एक पदार्थ है जिससे हम खून की मात्रा डिफाइंड करते हैं। जो हमारे प्रोटीन और विटामिन सी के संयुक्त प्रयोग से आता है। आयरन के साथ-साथ हमें और कुछ तत्वों का भी ध्यान रखना है जिसमें प्रोटीन, विटामिन बी 12, फोलिक एसिड सब मिलाकर हमारी गुणवत्ता को बढ़ाएंगे।

होम साइंस की विभागाध्यक्ष डॉ. यूवी किरन ने अपने संबोधन में कहा कि हम लोग पानी की बोतल, दूध की पाउच आदि का प्रयोग करने के बाद प्लास्टिक को फेंक देते हैं जो हमारे वातावरण के लिए बहुत ही हानिकारक है जिसके प्रयोग से हमें बचना होगा। वहीं डॉ. शालिनी अग्रवाल ने महिलाओं एवं आशाओं को जागरूक करते हुए कहा कि माहवारी के दौरान युवतियों को नैपकिंस के प्रयोग एवं उसका डिस्पोज करना सिखाएं जिससे हमारा पर्यावरण स्वच्छ और सुरक्षित बना रह सके। डॉक्टर शर्मिला ने अपने संबोधन में कहा कि कंगारू मदर केयर के विषय में जो सुनकर आए थे आज पता चला है कि शिवगढ़ कंगारू मदर केयर की मातृभूमि है, आज यहां आकर हम सभी अपने आपको गौरवान्वित महसूस कर रहे हैं। वहीं स्वाती राय ने महिलाओं को जागरूक करते हुए कहा कि छोटे बच्चों के पेट में कीड़े होते हैं जिसके लिए एल्बेंडाजोल का प्रयोग करते हैं,जिसके प्रयोग से कीड़े समाप्त हो जाते हैं। पेट में जो कीड़े होते हैं वह रक्त को खत्म करते हैं, जिससे बच्चे एनीमिया का शिकार हो जाते हैं,वहीं 15 से 49 वर्ष तक की जो महिलाएं होती हैं उनका माहवारी के समय काफी ज्यादा रक्त बह जाता है, इस तरह से महिलाएं एनीमिया का शिकार हो जाती हैं। गर्भावस्था के दौरान काफी ज्यादा महिलाएं एनीमिया का शिकार हो जाती हैं। हमारे देश में 80 प्रतिशत महिलाएं एनीमिया से पीड़ित पाई गई हैं। गर्भावस्था के दौरान मां की साथ की बच्चे को भी रक्त की जरूरत पड़ती है, इसलिए मां के शरीर में रक्त कणिकाओं की मात्रा तेजी से बढ़नी चाहिए। अगर ऐसा नहीं होता है तो मां और बच्चा दोनों एनीमिया से ग्रसित होकर कमजोर हो जाते हैं। कभी-कभी तो दोनों की जान को भी खतरा हो जाता है। जिसके मुख्य लक्षण चक्कर आना, थकन महसूस होना, हृदय गति तेज हो जाना, सांस फूलना, आंखों के नीचे सूजन आ जाना आदि लक्षण है। जिसकी रोकथाम के लिए बच्चों को साफ-सफाई से रखें, घरों के आस-पास साफ सफाई रखें, पोषकयुक्त भोजन एवं हरी सब्जियों और फलों का प्रयोग करें।

प्रोफेसरों एवं शोधकर्ताओं ने सीइएल एवं केएमसी को करीब से जाना

शिविर के समापन पर अम्बेडकर विश्वविद्यालय के प्रोफेसर एवं शोधकर्ताओं ने सीएचसी शिवगढ़ में स्थित केएमसी लाउंज एवं शिवगढ़ राजमहल में स्थित कम्युनिटी एंपावरमेंट लैब सक्षम शिवगढ़ ऑफिस का विजिट किया। जहां सभी ने कम्युनिटी एंपावरमेंट लैब के कार्य एवं उद्देश्य को बखूबी व करीब से समझा साथ ही भविष्य में पुनः आने या अवसर मिलने पर साथ कार्य करने के लिए प्रेरित भी हुई। सभी ने सीइएल के कार्यों की प्रशंसा की साथ ही आश्चर्य भी किया कि ऐसा अंतरराष्ट्रीय कार्य शिवगढ़ जैसे क्षेत्र में हो रहा है। सभी ने एक वृहद कार्यक्रम पुनः शिवगढ़ में करने की इच्छा जाहिर की।

Plate 3.7.4.3 Print Media Coverage of Awareness Camp

3.8 Tools and Techniques for Phase IV (Post Intervention)

A total eighty (80) respondents who took part in the intervention had been selected, and the information about anemia has been asked to them with a preset and pre-tested questionnaire consisting of eight questions. The drafted questionnaire which included eight (08) questions, related to its common cause, sign and symptoms of anemia, treatment was administered to the subjects. It took around 15-20 minutes for each subject to complete the questionnaire. Scores were given for all the questions. Every question has been given equal weight age. Correct answer was given a score point of "One" and wrong answer was given score point of "Zero". For multiple choice questions each correct options is given equal weights e.g. suppose a question have 4 correct options, then the score given to each of the options is Maximum score/ total options correct i.e. ¼ = 0.25 for each correct options. So, the maximum score of the set of 8 questions is 8 and minimum score is Zero. The score table is given in Annexure IV. Now, further the total score is divided into 3 categories:

0 to below 3	Low level knowledge
3 to below 6	Moderate Level Knowledge
6 to 8	High Level Knowledge

3.9 ANALYSIS OF DATA

The data was coded, tabulated and analyzed using appropriate statistical techniques i.e. Mean, SD, Frequency tabulation, Chi- square test, Paired t test, Logistic Regression (Odds Ratio and Relative Risk) and Correlation was administered to analyze the data accordingly.

Nutritional status has been assessed based on anthropometric measurement, bio chemical estimation and dietary survey. Various parameters viz., Weight for age, Height for age, Hemoglobin estimation, were examined against available reference values i.e., **WHO (2013).** Body Mass Index (BMI) of each study subject was computed by using the formula weight (kg) / height (m^2). Study subjects were graded in different grades of nutritional status according to previous WHO and proposed criteria for Asians **(WHO, 2013).**

Consumption pattern of all food groups and dietary practices was assessed using a Food Frequency table and Nature of meal, type of diet, number of meal, consumption of tea/coffee etc. Appropriate statistical tools were applied to draw relevant influences.

3.10 STATISTICAL ANALYSIS

Statistical analysis helps the researcher to make sense of quantitative information. Without statistics, quantitative data would be a chaotic mass of numbers. Statistical procedure enables researchers to summarize, organize, evaluate, interpret and communicate numeric information **(Polit and Denise, 2009).**

The data collected had been entered on SPSS data sheet showing various items/variables in columns and subjects in rows. The analysis of data was also done using statistical software SPSS version 20.0. The items of demographic profile and personal characteristics were summarized using frequency tables, percentage, graphs and for continuous variables, mean and standard deviation (SD) were determined. The formulae for mean and standard deviation are given below:

1. **Mean:** To obtain the mean, the individual observations were first added together and then divided by the number of observation. The operation of adding together or summation is denoted by the sign Σ.

The individual observation is denoted by the sign X, number of observation denoted by n, and the mean by $\overline{X}$.

$$\overline{X} = \frac{\Sigma X}{\text{No. of observations (n)}}$$

2. **Standard Deviation**: It is denoted by the Greek letter σ.

$$\sigma = \sqrt{\frac{\Sigma (X - \overline{X})^2}{n}}$$

where, σ = Standard deviation
Σ = summation
(x - x) = Square of deviation of each value
From the arithmetic mean
f = frequency
n = total number of observation

3. Chi square test:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Where O = Observed frequency, E = Expected frequency

Degree of freedom for chi - square test

df = (c - 1) (r - 1) where, c = number of columns
r = number of rows

4. Correlation

$$r = \frac{\sum (x - \overline{x})(y - \overline{y})}{\sqrt{\sum (x - \overline{x})^2 \sum (y - \overline{y})^2}}$$

Where, ∑xy = Sum of products of deviations of x and y from their averages
∑x = Sum of the deviation of x from its average
∑y = Sum of the deviation of x from its average
$\sum x^2$ = Sum of the square deviation of the first series, x
$\sum y^2$ = Sum of the square of deviation of second series, y

n = Number of pairs of observations

To test the significance of mean of difference of paired observations (BT versus AT) paired t test was applied

5. Paired t = $Meanofdifference SEofdifference$ SE = Standard Error = $SD\ \sqrt{n}$ n = no. of cases (sample size) and d.f. = degree of freedom n-1.

6. Wherever, the data did not satisfy the assumptions of parametric test, nonparametric test viz., Wilcoxon-Signed rank test was applied

7. **Level of significance:** "p" is level of significance

p > 0.05	Not significant
p < 0.10	Marginally significant
p < 0.05	Significant
p < 0.01	Highly significant

3.11 OPERATIONAL DEFINITIONS

3.11.1 GRAVIDA: The number of time a woman has conceived.

3.11.2 PARITY: A number of times a woman have given birth to a fetus with a gestational age of 20 weeks or more.

3.11.3 KNOWLEDEGE: In this study knowledge refers to correct response given by the reproductive age women to the items in the questionnaires regarding anemia and its prevention, which are scored and added to qualify their knowledge as low, moderate and high.

3.11.4 MELAENA: The production of dark sticky faeces containing partly digested blood, as result of intestinal bleeding.

CHAPTER - IV

RESULTS AND DISCUSSION

This chapter divulges the answer of the research work. The study has been categorized into phases viz. Preliminary and Post Intervention Phase. The results of this study have been classified and discussed under the following heads.

PHASE I PRELIMINARY PHASE

4.1. Background Information

4.1.1 Socio-Demographic Profile of Respondents

4.1.2 Socio-economic Profile of Respondents

4.2 Gynecological Status of Reproductive Age Women

4.2.1 Menstrual Status of Reporductive Age Women

4.2.2 Problem of Menorrhagia

4.2.3 Recent Experience of Heavy or Prolonged Menstrual Bleeding

4.3.1 Obstetrical History of Reproductive Age Women

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4.3.3 Breast Feeding Status of Respondents

4.4 Health and Medical Conditions Related to IDA among Reproductive Age Women

4.4.1 Grading of severity of Iron Deficiency Anemia

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4.4.3.2 Ever Diagnosed with Malaria

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4.4.3.4 Ever Diagnosed with Reproductive Tract Infection

4.4.3.5 Ever Had Blood Transfusion

4.4.2 Common Ailment Pattern in Anemia

4.4.3 Past History of Surgery (including C-Section)

4.5 Dietary Habits of Respondents

4.5.2 Food Consumption Pattern

4.5.3 Modified Diet during Pregnancy (n=257)

4.5.4 Nutritional Supplement

4.6 Knowledge Regarding Anemia

4.6.2 Mean ± SD of knowledge score associated with Anemia

4.7 Factors associated with Prevalence of IDA

4.7.1 Socio-demographic status associated with Prevalence of IDA

4.7.2 Socio-economic status associated with Prevalence of IDA

4.7.3 Menstrual status associated with Prevalence of IDA

4.7.4 Obstetrical history associated with Prevalence of IDA

4.7.5 BMI Status associated with Prevalence of Anemia

4.8 Correlation among factors related to IDA.

4.8.1 Correlation among Menstrual Status and Hemoglobin Levels

4.8.2 Correlation between Anthropometric Indices and Hemoglobin Levels

4.8.3 Relationship of IDA with Certain Morbid Conditions

4.8.3.1 Association of morbidity status with diagnosis of anemia

4.8.3.2 Association of morbidity status with malaria

4.8.3.3 Association of morbidity status with hookworm infestation

4.8.3.4 Association of morbidity status with reproductive tract infection

4.8.3.5 Association of morbidity status with peptic ulcer

4.8.3.6 Association of morbidity status with rectal bleeding

4.8.3.7 Association of morbidity status with melaena

4.8.3.8 Association of morbidity status with ulcerative colitis

4.8.3.9 Association of morbidity status with cancer

4.8.3.10 Association of morbidity status with blood transfusion

4.8.4 Relationship between Common Ailment Pattern and IDA

4.8.4.1 Pattern of Headache

4.8.4.2 Pattern of Dizziness

4.8.4.3 Pattern of Nausea

4.8.4.4 Pattern of Constipation

4.8.4.5 Pattern of Stomach Ache

4.8.4.6 Pattern of Melaena

4.8.4.7 Pattern of Insomnia

4.8.4.8 Pattern of Fatigue

4.8.4.9 Pattern of Heavy Bleeding

4.9 Relationship of BMI with Dietary Habits of Respondents

4.9.1 BMI associated with Food Consumption Pattern

4.9.2 BMI associated with No. of Meals per day

4.9.3 BMI associated with Food habits after Conceiving

4.9.4 BMI associated with Consumption of Tea/Coffee

4.9.5 BMI associated with Munching between Meals

4.10 BMI associated with Menstrual Status

4.11 Socio-demographic factors associated with Food Consumption Pattern

4.11.1 Association of Age and Religion with Food Consumption Pattern

4.11.2 Association of Residence Area and Type of Family with Food Consumption Pattern

4.12 Socio-Economic factors associated with Food Consumption Pattern

4.12.1 Association of Literacy Status and Food Consumption Pattern among respondents

4.12.2 Association of Family Income (monthly) and Food Consumption Pattern among respondents

4.12.3 Association of Socio-economic Strata and Food Consumption Pattern among respondents

4.13 Relative Risk Analysis of Dietary Habits with IDA Status

PHASE IV POST INTERVENTION

4.15 Mean ± SD of Pre and Post Intervention Variables

4.15.1 Mean ± SD of Knowledge during Pre and Post Intervention.

4.15.2 Mean ± SD of Level of Awareness change from Pre to Post Intervention.

4.16 Percentage wise change of Knowledge through pre to post intervention among respondents.

4.1 Background Information This section will discuss the background characteristics of the parameters based on various variables viz: age, religion, caste, data collection place, gender, marital status and morbidity status.

Table No. 4.1.1 Socio-demographic Profile of Respondents

Variables	Frequency (n=400)	Percentage
Age (in years)		
15-19	31	7.8
20-29	211	52.8
30-39	111	27.6
40-49	47	11.8
Religion		
Hindu	343	85.8
Muslim	36	9.0
Any other	21	5.2
Marital Status		
Single	57	14.2
Ever Married	343	85.8
Residence Area		
Rural	200	50.0
Urban	200	50.0
Family Type		
Joint	211	52.8
Nuclear	189	47.2
Family Size		
Small (2-4 members)	134	33.5
Medium(5-8 members)	152	38.0
Large (>8 members)	114	28.5
Total	**400**	**100**

The study results summarized in Table 4.1.1 reveals the socio- demographic characteristics of the respondents. The total numbers of respondents included in this study were four hundred (400) out of which 31 (7.75%) belonged to the age group of 15 to 19 years, 211 (52.75%) belonged to the age group of 20 to 29 years. There were 111 (27.60%) from the age group of 30 to 39 years and 47 (11.75%) were found between the age group of 40 to 49 years.

The majority of the respondents were Hindu 343 (85.75%), Muslim being 36 (9%), and Others being 21 (5.25%). Majority of the respondents were married 343 (85.75%), 57 (14.25%) were single.

4.1.2 Socio-economic Profile of Respondents

In the given table 4.1.2, most of the reproductive age women holds graduation degree and above were 168 (42%). An equal number of respondents were illiterate and primary literate that is 63 (15.80%) in each. Similarly, respondents studied up to secondary and higher secondary were 48 (12%) and 58 (14.50%) respectively.

Out of 400 women, 324 (81%) women were unemployed. 186 (46.50%) women revealed that they have more than eight thousand monthly family income and only 80 (20%) women said they have less than five thousand monthly family income. Joint family system is still prevalent in India, 211 (52.80%) women were living in joint family setup with medium family size 152 (38%) comprising five to eight members in a family.

The socioeconomic characteristic of an individual plays a vital role in affecting the overall understanding towards any particular area. According to the B.G. Prasad's modified socioeconomic classification it was observed that most of the women (30.80%) belonged to the Class II, strata and only eight percent belonged to Class V strata.

Table No. 4.1.2 Socioeconomic Profile of Respondents

Variables	Frequency (n=400)	Percentage
Literacy Status		
Illiterate	63	15.8
Primary	63	15.8
Secondary	48	12.0
Higher Secondary	58	14.5
Graduate and above	168	42.0
Employment Status		
Employed	76	19.0
Not Employed	324	81.0
Family Income (monthly)		
<5000	80	20.0
5000-8000	134	33.5
>8000	186	46.5

Socioeconomic Strata		
Class I	46	11.5
Class II	123	30.8
Class III	118	29.5
Class IV	81	20.2
Class V	32	8.0
Total	**400**	**100**

4.2 Gynecological Status of Reproductive Age Women

In the above table 4.2.1 Of the 400 participants 246 (61.50%) attained their menarche at the age of 13-15 years. 124 (31%) respondents had attained their menarche at less than or at 12 years of age. Very few respondents (7.50%) said that their menses started at the age of 16 years or more.

More than half of the participants (65%) had a normal length of the menstrual cycle. Quite an equal number of respondents were found to have more than thirty days and less than twenty eight days of length of the cycle that is 70 (17.50%) and 66 (16%) respectively. Only four (1%) respondents mentioned that they have irregular cycle. Over two-third of the participants had three to five days of menses. A proportion of 16% and 11.80% participants had six or more days and two or less days of menses respectively.

The majority of the women that is 274 (68.50%) denied the presence of clots and only 126 (31.50%) women complained about presence of clots.

Table No. 4.2.1 Menstrual History of the Respondents

Variables	**Frequency (n=400)**	**Percentage**
Age at menarche (in years)		
≤12	124	31.0
13-15	246	61.5
≥16	30	7.5
Length of a cycle (in days)		
<28	66	16.0
28-30	260	65.0
>30	70	17.5
Irregular	04	1.0
Duration of menses (in days)		

≤2	47	11.8
3-5	289	72.3
≥6	64	16.0
Presence of clots		
Present	126	31.5
Absent	z274	68.5
Total	**400**	**100**

4.2.2 Problem of Menorrhagia

The problem of menorrhagia among reproductive age women was quite less in number that is 108 (27%), rest of the population did not have problem of menorrhagia.

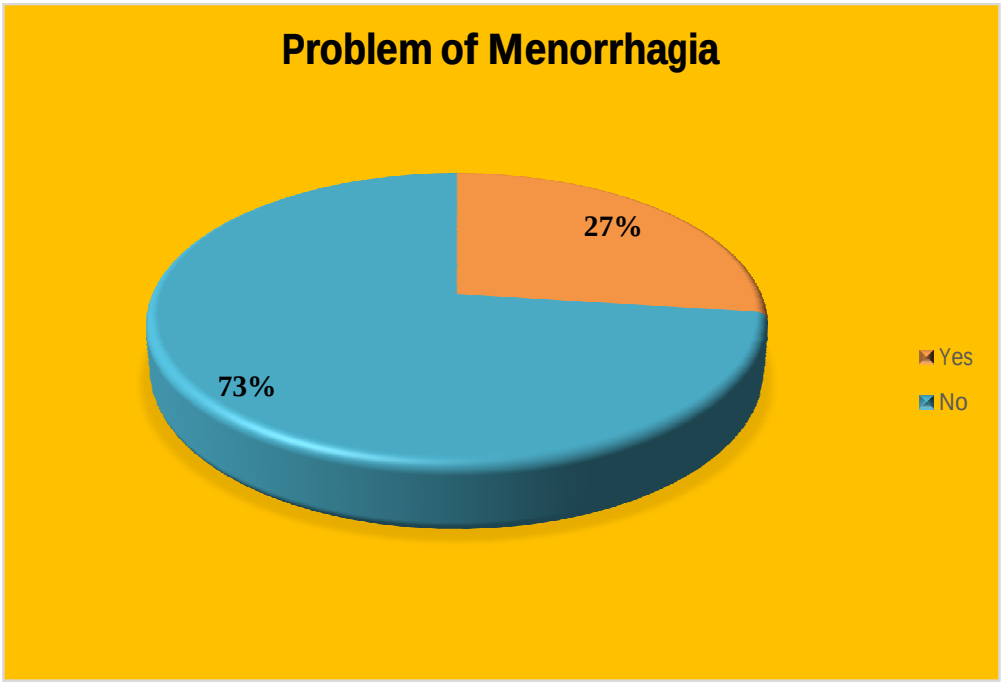

Figure 4.2.2 Percentage of women having menorrhagia

4.2.3 Recent Experience of Heavy or Prolonged Menstrual Bleeding

The majority of the women 292 (73%) said that they did not experience heavy or prolonged bleeding in their last few months. The flow during menses was normal. A small proportion of women 108 (27%) reported about heavy bleeding in recent times.

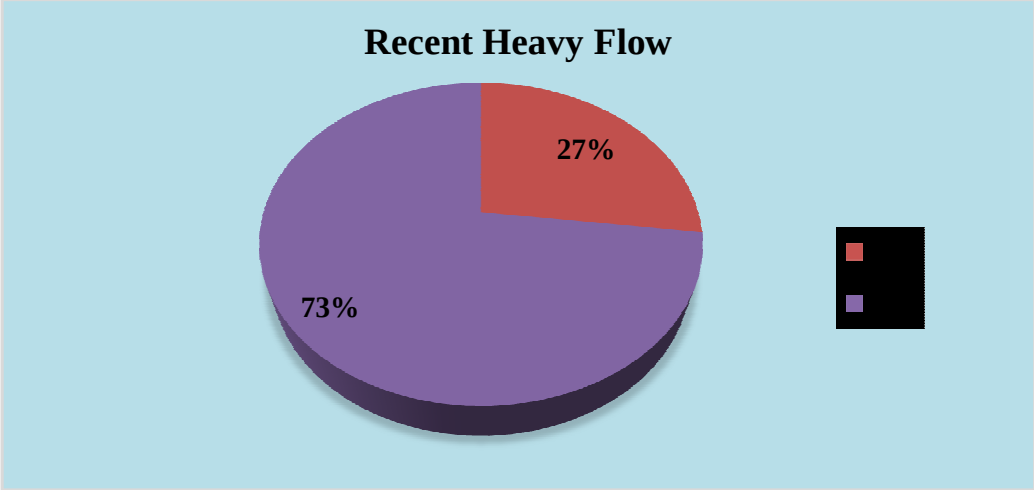

Figure 4.2.3 Percentage of women experienced recent heavy menstrual bleeding

4.3.1 Obstetrical History of Reproductive Age Women

Obstetrical history of women shows that, majority of them 215 (53.70%) were pregnant and 185 (46.30%) women were found not to be pregnant. The gravida status of the women reveals that 55% of them had more than two pregnancies that is multigravida followed by primi-gravida and nulli-gravida that constitutes 100 (25%) and 80 (20%) in number respectively.

It is clear from the table that women were conscious about their reproductive health and that's why out of 246 women 103 (66.90%) were having two years of gap between previous and current pregnancy.

Regarding parity status, most of the women 142 (35.50%) had not sustained any live births. The multi para women were 93 (23.20%) and women having two and a single live births were 86 (21.50%) and 79 (19.80%) respectively.

It is very common to have three or more children in India. Out of 400 women, more than half of them 208 (52%) had up to three children. It can be seen that 146 (36.50%) women had no child. Rest very few women had four to six and seven to nine children which comprises 35 (8.70%) and 11 (2.80%) respectively. The majority of the women 137 (61.70%) had kept spacing between children for more than a year. 69 (31.10%) women had kept spacing between their children for more than two years and only 16 (7.20%) women had kept less than a year gap between children.

Table No. 4.3.1 Detailed Obstetrical history of the Reproductive age women

Variables	Frequency (n=400)	Percentage
Current Pregnancy Status		
Pregnant	185	46.3
Not pregnant	215	53.7
Gravida		
Nulli-gravida	80	20.0
Primi-gravida	100	25.0
Multigravida	220	55.0
Parity		
Nulli-parous	142	35.5
Primi-parous	79	19.8
Bi-parous	86	21.5
Multiparous	93	23.2
Interval between previous & current pregnancy (n=154)		
≤1 year	16	10.4
2 years	103	66.9
≥3 years	35	22.7
No. of children		
None	146	36.5
1-3	208	52.0
4-6	35	8.7
7-9	11	2.8
Spacing between children (n=222)		
Up to 1 year	16	7.2
>1 year	137	61.7
>2 years	69	31.1

4.3.2 Abortion History of Respondents

The below figure highlights that there were only 30 (7.50%) women who terminated their pregnancy many times. The women who terminated their pregnancy only once were 82 (22.50%) and the majority of women 288 (72%) never terminated their pregnancy.

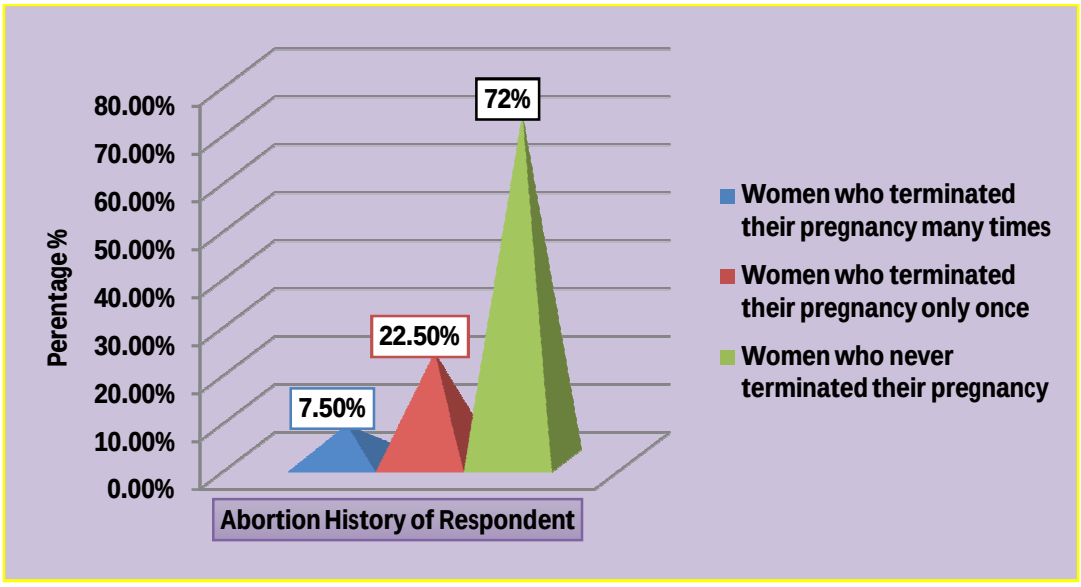

Figure 4.3.2 Percentage of women having history of abortion

4.3.3 Breast Feeding Status of Respondents

Regarding breast-feeding status, it was seen that out of 400 respondents, only 55 were breast-feeding and rest 345 were not breast feeding.

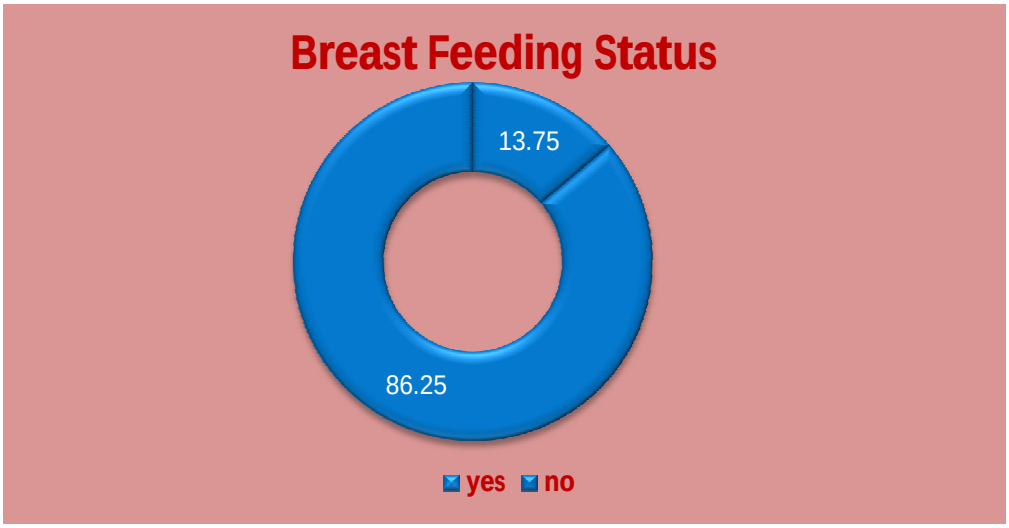

Figure 4.3.3 Percentage of women on breast-feeding

4.4 Health and Medical Conditions Related to IDA among Reproductive Age Women

4.4.1 Grading of severity of Iron Deficiency Anemia

All women age 15-49 years who are anemic contribute 62% of the total population. The maximum number of anemic cases (37%) had moderate anemia. The prevalence

of severe anemia (8%) was the least. Similar to the findings of ***Sharadamani G.S.*** who also observed the prevalence of moderate anemia to be maximum (57.2%) followed by mild (30.9%) and severe anemia (11.8%).

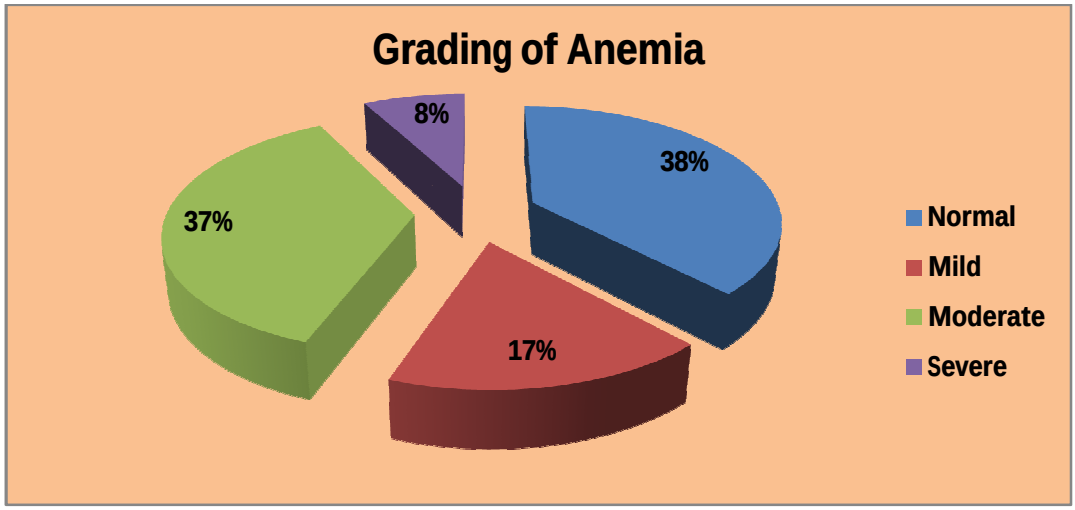

Figure 4.4.1 Grading of anemia on the basis of severity

4.4.2 Status of Body Mass Index

In our study a total of 17% respondents fell in the category of overweight whereas 24% in the obese class 1 along with 7% of those who were in the underweight category.

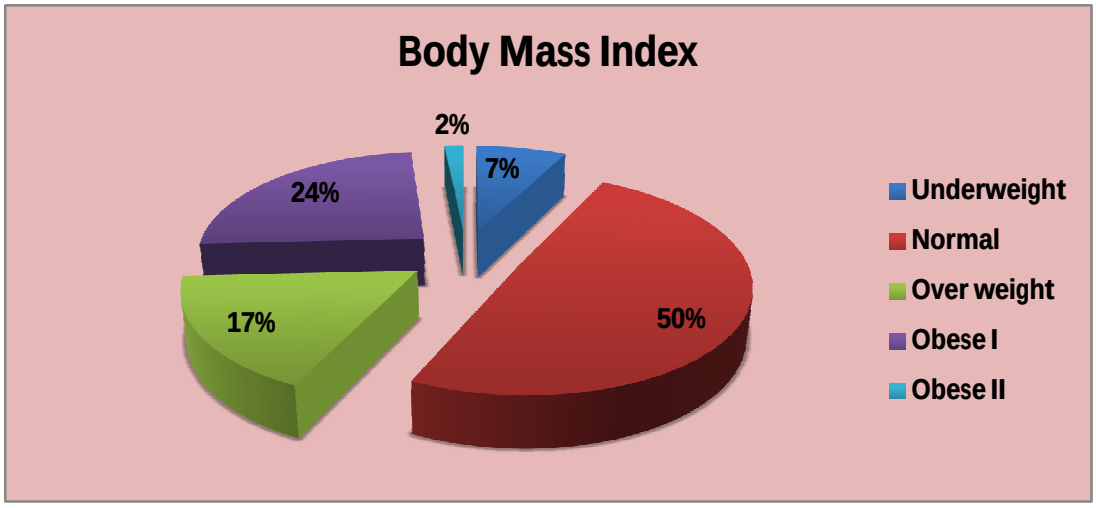

Figure 4.4.2 Respondents having different categories of BMI

4.4.3 Past Morbidity Status related to Anemia

4.4.3.1 Ever Diagnosed with Anemia

To diagnose the anemia, a simple test called complete blood count (CBC) performed. In this study, majority of the women 202 (50.50%) mentioned that they had never undergone test for diagnosis of anemia. The number of women diagnosed with anemia were 95 (23.80%). There were women 103 (25.75%) who had no idea whether they have ever been diagnosed with anemia or not.

