PREVALENCE OF IRON DEFICIENCY ANAEMIA AMONG ADOLESCENT GIRLS AND IMPACT OF HEALTH AND NUTRITION EDUCATION PROGRAMME IN CHANGING THEIR DIETARY BEHAVIOUR

Dissertation submitted to the

University of Kashmir
for the Award of Degree of

MASTER OF PHILOSOPHY
In
HOME SCIENCE
(Food Science and Nutrition)

BY

ROSHINA BASHIR

Under the Joint Supervision of

Supervisor
Prof.(Dr.) Nilofer Khan
Institute of Home science
University of Kashmir

Co- Supervisor
Dr. B. A. Ganai
Department of Biochemistry
University of Kashmir

INSTITUTE OF HOME SCIENCE
FACULTY OF APPLIED SCIENCE AND TECHNOLOGY
UNIVERSITY OF KASHMIR, SRINAGAR
HAZRATBAL, SRINAGAR (190006)

2013

Department of Home Science
University of Kashmir
Hazratbal, Srinagar-190006

CERTIFICATE

This is to certify that the dissertation entitled **"Prevalence of iron deficiency Anaemia among adolescent girls and impact of Health and Nutrition Education Programme in changing their dietary behaviour"** being submitted to the Institute of Home Science, Faculty of Applied Science and Technology, University of Kashmir for the award of Degree of Master of Philosophy in Home Science (Food and Nutrition) is a research work done by **Roshina Bashir** under our supervision. To the best of our knowledge and belief, no part of this work has been submitted to this or any other University in India for award of M.**Phil** Degree or any other Degree. The assistance and help received during this endeavour have been appropriately acknowledged.

Dr. Bashir Ahmad Ganai
(Co-Supervisor)
Associate Professor
Department of Biochemistry
University of Kashmir

Prof .Dr. Nilofer Khan
(Supervisor)
Professor
Institute of Home science
University of Kashmir

Dr. Nahid Vaida
Head of the Department
Department of Home science
University of Kashmir

Department of Home Science

University of Kashmir

Hazratbal, Srinagar-190006

DECLARATION

I **Roshina Bashir,** declare that the work embodied in this dissertation entitled **"Prevalence of iron deficiency Anaemia among adolescent girls and impact of Health and Nutrition Education Programme in changing their dietary behaviour"** has been carried out by me in the Department of Home Science, University of Kashmir, Srinagar and is original. The work embodies the results of my observations which are advancement to the previous knowledge in the subject.

Dated: **ROSHINA BASHIR**

ACKNOWLEDGEMENT

First of all, I sincerely acknowledge my gratitude to Almighty God for his compassion and bountiful of blessings, which made me see the moment whose euphoria is not vanishing from my mind till date.

It is often said that nobody can imprison wind, nobody can measure sky similarly nobody can have a vocabulary to express all his emotions. I hereby tried with all my heart to have a word of thanks for those innovative minds that have put their knowledge compendia open to me to bring the current work in its present form.

Truly admitting I have no words in my dictionary to express my inner feeling of ineffable indebtedness towards my revered guide ***Prof. (Dr.) Nilofer Khan, Professor,*** *Department of Home Science, University of Kashmir, who endowed me an opportunity to work under the shadow of his able supervision. Her inspiration, guidance, keen observation and amazing perspicacity throughout my research were really a great essence for the completion of this work. Without her help and insights, this endeavor might have never been come into shape. I am perpetually grateful to her for giving me constant encouragement, showing great optimism and faith in my abilities, giving advice from time to time and for making me feel that "Research is doing what everybody has done but thinking that nobody has thought."*

I feel opportunistic to express my debt of gratitude to my co-supervisor, ***Dr. B.A.Ganai, Associate Professor,*** *University of Kashmir, Srinagar for his meticulous and logical approach in*

solving problems, his innovative ideas and giving me a wide exposure of the latest technologies existing in the current topic assigned to me. I would like to convey my heartfelt thanks to him for being an active part of this work and always giving his ear towards the skepticism of my work.

I also wish to express deep sense of gratitude to ***Prof. Nahid Vaida*** *Head, Institute of Home science, University of Kashmir.*

My special thanks also extend to the Director, Food Technology ***Prof. F. A. Masoodi*** *for his constant support and encouragement.*

It would be unfair if I don't mention the names of other faculty members of our Department. ***Mrs.Naila Irshad, Ms.Gazala Nisar, Dr.Muzamil Jan*** *and* ***Fatima Buchh*** *for their advices, healthy discussions and valuable suggestions at the time of need. My thanks are also to the technical and non teaching staff of the Department of Home science.*

I express my deep sense of gratitude to ***Dr. Bilal Ahmed Bhat SKUAST****, Kashmir, for his valuable suggestions and fruitful discussions throughout this whole work. I would like to express my thanks Mr. Tariq Wani for his patient help in statistical analysis.*

Special thanks are due to librarian, Institute of Home Science, University of Kashmir for rendering me assistance which helped me to complete the study.

I also wish to express deep sense of profound gratitude to It gives me immense pleasure and privilege to thank my friend,

Mr. Omer Bazaz, *for his expert opinion and useful feedbacks, besides providing an emotional support throughout this period.*

It would not have been possible to complete this thesis without the support and devotion of my husband ***Mr. Ashiq Bazaz*** *and it gives me immense pleasure to thank my children* ***Daoud, Ayaan*** *and* ***Tabeer*** *who inspite of their tender years showed great patience and endurance during the course of the study.*

I owe special thanks to my friends ***Sheema, Saba*** *and* ***Tanveer,*** *who always stood with me.*

I am great thankful to entire team of (Al-Khaleel DTP Centre, Hazratbal) especially ***Mr. Showkat Ahmad*** *for typing and printing of the dissertation with meticulous care.*

Last but certainly not the least whatever endeavor I have put to achieve this goal would not have been possible without the support of my dear parents, whose unconditional love, blessings and sacrifices gave me strength to keep going on. Like the sun in the sky, even though far away from me, but always brightening my days with the ideals that they had taught me and their words of wisdom that remained with me like a guardian throughout this period.

ROSHINA BASHIR

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

UNICEF	United Nation International Children Fund
WHO	World Health Organization
BMI	Body Mass Index
IDA	Iron Deficiency Anemia
RBC	Red Blood Cell
SF	Serum Ferritin
Hb	Hemoglobin
IFA	Iron Folic Acid
HESA	High Socio Economic Status
LESA	Low Socio Economic Status
ID	Iron Deficiency
TRF	Transferring receptor
IBD	Inflammatory Bowel Disease

CHAPTER – 1

INTRODUCTION

Health is a fundamental human right and health is central to the concept of quality of life **(Sundar Lal, 2007).** Adolescent is a period of second decade of life and constitute over one fifth of India's population Adolescence begins when the secondary sex characteristics appear and ends when somatic growth is completed and the individual is psychologically mature, capable of becoming a contributing member of society. Adolescents are in the age group of 12 to 18 years. Girls begin to menstruate at this age. The girl should have weight approximately 42-64 kg and height approximately 155-169 cm. Total nutrient requirements are increased during adolescence age to support a period of dramatic growth and development. Eating right food at right time will prevent the nutritional deficiencies especially Iron deficiency disorders **(Dorothy *et al.*, 2007).**

Adolescence is a critical stage in the life cycle, when the health of females is affected due to growth spurt, beginning of menstruation, poor intake of iron due to poor dietary habits and gender bias. Iron deficiency anaemia affects over 60% of the adolescent girls in India. Anaemia in adolescent girls has far-reaching implications. The anemic adolescent girls grow into adult women with compromised growth, both physical and mental. These women have low pre-pregnancy weight, and are more likely to die during childbirth and deliver low birth weight babies **(UNICEF, 2012).**

In adolescence, development occurs in three periods and these are shown in Table 1.1.

Table 1.1: Periods of development in adolescence

Early adolescence	(10 -13 years)
Middle adolescence	(14 – 16 years)
Late adolescence	(17 -20 years)

Source: B. Srilakhsmi (2002) Dietetics (4th edition).

Iron is one of the micronutrient. It is used for formation of hemoglobin, oxygen transportation, brain development, regulation of body temperature and muscle activity. When the iron is decreased in human body, it is called as iron deficiency. Iron deficiency is the most common etiological factor in anaemia. The decreased hemoglobin level is called as iron deficiency anaemia **(Park, 2007).**

Anaemia 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 anaemia worldwide. About 2 billion people suffer from varying degrees of anaemia 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 anaemia (IDA).

Table 1.2: Cut –off points for the diagnosis of anaemia

Age Group	g/dl
Children 6 month-6 years	11
Children 6-14 years	12
Adult male	13
Adult female (Non pregnant)	12
Pregnant woman	11

Source: K. Park, (2000). Text book of Preventive and social medicine, 16th edition

RISK FACTORS FOR ANAEMIA

Anaemia 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 anaemia). Severe anaemia accounts for 20.3% of maternal deaths.

The risk of dying from haemorrhage and infection is five to ten times greater among anemic women compared with non-anemic women.

Anaemia among women also contribute to infant health by intra-uterine growth retardation, low birth weight and ultimately perinal mortality, and a higher risk of irreversible brain damage in infants. Anaemia 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 foetus and maternal tissues.

Nutritional anaemia is widely prevalent in many parts of the world, particularly in developing countries. Although many nutrients and co- factors are involved in the maintenance of a normal haemoglobin concentration, the most common nutrient deficiency in nutritional anaemia, from the public health point of view, is iron deficiency. Iron requirements of children are closely related to growth and the requirements of iron increase during the periods of rapid growth, both in pre-school and school age children. In girls, there is a further increase in iron requirements at the onset of menstruation **(Goyle and Prakash, 2009)**.

CAUSES OF ANAEMIA

Iron-deficiency anaemia (IDA), often caused by insufficient iron intake, is the major cause of anaemia in childhood. It has become much less common in the United States over the past 30 years, primarily due to iron-fortified infant formulas and cereals. Iron-deficiency anaemia 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 anaemia. Lack of iron usually is due to blood loss, poor diet, or an inability to absorb enough iron from the foods that we eat.

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 anaemia. 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 anaemia. 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

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 anaemia. 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. 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.

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.

Women

Women of child bearing age are at increased risk for iron-deficiency anaemia because of blood loss during their monthly periods. About 1 in 5 women of child bearing age has iron-deficiency anaemia. 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 foetus' growth. About half of all pregnant women develop iron-deficiency anaemia. The condition can increase a pregnant woman's risk for a premature or low-birth-weight baby.

Adults who have internal bleeding

Adults who have internal bleeding, such as intestinal bleeding, can develop iron deficiency anaemia due to the blood loss. Certain conditions, such as colon cancer and bleedings, ulcers can cause blood loss. Certain medicines such as aspirin also can cause internal bleeding.

Other risk groups

People who get kidney dialysis treatment may develop iron – deficiency anaemia. 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 **(U.S. Department of Health & Human Services, 2011).**

STAGES OF ANAEMIA

According to **Herbert (1992)** deviations from normal iron status have been summarized as follows:

- Stages I and II negative iron balance (i.e. iron depletion)-In these stages, iron stores are low and there is no dysfunction. In stage I negative iron balance, reduced iron absorption produces moderately depleted iron stores. Stage II negative iron balance is characterized by severely depleted iron stores. More than 50 % of all cases of negative iron balance fall into these stages. When persons in these two stages are treated with iron, they never develop dysfunction or disease.
- Stages III & IV negative iron balance (i.e. iron deficiency)-Iron deficiency is characterized by inadequate body iron, causing dysfunction and disease. In stage III negative iron balance, dysfunction is not accompanied by Anaemia; however, Anaemia does occur in stage IV negative iron balance.
- Stages I & II positive iron balance- Stage I positive iron balance usually lasts for several years with no accompanying dysfunction. Supplements of iron or vitamin C promote progression to dysfunction or disease, whereas iron removal prevents progression to disease. Iron overload disease develops in persons with stage II positive balance after years of iron overload have caused progressive damage to tissues and organs. Again iron removal stops disease progression. Iron status has a variety of indicators. Serum ferritin levels are in equilibrium with body iron stores. Very early (stage I) positive iron balance may be best recognized by measuring total iron binding capacity (TIBC) (transferrin IBC). Conversely, measurement of serum (plasma) ferritin levels may best reveal early (stages I &II) negative iron balance, although serum total iron- binding capacity may be as good as indicator.

Because anaemia is the last manifestation of chronic, long term iron deficiency, the symptoms reflect a mal-function of a variety of blood systems.

Inadequate muscle function is reflected in decreased work performance and exercise tolerance. Neurologic involvement is manifested by behavioral changes, such as fatigue, anorexia and pica especially pagophagia (ice eating).

Nokes and colleagues, in their report of **International Nutritional Anaemia Consultative Group (1998)** support earlier work by **Pollitt and colleagues (1986)** that abnormal cognitive development in children suggests the presence of iron deficiency before it has developed into overt anaemia. Growth abnormalities, epithelial disorders and a reduction in gastric acidity are common. A possible sign of early iron deficiency is reduced immune competence, particularly defects in cell mediated immunity and the phagocytic activity of neutrophils which may lead to an increased propensity for infection. As iron deficiency Anaemia becomes more severe, defects arise in the structure and function of the epithelial tissue, especially the tongue, nails, mouth, and stomach. The skin may appear pale and the inside of the lower eyelid may be light pink instead of red. Fingernails can become thin and flat and eventually koilonychias (spoon shaped nails) may be noted. Mouth changes include atrophy of the lingual papillae, burning, redness, and in severe cases a completely smooth, waxy, and glistening appearance to the tongue (glossitis). Angular stomatitis may also occur, as may a form of dysphagia (difficulty in swallowing). Gastritis occurs frequently and many results in cardiovascular and respiratory changes that can eventually lead to cardiac failure. Some behavioral symptoms of iron deficiency seem to respond to iron therapy before the Anaemia is cured, suggesting they may be the result of tissue depletion of iron containing enzymes rather than the result of a decreased level of hemoglobin **(Krauses, 2000)**.

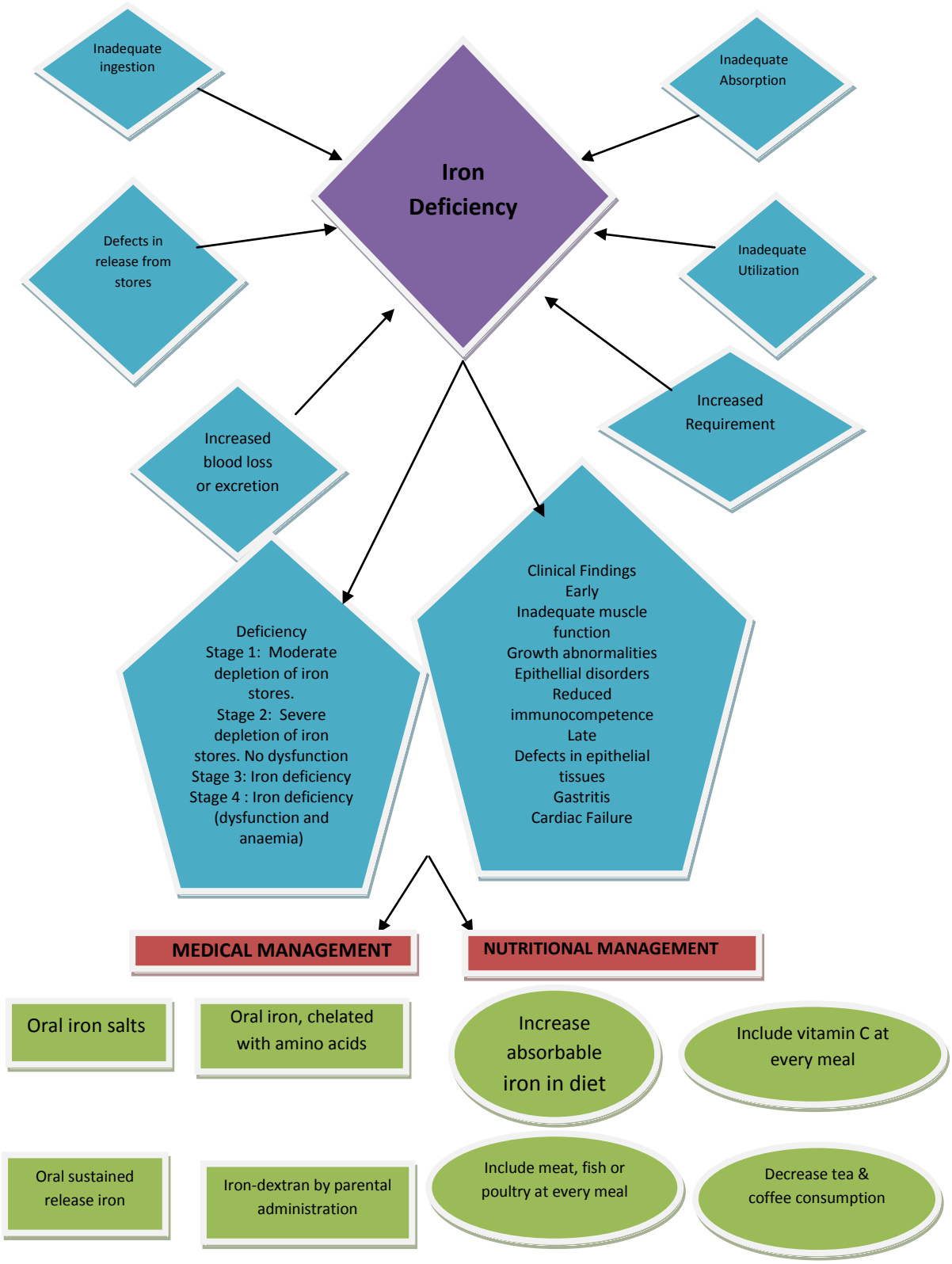
Iron absorption refers to the amount of dietary iron that the body obtains. Healthy adults absorb about 10% to 15% of dietary iron, but individual absorption is influenced by several factors.

Storage levels of iron have the greatest influence on iron absorption. Iron absorption increases when body stores are low. When iron stores are high, absorption decreases to help protect against toxic effects of iron overload. Iron

absorption is also influenced by the type of dietary iron consumed. Absorption of heme iron from meat proteins is efficient. Absorption of heme iron ranges from 15% to 35%, and is not significantly affected by diet. In contrast, 2% to 20% of nonheme iron in plant foods, such as rice, maize, black beans, soybeans and wheat is absorbed. Nonheme iron absorption is significantly influenced by various food.

Meat proteins and vitamin C will improve the absorption of nonheme iron. Tannins (found in tea), calcium, polyphenols, and phytates (found in legumes and whole grains) can decrease absorption nonheme iron. Some proteins found in soybeans also inhibit nonheme iron absorption. It is most important to include foods that enhance nonheme iron absorption when daily iron intake is less than recommended, when iron losses are high (which may occur with heavy menstrual losses), when iron requirements are high (as in pregnancy), and when only vegetarian nonheme source of iron are consumed. **(Rani, 2010).**

Iron deficiency anaemia will be prevented by adequate dietary intake or iron such as green leafy vegetables such as amaranthus, spinach, coriander leaves, drumstick 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 **(Swaminathan, 2008)**.



Source: Krauses (2000) Food nutrition and diet therapy (11th edition).

Figure 1.1: Flowchart showing causes of Iron Deficiency Anaemia (IDA)

NUTRITIONAL REQUIREMENT DURING ADOLESCENCE

1. Energy

Caloric needs increase with the metabolic demands of growth and energy expenditure. Although individual needs vary, girls consume less kilocalories than boys. Boys need 2500-2600kcal a day. The calories for both boys and girls from age group of 1-3 years to 7-9 years remain the same. During the adolescent year from the age of 10 years there is a marked difference in the caloric needs of boys and girls.

2. Protein

The protein for the both boys and girls are the same up to the age of 10 years. But there is gradual difference in their requirement from the age of 10 years and the boys have a greater requirement as compared to girls. This pattern is similar in caloric requirement also.

3. Minerals

Calcium and iron are particularly needed during adolescence. Bone growth demands about 150 mg of calcium to be retained each day to allow the increase in bone mass. Iron is needed for haemoglobin synthesis which is required for expansion of blood volume and for myoglobin which is needed for muscle growth.

4. Vitamins

The need for thiamine riboflavin and niacin, increase directly with increased caloric intake .Folic acid and B_{12} are essential for DNA and RNA synthesis and needed in higher amounts when tissue synthesis is occurring rapidly. Tissue growth involves amino acid metabolism particularly transamination to synthesis of nonessential amino acids. So the requirement for B_6 is increased. Skeletal growth requires vitamin D while the structural and functional integrity of newly formed cells depends on the availability of vitamin A, C and E **(Srilakhsmi, 2002).**

Iron deficiency is the most common and widespread nutritional disorder in the world and effects a large number of children and women in developing countries, it is the only nutrient deficiency which is also

significantly prevalent in industrialized countries. The numbers are staggering 2 billion people i.e. – over 30% of the world's population are anemic, many due to iron deficiency, and in resource-poor areas, this is frequently exacerbated by infectious diseases. Iron deficiency affects more people than any other condition, constituting a public health condition of epidemic proportions. More subtle in its manifestations than, for example, protein-energy malnutrition, iron deficiency exacts its heaviest overall toll in terms of ill-health and premature death. Iron deficiency and anaemia reduce the work capacity of individuals and entire populations, bringing serious economic consequences and obstacles to national development. Overall, it is the most vulnerable, the poorest and the least educated that are affected by iron deficiency **(WHO, 2012).**

STATEMENT OF THE PROBLEM

Adolescent is one of the most challenging period in human development. The relatively uniform growth of childhood is suddenly altered by a raped increase in the growth rate. The sudden changes create nutritional needs. Adolescent is considered as especially nutritionally vulnerable period for several reasons. First they have an increased demand for nutrients because of the dramatic increase in physical growth and development. Second the change in the life style and food habits of adolescent effect nutrients intake and needs. Third adolescence nutrient needs are effected by participation in sports, pregnancy, development of an eating disorder, excess diet, use of alcohol and drugs or some other situations.

In world health report of World Health Organization (WHO) states that the world wide mortality rate of iron deficiency anaemia is 60,404,000 in 2005 **(WHO, 2005)**.

High prevalence of iron deficiency anaemia reflects their poor status of nutrition because of their rapid growth combined with poor eating habits and menstruation **(Wongs, 2009).**

Estimates suggest that over one third of the world's population suffers from anaemia, mostly iron deficiency anaemia. India continues to be one of the countries with very high prevalence. National Family Health Survey (NFHS) reveals the prevalence of anaemia to be 70-80% in children, 70% in pregnant women and 24% in adult men. Prevalence of anaemia in India is high because of low dietary intake, poor availability of iron and chronic blood loss due to hook worm infestation and malaria. Anaemia has also well known adverse effects on physical and cognitive performance of individuals, the true toll of iron deficiency anaemia lies in the ill-effects on maternal and fetal health. Poor nutritional status and anaemia in pregnancy have consequences that extend over generations **(WHO, 2009).**

Against this backdrop the present study has been undertaken as a study of "Prevalence of Iron Deficiency Anaemia among adolescent Girls and impact of Health and Nutrition Education programme in changing their Dietary Behaviour"

OBJECTIVES OF THE STUDY

1. To assess the prevalence of iron deficiency anaemia among the sample group by biochemical test.
2. To assess the nutritional status of the sample by anthropometric measurements.
3. To examine the clinical signs and symptoms of the study group their by assessing the presence of various nutritional deficiencies.
4. To assess 24 hour dietary intake of the sample.
5. To assess the change in haemoglobin levels of anaemic sample after imparting Health and Nutrition Education.

In the present chapter besides introduction the problem taken for present research, objectives of study were also laid down. Since secondary data forms an important data of any research work, accordingly the next chapter has been devoted to the review of literature.

CHAPTER – 2

REVIEW OF LITERATURE

The survey of the related literature is an important step in conducting educational research. It enables the investigator to locate the gaps and find the trends in research in a particular filed. The information about the designs, samples and research tools employed by other investigators help the future investigators to formulate their design with more accuracy. Investigators must be aware of the new researches conducted in the past and only then he/she will be in a position to contribute something in original. Good (1972) has rightly remarked, "without a critical study of the related literature, the investigator will be groping in the dark and perhaps uselessly, repeat the work already done. Therefore to save time, energy and resources it is necessary to undertake a detailed and penetrating study of all available literature.

Review of literature is a broad, comprehensive, systematic identification and summary of written materials that contains information on related problem. Review of literature is an integral component of any study or research project. It inspires insight and enhances the depth of knowledge into the problem. The review of literature throws light on the study and their findings related to the study **(Basavanthappa, 1998).**

Hall G.S. (1844-1924) was first psychologist who systematically conducted research on adolescents in the beginning of the present century and collected enormous data on adolescents. According to his study, adolescent in terms of psychological changes occurring in adolescents. He begins this period from 10-13 years of age and ends when full adult status is attained by 22-25 years of age. It is found that adolescence is a period of storm and stress.

