"PREVALENCE OF ANAEMIA AMONG SCHOOL CHILDREN IN RURAL AND URBAN AREAS OF BELGAUM –A COMPARATIVE STUDY"

Submitted by

(REG. NO.BD0113001)

Dissertation

Submitted to the
KLE University, Belagavi, Karnataka.
In partial fulfilment
Of the requirements for the degree of

M. D. (Doctor of Medicine)

In

COMMUNITY MEDICINE

DEPARTMENT OF COMMUNITY MEDICINE,
J. N. MEDICAL COLLEGE, BELAGAVI – 590010.
KARNATAKA, INDIA.

APRIL – 2016

KLE UNIVERSITY, BELGAUM, KARNATAKA.

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LIST OF ABBREVIATIONS USED

BMI	–	Body Mass Index
CF	–	Correction Factor
cm	–	Centimeter
ELISA	–	Enzyme Linked Immuno Sorbent Assay
Fe	–	Iron
GLV	–	Green Leafy Vegetables
Hb	–	Hemoglobin
HIV	–	Human Immuno Deficiency Virus
IDA	–	Iron Deficiency Anaemia
Kg	–	Kilograms
mg/dL	–	milligram per deciliter
NFHS	–	National Family and Health Survey
NHANES	–	National Health and Nutrition Examination Survey
OAD	–	Open Air Defecation
PHC	–	Primary Health Centre
RCH	–	Reproductive and Child Health Services
SES	–	Socio Economic Status
WHO	–	World Health Organization
SD	–	Standard Deviation
χ^2	–	Chi – square test

ABSTRACT

BACKGROUND AND OBJECTIVES

Anaemia is a global health problem with a need of serious public health concern. Prevalence of anaemia in developing countries is 77%, which is three to four times higher than developed countries. An estimated 30% of world's population is anaemic, with global prevalence of anaemia among school children being 36%. Anaemia is a serious concern during this development phase, i.e. the schooling phase as it can adversely affect cognitive performance, behavior and motor development, and scholastic performance. So, there is need for more studies related to anaemia in school children. So the present, comparative study was undertaken to know the prevalence of anaemia and risk factors associated with anaemia in urban and rural school children of Belgaum.

METHODOLOGY

All Government aided schools coming under area of Vantamuri PHC and Ramnagar UHC were selected for the study, from January 2014 to December 2014. Students of class 8th, 9th and 10th standard were our study sample, total 800 students participated in our study (400 from each area). Size proportionate to sampling was done to select the sample. Permission was obtained from respective Heads of the schools before initiation of the studies. Written consent from the Heads of the school was taken. Student's assent was obtained. A predesigned and pretested questionnaire was used to collect data regarding socio-demographic profile, dietary intake and Environmental history. Haemoglobin estimation was done in all students of the study by using Sahli's Acid Hematin method. Detailed clinical examination was done and Anthropometry was measured.

RESULTS

The prevalence of anaemia was more in rural school children than that of urban area (52.75% vs 43%).This difference was found to be statistically significant, $p<0.001$. Prevalence of Anaemia in urban high school girls was found to be 50% and in rural girls it was 63.7%. Prevalence of Anaemia in urban high school boys was found to be 37.5% and in rural boys it was 43.58 %. Prevalence of anaemia was more among rural girls (81.2%) who have attained menarche compared to the urban (66.7%) counterpart. In urban area 63.4% prevalence of anaemia was seen in thin (undernourished) children i.e. BMI <5th percentile, similarly in rural area 68.6% prevalence was seen in thin children. Illiteracy of the mother, low SES, open air defecation, vegetarian diet, decreased consumption of green leafy vegetables and fruits were significantly associated with prevalence of anaemia with $p<0.001$.

CONCLUSION AND INTERPRETATION

The present community based study, reported a higher prevalence of anaemia among rural high school children compared to the urban counterpart. Prevalence of anaemia was more among girls in both urban and rural areas. The urban and rural areas in our study fall in to communities of severe public health significance (prevalence >40%).

KEY WORDS : Anaemia, Urban, Rural, School children

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Chapter 1

Introduction

INTRODUCTION

Anaemia is a global health problem with a need of serious public health concern. Prevalence of anaemia in developing countries is 77%, which is three to four times higher than developed countries[1]. An estimated 30% of world's population is anaemic, with global prevalence of anaemia among school children being 36%[2].

Adolescent is defined by WHO as a person between 10-19 years of age. The world is home to 1.2 billion individuals aged 10–19 years[3] and India has the largest national population of adolescents (243 million), followed by China (207 million), United States (44 million), Indonesia and Pakistan (both 41 million) [4].

Anaemia in children is commonest health problem in many countries. India continues to be one among them to have very high prevalence of anaemia because of low dietary intake, hookworm infestations, malaria and likewise many other factors. The most common among all is poor dietary intake. Children and Adolescents are at increased risk of developing anaemia because of their increased demand for nutrients during growth and puberty.

Adolescence is a period of transition from childhood to adulthood. It is characterized by rapid physical, biological and hormonal changes resulting in psycho-social, behavioral and sexual maturity in an individual. It is the second growth spurt of life and both boys and girls undergo different experiences in this phase.[5]

During this period, more than 20% of the total growth in stature and 50% of adult bone mass are achieved[6] and iron requirement increases dramatically in both adolescent boys and girls, from pre-adolescent level of 0.7-0.9 mg Fe/day to as much as 2.2 mg Fe/day. This increase in iron requirement is the result of expansion of total blood volume, increase in lean body mass and the onset of menstruation in adolescent females[7]. The nutritional anaemia in adolescent girls attributes to the high maternal mortality rate, the high incidence of low birth weight babies, high prenatal mortality and the consequent high fertility rates. This phase of life is also important due to the ever-increasing evidence that the control of anaemia in pregnant women can be more easily achieved if a satisfactory iron status can be ensured during adolescence.