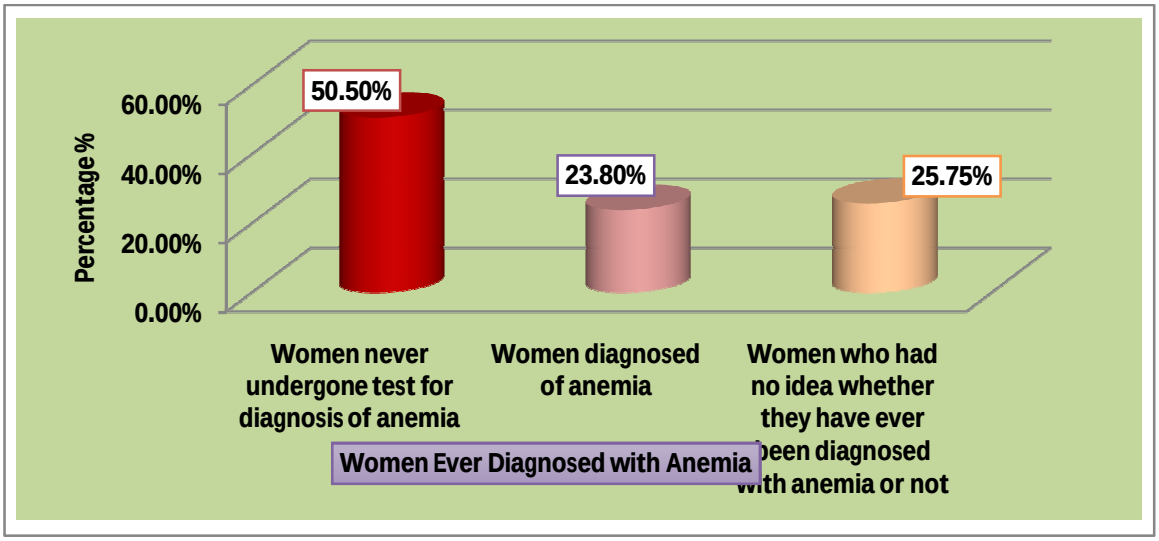

Figure 4.4.3.1 Percentage of women ever diagnosed with anemia

4.4.3.2 Ever Diagnosed with Malaria

Presence of malarial parasites in body has adverse effect on red blood cells. As at the end of the malaria infection cycle, a red blood cell ruptures, leading to severe anemia, this in turn is a major cause of morbidity. Most of the respondents, 298 (74.50%) had never been diagnosed with malaria. The women ever suffered from malaria being 62 (15.50%) and those who had no idea about being ever suffered from malaria accounts for 40 (10%) in number.

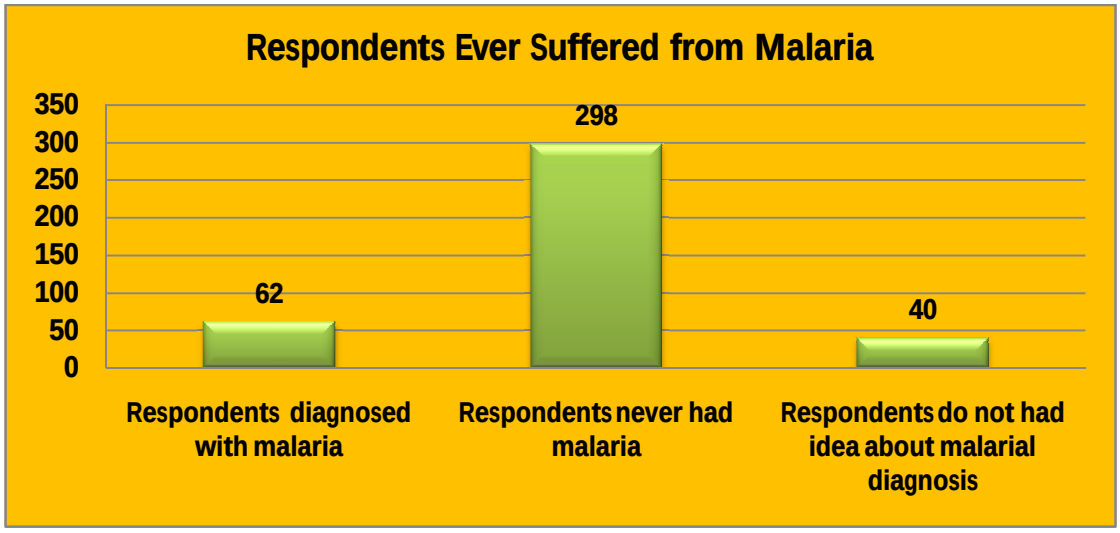

Figure 4.4.3.2 Percentage of women ever suffered from malaria

4.4.3.3 Ever Suffered from Hookworm Infestation

Major morbidity associated with hookworm infection in iron deficiency anemia caused by adult hookworms present in small intestine. They ingests blood, ruptures erythrocytes, and gradually degrading hemoglobin level. The majority of the respondents 286 (71.50%) denied the presence of hookworms. Only 28 (7%) respondents have suffered from hookworms and 86 (21.50%) respondents said they do not know about hookworm infestation in their body.

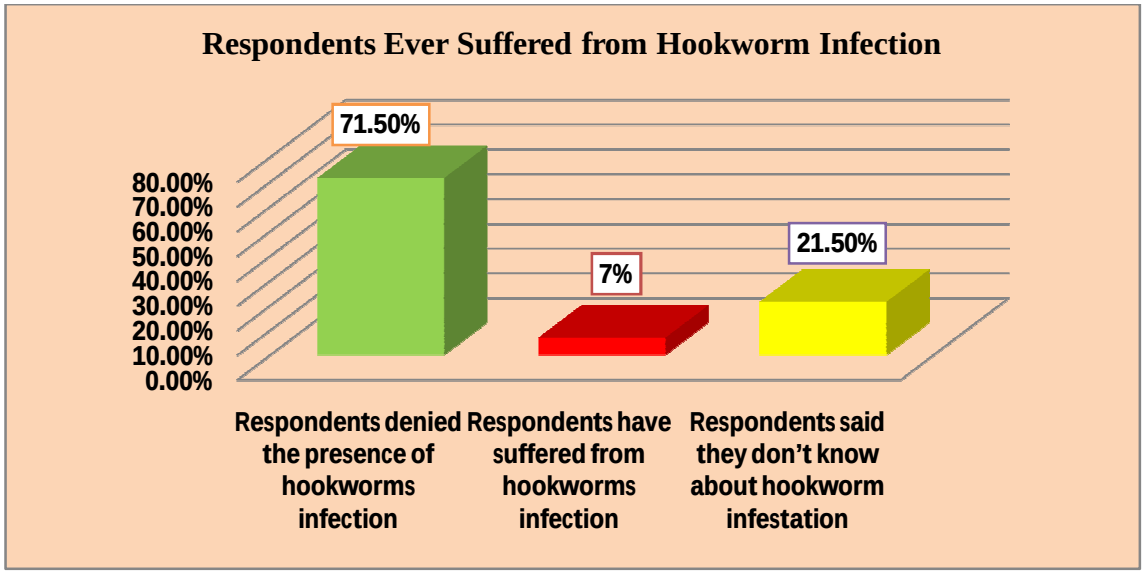

Figure 4.4.3.3 Percentage of women ever suffered from hookworm infection

4.4.3.4 Ever Diagnosed with Reproductive Tract Infection

Reproductive tract infection is common yet neglected global health problem, mainly among reproductive age group of women. Most common infections are bacterial vaginosis (BV), vaginal candidiasis (VVC) and trichomoniasis (TV). Most of the women 226 (56.50%) revealed that they never suffered from any reproductive tract infection. The number of women suffered from any type of reproductive tract infections were 110 (27.50%) and there were those women 64 (16%) who did not have any idea about reproductive tract infection.

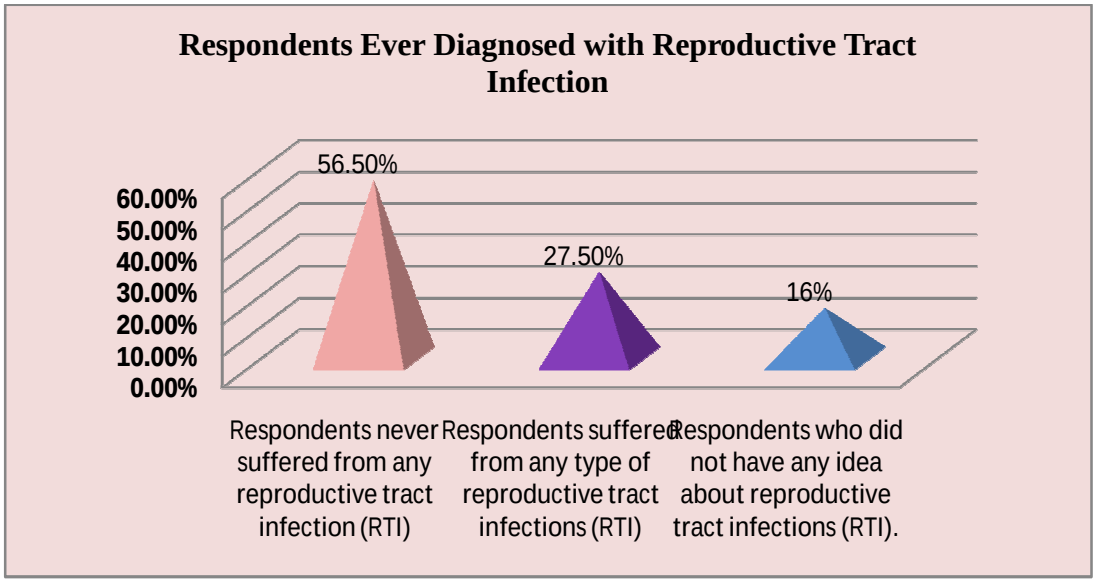

Figure 4.4.3.4 Percentage of women ever diagnosed with reproductive tract infection

4.4.3.5 Ever Had Blood Transfusion

The majority of respondents 354 (88.50%) said that they never had blood transfusion and rest 46 (11.50%) respondents had gone through blood transfusion.

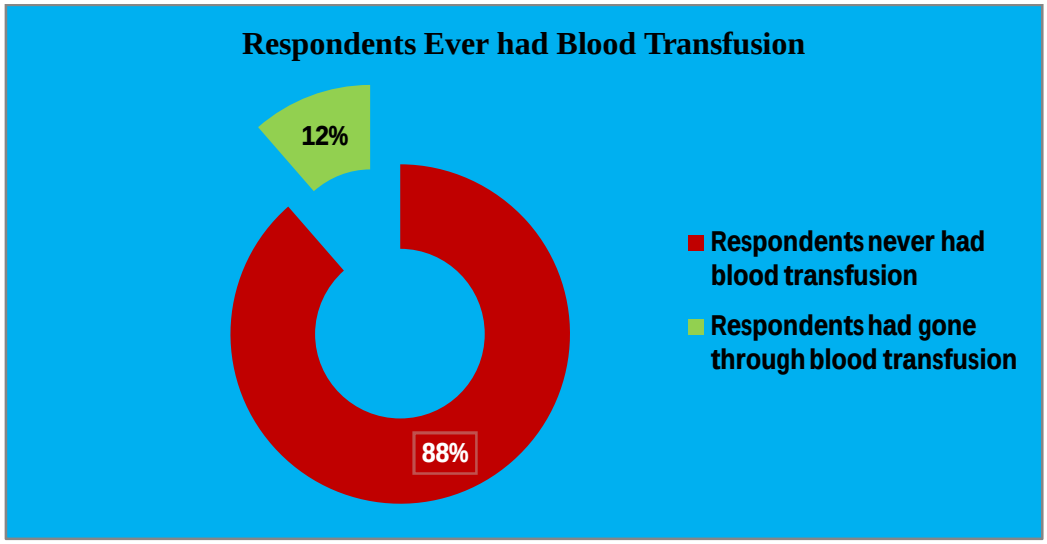

Figure 4.4.3.5 Percentage of women ever had blood transfusion

4.4.3.6 Other Morbid Conditions related to IDA

The other morbid conditions of the respondents with respect to IDA were categorised into peptic ulcer, rectal bleeding, melaenia, ulcerative colitis and cancer. The below table (4.4.3.6) shows that majority of the respondents had no severe morbid conditions which leads to iron deficiency anemia. It is evident from the table that 1.8% respondents had suffered from cancer.

Table No. 4.4.3.6 Detailed status of Other Morbid Conditions related to IDA

Options	Yes	No
a) Peptic ulcer	42 (10.5)	358 (89.5)
b) Rectal bleeding	71 (17.8)	329 (82.2)
c) Melaenia	32 (8.0)	368 (92.0)
d) Ulcerative colitis	15 (3.8)	385 (96.2)
e) Cancer	7 (1.8)	393 (98.2)

4.4.2 Common Ailment Pattern in Anemia

The common ailment pattern that is witnessed more often in anemia is headache, dizziness, nausea, constipation, stomach ache, melaena, insomnia, fatigue and heavy bleeding. According to the table no. 4.4.2 most of the respondents sometimes suffered

from headache, dizziness and fatigue were 48.5%, 40.5% and 36.5% respectively. In terms of nausea, constipation, stomach ache, melaena, insomnia and heavy bleeding most of the respondents did not suffer from any of that.

Table No. 4.4.2 Detail status of respondents showing Common Ailment Pattern

Ailments	Never	Sometimes	Often	All the time
a) Headache	89 (22.3)	194 (48.5)	73 (18.2)	44 (11.0)
b) Dizziness	135 (33.8)	162 (40.5)	73 (18.2)	30 (7.5)
c) Nausea	214 (53.5)	120 (30.0)	48 (12.0)	18 (4.5)
d) Constipation	225 (56.3)	132 (33.0)	33 (8.2)	10 (2.5)
e) Stomach Ache	183 (45.8)	153 (38.2)	49 (12.2)	15 (3.8)
f) Melaena	354 (88.5)	30 (7.5)	16 (4.0)	00 (00)
g) Insomnia	327 (81.8)	46 (11.5)	20 (5.0)	07 (1.7)
h) Fatigue	75 (18.8)	146 (36.5)	102 (25.5)	77 (19.2)
i) Heavy Bleeding	292 (73.0)	45 (11.2)	23 (5.8)	40 (10.0)

4.4.3 Past History of Surgery (including C-Section)

The majority of the respondents 283 (70.75%) responded that they never had any surgery and rest 117 (29.25%) had undergone various types of surgery including C-section.

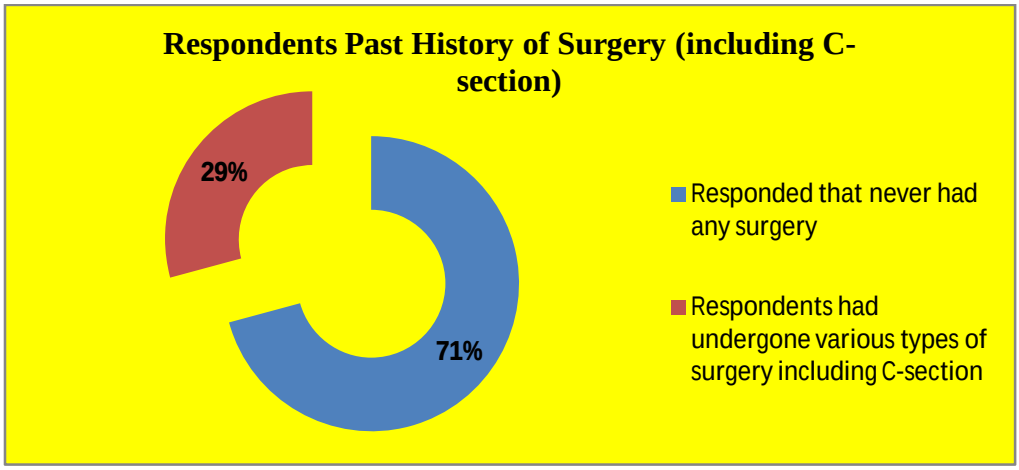

Figure 4.4.8 Percentage of women having past history of surgery

4.5 Dietary Habits of Respondents

The table 4.5.1 shows that most of the reproductive age women were vegetarian 212 (53%) followed by non-vegetarian 147 (36.75%) and ovo-vegetarian 41 (10.25%). It can be seen that most of the women 162 (40.50%) had their meals three times a day followed by two times a day 149 (37.25%). There were women 47 (11.75%) whose frequency of meals were not fixed and it was surprising to see that only 42 (10.50%) women had their meals four times a day.

Caffeine is not the only substance known to interfere iron absorption. The polyphenols found in tea and coffees are the major inhibitors of iron absorption. The majority of the respondents were found to consume tea/coffee 2-3 times a day were 162 (40.50%) followed by once in a day were 134 (33.50%). There were 66 (16.50%) respondents consumed tea/coffee whenever they felt like having it. Only 16 (4%) respondents consumed tea/coffee at regular intervals.

The majority of the respondents have appetizers in between meals were 272 (68%). Women who never have appetizers were 94 (23.50%) followed by women who once have appetizers between meals were 34 (8.50%). The majority of women agreed to have fulfilling meals in last 15 days when they did not lack appetite were 232 (58%). Quite an equal number of respondents have fulfilling meals in last 15 days only once and twice in a day were 85 (21.25%) and 83 (20.75%) respectively.

India is a male dominant country and it was of no surprise to note that about half the number of women that is 180 (45%) had no preferences of food they eat. On the other

hand, 163 (40.75%) women relied upon fried and spicy food and rest 57 (14.25%) women were dependent on partially boiled food.

Table No. 4.5.1 Detailed status of Dietary Habits of Respondents

Characteristic	Detail	Frequency (n=400)	Percentage
Nature of diet	Vegetarian	212	53.00
	Non- vegetarian	147	36.75
	Ovo- vegetarian	41	10.25
Number of meals per day	2 times a day	149	37.25
	3 times a day	162	40.50
	4 times a day	42	10.50
	Not fixed	47	11.75
Consumption of tea/coffee in a day	Once	134	33.50
	2-3 times	162	40.50
	4-5 times	22	5.50
	At regular intervals	16	4.00
	Whenever feel like having it	66	16.50
Munching between meals	Once	34	8.50
	Whenever feel hungry	272	68.00
	Never	94	23.50
Fulfilling meals when did not lack appetite (in last 15 days)	Once	85	21.25
	Twice	83	20.75
	Every meal a day	232	58.00
Type of food	Fried/spicy	163	40.75
	Partially boiled	57	14.25
	Whatever being cooked	180	45.00

4.5.2 Food Consumption Pattern

Various studies have proven the importance of dietary pattern and its major impact on our health and how our changing lifestyle has influenced the dietary pattern through

stages ***(Vasantha et al., 2015)*** and how each single nutrient is associated with the chronic diseases that have taken a toll on mankind ***(Wirfalt et al., 2013)***. In our study the consumption pattern and frequency was assessed using a Food Frequency Questionnaire (FFQ) for haem and non-haem iron sources such as red meat, chicken, fish, legumes, green leafy vegetables, citrus fruits/juices, whole grains, and soup. As our respondents mostly relied on vegetarian diet the consumption frequency of red meat, chicken and fish on daily basis was very low that is 7 (1.75%), 6 (1.50%) and 8 (2%) respectively. The respondents who never had red meat, chicken and fish were 288 (72%), 254 (63.50%) and 306 (76.50%) respectively. The consumption of green leafy vegetables (55.50%) and whole grains (54.25%) on daily basis was high and equally dominant. The intake of legumes, citrus fruits/juices and soup on a regular basis was merely low being 20%, 18.50% and 2% respectively.

Occasional intake of animal products such as red meat, chicken and fish was quite satisfactory as these are the sources of haem iron and enhances the hemoglobin level. Similarly, occasional intake of legumes, citrus fruits/juices and soups among women were 90 (22.50%), 117 (29.25%) and 65 (16.25%) respectively.

Table No. 4.5.2 Detailed status of Food Consumption Pattern

Food stuff	Daily	4-6 times/week	1-3 times/week	1-2 times/week	Never
Consumption of red meat	7 (1.7)	16 (4.0)	25 (6.3)	64 (16.0)	288 (72.0)
Consumption of chicken	6 (1.5)	21 (5.3)	34 (8.5)	85 (21.3)	254 (63.5)
Consumption of fish	8 (2.0)	9 (2.3)	18 (16.5)	59 (14.8)	306 (76.5)
Consumption of legumes	80 (20.0)	84 (21.0)	72 (18.0)	90 (22.5)	74 (18.5)
Consumption green leafy vegetables	222 (55.5)	96 (24.0)	51 (12.8)	26 (6.5)	05 (1.2)
Consumption of citrus fruits/fruit juices	74 (18.5)	62 (15.5)	86 (21.5)	117 (29.3)	61 (15.2)
Consumption of whole grains	217 (54.2)	110 (27.5)	36 (9.0)	25 (6.3)	12 (3.0)
Consumption of soup	08 (2.0)	13 (3.2)	18 (16.5)	65 (16.2)	296 (74.0)

4.5.3 Modified Diet during Pregnancy (n=257)

Women often make dietary changes during pregnancy, essential to support optimal growth and development of the fetus. Out of the 257 women (ever became pregnant), 156 (60.75%) were taking usual diet as they were taking before conception. The women who partly modified their diet were 52 (20.25%) and women who were on special diet comprised 49 (19%) only.

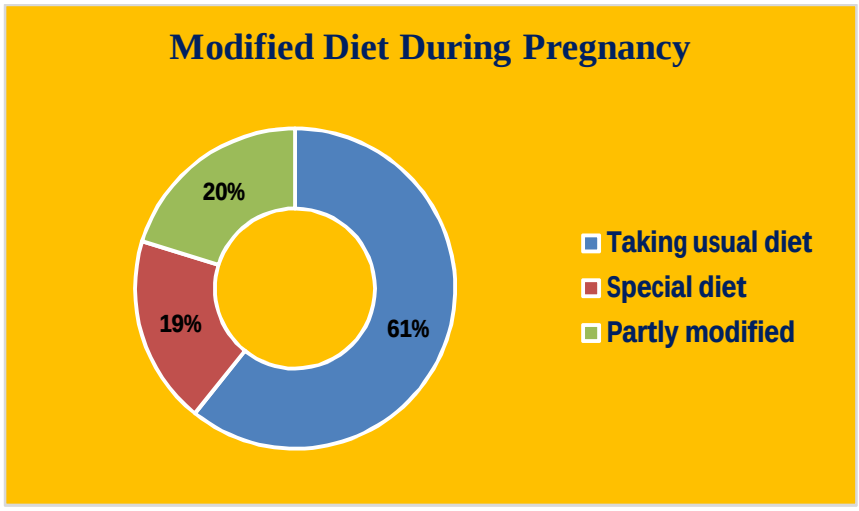

Figure 4.5.3 Percentage of women modified their diet during pregnancy

4.5.4 Nutritional Supplement

Nutritional supplements are any dietary supplements that intended to provide nutrients that may otherwise not be consumed in sufficient quantities. The number of women who were taking nutritional supplements were 189 and rest 211 women were not taking any supplement.

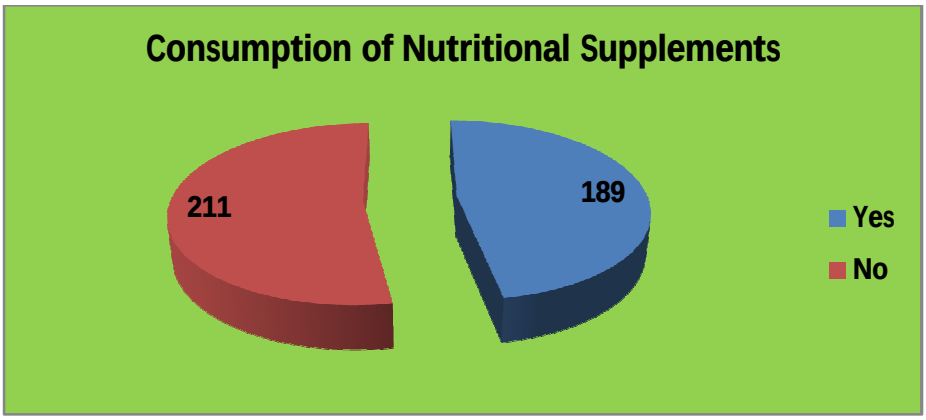

Figure 4.5.4 Percentage of women had nutritional supplement

4.6 Knowledge Regarding Anemia

Table No. 4.6.1 Detailed status of knowledge about anemia among women (rural and urban)

Variables	Frequency (n=400)	Percent
What is Anemia		
Old Age	10	2.5
Diarrhoea	14	3.5
Deficiency of Iron in Blood	208	52.0
Greying of Hairs	08	2.0
None of These	160	40.0
Blood in Anemia		
Increased Blood Cells	04	1.0
Decreased Hemoglobin	165	41.3
Increased Hemoglobin	02	0.5
Don't Know	229	57.3
Nutrient Deficient in Anemia		
Fat and Protein	03	0.8
Iodine and Calcium	17	04.3
Iron	200	50.0
Don't Know	180	45.0
Causes of Anemia		
Lack of Nutritious Food	60	15.0
Worm Infestation	02	0.5
Excessive Bleeding	33	8.3
Above All	134	33.5
Don't Know	171	42.8
Symptoms of Anemia		
Fatigue/Tiredness	66	16.5
Shortness of Breath	04	1.0
Irregular Menstrual Cycle	32	8.0
Impact on Learning Process	02	0.5
All are Correct	126	31.5

Don't Know	170	42.5
Effect of Anemia		
Impact on Growth and Development	07	1.8
Impact on Learning/Performance	02	0.5
Decreased Work Capacity	52	13.0
All are Correct	120	30.0
Don't Know	219	54.8
Preventive Measures of Anemia		
Consuming Iron Rich Food	62	15.5
Taking IFA Tablets	12	3.0
All are Correct	137	34.3
Don't Know	189	47.3
Iron Rich Foods		
Green Leafy Vegetables	83	20.8
Sprouted Pulses	6	1.5
Meat, Poultry	8	2.0
All are Correct	150	37.5
Don't Know	153	38.3
Total	**400**	**100.0**

4.6.2 Mean ± SD of knowledge score associated with Anemia

As depicted in table no.4.6.2, it can be seen that the level of awareness is different from rural respondents to urban respondents. On the basis of scoring the division was done into high, moderate and low level knowledge category. In the context of knowledge scored, it was observed as Low- 64%, Moderate- 14.5% and High- 21.5% among rural respondents having a Mean ± SD 2.65 ± 2.96, which subsequently different among urban respondents as Low- 37%, Moderate- 27% and High- 36% with a Mean ± SD 4.22 ± 2.99. The knowledge level of total 400 respondents was Low- 50.5%, Moderate- 20.8% and High- 28.7% with Mean ± SD 3.44 ± 3.08.

Table No. 4.6.2 Comparative Mean ± SD of Knowledge Score associated with Anemia among rural and urban respondents.

Rural (n=200)			**Urban** (n=200)			**Total** (n=400)		
Knowledge Level		Mean ±SD	Knowledge Level		Mean ±SD	Knowledge Level		Mean ±SD
Low	128 (64)	2.65 ±2.96	**Low**	74 (37)	4.22 ±2.99	**Low**	202 (50.5)	3.44 ±3.08
Moderate	29 (14.5)		**Moderate**	54 (27)		**Moderate**	83 (20.8)	
High	43 (21.5)		**High**	72 (36)		**High**	115 (28.7)	
Total	200 (100.0)		Total (%)	200 (100.0)		Total	400 (100.0)	

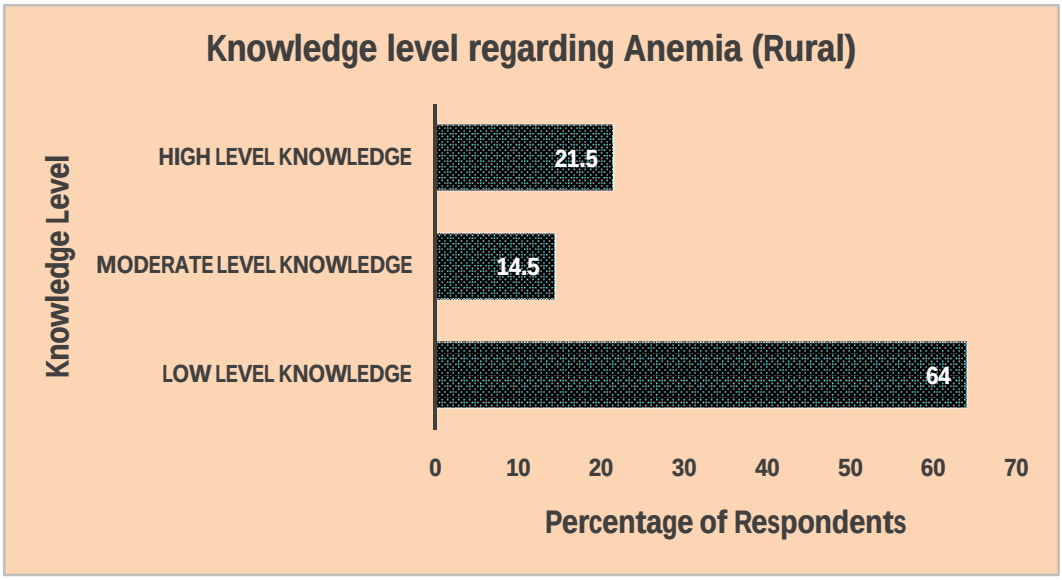

Figure 4.6.2.1 Knowledge level of respondents (rural) about Anemia

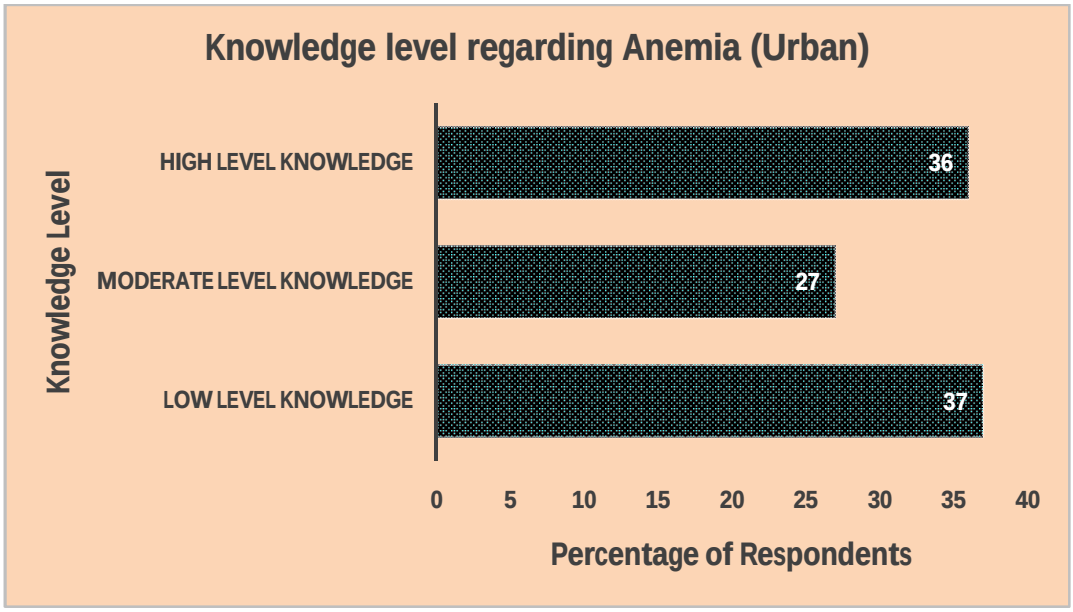

Figure 4.6.2.2 Knowledge level of respondents (urban) about Anemia

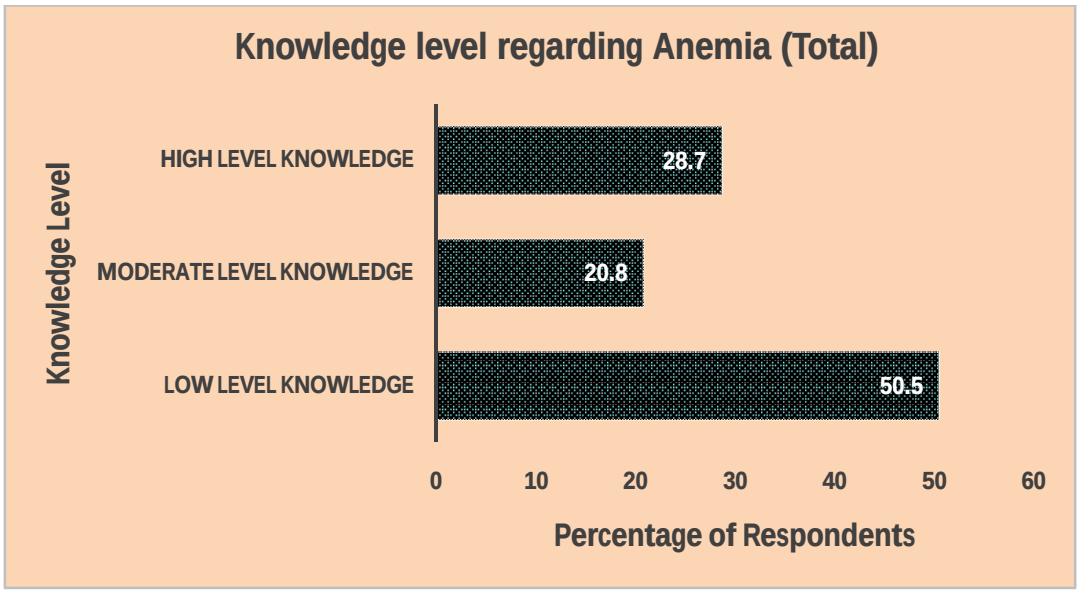

Figure 4.6.2.3 Knowledge level of respondents (total) about Anemia

4.7 Factors associated with Prevalence of IDA

4.7.1 Socio-demographic status associated with Prevalence of IDA

Association of Socio-demographic status with IDA among respondents

H_0: There exists a significant relationship between Socio-demographic Status and Prevalence of IDA.