Erikson (1964) a famous psychoanalyst, who developed very comprehensive theory of human development, stated that adolescence as a period of rapid changes physical, physiological, psychological and social According to **Adams (1973)** "Adolescence can be defined as a holding period

in which education maturating and waiting are the major tasks to be faced." For this reason it seems scarcely profitable to define adolescence as being tied with age. It is the time when child begins to feel a lesser need for the security of familial supervision and protection at the time when physiological and hormonal development begins to approximate adult maturity and lastly when psychological maturing moves in the child in the direction of becoming responsible in society adolescence has begun.

Pastides (1981) initiated a study in order to estimate and compare the occurrence of nutritional anemia in three groups of adolescents and young adults. The first group comprised 159 individuals aged 14-21 years, who had been previously screened for thalassemia in three cities of England. The second group was comprised of 163 Derby High School students, aged 14-18 years, who had also been previously screened for thalassemia. The third group consisted of 118 Yale undergraduate students, aged 16-21 years, who were monitored for nutritional anemia while undergoing routine physical examinations at the Yale University Health Service. The prevalence of nutritional anemia varied from 0.0% to 5.5% among the three female groups, and from 4.4% to 17.9% among the three male groups. Only the Yale undergraduate male group was found to be anemic and the Yale undergraduate females were discovered to have the highest prevalence.

Chauhan (1983) stated that the adolescence is the most important period in human development about which poets, writers and historians have made occasional references and have held esteem the sacrifices made by the adolescences. It is the transaction period and turning point in the life of the individual.

Switoniak *et al.* (1992) in their study found the prevalence of iron deficiency anemia in 224 women aged 31-47 years, working in textile industry. Anemia was found in 11.2% participating women, evident iron deficiency was found in 13.4% of population.

Hallalberg *et al.* (1993) stated that the prevalence of iron deficiency was determined in Göteborg, Sweden, in a sample of 15-16 year old girls (n = 220) and boys (n = 207) using serum ferritin (SF). In a this study of women regarding the relationship between SF and stainable bone marrow iron, it was established that at a cut off value for SF of < 16 micrograms/L in 75% of women with no iron stores SF concentration was below this value (sensitivity 75%), whereas in 98% of iron-replete women it was above this cut off value (specificity 98%). Thus the study showed that in 40% of the girls and 15% of the boys SF was below the cut off value, indicating iron deficiency.

Ayoub (1995) Conducted study on girl students of first and second academic years of Dubai Medical College it was found that the mean Hb was 12.83±1.49 and that for serum iron was 13.73 micromol/l. Anemia was detected 24.62% of the group among which Arab Gulf Nationalities constituted 31.25%. Egyptians showed the highest prevalence of anemia (50%). The study showed a significant effect of chronic blood loss whether menstrual or from any other cause which effected the Hb level. Also living in the hostel away from parents and families was reflected upon their dietary habits and had a significant reflection upon the prevalence of anemia among the studied group.

Alaofe (1996) found that 43% of subjects were anaemic (haemoglobin <120 g/l). Iron deficiency defined by a four-model index based on two or more abnormal values in the four independent indicators of iron status used (serum iron, total iron-binding capacity, mean corpuscular volume, mean corpuscular haemoglobin concentration) was present in 14% of the subjects, while 13% had iron deficiency anemia (haemoglobin <120 g/l+).

A study conducted by **Adgeppa *et al.* (1997)** in Indonesia including 805 adolescent girls showed that 21.1% of the girls (170) were anaemic having haemoglobin level less than 12 g/dl and according to **Kanani *et al.* (1997)** stated in their review on anemia among adolescent girls revealed that 70% of adolescent girls in low income communities had Hb levels, 110 g/L. When the WHO cut off of 120 g/L was applied, the prevalence was even higher (80–90%).

Singh (1998) concluded that there was a significant difference in prevalence of anemia in adolescent girls in relation to caste, socio-economic status, father's occupation and mother's education. Reverse association was seen between socio-economic status and the prevalence of anemia in adolescent girls. Lower the socio-economic status, higher the prevalence of anemia i.e. maximum (47.6%) in class V and minimum (29.1%) in class I and II. Fathers who were professionals had least prevalence of anemia in their adolescent girls. **Akkamahadevi *et al.* (1998)** studied the prevalence of anemia in adolescent girls (12-18 years) of rural and urban areas of Dharwad Taluka. Among 172 adolescents, 23.84% of the girls were severely anaemic, 22.67% moderately anaemic and 24.42% were having mild anemia. The prevalence was higher in rural girls (57.8%) compared to urban counterparts (31.32%).

Meier *et al.* (1999) found that 47% of all placebo-supplemented and 16% of all iron-supplemented patients exhibited IDA ($p<0.001$); 59% of adolescent placebo-supplemented and 20% of adolescent iron-supplemented patients exhibited IDA ($p=0.021$). Also **Maeda *et al.* (1999)** in their study conducted screening for anemia among adolescents in Tokyo enrolment started from 1966 and included 793 junior and senior high school students in the screening program. It increased to more than 70,000 by 1989. A normal haemoglobin (Hb) level was present in 90% of students before 1981, and in 98% of boys and 95% of girls in 1990 and found that the %age of girls with a normal Hb level decreased gradually after 1991. The high incidence of anemia suggested an increase in the prevalence of iron deficiency. **Kapoor *et al.* (1999)** in his study conducted on the prevalence of anemia found that anemia was prevalent 27.8% in young boys 12-14 years as compared to 41.3% in older boys 15-18 years. Anemia was present in 51% of young girls compared to 38.5% in older girls. The mean haemoglobin was higher in boys as compared to girls in both the age groups. In Sri Lanka, a study was conducted on 690 adolescent girls to estimate the prevalence of anemia **(Jayatissa and Piyasena, 1999)**. Results indicated that 21.1% (146) of girls were having haemoglobin less than 11.5 g/dl and thus were anaemic.

Terhune *et al.* (2000) conducted a study and found that the prevalence of iron deficiency anemia was 6.2±0.8% in Mexican American females and 2.3±0.4% in non-Hispanic white females. The prevalence of iron deficiency anemia was 2.3 times higher in Mexican American than in non- Hispanic white females. According to **Jackson *et al.* (2000)** in a study of prevalence anemia in adolescent Kuwaiti schoolgirls, and its association with hemoglobinopathies as well as the most common environmental cause, Fe deficiency. A cross-sectional sample of 1051 healthy adolescent schoolgirls was studied. Sample size was based on WHO criteria. Anemia, Fe deficiency and hemoglobin (Hb) variations were studied by Hb concentration, and erythrocyte protoporphyrin (EP). Out of the subjects sampled, 30% were anemic. Mildly elevated EP values were found in 68%. Girls with high erythrocyte protoporphyrin (EP) levels. Up to 25% of the girls may have had Fe deficiency anemia. Hemoglobinopathies were neither prevalent nor significantly associated with anemia. These data indicate that environmental factors play a significant role in anemia among healthy, well-to-do Kuwaiti adolescent girls. **Ahmad *et al.* (2000)** found that the prevalence of anemia (Hb<120 g/l) among the studies sample was 27%, 17% had depleted iron stores (SF<12 μg/l). Of all anaemic girls, 32% had iron deficiency anemia (Hb<120 g/l and SF<12 μg/l). **Creed *et al.* (2000)** in his study found that the prevalence of anemia is 35% in non pregnant women of fertile age and 24.7% in adolescent girls in slums of Spain. The major cause of anemia is low intake of dietary iron and results showed that there was a change in knowledge about anemia and improved dietary iron intake in 71 girls who completed the study as compared with the 66 girls in the control group. Similarly **Rajaratnam Jolly *et al.* (2000)** in his study concluded that the prevalence of anemia was 44.8% with severe anemia being 2.1%, moderate 6.3% and mild anemia 36.5%. There was a decrease in the prevalence as the age increased, however the difference was not statistically significant. The prevalence of anemia was 40.7% in premenarcheal girls as compared to 45.2% in postmenarcheal girls. **Shahabuddin *et al.* (2000)** conducted a study on nutritional status of adolescents in a rural community of Bangladesh. It was

reported that 98% (1453 out of 1483) of adolescent girls suffered from anemia. **Kanani *et al.* (2000)** revealed that the prevalence of anemia is high in adolescent girls in India, with over 70% anaemic. Iron-folic acid (IFA) supplements have been shown to enhance adolescent growth elsewhere in the world. To confirm these results in India, a study was conducted in urban areas of Vadodora, India to investigate the effect of IFA supplements on haemoglobin, hunger and growth in adolescent girls 10–18 years of age. Results show that there was a high demand for IFA supplements and >90% of the girls consumed 85 out of 90 tablets provided. There was an increase of 17.3 g/L haemoglobin in the group of girls receiving IFA supplements, whereas haemoglobin decreased slightly in girls in the control group. Girls and parents reported that girls increased their food intake. A significant weight gain of 0.83 kg was seen in the intervention group, whereas girls in the control group showed little weight gain. The growth increment was greater in the 10-14 year old age group than in the 15-18 year old group, as expected, due to rapid growth during the adolescent spurt. IFA supplementation is recommended for growth promotion among adolescents who are underweight. According to **Lynch (2000)** iron deficiency anemia (IDA) during pregnancy is associated with significant morbidity of mothers and infants. Over 50% of pregnant women in developing countries suffer from IDA. It is also prevalent among adolescent girls because the growth spurt and onset of menstruation increase iron requirements. Women who conceive during or shortly after adolescence are likely to enter pregnancy with low or absent iron stores or IDA. Iron supplementation during adolescence is one of the new strategies advocated to improve iron balance in pregnancy. However, iron requirements are highest in the second and third trimesters. Furthermore, although supplementation will correct anemia and increase iron stores in girls, the positive effect on iron status will be temporary if their diets do not contain adequate bio-available iron. Although iron status in early pregnancy may be improved if the period of supplementation continues up to the time of conception, supplementation

before pregnancy should be viewed as an additional strategy to supplementation during the second and third trimesters.

Saluja N., ***et al.*** **(2001)** found that the prevalence of anemia was significantly higher among adolescent girls belonging to joint family (45.2%) than those belonging to nuclear family (28.3%). Prevalence of anemia was also found to be significantly associated with socio-economic status as anemia was higher in socio-economic class V (50%) and significantly reduced with rise in socio-economic status being minimum (27.3%) in class I. Prevalence of anemia was found to be significantly higher (44%) in those adolescent girls whose fathers were working as labourers than those of agriculturists (27.1%). Prevalence of anemia was also found to be significantly higher in those adolescent girls having illiterate (42.2%) and just literate mother (51.9%) as compared to better literate mothers. A significantly high prevalence of anemia was found in adolescent girls belonging to families having family size >3(38%) than 27.2% in those girls from families of family size <3. **Brabin** ***et al.*** **(2001)** revealed that the relationship of anemia as a risk factor for maternal mortality was analyzed by using cross-sectional, longitudinal and case-control studies because randomized trials were not available for analysis. The following six methods of estimation of mortality risk were adopted: 1) the correlation of maternal mortality rates with maternal anemia prevalence derived from national statistics; 2) the proportion of maternal deaths attributable to anemia; 3) the proportion of anemic women who die; 4) population-attributable risk of maternal mortality due to anemia; 5) adolescence as a risk factor for anemia-related mortality; and 6) causes of anemia associated with maternal mortality. The average estimates for all-causes of anemia and attributable mortality (both direct and indirect) were 6.37, 7.26 and 3.0% for Africa, Asia and Latin America, respectively. Case fatality rates, mainly for hospital studies, varied from <1% to >50%. The relative risk of mortality associated with moderate anemia (hemoglobin 40-80 g/L) was 1.35. Population-attributable risk estimates can be defended on the basis of the strong association between severe anemia and maternal mortality but not for mild or moderate anemia. According

to **Al-Buhairan A.M., *et al.* (2001)** reported that anemia varied from a low of 17% in Saudi Arabia to a high of over 70% in Yemen among preschool children; from 14% in the United Arab Emirates to 42% in Pakistan among adolescents; and from a low of 11% in Egypt to over 40% in the Syrian Arab Republic and Oman among women of childbearing age. The comparatively low prevalence of anemia among adult males noted may be attributed to the high iron intake in the form of meat as reported in countries of this region. **Rawat *et al.* (2001)** in his study found that 174 (34.5%) of the 504 adolescent girls were anaemic. In his study he also found that the prevalence of anemia was significantly higher (45.2%) among adolescent girls from joint families as compared to those from nuclear families (28.3%), which may be related to household food security.

Kotech P.V., *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 μg/ml, indicative of poor iron storage. **Deeksha Agarwal *et al.* (2002)** in their study revealed that the prevalence of nutritional anemia in India show that 65% infant and toddlers, 60% children 1–6 years of age, 88% adolescent girls (3.3% had haemoglobin < 7.0 g/dl; severe anemia) and 85% pregnant women (9.9% having severe anemia) were anaemic. The prevalence of anemia was marginally higher in lactating women as compared to pregnancy. **S.N. Massawe *et al.* (2002)** examined that anemia (Hb<105 g/l) was highly prevalent in adolescent primigravidae (75.5%). Adolescent girls were more anaemic (Hb<120 g/l) than boys (14.5 vs. 7.9%). Iron deficiency and hookworm infestation were predominant in both groups of adolescents; however, malaria contributed more to anemia in the primigravidae. Nearly 40% of the anaemic primigravidae had indication of infection, and S-ferritin was less useful as a marker of iron deficiency in this group. STFR identified iron deficiency in both pregnant and non-pregnant adolescents. In another study by **Shah *et al.* (2002)** concluded that the prevalence of anemia declined from 68.6% and 70.1% in groups A and B to 20% and 13.4%, respectively, post supplementation ,whereas the prevalence in group changed little. There was a

significant rise in the mean hematocrit of both supplemented groups but no appreciable change in controls. Net change in mean hematocrit in both the supplementation groups was comparable. Hence the prevalence of anemia in adolescent Nepalese girls is high. Supervised iron and folic acid therapy once a week is an effective alternative to daily administration and helps lower the prevalence of anemia in adolescent girls. Similarly **Gowrikar *et al.* (2002)** reported that the mean haemoglobin was 9.80 g/dl and overall prevalence of anaemic was 96.5% in 459 girls of 10-18 years of age in Ujjain. **Leela *et al.* (2002)** conducted a study on iron status and morbidity pattern among 120 school children in Coimbatore. The results revealed that mean haemoglobin level was 12.5, 11.03 and 9.17 g/dl for the non-anaemic, mild and moderate anaemic, respectively. A study by **Indian Institute of Health and Family Welfare, Hyderabad (2002)** carried out study on Prevention and Control of Anemia in adolescent girls utilizing school system in rural areas of Andhra Pradesh and found that out of 1811 girls enrolled from 16 selected schools, 1516 subjects studying in Classes VI to X were covered. Iron deficiency anemia was found to be the most common nutritional problem encountered by 81% of respondents. Mild, moderate and severe grades of anemia was observed in 63.2%, 12.5% and 5.3% of respondents respectively. Only 19% of respondents had normal haemoglobin (Hb) levels of 12g / dl or above.

Garg (2002) revealed that adolescence (adolescence from adolescere to grow up) is the period from the beginning of puberty until the maturity. The onset of puberty and maturity is a gradual process and variable among individuals. Thus it is not practical to set exact age or chronological limits in defining the adolescent period.

Hamiel *et al.* (2003) stated in his study that iron levels below 8 micro-mol were noted in 38.8% of the obese children and 12.1% of the overweight children, compared with 4.4% of the normal-weight group. There was a significant negative correlation of low iron levels with BMI, but not with age or gender. Among the children with ID, 26.6% also had IDA. Groups 1, 2, and 3

accounted for 6.7%, 35%, and 58.3% of the children with IDA. **Pathak *et al.* (2003)** in his study observed that anemia was prevalent amongst 45.7% of the subjects; with 20-26% of adolescent pregnant mothers (APM) having mild to moderate anemia. This high prevalence of anemia could be due to low intake of dietary iron, as 80% of the APM were consuming iron less than 50% of iron of their recommended daily allowance. Similarly **Al-Sharbatti *et al.* (2003)** found that the prevalence of anemia among adolescents in high socio-economic area (HSEA) was 12.9% compared with 17.6% in low socio-economic area (LSEA). Haemoglobin concentration in males was significantly correlated with age and dietary iron intake while in females it was correlated significantly with years of education of father and mother and age at menarche. Similarly **Al-Mousa *et al.* (2003)** found in his study that more than one-half (55%) of the girls had iron intakes below 70% of RDA, while 49% had iron intakes between 30 and 69% of the RDA. Eighty seven% (87%) of the girls had folate intakes below 70% of RDA and 62% had Folate intakes between 30 and 69% of the RDA. 30.8%, 63.2%, and 51% of the girls consumed tea, cola drinks, and/or chocolates, which inhibit iron absorption .According to **Kumar Dharmender (2003)** in his study reported that iron deficiency anemia is most common and serious health problem in school going children. In his study he had observed high prevalence of iron deficiency anemia (31.6%) in adolescent school going children of district Srinagar in Kashmir valley. A study conducted by **Aggarwal *et al.* (2003)** amongst middle socio-economic group of North East Delhi reported a prevalence of anemia as 45%. Similarly, studies on prevalence of anemia from different states of rural India, reported prevalence of anemia from 46% to 98%.

Bagchi (2004) stated that anemia has remained a widespread public health problem in countries of the Eastern Mediterranean Region. Prevalence figures vary from a low of 17% to a high of over 70% among preschool children; from 14% to 42% among adolescents and from 11% to over 40% among women of childbearing age. Although the prevalence of anemia has often been used as a proxy indicator for iron deficiency anemia, this approach is not valid in settings where the etiology of anemia is complex or unknown or

where other micronutrient deficiencies of folate, vitamin B12 and vitamin A can co-exist. **Manios (2004)** examined that iron deficiency (serum ferritin <15g/l) prevalence was 17.5% among boys and 20.8% among girls. Furthermore, iron deficiency was significantly more prevalent among boys of lower SES, who were also found to have significantly lower levels of serum iron, serum ferritin, transferrin saturation, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration compared to those of higher SES. In terms of dietary factors affecting iron bioavailability, low SES boys exhibited significantly higher frequency of tea consumption and lower frequency of citrus fruit, red meat and fish consumption, compared to their higher SES counterparts. **Soekarjo (2004)** found that the baseline anemia prevalence (Hb<120 g/l) in girls was 20% (prepubertal) and 26% (pubertal), and in boys 24% (pre-pubertal) and 11% (pubertal). Serum retinol concentrations were low (<1.05 mol/l) in 41% of boys and 45% of girls. The interventions did not increase haemoglobin concentrations **Leenstra *et al.* (2004)** revealed that prevalence of anemia (Hb<120 g/l) was 21.1%; only one girl had an Hb less than 70 g/l. Ferritin levels were available from a subsample of 206 girls. The prevalence of iron deficiency (ferritin <12 g/l) was 19.8, and 30.4% of anaemic girls were iron deficient. Malaria and schistosomiasis were the main risk factors for anemia in younger girls 12-13 years, while menstruation was the principal risk factor in older girls 14-18years. According to **Nead *et al.* (2004)** in his sample of 9698 children found that 13.7% were at risk for overweight and 10.2% were overweight. Iron deficiency was most prevalent among 12-16-year-old subjects (4.7%), followed by 2-5 year old subjects (2.3%) and then 6-11year old subjects (1.8%). Overweight 2-5 year old subjects (6.2%) and overweight 12-16 year old subjects (9.1%) demonstrated the highest prevalence of iron deficiency. Overall, the prevalence of iron deficiency increased as BMI increased from normal weight to at risk for overweight to overweight (2.1%, 5.3%, and 5.5%, respectively), and iron deficiency was particularly common among adolescents (3.5%, 7.2%, and 9.1%, respectively). In a multivariate regression analysis, children who were at

risk for overweight and children who were overweight were approximately twice as likely to be iron-deficient (odds ratio: 2.0; 95% confidence interval: 1.2-3.5; and odds ratio: 2.3; 95% confidence interval: 1.4-3.9; respectively) as were those who were not overweight. **Verma *et al.* (2004)** in his study found that majority (81.8%) of girls were anaemic, out of which 55.2% were mildly anaemic, 0.6% severely anaemic and the rest were moderately anaemic. Anemia was found to be significantly higher among girls with the habit of post meal consumption of tea/ coffee (94.4%), whose fathers were working as semi-skilled/skilled workers (77%). The prevalence of anemia was significantly lower in girls consuming green leafy vegetables. **Basu *et al.* (2004)** made a cross sectional study to assess the prevalence of anemia and determined serum ferritin status among 1120 apparently healthy adolescents 12-18 years. The overall prevalence of anemia calculated as per WHO Guidelines was significantly higher among girls (23.9%) as compared to boys .Anemia was observed more in rural (25.4%) as compared to urban (14.2%) adolescents. **Deepa *et al.* (2004)** studied the prevalence rate of anemia. Nearly 32% of the adolescent girls were having severe anemia, 22-25% were having mild anemia and about 35% of them were moderately anaemic in the rural area. In the urban locality, nearly 17.5%, 35% and 32.5% of the subjects were having severe, mild and moderate anemia respectively.

Institute of Health Management Pachod, Pune (2005) carried out study on 1142 adolescent girls residing in 16 slums of Pune from 2000-2003 and it was found that anemia is significantly more likely to be among girls who eat two or fewer meals in a day, have been sick in the past year, and consume few iron rich foods. It was also found that intervention has influenced dietary behaviour with a significant increase in the Intervention site compared to the control site in the percentage of girls who eat more than 3 meals a day, eat lemon with their meals, as well as in the frequency of eating fruits. Blood testing showed that mean Hb levels increased from 5.8 to 9.5 gm/dl for severely anaemic girls and from 8.9 to 11.2 gm/dl for moderately anaemic girls. **Merkel *et al.* (2005)** in his study included 292 male adolescents. In his

study Hemoglobin (Hb), mean corpuscular volume, ferritin, iron, iron-transferrin saturation, and soluble transferrin receptor (TFR) were measured and reported that nearly 19% of the study subjects had mild anemia at recruitment, and depletion of iron stores was observed among 18%. Overall, these changes were not accompanied by a significant increase in soluble TFR. This high prevalence is most likely the result of "sports anemia" due to the intense physical training regimen adopted prior to their recruitment. According **to Sidhu *et al.* (2005)** made study on two hundred sixty-five adolescent girls (age 11+ to 15+) of scheduled caste community of Amritsar and concluded that only 29.43% girls were normal and 70.57% were affected with various grades of anaemic condition, 30.57% girls being mildly anaemic and 27.17% moderately anaemic while 12.83% suffered from severe anemia. Severe anemia was found in the age group of 15 years. **Gur *et al.* (2005)** also conducted a study with a aim to find out the prevalence of anemia among primary school children. The study group was composed of 1531 students between 6 and 16 years old from 14 primary schools located in seven different regions of Istanbul. The overall prevalence of anemia was found to be 27.6%. **Shekar (2005)** undertook a study on iron status of 150 adolescent girls to evaluate their physical fitness. Haemoglobin level estimation showed that 45% of girls were non anaemic (<12 g/dl), 12.6 and 46% were found to be moderately and mildly anaemic respectively. None of them were severely anaemic. Similarly **Devi and Uma (2005)** studied the clinical symptoms of anemia in 100-adolescent girls (14-16 years) from Sri. Avinashilingam higher secondary school for girls in Coimbatore. The results revealed that almost all the signs of iron deficiency anemia were observed and none of them was affected by Koilonychia and Poor stamina. **Iohnsen *et al.* (2005)** conducted a study to show the prevalence of iron-deficiency anemia. The study was conducted in Central Norway where a total of 3005 women aged 20 to 55 years were enrolled in a health survey program. Anemia was present in 4.7% and iron-deficiency anemia in about 3%.