Anemia in India primarily occurs due to iron deficiency and is the most widespread nutritional deficiency disorders in the country today. According to NFHS –III data over 55 percent of both adolescent boys and girls are anemic. Adolescent girls in particular are more vulnerable to anemia due to rapid growth of the body and loss of blood during menstruation. According to NFHS-III almost 56% of adolescent girls aged 15-19 years suffer from some form of anemia. More than 39% adolescent girls (15-19 years) are mildly anemic while 15% and 2% suffer from moderate and severe anemia respectively.

Anaemia is a serious concern during this development phase i.e. the schooling phase as it can adversely affect cognitive performance, behavior and motor development, and scholastic performance. Since the technological advancement and economic development of the nation depends heavily upon its trained human resources, the behavioral effects of anaemia are highly relevant.

Consequently if anaemia is highly prevalent in a country, it can substantially affect its intellectual and economic potential. The irreparable damage that anaemia can cause during childhood particularly in development makes this silent morbidity completely unacceptable.

Nutritional anaemia is also common in school children, where less importance is given during the implementation of health programmes .Neither the RCH (Reproductive and Child Health), nor the school based programmes have operationalized the programmes for detection and treatment of anaemia in school children in the country.

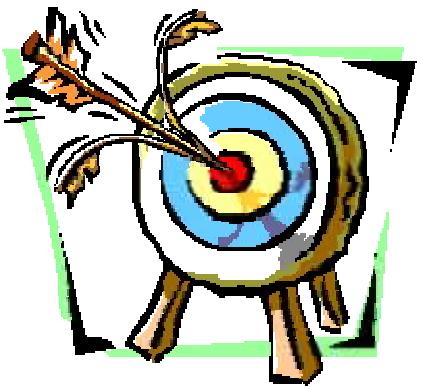
Although school children constitute approximately 25% of total population in India, few studies have been done to estimate their blood hemoglobin for anaemia detection. Anaemia prevalence among children of school going age varies from region to region. Prevalence rates for adolescent school children is close to that of adult females. Moderate and severe anaemia is seen even among educated families both in urban and rural areas. There are inter-state differences in prevalence of anaemia that are perhaps attributable partly to dietary intake and partly to access to health care[8].

Anaemia is preventable. Countries, which realized the magnitude of the problem and identified the associated risk factors, were able to intervene directly. At the same time, the application of intervention programs by several countries, for the last twenty years, resulted in a worldwide decrease in the occurrence of anaemia. Those programs were based on methods of anaemia diagnosis that combined ease of use, swiftness and reliability in diagnosis [9, 10].

Recent studies on prevalence of anaemia have been mainly concerned with preschool children. So, there is need for more studies related to anaemia in school children. So the present study will be a comparative study which will be undertaken to know the prevalence of anaemia in urban and rural school children in Belgaum.

Chapter 2

Objectives



OBJECTIVES

1. To compare the prevalence of anaemia among school children in rural and urban areas.

2. To know various factors influencing anaemia in rural and urban areas**.**

Chapter 3

Review of Literature

REVIEW OF LITERATURE

The term adolescence comes from Latin word meaning "to grow to maturity" [11]. The term adolescence was popularized 100 years ago when G. Stanley Hall Used it to describe the 2nd decade of life, since then adolescence has been considered a very turbulent period. Adolescents represent about a fifth of India's population. WHO has defined adolescence as a period between 10-19 years [12].This is the period of transition from childhood to adulthood which are formative years when maximum amount of physical, psychological and behavioral changes take place.

This phase of life cycle is marked by special characters which include[13]

- Rapid physical growth & development
- Physical, social & psychosocial maturity
- Sexual maturity & onset of sexual activity
- Beginning of menstrual cycle in girls & onset of reproductive cycle
- Development of adult mental processes & adult identity(want to establish their own identity
- Transition from total socioeconomic dependence to relative independence
- Under-served population group

Demographic Trend:

Size of adolescent population differs from country to country. Of the total adolescent population, 84% live in developing countries and remaining 16% live in developed countries.[14]

India:

According to Census 2011, adolescents belonging to age group of 10-19 years comprise 20.9 % of total population. There are approximately 230 million adolescents in India in the age group 10-19(2001).The sex ratio of adolescent girls in 10-19 age group has declined from 897 in 1981 to 880 in 2001.Female comprise almost 47% and males 53% of the total population[13].

Adolescence is divided into 3 stages[15]

1. Early adolescence (10-14 years) characterized by rapid growth (growth spurt) & development of secondary sexual characters.

2. Middle adolescence (15-17 years) striving for independence & identity & relationship with peers & opposite sex & experimentation.

3. Late adolescence (18-19 years) almost an adult.

This period is the healthiest period of life of one's life cycle. The morbidity & mortality is least, however during this period the adolescents gain up 50% of their adult weight & 50%of their adult skeletal mass.

Major problems of adolescents

- Anaemia, malnutrition & obesity: Over 89% of girls tend to be anaemic & 1/3rd of boys & girls have chronic energy malnutrition. Problem of obesity is emerging in urban adolescents because of unhealthy eating, eating junk foods as also physical inactivity.1/5th (20%) of Indian children above the age of 8 years are obese & overweight as per new national survey on physical fitness. One in ten adolescents and young adult in Delhi is clinically obese and 5% have high blood pressure because over 80% of them were physically inactive. Poor nutrition is cited

as an important cause of delay in onset of puberty in Indian adolescents due to poor dietary intakes, and discrimination of girls, these girls tend to develop as short stature females with low body weight and produce low birth weight babies.