Our null hypothesis stated a significant association between socio-demographic status and prevalence of IDA; however chi-square test revealed no such relationship thus

rejecting the hypothesis. A non-significant observation with socio-demographic status was observed with age and religion. Also, no significant association was observed between family setup and IDA. In contrast to this, ***Rajput S. et al. (2016)*** reported a significantly higher proportion of anemic women belonged to a joint family.

Table No. 4.7.1 Association between Socio-demographic status and Prevalence of IDA

Variables		Anemic (n=248)	Non-Anemic (n=152)	Chi-square value p-value
Age (in years)	15-19 (n=31)	21 (67.7)	10 (32.3)	2.681 0.443
	20-29 (n=211)	130 (61.6)	81 (38.4)	
	30-39 (n=111)	64 (57.7)	47 (42.3)	
	40-49 (n=47)	33 (70.2)	14 (29.8)	
Religion	Hindu(n=343)	216 (63.0)	127 (37.0)	5.564 0.062
	Muslim(n=36)	24 (66.7)	12 (33.3)	
	Any Other(n=21)	8 (38.1)	13 (61.9)	
Marital Status	Single(n=57)	36 (63.2)	21 (36.8)	0.038 0.846
	Ever Married (n=343)	212 (61.8)	131 (38.2)	
Residence Area	Rural(n=200)	115 (57.5)	85 (42.5)	3.438 0.064
	Urban(n=200)	133 (66.5)	67 (33.5)	
Family Type	Nuclear (n=189)	115 (60.8)	74 (39.2)	0.202 0.653
	Joint (n=211)	133 (63.0)	78 (37.0)	
Family Size	Small(2-4 members)(n=134)	81 (60.4)	53 (39.6)	0.637 0.727
	Medium(5-8 members)(n=152)	98 (64.5)	54 (35.5)	
	Large (>8 members)(n=114)	69 (60.5)	45 (39.5)	

4.7.2 Socio-economic status associated with Prevalence of IDA

Association of Socio-economic status with IDA among respondents

H_0: There exists no significant relationship between Socio-economic Status and Prevalence of IDA.

Iron deficiency anemia was more common among those who were illiterate or educated only up to higher secondary level with a high significant association. No significant association was observed between the prevalence of IDA and working status whereas a study done by ***Rahman et al. (2019)*** reported a significant association. A highly significant association was observed with literacy status, family income and socio-economic strata, our null hypothesis stated a non significant association with socio-economic status. According to the chi-square analysis the null hypothesis cannot be fully rejected as few parameters show a significant association with exception for employment status according to table no 4.7.2.

Table No. 4.7.2 Association between Socio-economic status and Prevalence of IDA

Variables		Anemic (n=248)	Non-Anemic (n=152)	Chi-square value p-value
Literacy Status	Illiterate(n=63)	56 (88.9)	7 (11.1)	30.077 0.000**
	Primary(n=63)	39 (61.9)	24 (38.1)	
	Secondary(n=48)	28 (58.3)	20 (41.7)	
	Higher secondary(n=58)	40 (69.0)	18 (31.0)	
	Graduate and above(n=168)	85 (50.6)	83 (49.4)	
Employment Status	Working(n=76)	43 (56.6)	33 (43.4)	1.170 0.279
	Non-working(n=324)	205 (63.3)	119 (36.7)	
Family Income	Less than 5000(n=80)	62 (77.5)	18 (22.5)	21.051 0.000**
	5000-8000(n=134)	92 (68.7)	42 (31.3)	
	More than 8000(n=186)	94 (50.5)	92 (49.5)	
Socio-economic Strata	Class 1(n=46)	22 (47.8)	24 (52.2)	25.161 0.000**
	Class 2(n=123)	70 (56.9)	53 (43.1)	
	Class 3(n=118)	68 (57.6)	50 (42.4)	
	Class 4(n=81)	57 (70.4)	24 (29.6)	
	Class 5(n=32)	31 (96.9)	1 (3.1)	

4.7.3 Menstrual status associated with Prevalence of IDA

Association of menstrual status with IDA among respondents

H_0: There exists a significant relationship between Menstrual Status and Prevalence of IDA.

The null hypothesis stated that there is association between IDA and Menstrual status. The chi-square test was carried out to determine the association between menstrual

status and anemia categories, where a non-significant relationship was observed between anemic and non-anemic women as p value is greater than 0.05. Thus, rejecting the null hypothesis as summarized in table No. 4.7.3. Most of the anemic women (37%) belonged to the age group of 13-15 years when they attained menarche. Along with 38.50% women had 28-30 days of cycle length, 45.20% of women had 3-5 days of menses. The 43.8% of women reported absence of clots, no problem of menorrhagia (44.5%) without heavy menstrual bleeding (44.2%) when compared non-anemic ones. Our results were quite similar to the study done by (***Ganapathi and Kumar 2016)***. Similarly, ***Dundar (2010)*** stated that duration of menstrual bleeding more than 5 days was found as risk factors for anemia and it was in agreement to another finding ***(Miah et al., 2014).***

The study by ***Kaur et al., (2006)*** reported excessive menstrual bleeding (OR= 5.65, CI: 1.26-25.38) as one of the strongest determinants of anemia among adolescent girls. On contrary, a study found no association between menstrual factors and anemia ***(Kulkarni et al., 2012).***

Table No. 4.7.3: Association between Menstrual Status and Prevalence of IDA

Variables		Anemia Categorization (n= 400)		Chi square value p value
		Anemic (n=248)	Non-anemic (n=152)	
Age at menarche (in years)	≤12 (n=124)	77 (19.2)	47 (11.8)	3.092 0.213
	13-15 (n=246)	148 (37.0)	98 (24.5)	
	≥16 (n=30)	23 (5.8)	7 (1.8)	
Length of cycle	<28 (n=66)	47 (11.8)	19 (4.8)	3.623 0.305
	28-30 (n=260)	154 (38.5)	106 (26.5)	
	>30 (n=70)	45 (11.2)	70 (17.5)	
	Irregular (n=4)	2 (0.5)	4 (1.0)	
Duration of menses (in days)	≤2 (n=47)	28 (7.0)	19 (4.8)	0.197 0.906
	3-5 (n=289)	181 (45.2)	108 (27.0)	
	≥6 (n=64)	39 (9.8)	25 (6.2)	
Clots	Present (n=126)	73 (18.2)	53 (13.2)	1.289 0.153
	Absent (n=274)	175 (43.8)	99 (24.8)	
Problem of menorrhagia	Yes (n=104)	70 (17.5)	34 (8.5)	1.680 0.119
	No (n=296)	178 (44.5)	118 (29.5)	
Recent experience of heavy or prolonged menstrual bleeding	Yes (n=108)	71 (17.8)	37 (9.2)	0.879 0.206
	No (n=292)	177 (44.2)	115 (28.8)	

4.7.4 Obstetrical history associated with Prevalence of IDA

Association of obstetrical history with IDA among respondents

H_0: There exists no significant relationship between Gravida, Parity and Prevalence of IDA.

The chi-square test was carried out to determine the association between IDA status and obstetrical history of women. Gravida and parity had a highly significant association with IDA status as χ^2 = 14.272, p=0.001 and χ^2 = 14.037, p=0.003 respectively. Our null hypothesis stated a non significant association of IDA with both gravida and parity, which according to table no. 4.7.4 is rejected as there exists an association between both gravida and parity with IDA. Similar results were carried out by ***Gerardo Alvarez-Uria et al. (2014),*** however there was no significant association observed with interval in pregnancies and spacing between children.

A study by ***Tiwari P. et al. (2015)*** reported a higher prevalence of anemia among pregnant women with high parity, women with the spacing of less than or equal to 1 year between consecutive pregnancies. On the contrary, two other studies reported no association between grades of anemia and child spacing ***(Gautam et al. 2002 and Nwachi et al. 2010)***.

In concordance with our study, ***Tiwari et al. (2015)***, found a significant association between anemia and history of abortion, with similar observations in another study by ***Gautam et al. (2002). Uche-Nwachi et al. (2010)***, in their study, found an inverse relationship between age and anemia, while gestational age was directly associated. They also reported an association between the prevalence of anemia and factors like gravida, parity, and previous abortions. Although child spacing was not associated with the presence or grades of anemia at the first (p = 0.500; p = 0.870) or final Hb readings (p = 0.196; p = 0.303).

Another study ***(Rahman et al. 2019)*** reported a significant association ($p<0.05$) between highest prevalence of IDA and women who were married before 20 years and were pregnant with first child before 20 years along with women with more than two pregnancies and more than two live children.

Table No. 4.7.4 Association between Obstetrical History and Prevalence of IDA

Variables		Anemia Categorization (n= 400)		Chi square value p value
		Anemic (n=248)	Non-anemic (n=152)	
Pregnancy Status	Pregnant (n=185)	102 (25.5)	83 (20.8)	6.885 0.006*
	Not Pregnant(n=215)	146 (36.5)	69 (17.2)	
Gravida	Nulligravida (n=80)	45 (11.2)	35 (8.8)	14.272 0.001**
	Primigravida (n=100)	49 (12.2)	51 (12.8)	
	Multigravida (n=220)	154 (38.5)	66 (16.5)	
Parity	Primiparous (n=79)	49 (12.2)	30 (7.5)	14.037 0.003*
	Biparous (n=86)	54 (13.5)	32 (8.0)	
	Multiparous (n=93)	71 (17.8)	22 (5.5)	
	Nulliparous (142)	74 (18.5)	68 (17)	
Abortions	None (n=288)	165 (42.4)	123 (31.6)	10.328 0.006*
	Once (n=82)	63 (16.2)	19 (4.9)	
	Multiple (n=19)	12 (3.1)	7 (1.8)	
Interval between Previous and Current Pregnancy	Less than 1 year (n=16)	11 (7.1)	5 (3.2)	0.084 0.959
	1-3 years (n=103)	67 (43.5)	36 (23.4)	
	More than 3 years (n=35)	23 (14.9)	12 (7.8)	
No. of Children	No Child (n=146)	70 (17.9)	76 (19.5)	21.932 0.000**
	1-3 children (n=208)	140 (35.9)	68 (17.4)	
	4-6 children (n=33)	27 (6.9)	6 (1.5)	
	7-9 children (n=3)	3 (0.8)	0 (0.0)	
Spacing between Children	1 year (n=16)	10 (4.5)	6 (2.7)	0.454 0.797
	Between 1-2 (n=137)	93 (41.9)	44 (19.8)	
	More than 2 years (n=69)	44 (19.8)	25 (11.3)	
Current Breast Feeding Status	Yes (n=55)	41 (11.0)	14 (3.8)	3.749 0.035*
	No (n=317)	193 (51.9)	124 (33.3)	

4.7.5 BMI Status associated with Prevalence of Anemia

Association of BMI with Prevalence of IDA

H_0: There exist a significant association between BMI and Prevalence of IDA.

Table no. 4.7.5 indicates a non-significant relationship of prevalence of IDA and BMI categories having $\chi^2 = 7.815$, df = 4. As according to our null hypothesis, significant association exists between hemoglobin levels and BMI categories, as per the chi-square analysis the null hypothesis can be rejected. Table showing association of anemia with BMI categories where a non-significant relation is obtained between anemic and non-anemic as p value is greater than 0.05. More percentage of anemic women was there in underweight category (6%), normal (31.8%), overweight (10.5%) and obese grade I (13%) categories of BMI when compared non-anemic ones. Underweight women were significantly higher risk of anemia (96.6%) when compared to women having normal weight (51.0%) similar to other studies in India ***(NFHS-3, 2005-2006)*** and Andhra Pradesh ***(Brantley and Griffiths 2003).***

A study reported a decreasing incline of IDA with increasing BMI and a linear relationship was found between increasing BMI status with increasing mean hemoglobin level ***(Rahman et al. 2019).*** A study reported underweight women of reproductive age are likely to suffer more from anemia compared to overweight and obese women ***(Kamruzzaman et al. 2015)***. Overweight was inversely associated with the prevalence of anemia.

In a similar way, another study ***(Woldu et al. 2020)*** reported significant association between high prevalence of anemia and women who are underweight as compared to women who are overweight which is in consistent with several other studies ***(Pal et al. 2014; Hemamalini 2013 and Qin 2013)***.

Table 4.7.5 Association between Categories of BMI and Prevalence of IDA

Categories of BMI	Anemia Categorization (n= 400)			Chi square value p value
	Anemic (n=248)	Non anemic (n=152)	Total (n=400)	
Underweight (n=30)	24 (6.0)	6 (1.5)	30 (7.5)	7.815 0.099 df = 4
Normal (n=198)	127 (31.8)	71 (17.8)	198 (49.5)	
Overweight (n=69)	42 (10.5)	27 (6.8)	69 (17.2)	
Obese I (n=97)	52 (13.0)	45 (11.2)	97 (24.2)	
Obese II (n=06)	3 (0.8)	3 (0.8)	6 (1.5)	
Total (n=400)	248 (62.0)	152 (38.0)	400 (100.0)	

4.8 Correlation among factors related to IDA.

4.8.1 Correlation among Menstrual Status and Hemoglobin Levels

H_0: There exists no significant correlation among Menstrual Status and Hemoglobin Levels.

As the table illustrates Pearson coefficient correlation between menstrual status and hemoglobin levels. A significant positive correlation was found between menses age and hemoglobin ($r = 0.222$, $p<.01$) along with a significant negative correlation between length of cycle and hemoglobin ($r = -0.135$, $p<.01$) and very weak and positive correlation between duration of menses and hemoglobin ($r = 0.020$, $p<.01$). When length of cycle was correlated with duration of menses a weak and negative correlation was observed with values as $r = -0.052$. A statistically significant negative correlation was also observed between menses age with length of cycle and duration of menses with values as $r = -0.244$, $r = -0.279$ at $p<.01$ level of significance, thus, rejecting the above mentioned hypothesis.

Table 4.8.1 Correlation between Menstrual status and Hemoglobin levels

Pearson Correlations (n=400)				
Parameters	**Menses age**	**Length of cycle**	**Duration of menses**	**Hemoglobin**
Menses age	1	-	-	-
Length of cycle	-.244**	1	-	-
Duration of menses	-.279**	-.052	1	-
Hemoglobin	.222**	-.135**	.020	1
**Correlation is significant at the 0.01 level (2-tailed).				

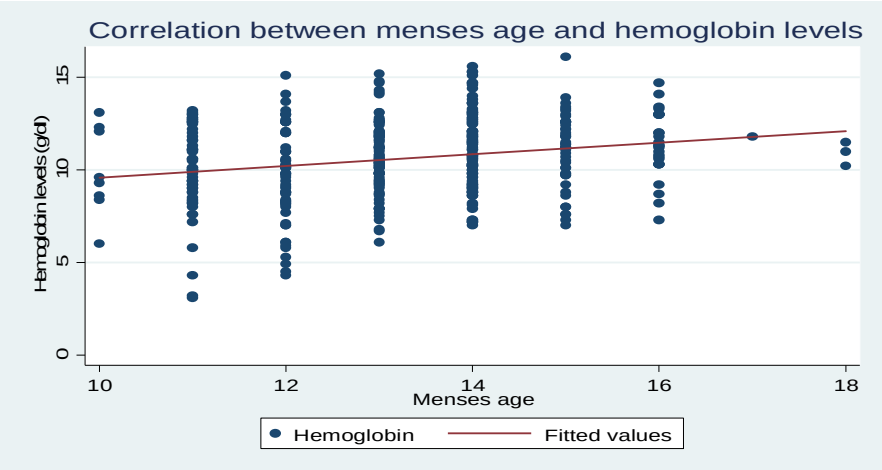

Figure 4.8.1.1 Correlation between Menses age and Hemoglobin levels

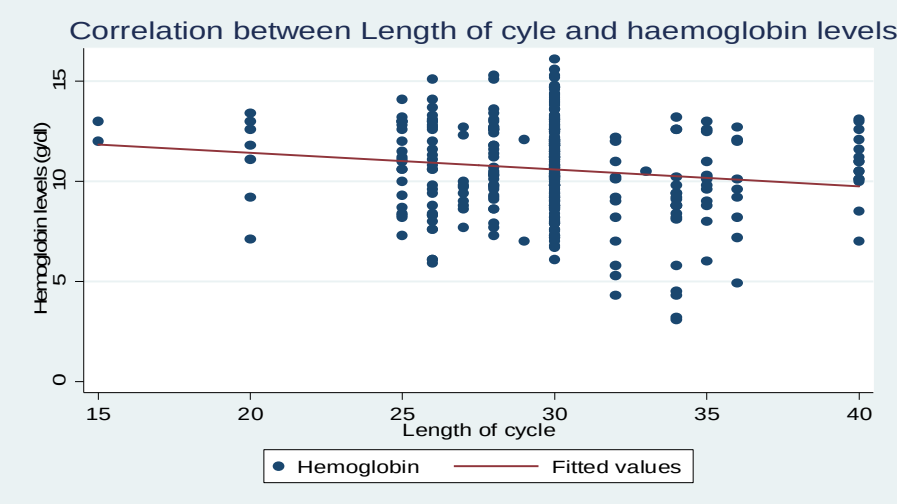

Figure 4.8.1.2 Correlation between Length of cycle and Hemoglobin levels

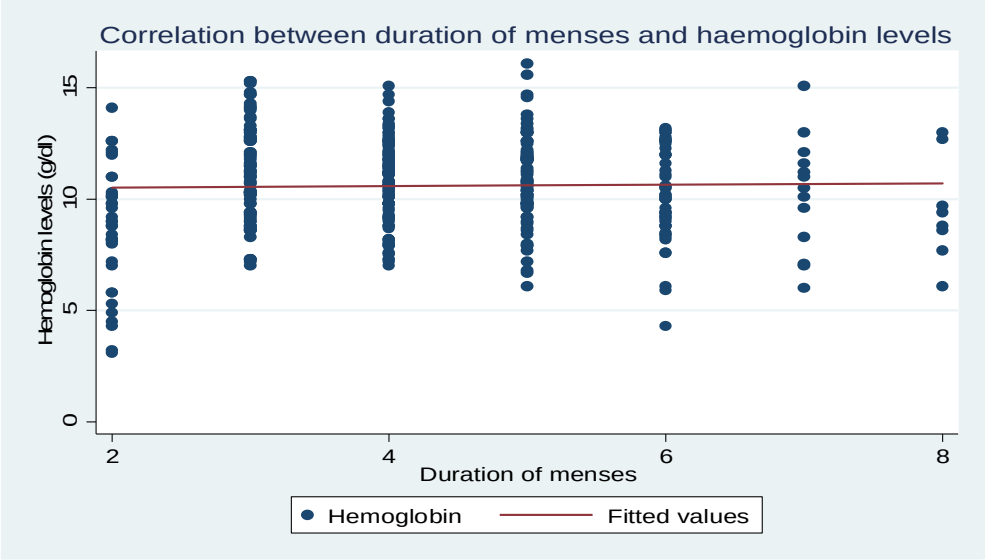

Figure 4.8.1.3 Correlation between Duration of menses and Hemoglobin levels

Table 4.8.2 Correlation between Anthropometric Indices and Hemoglobin Levels

Correlation among Anthropometric Indices and Hemoglobin Levels

H_0: There exists no significant correlation among Anthropometric Indices and Hemoglobin Levels.

Table depicts the correlation between anthropometric indices and hemoglobin levels. A statistically significant positive correlation was observed between hemoglobin level with weight (r=0.252, p<.01) followed by height (r= 0.174, p<.01). A marginally significant correlation was seen between hemoglobin levels with BMI (r= 0.189, p<.01) contrary to the results obtained by ***Minati Patnaik (2017).*** On correlating height with BMI, a non-significant negative correlation was observed (r=-0.011). When weight was correlated with height, a highly significant correlation was obtained with values as r=0.439, along with a strong and significant association with BMI (r=0.891), at p<.01 level of significance, thus rejecting the above-mentioned hypothesis.

Table No. 4.8.2 Correlation between Anthropometric Indices and Hemoglobin Levels

Pearson Correlations (n=400)				
Parameters	**Weight**	**Hemoglobin**	**BMI**	**Height**
Weight	1	-	-	-
Hemoglobin	.252**	1	-	-
BMI	.891**	.189**	1	-
Height	.439**	.174**	-.011	1
**Correlation is significant at the 0.01 level (2-tailed).				

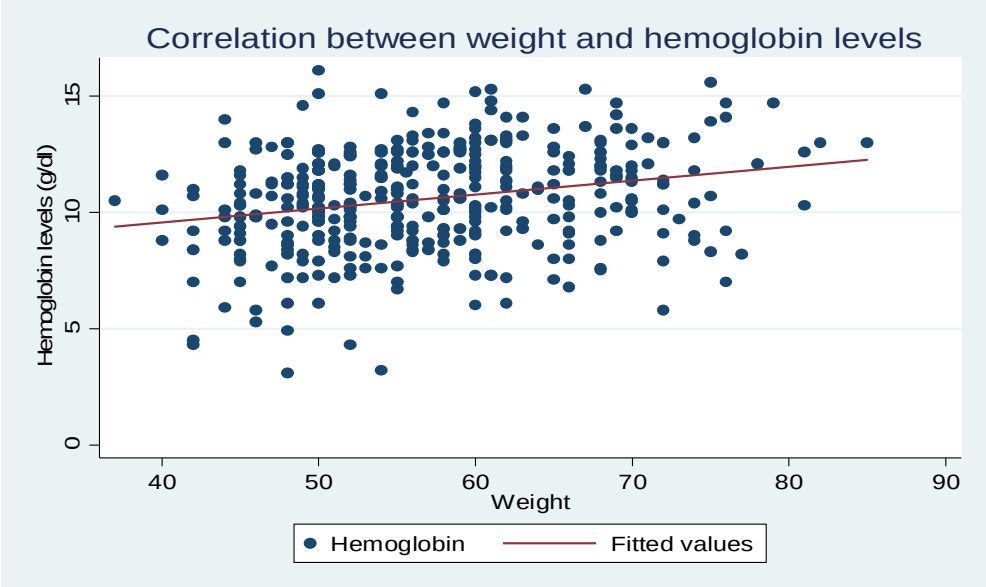

Figure 4.8.2.1 Correlation between Weight and Hemoglobin levels

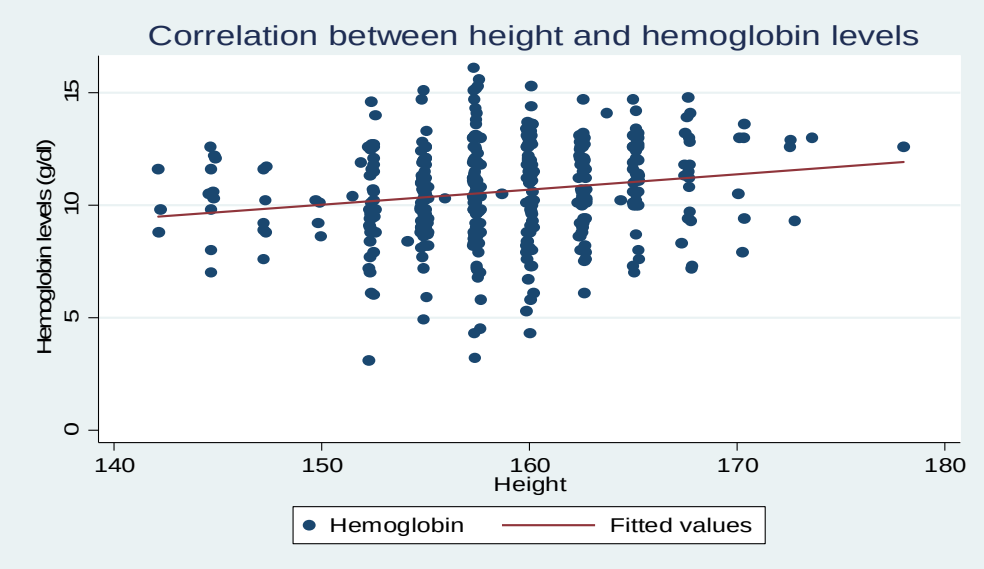

Figure 4.8.2.2 Correlation between Height and Hemoglobin levels

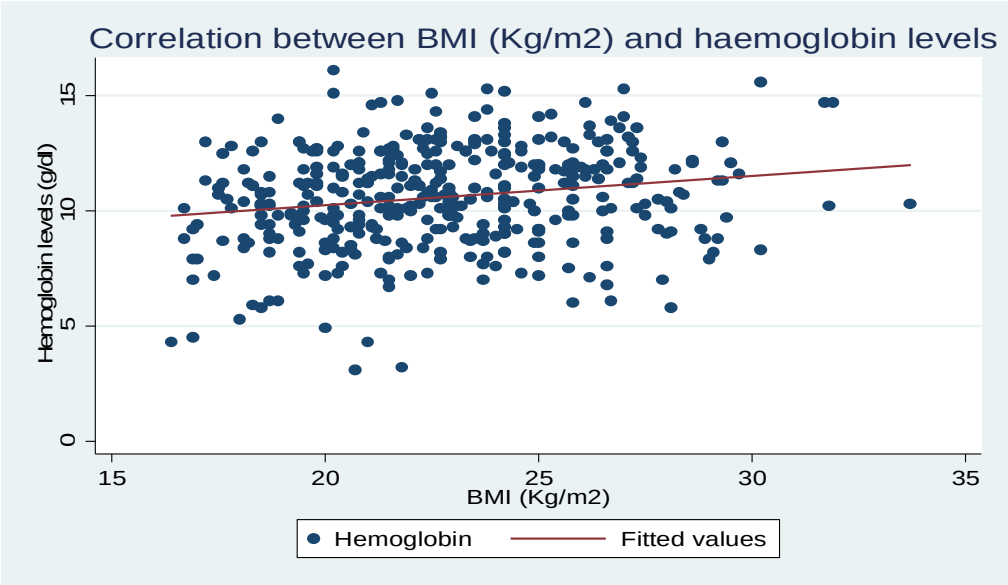

Figure 4.8.2.3 Correlation between BMI and Hemoglobin levels

4.8.3 Relationship of IDA with Certain Morbid Conditions

4.8.3.1 Association of morbidity status with diagnosis of anemia

Table shows the odds ratio of anemia diagnosis. Females were 15.03 times more aware about their anemia status (95% CI 6.504-40.057) and 2.32 times don't know about their anaemia status (95% CI 1.380-3.930), in both the cases odds were highly significant (p=0.000). Similar to this study, ***Jose J et al; (2016)*** in his study has shown an association between knowledge about anemia diagnosis.

Table No. 4.8.3.1 Logistic regression analysis of anemic and non-anemic respondents diagnosed with anemia

Past Morbidity Status		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Ever diagnosed with Anemia	Yes	88	07	1
	No	92	110	15.031 (6.504-40.057) (0.000)
	Don't know	68	35	2.322 (1.380-3.930) (0.000)

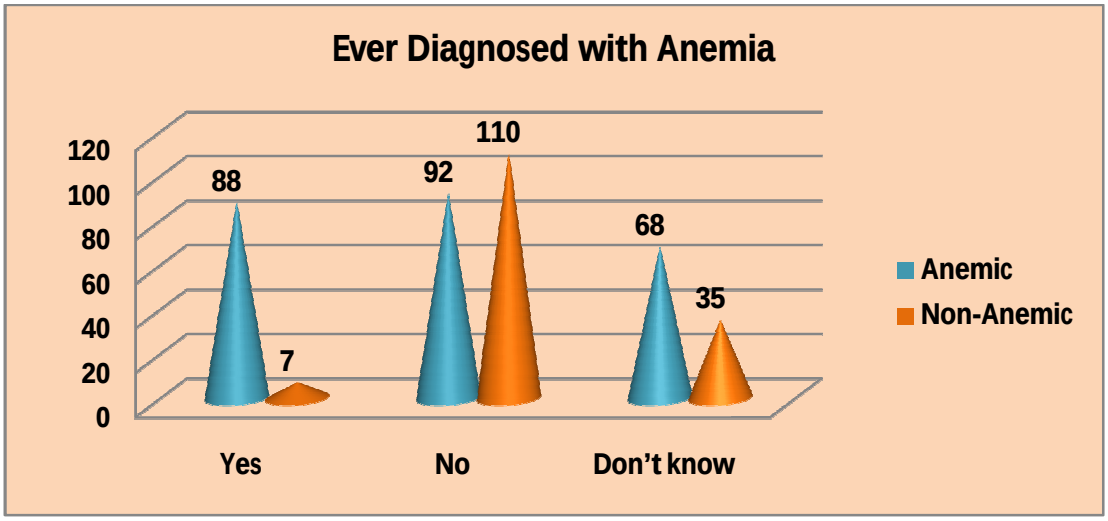

Figure 4.8.3.1 Association of morbidity status with diagnosis of anemia among anemic and non-anemic respondents

4.8.3.2 Association of morbidity status with malaria

Table depicts the history of subjects suffered from malaria where lower odds were observed among anemic females who did not suffer from malaria 0.731 (95% CI 0.406-1.325) while 1.40 times females were not knowing about their malaria history (95% CI 0.659-3.158). The results in both the cases were non-significant.