Gawarika *et al.* (2006) found that the prevalence of anemia among the adolescent girls of weaker economic group was 96.5% and among girls of

middle or higher income group was 65.18%. The prevalence of severe anemia among the adolescent girls of weaker income group was 11% and among girls of middle or higher income group was 2.63%. **Kakkar *et al.* (2006)** found that overall prevalence of anemia was 58.4% among adolescent schoolgirls. 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%). **Toteja *et al.* (2006**) reported that 84.9% of pregnant women (n = 6,923) were anaemic (hemoglobin< 110 g/L); 13.1% had severe anemia (hemoglobin< 70 g/L), and 60.1% had moderate anemia (hemoglobin ≥ 70 to 100 g/L). Among adolescent girls (n = 4,337) from 16 districts, the overall prevalence of anemia (defined as hemoglobin< 120 g/L) was 90.1%, with 7.1% having severe anemia (hemoglobin< 70 g/L)S. **Bülent *et al.* (2006)** made a cross-sectional study and out of which (9.7%) girls were anaemic and (3.6%) boys. Iron deficiency anemia was detected in 20/23 (86.9%) of anaemic children [15/17 (88.2%) girls and 4/6 (66.6%) boys]. **Kurniawan *et al.* (2006)** conducted cross sectional study in which 29 (21.8%) suffered from iron deficiency anemia, which was not significantly related to age and menarche. About 50% were underweight and stunted indicating the presence of acute and chronic malnutrition. The proportion of thinness was significantly higher among subjects who suffered from iron deficiency anemia. Furthermore, thin subjects had a 5 fold higher risk of suffering from iron deficiency anemia than non-thin subjects. According to **Cooper (2006)** revealed that poor dietary iron intake and iron deficiency exist in Canada, particularly in women of reproductive age. And suggested that the prevalence of inadequate iron intakes (and low intakes of absorbable iron) among women under 50 years of age is over 10%, which may reflect poor iron status. Teenage girls are at risk for low iron stores because of the adolescent growth spurt and the onset of menstruation; those who are vegetarian are at even greater risk. According to **Oregon University (2006)** reported that in U.S., the average prevalence IDA in target groups is: Infants 1-2 years 6-17per 1000, teenage girls 1.5%, non pregnant females of reproductive age 2%-5%. Factors associated with a higher

prevalence include prematurity and low birth weight, black or Mexican-American race, Alaskan native heritage, recent immigration, poverty and, among teenage girls, fad dieting or obesity. The prevalence among pregnant women is not known. **Aikawa *et al.* (2006)** in his study concluded that the prevalence of anemia (haemoglobin (Hb) <11.0 g dl(-1)) was 43.2% and of severe anemia (Hb<8.0 g dl(-1)) was 0.5%. Taking iron tablets, the consumption of eggs and the preference for Western medicine significantly and positively correlated with Hb concentration in the pregnant women in a multiple regression analysis. Pregnancy duration and hookworm infestation significantly and negatively correlated with Hb concentration in the pregnant women. Similarly a study conducted by **Kaur *et al.* (2006)** on 630 adolescent girls (13-16 years) in four villages of Sevagram, revealed that prevalence of severe, moderate and mild anemia was 0.6% (<7 g/dl), 20.8% (7-10 g/dl) and 38.4% (10-12 g/dl) respectively. **Choudhary *et al.* (2006)** conducted a community-based, cross-sectional study was conducted to determine the prevalence of anemia among unmarried, adolescent south Indian girls in an urban slum setting. A total of 100 apparently healthy girls between the ages of 11 and 18 years were recruited. Their socioeconomic, dietary and anthropometric information was collected, and blood haemoglobin (Hb) was estimated. The prevalence of anemia (Hb<12 g%) was 29%. Most had mild anemia; severe anemia was not seen. Two-thirds of those with anemia had low serum ferritin (<12 µg/L). **Imtiyaz Ali (2006)** conducted in his studies that the adolescent dietary showed calorie deficit up to 20 % of RDA at 10-12 years which reaches upto 25% by 15 years. The deficit was more common among girls. This calorie deficit couple with other specific nutrient deficiencies like iron, iodine and vitamin A.

Nhien *et al.* (2007) found that the prevalence of anemia was 20.4%. The incidences of low serum selenium (Se), zinc, and copper in subjects were 15.9%, 26.5%, and 4.1%, respectively. The parameter significantly associated with anemia was the low serum levels of Se. A body mass index <17.00 kg/m^2 was also found to be a risk factor for low serum selenium. **Killip *et al.***

(2007) in his study found that the prevalence of iron deficiency anemia is 2% in adult men, 9 to 12% in non-Hispanic white women, and nearly 20% in black and Mexican-American women. Nine% of patients older than 65 years with iron deficiency anemia have a gastrointestinal cancer when evaluated. Similarly **Muthaya *et al.*** (**2007)** studied the anemia prevalence in school aged children (5-15years) in Bangalore. The overall anemia prevalence in this group was 13.6%. Anemia prevalence was higher in girls than boys (15.3%,)There was no significant difference in anemia prevalence between children in urban and rural locations (14.6 and 12.3% respectively).Also a study was conducted by **Kalpana *et al.* (2007)** on 500 adolescent girls (13 to 15 years) of low income families in Coimbatore, which revealed that 76.4% of adolescent girls were anaemic and only 23.6% were non anaemic.

Zimmermann *et al.* (2008) in his study conducted on Thai women found that 20% were iron deficient and 22% were overweight. Independent of iron status, a higher BMI *Z*-score was associated with decreased iron absorption. In the Indian and Moroccan children, 42% were iron deficient and 6.3% were overweight. A higher BMI *Z*-score predicted poorer iron status at baseline and less improvement in iron status during the interventions. **Akramipour *et al.* (2008)** conducted a cross-sectional study to determine the prevalence of iron deficiency anemia among adolescent school girls aged 14-20 years from 20 different high schools in Western Iran. The prevalence of anemia among adolescent school girls was 21.4%. Iron deficiency using a ferritin level was found in 23.7% of studied girls. There were 47 girls (12.2%) with iron deficiency anemia l and ferritin. Around 57.3% of anaemic girls were iron deficient. **Turcato *et al.* (2008)** conducted a study to estimate the prevalence and incidence of anemia in adolescent girls predominantly of African-American origin. Baseline prevalence at first CBC age 12 or above was 13%. Of those not anaemic at baseline, 12% developed anemia during follow-up, for an incidence rate of 3.3% per year. Similarly **Chaudhary *et al.* (2008)** conducted a cross sectional survey in an urban area under Urban Health Training Center, Department of Preventive and Social Medicine, Government

Medical College and Hospital, Nagpur. 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 socio-economic strata and among those whose parents were less educated. It was seen that anemia affects the overall nutritional status of adolescent females. Also **Kowsalya *et al.* (2008)** conducted a study on prevalence of anemia in 100 adolescent girls (13-18 years) in Manipur. The results revealed that, among the total subjects, 30 were moderately anaemic (7-10 g/dl) and 25 girls were mildly anaemic (10-12 g/dl). Ten girls were severely anaemic (<7.0 g/dl). **NFHS New Delhi (2008)** reported that adolescence in India goes hand in hand with iron-deficiency anemia, medically known as IDA, says the latest NFHS report. While 56% of adolescent girls are anaemic, boys too are falling prey to the disease. Around 30% of adolescent boys are suffering from anemia, the report states. The National Family Health Survey (NFHS-3), conducted in 2005-06, presents the statistics that mark a growth in cases pertaining to anemia. Most of the anaemic patients, especially women, suffer from mild to severe deficiency of iron. The hemoglobin count in most of the adolescent girls in India is less than the standard 12 g/d, the standard accepted worldwide. "Normally women are not aware of their tendency of being anaemic. They don't have any complaints otherwise. It is only when they come for blood test for some disease. It was found that they are anaemic," reported by Dr. R. S. Chatterjee, Sr. Consultant of Rockland Hospital, New Delhi. Iron deficiency anemia (IDA) is the most prevalent form in India, but "Lack of consciousness among women aggravates the situation, as now a days, they attach more importance to loosing weigh" reports. Dr Anant Mohan of All India Institute of Medical Sciences (AIIMS), New Delhi. The report further reveals that the lack of consciousness, especially regarding the cause of the disease, is one of the main reasons of preponderance of anemia. "While heavy menstrual bleeding in adolescent girls cause anemia, intestinal worms and intake of mildly toxic elements by children, like paint and mud also facilitate the disease. It is very important to provide a child with iron

supplements in order to protect him or her from anemia," he says. His words are all the more significant in context of the NFHS report that shows prevalence of anemia in children in India is as high as 79%.The national family health survey 2, conducted in 1998-99 revealed that In Uttar Pradesh alone, 85% of children under the age of three years suffer from deficiency of iron. But women within the age group of 25-49 suffer the most. **Umeta *et al.* (2008)** made a cross-sectional study in 270 clustered villages drawn from 9 administrative regions of the country between June and July 2005. A total of 22,861 women of reproductive age (15-49 years) were examined clinically. The prevalence rate of clinical anemia, anemia, ID (iron deficiency) and IDA were 11.3%, 30.4%, 49.7% and 17.0% respectively. The majority of anaemic women were in the category of mild (19.3%) to moderate (10.3%) and severe anemia was 0.9%.

Haidar *et al.* (2009) in their study concluded that the overall prevalence rate of iron deficiency anemia was 18.0%. Prevalence of anemia, iron deficiency, and iron deficiency anemia was highest among those 31- 49 years old. Intake of vegetables less than once a day and meat less than once a week was common and was associated with increased anemia. **Esmat *et al.* (2009)** reported that the overall estimate of anemia prevalence in Iranian pregnant women was 13.6%. **Chang *et al.* (2009)** reported that mean value for hemoglobin of adolescents (12.6 ±0.9 g/dl) was significantly higher than adults (12.1 ±1.3 g/dl). Prevalence of anemia amongst adults (41.7%) was higher than adolescents (28.3%). Nutrient intake of anaemic adolescents was lower than non-anaemic adolescents. **Kalaivani (2009)** found that the prevalence of anemia in India is among the highest in the world. Prevalence of anemia is higher among pregnant women and preschool children. Even among higher income educated segments of population about 50% of children, adolescent girls and pregnant women are anaemic. Inadequate dietary iron, folate intake due to low vegetable consumption, perhaps low B12 intake and poor bioavailability of dietary iron from the fibre, phytate rich Indian diets are the major factors responsible for high prevalence of anemia. Increased

requirement of iron during growth and pregnancy and chronic blood loss contribute to higher prevalence in specific groups. Maternal anemia is associated with poor intrauterine growth and increased risk of preterm births and low birth weight rates. This in turn results in higher perinatal morbidity and mortality, and higher infant mortality rate. Thus maternal anemia contributes to intergenerational cycle of poor growth in the offspring. **Jyoti Nandarapu *et al.* (2009)** found that the prevalence of anemia was found to be 68.95%. A significant association of anemia was found with socio economic status and low literacy of parents. High prevalence of anemia was observed in parents of truck, auto drivers and amongst labourers. **Abdelrahim *et al.* (2009)** conducted a cross-sectional study to investigate the prevalence of anemia, iron deficiencies amongst adolescent school girls in New Halfa, eastern Sudan. Out of 187 adolescent schoolgirls, 181 (96.8%) had anemia; 21% had mild anemia; 66.8.1% had moderate anemia, and 12.1% had severe anemia. Similarly **Baral *et al.* (2009)** conducted a cross sectional community based study in Morang district to determine prevalence and distribution of anemia in terms of age, sex and locations (urban and rural) among adolescent population. Three hundred and eight adolescents (127 urban, 181 rural in terms of location and 151 male, 157 female in terms of sex) participated in the study. The overall prevalence of iron deficiency anemia among adolescent population was 65.6% with the distribution of rural 62.4%, urban 70.0%, male 52.3% and female 78.3%. **Patel *et al.* (2009)** in their study conducted amongst adolescent girls, in Gujarat, revealed that only 22% girls had normal Hb (i.e. 12-14gms) but 9% girls had severe anemia (below 8gms Hb) and 22% girls were nearer to anaemic level (8-10gms Hb), whereas 47% girls had normal Hb level i.e. 10-12 gms. According to **Goyle *et al.* (2009)** stated that iron deficiency anemia is widely prevalent amongst women and children in India. They took a study was designed to be an intervention study with nutrient fortified biscuits to ameliorate the micronutrient status of adolescent girls from a low socio-economic background. The baseline data on iron status of 109 adolescent girls 10-15 years studying in a government school in Jaipur city. India depicted that

the iron status of adolescent girls was determined through haemoglobin, serum iron and serum ferritin levels. The results revealed that 96.3% of the adolescent girls suffered from anemia, 31.2% of whom had mild deficiency and 65.1% had moderate deficiency. Anemia was more prevalent in the older age groups. About 31% of the subjects had normal levels while the rest (69%) had low levels of serum iron. Similarly, about 75% of the subjects had low serum ferritin levels. **Ramzan *et al.* (2009)** found in his study that 58.82% healthy/normal weight boys were anaemic, with maximum number at the age of 6 years. Similarly 70% healthy/normal weight girls were anaemic with maximum number at the age of 6 (100%), followed by 10 years (66.66%).

Gupta *et al.* (2010) found that the prevalence of anemia in females 5-30 years was89.5%, which included 49.8% of mild, 38.2% of moderate and 1.5% of severe anemia cases. The prevalence of anemia in males 5-20 years was 89.9%, with 51.2% suffering from mild, 38% from moderate and 0.7% from severe anemia. Both males and females who were in the younger age group, who were under weight, who belonged to a lower socio-economic status and who had a low activity life style, had a higher prevalence of anemia. **Agarwal *et al.* (2010)** reported that 77.2% adolescent girls were found anaemic with serve (3.5%) moderate (28.2%) and mild (45.5%) only 22.8% were observed non anaemic with their haemoglobin levels 12g/dl. **Karaoglu *et al.* (2010)** reported that anemia prevalence was 27.1% (Hb< 11.0 gr/dl). Having four or more living children being at 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 univariate analysis of anaemic 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 anemias were normocytic-normochromic (56.5%) indicating mixed anemia.

Bhanushali *et al.* (2010) stated that the prevalence of anemia is very high among adolescent girls (upto 60-70%) as the haemoglobin level is reported <120 g/l. There was an increment of 19.55 g/L hemoglobin in the

group of girls receiving IFA supplements whereas hemoglobin decreased slightly in girls in the control group. A significant weight gain of 2.66 kg was seen in the intervention group, whereas girls in the control group showed little weight gain. According to **Shamas *et al.* (2010)** carried out study among medical female students between the age of 18-25 years of Tehran and found that the prevalence of ID was 40.9% and that of IDA was 3.8%. Normal iron status was found in 49.8% of the subjects. The remaining (5.5%) had other kinds of anemia or required confirmatory tests. **Ayoya *et al.* (2010)** revealed that the prevalence of anemia among pregnant and non-pregnant women is higher than 50% and 40%, respectively, in all countries. Within countries, this prevalence varies by living setting (rural v. urban), women's age and education. Across countries, socio-economic and climatic differences have no apparent association with the prevalence of anemia among women. Several factors contribute either alone or jointly to the high rates of maternal anemia in this region. These include widespread nutritional deficiencies; high incidence of infectious diseases; low access to and poor quality of health services; low literacy rates; ineffective design, implementation and evaluation of anemia control programmes; and poverty**. Khalafallah *et al.* (2010)** in his study found that prior to delivery, the intravenous plus oral iron arm was superior to the oral iron only arm as measured by the increase in haemoglobin level, the increase in mean serum ferritin level, and the percentage of mothers with ferritin levels below 30 microg/l. A single dose of intravenous iron polymaltose was well tolerated without significant side effects. According to **Siddharam *et al.* (2010)** in his study reported that the prevalence of anemia was found to be 45.2%. A statically significant association was found with iron deficiency anemia, weight loss and anemia, pallor and anemia. In the study it was seen that among the 45.2% of anaemic adolescent girls 40.1% had mild anemia, 54.92% had moderate anemia and 4.92% had severe anemia. **Kabir *et al.* (2010)** conducted a cross sectional study in which Sixty-five adolescent girls aged 15-19 years were selected randomly from college of Dhaka. The prevalence of anemia among the participants was 23%. About 17% had low serum iron, 23% showed evidence of iron-deficient erythropoiesis. About 65% of the participants had correct knowledge about the causes of anemia; while

72.3% and 80% respectively, knew about the prevention and treatment of anemia.

Ramzi *et al.* (2011) reported that there were 21 cases of anemia (5.8%), 31 (8.5%) iron deficiency and 61.7%) iron deficiency anemia. Most of anemic girls (85.7%) had mild anemia. Age and BMI had statistically significant relationship with hemoglobin. Only parasites infestation in the last three months had 6.83 times more risk of anemia than those without this history. **Simon *et al.* (2011)** revealed that up to 10% or more of adolescent and adult women under 49 years are iron deficient. Hispanic American and African-American women have double the prevalence for anemia compared to Caucasian women. The risk for anemia in adolescent girls is about 3%.According to **Suja *et al.* (2011)** conducted study on the age group of the adolescent girls ranged from 12 to 15 years. They were studying in 8^{th}, 9^{th} or 10^{th} standard. Calorie, iron & protein consumption was less compared to their requirement. Hemoglobin ranged from 7.2 to 8.2 gm/dl. Menstruation, worm infestation and dietary deficiency were found as the major cause; which was consistent with the literature. Therefore their study helps to conclude that health awareness programme for the adolescent girls and their society is essential in preventing anemia. **Al-Sayes *et al.* (2011)** conducted a study to determine the prevalence of iron deficiency and iron deficiency anemia among apparently healthy Saudi young female university students studying at King Abdulaziz University in Jeddah. Three hundred ten blood samples were collected from the students. Their age ranged between 18 and 23 years and it was found that 25.9% of students had deficient iron store and 23.9% of students had iron deficiency anemia. **Okeke (2011)** reported that out of the 160 pregnant women blood samples analyzed, (38.8%) were anaemic, and the majority 71% were mildly anaemic cases whereas 29% were moderately anaemic and no severe anaemic cases recorded.

CHAPTER – 3

RESEARCH METHODOLOGY

This chapter provides detail on the design of the study that includes selection of locale, sampling procedure, methodology of data collection and its analysis. It also includes procedures adopted for the execution of the present investigation with the aim to find "Prevalence of Iron Deficiency Anaemia among Adolescent Girls an Impact of Health and Nutrition Education Programme in Changing their Dietary Behaviour." The data has been collected from two sources. **The primary data was obtained by collecting information through questionnaire and interview method.** The secondary data was collected from journals, books, periodicals etc.

A detailed account of the methodology applied in the present study is given as follows:

MATERIAL SELECTION

Locale

The locale for the study was district Srinagar from Kashmir region. The data was collected from 8 educational zones of district Srinagar. The areas of the study comprised of Batamaloo, Hawal, Iddgah, Rainawari, Gulab Bagh, Nishat, Zaldagar, and Srinagar Zone.

Following Government schools were selected from 8 zones ensuring that the age group of 13-16 years of children are enrolled in these schools. The list of schools surveyed are:

Table 3.1

S.No	Zones	Name of the School	No. of Girls Students
1.	Batmaloo	Govt. Girls Higher Secondary School, Batmaloo	25
2.	Eidgah	Govt. Girls High School, Narwara	25
3.	Gulab Bagh	Govt. Girls Secondary School, Gulab Bagh	25
4.	Hawal	Govt. Girls Higher Secondary Institute, Zadibal	25
5.	Nishat	Govt. Girls Higher Secondary, Nishat	25
6.	Rainawari	Government Girls Higher Secondary School, Saida-Kadal	25
7.	Srinagar	Govt. Girls Higher Secondary Institute, Amira Kadal, Srinagar	25
8.	Zaldagar	Govt. Girls Secondary School, Feteh Kadal	25

Sample Group

The sample for the study consisted of adolescent girls from Government schools of district Srinagar falling in the age group of 13-16 years.

Sample size

200 adolescent girls were selected from government schools of district Srinagar in order to arrive at dependable conclusion.

Sampling Technique

There are 476 Government schools in district Srinagar. List of schools of Srinagar district was obtained from the Directorate of School Education. Deliberate Sampling Technique was used to select schools from where sample was obtained. It was ensure that the schools were only meant for girls. Sample group was selected by lottery method. Finally the consent of school authorities was obtained after explaining the objective as well as method of study.

DEVELOPMENT OF QUESTIONNAIRE

In designing questionnaire simple language was used but still in some schools questions had to be explained in local Kashmiri Language to obtain appropriate information from the respondents. Pre-testing was done on 10% of adolescent girls falling in the age group of 13-16 years, to ensure the validity and feasibility of questionnaire before administering it on the entire population. On the basis of pre-testing necessary modifications were made. Pre-tested sample was excluded from the study.

The questionnaire included various sections. They were

- Socio demographic characteristics
- Anthropometric data
- Clinical and Bio-chemical assessment
- Dietary Information
- Menstrual history and history of past illnesses
- Dietary history

Section 1: Socio Demographic Characteristics

In this section the data for each of the selected subjects included information regarding age, dwelling, type of family, ordinal position, fathers qualification & mothers qualification etc.

Section 2: Anthropometric Measurements

These measurements were used to assess the physical development of adolescent girls. Various anthropometric measurements used were height weight and BMI.

Height:- Height was measured with the help of non stretch tape that was fixed to the flat wall. The respondents were asked to remain barefoot and the hair flat. Both feet were together with heels, buttocks, shoulders touching the wall. The respondents were asked to stand erect looking straight ahead the top of the ear and the outer corner of the eye were in line parallel to the floor. The hands were hanging by the sides in natural manner and a horizontal bar was allowed to rest flat on top of the head and height was recorded to the nearest 0.5 cm.

Weight:- The weight of the subjects was measured with the help of digital weighting machine. The subjects were weighed with minimum of clothing. The subjects were weighed thrice and an average of the three readings was taken as the final measurement.

Body Mass Index (BMI):- It is calculated by dividing weight in kg by the square of height in meters. The calculations were compared with standard for classification of the sample.

$$\mathbf{BMI} = \frac{\text{Weight (kg)}}{\text{Height}^2\ \text{(m)}}$$

Since the height of respondents was recorded in centimeters, for the calculation, BMI heights in centimeter were first converted into height in meters.

Table 3.2:

BMI classification of Body Mass Index (BMI)

Based on BMI	Body index Kg/m^2	Health risk associated
Under weight	Below 18.5	Low
Normal range	18.5 – 25.0	Moderate
Over weight	25.1 – 29.1	High
Obesity	30 above	Very high

Source: Sutra (2005) Food and nutrition world, Institute of science Bangalore

CLINICAL AND BIO-CHEMICAL ASSESSMENT

Clinical examination is the most essential part of all nutrition surveys, essentially the method is based examination the subject for changes, believed to be related various nutrient deficiency that can be seen or felt in superficial epithelial tissues especially skin, eyes, hair, tongue, teeth etc. This section of study dealt with observing various signs and symptoms of malnutrition and nutritional deficiency diseases. Clinical assessment consisted rating of respondents for general appearance, hair, eyes, tongue, teeth, gums, skin, nails which helped in assessing out any signs of nutritional deficiencies.

Pre Test: The Hemoglobin estimation of the all 200 sample was done in collaboration with well reputed clinical laboratory. (Sahli'smethod). The reading was compared with WHO standards for classification of anemic samples.

Table 3.3:

Classification of anaemia

Mild	10-11g
Moderate	7-10g
Severe	Less than 7g

NUTRITION EDUCATION

Nutrition and health education can be defined as planned effort to improve nutritional and health status by bringing about changes in the behavior of the people. Nutrition and health education is a process by which people gain the knowledge and develop confidence and skills are needed for establishing good dietary and health practices. However the changing behavior is not easy such changes requires a vigorous and concerted effort through a variety of communication channels. Therefore in this piece of research we have implemented Health and Nutrition Education in the form of a module for the adolescent girls taken as sample for the study.

The methodology adopted for implementation of the programme was as follows:

Development of intervention programme For Reducing Iron Deficiency Anaemia And Changing Dietary Behaviour Among Adolescent Girls

Educational material used in the programme were visual aids in the form of posters and charts. Lecture method was also used to incorporate information regarding various nutrients. The objective of the intervention program was

1. To make group aware of various food groups.
2. To encourage girls to consume iron rich foods.
3. To encourage girls to consume vitamin C rich foods which help in absorption of iron.
4. To make the adolescent girls aware about Recommended Dietary Allowances.

Post Test - Later on after 3 months all 200 respondents were again analyzed for hemoglobin level. 50 respondents out of the total sample were also analyzed for Serrum iron and serrum ferritin. Selection of the respondents

from each school was done by lottery method and from each school five students were taken for serum and ferritin level. Analysis procedure took place at SKIMS.

The procedures for Sahli's is given below:

1. Sahli's Method

Sahil's Method

Principle

Hemoglobin is converted to acid hematin by the action of HCl. The acid hematin solution is further diluted until its colour matches exactly with that of the permanent standard of the comparator block. The hemoglobin concentration is read directly from the calibration tube.

PROCEDURE

Clean the hemoglobin meter tube and pipette and ensure that they are dry.