- Knowledge & information of adolescents tend to be poor on several issues or they have erroneous impressions, myths & misconceptions. Moreover they tend to collect half backed knowledge from peers, which is seldom factual or scientific
- Early Marriages: over 45-50% of girls (NFHS-2, 3) get married below the legal age of marriage (18yrs) when their pelvises are small, uterus and cervix is immature, body weight is less. UNICEF state of world children report 2011 reveals 30% of adolescent girls get married in the 15-18 age groups. The girls enter into early reproduction and result in poor pregnancy out come in terms low birth weight babies.
- Teen Age Pregnancies: 16-19% of total pregnancies are teen age pregnancies which are risky pregnancies in adolescent leading to increased mortality rate (NHFS-3).
- Unwanted pregnancies & illegal abortions: pregnancies in adolescents may be unwanted or may occur in unmarried girls & consequently illegal abortions are sought which may be life threatening.
- HIV/AIDS: 50% of new HIV infections occur in young people in the age group 15-24, because of unsafe sex and early sexual initiation and premarital sexual relationships. Sexual abuse of boys and girls like rape, trafficking for prostitution, homosexuality are quite frequent.

- School dropouts: many of the girls & boys are dropouts from schools and only 1/3rd continue up to matric & beyond due to economic compulsion.
- Drug abuse: Adolescents indulge in unhealthy lifestyles like smoking, alcohol use & abuse of drugs apart from premarital sex, under the influence of peer pressure
- STIs & STDs: Early initiation of sexual activity without use of condoms exposes adolescents to the risk of acquiring & transmitting STIs. Contraceptive acceptance is poor in adolescents or they are reluctant to use it.
- Accidents & injuries: adolescents are involved in fatal road traffic accidents and the incidence of trauma is much higher because of high speed driving and driving without license & risky driving, non-use of helmets & violation of safety rules & mixing driving with alcohol.
- Lack of support: Broken families, one parent family, lack of support of parents, family, unfavorable environments in school/college & social pressure expose them to high-risk behaviors &unhealthy lifestyles. Oral health problems like: Caries teeth due to cariogenic food, junk food & lifestyles[13].

ANAEMIA

Definition of Anaemia[16]:

Anemia is defined as “a reduction in circulating hemoglobin concentration or red cell count below that which would be normal for an individual’s age and sex.”

Historical Perspective of Anaemia

The word Anaemia is derived from a Greek word meaning "Without blood"[14]. Anaemia symptoms were first identified by the term "chlorosis" a Greek term meaning Green. Anaemia is not a disease. It is a condition that results from below normal levels of Hemoglobin in the red blood cells. Earlier reference of anaemia can be dated back to 1684 when a study on composition of blood was conducted by Robert Boyle[17].The clinical manifestations of iron-deficiency anemia appear to have been recognized in earliest times. A disease characterized by pallor, dyspnea and edema was described in about 1500 B.C. in the Papyrus Ebers, a manual of therapeutics believed to be the oldest complete manuscript.

PATHOPHYSIOLOGY OF ANAEMIA

Tissue hypoxia develops when compensatory physiological adjustments that enhance release of oxygen from hemoglobin, and increase the flow of the blood to the tissues, fail to counteract the effects of the decreased oxygen carrying capacity of the blood. Hypoxia causes impairment of function in many tissues, the symptoms and signs of anaemia are therefore referred to many systems. The degree of functional impairment of individual tissues depends largely on their oxygen requirements, and thus symptoms referable to systems with high requirements, such as the skeletal musculature during activity, the heart and the central nervous system, are particularly prominent.

Several mechanisms are brought into play in anemia to make more effective use of the available hemoglobin for delivery of oxygen to the tissues.[18]

1. Increased release of oxygen from red cells:

A greater proportion of the oxygen attached to hemoglobin is released when the red cell passes through the tissues in anemic subjects. This results from the increase in concentration of 2, 3 di-phosphoglycerate in the red cells, the oxygen dissociation curve is shifted to the right, and a greater proportion of the oxygen on the hemoglobin molecule is released at the partial pressure of the oxygen of venous blood.

2 .Increased blood flow:

Cardiac output increases in anemia, mainly as a consequence of increased stroke volume. This high output state increases oxygen delivery to tissues by increasing the flow of blood through them.

3. Maintainence of blood flow:

A relatively rapid flow of fluid from the extravascular to the intravascular space occurs after acute blood loss, and along with other changes, results in restoration of the circulatory volume after 48-72 hours.

4. Redistribution of blood flow: Some deviation of blood flow occurs from tissues with lesser oxygen requirements to those with greater requirements rom hookworm infestation.

IRON DEFICIENCY ANAEMIA:

Iron deficiency is the state in which the content of iron in the body is less than normal. It occurs in varying degrees of severity that merge imperceptibly into one another.[19]

Iron absorption: Iron is maximally absorbed from the duodenum and less well from the jejunum.

Daily iron requirement:

Non-menstruating females and adolescent boys : 1.33mg/day

Menstruating females:1.65mg /day. [20]

Iron status can be considered as a continuum from iron deficiency with anaemia, to iron deficiency with no anaemia, to normal iron status with varying amounts of stored iron, and finally to iron overload - which can cause organ damage when severe. Iron deficiency is the result of long-term negative iron balance. Iron stores in the form of hemosiderin and ferritin are progressively diminished and no longer meet the needs of normal iron turnover. From this critical point onward, the supply of iron to the transport protein apotransferrin is compromised. This condition results in a decrease in transferrin saturation and an increase in transferrin receptors in the circulation and on the surface of cells, including the erythron.

All tissues express their need for iron in exactly the same way, i.e. by the same type of transferrin receptors on cell surfaces in proportion to actual iron need. Accordingly, a compromised supply of iron to the erythron is associated with a similarly insufficient supply of iron to all other tissues. Functionally, the lack of mobilizable iron stores will eventually cause a detectable change in

classical laboratory tests, including measurement of haemoglobin, mean corpuscular haemoglobin concentration, mean corpuscular volume, total iron-binding capacity, transferrin saturation, and zinc-erythrocyte protoporphyrin.