(Ouma et al; 2007) in his study reported that sleeping under mosquito nets was associated with a lower likelihood of anemia and prevalence of anemia was higher among women who did not sleep under a mosquito net (21.5, 95% CI: 19.5–23.6). The bivariate analysis found that having a mosquito bed net for sleeping (p = 0.020), 9) is significantly associated with anemia. In a study of Kenyan PSC, predictors associated with severe anemia included malaria, inflammation, and stunting, while

factors of more moderate forms of anemia were ID, malaria, and α-thalassemia ***(Foote 2013).***

In global analyses of anemia burden between 1990 and 2010, malaria constituted primary causes of anemia ***(Kassebaum N.J. et al. 2014).***

Table No. 4.8.3.2 Logistic regression analysis of anemic and non-anemic respondents suffered from malaria

Past Morbidity Status		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Ever suffered from Malaria	Yes	34	28	1
	No	186	112	0.731 (0.406-1.325) (0.165)
	Don't know	28	12	1.405 (0.659-3.158) (0.225)

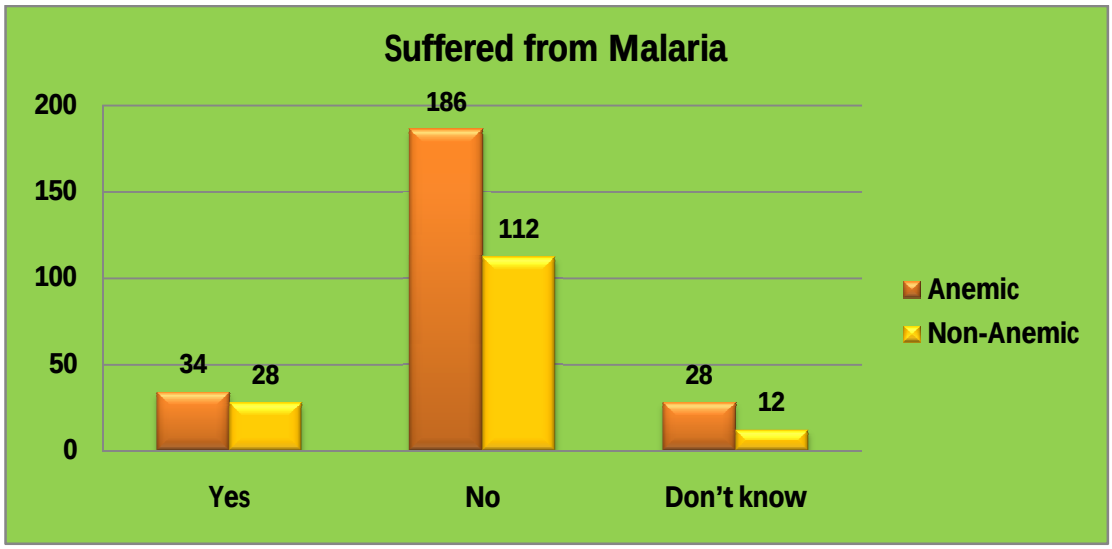

Figure 4.8.3.2 Association of morbidity status with malaria among anemic and non-anemic respondents

4.8.3.3 Association of morbidity status with hookworm infestation

Table Illustrates the history of subjects suffered from hookworm infestation where lower odds were observed among females who did not suffer from hookworm infestation 0.856 (95% CI 0.358-2.124). Similar trends were also observed among females not knowing about their hookworm infestation history with lower odds of

0.858 (95% CI 0.510-1.452). The results in both the cases were non-significant. Previous research has established that worm infestation causes anemia, there is a direct relationship between the number of hookworms and individual harbors and the amount of intestinal blood lost attributable to the cause of anemia ***(Fleming, 2000).***

(Brooker et al; 2007) reported that co-infection with P. falciparum and hookworm has an impact on hemoglobin levels on both school-age children and pregnant women which have the highest risk of anemia would be benefited from an integrated approach to malaria and helminth control. ***Toheed (2015)*** also considered hookworm infestation as contributing factor to the prevalence of anemia.

Table 4.8.3.3 Logistic regression analysis of anemic and non-anemic respondents suffered from hookworm infestation

Past Morbidity Status		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Ever suffered from Hookworm Infestation	Yes	16	11	1
	No	180	106	0.856 (0.358-2.124) (0.427)
	Don't know	51	35	0.858 (0.510-1.452) (0.313)

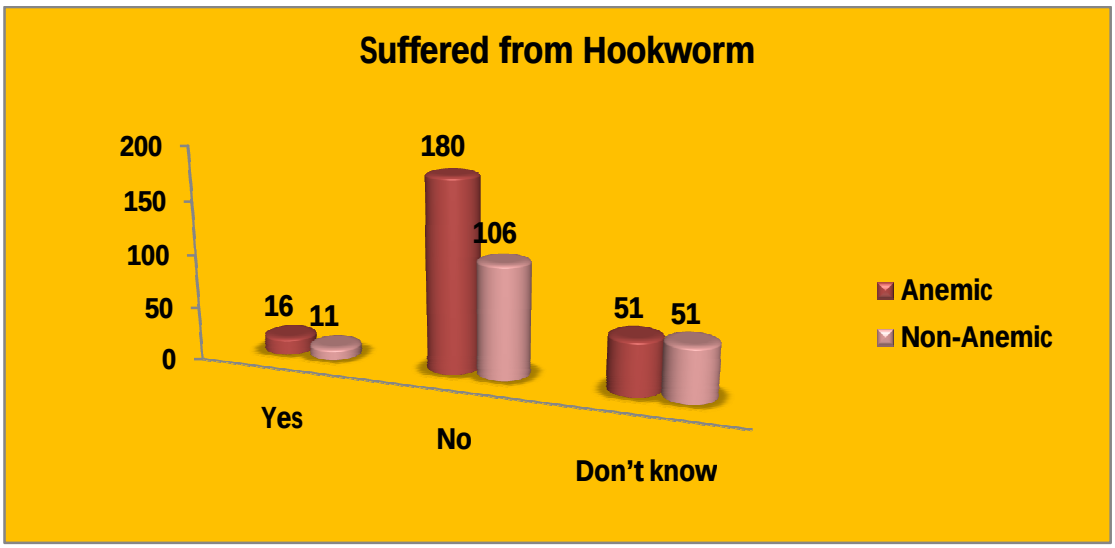

Figure 4.8.3.3 Association of morbidity status with hookworm infestation among anemic and non-anemic respondents

4.8.3.4 Association of morbidity status with reproductive tract infection

Table depicts the history of subjects suffered from reproductive tract infection where lower odds were observed among females who did not suffer from any infection 0.807 (95% CI 0.494-1.323) when compared to suffered ones, while 1.03 times females were not knowing about their infection history (95% CI 0.561-1.939). The p value was found to be non significant in both the cases.

Table No. 4.8.3.4 Logistic regression analysis of anemic and non-anemic respondents suffered from reproductive tract infection

Past Morbidity Status		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Had or having Reproductive Tract Infection	Yes	64	46	1
	No	143	83	0.807 (0.494-1.323) (0.217)
	Don't know	41	23	1.034 (0.561-1.939) (0.515)

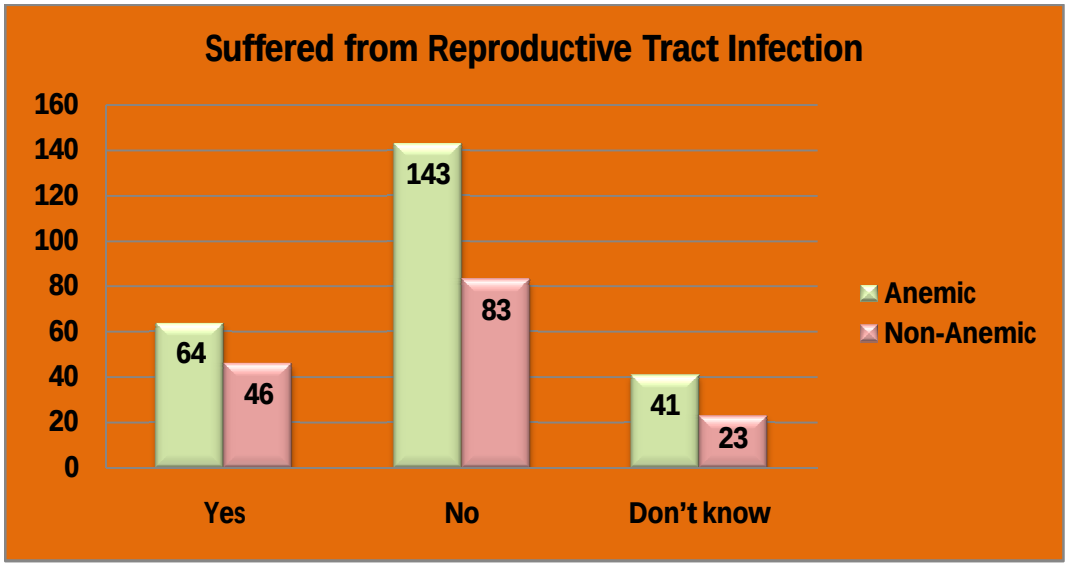

Figure 4.8.3.4 Association of morbidity status with reproductive tract infection among anemic and non-anemic respondents

4.8.3.5 Association of morbidity status with peptic ulcer

Table shows the knowledge based distribution of females not suffered from peptic ulcers where lower odds were examined among subjects 0.797 (95% CI 0.398-1.623).

In contrary to our study, another study reported a significant and adverse correlation between being serologically H. Pylori positive and hemoglobin level (P = 0.005, r = -0.218) ***(Parashi 2013)***.

Many studies have reported an association between H. Pylori infection and iron deficiency anemia ***(Dolatian et al. 2007; Choe 2006; Chen 2007; Duboisand Kearney 2005; Barabino et al. 2002; Iná S. Santo et al. 2009; Farag et al 2007; Weyermann et al. 2005)***. H. pylori infection causes iron deficiency anemia due to competition for iron between gastric cells and H. pylori and bleeding through peptic ulcers and other gastric lesions associated with H. pylori. (***Choe 2006; Dubois and Kearney, 2005)***. A high percentage of H. pylori-positive with iron deficiency anemia demonstrated atrophic changes in the gastric body. Patients with H pylori gastritis showed an increase in gastric pH (a median of > 3), which is known to be critical in the process of iron absorption ***(Chen and Luo 2007)***.

Table No. 4.8.3.5 Logistic regression analysis of anemic and non-anemic respondents suffered from peptic ulcer

Past Morbidity Status		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Suffered from Peptic Ulcer	Yes	24	18	1 0.797 (0.398-1.623) (0.299)
	No	224	134	

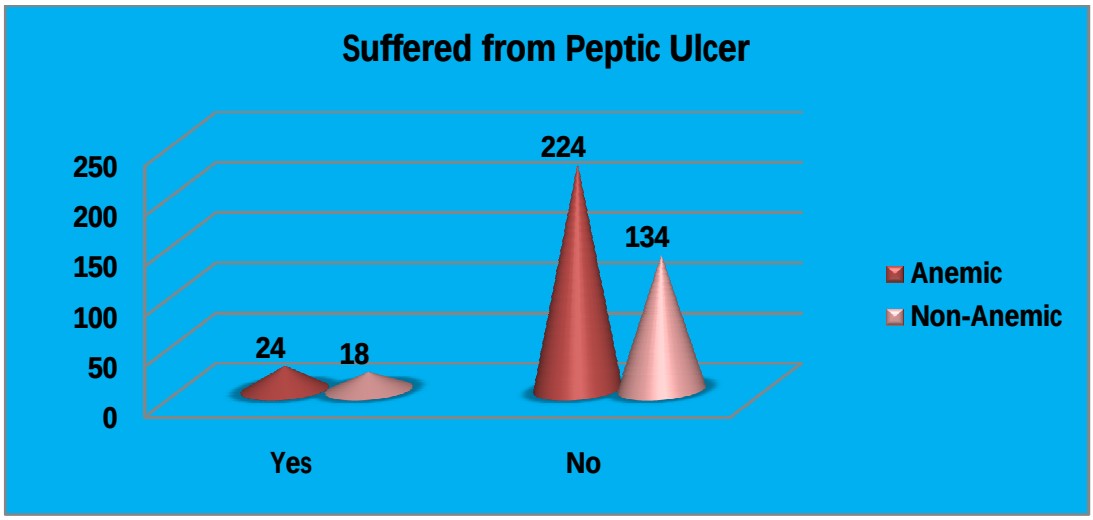

Figure 4.8.3.5 Association of morbidity status with peptic ulcer among anemic and non-anemic respondents

4.8.3.6 Association of morbidity status with rectal bleeding

Table depicts the health status of females having history of rectal bleeding where females were 1.57 times more likely not suffered from rectal bleeding than suffering from (95% CI 0.880-2.893).

Table No. 4.8.3.6 Logistic regression analysis of anemic and non-anemic respondents suffered from rectal bleeding

Past Morbidity Status		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value) (CI)
Suffered from Rectal Bleeding	Yes	50	21	1 1.575 (0.880-2.893) (0.06)
	No	198	131	

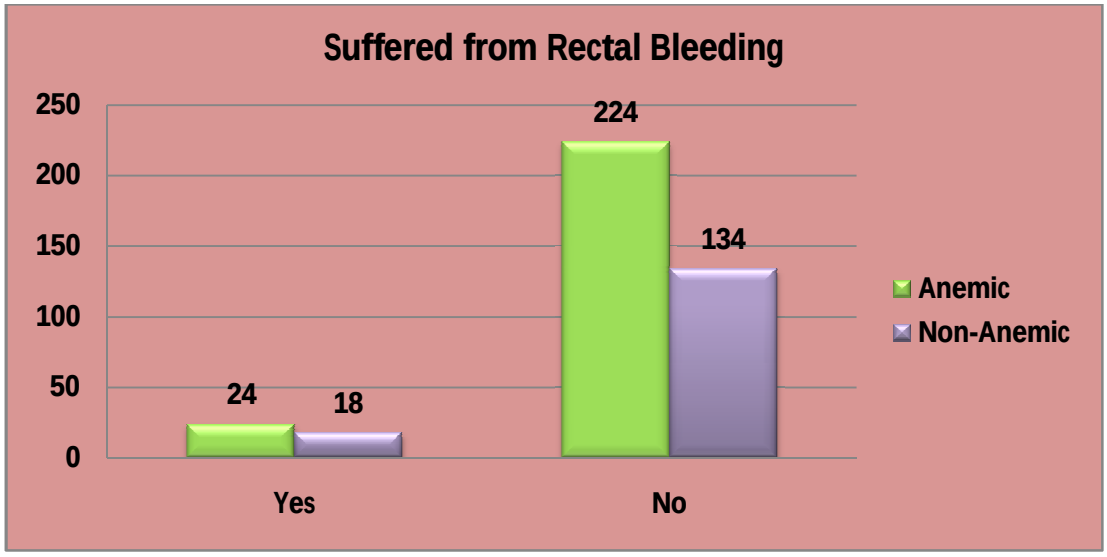

Figure 4.8.3.6 Association of morbidity status with rectal bleeding among anemic and non-anemic respondents

4.8.3.7 Association of morbidity status with melaena

Table illustrates about the medial status of females suffered from melaena where females having history of melaena were 1.02 times more likely not suffered from this medical condition from (95% CI 0.459-2.371) with p = 0.556 showing non-significant association.

Table No. 4.8.3.7 Logistic regression analysis of anemic and non-anemic respondents suffered from melaena

Past Morbidity Status		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value) (CI)
Suffered from Melaena	Yes	20	12	1 1.023 (0.459-2.371) (0.556)
	No	228	140	

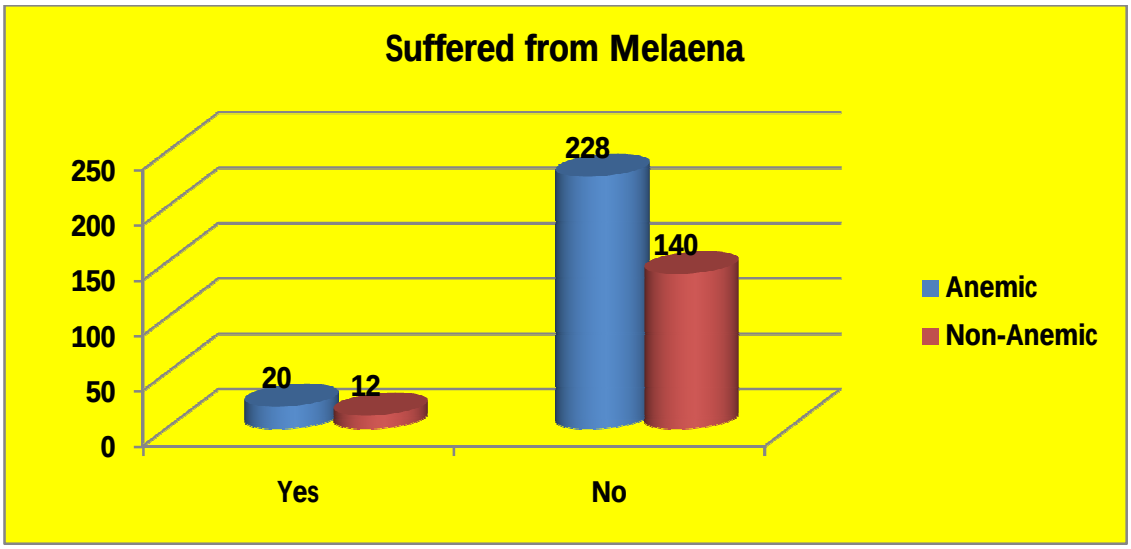

Figure 4.8.3.7 Association of morbidity status with melaena among anemic and non-anemic

4.8.3.8 Association of morbidity status with ulcerative colitis

Table depicts the health status of females having history of ulcerative colitis where females were having lower odds 0.706 times less likely to suffer from ulcerative colitis than suffering from (95% CI 0.199-2.600).

Table No. 4.8.3.8 Logistic regression analysis of anemic and non-anemic respondents suffered from ulcerative colitis

Past Morbidity Status		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Suffered from Ulcerative Colitis	Yes	7	6	1 0.706 (0.199-2.600) (0.365)
	No	241	146	

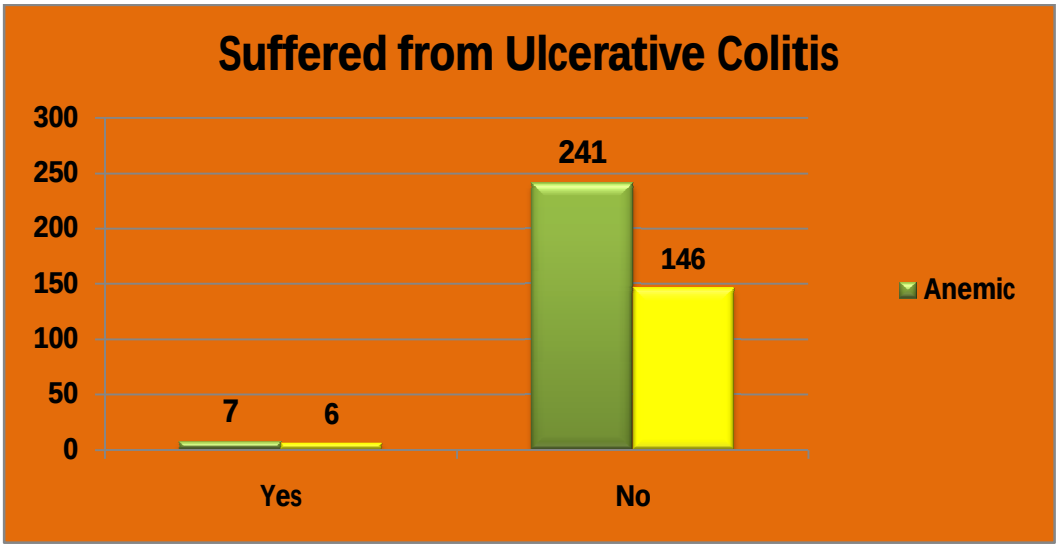

Figure 4.8.3.8 Association of morbidity status with ulcerative colitis among anemic and non-anemic

4.8.3.4 Association of morbidity status with cancer

Table illustrates about the medical status of females showing history of cancer where females where 1.54 times females more likely not suffered from this medical condition from (95% CI 0.248-16.380). In a similar study, a lower prevalence of anemia of 13.8 was found among tumor patients ***(Verbekeet et al; 2008).*** A study by ***Kanuri et al; (2016)*** reported that the prevalence of anemia is high in cancer patients and majorly due to iron deficiency (64%), similar with findings from other studies ***(Ludwig et al; 2004; Steegmann 2013; Merlini 2013; Verbeke 2012; Seshadri et al 2005; Kitano et al 2007).***

In an another study, patients with anemia and a ferritin above 100 ng ml $^{-1}$ have a risk of cancer little above those who are neither anemic nor iron-deficient ***(Sawhney et al; 2007).***

In a multivariable conditional logistic regression model, there were strong (P<0.001) independent associations between colorectal cancer and anaemia, microcytosis, and a low ferritin ***(Hamilton et al., 2008).***

Table No. 4.8.3.9 Logistic regression analysis of anemic and non-anemic respondents suffered from cancer

Past Morbidity Status		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Suffered from Cancer	Yes	5	2	1 1.543 (0.248-16.380) (0.2463)
	No	243	150	

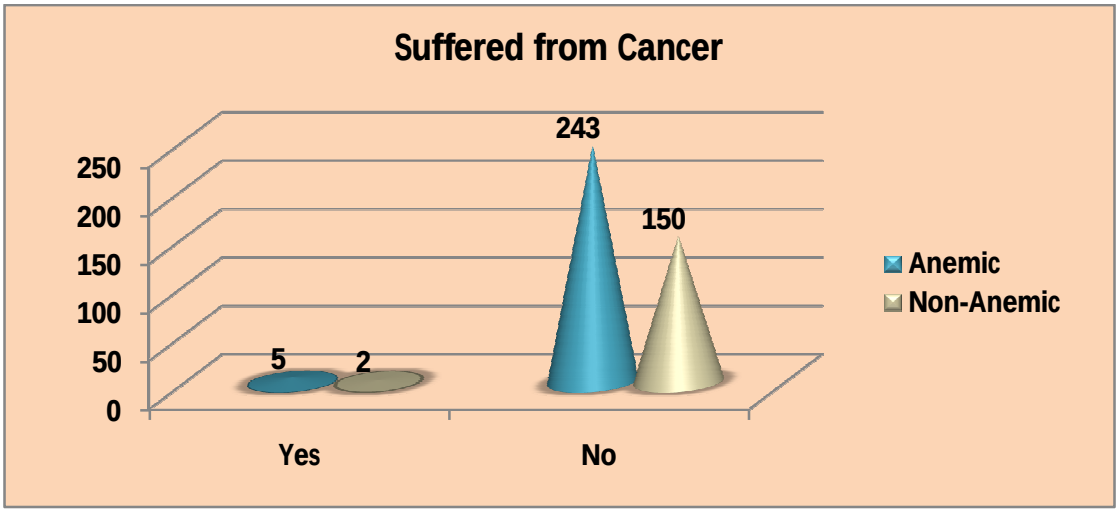

Figure 4.8.3.9 Association of morbidity status with cancer among anemic and non-anemic

4.8.3.10 Association of morbidity status with blood transfusion

Table depicts the blood transfusion status of females where females were having 1.30 times more not likely to have blood transfusion than the one who had in past (OR=1.304, 95% CI: 0.654-2.699). The result is not significant. A study reported that there was a significant difference in the total number of symptoms pre-transfusion compared with symptoms post-transfusion ($p < 0.01$) ***(Raza et al; 2014).***

Table No. 4.8.3.10 Logistic regression analysis of anemic and non-anemic respondents ever had blood transfusion

Past Morbidity Status		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Ever had Blood Transfusion	Yes	31	15	1 1.304 (0.654-2.699) (0.263)
	No	217	137	

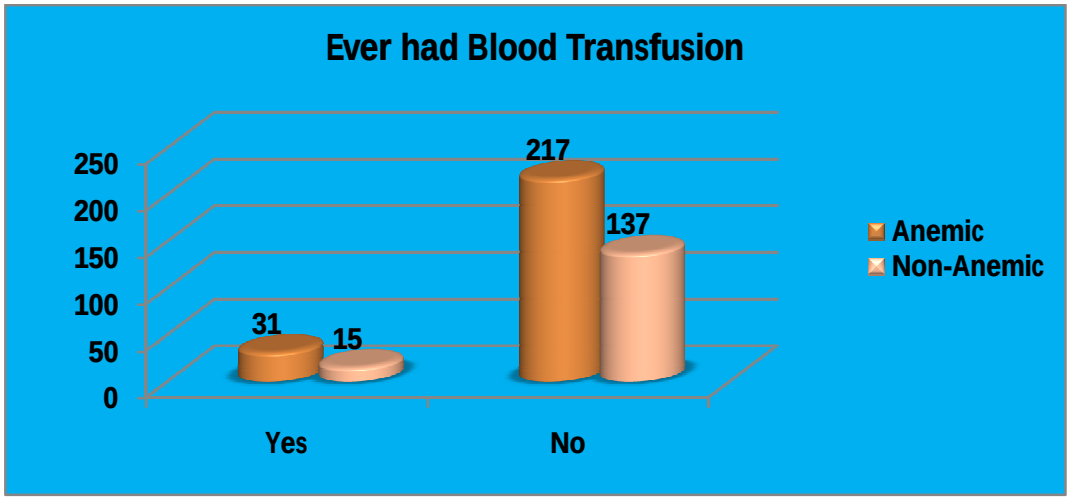

Figure 4.8.3.10 Association of morbidity status with blood transfusion among anemic and non-anemic

4.8.4 Relationship between Common Ailment Pattern and IDA

The association between common ailment pattern in anemia among anemic and non-anemic females were observed which showed more risk among anemic having these ailments never, sometimes, often and all the time. Females having following morbid conditions all the time have more risk of becoming anemic as it can be one of the factors associated with anemia.

4.8.4.1 Pattern of Headache

Table depicts the association between pattern of headache and anemia in females where headache being sometimes (OR=1.655 95% CI: 0.963-2.840) and all the time (OR= 2.229 95% CI: 0.97-5.25, p= 0.029) was found to be associated with anemia. According to ***Woldu et al. (2020)*** pallor, low blood pressure, headache, and edema are the most common manifestations of anemia.

Table No. 4.8.4.1 Association between headache and anemia among selected subjects

Ailment	Pattern	Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Headache	Never	46	43	1
	Sometimes	124	70	1.655 (0.963-2.840) (0.034)
	Never	46	43	1
	Often	47	26	1.689 (0.855-3.353) (0.071)
	Never	46	43	1
	All the time	31	13	2.229 (0.973-5.255) (0.029)

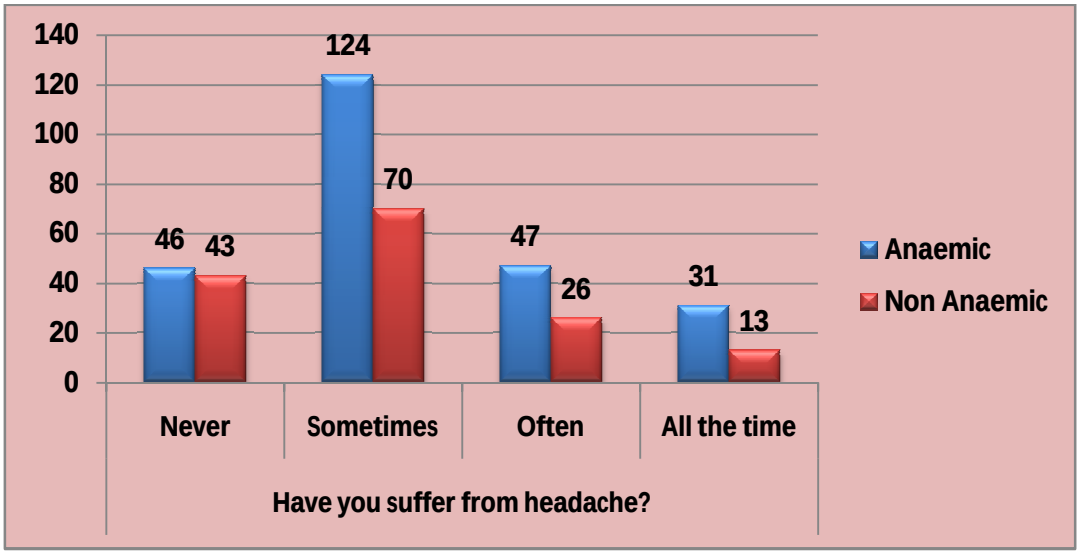

Figure 4.8.4.1 Association between headache and anemia among selected subjects

4.8.4.2 Pattern of Dizziness

Table depicts the association between pattern of dizziness and anemia in females where dizziness being sometimes (OR=1.652 95% CI: 1.005-2.715, p=0.023) and often (OR=1.734 95% CI: 0.921-3.297, p= 0.046) was found to be associated with anemia. Dizziness all the time was non-significant.

Table No. 4.8.4.2 Association between dizziness and anemia among selected subjects

Ailment	Pattern	Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Dizziness	Never	73	62	1
	Sometimes	107	55	1.652 (1.005-2.715) (0.023)
	Never	73	62	1
	Often	49	24	1.734 (0.921-3.297) (0.046)
	Never	73	62	1
	All the time	19	11	1.466 (0.606-3.683) (0.236)

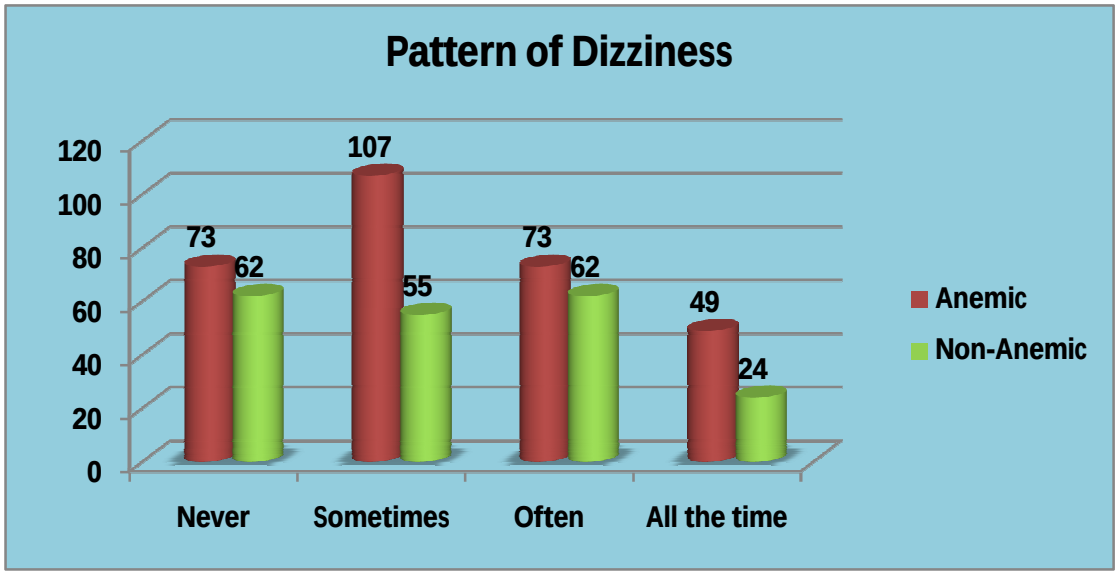

Figure 4.8.4.2 Association between dizziness and anemia among selected subjects

4.8.4.3 Pattern of Nausea

In our analysis, pattern of nausea was not associated with anemia as p values of sometimes, often and all the time being p=0.231, p=0.454 and p=0.577 respectively.