1. Fill the hemoglobin meter tube with N/10 HCl upto its lowest mark (10% or 2g) with the help of a dropper.
2. Prick the finger under all aseptic precautions, and discard the first drop of blood. Note that the prick should be deep enough to give spontaneous flow of blood. Do not squeeze the finger to make the drop of blood.
3. Allow a large drop of blood to form on the fingertip, and then dip the tip of the hemoglobin meter pipette into the blood drop and suck blood upto $20mm^3$ mark of the pipette. Note while sucking the blood into the pipette care should be taken to prevent entry of air bubbles. This is done by not lifting the tip of pipette out of the blood-drop during pipetting. If an air bubble enters, remove and discard the blood and make another drop of blood to repipette. If the blood is sucked above the $20mm^3$ mark of pipette, bring down the blood column to the mark by tapping the pipette against the finger, but not by using any absorbent material like cotton wool.

4. Wipe the tip of the pipette. Immediately transfer the 0.02 ml of blood from the pipette into the hemoglobin meter tube containing N/10 HCl by immersing the tip of the pipette in the acid solution and blow out blood from the pipette. Rinse the pipette two to three times by drawing up and blowing out the acid solution. Withdraw the pipette from the tube. Note Make sure that no solution remains in the pipette.
5. Leave the solution in the tube in the hemoglobin meter, for about ten minutes (for maximum conversion of hemoglobin to acid hematin, which occurs in the first ten minutes).
6. After ten minutes, dilute the acid hematin by adding distilled water drop by drop. Mix it with stirrer. Match the colour of the solution in the tube with the standards of the comparator. After the addition of every drop of distilled water, the solution should be mixed and the colour of the solution should be mixed and the colour of the solution should be compared with the standard. While matching, take care to hold the stirrer above the level of the solution. However, remember that at no stage should the stirrer be taken out of the tube.
7. If the colour of the test solution is darker, continue dilution till it matches that of the standard.
8. Note the reading when the colour of the solution exactly matches with the standard and express the hemoglobin content as g%. Note the reading of the lower meniscus of the solution should be noted as the result. One more drop of distilled water should be added and the colour should be observed to check the result. The colour will be lighter than the standard if the previous reading was accurate.

Serum Iron

Iron measurements are used in the diagnosis and treatment of diseases such as iron deficiency Anaemia, hemochromatosis (a disease associated with wide spread deposit in the tissues of two iron containing pigments, hemosiderin and hemofucsin, and characterized by pigmentation of the skin), and chronic renal disease .Ferric iron is dissociated from its carrier protein, transferring in

an acid medium and simultaneously reduced to ferrous form. The ferrous iron is then complexed with the chromogen, a sensitive iron indicator, to produce a blue chromophore which absorbs maximally at 595 nm.

Table 3.4:

Normal Values of Serum Iron

Male	59 – 158 µg/dl
Female	37 – 145 µg /dl

Serum Ferritin

Ferritin is a globular protein found mainly in the liver, which can store about 2250 iron (Fe). The ferritin molecule consists of a protein shell (apo ferritin) composed of heavy and light sub units, which surrounds a crystalline core containing iron oxide and phosphate.

Ferritin is synthesized in the liver, spleen and numerous other body tissues, with major concentration found in the liver spleen, bone marrow and intestinal mucosa. The ferritin levels measured have direct correlation with the total amount of iron stored in the body. In the setting of Anaemia, serum feritin is the most sensitive lab test for iron deficiency Anaemia. The serum values are comprised in the following intervals.

Table 3.5:

Normal values of serum ferritin

Normal Values of serum ferritin		Mean (ng/ml)	Range (ng/ml)
Women	Premenopausal	53	6-180
	Post-menopausal	105	8-350
Men		175	20-400

Section 3: Dietary Information

In this section various questions related to dietary information of the individual were put forth. Questions regarding intake of junk foods, frequency of taking green leafy vegetables in their diet, consumption of different foods like fruits, milk etc. were asked to the respondents.

Section 4: Menstrual History and History of past illnesses

This section pertained to the menstrual history of the respondents. The questions included in this section were age of menarche, menopausal syndrome, foods avoided and taken during menstruation, duration of the blood flow & interval between the next menstrual cycle. Moreover, it also included history of past illnesses.

Section 5: Dietary History

Dietary studies are an integral part of nutritional assessment. This section includes various questions about dietary behavior of respondent. Moreover, 24 hour recall was also used to obtained information regarding the intake of different nutrients such as calories, proteins, calcium, fat and iron. In this the quantity of food consumed by the respondents in terms of household measures (cup, spoons, ladles, serving spoons, katories, plates etc) was

recorded. Subjects were asked to recall the actual food consumed during last 24 hours and this was recorded on the diet sheet. The quqntity was measured through these standardized containers. These were later converted into metric weight and the nutritive value was calculated using food consumption table (Nutritive Value of Indian Foods, Gopalan, 2004).

Limitations

Though the research was ridden with problems and the researcher encountered problems in the execution of current research. Firstly adolescent girls were not much copertaive and were reluctant to allow the invest tigator to draw blood for estimation of hemoglobin, serum iron and serum ferritin for which at least 3ml of blood was required. Secondary target group was limited to adolescent girls only.

Data Analysis

The data obtained through questionnaire was consolidated, analysed and interpreted as per the requirement of the objectives, using specific statistical tools for example percentage, mean ± SD, t –test, man Whitney U test and chi square analysis. The p – value of less than 0.05 was considered insignificant. MS excel, SPSS and Minitab, Software were used for data analyses. The data was presented with the help of tables.

CHAPTER – 4

RESULTS

This chapter deals with the analysis and interpretation of data. In order to have results of the investigation at a glance they are presented in a tabular and graphical form:

Table 4.1:

Age wise distribution of respondents

Age in years	Anaemic (<10.0 g%)		Normal (≥ 10.0 g%)		Total	Percentage of anaemic	p value
	Count	% age	Count	% age			
13	12	10.7%	5	5.7%	17	70.6%	0.49 (NS)
14	22	19.6%	14	15.9%	36	61.1%	
15	41	36.6%	35	39.8%	76	53.9%	
16	37	33.0%	34	38.6%	71	52. %1	
Total	112		88		200		

*P < 0.05 show the significant results, $\chi 2 = 2.41$

Table 4.1 presents the distribution of anaemic and non anaemic respondents as per the age. The study was conducted on 200 school going adolescent girls. Out of 200 respondents 56% were found anaemic, the lowest percentage among the anaemic (10.7%) were from the age group of 13 years and the highest (36.6%) belonged to age group of 15 years. Almost same scenario was seen in the normal respondents wherein almost 6% were recorded from age group of 13years and highest in the age group of 15 years considering the age wise distribution of anaemic respondents, table reveals that highest percentage (70.6%) of anaemic respondents were falling in the age group of 13 years.

In order to ascertain whether there is any statistically significant association between the two groups with respect to age chi-square test was employed. The association was statistically insignificant ($\chi 2$= 2.41, p=0.49) between the two groups.

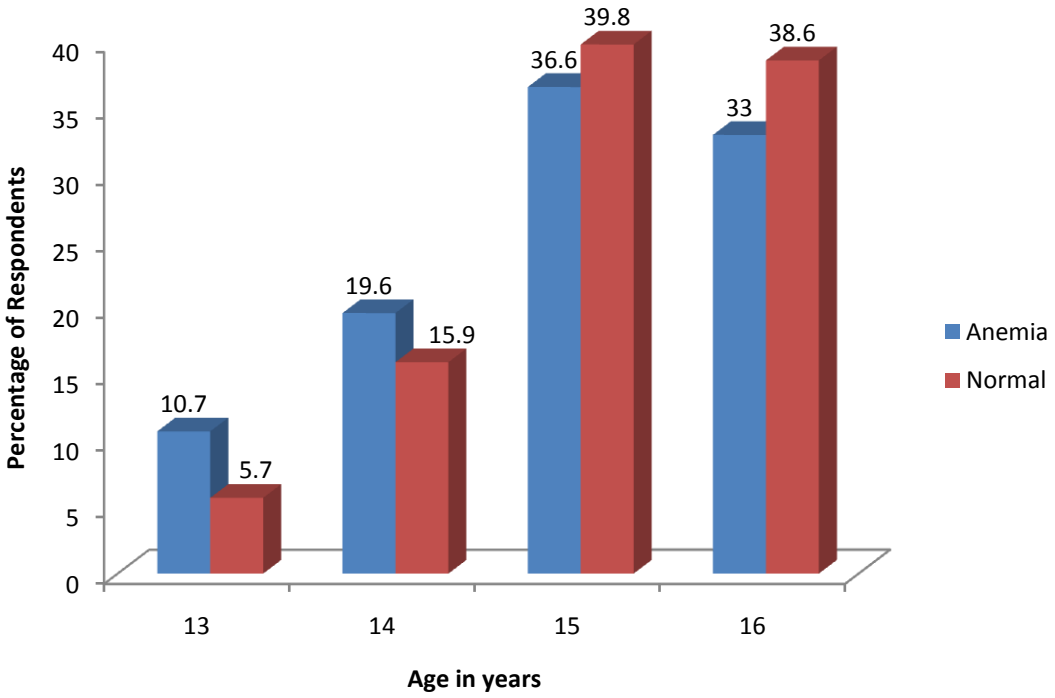


Figure 4.1:

Age wise distribution of respondents

Table 4.2:

Distribution of respondents according to type of family

Type of family	Anaemic (<10.0 g%)		Normal (≥ 10.0g%)		Total	Percentage of anaemic	p value
	Count	% age	Count	% age			
Nuclear	75	67%	44	50%	119	63.02%	0.016 (S)
Joint	37	33%	44	50%	81	45.67%	

*P < 0.05 show the significant results, $\chi 2 = 5.88$

The distribution of respondents according to their type of family is shown in Table 4.2. The nuclear family setup has emerged as the main pattern of families during current years thus vanishing the joint setup. Within group analysis figures show that majority 67 percent of girls in the anaemic group were belonging from nuclear type of family, whereas in the normal group respondents were distributed equally. Group comparison revealed that the prevalence of anaemia was highest (63%) in girls falling in the nuclear family setup. The association between the two groups with respect to type of family was found statistically significant as the p value (p= 0.016) is less than level of significance 0.05.

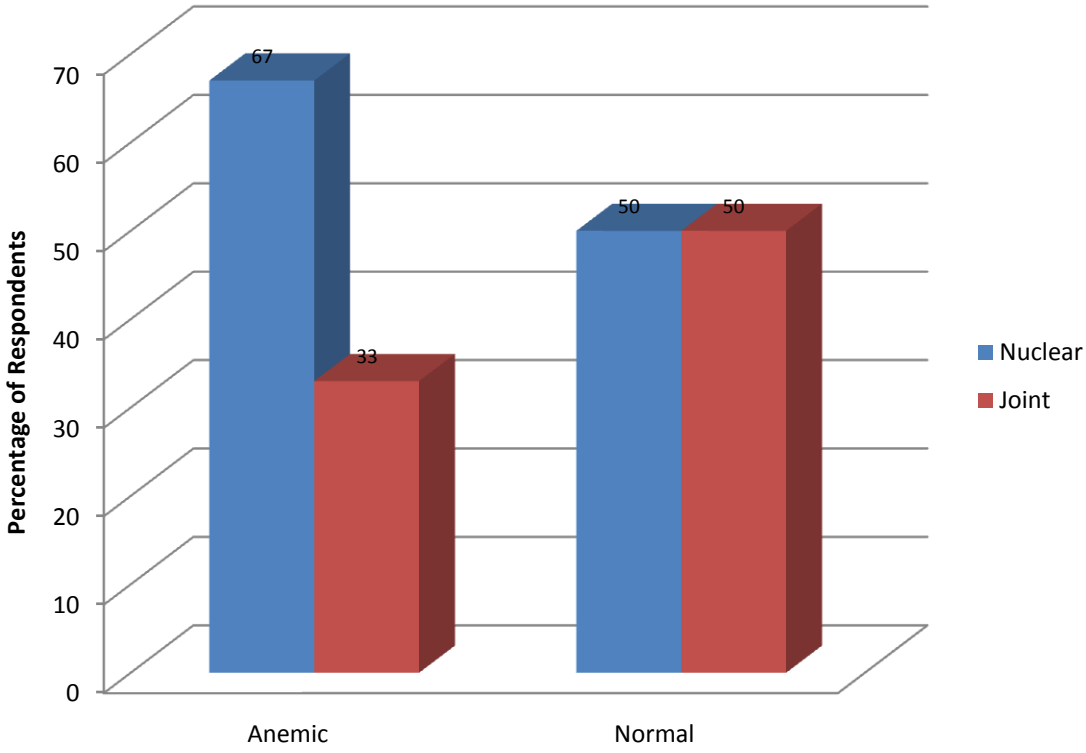


Figure 4.2:

Distribution of respondents according to type of family

Table 4.3:

Distribution of respondents according to the number of family members

No of family members	Anaemic (<10.0 g%)		Normal (≥ 10.0g%)		Total	Percentage of anaemic	p value
	Count	% age	Count	% age			
Up to 5	13	11.6%	19	56.8%	32	40.6%	0.132 (NS)
6-8	23	20.5%	19	21.6%	42	54.8%	
>8	76	67.9%	50	21.1%	126	60.3%	

*P < 0.05 show the significant results, $\chi 2 = 4.04$

The family size plays an important role in dietary intake of individuals, Table 4.3 envisages that almost 68 percent of the respondents having anaemia were from the families having family size of more than eight members. A gradual decrease in percentage of anaemic girls was seen in both groups as the family size gets reduced. The overall percentage of anaemic girls were found less (40.6%) in the families having less than five family members. Insignificant association was found between two groups and the family size, suggesting that both the groups are effected by family size (p=0.132).

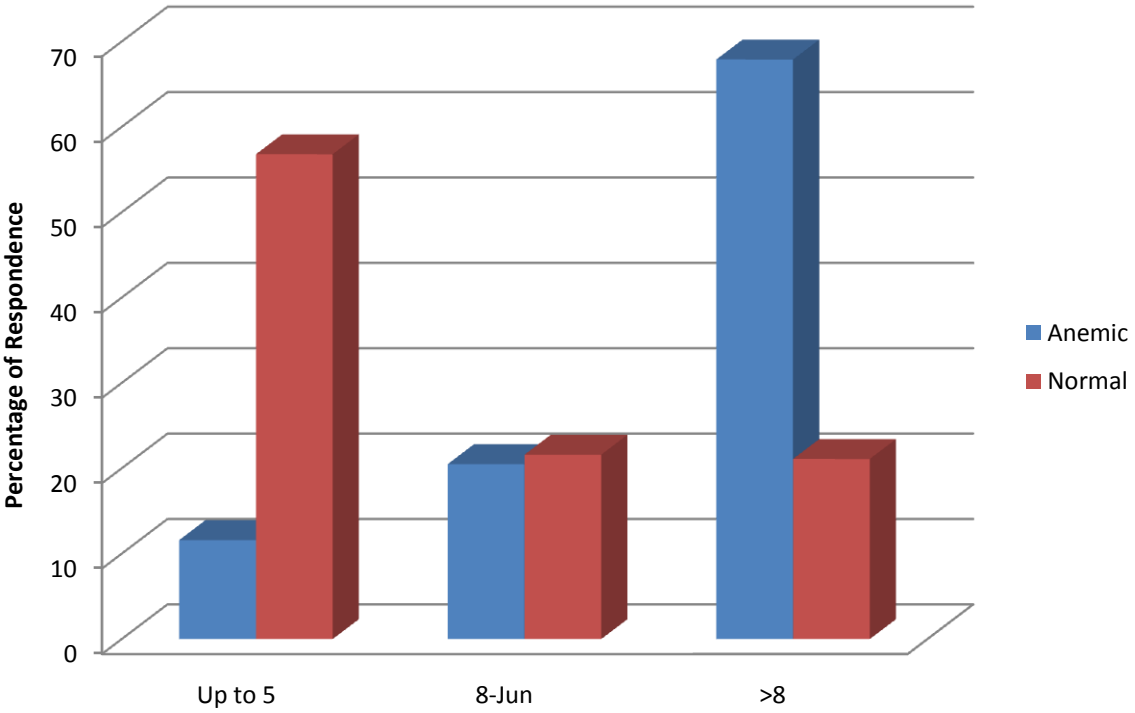


Figure 4.3:

Distribution of respondents according to the number of family members

Table 4.4:

Distribution of respondents according to the number of children in their family

No of children in the family	Anaemic (<10.0 g%)		Normal (≥ 10.0g%)		Total	Percentage of anaemic	p value
	Count	% age	Count	% age			
≤ 3	36	32.1%	32	36.4%	68	52.9%	0.59 (NS)
4-6	73	65.2%	52	59.1%	125	58.4%	
>6	3	2.7%	4	4.5%	7	42.9%	

*P < 0.05 show the significant results, $\chi 2 = 1.04$

The distribution of respondents as per the number of children in their families is given in Table 4.4. Within two groups of study majority of the respondents belonged to those families having the number of children 4-6. As far as the percentage of total respondents to the number of anaemic are concerned the highest percentage of anaemic i.e 58.4% were observed in the families having children 4-6 in number.

In order to ascertain whether there is any statistically significant association between the two groups with respect to age chi-square test was employed. The association was statistically insignificant ($\chi 2= 1.04$, p=0.59) between the two groups.

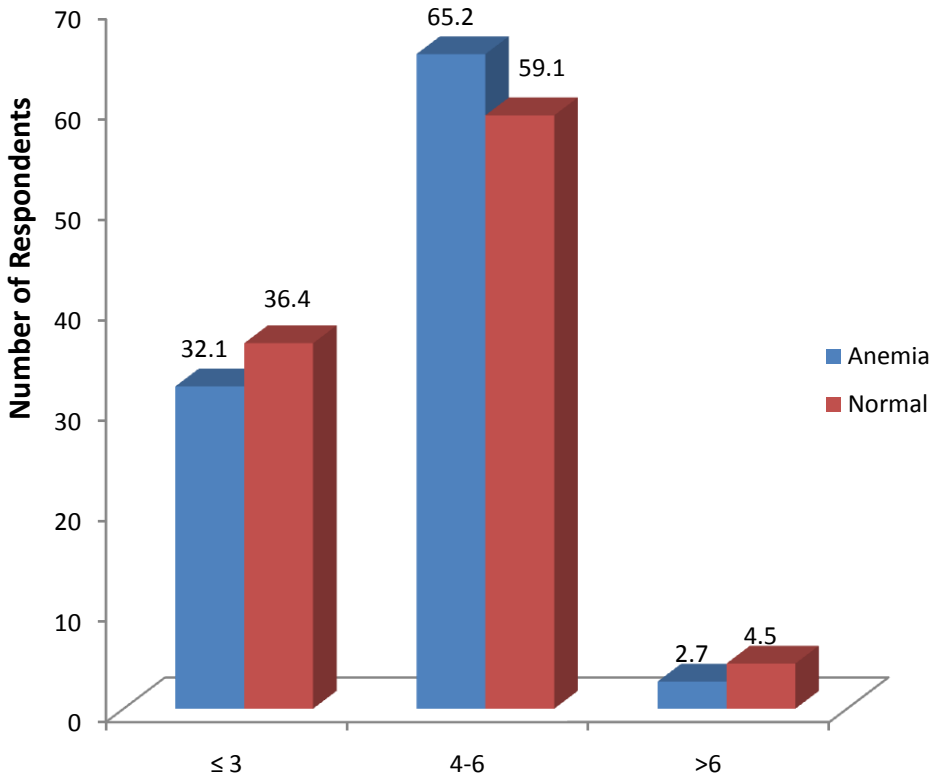


Figure 4.4:

Distribution of respondents according to the number of children in their family

Table 4.5:

Distribution of respondents according to their ordinal position in the family

Ordinal position of respondents	Anaemic (<10.0 g%)		Normal (≥ 10.0 g%)		Total	Percentage of anaemic	p value
	Count	% age	Count	% age			
≤ 2	56	50.0%	49	55.7%	105	53.3%	0.426 (NS)
>2	56	50.0%	39	44.3%	95	58.9%	

*p< 0.05 show the significant results, $\chi 2 = 0.638$

Table 4.5 gives distribution of respondents according to the ordinal position in their family. The respondents were equally observed in two groups viz anaemic respondents while as 55.7% and 44.3% of respondents were observed in normal group. The p value (0.426) shows that there is no significant association between groups and ordinal position of respondents.

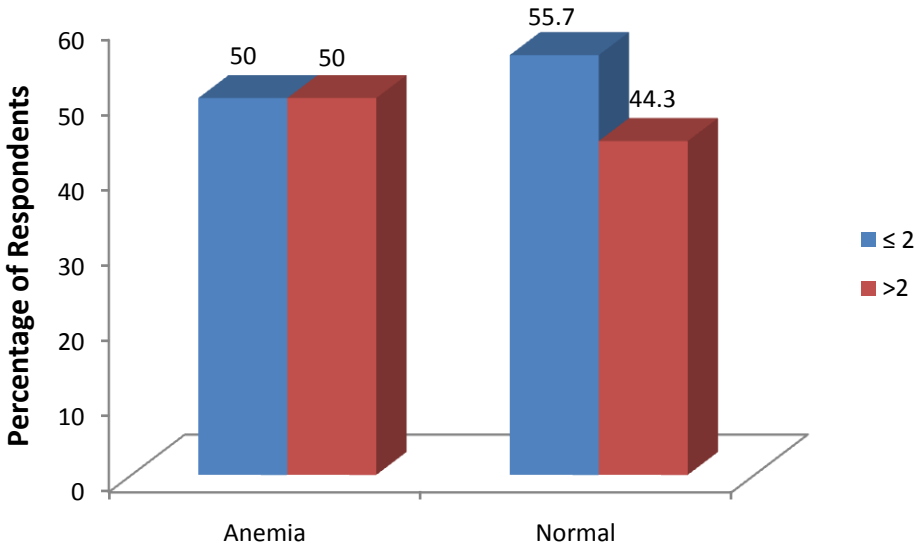


Figure 4.5:

Distribution of respondents according to their ordinal position in the family

Table 4.6

Respondents standard of enrollment in school

Enrollment of respondent	Anaemic (<10.0 g%)		Normal (≥ 10.0 g%)		Total	Percentage of anaemic	p value
	Count	% age	Count	% age			
7th standard	5	4.5%	1	1.1%	6	83.3%	0.51 (NS)
8th standard	19	17%	13	14.8%	32	59.4%	
9th standard	44	39.3%	35	39.8%	79	55.7%	
10th standard	44	39.3%	39	44.3%	83	53.0%	

*$p < 0.05$ show the significant results, $\chi 2 = 2.27$

The distribution of respondents according to their standard of enrollment in school is presented in table 4.6. The highest percentage (83.3%) of anaemic girls were seen studying in 7th standard but these figures are based only on six observations. Rest in all the classes of the observation of anaemic girls the percentage was from 53% to 60 %. It is evident from the table that percentage of anaemic girls were more in proportion to normal group of girls. In order to ascertain whether there is any association between the two groups with respect to class of study ,chi-square test was employed which showed that there is statistically insignificant association (p=0.51) between the groups.

Table 4.7:

Distribution of respondents according to the educational qualification of their parents

Literacy status of parents	Anaemic (<10.0 g%)		Normal (≥ 10.0g%)		Total	Percentage of anaemic	p value
	Count	% age	Count	% age			
Both illiterate	92	82.1%	53	60.2%	145	63.4%	0.000 (S)
Single literate	19	17.0%	25	28.4%	44	43.2%	
Both literate	1	0.9%	10	11.4%	11	9.1%	

*$p < 0.05$ show the significant results, $\chi 2 = 16.02$

It is common belief that educated parents are conscious of giving their children the requisite and balanced diet. The figures in table 4.7 is testimony to this fact almost 82 % of the girls among anaemic group were those having both the parents illiterate and negligible percentage (0.9%) were respondents in the anaemic group whose both parents were literate. It can also be seen from the table that there is a sharp decline in percentage of anaemic girls when both the parents are illiterate as against when at least one of them is literate. Inter group comparison show that in totality the highest percentage 63.4% of anaemic respondents had both parents illiterate. To justify the fact statistically, whether educational status of parents does influence the anaemic condition, chi-square test was employed which show that there is significant association (p=0.000).

Table 4.8:

Distribution of respondents according to the monthly income of their family

Socio economic status	Anaemic (<10.0 g%)		Normal (≥ 10.0 g%)		Total	Percentage of anaemic	p value
	Count	% age	Count	% age			
Low & lower middle Class (<5000)	100	89.3%	77	87.5%	177	56.5%	0.695 (NS)
Average Middle (5000 to 10000)	12	10.7%	11	12.5%	23	52.2%	

Source: Socio-economic Status Scale by Dr. A.G. Madhosh and K.P. Rafiqui,

*P < 0.05 show the significant results, $\chi 2 = 0.15$

Table 4.8 show the distribution of respondents according to the montly income of their family. There is not much difference in the percentages of anaemic and normal respondents as far as the income of family is concerned. In both the groups whether the income is less than Rs.5000 or more the percentage is almost proportional. No doubt that the number of anaemic is higher in low income group, but at the same time normals are also equally high in this income group. A slight difference in percentages cannot be taken as significant which is evident from chi square value and p value (p=0.695) of the test of association.