Iron deficiency is defined as a condition in which there are no mobilizable iron stores and in which signs of a compromised supply of iron to tissues, including the erythron, are noted. The more severe stages of iron deficiency are associated with anaemia. When iron-deficient erythropoiesis occurs, haemoglobin concentrations are reduced to below-optimal levels. When individual haemoglobin levels are below two standard deviations (-2SD) of the distribution mean for haemoglobin in an otherwise normal population of the same gender and age who are living at the same altitude, iron deficiency anaemia is considered to be present

Etiology:

The most common causes for iron deficiency anemia are as follows:

1. Inadequate dietary intake:

Iron requirements increase with normal growth spurts around 2 years of age and during adolescent years. In females, the adolescent spurt is usually coupled with the onset of menstrual periods.

2 .Chronic blood loss:

Hook worm infestations are common source of iron deficiency anaemia. In adults, chronic blood loss may occur due to various factors. The most common causes of gastrointestinal bleeding are peptic ulcer, hiatal hernia, gastritis and hemorrhoids. Other causes include infections and neoplastic conditions of colon, respiratory tract and biliary tract.

3. Malabsorption of iron:

In malabsorption syndromes, absorption of iron may be so limited that iron deficiency anemia develops over a period of years. Iron deficiency anaemia may be associated with overt or occult Celiac disease.

4. Intravascular hemolysis and hemoglobinuria:

Iron deficiency anaemia may occur in Paroxysmal nocturnal hemoglobinuria and in hemolysis resulting from intracardiac myxomas and valvular prosthesis. In these disorders, iron is lost in the urine as hemosiderin and ferritin in desquamated tubular cells.

5. Pregnancy and parturition: Repeated pregnancies without supplemental iron can result in iron deficiency anemia for both mother and child.

MEGALOBLASTIC ANEMIA:

It is caused by the deficiency of either vitamin B12 or folic acid which are critical nutrients for DNA production and subsequent cell division.[21]

Vitamin B12 (Cobalamin) daily intake and absorption: The only source for humans is food of animal origin. Dietary cobalamin deficiency occurs in vegetarians. Cobalamin is maximally absorbed from the ileum.

Cobalamin requirement: 1-3 micro grams/day [22]

Causes of Vitamin B12 deficiency:

1. Dietary insufficiency: A decrease in dietary amounts or increase in need results in anemia in about 15 months.

2. Pernicious anemia: Pernicious anemia is defined as lack of vitamin B12 absorption due to lack of functional intrinsic factor. Most cases are caused by antibodies directed against the gastric parietal cells.

3**. Biologic competition**: Infestation with fish tapeworm, Diphyllobothrium latum and blind loop syndrome may lead to vitamin B12 deficiency.

4. Gastrectomy: Both partial and total gastrectomy cause vitamin B12 deficiency because of lack of gastric acid and production of intrinsic factor. [20]

Folic acid:

The principle site of folate absorption is duodenum.

Folate requirement: 100 micrograms /day. [21]

Causes of folate deficiency:

1. Increased need: The need for folate is especially more in young infants, pregnant and nursing mothers.

2. Dietary insufficiency: Deficiency of folate is common in persons with inadequate diet.

3. Malabsorption syndromes: Tropical and Non-tropical sprue are the most common causes of malabsorption syndrome

4. Chronic hemolysis: Sickle cell anemia, thalassemia, hereditary spherocytosis and other chronic hemolytic conditions stress the bone marrow with increased demand for red blood cells.

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5. Folate antagonists:E.g. Methotrexate, Dilantin, Isoniazid and Pyrimethamine.

6. Hemodialysis for renal failure: Folate is lost with the dialysate.

HEALTH PROBLEMS OF ANAEMIA

Effects of Anaemia on Mental Performance

Iron-deficiency anemia among children has been demonstrated in many studies to be associated with impaired cognitive and intellectual performance, motor development, coordination, language development, and scholastic achievement (Scrimshaw, 1984; Lozoff et al., 1991; de Andraca et al., 1997; Pollitt, 1997). Other effects include irritability, apathy, lack of attention, reduced learning capacity, and low school performance scores. Some of these symptoms can be reversed after iron therapy. Because of multifactorial determinism of these types of abnormalities, the contribution of iron deficiency to these symptoms is hard to evaluate. Iron deficiency may result in an imbalance of the brain hormones, particularly of the monoamine oxidase system, which plays an important role in the brain functions. This may lead to impaired cognitive performance and other types of dysfunctions of the central nervous system.

Anaemia and Resistance to Infections:

Anemia increases morbidity from infectious diseases because important immune mechanisms, especially cellular immunity, are adversely affected. Several epidemiological and clinical studies have shown that higher morbidity rates due to infections have been found in anaemic subjects than in non-anaemic subjects, and that iron supplementation has been shown to have a beneficial effect upon the incidence of infection (Scrimshaw, 1984; Hercberg and Galan, 1992). The antibacterial affects of two iron-binding proteins, transferrin and lactoferrin, have been studied. These proteins prevent microorganisms from using iron and thereby limit the micro-organisms growth.

Effect on Work Capacity

Several studies have shown a direct relationship between hemoglobin concentration and the physical performance of agricultural workers: sugar cutters in Guatemala, latex tappers and weeders in Indonesia, tea harvesters in India. The deleterious effect of anemia on work capacity may be related to irons role in the biochemical reactions which facilitate oxygen transport to the muscle cells. Many studies have shown that the work capacity of anaemic persons can be increased by iron supplementation (Hercberg and Galan, 1992).

Impaired work performance in anaemic individuals and the possibility of improving it by balancing their iron status may have far-reaching socioeconomic consequences. For this reason, anemia-controland- prevention programs have been recognized by the World Bank to be among the most cost-effective interventions in the field of public health (Levin, 1986).