Similarly, ***Parashi et al; (2013)*** in their study reported no association between age, educational level, history of nausea and vomiting of participants and the hemoglobin level. Association between nausea and anemia has been reported by ***Meier et al; (2003).*** Motility disorder, nausea, anorexia, and even malabsorption have been attributed to anemia ***(Gasche et al; 2004).***

Table No. 4.8.4.3 Association between nausea and anemia among selected subjects

Ailment	Pattern	Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Nausea	Never	129	85	1 1.223 (0.750-2.005) (0.231)
	Sometimes	78	42	
	Never	129	85	1 1.098 (0.551-2.232) (0.454)
	Often	30	18	
	Never	129	85	1 1.035 (0.350-3.281) (0.577)
	All the time	11	7	

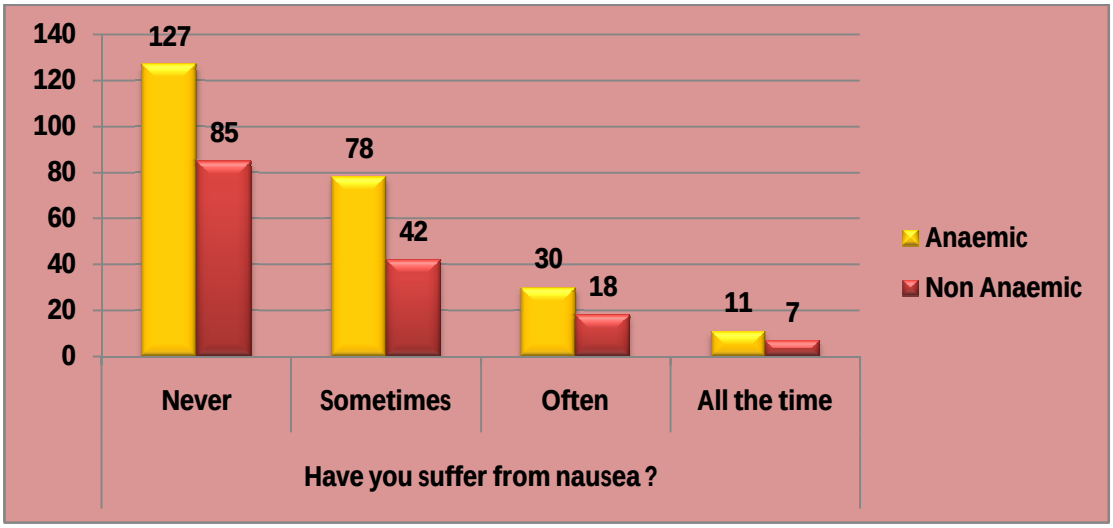

Figure 4.8.4.3 Association between nausea and anemia among selected subjects

4.8.4.4 Pattern of Constipation

According to a recent Cochrane systematic review pregnant women who intermittently receive iron supplementation are less likely to report side-effects (such as constipation and nausea), as compared to those who receive a daily regimen ***(Peña-Rosas et al; 2015).*** A study reported that moderately anemic mothers have a higher proportion of having health complaints such as headache, nausea/vomiting, decreasing appetite, constipation than mildly anemic mothers ***(Diana et al; 2019).*** In contrast, a study reported no significant association between constipation and anemia ***(Meier et al; 2003).***

Table No. 4.8.4.4 Association between constipation and anemia among selected subjects

Ailment	Pattern	Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Constipation	**Never**	134	91	1 1.507 (0.935-2.444) (0.047)
	Sometimes	91	41	
	Never	134	91	1 0.814 (0.367-1.835) (0.358)
	Often	18	15	
	Never	134	91	1 0.679 (0.151-3.045) (0.386)
	All the time	5	5	

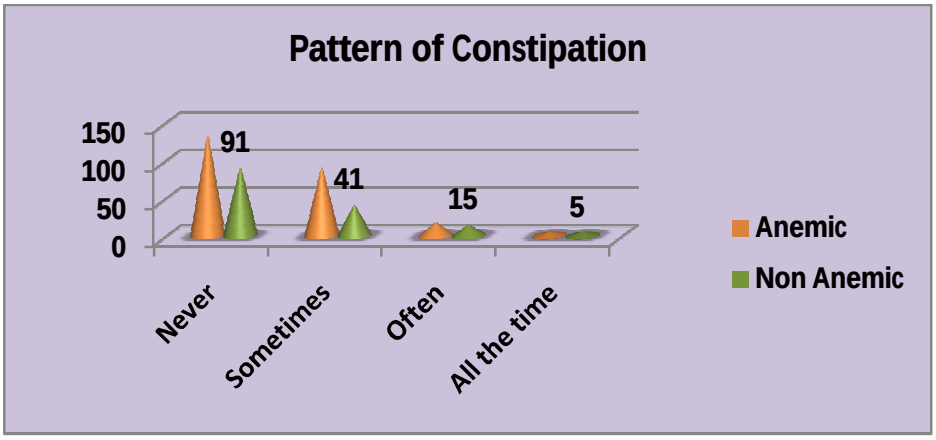

Figure 4.8.4.4 Association between constipation and anemia among selected subjects

4.8.4.5 Pattern of Stomach Ache

In association with pattern of stomach ache and anemia, where higher odds were found in subjects who sometimes had stomach ache (OR= 1.589, CI: 0.989-2.560, p=0.027) in comparison to those who suffered often and all the time.

Table No. 4.8.4.5 Association between stomach ache and anemia among selected subjects

Ailment	Pattern	Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Stomach Ache	Never	106	77	1 1.589 (0.989-2.560) (0.027)
	Sometimes	105	48	
	Never	106	77	1 1.053 (0.530-2.120) (0.503)
	Often	29	20	
	Never	106	77	1 0.830 (0.251-2.815) (0.465)
	All the time	8	7	

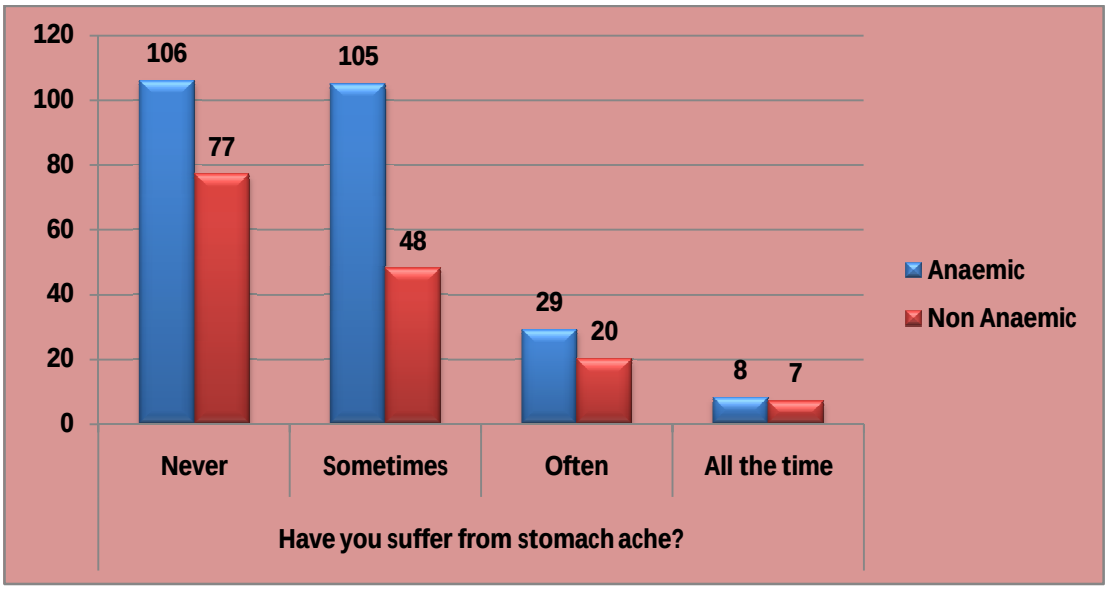

Figure 4.8.4.5 Association between stomach ache and anemia among selected subjects

4.8.4.6 Pattern of Melaena

In association with pattern of melaena and anemia, where higher odds were found in subjects who sometimes had black stool (melaena) (OR=2.603, 95% CI: 1.001-7.973, p=0.024) in comparison to those who suffered often and all the time.

Table No. 4.8.4.6 Association between melaena and anemia among selected subjects

Ailments	Pattern	Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Melaena	Never	212	138	1 2.603 (1.001-7.973) (0.024)
	Sometimes	24	6	
	Never	212	138	1 1.084 (0.347-3.716) (0.549)
	Often	10	6	
	Never	212	138	1 0.650 (0.467-9.088) (0.517)
	All the time	2	2	

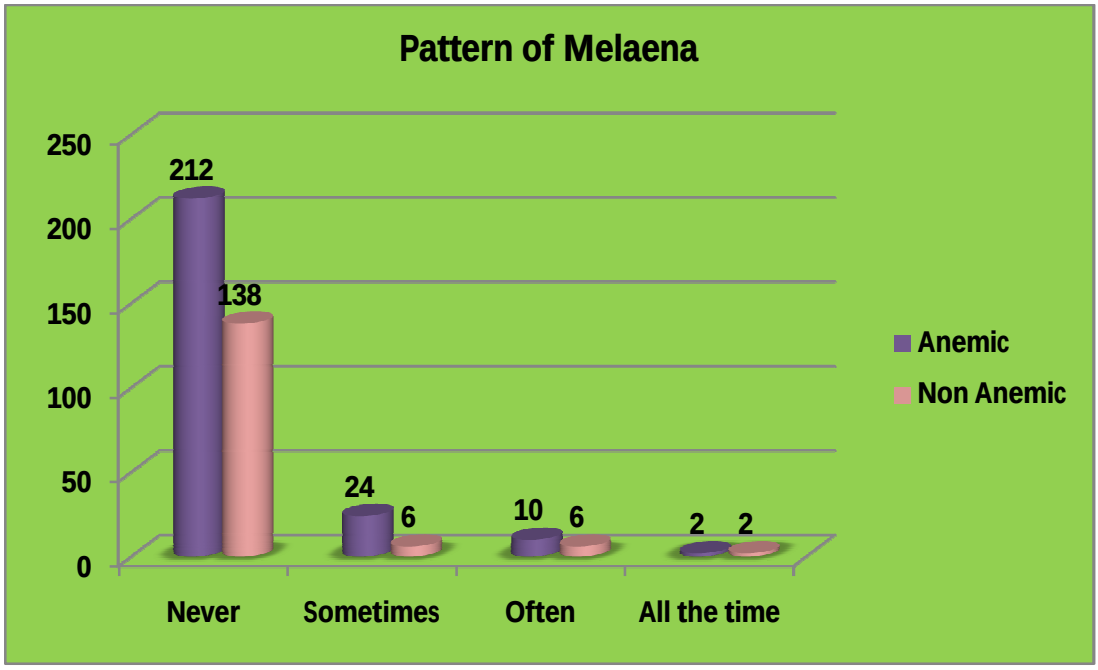

Figure 4.8.4.6 Association between melaena and anemia among selected subjects

4.8.4.7 Pattern of Insomnia

In association between insomnia and anemia, where higher odds were found in subjects who sometimes and often had problem of insomnia (OR= 4.66, CI: 1.87-13.85) in comparison to those who suffered all the time.

In another study by ***Chen-Edinboro et al. (2019)*** reported that non-iron-deficient anemic individuals indicating greater insomnia severity, compared to those without anemia (predicted adjusted mean WHIIRS of 7.24 [95% confidence interval (CI): 6.40–8.08] vs. 5.92 [95% CI: 5.65–6.19]. They also had twice the risk of reporting ≥2 insomnia symptoms (vs. 0 symptoms; relative risk ratio = 2.20, 95% CI: 1.25–3.89).

Table No. 4.8.4.7 Association between insomnia and anemia among selected subjects

Ailments	Pattern	Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Insomnia	**Never**	190	137	1
	Sometimes	35	11	2.294 (1.089-5.180) (0.013)
	Never	190	137	1
	Often	17	3	4.085 (1.145-22.109) (0.012)
	Never	190	137	1
	All the time	6	1	4.326 (0.514-20.393) (0.139)

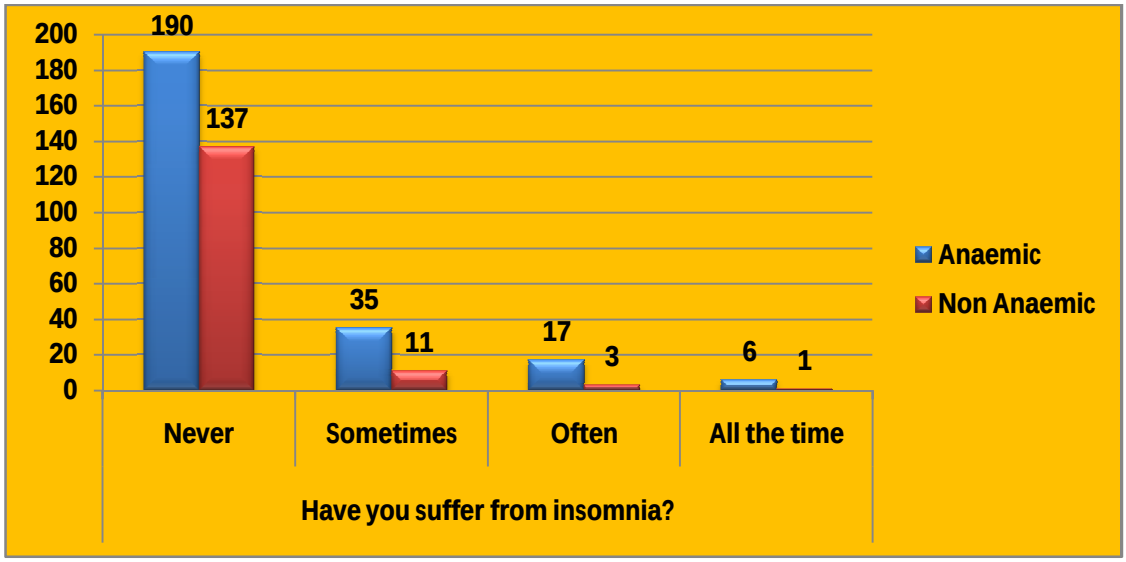

Figure 4.8.4.7 Association between insomnia and anemia among selected subjects

4.8.4.8 Pattern of Fatigue

Relative risk for fatigue all the time (RR= 6.777, CI-3.10515.005) where fatigue was the most significant risk factor as anemic females had high risk of feeling fatigue all the time.

Mamta (2014) assessed the clinical signs of anemia and found that 22(55%) of them had fatigue. According to ***UNICEF (2002)***, fatigue, irritability, weakness, shortness of breath and decreased appetite were signs and symptoms of anemia. A similar study reported that minimum hemoglobin level was strongly associated with fatigue. Patients with a minimum Hb<8g/dL had higher fatigue levels and were more likely to report high levels of fatigue ***(Prochaska et al. 2017).***

Table No. 4.8.4.8 Association between fatigue and anemia among selected subjects

Ailment	Pattern	Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Fatigue	Never	27	48	1
	Sometimes	96	50	3.413 (1.833-6.386) (0.000)**
	Never	27	48	1
	Often	64	38	2.994 (1.542-5.838) (0.000)**
	Never	27	48	1
	All the time	61	16	6.777 (3.105-15.005) (0.000)**

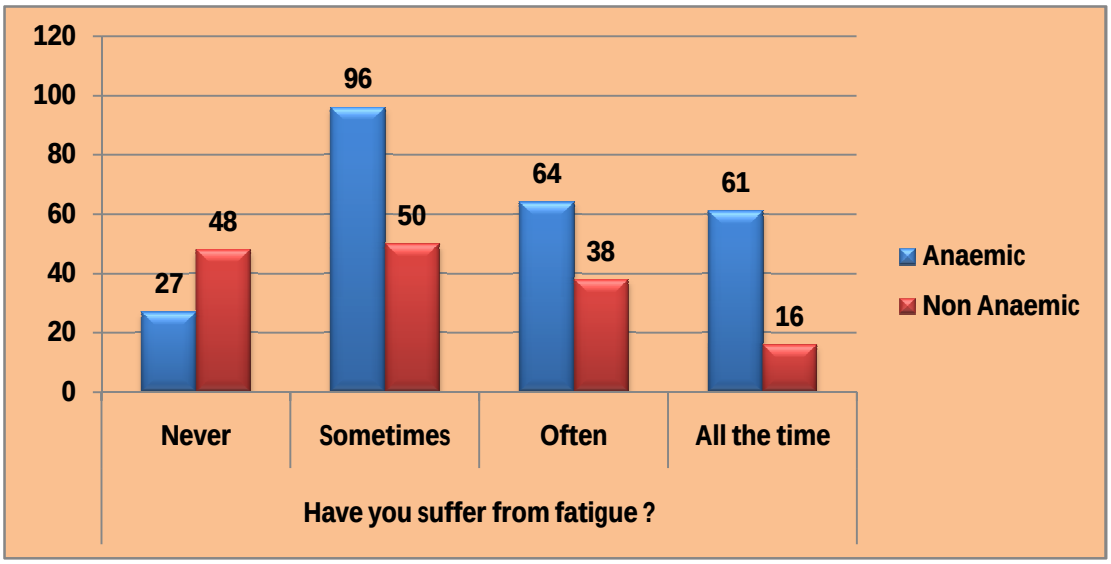

Figure 4.8.4.8 Association between fatigue and anemia among selected subjects

4.8.4.8 Pattern of Heavy Bleeding

In association between heavy bleeding and anemia, where higher odds were found in subjects who sometimes suffered from heavy bleeding (OR=4.66, 95% CI: 1.87-13.85, p=0.000) in comparison to those who suffered often and all the time. Heavy blood losses at menstrual periods are at an additional higher risk of developing anemia ***(Mawani M et al; 2016).***

Table No. 4.8.4.8 Association between heavy bleeding and anemia among selected subjects

		Anemic (n=248)	Non Anemic (n=152)	Odds Ratio (CI) (p value)
Heavy Bleeding	Never	170	122	1 4.664 (1.874-13.856) (0.000)
	Sometimes	39	6	
	Never	170	122	1 0.782 (0.305-2.030) (0.361)
	Often	12	11	
	Never	170	122	1 1.490 (0.707-3.277) (0.171)
	All the time	27	13	

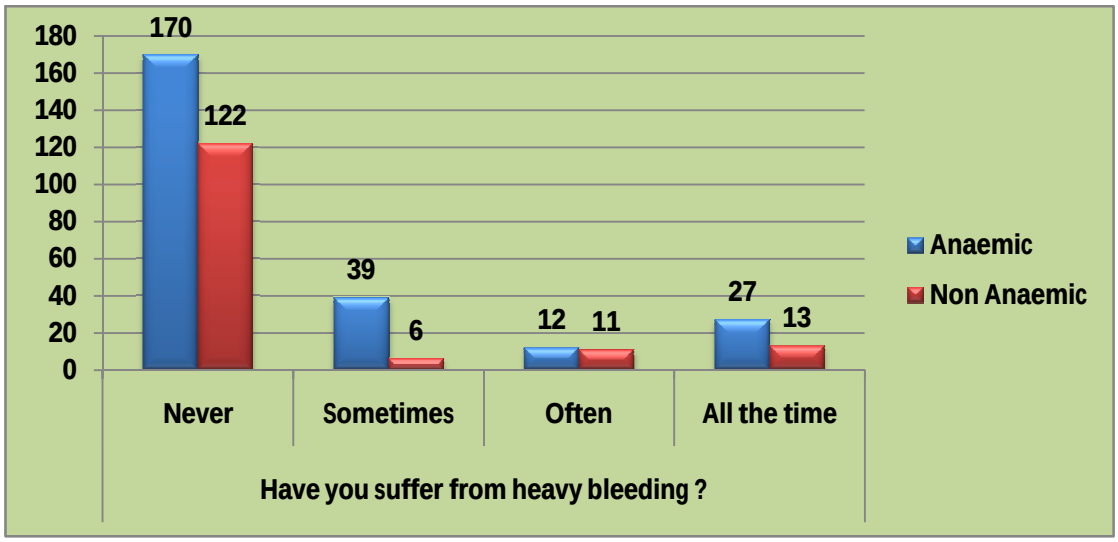

Figure 4.8.4.9 Association between heavy bleeding and anemia among selected subjects

4.9 Relationship of BMI with Dietary Habits of Respondents

4.9.1 BMI associated with Food Consumption Pattern

Association of BMI and Food Consumption Pattern among respondents:

H_0: There exists no significant relationship between BMI and Food Consumption Pattern.

On evaluating the association between categories of BMI and food consumption pattern, a significant relationship was observed among all patterns of food consumption except for consumption of supplements, soups, fruits and legumes. Table showing a strong significant association of BMI and consumption of red meat (p=0.00), chicken (p=0.00) fish (p=0.05), followed by green leafy vegetables (p=0.04) and whole grains (p=0.01) where as a non-significant association was observed between legumes (p=0.08), citrus fruits (p=0.11) and soups (p=0.15). Our null hypothesis cannot be fully rejected with exception for consumption of soups, fruits and legumes whilst not all other foods had a significant association with BMI as shown in table 4.9.1. As per a study done in India, only 28% of women consume meat, fish, or eggs on a weekly basis ***(Arnold et al. 2014)***, and there is poor iron bioavailability in the vegetarian diet ***(Shridhar et al. 2014 and Thankachan et al. 2007)***.

Table No. 4.9.1 Chi-square test for the association of BMI status and Food Consumption Pattern

BMI	Consumption Pattern of Red Meat					Total	Chi-square significance
	Daily	4-6 Times/ Week	1-3 Times/ Week	1-2 Times/ Week	Never		
Under weight (n=30)	0	0	2	2	26	30	38.769** 0.001 df=16
	0.0%	0.0%	0.5%	0.5%	6.5%	7.5%	
Normal (n=198)	6	8	12	31	141	198	
	1.5%	2.0%	3.0%	7.8%	35.2%	49.5%	
Over weight (n=69)	1	4	5	7	52	69	
	0.2%	1.0%	1.2%	1.8%	13.0%	17.2%	
Obese I (n=97)	0	2	4	24	67	97	
	0.0%	0.5%	1.0%	6.0%	16.8%	24.2%	
Obese II (n=6)	0	2	2	0	2	6	
	0.0%	0.5%	0.5%	0.0%	0.5%	1.5%	
Total	7	16	25	64	288	400	
	1.8%	4.0%	6.2%	16.0%	72.0%	100.0%	
Consumption Pattern of Chicken							
Under	0	1	1	4	24	30	

weight (n=30)	0.0%	0.2%	0.2%	1.0%	6.0%	7.5%	64.983** 0.000 df=16
Normal (n=198)	6	7	15	40	130	198	
	1.5%	1.8%	3.8%	10.0%	32.5%	49.5%	
Over weight (n=69)	0	6	6	12	45	69	
	0.0%	1.5%	1.5%	3.0%	11.2%	17.2%	
Obese I (n=97)	0	3	12	28	54	97	
	0.0%	0.8%	3.0%	7.0%	13.5%	24.2%	
Obese II (n=6)	0	4	0	1	1	6	
	0.0%	1.0%	0.0%	0.2%	0.2%	1.5%	
Total	6	21	34	85	254	400	
	1.5%	5.2%	8.5%	21.2%	63.5%	100.0%	
Consumption Pattern of Fish							
Under weight (n=30)	0	0	2	2	26	30	25.920* 0.055 df=16
	0.0%	0.0%	0.5%	0.5%	6.5%	7.5%	
Normal (n=198)	6	4	7	31	150	198	
	1.5%	1.0%	1.8%	7.8%	37.5%	49.5%	
Over weight (n=69)	2	2	3	9	53	69	
	0.5%	0.5%	0.8%	2.2%	13.2%	17.2%	
Obese I (n=97)	0	2	4	16	75	97	
	0.0%	0.5%	1.0%	4.0%	18.8%	24.2%	
Obese II (n=6)	0	1	2	1	2	6	
	0.0%	0.2%	0.5%	0.2%	0.5%	1.5%	
Total	8	9	18	59	306	400	
	2.0%	2.2%	4.5%	14.8%	76.5%	100.0%	
Consumption Pattern of Legumes							
Under weight (n=30)	9	4	4	9	4	30	24.098 0.087 df=16
	2.2%	1.0%	1.0%	2.2%	1.0%	7.5%	
Normal (n=198)	35	42	35	47	39	198	
	8.8%	10.5%	8.8%	11.8%	9.8%	49.5%	
Over weight (n=69)	15	9	19	14	12	69	
	3.8%	2.2%	4.8%	3.5%	3.0%	17.2%	
Obese I	21	25	12	20	19	97	
	5.2%	6.2%	3.0%	5.0%	4.8%	24.2%	

(n=97)							
Obese II (n=6)	0	4	2	0	0	6	
	0.0%	1.0%	0.5%	0.0%	0.0%	1.5%	
Total	80	84	72	90	74	400	
	20.0%	21.0%	18.0%	22.5%	18.5%	100.0%	
Consumption Pattern of Green Leafy Vegetables							
Under weight (n=30)	16	8	5	1	0	30	27.101* 0.040 df=16
	4.0%	2.0%	1.2%	0.2%	0.0%	7.5%	
Normal (n=198)	111	36	31	16	4	198	
	27.8%	9.0%	7.8%	4.0%	1.0%	49.5%	
Over weight (n=69)	47	15	3	4	0	69	
	11.8%	3.8%	0.8%	1.0%	0.0%	17.2%	
Obese I (n=97)	45	36	11	5	0	97	
	11.2%	9.0%	2.8%	1.2%	0.0%	24.2%	
Obese II (n=6)	3	1	2	0	0	6	
	0.8%	0.2%	0.5%	0.0%	0.0%	1.5%	
Total	222	96	52	26	4	400	
	55.5%	24.0%	13.0%	6.5%	1.0%	100.0%	
Consumption Pattern of Citrus Fruits/Juices							
Under weight (n=30)	6	5	7	9	3	30	23.080 0.112 df=16
	1.5%	1.2%	1.8%	2.2%	0.8%	7.5%	
Normal (n=198)	36	22	36	72	32	198	
	9.0%	5.5%	9.0%	18.0%	8.0%	49.5%	
Over weight (n=69)	9	13	21	14	12	69	
	2.2%	3.2%	5.2%	3.5%	3.0%	17.2%	
Obese I (n=97)	22	20	22	22	11	97	
	5.5%	5.0%	5.5%	5.5%	2.8%	24.2%	
Obese II (n=6)	1	2	0	1	2	6	
	0.2%	0.5%	0.0%	0.2%	0.5%	1.5%	
Total	74	62	86	118	60	400	
	18.5%	15.5%	21.5%	29.5%	15.0%	100.0%	
Consumption Pattern of Whole Grains							
Under weight (n=30)	14	11	3	1	1	30	
	3.5%	2.8%	0.8%	0.2%	0.2%	7.5%	

Normal (n=198)	111	55	13	9	10	198	30.166** 0.017 df=16
	27.8%	13.8%	3.2%	2.2%	2.5%	49.5%	
Over weight (n=69)	48	10	6	4	1	69	
	12.0%	2.5%	1.5%	1.0%	0.2%	17.2%	
Obese I (n=97)	40	32	14	11	0	97	
	10.0%	8.0%	3.5%	2.8%	0.0%	24.2%	
Obese II (n=6)	4	2	0	0	0	6	
	1.0%	0.5%	0.0%	0.0%	0.0%	1.5%	
Total	217	110	36	25	12	400	
	54.2%	27.5%	9.0%	6.2%	3.0%	100.0%	
Consumption Pattern of Soup							
Under weight (n=30)	0	0	0	9	21	30	21.771 0.151 df=16
	0.0%	0.0%	0.0%	2.2%	5.2%	7.5%	
Normal (n=198)	6	6	5	31	150	198	
	1.5%	1.5%	1.2%	7.8%	37.5%	49.5%	
Over weight (n=69)	0	3	8	8	50	69	
	0.0%	0.8%	2.0%	2.0%	12.5%	17.2%	
Obese I (n=97)	2	4	5	15	71	97	
	0.5%	1.0%	1.2%	3.8%	17.8%	24.2%	
Obese II (n=6)	0	0	0	2	4	6	
	0.0%	0.0%	0.0%	0.5%	1.0%	1.5%	
Total	8	13	18	65	296	400	
	2.0%	3.2%	4.5%	16.2%	74.0%	100.0%	

4.9.2 BMI associated with No. of Meals per day

Association of BMI with No. of Meals per day among respondents

Table depicts the association between BMI and no. of meals consumed per day where p=0.06 which reveals a non-significant relation as no. of meals taken have no effect on BMI. 32.7% of the participants consumed dairy products once a day and 24.8% 5-6 times a week, followed by 23.9% once a week. 43.5% of participants ate vegetables once a week while 35.9% of participants ate two-four times a week. More than half of the participants (56.50%) ate pulses 2-4 times a week, and 33.7% once a week ***(Gómez et al. 2020).***

Table 4.9.2 Association between No. of Meals per day with Categories of BMI

BMI	No. of meals per day				Total	Chi Square value p value
	2 times a day	3 times a day	4 times a day	Not fixed		
Underweight (n=30)	14	12	2	2	30	20.185 0.064
	3.5%	3.0%	0.5%	0.5%	7.5%	
Normal Range (n=198)	71	86	18	23	198	
	17.8%	21.5%	4.5%	5.8%	49.5%	
Overweight (n=69)	27	22	9	11	69	
	6.8%	5.5%	2.2%	2.8%	17.2%	
Obese I (n=97)	37	41	11	8	97	
	9.2%	10.2%	2.8%	2.0%	24.2%	
Obese II (n=6)	0	1	2	3	6	
	0.0%	0.2%	0.5%	0.8%	1.5%	
Total (n=400)	149	162	42	47	400	
	37.2%	40.5%	10.5%	11.8%	100.0%	

4.9.3 BMI associated with Food habits after Conceiving

Association of BMI with Food habits after Conceiving among respondents

Association between food habits after becoming pregnant and BMI illustrated in table 4.9.4 reveals that eating habit after becoming pregnant have no relation with BMI categories as the relation was non-significant (p=0.61).

Western dietary pattern was associated with increased GWG (β = 1.217; standard error [SE] = 0.487; p = 0.013), among obese women (β = 7.363; SE = 1.808; p = 0.005). Whereas, prudent dietary pattern was found to be positively associated with GWG among underweight (β = 4.127; SE = 1.722; p = 0.048), and negatively among overweight and obese women (β = −4.209; SE = 1.635; p = 0.016 and β = −7.356; SE = 2.304; p = 0.031, respectively) ***(Maugeri et al. 2019).***

About BMI, pregnant women in the obese category preferred a prudent dietary pattern (41.4%) compared to those who were overweight, who exhibited a mixed dietary pattern (38.3%). Pregnant women having normal weight had equal distribution across all three dietary patterns (western, mixed and prudent diet) (***Gómez et al. 2020).***

Table No. 4.9.3 Association between food habit after becoming pregnant and categories of BMI

BMI	Food habit after becoming pregnant			Total	Chi square value p value
	Taking usual diet	Taking special diet	Partly modified		
Underweight (n=30)	9	3	5	17	6.326 0.611
	3.5%	1.2%	1.9%	6.6%	
Normal Range (n=198)	69	25	28	122	
	26.8%	9.7%	10.9%	47.5%	
Overweight (n=69)	26	8	9	43	
	10.1%	3.1%	3.5%	16.7%	
Obese I (n=97)	48	13	10	71	
	18.7%	5.1%	3.9%	27.6%	
Obese II (n=6)	4	0	0	4	
	1.6%	0.0%	0.0%	1.6%	
Total (n=400)	156	49	52	257	
	60.7%	19.1%	20.2%	100.0%	

4.9.4 BMI associated with Consumption of Tea/Coffee

Association of BMI with Consumption of Tea/Coffee among respondents

The below table showed a significant (p=0.01) association between BMI and daily average consumption of tea and coffee where tea and coffee consumed more than one time shown effects on BMI. A study reported about 39.2% of the participants consumed coffee and tea 2-3 times a day after cereals (bread) ***(Gómez et al. 2020).*** While, another study reported consumption of tea was more in underweight individuals in comparison to overweight individuals. Coffee was preferred beverage among overweight followed by underweight and normal weight individuals with non-significant difference between BMI categories (P > 0.05) ***(Muammar et al. 2012).***

Table No. 4.9.4 Association between consumption of tea/coffee daily in average and categories of BMI

BMI	Consumption of tea/coffee daily					Total	Chi square value p value
	Once	2-3 times	4-5 times	At regular intervals	Whenever feel like having it		
Underweight (n=30)	12	16	1	0	1	30	30.892 0.014
	3.0%	4.0%	0.2%	0.0%	0.2%	7.5%	
Normal Range (n=198)	71	74	9	10	34	198	
	17.8%	18.5%	2.2%	2.5%	8.5%	49.5%	
Overweight (n=69)	26	24	4	4	11	69	
	6.5%	6.0%	1.0%	1.0%	2.8%	17.2%	
Obese I (n=97)	25	47	8	1	16	97	
	6.2%	11.8%	2.0%	0.2%	4.0%	24.2%	
Obese II (n=6)	0	1	0	1	4	6	
	0.0%	0.2%	0.0%	0.2%	1.0%	1.5%	
Total (n=400)	134	162	22	16	66	400	
	33.5%	40.5%	5.5%	4.0%	16.5%	100.0%	

4.9.5 BMI associated with Munching between Meals

Association of BMI with Munching between Meals among respondents

Table depicts the association between BMI and no. of times one can eat between meals where p=0.41 which reveals a non-significant relation as no. of times one can eat between meals have no effect on BMI. In concordance, a study reported no significant difference between the BMI categories with dietary pattern (P > 0.05) ***(Muammar et al. 2012).*** The same study reported that a majority of the sample (89.5%) consumed snacks daily with non-significant differences (P > 0.05) between BMI categories.