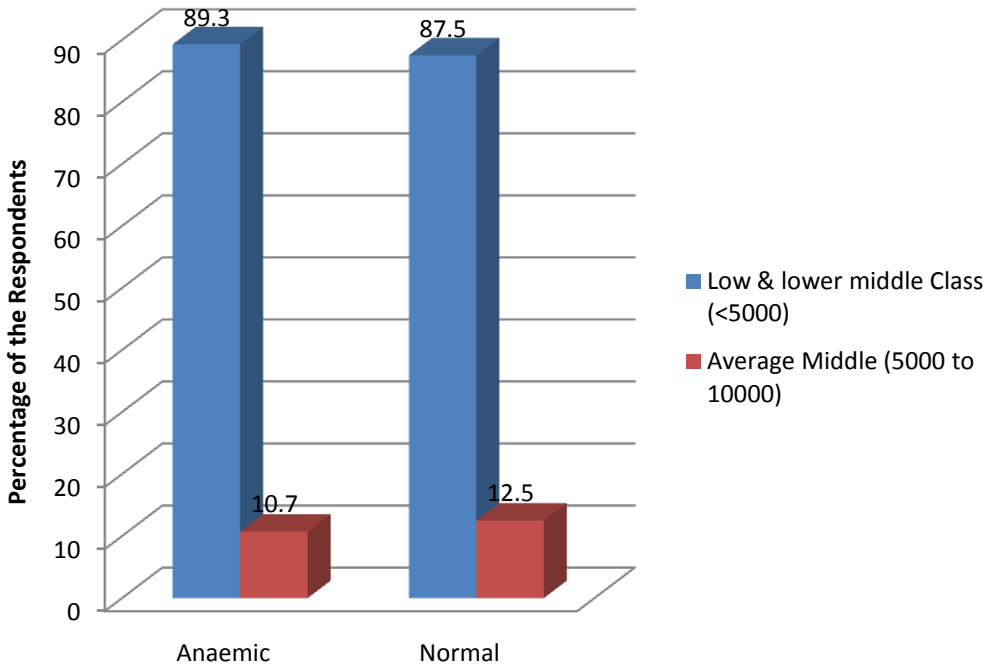


Figure 4.6:

Distribution of respondents according to the monthly income of their family

Table 4.9:

Descriptive statistics of Height (cm) of respondents

Age	Anaemic Mean ± SD	Normal Mean ± SD	P-value	Recommended values (cm)
13 years	144.0±17.9	152.63±6.9	0.421 (NS)	157
14 year	148.3±12.3	152.2±14.3	0.408 (NS)	157
15 years	145.1±13.8	153.4±10.9	0.008 (S)	160
16 years	148.6±12.7	152.2±12.2	0.182 (NS)	160

Source: Food and Nutrition Board of India, National Academy of Science Designed for the Maintenance of Good Nutrition.

Heights were measured for all the 200 respondents and mean and standard deviations for different age groups were calculated and same is presented in the tabular form as in table 4.9. To test whether the respondents meet the standard values. t-test for single mean was used. In case of respondents belonging to 15 years of age there was statistically significant difference between the standard heights given by National Nutrition Bureau and the respondents in that particular group wherein as per National Nutrition Bureau standards height should be on an average 160cm but our study group had much lower height than that. ($p = 0.008$).

Table 4.10:

Descriptive statistics of Weight (Kg) of respondents

Age	Anaemic Mean ± SD	Normal Mean ± SD	P-value	Recommended value (Kg) ICMR
13 years	42.25±6.54	38.50±7.05	0.414 (NS)	46.7
14 year	44.24±5.53	44.36±5.54	0.951 (NS)	46.7
15 years	45.13±7.14	43.22±5.61	0.214 (NS)	46.7
16 years	46.58±5.19	47.76±8.59	0.445 (NS)	49.9

*p<0.05 show the significant difference

Weights were measured for all the 200 respondents and mean and standard deviations for different age groups were calculated and same is presented in the tabular form as in table 4.10. To test whether the respondents meet the standard values given by ICMR, t-test for single mean was used. There was statistically insignificant difference between the standard weight given by ICMR.

Table 4.11:

Body Mass Index of the respondents

Body Mass Index	Anaemic Hb (<10.0 g%)		Normal Hb (≥ 10.0 g%)		Total	Percentage of anaemic	p value
	Count	%age	Count	%age			
Low (below 18.5 Kg)	44	39.3%	24	23.7%	68	64.7%	0.015 (S)
Normal (18.5-25.0Kg)	58	51.8%	44	50.0%	102	56.9%	
Over Weight (25.1-29.1Kg)	10	8.9%	20	22.7%	30	33.3%	

*$p < 0.05$ show the significant results, $\chi 2 = 8.37$

Table 4.11 show the body mass index of respondents studied. The lowest percentage of anaemic group i.e 8.9% belongs to overweight category and highest percentage i.e 51.8% belongs to normal category. While same observations were found in normal group, the lowest percentage i.e 22.7% belongs to overweight and highest percentage i.e 50.0% belongs to normal. Thus, it was found that the highest percentage of anaemic i.e 64.7% belonged to the low weight category (less than 18.5Kg). In order to ascertain whether there is any association between the two groups with respect to their Body Mass Index (BMI) chi-square test was employed which show that there is statistically insignificant association (p=0.015) between the two groups.

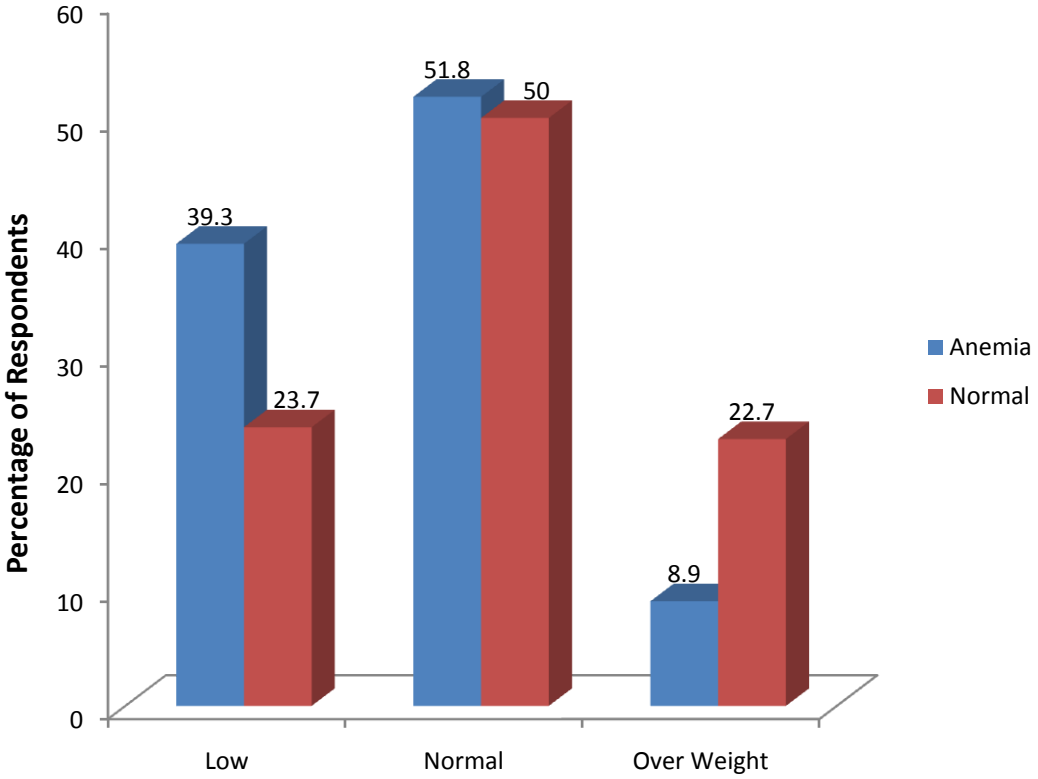


Figure 4.7:

Body Mass Index of the respondents

Table 4.12:

Clinical Signs and Symptoms of the respondents

Clinical Signs		Anaemic Hb (< 10.0 g%)		Normal Hb (≥ 10.0 g%)		Total	Percentage of anaemic	p value
		Count	%age	Count	%age			
Body appearance	Small	48	42.9%	35	39.8%	83	57.8%	0.817 (NS)
	Average	51	45.5%	44	50.0%	95	53.7%	
	Large	13	11.6%	9	10.2%	22	59.1%	

*$p < 0.05$ show the significant results, $\chi 2 = 0.40$

Table 4.12 show clinical signs and symptoms of the respondents. In case of anaemic group the lowest percentage i.e 11.6% had large body appearance and highest percentage i.e, 45.5% had average body appearance. While in normal group the lowest percentage 10.2% had large body appearance and highest percentage 50.0% had average appearance. Thus, it is found that highest percentage of anaemic i.e, 59.1% had large body appearance. The p-value (0.817) show that there is no significant association between the groups.

Table 4.13:

Clinical Signs and Symptoms of the respondents

Clinical Signs		Anaemic Hb (< 10.0 g%)		Normal Hb (≥ 10.0 g%)		Total	Percentage of anaemic	p value
		Count	%age	Count	%age			
Eyes	Normal	55	49.1%	54	61.4%	109	50.5%	0.22 (NS)
	Watery	16	14.3%	10	11.4%	26	61.5%	
	Dry	41	36.6%	24	27.3%	65	63.1%	
Lips	Normal	63	56.3%	42	47.7%	105	60.0%	0.232 (NS)
	Angular stomatitis	49	43.8%	46	52.3%	95	51.6%	
Tongue	Normal	66	58.9%	38	43.2%	104	63.5%	0.082 (NS)
	Pale	28	25.0%	32	36.4%	60	46.7%	
	Red	18	16.1%	18	20.5%	36	50.0%	

*$p < 0.05$ show the significant results,

(Eyes $\chi 2 = 3.00$, Lips $\chi 2 = 1.43$, Tongue $\chi 2 = 4.99$)

Table 4.13 show clinical signs and symptoms of the respondents. In case of anaemic group the lowest percentage i.e 14.3% had watery eyes and highest percentage i.e, 49.1% had normal eyes. While in normal group the lowest percentage 11.4% had watery eyes and highest percentage 61.4% had normal eyes. It is found that highest percentage of anaemic i.e, 63.1% had dry eyes.

In case of anaemic group the lowest percentage i.e 43.8% had angular stomatitis lips and highest percentage i.e, 56.3% had normal lips. While in case of normal group the lowest percentage 47.7% had normal lips and highest

percentage 52.3% had angular stomatitis lips. Thus, it is found that highest percentage of anaemic i.e, 60.0% had normal lips.

Further in anaemic group the lowest percentage i.e 16.1% had red tongue and highest percentage i.e, 58.9% had normal tongue. While in case of normal group the lowest percentage 20.5% had red tongue and highest percentage 43.2% had normal tongue. Thus, it is found that highest percentage of anaemic i.e, 63.5% had normal tongue.

In order to ascertain whether there is any association between the two groups with respect to the clinical signs and symptoms (eyes, lips and tongue), chi-square test was employed which show that there is statistically insignificant association ($p=0.22$, $p=0.23$ and $p=0.08$) between the two groups.

Table 4.14:

Clinical Signs and Symptoms of the respondents

Clinical Signs		Anaemic Hb (< 10.0 g%)		Normal Hb (≥ 10.0 g%)		Total	Percentage of anaemic	p value
		Count	%age	Count	%age			
Skin	Normal	60	53.6%	40	45.5%	100	60.0%	0.519 (NS)
	Pale	4	3.6%	4	4.5%	8	50.0%	
	Dry and Rough	48	42.9%	44	50.0%	92	52.2%	
Teeth	Normal	75	67.0%	58	65.9%	133	56.4%	0.876 (NS)
	Discoloured	37	33.0%	30	34.1%	67	55.2%	
Gums	Normal	60	53.6%	49	55.7%	109	55.0%	0.767 (NS)
	Bleeding	52	46.4%	39	44.3%	91	57.1%	
Nails	Normal	70	62.5%	58	65.9%	128	54.7%	0.619 (NS)
	Abnormal	42	37.5%	30	34.1%	72	58.3%	

*p < 0.05 show the significant results

(Skin $\chi 2 = 1.31$, Teeth $\chi 2 = 0.02$, Gums $\chi 2 = 0.08$, Nails = 0.24)

Table 4.14 show clinical signs and symptoms of the respondents. In case of anaemic group the lowest percentage i.e 3.6% had pale skin and highest percentage i.e, 53.6% had normal skin. In normal group the lowest percentage 4.5% had pale skin and highest percentage 50.0% had dry and rough skin. Thus, it is found that highest percentage of anaemic i.e, 60.0% had normal skin.

Further in anaemic group the lowest percentage i.e 33.0% had discoloured teeth and highest percentage i.e, 67.0% had normal teeth. In case of normal group the lowest percentage 34.1% had discoloured teeth and highest

percentage 65.9% had normal teeth. Thus, it is found that highest percentage of anaemic i.e, 56.4% had normal teeth.

Also, in case of anaemic group the lowest percentage i.e 46.4% had bleeding gums and highest percentage i.e, 53.6% had normal gums. In case of normal group the lowest percentage 44.3% had bleeding gums and highest percentage 55.7% had normal gums. Thus, it is found that highest percentage of anaemic i.e, 57.1% had bleeding gums.

Furthermore, in anaemic group the lowest percentage i.e 37.5% had abnormal nails and highest percentage i.e, 62.5% had normal nails. In case of normal group the lowest percentage 34.1% had abnormal nails and highest percentage 65.9% had normal nails. Thus, it is found that highest percentage of anaemic i.e, 58.3% had abnormal nails either spoon-shaped nails or white spot on nails a common sign of anaemia.

In order to ascertain whether there is any association between the two groups with respect to the clinical signs and symptoms (skin, teeth, gums and nails), chi-square test was employed which show that there is statistically insignificant association ($p=0.519$, $p=0.876$, $p=0.767$ and $p=0.619$) between the two groups.

Table 4.15:

Health status of the respondents

Health status		Anaemic Hb (< 10.0 g%)		Normal Hb (≥10.0 g%)		Total	Percentage of anaemic	p value
		Count	%age	Count	%age			
Breathlessness	Present	8	7.1%	22	25.0%	30	26.7	0.000 (S)
	Absent	104	92.9%	66	75.0%	170	61.2	
Weakness	Present	16	14.3	16	18.2	32	50.0	0.560 (NS)
	Absent	96	85.7	72	81.8	168	57.1	
Tiredness	Present	37	33.0	31	35.2	68	54.4	0.765 (NS)
	Absent	75	67.0	57	64.8	132	56.8	
Irritability	Present	50	44.6	34	38.6	84	59.5	0.394 (NS)
	Absent	62	55.4	54	61.4	116	53.4	

*$p < 0.05$ show the significant results

(Breathlessness $\chi 2 = 12.32$, Weakness $\chi 2 = 0.55$, Tiredness $\chi 2 = 0.10$, Irritability $\chi 2 = 0.73$)

Table 4.15 gives health status of the respondents. In case of anaemic group the lowest percentage i.e 7.1% had breathlessness and highest percentage i.e 92.9% had no such symptoms. In case of normal group, lowest percentage 25.0% had breathlessness and highest percentage i.e 75.0% had no such symptoms. Thus the results revealed that 26.7% of the respondents had breathlessness present and 61.2% had no such symptoms.

Again in case of anaemic group the lowest percentage i.e 14.3% had complaints of body weakness present and highest percentage i.e, 85.7% had no such symptoms. In case of normal group, lowest percentage 18.2% had again

weakness and highest percentage i.e 81.8% had no such symptoms. Thus, it is found that highest percentage of anaemic i.e 57.1% between the two groups had no complaints of body weakness.

Further, in case of anaemic group the lowest percentage i.e 33.0% had body tiredness and highest percentage i.e, 67.0% had no complaints of tiredness. Again in the case of normal group, lowest percentage 35.2% had tiredness and highest percentage i.e, 64.8% had no such complaints. Thus, it is found that highest percentage of anaemic i.e 56.8% between the two groups who had no complaint of tiredness.

However, in case of anaemic group the lowest percentage i.e 44.6% could feel irritability quite often and highest percentage i.e, 55.4% had no such complaints. In case of normal group, lowest percentage 38.6% had complaint of irritable nature and highest percentage i.e, 61.4% had no such symptoms. Thus, it is found that highest percentage of anaemic i.e 59.5% was found between the two groups who had complaints of irritability.

The association between the two groups with respect to health status of the respondents (breathlessness, weakness, tiredness and irritability) chi-square test was employed which show that in case of breathlessness there is statistically significant association (p=0.000) between the two groups.

Table 4.16:

Types of past illness of the respondents

Types of illness	n	% of Illness
Anaemia	24	12.0
Tonsillitis	9	4.5
Stomach Pain	3	1.5
Renal Infection	1	0.5
Normal	163	81.5
Total	**200**	**100%**

Table 4.16 throw light on the types of illness of the respondents. It was found that 81.5% of the adolescent had normal health, 12.0% had anaemia followed by 4.5% and 1.5% who had tonsillitis and stomach pain. 0.5% had renal infection. Moreover, majority of respondents did not had complaint of any type of past illness.

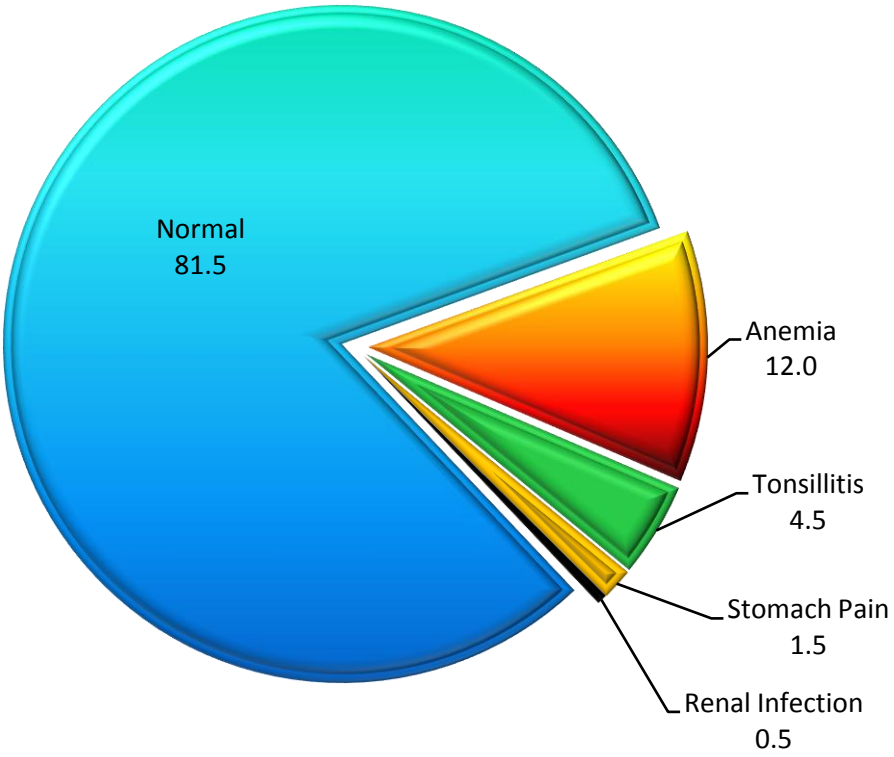


Figure 4.8: Types of past illness of the respondents

Table 4.17:

Menarche status of the respondents

Menarche status		Anaemic Hb < 10.0 g%)		Normal Hb (≥10.0 g%)		Total	Percentage of anaemic	p value
		Count	%age	Count	%age			
Age of Menarche (years)	< 12	19	17.1%	17	19.8%	36	52.8%	0.634 (NS)
	≥ 12	92	82.9%	69	80.2%	161	57.1%	
Dysmenorrhea	Yes	86	77.5%	67	77.9%	153	56.2%	0.943 (NS)
	No	25	22.5%	19	22.1%	44	56.8%	
Syndrome (vomiting, adnominal pain & backache)	Yes	86	77.5%	68	79.1%	154	55.8%	0.789 (NS)
	No	25	22.5%	18	20.9%	43	52.2%	
Duration of Blood Flow	2 to 3 days	12	10.8%	11	12.8%	23	52.2%	0.976 (NS)
	3 to 4 days	26	23.4%	19	22.1%	45	57.1%	
	4 to 5 days	36	32.4%	28	32.6%	64	56.3%	
	> 5 days	37	33.3%	28	32.6%	65	55%	
Cycle Duration (month)	> 28 days	85	76.6%	68	79.1%	153	55.6%	0.678 (NS)
	< 28 days	26	23.4%	18	20.9%	44	59.1%	
Cycle	Regular	100	90.1%	72	83.7%	172	58.1%	0.184 (NS)
	Irregular	11	9.9%	14	16.8%	25	44.0%	

*p < 0.05 show the significant results

(Age of Menarche years $\chi 2 = 0.22$, Dysmenorrhea $\chi 2=0.005$, Syndrome $\chi 2 = 0.07$, Duration of Blood Flow $\chi 2=0.209$, Cycle Duration $\chi 2= 0.174$, Cycle $\chi 2=1.77$)

Table 4.17 gives the menarche status of the respondents. In case of anaemic group the lowest percentage i.e, 17.1% fall in less than 12 years of age of menarche and highest percentage i.e 82.9% fall in greater than or equal to 12 years of age of menarche. In the case of normal group lowest percentage i.e 19.8% fall in the age of manarche less than 12 years. Thus, it was found that the highest percentage of anaemic i.e 57.1% fall in the age group who had menarche either greater than or equal to 12 years.

While in case of anaemic group the lowest percentage i.e, 22.5% had no dysmenorrhea and highest percentage i.e 77.5% had dysmenorrhea. In case of

normal group lowest percentage i.e 22.1% had no dysmenorrhea. Thus, it was found that the highest percentage of anaemic i.e 56.8% had no dysmenorrhea.

Further in case of anaemic group the lowest percentage i.e, 22.5% had no syndrome and highest percentage i.e 77.5% had some syndrome (vomiting, adnominal pain and backache). In case of normal group lowest percentage i.e 20.9% had no syndrome (vomiting, adnominal pain and backache). Thus, it was found that the highest percentage of anaemic i.e 55.8% had syndrome (vomiting, adnominal pain and backache).

Also, in case of anaemic group the lowest percentage i.e, 10.8% had duration of blood flow of 2-3 days and highest percentage i.e 33.3% had duration of blood flow for more than 5 days. In case of normal group lowest percentage i.e 12.8% the duration of blood flow for 2-3 days. Thus, it was found that the highest percentage of anaemic i.e 57.1% had duration of blood flow 3-4 days.

Moreover, in case of anaemic group the lowest percentage i.e, 23.4% had monthly cycle duration less than 28 days and highest percentage i.e 76.6% had monthly cycle duration more than 28 days. In case of normal group lowest percentage i.e 20.9% had monthly cycle duration less than 28 days. Thus, it was found that the highest percentage of anaemic i.e 59.1% had monthly cycle duration less than 28 days.

Lastly, in case of anaemic group the lowest percentage i.e, 9.9% had irregular cycle and highest percentage i.e 90.1% had regular cycle. In case of normal group lowest percentage i.e 16.8% had irregular cycle. Thus, it was found that the highest percentage of anaemic i.e 58.1% had regular menstrual cycle.

In order to ascertain whether there is any association between the two groups with respect to the menarche status of the respondents, chi-square test was employed which show that there is statistically insignificant association ($p=0.634$, $p=0.943$, $p=0.789$, $p=0.976$, $p=0.678$ and $p=0.184$) between the two groups.

Table 4.18:

Source of drinking water consumed by the respondents

Type of drinking water consumed		Anaemia Hb (< 10.0 g%)		Normal Hb (≥10.0 g%)		Total	Percentage of anaemic	p value
		Count	%age	Count	%age			
Source of Drinking Water	Tube well	21	18.7%	1	1.1%	22	95.4%	0.00 (S)
	Tap water	91	93.9%	87	94.3%	178	51.1	

*$p < 0.05$ show the significant results, $\chi 2 = 15.61$

Table 4.18 show source of drinking water consumed by the respondents. Almost 94% in both the study groups were drinking tap water, the percentage of respondents consuming water from tube well was slightly higher in case of anaemic group were it was 18.7% as against 1.1% in normal group. Overall it is found that there is strong association between the two sources of drinking water and anaemic or normal conditions.