Economic implications of Anaemia :

National socioeconomic development, as well as personal health and self-fulfillment, are impaired by Anaemia. The negative impact on national development can be estimated from:

- The number of individuals affected in various age and gender categories
- The severity of the deficiency
- The duration and consequences of the condition

The economic implications of such conditions include:

- The costs incurred by the public and private sectors in therapeutic measures for the prevalent level of anaemia

- The societal consequences of increased maternal mortality and resultant restraints on productivity
- The long-term projected negative consequences of impaired mental development on human capital formation

CLINICAL MANIFESTATIONS OF ANEMIA

Patients with anemia usually complain of decreased work tolerance, fatigue, shortness of breath, palpitations, and other signs of adjustments of the heart and lungs to anaemia. When significant anaemia is developed, the patient may notice a humming or whirring sound in the head, attributed to the rapid blood flow through blood vessels in the brain (Lee, 1999a).

It is important to note, however, that patients complaints are often quite subjective and may not be related to anaemia. On the other hand, in some cases the patients adjustment to anaemia may be so good that despite the presence of severe anemia, the patient may not experience enough symptoms to appreciate the situation and become motivated to seek medical attention.

Clues to a diagnosis of anaemia and a determination of its causes may be found after physical examination, evaluation of the patients history, laboratory investigation, and systematic analysis of the factors and mechanisms that may operate to produce anaemia.

On physical examination of patients with anemia, many symptoms related to dysfunction of cardiovascular, pulmonary, neuromuscular, gastrointestinal and genitourinary systems may be evident. Skin pallor is perhaps the most evident sign of anaemia, since there is a general relationship between skin and mucous membrane color and hemoglobin level. Skin pallor in patients with anemia is

usually noticed by their friends and family. The pallor associated with anaemia is detected most accurately in the eye conjunctivae, the lips, the nail beds, the palmar creases of the hand, and the mucous membranes of the mouth and pharynx.

However, it is important to note that many factors other than hemoglobin concentration may affect skin color. These factors include temperature, age, and kidney or endocrine disorders. Certain people normally have pale skin. Many symptoms of anemia, such as shortness of breath, dizziness, and palpitation, are noticeable only after exertion or excitement. For these reasons, laboratory examination is a far more definitive measure of anemia status than physical examination and the patients history. Among laboratory diagnostic methods, three measures may be used to establish the presence of anaemia: hemoglobin, hematocrit, and number of red blood cells.

The blood hemoglobin concentration is recognized as the most informative, in part because of its relatively high accuracy and reproducibility, and in part because it is the value most indicative of the pathophysiologic consequences of anemia (Perkins, 1999). Hemoglobin measurement is also recommended for anaemia testing in population-based surveys.

PREVENTION STRATEGIES[23]

Efforts should be targeted to:

- Reduce poverty
- Improve access to diversified diets
- Improve health services and sanitation
- Promote better care and feeding practices

Food-based approaches:

Food-based approaches should include strategies to:

- Improve the year-round availability of micronutrient-rich foods
- Ensure the access of households, especially those at risk,to these foods
- Change feeding practices with respect to these foods

In practice, food-based approaches should first address the production, preservation, processing, marketing, and preparation of food. Secondly, they should address feeding practices, such as intra-family food distribution and care for vulnerable groups.

Applied to iron deficiency, efforts should be directed towards promoting the availability of, and access to, iron-rich foods. Examples include meat and organs from cattle, fowl, fish, and poultry; and non-animal foods such as legumes and green leafy vegetables.

Similarly, focus should be upon foods which enhance the absorption or utilization of iron. Examples include those of animal origin, and non-animal foods – such as some fruits, vegetables, and tubers - that are good sources of vitamins A and C, and folic acid. Finally, effective nutrition education - and information on health and nutrition for both supply and demand aspects of programmes – may be needed to increase the demand for and consumption of such foods.

Iron absorption can vary from 1% to 40%, depending on the mix of enhancers and inhibitors in the meal. Therefore, the adequacy - i. e.

bioavailability - of iron in usual diets can be improved by altering meal patterns to favour enhancers, lower inhibitors, or both.

Enhancers of iron absorption include:

- Haem iron- present in meat, poultry, fish, and seafood
- Ascorbic acid or vitamin C- present in fruits, juices, potatoes and some other tubers, and other vegetables such as green leaves, cauliflower, and cabbage
- Some fermented or germinated food and condiments, such as sauerkraut and soy sauce (note that cooking, fermentation, or germination of food reduces the amount of phytates).

Inhibitors of iron absorption include:

- Phytates, present in cereal bran, cereal grains, high-extraction flour, legumes, nuts, and seeds
- Food with high inositol content
- Iron-binding phenolic compounds (tannins)
- Foods that contain the most potent inhibitors resistant to the influence of enhancers include tea, coffee, cocoa, herbal infusions in general, certain spices (e.g. Oregano), and some vegetables
- Calcium, particularly from milk and milk products

Food fortification

Essential requirements for implementing fortification strategies include the identification of an appropriate food vehicle that reaches the target population, that is centrally processed, and that is widely available and consumed in relatively predictable amounts by vulnerable population groups. It is essential

that the final product not be significantly changed in terms of its organoleptic quality, shelf life, or price; and that the food as prepared be acceptable to the population.

The dietary habits of the population are an important consideration in selecting a food for fortification. For example, possible appropriate food vehicles range from wheat flour or pasta and condiments like sugar, salt, curry powder, haldi, monosodium glutamate (MSG), to bouillon cubes and soy sauce.

In subsistence farming areas in most developing countries, a fortified-food approach has limited potential because few households ever consume commercially processed foods. Instead, fortified food supplements can be effectively and widely distributed through general food distribution programmes, e.g. school lunch or other supplemental or emergency feeding programmes.

Several iron fortificants have been used successfully in a variety of national programmes. Examples are as follows.