A strong relationship between higher BMI and unhealthy dietary patterns (westernized and HPF) in adolescents. On the contrary, a negative correlation was found for the prudent dietary pattern (r =-.576 p < 0.01) ***(Laura Elisa Gutiérrez-Pliego et al. 2016).*** Another study reported an "obesogenic" dietary pattern was associated with increased BMI (ßi = 0.244; p = 0.018) in children and adolescents ***(Santos et al. 2014).***

Table No. 4.9.5 Association between no. of times one eats between meals and categories of BMI

BMI	How many times do you eat between meals			Total	Chi square value p value
	Only once	Whenever feel hungry	Never		
Underweight (n=30)	1	23	6	30	8.223 0.412
	0.2%	5.8%	1.5%	7.5%	
Normal Range (n=198)	20	130	48	198	
	5.0%	32.5%	12.0%	49.5%	
Overweight (n=69)	3	47	19	69	
	0.8%	11.8%	4.8%	17.2%	
Obese I (n=97)	10	69	18	97	
	2.5%	17.2%	4.5%	24.2%	
Obese II (n=6)	0	3	3	6	
	0.0%	0.8%	0.8%	1.5%	
Total (n=400)	34	272	94	400	
	8.5%	68.0%	23.5%	100.0%	

4.10 BMI associated with Menstrual Status

Association of BMI with Menstrual Status among respondents:

H_0: There exists no significant relationship between BMI with Menstrual Status.

On evaluating the association of BMI categories with menstrual status, a non-significant relationship was observed among all categories of BMI except for age at menarche (p= 0.035) and flow during menses (p= 0.048). So, our null hypothesis cannot be fully rejected with exception for age at menarche and flow during menses whilst all other categories had a non-significant association with BMI as shown in table any. Hemoglobin levels were significantly associated (Chi-square = 9.325, P=0.009) with the regularity of the length of the cycle in the participants ***(Sen et al. 2018).*** A study reported a significant correlation between lower BMI (<18.5 Kg/m2) and problems related to the irregular menstrual cycle ***(Monika et al. 2019)***. The same study reported the duration of blood flow to be negatively associated with BMI <18.5. A significant association was found between high BMI and menstrual cycle length (P-value < 0.001) ***(Monika et al. 2019)***. A similar finding was found in other studies ***(Jena et al. 2016 and Dars et al. 2014)***. On similar lines, another study reported an association between the BMI and the irregular menstrual cycle was found to be

significant ($p<0.05$) ***(Ganesan et al. 2019)***. Similar results were reported by other studies ***(Lakkawar et al. 2014 and Deshpande et al. 2013).***

In addition, several other studies reported an association between menorrhagia and other related menstrual symptoms and problems with the length of the menstrual cycle ***(Nabila et al. 2016 and Monika et al. 2019)***.

Table No. 4.10 Association between Categories of BMI and Menstrual Status

Variables		BMI Categorization						Chi square value p value
		Under weight (n=30)	Normal (n=198)	Over weight (n=69)	Obese I (n=97)	Obese II (n=6)	Total (n=400)	
Age at menarche	≤12 (n=124)	13 (3.2)	58 (14.5)	26 (6.5)	23 (5.8)	4 (1.0)	124 (31.0)	16.540 0.035 *
	13-15 (n=246)	14 (3.5)	122 (30.5)	38 (9.5)	71 (17.8)	1 (0.2)	246 (61.5)	
	≥16 (n=30)	3 (0.8)	18 (4.5)	5 (1.2)	3 (0.8)	1 (0.2)	30 (7.5)	
Length of cycle	<28 (n=66)	4 (1.0)	32 (8.0)	15 (3.8)	15 (3.8)	0 (0.0)	66 (16.5)	5.577 0.936
	28-30 (n=260)	19 (4.8)	131 (32.8)	42 (10.5)	63 (15.8)	5 (1.2)	260 (65.0)	
	>30 (n=70)	6 (1.5)	33 (8.2)	12 (3.0)	18 (4.5)	1 (0.2)	70 (17.5)	
	Irregular (n=4)	1 (0.2)	2 (0.5)	0 (0.0)	1 (0.2)	0 (0.0)	4 (1.0)	
Duration of menses	≤2 (n=47)	3 (0.8)	24 (6.0)	9 (2.2)	11 (2.8)	0 (0.0)	47 (11.8)	5.661 0.685
	3-5 (n=289)	19 (4.8)	142 (35.5)	50 (12.5)	74 (18.5)	4 (1.0)	289 (72.2)	
	≥6 (n=64)	8 (2.0)	32 (8.0)	10 (2.5)	12 (3.0)	2 (0.5)	64 (16.0)	
Clots	Present (n=126)	10 (2.5)	65 (16.2)	22 (5.5)	27 (6.8)	2 (0.5)	126 (31.5)	0.827 0.935
	Absent (n=274)	20 (5.0)	133 (33.2)	47 (11.8)	70 (17.5)	4 (1.0)	274 (68.5)	
Flow during menses	Normal (n=292)	15 (3.8)	150 (37.5)	49 (12.2)	74 (18.5)	4 (1.0)	292 (73.0)	9.608 0.048
	Excessi	15	48	20	23	2	108	

	ve (n=108)	(3.8)	(49.5)	(5.0)	(5.8)	(0.5)	(27.0)	*
Problem of menorrhagia	Yes (n=104)	14 (3.5)	47 (11.8)	19 (4.8)	22 (5.5)	2 (0.5)	104 (26.0)	7.994 0.092
	No (n=296)	16 (4.0)	151 (37.8)	50 (12.5)	75 (18.8)	4 (1.0)	296 (74.0)	
Recent experience of prolonged bleeding	Yes (n=108)	13 (3.2)	51 (12.8)	20 (5.0)	22 (5.5)	2 (0.5)	108 (27.0)	5.394 0.249
	No (n=292)	17 (4.2)	147 (36.8)	49 (12.2)	75 (18.8)	4 (1.0)	292 (73.0)	

4.11 Socio-demographic factors associated with Food Consumption Pattern

4.11.1 Association of Age and Religion with Food Consumption Pattern

H_0: There exists a significant relationship between Age and Religion with Food Consumption Pattern.

On evaluating the association between age group and food consumption pattern, a non-significant relationship was observed among the consumption pattern of green leafy vegetables, citrus fruits, whole grains and soup having the p values <.05 respectively (green leafy vegetables p=0.294; citrus fruits p=0.127; whole grains p=0.07 and soup p=0.121) as summarized in Table no. 4.11.1.1. On evaluating the association between age group and food consumption pattern, a highly significant relationship was observed among the consumption pattern of red meat, chicken, fish, legumes, green leafy vegetables, whole grains, citrus fruits/juices and soup p=0.000 respectively.

Our null hypothesis cannot be fully accepted with the above-mentioned exceptions, whilst not all other foods had a significant association with all Socio demographic factors as shown in table no. 4.11.1.1.

Table No. 4.11.1.1 Chi-square test for the association of Age and Food Consumption Pattern

Age	Consumption Pattern of Red Meat					Total	Chi-square significance
	Daily	4-6 times/ week	1-3 times/ week	1-2 times/ week	Never		
15-19	0	0	2	3	26	31	24.55*** df=12 p=0.01
	0.0%	0.0%	0.5%	0.8%	6.5%	7.8%	
20-29	4	1	12	38	156	211	
	1.0%	0.2%	3.0%	9.5%	39.0%	52.8%	
30-39	2	10	9	17	73	111	
	0.5%	2.5%	2.2%	4.2%	18.2%	27.8%	
40-49	1	5	2	6	33	47	
	0.2%	1.2%	0.5%	1.5%	8.2%	11.8%	
Total	7	16	25	64	288	400	
	1.8%	4.0%	6.2%	16.0%	72.0%	100.0%	
Consumption Pattern of Chicken							
15-19	0	1	1	5	24	31	21.01** df=12 p=0.05
	0.0%	0.2%	0.2%	1.2%	6.0%	7.8%	
20-29	4	4	17	48	138	211	
	1.0%	1.0%	4.2%	12.0%	34.5%	52.8%	
30-39	1	9	12	25	64	111	
	0.2%	2.2%	3.0%	6.2%	16.0%	27.8%	
40-49	1	7	4	7	28	47	
	0.2%	1.8%	1.0%	1.8%	7.0%	11.8%	
Total	6	21	34	85	254	400	
	1.5%	5.2%	8.5%	21.2%	63.5%	100.0%	
Consumption Pattern of Fish							
15-19	0	0	2	4	25	31	25.24*** df=12 p=0.01
	0.0%	0.0%	0.5%	1.0%	6.2%	7.8%	
20-29	5	0	6	34	166	211	
	1.2%	0.0%	1.5%	8.5%	41.5%	52.8%	
30-39	1	8	8	13	81	111	
	0.2%	2.0%	2.0%	3.2%	20.2%	27.8%	
40-49	2	1	2	8	34	47	
	0.5%	0.2%	0.5%	2.0%	8.5%	11.8%	
Total	8	9	18	59	306	400	
	2.0%	2.2%	4.5%	14.8%	76.5%	100.0%	

Consumption Pattern of Legumes							
15-19	13	4	2	8	4	31	31.27*** df=12 p=0.001
	3.2%	1.0%	0.5%	2.0%	1.0%	7.8%	
20-29	50	54	33	39	35	211	
	12.5%	13.5%	8.2%	9.8%	8.8%	52.8%	
30-39	12	18	26	31	24	111	
	3.0%	4.5%	6.5%	7.8%	6.0%	27.8%	

40-49	5	8	11	12	11	47	
	1.2%	2.0%	2.8%	3.0%	2.8%	11.8%	
Total	80	84	72	90	74	400	
	20.0%	21.0%	18.0%	22.5%	18.5%	100.0%	
Consumption Pattern of Green Leafy Vegetables							
15-19	18	8	3	2	0	31	14.11 df=12 p=0.294
	4.5%	2.0%	0.8%	0.5%	0.0%	7.8%	
20-29	103	61	32	13	2	211	
	25.8%	15.2%	8.0%	3.2%	0.5%	52.8%	
30-39	73	19	11	6	2	111	
	18.2%	4.8%	2.8%	1.5%	0.5%	27.8%	
40-49	28	8	6	5	0	47	
	7.0%	2.0%	1.5%	1.2%	0.0%	11.8%	
Total	222	96	52	26	4	400	
	55.5%	24.0%	13.0%	6.5%	1.0%	100.0%	
Consumption Pattern of Citrus Fruits/Juices							
15-19	2	5	8	12	4	31	17.65 df=12 p=0.127
	0.5%	1.2%	2.0%	3.0%	1.0%	7.8%	
20-29	46	32	48	60	25	211	
	11.5%	8.0%	12.0%	15.0%	6.2%	52.8%	
30-39	23	20	17	31	20	111	
	5.8%	5.0%	4.2%	7.8%	5.0%	27.8%	
40-49	3	5	13	15	11	47	
	0.8%	1.2%	3.2%	3.8%	2.8%	11.8%	
Total	74	62	86	118	60	400	
	18.5%	15.5%	21.5%	29.5%	15.0%	100.0%	
Consumption Pattern of Whole Grains							
15-19	15	10	3	1	2	31	19.82 df=12 p=0.07
	3.8%	2.5%	0.8%	0.2%	0.5%	7.8%	
20-29	100	62	27	16	6	211	
	25.0%	15.5%	6.8%	4.0%	1.5%	52.8%	
30-39	70	26	4	7	4	111	
	17.5%	6.5%	1.0%	1.8%	1.0%	27.8%	
40-49	32	12	2	1	0	47	
	8.0%	3.0%	0.5%	0.2%	0.0%	11.8%	
Total	217	110	36	25	12	400	
	54.2%	27.5%	9.0%	6.2%	3.0%	100.0%	
Consumption Pattern of Soup							
15-19	0	0	0	9	22	31	17.82 df=12 p=0.121
	0.0%	0.0%	0.0%	2.2%	5.5%	7.8%	
20-29	5	6	6	33	161	211	
	1.2%	1.5%	1.5%	8.2%	40.2%	52.8%	
30-39	2	7	7	16	79	111	
	0.5%	1.8%	1.8%	4.0%	19.8%	27.8%	
40-49	1	0	5	7	34	47	
	0.2%	0.0%	1.2%	1.8%	8.5%	11.8%	
Total	8	13	18	65	296	400	
	2.0%	3.2%	4.5%	16.2%	74.0%	100.0%	

Table No. 4.11.1.2 Chi-square test for the association of Religion and Food Consumption Pattern

Religion	Consumption Pattern of Red Meat					Total	Chi-square significance
	Daily	4-6 times/ week	1-3 times/ week	1-2 times/ week	Never		
Hindu	5	9	16	37	276	343	109.15*** df=8 p=0.000
	1.2%	2.2%	4.0%	9.2%	69.0%	85.8%	
Muslim	1	4	4	23	4	36	
	0.2%	1.0%	1.0%	5.8%	1.0%	9.0%	
Others	1	3	5	4	8	21	
	0.2%	0.8%	1.2%	1.0%	2.0%	5.2%	
Total	7	16	25	64	288	400	
	1.8%	4.0%	6.2%	16.0%	72.0%	100.0%	
Consumption Pattern of Chicken							
Hindu	5	12	25	59	242	343	74.78*** df=8 p=0.000
	1.2%	3.0%	6.2%	14.8%	60.5%	85.8%	
Muslim	1	4	4	22	5	36	
	0.2%	1.0%	1.0%	5.5%	1.2%	9.0%	
Others	0	5	5	4	7	21	
	0.0%	1.2%	1.2%	1.0%	1.8%	5.2%	
Total	6	21	34	85	254	400	
	5	12	25	59	242	343	
Consumption Pattern of Fish							
Hindu	7	7	12	43	274	343	23.88*** df=8 p=0.002
	1.8%	1.8%	3.0%	10.8%	68.5%	85.8%	
Muslim	1	1	2	10	22	36	
	0.2%	0.2%	0.5%	2.5%	5.5%	9.0%	
Others	0	1	4	6	10	21	
	0.0%	0.2%	1.0%	1.5%	2.5%	5.2%	
Total	8	9	18	59	306	400	
	2.0%	2.2%	4.5%	14.8%	76.5%	100.0%	
Consumption Pattern of Legumes							
Hindu	75	63	64	75	66	343	15.88** df=8 p=0.044
	18.8%	15.8%	16.0%	18.8%	16.5%	85.8%	
Muslim	4	14	4	8	6	36	
	1.0%	3.5%	1.0%	2.0%	1.5%	9.0%	
Others	1	7	4	7	2	21	
	0.2%	1.8%	1.0%	1.8%	0.5%	5.2%	
Total	80	84	72	90	74	400	
	20.0%	21.0%	18.0%	22.5%	18.5%	100.0%	
Consumption Pattern of Green Leafy Vegetables							
Hindu	195	77	41	26	4	343	16.15** df=8 p=0.040
	48.8%	19.2%	10.2%	6.5%	1.0%	85.8%	
Muslim	13	14	9	0	0	36	
	3.2%	3.5%	2.2%	0.0%	0.0%	9.0%	

Others	14	5	2	0	0	21	
	3.5%	1.2%	0.5%	0.0%	0.0%	5.2%	
Total	222	96	52	26	4	400	
	55.5%	24.0%	13.0%	6.5%	1.0%	100.0%	
Consumption Pattern of Citrus Fruits/Juices							
Hindu	67	51	80	98	47	343	15.69** df=8 p=0.047
	16.8%	12.8%	20.0%	24.5%	11.8%	85.8%	
Muslim	2	7	3	13	11	36	
	0.5%	1.8%	0.8%	3.2%	2.8%	9.0%	
Others	5	4	3	7	2	21	
	1.2%	1.0%	0.8%	1.8%	0.5%	5.2%	
Total	74	62	86	118	60	400	
	18.5%	15.5%	21.5%	29.5%	15.0%	100.0%	
Consumption Pattern of Whole Grains							
Hindu	186	99	29	18	11	343	20.00** df=8 p=0.010
	46.5%	24.8%	7.2%	4.5%	2.8%	85.8%	
Muslim	15	7	6	7	1	36	
	3.8%	1.8%	1.5%	1.8%	0.2%	9.0%	
Others	16	4	1	0	0	21	
	4.0%	1.0%	0.2%	0.0%	0.0%	5.2%	
Total	217	110	36	25	12	400	
	54.2%	27.5%	9.0%	6.2%	3.0%	100.0%	
Consumption Pattern of Soup							
Hindu	8	11	15	57	252	343	18.31** df=8 p=0.019
	2.0%	2.8%	3.8%	14.2%	63.0%	85.8%	
Muslim	0	0	1	1	34	36	
	0.0%	0.0%	0.2%	0.2%	8.5%	9.0%	
Others	0	2	2	7	10	21	
	0.0%	0.5%	0.5%	1.8%	2.5%	5.2%	
Total	8	13	18	65	296	400	
	2.0%	3.2%	4.5%	16.2%	74.0%	100.0%	

4.11.2 Association of Residence Area and Type of Family with Food Consumption Pattern

H_0: There exists a non-significant relationship between Residence Area and Type of Family with Food Consumption Pattern.

On evaluating the association between residence area and food consumption pattern, a very high significant relationship was observed with the consumption pattern of red meat, chicken, fish, legumes, green leafy vegetables, citrus fruits, whole grains and soup having the p values =0.000 respectively as summarized in table no. 4.11.2.1. Family type showed non-significant association with consumption pattern of fish p=0.09 and red meat p=0.121, rest all the other food groups were having a highly significant values. Our null hypothesis cannot be fully rejected with the above-

mentioned exceptions as few variables of type of family showing non-significant values.

Table No. 4.11.2.1 Chi-square test for the association of Residence Areas and Food Consumption Pattern

Residence Area	Consumption Pattern of Red Meat					Total	Chi-square significance
	Daily	4-6 times/ week	1-3 times/ week	1-2 times/ Week	Never		
Urban	7	15	21	34	123	200	37.18*** df=4 p=0.000
	1.8%	3.8%	5.2%	8.5%	30.8%	50.0%	
Rural	0	1	4	30	165	200	
	0.0%	0.2%	1.0%	7.5%	41.2%	50.0%	
Total	7	16	25	64	288	400	
	1.8%	4.0%	6.2%	16.0%	72.0%	100.0%	
Consumption Pattern of Chicken							
Urban	6	21	28	36	109	200	48.32*** df=4 p=0.000
	1.5%	5.2%	7.0%	9.0%	27.2%	50.0%	
Rural	0	0	6	49	145	200	
	0.0%	0.0%	1.5%	12.2%	36.2%	50.0%	
Total	6	21	34	85	254	400	
	1.5%	5.2%	8.5%	21.2%	63.5%	100.0%	
Consumption Pattern of Fish							
Urban	7	9	17	30	137	200	31.08*** df=4 p=0.000
	1.8%	2.2%	4.2%	7.5%	34.2%	50.0%	
Rural	1	0	1	29	169	200	
	0.2%	0.0%	0.2%	7.2%	42.2%	50.0%	
Total	8	9	18	59	306	400	
	2.0%	2.2%	4.5%	14.8%	76.5%	100.0%	
Consumption Pattern of Legumes							
Urban	15	28	58	56	43	200	74.79*** df=4 p=0.000
	3.8%	7.0%	14.5%	14.0%	10.8%	50.0%	
Rural	65	56	14	34	31	200	
	16.2%	14.0%	3.5%	8.5%	7.8%	50.0%	
Total	80	84	72	90	74	400	
	20.0%	21.0%	18.0%	22.5%	18.5%	100.0%	
Consumption Pattern of Green Leafy Vegetables							
Urban	147	33	14	3	3	200	60.18*** df=4 p=0.000
	36.8%	8.2%	3.5%	0.8%	0.8%	50.0%	
Rural	75	63	38	23	1	200	
	18.8%	15.8%	9.5%	5.8%	0.2%	50.0%	
Total	222	96	52	26	4	400	
	55.5%	24.0%	13.0%	6.5%	1.0%	100.0%	
Consumption Pattern of Citrus Fruits/Juices							
Urban	57	27	37	42	37	200	
	14.2%	6.8%	9.2%	10.5%	9.2%	50.0%	37.39***

Rural	17	35	49	76	23	200	df=4
	4.2%	8.8%	12.2%	19.0%	5.8%	50.0%	p=0.000
Total	74	62	86	118	60	400	
	18.5%	15.5%	21.5%	29.5%	15.0%	100.0%	
Consumption Pattern of Whole Grains							
Urban	144	42	2	3	9	200	
	36.0%	10.5%	0.5%	0.8%	2.2%	50.0%	75.26***
Rural	73	68	34	22	3	200	df=4
	18.2%	17.0%	8.5%	5.5%	0.8%	50.0%	p=0.000
Total	217	110	36	25	12	400	
	54.2%	27.5%	9.0%	6.2%	3.0%	100.0%	
Consumption Pattern of Soup							
Urban	8	13	17	43	119	200	
	2.0%	3.2%	4.2%	10.8%	29.8%	50.0%	53.37***
Rural	0	0	1	22	177	200	df=4
	0.0%	0.0%	0.2%	5.5%	44.2%	50.0%	p=0.000
Total	8	13	18	65	296	400	
	2.0%	3.2%	4.5%	16.2%	74.0%	100.0%	

Table No. 4.11.2.2 Chi-square test for the association of Type of Family and Food Consumption Pattern

Family Type	Consumption Pattern of Red Meat					Total	Chi-square significance
	Daily	4-6 times/ week	1-3 times/ week	1-2 times/ week	Never		
Nuclear	3	12	15	28	131	189	7.302 df=4 p=0.121
	0.8%	3.0%	3.8%	7.0%	32.8%	47.2%	
Joint	4	4	10	36	157	211	
	1.0%	1.0%	2.5%	9.0%	39.2%	52.8%	
Total	7	16	25	64	288	400	
	3	12	15	28	131	189	
Consumption Pattern of Chicken							
Nuclear	3	17	21	36	112	189	14.29*** df=4 p=0.006
	0.8%	4.2%	5.2%	9.0%	28.0%	47.2%	
Joint	3	4	13	49	142	211	
	0.8%	1.0%	3.2%	12.2%	35.5%	52.8%	
Total	6	21	34	85	254	400	
	1.5%	5.2%	8.5%	21.2%	63.5%	100.0%	
Consumption Pattern of Fish							
Nuclear	4	8	10	30	137	189	7.844 df=4 p=0.097
	1.0%	2.0%	2.5%	7.5%	34.2%	47.2%	
Joint	4	1	8	29	169	211	
	1.0%	0.2%	2.0%	7.2%	42.2%	52.8%	
Total	8	9	18	59	306	400	
	1.8%	4.0%	6.2%	16.0%	72.0%	100.0%	
Consumption Pattern of Legumes							
Nuclear	21	29	50	54	35	189	39.71*** df=4 p=0.000
	5.2%	7.2%	12.5%	13.5%	8.8%	47.2%	
Joint	59	55	22	36	39	211	
	14.8%	13.8%	5.5%	9.0%	9.8%	52.8%	
Total	80	84	72	90	74	400	
	20.0%	21.0%	18.0%	22.5%	18.5%	100.0%	
Consumption Pattern of Green Leafy Vegetables							
Nuclear	130	31	18	9	1	189	25.79*** df=4 p=0.000
	32.5%	7.8%	4.5%	2.2%	0.2%	47.2%	
Joint	92	65	34	17	3	211	
	23.0%	16.2%	8.5%	4.2%	0.8%	52.8%	
Total	222	96	52	26	4	400	
	55.5%	24.0%	13.0%	6.5%	1.0%	100.0%	
Consumption Pattern of Citrus Fruits/Juices							
Nuclear	45	23	33	50	38	189	18.09*** df=4 p=0.001
	11.2%	5.8%	8.2%	12.5%	9.5%	47.2%	
Joint	29	39	53	68	22	211	
	7.2%	9.8%	13.2%	17.0%	5.5%	52.8%	
Total	74	62	86	118	60	400	

	18.5%	15.5%	21.5%	29.5%	15.0 %	100.0%	
Consumption Pattern of Whole Grains							
Nuclear	124	52	2	4	7	189	44.01*** df=4 p=0.000
	31.0%	13.0%	0.5%	1.0%	1.8%	47.2%	
Joint	93	58	34	21	5	211	
	23.2%	14.5%	8.5%	5.2%	1.2%	52.8%	
Total	217	110	36	25	12	400	
	54.2%	27.5%	9.0%	6.2%	3.0%	100.0%	
Consumption Pattern of Soup							
Nuclear	3	8	14	39	125	189	15.33*** df=4 p=0.004
	0.8%	2.0%	3.5%	9.8%	31.2 %	47.2%	
Joint	5	5	4	26	171	211	
	1.2%	1.2%	1.0%	6.5%	42.8 %	52.8%	
Total	8	13	18	65	296	400	
	2.0%	3.2%	4.5%	16.2%	74.0 %	100.0%	

4.12 Socio-Economic factors associated with Food Consumption Pattern

4.12.1 Association of Literacy Status and Food Consumption Pattern among respondents

H_0: There exists no significant relationship between Literacy Status and Food Consumption Pattern.

On evaluating the association between literacy status and food consumption pattern, a significant relationship was observed between literacy statuses with chicken and fish consumption pattern.

More than half of the respondents belonging to graduate and above group consumed green leafy vegetables on a daily basis. Consumption of legumes and green leafy vegetables had a significant association with literacy status at $p<0.10$ level of significance (χ^2 = 89.953, df=16 and χ^2 = 88.468, df=16) respectively. Moreover, consumption of whole grains, citrus fruits/juices and soup was found to be higher in graduate and above group in daily basis and for 4 – 6 times per week.

A study reported that sometimes more educated persons over report their food intake in order to maintain their social status ***(Roos 2001; Irala-Estevez 2000).*** Compared to women with lowest level of education (primary school), women who had completed middle and high school consumed more energy (78 and 40 Kcal respectively), in a study conducted on food consumption pattern in Vietnamese women ***(Nguyen et al.***

2013). Our null hypothesis cannot be fully rejected with exception for red meat only, whilst all other foods had a significant association with literacy status as shown in table no. 4.12.1.

Table No. 4.12.1 Chi-square test for the association of Literacy status and Food Consumption Pattern

Literacy status	Consumption Pattern of Red Meat					Total	Chi-square significance
	Daily	4-6 times/ week	1-3 times/ week	1-2 times/ week	Never		
Illiterate	2	1	2	10	48	63	25.463 NS (p=0.062) df=16
	28.6%	6.2%	8.0%	15.6%	16.7%	15.8%	
Primary	0	1	2	13	47	63	
	0.0%	6.2%	8.0%	20.3%	16.3%	15.8%	
Secondary	0	0	4	3	41	48	
	0.0%	0.0%	16.0%	4.7%	14.2%	12.0%	
Higher secondary	0	5	2	7	44	58	
	0.0%	31.2%	8.0%	10.9%	15.3%	14.5%	
Graduate & Above	5	9	15	31	108	168	
	71.4%	56.2%	60.0%	48.4%	37.5%	42.0%	
Total	7	16	25	64	288	400	
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Chicken							
Illiterate	2	0	4	16	41	63	35.480*** df=16
	33.3%	0.0%	11.8%	18.8%	16.1%	15.8%	
Primary	0	1	3	22	37	63	
	0.0%	4.8%	8.8%	25.9%	14.6%	15.8%	
Secondary	0	1	3	5	39	48	
	0.0%	4.8%	8.8%	5.9%	15.4%	12.0%	
Higher secondary	0	3	3	11	41	58	
	0.0%	14.3%	8.8%	12.9%	16.1%	14.5%	
Graduate & Above	4	16	21	31	96	168	
	66.7%	76.2%	61.8%	36.5%	37.8%	42.0%	
Total	6	21	34	85	254	400	
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Fish							
Illiterate	2	0	2	4	55	63	32.493**
	25.0%	0.0%	11.1%	6.8%	18.0%	15.8%	
Primary	0	0	1	15	47	63	
	0.0%	0.0%	5.6%	25.4%	15.4%	15.8%	
Secondar	0	0	2	3	43	48	

y	0.0%	0.0%	11.1%	5.1%	14.1%	12.0%	*
Higher secondary	0	1	1	10	46	58	df=16
	0.0%	11.1%	5.6%	16.9%	15.0%	14.5%	
Graduate & Above	6	8	12	27	115	168	
	75.0%	88.9%	66.7%	45.8%	37.6%	42.0%	
Total	8	9	18	59	306	400	
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0 %	
Consumption Pattern of Legumes							
Illiterate	15	22	3	10	13	63	
	18.8%	26.2%	4.2%	11.1%	17.6%	15.8%	
Primary	19	25	4	4	11	63	89.953***
	23.8%	29.8%	5.6%	4.4%	14.9%	15.8%	df=16
Secondary	15	5	7	6	15	48	
	18.8%	6.0%	9.7%	6.7%	20.3%	12.0%	
Higher secondary	11	4	8	23	12	58	
	13.8%	4.8%	11.1%	25.6%	16.2%	14.5%	
Graduate & Above	20	28	50	47	23	168	
	25.0%	33.3%	69.4%	52.2%	31.1%	42.0%	
Total	80	84	72	90	74	400	
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Green Leafy Vegetables							
Illiterate	14	19	19	10	1	63	
	6.3%	19.8%	36.5%	38.5%	25.0%	15.8%	88.468***
Primary	20	25	13	5	0	63	df=16
	9.0%	26.0%	25.0%	19.2%	0.0%	15.8%	
Secondary	25	14	6	3	0	48	
	11.3%	14.6%	11.5%	11.5%	0.0%	12.0%	
Higher secondary	36	12	4	4	2	58	
	16.2%	12.5%	7.7%	15.4%	50.0%	14.5%	
Graduate & Above	127	26	10	4	1	168	
	57.2%	27.1%	19.2%	15.4%	25.0%	42.0%	
Total	222	96	52	26	4	400	
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Citrus Fruits/Juices							
Illiterate	6	5	16	22	14	63	
	8.1%	8.1%	18.6%	18.6%	23.3%	15.8%	48.503***
Primary	3	11	13	25	11	63	df=16
	4.1%	17.7%	15.1%	21.2%	18.3%	15.8%	
Secondary	10	15	8	9	6	48	
	13.5%	24.2%	9.3%	7.6%	10.0%	12.0%	
Higher secondar	10	3	12	18	15	58	
	13.5%	4.8%	14.0%	15.3%	25.0%	14.5%	

y							
Graduate &Above	45	28	37	44	14	168	
	60.8%	45.2%	43.0%	37.3%	23.3%	42.0%	
Total	74	62	86	118	60	400	
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Whole Grains							
Illiterate	19	13	19	10	2	63	152.281*** df=16
	8.8%	11.8%	52.8%	40.0%	16.7%	15.8%	
Primary	10	31	13	8	1	63	
	4.6%	28.2%	36.1%	32.0%	8.3%	15.8%	
Secondary	21	24	2	1	0	48	
	9.7%	21.8%	5.6%	4.0%	0.0%	12.0%	
Higher secondary	40	11	0	3	4	58	
	18.4%	10.0%	0.0%	12.0%	33.3%	14.5%	
Graduate & Above	127	31	2	3	5	168	
	58.5%	28.2%	5.6%	12.0%	41.7%	42.0%	
Total	217	110	36	25	12	400	
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Soup							
Illiterate	0	0	0	1	62	63	77.931*** df=16
	0.0%	0.0%	0.0%	1.5%	20.9%	15.8%	
Primary	0	0	0	4	59	63	
	0.0%	0.0%	0.0%	6.2%	19.9%	15.8%	
Secondary	0	0	0	13	35	48	
	0.0%	0.0%	0.0%	20.0%	11.8%	12.0%	
Higher secondary	3	1	1	8	45	58	
	37.5%	7.7%	5.6%	12.3%	15.2%	14.5%	
Graduate & Above	5	12	17	39	95	168	
	62.5%	92.3%	94.4%	60.0%	32.1%	42.0%	
Total	8	13	18	65	296	400	
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

4.12.2 Association of Family Income (monthly) and Food Consumption Pattern among respondents

H_0: There exists no significant relationship between Family Income and Food Consumption Pattern.