Table 4.19:

Hygiene of drinking water consumed by the respondents

Drinking water consumed		Anaemia Hb (< 10.0 g%)		Normal Hb (≥10.0 g%)		Total	Percentage of anaemic	p value
		Count	%age	Count	%age			
Boiled Water	Yes	40	35.7%	38	43.2%	78	51.3%	0.284 (NS)
	No	72	64.3%	50	56.8%	122	59.0%	

*p < 0.05 show the significant results, $\chi 2 = 1.15$

Table 4.19 show hygiene of drinking water consumed by the respondents. In case of anaemic group the lowest percentage i.e 35.7% are those who take boiled water and highest percentage i.e 64.3% are those who do not take boiled water. In normal group the lowest percentage i.e, 43.2% are those who take boiled water and highest percentage i.e 56.8% do not take boiled water. Thus, it is found that the highest percentage between the two groups i.e 59.0% are those who do not take boiled water. Overall it is found that there is no association between the two sources of drinking water under anaemic or normal conditions.

Table 4.20:

Junk foods taken by the respondents

Junk food taken	Anaemic Hb (< 10.0 g%)		Normal Hb (≥10.0 g%)		Total	Percentage of anaemic	p value
	Count	%age	Count	%age			
Yes	87	77.7%	68	77.3%	155	56.1%	0.946 (NS)
No	25	22.3%	20	22.7%	45	55.6%	

*p < 0.05 show the significant results, $\chi 2 = 0.005$

Table 4.20 shows junk foods taken by respondents. In case of anaemia group the lowest percentage i.e 22.3% are those who do not take junk food and highest percentage i.e 77.7% are those who take junk food. In case of normal group the lowest percentage i.e, 22.7% are those who do not take junk food and highest percentage i.e 77.3% are those who take junk food. Thus, it is found that the highest percentage between the two groups i.e 56.1% are those who take junk food.

In order to ascertain whether there is any association between the two groups with respect to junk foods taken by the respondents, chi-square test was employed which show that there is statistically significant association (p=0.946) between the two groups.

Table 4.21:

Frequency of junk foods taken by the respondents

Frequency		Anaemic Hb (< 10.0 g%)		Normal Hb (≥10.0 g%)		Total	Percentage of anaemic	p value
		Count	%age	Count	%age			
Frequency of junk foods	Daily	18	20.7%	8	11.8%	26	69.2%	0.006 (S)
	Twice a week	38	43.7%	49	72.1%	87	43.7%	
	Once a week	22	25.3%	8	11.8%	30	73.3%	
	Once a month	9	10.3%	3	4.4%	12	75.0%	

*$p < 0.05$ show the significant results, $\chi 2 = 12.63$

Table 4.21 shows frequency of junk foods taken by respondents. In case of anaemia group the lowest percentage i.e 10.3% are those whose frequency of junk food is once a month and highest percentage i.e 43.7% are those whose frequency of junk food is twice a week. In case of normal group the lowest percentage i.e, 4.4% are those whose frequency of junk food is once a month and highest percentage i.e 72.1% are those whose frequency of junk food is twice a week.

In order to ascertain whether there is any association between the two groups with respect to the frequency of junk foods taken by the respondents, chi-square test was employed which show that there is statistically significant association (p=0.006) between the two groups.

Table 4.22:

Packed school lunch consumed by the respondents

Packed school lunch taken	Anaemic Hb (< 10.0 g%)		Normal Hb (≥10.0 g%)		Total	Percentage of anaemic	p value
	Count	%age	Count	%age			
Yes	47	42.0%	38	43.2%	85	55.3%	0.863 (NS)
No	65	58.0%	50	56.8%	115	56.5%	

*p < 0.05 show the significant results, $\chi 2 = 0.03$

Table 4.22 show packed school lunch consumed by the respondents. Among the anaemic group the lowest percentage i.e, 42.0% had packed school lunch and highest percentage i.e 58.0% had no packed school lunch. In case of normal group the lowest percentage i.e 43.2% had packed school lunch and highest percentage i.e 56.8% had no school lunch.

In order to ascertain whether there is any association between the two groups with respect to the packed school lunch by the respondents, chi-square test was employed which show that there is statistically insignificant association (p=0.863) between the two groups.

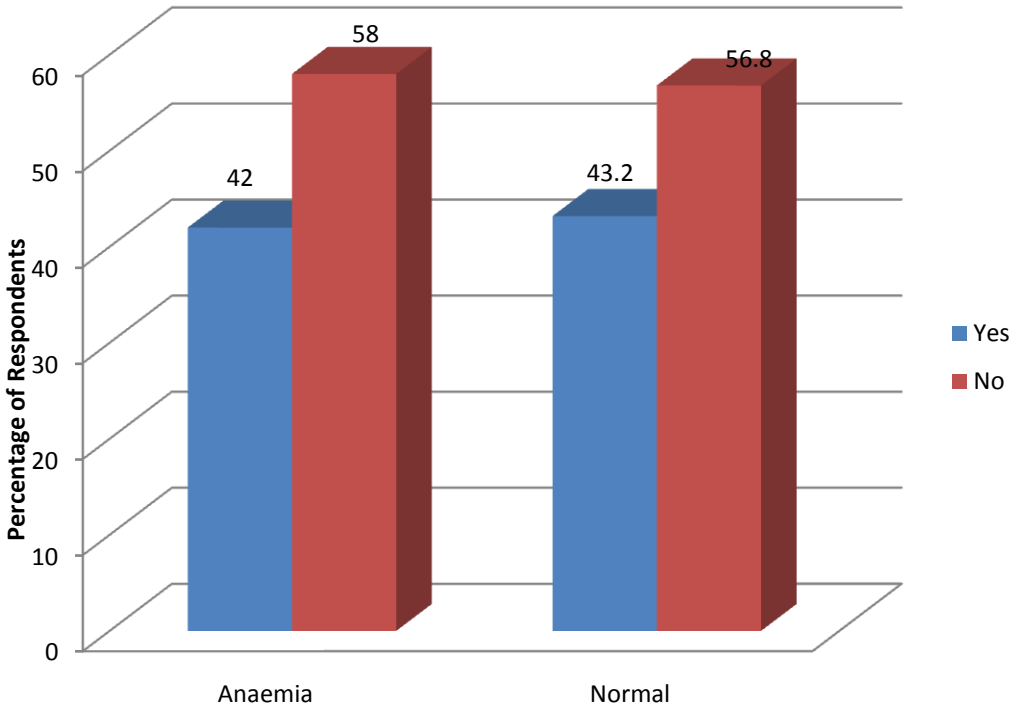


Figure 4.9:

Packed school lunch consumed by the respondents

Table 4.23:

Consumption of fruits and milk by the respondents

Consumption of fruits and milk		Anaemic Hb (< 10.0 g%)		Normal Hb (≥10.0 g%)		Total	Percentage of anaemic	p value
		Count	%age	Count	%age			
Fruits	Yes	83	74.1%	59	67.8%	142	58.5%	0.331 (NS)
	No	29	25.9%	28	32.2%	57	50.9%	
Milk	Yes	28	25.0%	21	23.9%	49	57.1%	0.853 (NS)
	No	84	75.0%	67	76.1%	151	55.6%	

*$p < 0.05$ show the significant results, (Fruits $\chi 2 = 0.94$, Milk $\chi 2 = 0.03$)

Table 4.23 shows consumption of fruits and milk by the respondents. In anaemic group the lowest percentage i.e 25.9% consumed no fruits and 25.0% consumed milk and highest percentage i.e 74.1% consumed fruits and 75.0% consumed no milk. Also, the highest percentage among both groups i.e 58.5% consumed fruits and 57.1% consumed milk.

In order to ascertain whether there is any association between the two groups with respect to the consumption of fruits and milk taken by the respondents, chi-square test was employed which show that there is statistically insignificant association ($p = 0.331$ and 0.853) between the two groups.

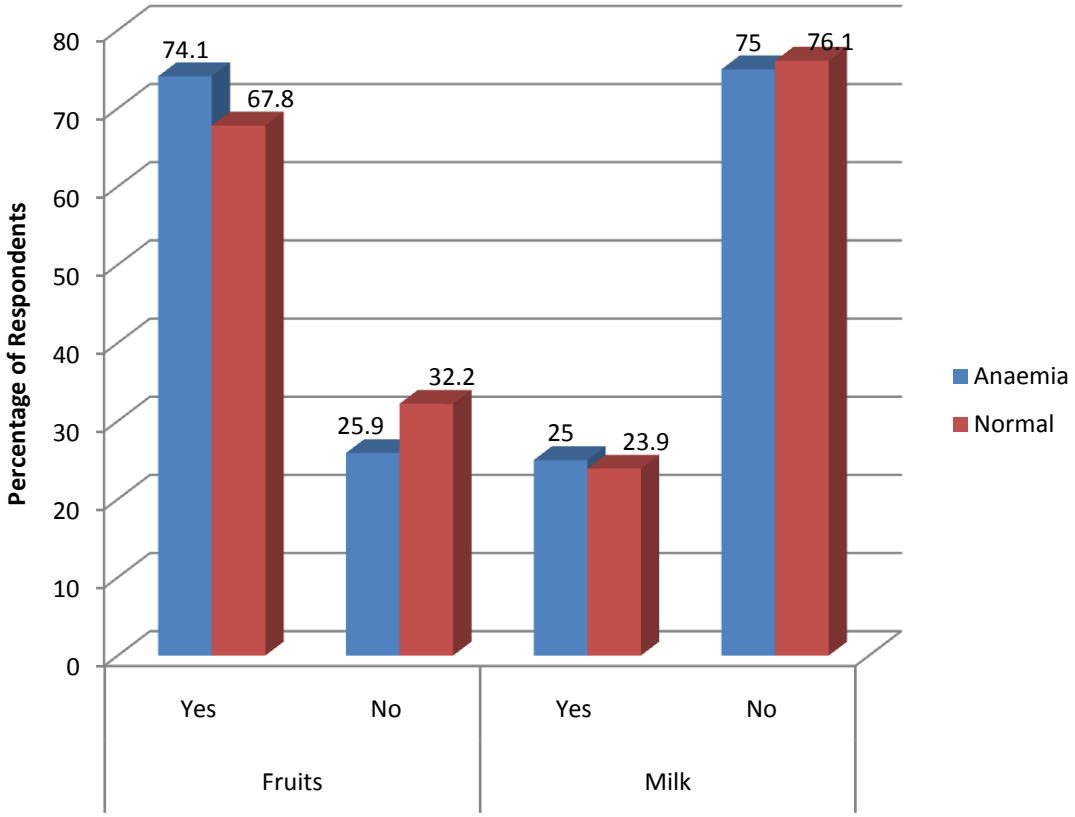


Figure 4.10:

Consumption of fruits and milk by the respondents

Table 4.24:

Consumption of green vegetables by the respondents

Green vegetables consumed		Anaemic Hb (< 10.0 g%)		Normal Hb (≥10.0 g%)		Total	Percentage of anaemic	p value
		Count	**%age**	**Count**	**%age**			
Yes		112	100%	88	100%	200	56.0%	N.A
Frequency of Green vegetables consumed	Daily	53	0.4%	33	37.5%	86	61.6%	0.082 (NS)
	Alternately	10	8.9%	7	8.0%	17	58.8%	
	Once a week	18	16.1%	16	18.2%	34	52.9%	
	Twice a week	31	27.7%	30	34.1%	61	50.8%	
	Twice a month	0	0.0%	2	2.3%	2	0%	

*$p < 0.05$ show the significant results, $\chi 2 = 4.49$

Table 4.24 shows the consumption of green vegetables by the respondents. In both cases anaemic and normal cent percent of the respondents consumed green vegetables in their diet. Among them the lowest percentage of anaemic i.e 0.4% of the respondents consumed green vegetables daily, 8.9% consumed alternately, 16.1% consumed once a week and 27.7% consumed twice a week. Whereas in normal group 37.5% consumed green vegetables daily, 8.0% consumed alternately, 18.2% consumed once a week, 34.1% consumed twice a week and 2.3% consumed twice a month. The highest percentage of anaemic i.e 61.6% are those who consumed green vegetables daily.

In order to ascertain whether there is any association between the groups with respect to green vegetables consumed and frequency of green vegetables, chi – square was employed which show that there is statistically insignificant association ($p = 0.082$) between the groups.

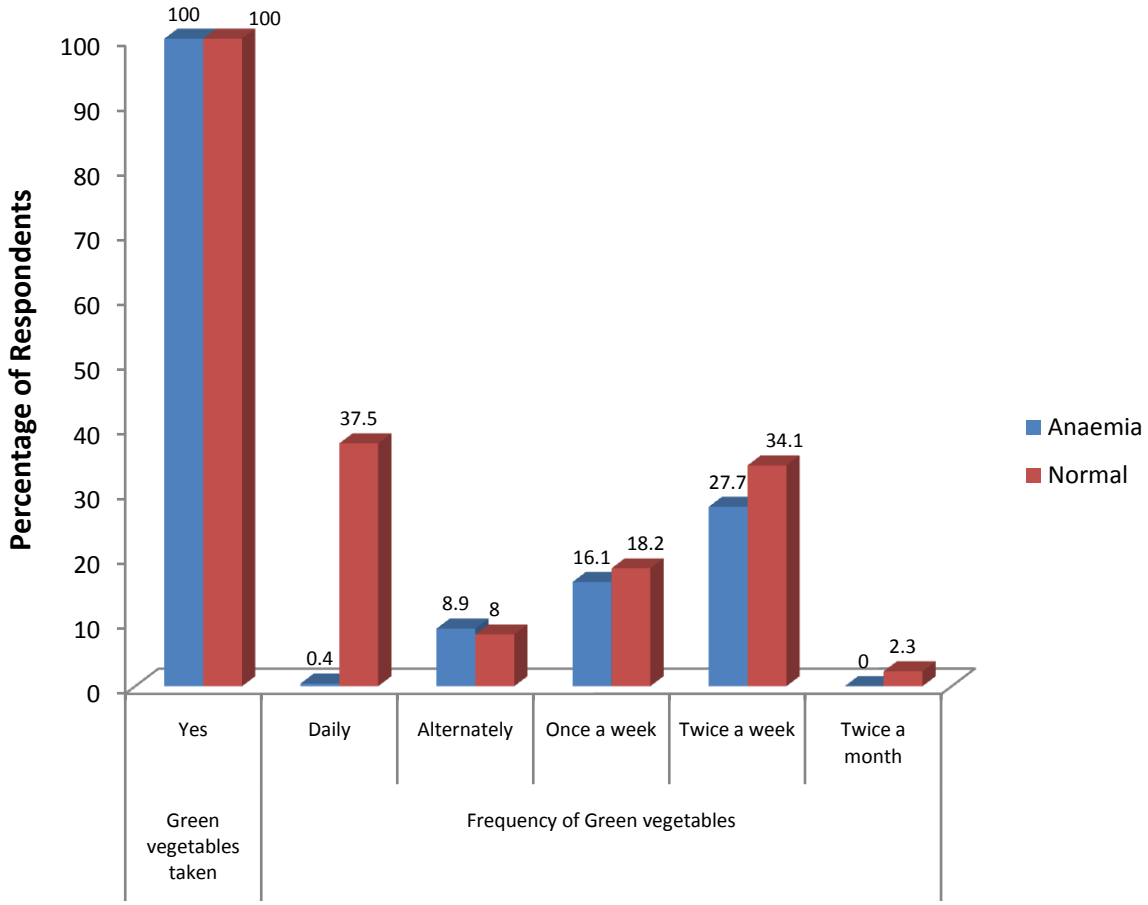


Figure 4.11:

Consumption of green vegetables taken by the respondents

Table 4.25:

Staple Diet of the Respondents

Staple Diet	Anaemic Hb (< 10.0 g %)		Normal Hb (≥10.0 g %)		Total
	count	%age	count	%age	
Rice	112	56.0%	88	44.0%	200

Table 4.25 depicts that rice which is a staple diet of kashmiris is consumed by cent percent of the respondents among these highest percentage i.e 56.0% were anaemic.

Table 4.26:

Hemoglobin Status of the respondents

Hemoglobin status	Means± S.D.	p value
Baseline (g%)	9.8 ± 1.7	*p < 0.01
After 3 months of intervention of Health and Nutrition Education Programme (g%)	10.4 ± 1.4	

*p < 0.05 show the significant results

Table 4.26 reveals that hemoglobin mean ± S.D. of baseline (g%) and after 3 months of intervention (g%) was 9.8 ± 1.7. After 3 months of intervention of health and nutrition programme, hemoglobin mean±S.D was increased to 10.4 ± 1.4. Statistically significant difference was observed between baseline hemoglobin and 3 months of intervention of Health and Nutrition Education Programme among the respondents.

As explained health and nutrition education programme was based on giving information to the respondents about various food groups, iron rich foods, vitamin c rich foods and to make them aware about RDA with the help of visual aids

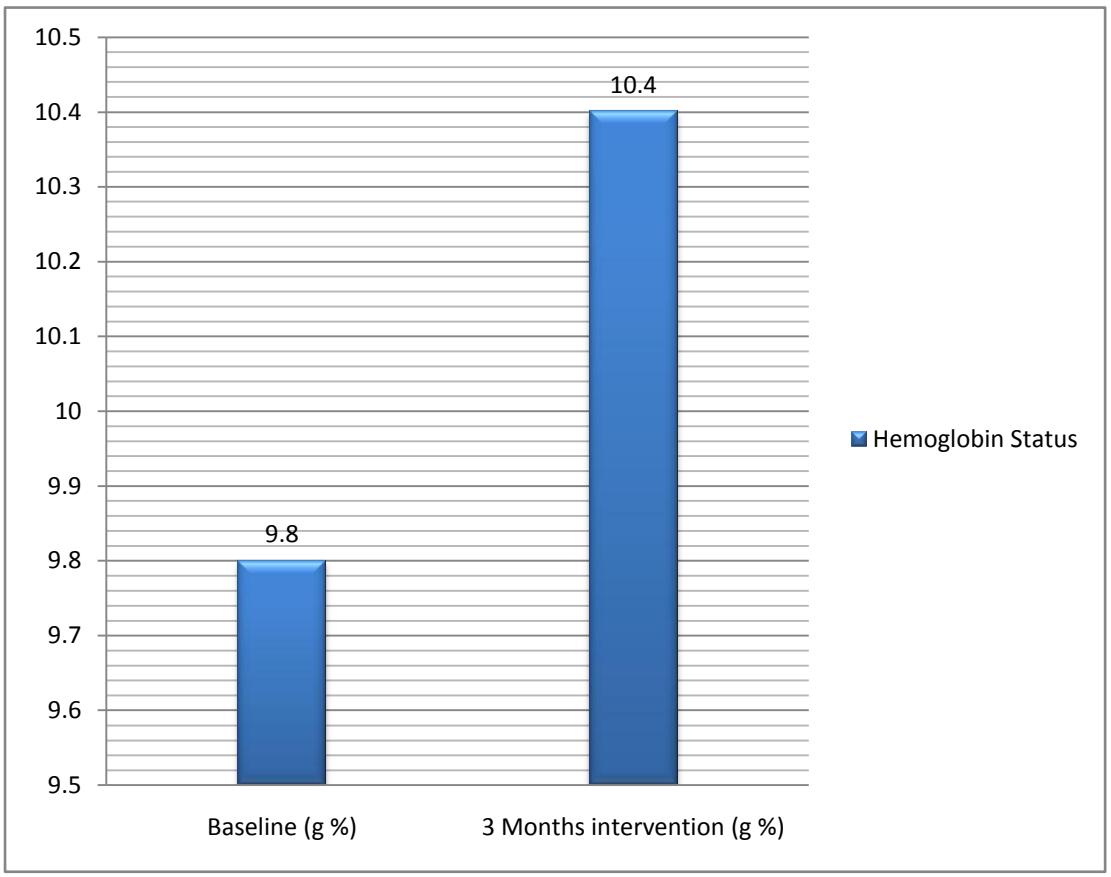


Figure 4.12:

Hemoglobin Status of the respondents

Table 4.27:

Frequency distribution of respondents according to serum Iron level

Age in years	Normal Respondents	Deficiency in Serum iron (%)	Deficient anaemia	Deficiency in Serum Iron (%)	p value
13	5	20%	12	25%	
14	14	21.43%	22	18.1%	0.49
15	35	14.29%	41	12.1%	(NS)
16	34	11.76%	37	13.5%	

*p< 0.05 show the significant results, $\chi 2 = 2.41$

Table 4.27 reveals the frequency distribution of respondents according to the serum iron levels. It was observed that among normal group 14.77% of the respondents had low serum iron level whereas in case of anaemic group it was found that 14.28% of respondents had low serum iron level.

When the data was analyzed age wise, the low serum iron concentration was observed for respondents of 16 years in normal group. Low serum iron concentration in case of anaemic group was observed for respondents of 15 years.

Data on serum iron level revealed that anaemia was prevalent in the school girls and it was highest in the older age group. This could be due to onset of menstruation of girls and hence lowering their iron status.

Table 4.28:

Frequency distribution of respondents according to serum Ferritin level

Age in years	Normal Group	Deficiency in Serum Ferritin (%)	Deficient anaemia group	Deficiency in Serum Ferritin (%)	p value
13	5	20%	12	66.6%	
14	14	14.2%	22	22.7%	0.49
15	35	8.5%	41	12.1%	(NS)
16	34	5.8%	37	8.1%	

*$p < 0.05$ show the significant results, $\chi 2 = 2.41$

Table 4.28 gives frequency distribution of respondents according to serum ferritin. The serum ferritin level is the most specific biochemical test that correlates with relative total body iron stores. The above table revealed serum ferritin level of respondents among the anaemic and normal group. It was found that 9.0% of the respondents had low serum ferritin levels in normal group and 18.75% had low serum ferritin level in anaemic group.

When the data was analysed age wise it revealed that low serum ferritin level was present in respondents of 15 and 16 years among normal group. Low serum ferritin level in case of anaemic group was found among respondents of 15 and 16 years. Hence, these respondents suffered from an added disadvantage of low iron stores too.

Table 4.29:

Nutritional Intake of Respondents as per 24 Hours Dietary Recall

Nutrients	Age	Anaemia Mean ± SD	Normal Mean ± SD	RDA	P-value
Proteins (gm)	13 years	44.84±6.6	43.3±18.3	65gm/day	0.884
	14 year	37.6±13	44.76±5.27		0.091
	15 years	42.46±7.4	44.90±7.7		0.809
	16 years	40.32±8.3	42.20±8.9	63gm/day	0.648
	Overall	**41.63±7.3**	**43.3±10.1**		
Fats (gm)	13 years	10.40±8.7	14.68±3.6	22gm/day	0.286
	14 year	10.77±4.2	12.29±2.3		0.217
	15 years	11.95±4.6	12.98±3.4		0.974
	16 years	11.97±2.7	12.52±4.9		0.531
	Overall	**10.68±4.4**	**12.45±4.2**		
Calories (kcal)	13 years	1523±479	1649±192	2060kcal/day	0.646
	14 year	1465±325	1636±158		0.098
	15 years	1576±253	1651±292		0.699
	16 years	1531±311	1606±244		0.241
	Overall	**1592±293**	**1622±255**		
Calcium (mg)	13 years	313±108	395.0±11	600mg/day	0.258
	14 year	324.8±66.9	370.6±85.9		0.101
	15 years	369.2±73.9	378.0±112		0.680
	16 years	352.0±148	372.0±102	500mg/day	0.464
	Overall	**357.7±114**	**372.4±105**		
Iron (mg)	13 years	5.10±1.93	8.72±4.52	28mg/day	0.037
	14 year	5.38±1.64	7.03±2.84		0.048
	15 years	5.11±1.93	7.14±3.32		0.010
	16 years	5.21±4.29	6.55±5.11	30mg/day	0.086
	Overall	5.21±3.31	7.05±3.96		0.035

*p<0.05 show the significant difference

The data presented in table 4.29 show the nutrient intake of protein among respondents of various age groups (13-16 years). The overall protein intake of the anaemic group was 41.6 gm with a standard deviation of 7.31gm and that of normal group was 43.3 gm and with S.D of 10.1 gm. Thus the difference was found insignificant. The overall protein intake taken by both the groups was then compared with the RDA values. It was found that protein intake difference was significant in the age group of 14 years,

It was observed that the overall fat intake of the anaemic sample was 10.68 gm whereas mean intake of fat among normal sample group was found 12.45 gm.

Furthermore the caloric intake of normal group was 1622 kcal and for anaemic group was almost same 1592 kcal. Interval variation was not much as given by the values of standard deviation of two groups i.e, 255 kcal 293 kcal respectively. Comparison of mean caloric intake by respondents and prescribed value by RDA show difference is insignificant across all age groups.