- Rice in the Philippines is fortified with a standard ferrous sulphate mix.
- Where bread and pasta are abundantly consumed, and flour is milled in only a few places, several iron fortificants have been added successfully during the milling process. Ferrous sulphate is adequate if the turnaround time between milling and bread consumption is relatively short (3 to 4 months), as in Chile.
- If flour (wheat or maize) is stored for a long time, metallic iron (Sweden, UK, and USA) or ferrous fumarate (Venezuela) have been used. When flour is used as a vehicle, the general population

is the target group, but this approach does not reach infants and young children, who usually consume little bread

- Iron-EDTA

Other actions that indirectly affect iron status might include:

Parasitic disease control programmes, in particular those directed to hookworm, schistosomiasis and malaria control; these programmes can enhance iron deficiency anemia control programme effectiveness in a population with moderate to severe levels of infection.

REVIEW OF LITERATURE

A cross sectional study was conducted on prevalence of anaemia among children in urban schools of Ludhiana, Punjab. Two thousand children aged 5-15 years from government, private and mission run schools comprised the study population. Overall prevalence of anaemia was 51.5%.Girls had significantly higher prevalence of anaemia. More menarcheal girls were anaemic. Prevalence was high (38%) even in higher socioeconomic groups. Nearly half (47.6%) of well-nourished children were anaemic. Compared to non-vegetarians (38%), more vegetarians (65.9%) were anaemic.[24]

A cross sectional study conducted to know the prevalence of anaemia in school children of Kattankulathur, Tamilnadu included 900 students from four Government schools in the age group of 8-16 years. Prevalence of anaemia among them was found to be 52.88%, of which prevalence in girls (67.7%) was higher than that of boys (35.55%).The results also showed anaemic children were underweight.[25]

A cross sectional study conducted on prevalence of anaemia using 200 children aged 5 to 16 years, studying in the Government school at Rishikesh, Uttarakhand showed prevalence of anaemia to be 56.5%. More menarcheal girls (36.5%) were anaemic. The most common blood picture was microcytic hypochromic (54.86%), suggesting lack of nutrients. Lower socioeconomic classes, Vegetarians (65.2%) and girls (75%) were more anaemic than their opposite group.[26]

A cross sectional community based study was carried out in Morang district, Nepal to determine the prevalence and distribution of anaemia in terms of age, sex and locations (urban and rural) among children of 10-19 years. 308 (127 urban, 181 rural) participated in the study. The overall prevalence of iron deficiency anaemia among them was 65.6 with the distribution of anaemia in rural being 62.4%, urban 70%, male 52.3% and female 78.3%.[27]

A cross sectional study was conducted to assess the prevalence of anaemia and determine serum ferritin status among 1120 apparently healthy adolescents (12-18 years) sampled from 11 city and 2 rural schools in Chandigarh. Serum ferritin was estimated in 183 students. The overall prevalence of anaemia was significantly higher among girls (23.9%) as compared to boys (odds ratio -3.75, 95% CI -2.59 to 5.43, $P<0.01$). Prevalence of anaemia was observed more in rural (25.4%) as compared to urban (14.2%) adolescents. Iron stores estimated by serum ferritin in 183 subjects were deficient in 81.7% and 41.6% of the adolescent girls and boys, respectively.[28]

A cross sectional study was conducted from March 2007 to October 2007 on socio-demographic factors affecting anaemia in school children in urban area

of Meerut, India. 515 children (5-11 years) were selected randomly from all the government schools in that area. Out of which 265 were boys and 250 girls. 194 children (37.7%) were found to be anaemic. Prevalence among girls (45.2%) was higher than boys (30.6%). It was found that as socioeconomic status decreased, the prevalence of anaemia increased significantly. Percentage of anaemia was significantly higher (P=0.039) in vegetarians and also higher (P<0.01) in children belonging to joint families. Anaemia was significantly higher in children of illiterate and working mothers.[29]

A Comparison of Nutritional Profile and prevalence study of Anemia among Rural Girls and Boys was conducted from 100 students, 50 girls & 50 boys in the age group of 16-18 years belonging to different villages and studying in government senior secondary school, Chanarthal Kalan, district Fatehgarh Sahib, Punjab. The average hemoglobin levels were found to be 8.9 and 10.77 g /dl in female and male subjects, respectively and were positively correlated with anthropometric parameters of height, weight and BMI. 50% of female subjects were suffering from disturbances in menstrual cycle. Clinical signs and ill effects of anemia were common. Consumption of tea was high and diets were inadequate in fruits, vegetables and milk products reflecting deficiencies in energy, protein, fat, iron and B vitamins. Overall female subjects showed poorer nutritional profile and higher prevalence of anemia as compared to male subjects.[30]

A cross sectional study to assess risk factors of Anaemia was conducted among rural school children in Kenitra, Morocco.295 students between 6 and 16 years old composed the study group. The level of haemoglobin was measured in a group of 295 school children.The mean haemoglobin concentration was 12.4

g/dl in boys and 12.5 g/dl in girls, whereas the mean ferritin level was 26.7 mg/l in boys and 27.9 Wg/l in girls. The overall prevalence of anaemia in the studied population was 12.2 % and iron deficiency was 20.4 %.There was a significant relationship between education of the mother and anaemia in children (p= 0.01). Serum ferritin (SF), serumiron concentrations and mean corpuscular volume (MCV) were significantly correlated with haemoglobin by multiple regression analysis. However, using logistic regression analysis, the results showed that anaemia was not significantly associated with gender parents' employment and monthly family income.[31]

A study conducted to know the prevalence of anemia in adolescent girls, aged 10.5 to 18 years in Ujjain city, in western Madhya Pradesh belonging to different economic groups showed that the overall prevalence of anemia was 96.5% among weaker economic group and 65.18% among middle income group. The prevalence of severe anemia was 11.0% and 2.63% among weaker and middle income group respectively. The prevalence of severe anemia was more among girls above 14 years of age than among girls below 14 years of age. The prevalence of severe anemia among girls above 14 years of age among weaker economic group was 13.49% and among girls below 14 years of age was 4.23%. Similarly in the middle income group, severe anemia was 5.28% among girls above 14 years of age and it was 0.7% below 14 years. The association between the age of the adolescent girls and the prevalence of anemia was found to be significant.[32]