On evaluating the association between family income (monthly) and food consumption pattern, the table shows significant relationship among the two family income groups (including less than 5000 and 5000-8000) with chicken and meat consumption pattern having the chi-square values as χ^2 = 21.288, df=8 and χ^2 = 31.759, df=8 respectively. Both the study groups did not consume chicken and meat on daily basis. The consumption of fish on daily basis was very low (12.50%).

Even animal products (red meat, chicken, fish), legumes and whole grains consumption including soup increased in higher monthly income group (more than 8000) whereas it was minimal in lower income group (less than 5000 and 5000-8000) on a daily basis.

The shift to non-vegetarian foods and legumes increases with higher income groups. This clearly shows that the people with less monthly income group suffers in getting a quality of food as dietary diversity tend to increase with higher income classes.
Similar to this analysis, another study reported increase in consumption of pulses, milk, fruits and vegetables with higher income classes which are believed to decrease with income in diet ***(Gupta and Mishra 2014).***

Similar to the above report in reference to purchasing power, another study reported that not all but most of rural areas have less access to diversified food including both quality and quantity from either due to availability, seasonality, nature of food production and poor transportation from surplus areas or low purchasing power ***(Magboul and Mohamed 2003).***

Consumption pattern of every food article was highly significant with monthly income group. Difference in consumption of green leafy vegetables are quite low across all income groups. Our null hypothesis stated a non significant association of family income and food consumption pattern, but our results revealed a statistical significance thus rejecting the null hypothesis.

Table No. 4.12.2 Chi-square test for the association of Family Income (monthly) and Food Consumption Pattern

Family Income (monthly)	Consumption Pattern of Red Meat					Total	Chi-square significance
	Daily	4-6 times/ week	1-3 times/ week	1-2 times/ week	Never		
Less than 5000	0	2	2	11	65	80	21.288*** df=8
	0.0%	12.5%	8.0%	17.2%	22.6%	20.0 %	
5000-8000	0	6	4	20	104	134	
	0.0%	37.5%	16.0%	31.2%	36.1%	33.5 %	
More than 8000	7	8	19	33	119	186	
	100.0 %	50.0%	76.0%	51.6%	41.3%	46.5 %	
Total	7	16	25	64	288	400	
	100.0 %	100.0%	100.0 %	100.0 %	100.0 %	100.0 %	
Consumption Pattern of Chicken							
Less than 5000	0	0	3	20	57	80	31.759*** df=8
	0.0%	0.0%	8.8%	23.5%	22.4%	20.0 %	
5000-8000	0	2	10	28	94	134	
	0.0%	9.5%	29.4%	32.9%	37.0%	33.5 %	
More than 8000	6	19	21	37	103	186	
	100.0 %	90.5%	61.8%	43.5%	40.6%	46.5 %	
Total	6	21	34	85	254	400	
	100.0 %	100.0%	100.0 %	100.0 %	100.0 %	100.0 %	
Consumption Pattern of Fish							
Less than 5000	1	0	1	7	71	80	19.860** df=8
	12.5 %	0.0%	5.6%	11.9%	23.2%	20.0 %	
5000-8000	1	5	3	18	107	134	
	12.5 %	55.6%	16.7%	30.5%	35.0%	33.5 %	
More than 8000	6	4	14	34	128	186	
	75.0 %	44.4%	77.8%	57.6%	41.8%	46.5 %	
Total	8	9	18	59	306	400	
	100.0 %	100.0%	100.0 %	100.0 %	100.0 %	100.0 %	

Consumption Pattern of Legumes							
Less than 5000	12	28	5	17	18	80	32.467*** df=8
	15.0 %	33.3%	6.9%	18.9%	24.3%	20.0 %	
5000-8000	21	28	20	37	28	134	
	26.2 %	33.3%	27.8%	41.1%	37.8%	33.5 %	
More than 8000	47	28	47	36	28	186	
	58.8 %	33.3%	65.3%	40.0%	37.8%	46.5 %	
Total	80	84	72	90	74	400	
	100.0 %	100.0%	100.0 %	100.0 %	100.0 %	100.0 %	
Consumption Pattern of Green Leafy Vegetables							
Less than 5000	23	19	17	20	1	80	86.704*** df=8
	10.4 %	19.8%	32.7%	76.9%	25.0%	20.0 %	
5000-8000	70	33	25	4	2	134	
	31.5 %	34.4%	48.1%	15.4%	50.0%	33.5 %	
More than 8000	129	44	10	2	1	186	
	58.1 %	45.8%	19.2%	7.7%	25.0%	46.5 %	
Total	222	96	52	26	4	400	
	100.0 %	100.0%	100.0 %	100.0 %	100.0 %	100.0 %	
Consumption Pattern of Citrus Fruits							
Less than 5000	5	1	8	37	29	80	100.450*** df=8
	6.8%	1.6%	9.3%	31.4%	48.3%	20.0 %	
5000-8000	18	13	39	42	22	134	
	24.3 %	21.0%	45.3%	35.6%	36.7%	33.5 %	
More than 8000	51	48	39	39	9	186	
	68.9 %	77.4%	45.3%	33.1%	15.0%	46.5 %	
Total	74	62	86	118	60	400	
	100.0 %	100.0%	100.0 %	100.0 %	100.0 %	100.0 %	
Consumption Pattern of Whole Grains							
Less than 5000	32	29	11	5	3	80	23.066*** df=8
	14.7 %	26.4%	30.6%	20.0%	25.0%	20.0 %	
5000-8000	78	25	17	12	2	134	
	35.9 %	22.7%	47.2%	48.0%	16.7%	33.5 %	
More	107	56	8	8	7	186	

than 8000	49.3 %	50.9%	22.2%	32.0%	58.3%	46.5 %	
Total	217	110	36	25	12	400	
	100.0 %	100.0%	100.0 %	100.0 %	100.0 %	100.0 %	
Consumption Pattern of Soups							
Less than 5000	2	0	0	1	77	80	55.235*** df=8
	25.0 %	0.0%	0.0%	1.5%	26.0%	20.0 %	
5000-8000	1	5	3	14	111	134	
	12.5 %	38.5%	16.7%	21.5%	37.5%	33.5 %	
More than 8000	5	8	15	50	108	186	
	62.5 %	61.5%	83.3%	76.9%	36.5%	46.5 %	
Total	8	13	18	65	296	400	
	100.0 %	100.0%	100.0 %	100.0 %	100.0 %	100.0 %	

4.12.3 Association of Socio-economic Strata and Food Consumption Pattern among respondents

H_0: There exists no significant relationship between Socio-economic Strata and Food Consumption Pattern.

The table shows significant variations in food consumption pattern across different socio-economic class. On evaluating the association between socio-economic strata and food consumption pattern, a significant relationship was observed among the different class groups with chicken and legumes consumption pattern having the chi-square values as $\chi^2 = 81.759$ and $\chi^2 = 80.530$ significant at $p<0.01$ level respectively as summarized in table 4.12.3. A study reported that rich people tend to enjoy consumption of all food items including cereals, which are believed to decline with income in diet. The same study shows that bottom MPCE (monthly per capita expenditure) classes are worst sufferers in getting a quality of food as dietary diversity tend to increase with high income classes ***(Gupta and Mishra 2014).***

About 41% of the respondents belonging to (class 2) consumed vegetables on a daily basis. Hence, consumption of green leafy vegetables was significantly associated with socio economic strata. Furthermore, consumption of whole grains was also significantly associated with socio-economic strata. Consumption of legumes was minimal in most of the socio-economic strata (class 1, 4 and 5). In many studies it was

found that there was increase in knowledge and awareness about health and healthy foods with higher income and socio-economic status ***(Deshmukh-Taskar et al. 2007; Prattala et al. 2003; Sanchez-Villegas A et al. 2003; Giskes et al. 2002; Bhandari and Smith 2000; Roos 1998; Yang 1998).*** Other studies ***(Roos et al. 1998; Dittus et al. 1995; Hupkens et al. 2000),*** reported that less purchasing power with unemployment becomes a barrier in the purchase of fruits and vegetables consumption as they spend less money on food. Our null hypothesis stated a non significant association of socio-economic strata and food consumption pattern, but our results revealed a statistical significance thus rejecting the null hypothesis and accepting the alternate as shown in table 4.12.3.

Table No. 4.12.3 Chi-square test for the association of Socio-economic Strata and Food Consumption Pattern

Socio-economic status	Consumption Pattern of Red Meat					Total	Chi-square significance
	Daily	4-6 times/ week	1-3 times/ week	1-2 times/ week	Never		
class 1	3	7	7	7	22	46	47.521*** df=16
	42.9%	43.8%	28.0%	10.9%	7.6%	11.5%	
class 2	4	2	7	22	88	123	
	57.1%	12.5%	28.0%	34.4%	30.6%	30.8%	
class 3	0	3	6	18	91	118	
	0.0%	18.8%	24.0%	28.1%	31.6%	29.5%	
class 4	0	4	4	16	57	81	
	0.0%	25.0%	16.0%	25.0%	19.8%	20.2%	
class 5	0	0	1	1	30	32	
	0.0%	0.0%	4.0%	1.6%	10.4%	8.0%	
Total	7	16	25	64	288	400	
	100.0 %	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Chicken							
class 1	2	14	4	6	20	46	81.759*** df=16
	33.3%	66.7%	11.8%	7.1%	7.9%	11.5%	
class 2	4	4	13	22	80	123	
	66.7%	19.0%	38.2%	25.9%	31.5%	30.8%	
class 3	0	3	10	30	75	118	
	0.0%	14.3%	29.4%	35.3%	29.5%	29.5%	
class 4	0	0	5	21	55	81	
	0.0%	0.0%	14.7%	24.7%	21.7%	20.2%	
class 5	0	0	2	6	24	32	
	0.0%	0.0%	5.9%	7.1%	9.4%	8.0%	
Total	6	21	34	85	254	400	

	100.0 %	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Fish							
class 1	class 1	3	3	7	7	26	36.516*** df=16
		37.5%	33.3%	38.9%	11.9%	8.5%	
class 2	class 2	3	2	4	23	91	
		37.5%	22.2%	22.2%	39.0%	29.7%	
class 3	class 3	1	4	4	16	93	
		12.5%	44.4%	22.2%	27.1%	30.4%	
class 4	class 4	1	0	3	12	65	
		12.5%	0.0%	16.7%	20.3%	21.2%	
class 5	class 5	0	0	0	1	31	
		0.0%	0.0%	0.0%	1.7%	10.1%	
Total	**Total**	8	9	18	59	306	
		100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Legumes							
class 1	5	8	21	9	3	46	80.530*** df=16
	6.2%	9.5%	29.2%	10.0%	4.1%	11.5%	
class 2	35	12	27	27	22	123	
	43.8%	14.3%	37.5%	30.0%	29.7%	30.8%	
class 3	21	21	16	38	22	118	
	26.2%	25.0%	22.2%	42.2%	29.7%	29.5%	
class 4	11	28	6	14	22	81	
	13.8%	33.3%	8.3%	15.6%	29.7%	20.2%	
class 5	8	15	2	2	5	32	
	10.0%	17.9%	2.8%	2.2%	6.8%	8.0%	
Total	80	84	72	90	74	400	
	100.0 %	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Green Leafy Vegetables							
class 1	40	4	2	0	0	46	107.747*** df=16
	18.0%	4.2%	3.8%	0.0%	0.0%	11.5%	
class 2	91	24	5	2	1	123	
	41.0%	25.0%	9.6%	7.7%	25.0%	30.8%	
class 3	58	39	16	4	1	118	
	26.1%	40.6%	30.8%	15.4%	25.0%	29.5%	
class 4	28	19	21	11	2	81	
	12.6%	19.8%	40.4%	42.3%	50.0%	20.2%	
class 5	5	10	8	9	0	32	
	2.3%	10.4%	15.4%	34.6%	0.0%	8.0%	
Total	222	96	52	26	4	400	
	100.0 %	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Citrus Fruits/Juices							
class 1	16	7	8	11	4	46	
	21.6%	11.3%	9.3%	9.3%	6.7%	11.5%	
class 2	27	30	32	27	7	123	
	36.5%	48.4%	37.2%	22.9%	11.7%	30.8%	

class 3	19	16	30	36	17	118	61.034*** df=16
	25.7%	25.8%	34.9%	30.5%	28.3%	29.5%	
class 4	11	9	9	31	21	81	
	14.9%	14.5%	10.5%	26.3%	35.0%	20.2%	
class 5	1	0	7	13	11	32	
	1.4%	0.0%	8.1%	11.0%	18.3%	8.0%	
Total	74	62	86	118	60	400	
	100.0 %	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Whole Grains							
class 1	43	3	0	0	0	46	90.571*** df=16
	19.8%	2.7%	0.0%	0.0%	0.0%	11.5%	
class 2	70	38	4	4	7	123	
	32.3%	34.5%	11.1%	16.0%	58.3%	30.8%	
class 3	66	29	15	6	2	118	
	30.4%	26.4%	41.7%	24.0%	16.7%	29.5%	
class 4	31	26	7	14	3	81	
	14.3%	23.6%	19.4%	56.0%	25.0%	20.2%	
class 5	7	14	10	1	0	32	
	3.2%	12.7%	27.8%	4.0%	0.0%	8.0%	
Total	217	110	36	25	12	400	
	100.0 %	100.0%	100.0%	100.0%	100.0%	100.0%	
Consumption Pattern of Soup							
class 1	1	6	7	15	17	46	84.731*** df=16
	12.5%	46.2%	38.9%	23.1%	5.7%	11.5%	
class 2	2	3	10	30	78	123	
	25.0%	23.1%	55.6%	46.2%	26.4%	30.8%	
class 3	3	4	1	16	94	118	
	37.5%	30.8%	5.6%	24.6%	31.8%	29.5%	
class 4	2	0	0	4	75	81	
	25.0%	0.0%	0.0%	6.2%	25.3%	20.2%	
class 5	0	0	0	0	32	32	
	0.0%	0.0%	0.0%	0.0%	10.8%	8.0%	
Total	8	13	18	65	296	400	
	100.0 %	100.0%	100.0%	100.0%	100.0%	100.0%	

4.13 Relative Risk Analysis of Dietary Habits with IDA Status

Table shows the dietary habit-based distribution of subjects. Females having lower odds of becoming anemic when compared to non-anemic ones. The logistic regression analysis shows that more number of anemic females was vegetarian and majority of females were taking usual diets during pregnancy. They were having their meals three times a day and ate in between meals whenever they felt hungry. A study by ***Kefiyalew and Eshetu (2018)*** reported that the majority of women (57.8%) consumed three meals per day. The study also found that the majority of the study

subjects, 71(57.8%), were used to have three meals a day, and about 18% ate only twice a day. Similar to our study, another study reported a vegetarian diet as one of the strongest predictors of anemia ***(Kaur et al., 2006).*** Anemia was more in vegetarians compared to non-vegetarians ***(Chaturvedi et al., 2017)*** that were in agreement with another study by ***Ganapathi and Kumar (2016).***

Those females who relied upon fried/spicy food have more risk of becoming anemic (RR= 1.261, CI-0.963, 1.651) and significant risk of becoming anemic among those who relied upon whatever being cooked (RR= 1.345, CI-1.044, 1.733; $p<0.05$) when compared to the one taking partially boiled food..

In a study by ***Kefiyalew and Eshetu (2018)***, 72.6% had a decrease in appetite, whereas 27.4% experienced an increase in their appetite. A similar study found determinants such as the number of cups of tea and coffee have taken per day on an average ($p=0.003$) were statistically negatively associated with maternal hemoglobin concentration in the women.

Table No. 4.13 Logistic regression analysis of Dietary habits among anemic and non-anemic respondents

Dietary Habits	Anemic	Non-Anemic	Relative Risk (CI) (p value)
Nature of Diet			
Vegetarian	69	143	1
Non-vegetarian	64	83	0.837 (0.710-0.986) (0.022)
Ovo-vegetarian	19	2	0.795 (0.610-1.036) (0.066)
No. of meals per day			
2 times a day	52	97	1
3 times a day	56	106	0.994 (0.845-1.170) (0.522)
4 times a day	25	17	0.618 (0.449-0.852) (0.003)
Not fixed	19	28	0.910 (0.709-1.169) (0.284)
Daily consumption of tea/coffee			
Once	58	76	1
2-3 times	48	114	1.240 (1.042-1.476) (0.010)
4-5 times	6	16	1.282 (0.907-1.811) (0.117)
At regular intervals	6	10	1.101 (0.733-1.656) (0.435)
Whenever feel like having it	34	32	0.854 (0.640-1.141) (0.171)
Munching between meals			
Once	34	8.50	1
Whenever feel hungry	272	68.00	1.005 (0.760-1.331) (0.553)
Never	94	23.50	0.490 (0.375-0.639) (0.000)
During the last 15 days fulfilling meal in a day when you didn't lack appetite			
Once	27	58	1
Twice	29	54	0.953 (0.769-1.181) (0.392)
Every meal a day	96	136	0.859 (0.709-1.040) (0.076)

Type of food mostly rely upon			
Partially boiled	29	28	1
Fried/spicy	62	101	1.261 (0.963-1.651) (0.062)
Whatever being cooked	61	119	1.345 (1.044-1.733) (0.016)
Food habit after conceiving			
Taking usual diet	50	106	1
Taking special diet	34	15	0.450 (0.321-0.631) (0.000)
Partly modified	24	28	0.792 (0.618-1.015) (0.048)
Nutritional Supplement			
No	79	132	1
Yes	73	116	1.019 (0.873-1.188) (0.444)

Phase IV Post Intervention Phase

On the basis of the scoring, tests of normality was performed to determine whether the data is normal or not. Below table shows the asymptotic significances at 0.05 significance level.

Table No. 4.14.1 Tests of Normality

	Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-Total	.236	80	.000	.765	80	.000
Post-Total	.206	80	.000	.790	80	.000

a. Lilliefors Significance Correction

The test result shows that the data is non-normal. Hence, for testing that whether there is any significant increase in the level of knowledge after intervention or not, we have to apply a non-parametric test.

The wilcoxon signed rank test was done to determine the level of knowledge after intervention. The Mean ± SD of pre-intervention 2.65 ± 3.13 which post intervention changed to Mean ± SD 5.87 ± 2.59. The Z value is -6.95 and found to be highly

significant as shown in table no. The results obtained shows that there is significant increase in the level of knowledge after intervention.

4.14.2 Test Statistics[a]

	Post-Total – Pre-Total
Z	-6.956[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

4.15 Mean ± SD of Pre and Post Intervention Variables

4.15.1 Mean ± SD of Knowledge during Pre and Post Intervention.

H_0: There is no significant association between Pre and Post Intervention evaluation of knowledge regarding anemia.

The null hypothesis stated that there is no significant association between Pre and Post Intervention evaluation of knowledge regarding anemia. The comparison of mean scores was done using Paired t test analysis revealed a statistically significant relationship among all categories except about knowledge about symptoms of anemia and about iron rich food. Thus, our null hypothesis cannot be fully rejected, as some scores were not significantly associated.

Table 4.15.1 depicts a significant difference after intervention in knowledge regarding anemia, where respondents becomes much aware after intervention except in knowledge about the symptoms of anemia and iron rich food sources. So, need of more awareness on these points.

A study reported only 39.87% of the participants were aware of the term anemia ***(Nivedita et al. 2016)***. Another study observed 52.5% of the subject had average knowledge regarding causes, symptoms, and treatment for anemia ***(Mamta and Devi 2014).*** No significant correlation was found between the knowledge levels of participants with their hemoglobin levels. However, a significant positive correlation (1% level) between attitude scores of subjects and hemoglobin levels was observed ***(Jose et al. 2016).*** Another study by ***Fredanna et al. (2012)*** reported a majority of

subjects knew about anemia, and most of the subjects told, that a poor iron-rich diet causes anemia.

Only 25% of the women were aware of maternal complications related to anemia like cardiac failure, failing lactation, recurrent infections. While 31% of them were aware of fetal complications like IUGR, infections, leading to preterm labor ***(Raksha and Sheeman 2016).***

33% of adolescent girls told poor diet to be the only cause for anemia, and 74% were aware that vitamin C enhances iron absorption; this finding is higher than a study conducted by ***Kotecha et al. (2001)*** (37.3%).

Table No. 4.15.1 Comparison of Pre and Post-intervention Knowledge about Anemia with significance of change (n=80)

Variables	Pre intervention		Post intervention		Significance of Change
	Mean	SD	Mean	SD	t value
What is anemia?	1.1250	1.46153	2.5500	1.07797	5.921**
Blood in anemia	.5500	.89866	1.7500	.66561	10.276**
Nutrient deficient in anemia	1.2500	1.86575	3.1500	1.64663	3.725**
Causes of anemia	1.5000	1.74298	2.6875	1.54751	3.679**
Symptoms of anemia	1.7875	2.10300	.6875	1.13175	1.019
Effects of anemia	1.3375	1.84832	2.9125	1.45127	6.906**
Preventive measures of anemia	1.2250	1.79292	2.7625	1.61671	4.588**
Iron rich food	1.4625	1.76423	3.0625	1.53725	.877

**** Sig at 1% level of significance**

4.15.2 Mean ± SD of Level of Awareness change from Pre to Post Intervention.

According to table no. 4.15.2, it is revealed that the level of awareness change from pre to post- intervention in the context of knowledge was observed as Low- 66.3%, Moderate- 6.3% and High- 27.5% during pre-intervention having a total Mean ± SD 2.65 ± 3.13, which subsequently changed to Low- 17.5%, Moderate- 21.3% and High- 61.3% with a total Mean ± SD 5.87±2.59.

A study observed high-level knowledge (Mean ±SD = 9.5 ± 3.89) and poor attitude (Mean ±SD =2.25 ± 1.44) and practice (Mean ±SD =1.6 ± 0.64) among adolescent girls towards anemia ***(Angadi and Ranjitha 2015).*** Another study found the mean knowledge and attitude score of the participants to be (4.73 ± 2.35) and (13.47 ± 1.62) respectively among pregnant women towards anemia ***(Nivedita et al. 2016).*** A study reported an average knowledge (average mean of 6.92) among participants regarding anemia ***(Upadhya et al. 2011)***.

The mean knowledge level of the subjects was 8.8 regarding causes, symptoms, and treatment of anemia ***(Jose et al. 2016)***. Several studies reported significant improvement in knowledge, attitude, and practice of adolescents post nutritional health education intervention ***(Bandyopadhyay et al. 2017; Grover, Choudhary 2017 and Chaluvaraj et al. 2018).***

Table No. 4.15.2 Mean ± SD of Pre and Post Intervention Level of Awareness change regarding Knowledge

Pre-Intervention			**Post-Intervention**		
Knowledge Level n (%)		**Mean ±SD**	**Knowledge Level n (%)**		**Mean ±SD**
Low n (%)	53 (66.3)	2.65 ±3.13	Low (%)	14 (17.5)	5.87±2.59
Moderate n (%)	5 (6.3)		Moderate (%)	17 (21.3)	
High n (%)	22 (27.5)		High (%)	49 (61.3)	
Total n (%)	80 (100.0)		Total (%)	80 (100.0)	

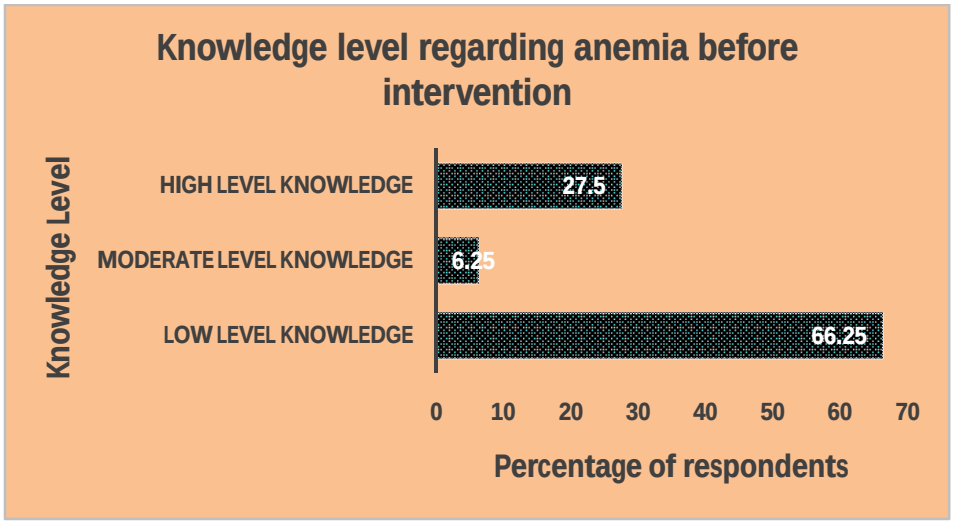

Figure 4.15.2.1 Knowledge level of respondents about anemia before intervention

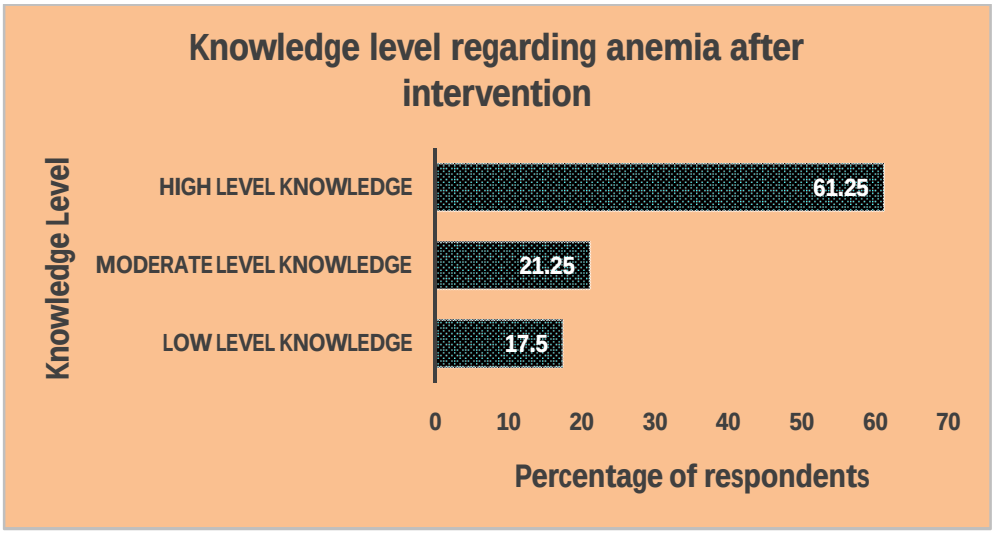

Figure 4.15.2.2 Knowledge level of respondents about anemia after intervention

4.16 Percentage wise change of Knowledge through pre to post intervention among respondents

According to table no. 4.16, it is quite evident that the maximum change was observed after intervention about the knowledge of anemia among reproductive age women. It was observed that only 37.50% women were aware about anemia before intervention, post intervention it was 85%. Women had no idea (71.30%) about what happens to blood in anemia before intervention, post intervention many of them (87.50%) retained knowledge. Responses recorded from women in terms of nutrients deficient in anemia, causes and symptoms of anemia, effects of anemia, preventive measures and iron rich foods revealed that most of the women were not aware about

anemia before intervention while after intervention an appreciable improvement in the knowledge was observed as compared to pretested baseline scores.

Table No. 4.16 Comparative Assessment of Pre-Post Intervention Knowledge regarding Anemia

What is anemia?					
	Old age n (%)	**Diarrhea n (%)**	**Deficiency of iron in blood n (%)**	**Greying of hairs n (%)**	**None of these n (%)**
Pre Intervention	3 (3.8)	4 (5.0)	30 (37.5)	1 (1.3)	42 (52.5)
Post Intervention	2 (2.5)	4 (5.0)	68 (85)	0 (0)	6 (7.5)
What happens to blood in anemia?					
		Increased blood cells n (%)	**Decreased hemoglobin n (%)**	**Increased hemoglobin n (%)**	**Don't know n (%)**
Pre Intervention		1 (1.3)	22 (27.5)	0 (0)	57 (71.3)
Post Intervention		0 (0)	70 (87.5)	0 (0)	10 (12.5)
Nutrient deficient in anemia					
	Carbohydrate n (%)	**Fat and Protein n (%)**	**Iodine and Calcium n (%)**	**Iron n (%)**	**Don't know n (%)**
Pre Intervention	0 (0)	1 (1.3)	7 (8.8)	25 (31.3)	47 (58.8)
Post Intervention	1 (1.3)	0 (0)	1 (1.3)	63 (7.8)	15 (18.8)
Causes of anemia					
	Lack of nutritious food	**Worm infestation n (%)**	**Excessive bleeding n (%)**	**Above all n (%)**	**Don't know n (%)**

	n (%)				
Pre Intervention	12 (15)	0 (0)	8 (10)	21 (26.3)	39 (48.8)
Post Intervention	23 (28.8)	0 (0)	8 (10)	42 (52.5)	7 (8.8)

Symptoms of anemia						
	Fatigue/ tiredness n (%)	**Shortness of breath n (%)**	**Irregular menstrual cycle n (%)**	**Impact learning process n (%)**	**All are correct n (%)**	**Don't know n (%)**
Pre Intervention	16 (20)	3 (3.8)	4 (5)	1 (1.3)	21 (26.3)	35 (43.8)
Post Intervention	13 (16.3)	0 (0)	14 (17.5)	0 (0)	41 (51.3)	12 (15)

Effects of anemia					
	Impact on growth and development n (%)	**Impact on learning/ performance n (%)**	**Decreased work capacity n (%)**	**All are correct n (%)**	**Don't know n (%)**
Pre Intervention	0 (0)	0 (0)	5 (6.3)	23 (28.8)	52 (65)
Post Intervention	1 (1.3)	0 (0)	28 (35)	37 (46.3)	14 (17.5)

Preventive measures of anemia					
	Consuming iron rich food n (%)	**Personal hygiene n (%)**	**Taking IFA tablets n (%)**	**All are correct n (%)**	**Don't know n (%)**
Pre Intervention	6 (7.5)	0 (0)	0 (0)	23 (28.8)	51 (63.8)
Post Interventio	14 (17.5)	0 (0)	10 (12.5)	43 (53.8)	13 (16.3)

n					
Iron rich foods					
	Green leafy vegetables n (%)	**Sprouted pulses n (%)**	**Meat & poultry n (%)**	**All are correct n (%)**	**Don't know n (%)**
Pre Intervention	17 (21.3)	0 (0)	0 (0)	25 (31.3)	38 (47.5)
Post Intervention	12 (15)	1 (1.3)	1 (1.3)	57 (71.3)	9 (11.3)

In a study reported by ***Angadi and Ranjitha (2016)***, 91% had heard of anemia; 33% of girls told poor diet is the only cause for anemia; 31% told tiredness is the only feature of anemia; 13% answered anemia impacts on physical growth, learning process, and decreases work capacity; and 55% girls told they will consult a doctor and takes iron tablets whereas, a study by ***Chakma et al.*** reported about 12% of participants knew about multiple signs and symptoms of anemia.

A study reported 44% of participants were aware of the consumption of iron-rich food as the only protective measure against anemia and 56% of subjects told that GLVs were the only source of iron-rich food ***(Angadi and Ranjitha 2016).*** Whereas, another study found around 81.4% of adolescent girls did not know about the prevention or treatment of anemia (***Chakma et al. 2012)***.

Only 32.6% gave the correct response that pregnant women should take iron supplementation along with a healthy diet. Knowledge about food rich in iron was poor among the participants. 74.36% claimed to have taken iron supplementation regularly ***(Nivedita et al. 2016)***.

56% of the participants told green leafy vegetables (GLVs) are the only source of iron-rich food and 13% answered GLVs, sprouted pulses, meat, and poultry as rich sources of iron moreover, 43% told tea or coffee reduces the absorption of iron ***(Angadi and Ranjitha 2015).*** 64% of the women were aware of the food items, which were a rich source of iron, 50% were aware of a high protein diet in the correction of anemia ***(Raksha and Sheeman 2016).***

CHAPTER - V

SUMMARY

Health and individuals well-being is a fundamental human right and central to the concept of quality of life. Women's health is vital to the survival of the society. They are the pivot of the family, they nurture the next generation and give care to the elderly. Reproductive health majorly affects the lives of women from adolescence to old age, through conception to giving birth and includes the attainment and maintenance of good health as well as the prevention and treatment of ill health.