The overall calcium intake of the normal respondents was 372.4 mg and that of the anaemic respondents was 357.7 mg. Calcium intake when compared with RDA, t test showed that there was insignificant difference in all age groups.

The overall mean iron intake in case of anaemic group 5.21gm while as that of the normal respondents was 7.05gm in both the cases intake is much lower than RDA values. Wherein 28mg/day is prescribed for the age group of 13-15 years while as for 16 years of age it is 30 mg/day. Hence the difference significant as is evident by p values also.

CHAPTER – 5

DISCUSSION

To be well nourished and well developed is one of the rights of childhood. The responsibility of turning this right into a reality rest with the parents, shared by teachers and in fact of all those who are interested in the welfare of children as they are important assets. Better health and nutrition is one of the important factors responsible for increased growth. The influence of age on the requirements or influence of sex determines the nutritional need that once appears process through adolescence.

Adolescence is often turbulent period in which they experience hormonal changes, physical maturation and frequent opportunities to begin planning for the future and to adopt healthy attitude and behavior. Adolescent have to meet the challenge of growth while on other hand they have poor nutrition that hampers their growth and this when coupled with societal discrimination, makes them more vulnerable to these hazards.

Although as per national figure our state ranks nutritionally better than many other states, yet due to recent socio-political and socio-economic changes in pass decade and a half, it is likely health of adolescents may have been affected. The present study looks at the "Percentage of iron deficiency anaemia among adolescent girls and impact of health and nutritional education programmes in changing their dietary behaviour". The detailed discussion has been put forth under the following headings:

- Socio demographic characteristics
- Anthropometric data
- Clinical and Bio-chemical assessment
- Dietary Information
- Menstrual history and history of past illnesses
- Dietary history

Demographic pattern

Health and nutritional conditions are mainly the outcome of demographic characteristic of the population itself. The demographic picture of 200 Government school going adolescent girls in the age group of 13-16 years were selected by random sampling method from district Srinagar of J&K state. Out of 200 subjects, 56% were found anemic, 70.6% subjects had highest percentage of anaemic falling in the age group of 13 years. 61.1% subjects who had anaemia belonged to 14 years age group followed by 53.9% and 52.1% in the age group of 15 and 16 years respectively. While as same study conducted in Haryana on 110 adolescent girls who belonged to low socio – economic group it was found that anaemia was more prevalent in girls who where more than 14 years of age by **Biradar S. Shipa *et al.* (2012)**.

The nuclear family set up has emerged as the main pattern of current years thus vanishing the joint setup. Maximum (63.0%) percentage of anemic was found in subjects belonging to nuclear setup where as 45.7% subjects belonged to joint family setup. The findings were similar to studies where 45.71% population belonged to joint families and higher 55.28% populations belong to nuclear families by **Akhter (2003)**. While as same study confirms that nuclear families are coming and joint family system is breaking. Migration from rural to urban area could also be contributing factor. Therefore we conclude the higher trend towards the nuclear family setup is increasing by **Ketan, *et al.* (1993)**.

Majority of adolescent girls (58.4%) belonged to families with 4-6 children. Highest percentage of anaemic (60.3%) belonged to those families who had more than 8 members.

It was revealed that the majority of respondents belonged to a family with more than 8 members. Similar results were found by **Gupta and Kocher (2009)** who revealed that size of family also affects the percentage of anaemia. Higher the number of members in the family, higher is the percentage of

anaemia. As both quality and quantity of food gets affected with number of members in the family especially with limited income source.

Majority (58.9%) of the respondents whose ordinal position was more than 2 in the family had higher percentage of anaemic whereas 53.3% of the respondents had less than or equal to 2 in the family. Majority of the subjects with ordinal position of 2 and above suffered from anaemia because of the gradual depletion of iron stores of mother after repeated pregnancies. Similarly **Amine and Al-Awadi (1996)** stated that the magnitude of anaemia is associated with birth order.

The educational status of the parents, particularly mother's, plays an important role in maintenance of good health and nutrition of adolescent. The parents of better educational status have been shown to have improved health and nutritional status compare to less educated parents. In the present study it was observed that highest percentage of anemic i.e., 63.4% of the children belonged to families where both parent were illiterate. Socio economic status has a bearing on the percentage of anaemic in poor communities. About 56.5% of the adolescent girls who had a percentage of anemic belonged to low or lower middle class group whereas 52.2% respondents belonged to average middle class group. Maximum number of subjects belonged to low or lower middle class group who had higher percentage of anaemia. More over similar results were found by **Vasantshi *et al*. (1994)** who revealed that mean Hb showed a rising trend with improved socio economic status and most of the children who belonged to families with lower economic status were anemic. This may be due to better availability of high quality of food for children with better socio economic status.

Anthropometric Data

The adolescent girls of both normal and anemic group had less height and weight as compared to recommended values in all the age groups (13-16 years). While analyzing heights it was observed that in both the groups anemic and normal there was significant difference between the standard

heights given by National Nutrition Bureau and adolescent girls in the particular age group i.e 15 years. Similar results were found by **Sachan *et al.* (2012)** who reported that the mean weight and mean height in both urban and rural schools showed significant difference with the ICMR mean weight for respective ages except in ages 18 and 19 years in urban school girl's and in ages 10 and 19 years in rural school girls. The mean height in all age groups in both urban and rural schools showed significant difference with the ICMR mean height for respective ages except in ages 18 and 19 years in urban schools and in ages 16, 17, 18, and 19 years in rural schools. While analyzing BMI it was found that maximum percentage of anaemic i.e 64.7% of adolescent girls had low BMI (below18.5kg). Similar result was found by **Choudhary *et al.* (2003)** who reported that 68.2% of adolescence had BMI of less than 18.5kg per square meter in rural area of Varanasi.

Clinical Examination and biochemical Assessment

A study revealed that the presence in degree of anaemia can be estimated clinically by careful physical examination. Certain clinical findings such as pallor of conjunctiva, nail beds, lips, oral mucosa, pamar creases have been used in the diagnosis of anaemia by **Strobach *et al*. (1988)**.

In our present study it was observed that 59.1% of the respondents had large appearance, 57.8% of the respondents had small appearance and 53.7% of the respondents had average appearance.

It was found that 63.1% of the subjects had dry eyes, 61.55% had watery eyes whereas 50.5% had normal eyes. About 51.6% of the studied subjects had angular stomatitis whereas 60.0% had normal lips. Majority of the subjects 63.5% had normal tongue followed by 50.0%, 46.7% who had red and pale tongue. It was revealed in the present study that 60.0% of the subjects had normal skin whereas 52.2% had dry and rough skin and 50.0% had pale skin. It was observed that 56.4% of the subjects had normal teeth whereas 55.2% had discolored teeth. Majority (57.1%) of the subjects had bleeding gums whereas

55.0% had normal gums. 58.3% of the subjects had abnormal shaped nails whereas 54.7% had normal shaped nails.

Majority of the respondents i.e. 59.5% could feel irritability followed by 54.4% of the respondents who experienced tiredness, 50.0% of the subjects where suffering from weakness and 26.7% of the subjects were found to feel breathlessness respectively. According to **UNICEF (2002)** it was revealed that fatigue, irritability, weakness, shortness of breath and decreased appetite were signs and symptoms of anaemia.

Hemoglobin status

The results for hemoglobin mean ± SD of baseline (g%) and 3 month of intervention (g%) was 9.8 ± 1.7 and 10.4± 1.4 respectively. Similar results which revealed that the mean initial level of hemoglobin in the experimental group was 9.7 g/dl which increased to 10.5g/dl after 3 months of nutrition education by **Jyoti (2008)**. Also similar finding were found that a proportion of girls had serum ferritin less than 12 μg/ml, indicative of poor iron storage by **Kotech P.V., *et al* (2002)**. Furthermore, it was found that the respondents had low serum ferritin and low serum iron levels in both normal and anemic group.

Dietary Information

It was revealed in our study that majority of the adolescents girls (93.9%) and (94.3%) among both groups consumed tap water and highest percentage of aneamic (59.0%) of the adolescent girls consumed unboliled water. Also majority of the respondents 56.1% had high tendency of taking junk foods. It was also found that maximum number of the respondents had school lunch, fruits and milk. A study found that 16.5% did not take lunch to school by **Gulzar (2005)**. About 56.0% of the respondents had green leafy vegetables in their diet. The present study revealed that while analyzing the consumption pattern of adolescent food, it was observed that almost all adolescent girls get more of their daily nutrition from rice, because rice is culturally accepted, easily available and gives feeling of fullness after eating.

Menarche and history of past illness

In the present study only one respondent from anemic group and two respondents from normal group had not reached menarche, however rest of the respondents had reached menarche. The mean age of menarche was 12 years or more, with percentage of anaemic i.e 57.1% which was similar to the study who found that the mean age for menarche was 12.5 years by **Singh *et al.* (2008)**. 56.8% of the subjects did not suffer from menstrual problem whereas 56.2%. **Campbell M.A. *et al.* (1997)** in his study reported that dysmennorhea was a common problem. Therefore majority of the girls relied on the use of medicines during period. The duration of menstrual blood flow for majority of girls was 3 to 4 days. 59.0% of the subjects had cycle duration of 28 days where as 55.5% had before 28 days. Majority of girls in the age group of 13-16 years had regular menstrual periods whereas only 44% had irregular periods. Majority of adolescent girls did not have any history of past illness.

It was highlighted that the adolescent girls need to have thorough knowledge and awareness on reproductive cycles and may even need medical checkup for menstrual problems at least at the initial stage. Furthermore the adolescents should be aware of the hygienical practices related to menstrual cycle, so as to avoid reproductive tract infection and must have other useful knowledge about health education.

Dietary history

The findings of the present study showed that the overall nutrient intake of adolescent girls in both groups, either anemic or normal group, was less as per the Recommended Dietary Allowances. **Adamson (1996)** reported that daily energy intake of the adolescent is less as they derive maximum energy from snack foods. A study on adolescent girls reported poor intake of all nutrients by adolescents by **Pati (2004)**.

CHAPTER – 6

CONCLUSION

AND

RECOMMENDATIONS

CONCLUSION

From the present study it was revealed that anaemia is a major health problem among adolescents especially girls. Because of lack of proper information regarding dietary habits adolescents have a habit of skipping their meals because they are more conscious about their body structure. Anaemia could be also the result of heavy periods and reduced iron intake, thus govt. should promote awareness programs in schools which will lead to healthy eating patterns and selection of appropriate foods. They should also be given education about enhancing factor intake of vitamin C which helps in the absorption of iron.

From the study it was concluded that overall nutritional status of adolescent girls was not up to the mark. Clinical examination showed that girls had signs of various deficiencies. BMI of adolescent girls was less than the standard. The intake of all the nutrients was found less than recommended dietary allowances.

RECOMMENDATIONS

Measures which can be implemented for adolescent girls in order to improve their nutritional status (especially iron level) are:

- Inclusion of iron rich foods and regularity of meals need to be established among the adolescent girls.
- Foods like green leafy vegetables, meat, chicken, pulses and egg to be consumed in abundance so as to improve the nutritional stores of the body. Moreover vitamin C rich fruits should be consumed to enhance iron absorption.
- Fortification of widely consumed foods with iron/folate.
- Regular deworming of adolescents.
- The strategy for Nutrition intervention in adolescence suggests components of promotion, prevention and treatment. Thus, promoting adequate nutrition with adolescents means enhancing control of

adolescents over their food and food resources and improving their access to appropriate nutrition services in addition to strengthening food related skills and encouraging healthy eating and lifestyle. Prevention focuses on specific condition like malnutrition and specific micronutrient deficiencies. Treatment includes health care services to deal with nutritional aspects diseases in adolescents in an appropriate manner

- School based nutrition intervention also provide the most effective and efficient way. Schools should provide a setting to introduce nutrition information, technologies to the community and also interventions such as nutritional screening, providing micro nutrient supplements, ensuring consumption and nutrition behaviour development and school feeding programmes. Moreover, population where many adolescents are not in school, school outreach programme had been found effective. Vocational schools and other community based institutions such as youth groups can also be involved in addition to using the media.

BIBLIOGRAPHY

Adams, J.F. (1973). Understanding Adolescents Current Developments in Adolescent Psychology. 2nd edition, Stanley O. and Kochman.

Agarwal, D., & Agarwal, D.K (2002). Nutritional anaemia and its control, *Indian Journal of Pediatrics*, **69** (7), 607-616.

Abdelrahim, I.I., Mahgoub, H.M., Mohamed, A.A., Ali, N.J., Elbashir, M.I & Adam,I. (2009). Anaemia, Folate, Zinc and Copper Deficiencies Among Adolescent Schoolgirls in Eastern Sudan. Biological trace element research, **132** (1-3), 60-66.

Adamson (1996). A longitudinal study of change in food habits between adolescents 11-12 years and adult hood. *Oxford Journal of Public Health pp* 32-33.

Agarwal, K.N., Gomber, S., Bisht, H & Som, M. (2010). Anaemia prophylaxis in adolescent school girls by weekly or daily iron-folate supplementation. *Indian Pediatrics,* **(40)** 296-301.

Agarwal., Madhu. (2010). A Study on impact of iron folic acid along with vitamin C on the haemoglobin status of adolescent girls in an ICDS block, Lucknow. NIPCCD Regional Centre, 77 DCWC Research Bulletin, XV (2).

Agdeppa, I.A., Schultink, W., Sastroamidijojo, S., Gross, R., & Karyadi, D. (1997). Weekly micro-nutrient supplementation to build iron stores in Indonesian adolscents: *American Journal of Clinical Nutrition,* (**66)** 177-183.

Ahmed, F., Khan, M.R., Islam, M., Kabir, I & Fuchs, G.J. (2000). Anaemia and iron deficiency among adolescent schoolgirls in peri-urban Bangladesh, *European Journal of Clinical Nutrition* **(54)** 678-683.

Aikawa, R., Ngyen, K.,C. Sasaki, S & Binns, C.W. (2006). Risk factors for iron-deficiency anaemia among pregnant women living in rural Vietnam. *Public Health Nutrition,* **9**(4), 443-448.

Akhter Shabnum , (2003). "A study of health and nutritional status of school going children in the age of (6-12 years) in the schools of Pattan block". *Unpublished M.Sc dissertation, Institute of Home Science,* University of Kashmir.

Akkamahadevi, K.H., Kasturiba, B. and Rao M.(1998). Prevalence of anaemia in urban and rural adolescent girls. **31**(4) Journal of Agriculture Sciences.

Akramipour, R., Rezaei, M., and Rahimi, Z. (2008). Prevalence of iron deficiency anaemia among adolescent school girls from Kermanshah, Western Iran. Hematology,**13**(6),352-5.

Al Mousa,M., Prakash,P., Jackson,R.T & Al Raqua,M (2003). A comparison of selected nutrient intakes in Anemic and non Anemic adolescent girls in Kuwait. Nutrition Research, **(23),**425–433.

Alaofè, H., Zee, J., and Turgeon, O. Brien. H. (1996). Dietary iron and iron deficiency anaemia among adolescent girls from Benin: *Rev Epidemiol Sante Publique.* **55**(3), 187-96.

Al-Buhairan AM& Oluboyede OA.(2001). Determination of serum iron, total iron-binding capacity and serum ferritin in Saudi adults. *Annals of Saudi medicine,* 21(1-2), 100.

Al-Sayes, F., Gari , M., Qusti, S., Bagatian ,N & Abuzenadah, A. (2010). Prevalence of iron deficiency and iron deficiency anaemia among females at university stage. Journal of Medical Laboratory and Diagnosis, **2**(1) pp. 5-11.

Al-Sharbatti,S.S., Al-Ward,N.J & Al-Timimi, D.J (2003). Anaemia among adolescents. *Saudi Medical Journal* **(2),**189-194.

Amine E.K, .AL-Awadi FA (1996). Nutritional status survey of preschool children in Kuwait. East Mediterr Health **2** (3) :386-95.

Anand, K., Kant,S., Kapoor,SK. (1999). Nutritional Status Of Adolscent School Children In Rural North India. From the Comprehensive Rural Health Services Project, Ballabgarh, *All India Institute of Medical Sciences,* New Delhi 110 029, India. **(29)**1203-1268.

Ayoub, AI. (1995). Iron deficiency anaemia in Dubai Medical College for Girls: a preliminary study: *J. Egypt Public Health Association* ,**170** (1-2), 213-28.

Ayoya, M.A., Bendech, M.A., Zagre, N.M & Tchibinda, F.(2010). Maternal anaemia in West and Central Africa: time for urgent action. *Public Health Nutrition,* 1-12.

Baral, K.P & Onta, S.R.(2009). Prevalence of anaemia amongst adolescents in Nepal. A community based study in rural and urban areas of Morang District. *Nepal Med Coll J.,* **11**(3), 179-182.

Basavanthappa B.T., (1998). Nursing Research published by Jaypee Brothers.

Basu, S., Hazarika, R. and Parmar,V.(2004). Prevalence of Anaemia Among School Going Adolescents of Chandigarh, Indian Pediatrics.

Bhanushali, M. M., Shirode, A.R., Joshi, Y.M & Kadam, V.J. (2010). An intervention on iron deficiency anaemia and change in dietary behavior among adolescent girls. *International Journal of Pharmacy and Pharmaceutical Sciences,* **3**(1)

Brabin, J.B., Hakimi, M. & Pelletier, D., (2001). An Analysis of Anaemia and Pregnancy-Related Maternal Mortality. *Journal of Nutrition,* **(131),** 604S-615S.

Bülent, K., Sanda, C., Ayşen,A & Nanzan,S. (2006). The Prevalence of Anaemia in Adolescents, *Journal of Pediatrics Hematology/Oncology* **28** (5), 316-321.

Campbell M.A., McGrath P.J., (1997). Use of medication by adolescence for the management of menstrual discomfort. Arch. Pediatr. Adolescent – Med. **151**(19): 905-913

Chang, M.C., Poh, B.K., June, J., Jefrydin, N., & Das, S.(2009). A study of prevalence of anaemia in adolescent girls and reproductive-age women in Kuala Lumpur. Arch Med **5** (1), 63-68.

Chaudhary, S.M & Dhage,V.R.(2007). A study of anaemia among adolescent females in the urban area of Nagpur. *Indian Journal Community Med,* **33**(4),243-5.

Choudhary S., Mishra C.P and Shulka P.K (2003). *Indian Journal of preventive and social medicine* vol 34 No. 1 and 2.

Choudhary, A., Moses, P.D., Mony, P ., Mathai,M & Mobstet (2006). Prevalence of anaemia among adolescent girls in the urban slums of Vellore, South India. Trop Doct1, **36** (3), 167-169.

Control of Nutritional Anaemia in School going Adolescent Girls, Experiences in Bihar Directorate of Social Welfare Department of Education Department of Health and Family Welfare Government of Bihar UNICEF 2012.
http://www.newconceptinfo.com/sites/default/files/Unicef-ControlofNutritionalAnaemiainSchoolGoingAdolescentGirlExperiences Bihar.pdf

Cooper, M.J., Cockell, K.A & Abbé, M. (2007). The iron status of Canadian adolescent and Adults. *Canadian Journal of Dietetic Practice and Research*, **67** (3).

Chauhan, S.S. (1983). Psychology of Adolescents. *Allied Publishers Pvt. Ltd.*

Creed–Kanashiro, H.M., Uribe, T.G, Bartolini, R.M, Fukumoto, M.N, Lopez, T.T, Zavaleta, N.M & Bentley, M.E. (2000). Improving Dietary Intake to Prevent Anaemia in Adolescent Girls through Community Kitchens in a Periurban Population of Lima, Peru, *American Society for Nutritional Sciences J. Nutrition*, 130: **459** S–461S.

Merkel, D., M., Huerta., I., Grotto., D., Blum., O., Tal., E., Rachmilewitz., E., Fibach, Y., Epstein & O. Shpilberg (2005). Prevalence of iron deficiency and anaemia among strenuously trained adolescents. *J. Adolescent Health,* **37**(3), 220-3.

Deepa, K.S., Pushpabharati and Kasturiba, B.(2004). Seasonal variation in iron status of adolescent girls in Dharwad taluk. *J. Human Ecology*, **15** (3),175-178.

Devi, T.A. and Uma, K.R., (2005). Effect of supplementation of spirulina on Anemic adolescent girls. *The Ind. J. Nutr and Dietetics,* **42,** 534-539.

Dorothy, R. Morlow (2007) Text book of Pediatrics, 6th edition, *Elsevier publisher*, published in New Delhi, pp. 1133-1136.

E.Gur., I.Yildiz., T.Celkan., G.Can., S.Akkus., A.Arvas., S.Guzeloz & S.Cifcili (2005). Prevalence of anaemia and the risk factors among school children in Istanbul. *J. Trop Pediat,* **51**(6), 346-50.

Esmat, B., Mohammad,R., Behnam,S ., Shahrzad,V., Soodabeh,T., Minoo ,A.,Saman, S & Ali-Akbar, H.(2009). Prevalence of Iron Deficiency Anaemia among Iranian Pregnant Women; a Systematic Review and Meta-analysis. *J. Reprod Infertil*, **11**(1),17-24.

Erickson E.H. (1964). Childhood and Society. Revised Edition, New York: Norton.

G.S, Toteja, Padam, B.N, Saxena., F.U., Ahmed., Singh, R.P., Balendu, Y. Singh & A. Rauf. (2006). Prevalence of anaemia among pregnant women and adolescent girls in 16 districts of India. *Food & Nutrition Bulletin*, **27**(4), 311-315.

Gawarika, R., Gawarika, Mishra, A.K.(2006). Prevalence of anaemia in adolescent girls belonging to different economic groups. *Indian Journal of community medicine* **31**(4).

Garg, B.S. (2000). Indian Adult Education Association National Documentation Centre on Literacy and Population Education. *Journal of Population,* ed. **(18)**

Gowarikar, R.S., S.B., and Tripathi, B.C., (2002). Prevalence of anaemia in adolescents girls of Ujjain in Western M.P. *Indian J. Nutr. And Dietetics,* **(39),** pp 493-498.

Gopalan. C, Rama Sastri B.V. and Balasubramanian, S.C., (2004), Nutritive Value of Indian Foods, National Institute of Nutrition, ICMR, Hyderabad.

Goyle A., & Prakash S., (2009). Iron Status of Adolescent Girls (10-15 years) attending a Government School in Jaipur City, Rajasthan, India. *Mal J. Nutr* **15**(1): 205 - 211, 2009. Retrieved March 10 2010.

Goyle, A. and Prakash, S. (2009). Iron Status of Adolescent Girls (10-15 years) Attending a Government School in Jaipur City, Rajasthan, *India. Mal J. Nutr,* **15**(1), 205 – 211. Retrieved 21st Oct 2011.

Gupta, V.K., Maria, A. K., Kumar, R., Bahia, J.S & Arora, S.(2010). To study the pervalence of anaemia in young males and females with respect to the age body mass index , activity profile and socio economic status in rural Punjab. *Journal of Clinical and Diagnostic Research*, **5**(5), 1020-1026.

Gulzar. N., (2005) "Gender Bias Regarding Health and Nutritional Care among 0-12 years in Rural and Urban Families". *Unpublished M.Sc Dissertation, Institute of Home Science,* University of Kashmir.

Haidar, J.A & S Pobocik, R.S., (2009). Iron deficiency anaemia is not a rare problem among women of reproductive ages in Ethiopia: A community based cross sectional study. BMC Blood Disorders **9**(7).

Hallberg, L., Hulten, L., Lindstedt, G., and Arne Lundberg (1993). Prevalence of Iron Deficiency in Swedish Adolescents: *Pediatric Research,* **34,** 680–687.

Hamiel, P., Koren, RSI., A, Agmon., P. Lilos and M. Philip (2003). Greater prevalence of iron deficiency in overweight and obese children and adolescents. *Int J. Obes Relat Metab Disord,* **(3)** 416-8.

Hall G.S. (1916) Adolescents, Vol. **2**, New York: Appleton.

Imtiyaz Ali (2006) Nutrition Status of Adolescent, *Journal of Medical Sciences,* SKIMS, Srinagar.

Institute of Health Management Pachod, Pune. (2005). Reducing iron deficiency anaemia and changing dietary behaviours among adolescent girls in Maharashtra. Pune IHMP. 2 p. *Research Abstracts on Nutrition,* 1998-2008.

Iohnsen, B.B., Sandstad, B & A Sberg, B. (2005). Iron status among 3005 women aged 20–55 years in Central Norway: The Nord-Trøndelag Health Study. *Scand J. Clin. Lab Invest* **65**, 45–54.