A study was conducted to know the prevalence of anaemia among 308 adolescents in rural (181) and urban (127) areas of Morang district. Nepal. The

overall prevalence of anemia among females was 78.3%. About 83.7% & 71.9% of female adolescents were found anemic in urban and rural areas respectively. The prevalence of anemia in the age group of 10-14 years was found higher (85.7% in the urban and 77.8% in the rural female adolescents). In the age group 15-19 the prevalence was slightly lower (83.71% among urban adolescents and 71.9% among rural female adolescents). 48% of the population studied was found with normal level Hb. There were no cases with severe anaemia and the number of mild anaemic adolescents was found equal to number with normal Hb levels.[33]

A study conducted to assess the prevalence of anemia among 911 school going children between age 12-18 years including boys and girls in Chandigarh city using cyanomethohemoglobin method and serum ferritin by ELISA (UB 1 magiwel enzyme immonuassay) using WHO criteria to detect anemia showed that the prevalence was high among girls ($P<0.01$) compared to boys, less among urban than rural students (14.16% Vs 25.4%). The serum ferritin level was estimated in 183 adolescentsamong which 86.8% girls and 13.2% were boys, serum ferritin less than 15ng/mL was noted in 81.8% girls as compared 41.7% boys.[34]

A cross sectional study conducted to assess the epidemiological correlates of nutritional anemia among 630 adolescent's girls in the age group 13-19 years in rural Wardha showed that the prevalence of anemia was 59.8%.The prevalence of severe, moderate and mild anemia was 0.6%, 20.8% and 38.4% respectively. 0.9% girls were illiterate with more than 50% girls completed secondary level education. Majority girls belonged to families with income group grade III.6.6% girls had history of excessive menstrual bleeding, 90% girls had daily iron intake

of < 20mg, 58.6% girls were non- vegetarians .Worm infestation was present in 10.3% girls. Significant association of anemia was seen with socioeconomic status, iron intake, vegetarian diet, excessive menstrual bleeding and worm infestation.[35]

A Community based cross sectional study was conducted in urban slum, Multan nagar, Meerut showed prevalence of anaemia among adolescent males and females as 31.6% and 52.8% respectively. Statistical significant association ($p< 0.05$) of anaemia among boys wasfound with type of family, socio-economic status, educational status, academic performance, hand washing before eating main meal, daily frequency of main meals, daily consumption of lemon/sour fruits and BMI.[36]

A study conducted in Fatehgarh, Punjab showed that blood hemoglobin levels of the female subjects ranged from 6-12 g / dl with the mean value of 8.9 ± 1.46 g / dl whereas blood hemoglobin of male subjects ranged from 7.5 -14 g / dl with the mean value of 10.77 ±1.71 g /dl. Most of the female subjects (98%) and 56% of male subjects were anemic. 68% of female subjects and 30% of male depicted skin pallor. 64% of female and 32% of male subjects were suffering from easy fatigability. Frequent headache was reported by 44% of female subjects and 4% of male subjects. An equal number of female subjects (50% each) showed reduced physical work capacity and shortness of breath while 10% and 30% of male subjects, respectively showed reduced physical work capacity and shortness of breath. Loss of appetite was reported by 4% each of both female and male subjects. Feeling of weakness was reported by 34% of female and 22%

of male subjects while dizziness was reported by 10% of female subjects and 2% of male subjects.[37]

A Cross-sectional survey in Bangalore district showed overall anemia prevalence in this group was 13.6%. In children who had anemia, 11.2%, 2.1% and 0.3% had mild, moderate and severe anemia, respectively. Boys (1037) had a significantly lower anemia prevalence i.e. 12.0% compared to girls, 15.3%.There was no significant difference in anemia prevalence between children in urban and rural locations (14.6 and 12.3 % respectively). However, there was a significant difference in anemia prevalence between urban and rural boys.[38]

Chapter 4

Methodology

METHODOLOGY

The present study was conducted at Government aided schools coming under Urban Health Centre, Ramnagar and Primary Health centre, Vantamuri which are the field practice areas of Department of Community Medicine, Jawaharlal Nehru Medical College, Belagavi.

a) SOURCE

Children belonging to VIIIth, IXth and Xth standards of Government aided schools from Vantamuri PHC and Ramnagar UHC.

b) STUDY DESIGN

Cross - Sectional Study.

c) STUDY PERIOD

The study was conducted between Jan 2014 to Dec 2014.

d) SAMPLE SIZE

Assuming 50% to be the prevalence of anemia in rural and urban areas sample size was calculated.

FOR RURAL AREA

$n = 4pq/d^2$

$= 4*50*50 / 5*5 = 400$

FOR URBAN AREA

$n = 4pq/d^2$

$= 4*50*50 / 5*5 = 400$

Where p= prevalence of anemia, assumed to be 50%

q=100-p

d = relative error = 10 % of p

TOTAL SAMPLE SIZE = 400+400 = **800**

Therefore, 400 Children from urban schools and 400 Children from rural schools were included in the study.

METHODOLOGY

Government aided schools from Vantamuri PHC and Ramnagar UHC were selected for the study. Probability proportionate to the size sampling technique was used to select sample from each school. Students were selected from each class (8th -10th Std) by simple random sampling using the student register till desired sample size was met. Permission was obtained from respective Heads of the schools before initiation of the study. Written consent from the Head of the school was taken. Student's assent was also obtained. A predesigned and pretested questionnaire was used to collect data regarding socio-demographic profile, dietary intake and Environmental history. Haemoglobin estimation was done in all students of the study by using Sahli's Acid Hematin

method. Detailed clinical examination was done and Anthropometry was be measured.