According, to CDC (centre for disease control and prevention) report, "IDA is a condition resulting from too little iron concentration in our body." Iron (as a part of hemoglobin) is one of the minerals required by our body to carry out essential function, which is to transport oxygen from lungs to cells within our body. Iron is essential for the production of hemoglobin by erythroblasts. If it is not in adequate, the hemoglobin production does not succeed and red blood cells decreases. This condition is prevalent as 'anemia'. According to WHO, the recommended hemoglobin level, for reproductive women (age 15 and over) is 120gm/l.

Anemia is defined that in clinical terms as an insufficient mass of RBCs circulating in the blood; in public health terms anemia is defined as a hemoglobin concentration below the thresholds given by ***WHO, UNICEF & UNU (2001).*** Anemia is the decreased ability of the RBCs to provide adequate oxygen to body tissues. It may be due to a decreased number of RBCs, a decreased amount of substance in RBCs, which transports oxygen (hemoglobin), or a decreased volume of RBCs ***(Balducci, et al., 2007; Bridges & Pearson, 2008).***

The prevalence of ID and IDA varies greatly from population to population according to a variety of host and environmental factors. The etiology of anemia is multifaceted and often several factors are at play in an anemic individual. Nutritional anemia as a result of iron deficiency is the most common cause of anemia worldwide, with approximately 50% of all cases attributed to a lack of iron in the diet. A number of host and environmental factors are associated with iron deficiency, and in more severe forms contribute to IDA as well.

This study helps to identify the important risk factors that have a direct effect on an individual's thought process to adapt any behavioral change. The information gained from this present study will help to further implement policies to combat the health of women who are at the risk of developing IDA or are already suffering from. In fact, this study provides a broader perspective on how much knowledge they have and follow and in what way they relate it to their daily living.

Chapter I dealt with introduction part it includes the brief information of Theoretical background of Iron-Elemental Iron, Metabolism of Iron, Iron Bio-availability, Iron Absorption, Enhancement of iron absorption, Inhibition of iron absorption, Iron Storage and Losses, Iron overload. Definition of Anemia, Prevalence of Anemia, Classification and etiology of anemia, Contributors to IDA, Types of Anemia- Iron Deficiency Anemia, Iron Deficiency in Pregnancy, Folic Acid Deficiency Anemia, Pernicious Anemia, Hemolytic Anemia, Sickle Cell Anemia, Aplastic Anemia. Stages of development of Iron Deficiency Anemia, Causes of Iron Deficiency Anemia, Symptoms and consequence of iron deficiency, Common signs and symptoms, Magnitude of Anemia, Assessment of Anemia, Risk factors of Anemia, Epidemiology of Anemia, Global and Indian Scenario of Anemia, and Treatment of Iron Deficiency Anemia.

Objectives of the Study:

1. To estimate the prevalence of iron deficiency anemia among reproductive age women of rural and urban areas.
2. To determine association of iron deficiency anemia with its pre-disposing factors in rural and urban areas.
3. To associate IDA with food consumption pattern and BMI.
4. To evaluate the knowledge about anemia and its consequences among respondents.
5. To create awareness among rural women through camp and exhibition.
6. To evaluate the effectiveness of intervention and associate with pre and post phase of the study

Chapter II dealt with Review of Literature of the study under the sub headings: Prevalence of Anemia, Iron Deficiency Anemia, Socio-demographic Profile,

Reproductive Health, Dietary Habits, Anthropometric Measurement, Menstrual Health, Medical Status, and Knowledge regarding Anemia, Iron Rich Foods, Diagnosis of Anemia, and Effectiveness of Structured Teaching Programme in Prevention of Anemia.

Chapter III dealt with the Materials and Methods of the study. The cross sectional study was conducted followed by non-experimental pre-test/post-test design in which, evaluator surveyed the two groups of reproductive age women categorized under rural and urban areas. As the choice of the participants for this study included only reproductive age women (15-49 years), and their blood samples had to be collected for checking their hemoglobin level and iron status in the body, thus the availability of such participants played a very important role in deciding the sample size.
Total sample taken for the study is 400, which is slightly more than the minimum sample size requirement. Equal number of subjects from rural and urban has been taken in the study i.e. two hundred from urban population and two hundred from rural population. The target population for this study included reproductive age women. The subjects selected for this study belonged to the age group of 15-49 years irrespective of their menarche status.

Before initiating the actual research, a pilot study was conducted on 30 study subjects from Community Health Center in rural area. The questions were personally asked to the respondents along with collecting their blood samples for checking their hemoglobin levels. The study was conducted into three phases; for each phase a different approach of sampling was used, Multi-stage Random Sampling was followed in the present study at the preliminary phase followed by non – probability sampling and purposive sampling.

The data was coded, tabulated and analyzed using appropriate statistical techniques i.e. Mean, SD, Frequency tabulation, Chi- square test, Logistic Regression, Paired t test**,** Wilcoxon signed rank test, Correlation was administered to analyze the data accordingly.

Chapter IV dealt with results and discussion of the study. The major findings of the study are mentioned below:

General Characteristics of the Respondents:

- The total numbers of respondents included in this study were four hundred (400) out of which majority of respondents 211 (52.75%) belonged to the age group of 20 to 29 years. The majorities of the respondents were Hindu 343 (85.75%) and were married 343 (85.75%).
- Most of the women were literate (42%) but unemployed (81%). 186 (46.50%) women revealed that they have more than eight thousand monthly family income and only 80 (20%) women said they have less than five thousand monthly family income.
- 211 (52.80%) women were living in joint family setup with medium family size 152 (38%) comprising five to eight members in a family.
- It was observed that most of the women (30.80%) belonged to the Class II, strata and only eight percent belonged to Class V strata.
- Of the 400 participants 246 (61.50%) attained their menarche at the age of 13-15 years. 124 (31%). More than half of the participants (65%) had a normal length of the menstrual cycle.
- Over two-third of the participants had three to five days of menses. A proportion of 16% and 11.80% participants had six or more days and two or less days of menses respectively.
- The majority of the women that is 274 (68.50%) denied the presence of clots and only 126 (31.50%) women complained about presence of clots. The majority of the women 292 (73%) said that they did not experience heavy or prolonged bleeding in their last few months.
- Obstetrical history of women shows that, majority of them 215 (53.70%) were pregnant. The gravida status of the women reveals that 55% of them had more than two pregnancies that is multigravida followed by primi-gravida and nulli-gravida that constitutes 100 (25%) and 80 (20%) in number respectively.
- Regarding parity status, most of the women 142 (35.50%) had not sustained any live births. The multi para women were 93 (23.20%) and women having two and a single live births were 86 (21.50%) and 79 (19.80%) respectively.
- Out of 400 women, more than half of them 208 (52%) had up to three children. The majority of the women 137 (61.70%) had kept spacing between

children for more than a year. The majority of women 288 (72%) never terminated their pregnancy.

Past Morbidity Status of the Respondents:

- Majority of the women 202 (50.50%) mentioned that they had never undergone test for diagnosis of anemia. The number of women diagnosed with anemia was 95 (23.80%).
- Most of the respondents, 298 (74.50%) had never been diagnosed with malaria. The women ever suffered from malaria being 62 (15.50%).
- Most of the respondents, 298 (74.50%) had never been diagnosed with malaria. The women ever suffered from malaria being 62 (15.50%).
- Most of the women 226 (56.50%) revealed that they never suffered from any reproductive tract infection. The numbers of women suffered from any type of reproductive tract infections were 110 (27.50%). The majority of respondents 354 (88.50%) said that they never had blood transfusion and rest 46 (11.50%) respondents had gone through blood transfusion.
- The majority of the respondents 283 (70.75%) responded that they never had any surgery and rest 117 (29.25%) had undergone various types of surgery including C-section.

Dietary Practices:

- Most of the reproductive age women were vegetarian 212 (53%). It can be seen that most of the women 162 (40.50%) had their meals three times a day followed by two times a day 149 (37.25%). There were women 47 (11.75%) whose frequency of meals were not fixed.
- The majority of the respondents were found to consume tea/coffee 2-3 times a day were 162 (40.50%) followed by once in a day were 134 (33.50%). The majority of the respondents have appetizers in between meals were 272 (68%). The majority of women agreed to have fulfilling meals in last 15 days when they did not lack appetite were 232 (58%).
- About half the number of women that is 180 (45%) had no preferences of food they eat. On the other hand, 163 (40.75%) women relied upon fried and spicy food and rest 57 (14.25%) women were dependent on partially boiled food.

- As our respondents mostly relied on vegetarian diet the consumption frequency of red meat, chicken and fish on daily basis was very low that is 7 (1.75%), 6 (1.50%) and 8 (2%) respectively.
- The consumption of green leafy vegetables (55.50%) and whole grains (54.25%) on daily basis was high and equally dominant. The intake of legumes, citrus fruits/juices and soup on a regular basis was merely low being 20%, 18.50% and 2% respectively.
- Out of the 257 women (ever became pregnant), 156 (60.75%) were on usual diet as they were taking before conception. The women who partly modified their diet were 52 (20.25%) and women who were on special diet comprised 49 (19%) only.

Knowledge about Anemia:

- Most of the women 208 (52%) were aware about the term anemia but mostly 229 (57.3%) not aware about what happens in anemia.
- In the context of knowledge scored, it was observed as Low- 64%, moderate- 14.5% and high- 21.5% among rural respondents having a Mean 2.65 ± 2.96 SD, which subsequently different among urban respondents as Low- 37%, Moderate- 27% and High- 36% with a Mean 4.22 ± 2.99 SD.
- The knowledge level of total 400 respondents was Low- 50.5%, Moderate- 20.8% and High- 28.7% with Mean ± SD 3.44 ± 3.08.

Factors associated with IDA:

- A non-significant observation with socio-demographic status was observed with age and religion. Also, no significant association was observed between family setup and IDA.
- A highly significant association was observed with literacy status, family income and socio-economic strata at $\square^2 = 30.077$, $\square^2 = 21.051$ and , $\square^2 = 25.161$, p=0.000 respectively
- The chi-square test was carried out to determine the association between menstrual status and anemia categories, where a non-significant relationship was observed between anemic and non-anemic women as p value is greater than 0.05.

- Gravida and parity had a highly significant association with IDA status at χ^2 = 14.272, p=.001 and χ^2 =14.037, p=.003 respectively.
- A non-significant relationship of prevalence of IDA and BMI categories having χ^2 =7.815, df =4. association of anemia with BMI categories where the a non-significant relation is obtained between anemic and non-anemic as p value is greater than .05, more percentage of anemic women are there in underweight (6%), normal (31.8%), overweight (10.5%) and obese grade I (13%) categories of BMI when compared non-anemic ones.
- Pearson coefficient correlation between menstrual status and hemoglobin levels showed a significant positive correlation with menses age (r = 0.222, p<.01) along with a significant negative correlation with length of cycle (r = -0.135, p<.01) and very weak and positive correlation with duration of menses (r = 0.020, p<.01).
- A significant positive correlation was found between menses age and hemoglobin (r = 0.222, p<.01) along with a significant negative correlation between length of cycle and hemoglobin (r = -0.135, p<.01) and very weak and positive correlation between duration of menses and hemoglobin (r = 0.020, p<.01).
- Pearson coefficient correlation between anthropometric indices and hemoglobin levels showed a statistically significant positive correlation was observed between hemoglobin level with weight (r=0.252, p<.01) followed by height (r= 0.174, p<.01) and marginally significant correlation with BMI (r= 0.189, p<.01).
- Females who were not diagnosed with anemia more likely to become anemic when compared to non-anemic ones (95% CI 6.504-40.057) and females who don't know about their anemia status were 2.32 time (95% CI 1.380-3.930) more likely to become anemic when compared to non-anemic ones, in both the cases odds were highly significant (p<0.001).
- Relative risk for headache all the time (RR= 2.229, CI-0.973, 5.255), dizziness all the time (RR= 1.466, CI-0.606, 3.683), nausea all the time (RR= 1.035, CI-0.350, 3.281), insomnia all the time (RR= 4.326, CI-0.514, 20.393). Heavy bleeding all the time (RR= 1.490, CI-0.707, 3.277) and fatigue all the time

(RR= 6.777, CI-3.105,15.005) where fatigue was the most significant risk factor as anaemic females high risk of feeling fatigue all the time.

- A strong significant association of BMI and consumption of red meat (p=0.00), chicken (p=0.00) fish (p=0.05), followed by green leafy vegetables (p=0.04) and whole grains (p=0.01) where as a non-significant association was observed between legumes (p=0.08), citrus fruits (p=0.11) and soups (p=0.15).
- Association between BMI and no. of meals consumed per day where p=0.06 which reveals a non-significant relation as no. of meals taken have no effect on BMI.
- Association between food habits after becoming pregnant and BMI reveals that eating habit after becoming pregnant have no relation with BMI categories as the relation was non-significant (p=0.61).
- A significant (p=0.01) association between BMI and daily average consumption of tea and coffee where tea and coffee consumed more than one time shown effects on BMI.
- The association of BMI categories with menstrual status, a non-significant relationship was observed among all categories of BMI except for age at menarche (p= 0.035) and flow during menses (p= 0.048).
- The association between age group and food consumption pattern, a non-significant relationship was observed among the consumption pattern of green leafy vegetables, citrus fruits, whole grains and soup having the p values <.05 respectively (green leafy vegetables p=0.294; citrus fruits p=0.127; whole grains p=0.07 and soup p=0.121).
- On evaluating the association between residence area and food consumption pattern, a very high significant relationship was observed with the consumption pattern of red meat, chicken, fish, legumes, green leafy vegetables, citrus fruits, whole grains and soup having the p values =0.000 respectively whereas Family type showed non-significant association with consumption pattern of fish p=0.09 and red meat p=0.121, rest all the other food groups were having a highly significant values.
- On evaluating the association between socio-economic status and food consumption pattern, a significant relationship was observed among the different class groups with chicken and legume consumption pattern having

the chi-square values as χ^2=81.759, df=16 and χ^2=80.530, df=16 significant at p<.01 level respectively.

- Logistic regression analysis showed that females who relied upon fried/spicy food have more risk of becoming anemic (RR= 1.261, CI-0.963, 1.651) and significant risk of becoming anemic among those who rely upon whatever being cooked (RR= 1.345, CI-1.044, 1.733; p<0.05) when compared to the one taking partially boiled food.

Post Intervention:

- The comparison of mean scores was done using Paired t test, analysis revealed a statistically significant relationship among all variables of knowledge except knowledge about symptoms of anemia and about iron rich foods.
- It is revealed that the level of awareness change from pre to post- intervention in the context of knowledge was observed as Low- 66.3%, average- 6.3%, High- 27.5% during pre-intervention having a total Mean 2.65 ±3.13 SD, which subsequently changed to Low- 17.5%, average-21.3%, High- 61.3% with a total Mean ± SD 5.87±2.59.
- It was observed that only 37.50% women were aware about anemia before intervention, post intervention it was 85%. Women had no idea (71.30%) about what happens to blood in anemia before intervention, post intervention many of them (87.50%) retained knowledge.
- Responses recorded from women in terms of nutrients deficient in anemia, causes and symptoms of anemia, effects of anemia, preventive measures and iron rich foods revealed that most of the women were not aware about anemia before intervention while after intervention an appreciable improvement in the knowledge was observed as compared to pretested baseline scores.

HYPOTHESIS OF THE STUDY

1. H_0: There exists a significant relationship between Socio-demographic Status and Prevalence of IDA.
2. H_0: There exists no significant relationship between Socio-economic Status and Prevalence of IDA.

3. H_0: There exists a significant relationship between Menstrual Status and Prevalence of IDA.
4. H_0: There exists no significant relationship between Gravida, Parity and Prevalence of IDA.
5. H_0: There exist a significant association between BMI and Prevalence of IDA.
6. H_0: There exists no significant correlation among Menstrual Status and Hemoglobin Levels.
7. H_0: There exists no significant correlation among Anthropometric Indices and Hemoglobin Levels.
8. H_0: There exists no significant relationship between BMI and Food Consumption Pattern.
9. H_0: There exists no significant relationship between BMI with Menstrual Status.
10. H_0: There exists a significant relationship between Age and Religion with Food Consumption Pattern.
11. H_0: There exists a non-significant relationship between Residence Area and Type of Family with Food Consumption Pattern.
12. H_0: There exists no significant relationship between Literacy Status and Food Consumption Pattern.
13. H_0: There exists no significant relationship between Family Income and Food Consumption Pattern.
14. H_0: There exists no significant relationship between Socio-economic Strata and Food Consumption Pattern.
15. H_0: There is no significant association between Pre and Post Intervention evaluation of knowledge regarding anemia.

CHAPTER – VI

CONCLUSION

- The total numbers of respondents included in this study were four hundred (400) out of which majority of respondents 211 (52.75%) belonged to the age group of 20 to 29 years. The majorities of the respondents were Hindu 343 (85.75%) and were married 343 (85.75%).
- Most of the women were literate (42%) but unemployed (81%). 186 (46.50%) women revealed that they have more than eight thousand monthly family income and only 80 (20%) women said they have less than five thousand monthly family income.
- 211 (52.80%) women were living in joint family setup with medium family size 152 (38%) comprising five to eight members in a family.
- It was observed that most of the women (30.80%) belonged to the Class II, strata and only eight percent belonged to Class V strata.
- Of the 400 participants 246 (61.50%) attained their menarche at the age of 13-15 years. 124 (31%). More than half of the participants (65%) had a normal length of the menstrual cycle.
- Over two-third of the participants had three to five days of menses. A proportion of 16% and 11.80% participants had six or more days and two or less days of menses respectively.
- The majority of the women that is 274 (68.50%) denied the presence of clots and only 126 (31.50%) women complained about presence of clots. The majority of the women 292 (73%) said that they did not experience heavy or prolonged bleeding in their last few months.
- Obstetrical history of women shows that, majority of them 215 (53.70%) were pregnant. The gravida status of the women reveals that 55% of them had more than two pregnancies that is multigravida followed by primi-gravida and nulli-gravida that constitutes 100 (25%) and 80 (20%) in number respectively.
- Regarding parity status, most of the women 142 (35.50%) had not sustained any live births. The multi para women were 93 (23.20%) and women having two and a single live births were 86 (21.50%) and 79 (19.80%) respectively.

- Out of 400 women, more than half of them 208 (52%) had up to three children. The majority of the women 137 (61.70%) had kept spacing between children for more than a year. The majority of women 288 (72%) never terminated their pregnancy.

Past Morbidity Status of the Respondents:

- Majority of the women 202 (50.50%) mentioned that they had never undergone test for diagnosis of anemia. The number of women diagnosed with anemia was 95 (23.80%).
- Most of the respondents, 298 (74.50%) had never been diagnosed with malaria. The women ever suffered from malaria being 62 (15.50%).
- Most of the respondents, 298 (74.50%) had never been diagnosed with malaria. The women ever suffered from malaria being 62 (15.50%).
- Most of the women 226 (56.50%) revealed that they never suffered from any reproductive tract infection. The numbers of women suffered from any type of reproductive tract infections were 110 (27.50%). The majority of respondents 354 (88.50%) said that they never had blood transfusion and rest 46 (11.50%) respondents had gone through blood transfusion.
- The majority of the respondents 283 (70.75%) responded that they never had any surgery and rest 117 (29.25%) had undergone various types of surgery including C-section.

Dietary Practices:

- Most of the reproductive age women were vegetarian 212 (53%). It can be seen that most of the women 162 (40.50%) had their meals three times a day followed by two times a day 149 (37.25%). There were women 47 (11.75%) whose frequency of meals were not fixed.
- The majority of the respondents were found to consume tea/coffee 2-3 times a day were 162 (40.50%) followed by once in a day were 134 (33.50%). The majority of the respondents have appetizers in between meals were 272 (68%). The majority of women agreed to have fulfilling meals in last 15 days when they did not lack appetite were 232 (58%).

- About half the number of women that is 180 (45%) had no preferences of food they eat. On the other hand, 163 (40.75%) women relied upon fried and spicy food and rest 57 (14.25%) women were dependent on partially boiled food.
- As our respondents mostly relied on vegetarian diet the consumption frequency of red meat, chicken and fish on daily basis was very low that is 7 (1.75%), 6 (1.50%) and 8 (2%) respectively.
- The consumption of green leafy vegetables (55.50%) and whole grains (54.25%) on daily basis was high and equally dominant. The intake of legumes, citrus fruits/juices and soup on a regular basis was merely low being 20%, 18.50% and 2% respectively.
- Out of the 257 women (ever became pregnant), 156 (60.75%) were on usual diet as they were taking before conception. The women who partly modified their diet were 52 (20.25%) and women who were on special diet comprised 49 (19%) only.

Knowledge about Anemia:

- Most of the women 208 (52%) were aware about the term anemia but mostly 229 (57.3%) not aware about what happens in anemia.
- In the context of knowledge scored, it was observed as Low- 64%, moderate- 14.5% and high- 21.5% among rural respondents having a Mean 2.65 ± 2.96 SD, which subsequently different among urban respondents as Low- 37%, Moderate- 27% and High- 36% with a Mean 4.22 ± 2.99 SD.
- The knowledge level of total 400 respondents was Low- 50.5%, Moderate- 20.8% and High- 28.7% with Mean ± SD 3.44 ± 3.08.

The present study revealed that a very high prevalence of IDA among reproductive-age women (66.5%) is an alarming sign and indicator of socioeconomic status and illiteracy. Women who were under peak childbearing age, as well as low-income groups, have more chances to experience IDA because there is a definite role of nutritional deprivation in the development of anemia and lack of balanced diet especially deficient in iron and folic acid. It has seen that the educational level of women and the standard of living of households play a considerable role in determining the degree of anemia in women. Reproductive age women are susceptible to iron deficiency anemia due to below par socioeconomic status along with literacy

status. Large family size in rural areas keeps women busy in fostering others and disregarding their own health. Ignorance and lack of affordability to nutritious diet especially rich in iron makes women anemic. High prevalence of anemia and association with predisposing factors indicating the necessity of improvement of socio-demographic and dietary practices to tackle this alarming condition. Efforts must be taken to enhance the level of education and the economic status of all women. Addressing determinants, there is a scope to improve anemia in this area.

RECOMMENDATIONS

- Further research should be carried out in other communities so as to obtain an iron deficiency data base for effective planning and implementation of control programs.

- A stratified research of high income earning and low income earning reproductive participants should be carried out to determine the level of risk factors between the two groups.

- A case control study should be investigated to determine the level of contribution of nutrition to iron deficiency in remote rural communities and urban communities.

- Periodic check-up camps can be organized at institutional level.

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ANNEXURE-I

An Epidemiological Study of Iron Deficiency Anemia and Its Impact On The Health Status of The Reproductive Age Women

Form No :
Date:

Section 1 [A]: GENERAL INFORMATION

1 Location Urban:_____ Rural:_____

1.2 Family Size: [i] Small (2 – 4 members)
[ii] Medium (5 – 8 members)
[iii] Large (more than 8 members)

1.3 Type of Family: [i] Joint [ii] Nuclear Family
1.4 Family income (monthly): [i] Less than 5000 [ii] 5000 – 8000
1.5 [iii] More than 8000

1.6 Details of the Subject:

- Age in years:_____

- Religion: [i] Hindu [ii] Muslim [iii] Sikh [iv]Christian [v]Other

- Marital Status : [i]Unmarried [ii]Married [iii] Seprated/Divorce

- Literacy Status: [i] Illiterate
[ii] Primary
[iii] Secondary
[iv]Higher Secondary
[v]Graduate
[vi]Other

- Socio-Economic status: [i]Class 1
[ii]Class 2
[iii]Class 3
[iv]Class 4
[v]Class 5

Occupation Of Subject	Income (rupees per month)
Employed	
Unemployed	

Section 2 [B]: MENSTRUAL STATUS

- Age of Menarchy: [i] 10-12 years [ii] 13-15 years [iii] More than 15 years
- Menstrual cycle: [i] Less than 28 days [ii] 28 – 30 days [iii] More than 30 days
- No. of days of menstruation: [i] 2 days [ii] 3 – 5 days [iii] More than 6 days
- Flow during menstruation: [i] Normal [ii] Excessive
- Clots: [i] Present [ii] Absent
- Do you have problem of menorrhagia? [i] Yes [ii] No
- Have you experienced heavy or prolonged menstrual bleeding recently? [i] Yes [ii] No

Section 3 [C]: REPRODUCTIVE & OBSTETRICAL HISTORY

- Pregnancy status: [i] Pregnant [ii] Not pregnant
- Gravida: [i] Nulligravida [ii] Primigravida [iii] Multigravida
- Parity: [i] Primiparous [ii] Biparous [iii] Multiparous
- How long was the interval between your previous and current pregnancy? [i] Less than 1 year [ii] 1 – 3 years [iii]More than 3 years
- How many children do you have? [i] No child [ii] 1 – 3 children [iii] 4 – 6 children [iv] 7 – 9 children [v] More than 10
- Spacing between children:[i] 1 year [ii] Between 1 – 2 years [iii] More than 2 years
- Are you currently breast feeding? [i]Yes [ii] No

Section 4 [D]: HEALTH & MEDICAL STATUS

- Have you ever been diagnosed with anemia? [i]Yes [ii]No [iii]Don't know

- Have you ever suffered from malaria? [i]Yes [ii]No
- Have you ever suffered from hookworm? [i]Yes [ii]No [iii]Don't know
- Have you had or having any infection? [i]Yes [ii]No [iii]Don't know
- Have you ever suffered from any of the following?

Options	Yes	No
a) Peptic Ulcer		
b) Rectal Bleeding		
c) Melaenia		
d) Ulcerative Colitis		
e) Cancer		

- Have you ever had a blood transfusion?

  [i] Yes

  [ii] No

- Do you suffer from any of the following?

	Never	Sometimes 1-3 times/month	Often 4-6 times/month	All the time
a) Headache				
b) Dizziness				
c) Nausea				
d) Constipation				
e) Stomach Ache				
f) Black stool				
g) Insomnia				
h) Heavy bleeding				
i) Fatigue				

- Have you had any surgery in the past few years? [i] Yes [ii] No

- Type of diet –

[i] Vegetarian [ii]Non-vegetarian [iii]Ovo-vegetarian

Number of meals per day –

[i] 2 times a day [ii] 3 times a day [iii] 4 times a day [iv] Not fixed

- How is your food habit after becoming pregnant?

[i] Taking the usual diet [ii]Taking the special diet [iii] Partly modified

- How many cups of coffee/tea do you consume daily in average?

[i] Once [ii] 2 – 3 times [iii] 4 – 5 times [iv] At regular intervals

[v] Whenever feel like having it

- How many times do you eat between meals?

  [i] Only once [ii] Whenever feel hungry [iii] NeverHow often do

Food Consumption pattern

	Daily	4-6 times/week	1-3 times/week	1-2 times/week	Never
a) Red meat					
b) Chicken					
c) Fish					
d) Legumes					
e) Green leafy vegetables					
f) Citrus fruits					
g) Whole grains					
h) Soups					

- During the last 15 days, how many times on an average have you had a fulfilling meal in a day when you did not lack appetite?

[i] One time [ii] Two times [iii]Every meal a day

- Which type of food you mostly rely upon?

[i] Fried food [ii] Spicy food [iii] Partially boiled [iv] Baked

- Are you taking any nutritional supplement as prescribed by the Doctor?

[i] Yes [ii] No

Section 5 [E]: KNOWLEDGE REGARDING ANEMIA

- What is anemia?

[i] Old age [ii] Diarhoea [iii] Deficiency of iron in blood

[iv] Graying of hairs [v] None of these

- In anemia there is -:

[i] Increased blood cells [ii] Decreased haemoglobin

[iii] Increased haemoglobin [iv] Don't know

- Nutrient deficient in anemia -:

  [i] Carbohydrate [ii] Fat and Protein

  [iii] Iodine and Calcium [iv] Iron

  [v] Don't know

- What causes anemia?

  [i] Lack of nutritious food [ii] Worm infestation

  [iii] Excessive bleeding [iv] Above all

  [v] Don't know

- Symptoms of anemia -:

  [i] Fatigue/tiredness [ii] Shortness of breath

  [iii] Irregular menstrual cycle [iv] Impact learning process

  [v]All are correct [vi] Don't know

- Effects of anemia -:

  [i] Impact on growth and development

  [ii] Impact on learning/performance

  [iii] Decreased work capacity

  [iv] All are correct

  [v] Don't know

- What are the preventive measures of anemia?

  [i] Consuming iron rich food [ii] Personal hygiene

  [iii] Taking IFA tablets [iv] All are correct

  [v] Don't know

- Which is a iron rich food?

  [i] Green leafy vegetables [ii] Sprouted pulses

  [iii] Meat, poultry [iv] All are correct

  [v] Don't know

Section 6 [F]: ANTHROPOMETRY MEASUREMENT -:

- Height (in cms) –
- Weight (in kgs) –
- BMI –

Section 8 [H]: FULL HEMOGRAM -:

- Hemoglobin concentration (g/dl) –
- Mild
- Moderate
- Severe
- Serum Ferritin

ANNEXURE – II

B.G. Prasad's Classification of Socioeconomic Status (SES)

Monthly per capita income in Rs	Socioeconomic Class
7008 and above	Upper Class
3504-7007	Upper Middle Class
2102-3503	Middle Class
1051-2101	Lower Middle Class
Below 1050	Lower Class

ANNEXURE-III

CONSENT FORM

Namaste, My name is Swati Rai. I am working on behalf of Department Of Human Development And Family Studies, School Of Home Science, Babasaheb Bhimrao Ambedkar University, on research topic **"An Epidemiological Study of Iron Deficiency Anemia and its Impact on the Health Status of the Reproductive Age Women".** In this study detail information about Iron Deficiency Anemia will be obtained by interview technique. Weight and height will be recorded. Hemoglobin Status will be taken. The findings of the study will suggest the planning and policy bodies and implementing women health services in urban and rural areas. The information provided by you will be kept confidential and use only for scientific purpose. Necessary support and counseling will be provided wherever necessary at any time during interview or measurement. If you feel inconvenience you may stop answering or refuse undergo measurement.

I shall be grateful for your support in this regard.

Agreed/Disagreed

Signature/Thumb impression

Signature of the witness

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ueLr] ejk uke Lokfr jk; g] e xg foKku fo|k;kihB] ekuo fodkl ,o ifjokj v/;;u foHkkx ckckl kgc Hkhejko vEcMdj fo'ofo|ky; d rgr 'kks/k dk; ^^An Epidemiological Study of Iron Deficieny Anemia and its Impact on the Health status of the Reproductive age Women** l lcf/kr fo"k; ij v/;;u dj jgh gA bl v/;;u d ckj e vkil foLrr tkudkjh yh tk,xh vkidk otu vkj yEckb Hkh ekik tk;xkA bld }kjk ikIr tkudkjh 'kgj rFkk xko e jgu oky ykxk d LokLF; lokvk dh ;ktuk cuku e ennxkj gkxkA vkid }kjk inku dh xb lpuk xkiuh; j[kh tk;xh] bldk i;kx doy vul/kku d fy, tk;xkA lk{kRdkj ,o v/;;u d nkjku vkidk lk{kRdkj l lEcfU/kr mfpr tkudkjh ,o li"k.k inku fd;k tk;xkA ;fn lk{kRdkj d nkjku vkidk fdlh Hkh idkj dh vlfo/kk gk rk vki mRrj nuk cUn dj ldr g ;k if'k{k.k djku l euk dj ldr gA vkidh Hkkxhnkjh d fy, e vkidh vkHkkjh gA

lger@vler

gLrk{kj@vxB dk fu'kku

xokg dk gLrk{kj

ANNEXURE – IV

Evaluation of Score of Respondents

Question	Minimum Score	Maximum Score	Score for each correct answer (For MCQs equal weight age was given for each correct response)	Categorization Incorrect (0) Partial Correct (0<Score<1) Correct (1)
What is anemia	0	1	1	Incorrect Correct
Blood in anemia becomes	0	1	1	Incorrect Correct
Nutrient deficient in anemia	0	1	1	Incorrect Correct
Causes anemia	0	1	0.33	Incorrect Partial Correct Correct
Symptoms of anemia	0	1	0.25	Incorrect Partial Correct Correct
Effect of anemia	0	1	0.33	Incorrect Partial Correct Correct
Preventive measures of anemia	0	1	0.33	Incorrect Partial Correct Correct
Iron rich food	0	1	0.33	Incorrect Partial Correct Correct