Iron deficiency Anaemia (2011). National Heart lung & blood institute. U.S Dept. of Health & Human Services, National Institute of Health. http://www.nhlbi.nih.gov/health/dci/ Diseases/ida/ida_diagnosis.html

Jackson, R.T, & Al-Mousa, Z.(2000). Iron deficiency is a more important cause of anaemia than hemoglobinopathies in Kuwaiti adolescent girls, *Journal of nutrition* **130** (5), 1212-1216.

Jayatissa, R. and Piyasena, C., (1999). Adolescent school girls: Daily or weekly iron supplementation. *Food and Nutr. Bulletin.*

Jyoti, N., Chandra,K., Shekhar, K. J., Kumar, K., Sujit ,D.S & Krishna, C.B. (2009). Prevalence of anaemia among adolescent girls of Kadapa. Department of community medicine, medical college Trivandrum.

Jyoti. S.T., (2008). Consumption patter of green leafy vegetable and impact of nutrition education on hemoglobin status of rural adolescent girls. Department of Food Science and Nutrition College for rural home science, University of Agricultural Sciences, Drawad.

Bagchi K., (2004). Iron deficiency anaemia--an old enemy. *East Mediterrian Health J.*, **(6),**754-60.

Park K., (2007) Text book of Preventive and Social Medicine, 16th Edition, published by Bhanot, *published in Jabalpur,* pp. 449-450.

Kabir, Y., Shahjalal, H.M., Saleh , F & Obaid ,W. (2010). Dietary pattern, nutritional status, anaemia and anaemia-related knowledge in urban adolescent college girls of Bangladesh. *Journal of Pakistan Medical Association.*

Kakkar, R., Kakkar, M., Kandpal, S.D & Jethani, S. (2006). Study of anaemia in adolescent school girls of Bhopal. Indian Journal of Community Health **22**(2).

Kalaivani K.(2009). Prevalence & consequences of anaemia in pregnancy. *Indian Journal Med Res*, **130**(5), 627-33.

Kalpana, C.A., Aruna Narayanan and Thangarathi, T.(2007). Effect of medicinal iron supplementation and nutrition education on Anemic

adolescent girls of low income families. *The Indian J. Nutr. and Dietet,* **44,** 551-559.

Kanani , S.J and Poojara, R.H .(2000). Supplementation with Iron and Folic Acid Enhances Growth in Adolescent Indian Girls. *J. Nutr,* (130), 452S-455.

Kanani S.,Ghanekar J.(1997). Anaemia and the adolescent girls: A review of some research evidence and intervention strategies, Department of Food and Nutrition M.S. University of Baroda and UNICEF, India.

Karaoglu, L., Pehlivan, E., Egri, M., Deprem, C., Gunes, G., Genc, M. F & Temel, I. (2010). The prevalence of nutritional anaemia in pregnancy in an east Anatolian province Turkey. BMC Public Health, 10, 329.

Kaur, S., Deshmukh, P.R & Garg, B.S. (2006). Epidemiological Correlates of Nutritional Anaemia in Adolescent Girls of Rural Wardha. *Indian Journal of Community Medicine,* **31**(4)10-12.

Keskin, Y., Moschonis, G., Dimitriou, M., Sur, H., Kocaoglu, B., Hayran,O., and Manios Y.(2004). Prevalence of iron deficiency among schoolchildren of different socio-economic status in urban Turkey. *European Journal of Clinical Nutrition,* **(59),** 64–71.

Ketan, S.J., (1993). "Working women and modernization" *Ashish publishing house,* New Delhi.

Khalafallah, A., Dennis, A., Bates, J., Bates, G., Robertson, I .K., Smith. L., Ball. M.J., Seaton, D., Brain, T & Rasko, J.E. (2010). A prospective randomized, controlled trial of intravenous versus oral iron for moderate iron deficiency anaemia of pregnancy. *J. Intern Med,* **268**(3), 286-95.

Killip, S., Bennett, J.M and Chambers, M.D. (2007). Iron Deficiency Anaemia. *American Family Physician,* **7**(5).

Kowsalya, S.,Crassina and A., Shimaray (2008). Impact of supplementation of lotus stem (Nelumbium nelumbo) on the iron nutriture of adolescent girls (13-18 years) in Manipur. *The Indian J. Nutr. Dietet,* 45:47-53.

Kotech P.V., Patel R.Z., Karkar P.D., and Nirupam S., (2002) Adolescent girls anaemia reduction programme – Impact evaluation midterm of Vadodara district, *Department of Preventive and Social Medicine,* Vadodara.

Kumar Dharmender (2003). Prevalence of iron deficiency anaemia in adolescent school going children of district Srinagar, in Kashmir Valley. *Unpublished dissertation,* department of medicine SKIMS, Srinagar.

Kurniawan, Y. A. I.; Musilmatun, S.; Achadi, E. L.; Sastroamidjojo, S. (2006). Anaemia and iron deficiency anaemia among young adolescent girls from the peri urban coastal area of Indonesia. *Asia Pacific Journal of Clinical Nutrition*, **15**(3).

Leela T. and Priya, S.,(2002). Iron status and morbidity pattern among selected school children. *The Indian J. Nutr. and Dietetics,* **(39),** pp 216-222.

Leenstra,T., Kariuki,S.K., Kurtis,J.D., Oloo,A.J., Kager P.A and Kuile F.O.(2004). Prevalence and severity of anaemia and iron deficiency: cross-sectional studies in adolescent schoolgirls in western Kenya. *European Journal of Clinical Nutrition,* **(58),** 681–691.

Lynch, SR.(2000). The potential impact of iron supplementation during adolescence on iron status in pregnancy. *J Nutrition.*,**130** (2S Suppl):448S-451S.

M. L Krauses and Escott-Stump S. (2000). Food nutrition and diet therapy (11th edition). *Sander's publication*: Philadelphia.

Maeda, M., Yamamoto M, Yamauchi K.(1999). Iron requirements and iron deficiency in adolescents. *Int J. Hematol*, **69**(2):75.

Meier, P.R., Nickerson, J.H., Olson, K.A., Berg, R.L., and Meyer, J.A.(1999). Prevention of Iron Deficiency Anaemia in Adolescent and Adult Pregnancies. *Clinical Medicine and Research*, **(1)**: 29-36.

Muthaya, S., Thankachan, P., Zimmermann, M.B., Anderson, M., Eilander, A., Misquith, D.,Hurrell, R.F & Kurpad, A.V.(2007). Low anaemia prevalence in school-aged children in Bangalore, South India: Possible effect of school initiatives. *European J. Clinical Nutri.* **61**(7), 865-9.

N. Gupta, G. Kocher (2009). Pervasiveness of anaemia in adolescent girls of low socio economic girls of the district of Kurukshetra (Haryana).*The internet journal of nutrition and wellness* vol **7**(1).

Nasreen, N.,(2005)."Nutritional status and dietary habits of Kashmiri women". Unpublished Ph.D. Thesis. Institute of Home Science, University of Kashmir.

Nead, K.G., Halterman, J.S. , Kaczorowski, J.M ., Auinger, P. & Weitzman, M.(2004). Overweight Children and Adolescents. A Risk Group for Iron Deficiency Pediatrics, **114**(1), 104 -108.

NFHS Report (2008). Anaemia is on the rise in India.

Nhien, V.N., Yabutani.T., Khan, N.C., Khanh, L.N.B., Ninh,X.N., Chung, L.T.M., Montonaka, J & Nakaya, Y.(2007). Association of low serum selenium with anaemia among adolescent girls living in rural Vietnam. Nutrition, **25**(1), 6-10. http://www.nutritionjrnl.com/article/S0899-9007(08)00305-5/abstract

Okeke, P.U. (2011). Anaemia in pregnancy is it a persisting public health problem in porto novo- cape verde. Medical Technologist, Dept. of Medical laboratory Clinic, Hospital of Porto Novo- Cape Verde. http://www.monografias.com/trabajos-pdf4/anaemia-in-pregnancy/anaemia-in-pregnancy.pdf

Oregon Evidence-based Practice Center, Oregon Health and Science University (2006). Screening for Iron Deficiency Anaemia in Childhood and Pregnancy: Update of the 1996 U.S. Preventive Services Task Force Review, Agency for Healthcare Research and Quality U.S. Department of Health and Human Services, AHRQ Publication No. 06-0590-EF-1.

Pastides, H., (1981). Iron deficiency anaemia among three groups of adolescents and young adults: *Yale J. Biol Med,* 54(4): 265–271.

Patel, H. J & Shah, P.U.(2009). A Study about Anemic Condition Of adolescent Girls By Hemoglobin Estimation And Dietary Survey. Shodh Samiksha aur Mulyankan, *International Research Journal,* II, (7).

Pathak, P., Singh, P., Kapil ,U and Raghuvanshi R.S., (2003). Prevalence of iron, vitamin A, and iodine deficiencies amongst Adolescent Pregnant Mothers. *Indian journal of pediatrics,* **70**(4), 299-301.

Pati, R.N. (2004). Adolescent girls. APM Publishing Corporation New Delhi Edition 1.

Prevention and control of anaemia in rural adolescent girls through school system, Andhra Pradesh (Hathnura and Kondapur) (2002). Indian Institute of Health and Family Welfare, Hyderabad.

Rajaratnam,J., Abel ,R., Asokan J.S & Jonathan, P. (2000). Prevalence of Anaemia among Adolscent Girls of Rural Tamil Nadu. Indian Pediatrics, **(37):**532-536.

Ramzan, M., Ali, I. & and Salam, A. (2009). Iron Deficiency Anaemia in School Children of Dera Ismail Khan, Pakistan. *Pakistan Journal of Nutrition,* **8** (3), 259-263, 2009.

Ramzi, M., Haghpanah, S., Malekmakan, L., Cohan ,N., Baseri, A., Alamdari ,A & Zare, N. (2011). Anaemia and Iron Deficiency in Adolescent School Girls in Kavar Urban Area, Southern Iran. *Iran Red Crescent Med,* **13**(2),128-133.

Rawat, C.M.S., Garg, S.K.,. Singh, J.V., Bhatnagar, M., Chopra, H & Bajpai, S.K.(2001). Socio-Demographic Correlates of Anaemia among Adolescent Girls in Rural Area of District Meerut (U.P.). *Indian Journal of Community Medicine*, **26**(4), (2001-10 - 2001-12).

Rani A. (2010). Assessment of nutritional status, *Nonali publications* 4228/1, Ansari Road, Darya Ganj, New Delhi.

Sachan B, Idris MZ, Jain S, Kumari R, Singh A. (2012). Nutritional status of school going adolescent girls in Lucknow District. *J Med Nutr. Nutraceut;*1:101-5Pediatrics vol **31**.

Saluja, N., Garg, S., Chopra, H., & Bajpai, S., (2001). Socio-Demographic Factors Affecting Anaemia in School Children in Urban Area of Meerut, India. The Internet *Journal of Preventive. Medicine* (1).

Shah, B.K & Gupta, P. (2002). To compare the effectiveness of weekly vs daily iron and folic acid supplementation for control of anaemia in adolescent Nepalese girl. Arch Pediatr. Adolescent Med.,(156),131-135.

Shekhar A., (2005). Iron Status of Adolescents Girls and Its Effect on Physical Fitness. *The Indian Journal of Nutrition and Dietetics*, **42**(10), 451-456.

Shahabuddin, AK and Talukder, K and Talukder, MK and Hassan, M and Seal, A and Rahman, Q and Mannan, A., and Tomkins,

A and Costello, A (2000) Adolescent nutrition in a rural community in Bangladesh, Indian J Pediatr : **67**(2) 93 - 98.

Shams S, Asheri H, Kianmehr A, Ziaee V., Koochakzadeh L, Monajemzadeh M, Nouri M, Irani H, Gholami N. (2010). The prevalence of iron deficiency anaemia in female medical students in Tehran. Singapore Med., **51**(2), 116.

Shipa S.Biradar, Soma Shekhar P.Biradar, A.C. Alatagi, A.S.Wantamutte, P.R. Malur (2012). Prevalence of anaemia among adolescent girls: a one year cross sectional study, *journal of clinical and diagnostic research* (Suppl-1) ,vol **61**(3):372-377.

Siddharam, S. M., Venketesh, G. M & Thejeshwari, H. L. (2010). A Study of Anaemia Among Adolescent Girls in Rural Area of Hassan district, Karnataka, South India. *Int J. Biol Med Res*, **2**(4), 922 – 924.

Sidhu, S., Kumari, K and Uppal, M. (2005). Prevalence of Anaemia Among Adolescent Girls of Scheduled Caste Community of Punjab. Anthropologist, **7**(4), 265-267.

Simon, H & Zieve, D.(2011). Anaemia, New York Times Health Guide.13/01/2011.

Singh A , Kiran D ,Singh H , Nel B , Singh P and Tiwari P (2008). Prevalence and severity of dysmenorrheal: A problem related to mensuration , among first and second year female students. *Indian J . Physiol, Pharmacol*: **52**(4) 389-97.

Singh, R. (1998). Socio-Demographic Factors Causing Anaemia In Adolescent girls In Meerut. Health and Population-Perspectives and Issues, 31(3), 198-203.

S.N., Massawe ., G,Ronquist., L,Nystrom & G,Lindmark.(2002). Iron status and iron deficiency anaemia in adolescents in a Tanzanian suburban area, Gynecol Obstet. Invest, **54**(3), 137-44.

Soekarjo, D.D., Pee, S., Kusin, J.A., Schreurs, W.H.P., Schultink, W., Muhilal and Bloem M.W. (2004). Effectiveness of weekly vitamin A (10000 IU) and iron (60 mg) supplementation for adolescent boys and girls through schools in rural and urban East Java, Indonesia. European Journal of Clinical Nutrition, (58), 927–937.

Srilakhsmi B (2002). Dietetics (4th edition). Publication New Age International Ltd., India.

Strobach R. S., Anderson S. K., Doll D. C., Ringgenburj Q. S. (1998). The value of physical examination in the diagnosis of anaemia .Correlation of physical findings and the hemoglobin concentration. Arch Intern Med **148**(4) 831-32.

Suja, K., Aparna, B., Anice, G & Sarala, S.(2011). Risk factors for anaemia among adolescent girls. International Journal of Nursing Education, **3**(1), 51-55. http://www.indianjournals.com/ijor.aspx?target=ijor:ijone&volume=3&issue=1&article=018.

Sutra (2005). Food and Nutrition World. Institute of Science Bangalore.

Sundar Lal (2007). Text book of Community Medicine, published by CBS publisher, published in New Delhi, pp. 115-130

Swaminathan M., (2008). Advanced Text book on Food and Nutrition, published by *Bappco Publisher*, Bangalore **(1)**, pp. 392-394

Switonial T., & A. Krol (1992). Iron deficiency and anaemia in professional working women: **46**(4),379-87.

Terhune A.L.F., Cogswell, M.E., Khan, L.K., Will, J.C. and Ramakrishnan, U.(2000). Iron deficiency anaemia: higher prevalence in Mexican American than in non-Hispanic white females in the third National Health and Nutrition Examination Survey, *American Journal Clinical Nutrition:* **(72):**963–8.

Turcato , B.R ., Lisi, L.M., Robbins, S.W., Baba, T.R., C Garcia ,E.C & Robbins, J.M. (2008). Anaemia among adolescent females in urban public health clinics: Prevalence's incidences & need for screening. American Public Health Association 136th Annual Meeting & Expo Oct 25-29 California.

Umeta, M., Haidar, J., Demissie, T., Akalu, G., & Ayana, G. (2008). Iron Deficiency Anaemia among Women of Reproductive Age in Nine Administrative Regions of Ethiopia. *Ethiop. J. Health,* **22**(3), 252-258.

United Nation Children's Fund (2002) Prevention and Control of Nutritional Anaemia: A South Asia priority.

Vasantshi CR. Pawashe, A.B: Susie-H, Sujatha T and Ramesh L. (1994). Nutritional status of adolescent girls from rural and urban slums, India

Verma, A., Rawal,V.S., Kedia,G., Kumar, D & Chauhan,J. (2004). Factors influencing Anaemia among girls of school going age (6-18 years) from the slums of Ahmedabad city. *Indian Journal of Community Medicine,* **xxix** (1).

WH0 (2012). Micronutrient Deficiencies http://www.who.int/nutrition/topics/ida/en/index.html

WHO (2009). Addressing Iron Deficiency Anaemia: 12 x 12 Initiatives. http://whoindia.org/en/Section6/Section324_1467.htm

Wong's, Essentials of Pediatric Nursing (2009), 8th Edition published by Mosby publisher, India pp. 915-917.

World Health Organization (WHO) (2005). statistics for iron deficiency Anaemia, from www.pubmed.com

Zimmermann, M.B., Zeder, C., Muthayya, S., Winichagoon, P., Chaouki, N., Aeberli, I & Hurrell, R.F. (2008). Adiposity in women and children from transition countries predicts decreased iron absorption, iron deficiency and a reduced response to iron fortification. *International journal of obesity*, **3**(7), 1098-1104.

APPENDIX

QUESTIONNAIRE

Prepared By:

Prof.(Dr.) Nilofer Khan **&** **Roshina Bashir**

(Supervisor) **(Investigator)**

Institute of Home Science Research Scholar

University of Kashmir

RESEARCH TOPIC: Prevalence of iron deficiency Anemia among adolescent girls and impact of Health and Nutrition Programmme in changing their dietary behaviour

Course: M.Phil in Home Science

SECTION –A

a. Name :

_____

b. Age :

_____

c. Residential Address:

_____

d. Urban/Rural :

_____

e. Type of Family : (Joint/Nuclear)

f. Total No. of Members : _____

g. Detail of Children in the Family: No. _____, Age ____, Sex _____

h. Ordinal position of the sample : _____

i. Class of Studying of the respondent : _____

j. Educational qualification of the mother :

(illiterate/up to higher secondary/ graduate or above)

k. Educational qualification of father:

(illiterate/up to higher secondary/graduate or above)

SECTION –B

ANTHROPOMETRIC DATA

Height	cm
Weight	Kg
B.M.I	

BIOCHEMICAL DATA

Hemoglobin	g/dl
Below 7g/dl	7-10 g/dl
10-11 g/dl	Above 11 g/dl

CLINICAL EVALUATION

a. General Appearance

Small

Average

Large

b. Signs of malnutrition and deficiency disease

1. Eye. Normal/watery/dry
2. Lips Normal/Angular
   Stomatitis

3. Tongue Normal/Pale/Red
4. Skin Normal/Pale/Dry & Rough
5. Teeth Normal/ Discolored
6. Gums Normal/Bleeding
7. Other symptoms breathlessness/ Weakness/ tiredness/irritability/none.

SECTION C

DIETARY INFORMATION

1.	What is your main diet at home?	Rice / Wheat Bread / Maize Bread
2.	What is source of your drinking water?	Well / Running water / Pipe water / Others
3.	Do you use boiled water?	(Yes/No)
4.	Do you prefer junk food?	(Yes/No) If yes how often Daily/Twice a week/Once a week/ Once a month
5.	Do you take lunch daily to school	(Yes/No)
6.	Do you include green leafy vegetables in your diet?	(Yes/No) If yes how often Daily/Alternately Once a week/Twice a week/ twice a month
7.	Do you include fruits like (orange, lime, mango, melon) etc in your diet?	(Yes/No)

8. Do you drink milk daily? (Yes/No)

SECTION D

MENSURAL HISTORY

1. Age of Menarchy _____
2. Are you having dismenuria _____
3. Menopausal Syndrome

   (Vomiting / Nausea / Abdominal Pain / Backache)

4. Do you avoid some foods during these days?

   (Yes / No)

   If Yes Specify:

   (Pickles / Lassi / Curd / Others)

5. Foods more frequently taken:

   (Halwa / Milk with Turmeric/ Hot milk / Others)

6. Duration of Blood Flow:

   (2-3 days / 3-4 days / 4-5 days / More than 5 days)

7. Duration of your menstrual cycle:

   (More than 28 days / Less than 28 days)

8. Is your menstrual cycle (Rugular / Irregular)

9. Do you have any type of Illness:

   (Anemia / Tonsillitis / Stomach pain / Renal infection / Normal)

24 hour food recall

Breakfast:
Lunch:
Tea Time:
Dinner:

RECOMMENDED VALUES OF HEIGHTS FOR ADOLESCENTS GIRLS

(13-16 years)

Age (years)	Recommended Values (cm)
13 years	157
14 years	157
15 years	160
16 years	160

Source: Food and Nutrition Board of India, National Academy of Science Designed for Maintenance of Good Nutrition.

Charts used in Health and Nutrition Education Intervention Programme

Toothed Dock (Abuj)

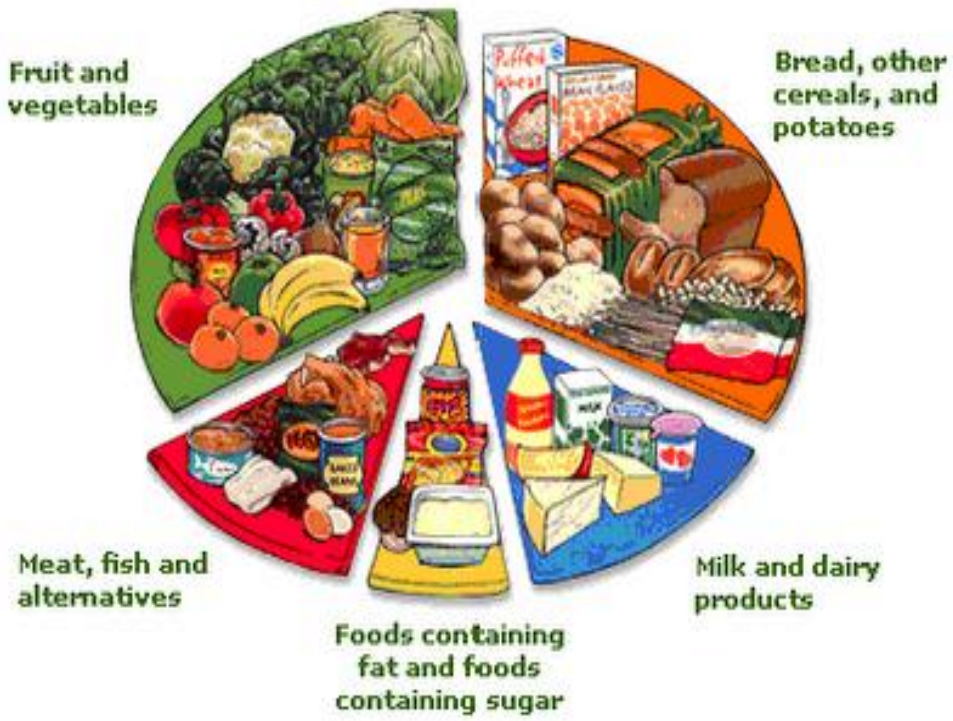
Fenugreek (Meethi)

Orache (Wuste Hakh)

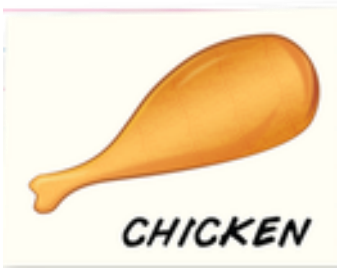
Dandelion (Hund)

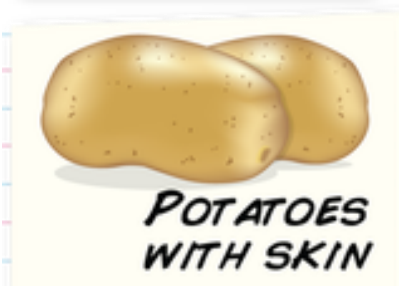
Coriander (Daniwal)

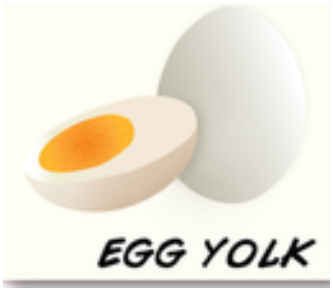
GREEN LEAFY VEGETABLES RICH IN IRON

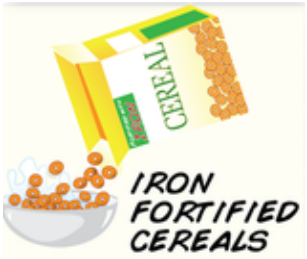

Fruit and vegetables
Bread, other cereals, and potatoes
Meat, fish and alternatives
Foods containing fat and foods containing sugar
Milk and dairy products

Food Groups









MEAT

Iron Rich Foods

Vitamin C Rich Foods

Vegetables Rich in Iron

Photographs of
Health and Nutrition Education Intervention Programme


24-08-11
Date: 26-08-011
Class- 10th
Class- 10th