INCLUSION CRITERIA

Students of class 8th, 9th and 10th standard of government aided schools under Vantamuri PHC and Ramnagar UHC were included in the study.

EXCLUSION CRITERIA

Students who did not give assent for the study.

SAMPLING METHOD

Probability Proportionate to size sampling.

SAMPLING PROCEDURE

All Government aided schools were selected for the study. Size proportionate to the sample was taken from each class (8^{th}, 9th and 10^{th}) of every school.

Students in each class were selected by random number table.

SAMPLING FRAME:

URBAN AREA RAMNAGAR:

Five government aided schools in Ramnagar were taken for the study purpose.

1. Sherman English Medium High school

2. Sherman Kannada Medium High school

3. MVM English Medium High school

4. GA High School

5. Maratha English Medium High School

After doing proportionate calculation for the sample for girls and boys of each class from every school, following table was framed.

Standard	Boys	Girls	Total
8th std	80	58	138
9th std	74	68	142
10th std	70	50	120
TOTAL	**224**	**176**	**400**

RURAL AREA VANTAMURI:

Five Government aided schools of Vantamuri were taken for the study.

1. B.M.J English Medium High school

2. Murarji Desai Residential Model School

3. Shri Shivasiddha Someshwar High School

4. Maratha Mandal High School

5. R.R.High School Vantamuri

After doing proportionate calculation for the sample for girls and boys of each class from every school, following table was framed

Standard	**Boys**	**Girls**	**Total**
8th std	69	63	132
9th std	70	63	133
10th std	79	56	135
TOTAL	**218**	**182**	**400**

Ethical Clearance

The study was approved from Institutional Ethics Committee for Human Subject's Research, Jawaharlal Nehru Medical College, Belgaum.

Data collection procedure

A pilot study was conducted using the predesigned questionnaire and required modifications were made.

Data was collected from the participants through interview. Data regarding socio demographic variables like age, sex, address, educational status of parents, occupation, socio-economic status were collected.

All the subjects in the sample were informed about the purpose of the study and after obtaining informed consent from Principal and assent from the students, they were interviewed separately using pre-structured and pretested proforma and Haemoglobin was estimated.

Sahli's Acid Hematin method

N/10 HCl is taken in the tube up to mark 2gm%. 0.02ml of blood from the participant after a sterile lancet prick, is pipetted in to the tube. Mixing blood with the acid is done thoroughly and allowed to stand undisturbed for 10min. Hemoglobinometer tube is placed in the comparator and distilled water is added to the solution drop by drop stirring with the glass rod till its color matches with that of the comparator glass. The quantity of hemoglobin is determined by reading the level of the solution on the scale of the test tube.

Criteria for Anaemia:

Hemoglobin level was used to assess the anemia & severity based on cut off values by WHO. If Hb% <12gm%, participant was considered Anaemic.[1]

Criteria for severity:

Mild anemia Hb < 11.9 to10gm Hb/100 ml blood

Moderate anemia Hb <9.9 to 7gm Hb/100 ml blood

Severe anemia Hb <7gm Hb/100 ml blood

The Proforma included the following:

First part consists of questions related to socio-demographic profile.

It included information on age, religion, education and occupation of parents, family type, socio-economic status.

Age: Calendar age in years was considered for the study

Religion: Hindu, Muslim, Christian, Others (specify)

Education: Every study subject was asked about the Education status of their parents. He/she was informed a day before to get the information. It was classified as:

a. **Illiterate:** A person who cannot read and write any language.
b. **Primary school:** A person who has studied from first to seventh standard.
c. **High school:** The person who has studied eighth to tenth standard.
d. **Greater than High School:** The person who has studied up to Pre-University College second year (PUC) or a diploma course or a Graduate or more.

Occupation: Every study subject was asked about the occupation of their parents. He/she was informed a day before to get the information. It was classified as:

a. **Semiprofessional/ Professionals:** which include doctors, engineers, college lecturers etc.
b. **Skilled workers:** skilled based jobs, such as technicians, mechanic, electricians etc.
c. **Semiskilled worker:** drivers, conductors, office attenders, security personnel, super visors etc.
d. **Unskilled workers/ manual workers:** In this group the occupations which involve physical exertion like masonry, farming, coolie etc.
e. **Unemployed/Expired**

Type of family:

a. **Nuclear family:** The family consisting of married couple along with their dependent children.
b. **Joint family:** It consists of number of married couples and their children who live in the same household.
c. **Broken family:** A family consists of widow/ widower/ divorcee living with or without their dependent children.
d. **Problem family:** In these families the standards of life are generally far below the accepted minimum and parents are unable to meet the physical and emotional needs of the children and they lag behind the rest of community.

Socio-Economic status (SES) class:[39]

Modified BG Prasad SES classification was used. This was obtained by multiplying per capita monthly income of 1961, (as suggested by BG Prasad) with the Multiplication factor.

$$\text{Multiplication factor} = \frac{\text{Current Consumer Price Index (CPI) X 4.93}}{100}$$

Average consumer price index for year 2014 was Rs. 1130.

Substituting in the formula,

Multiplication factor = 1130 X 4.93/ 100 = 55.71

Socio Economic Status: Class	BG Prasad's Classification of 1961	Modified BG Prasad's Classification for 2014(per capita income in rupees/month)
I	100 and above	5571 and above
II	50—99	2786-5570
III	30-49	1671-2785
IV	15-29	836-1670
V	<15	Below 836

The second part of the proforma had questions to find out various factors associated with Anaemia.

Third part of the proforma was for general physical examination and systemic examination.

Anthropometry

Height: The subject was asked to stand straight without footwear, with heels, buttocks and back straight and arms hanging by side. The height was measured from head to heal. The coinciding reading was measured to the nearest 0.1 cm using a metallic measuring tape.[40]

Weight: Body weight was measured without any foot wear and with minimal clothing to the nearest 0.1 kilogram using a standard portable adult weighing machine, which was standardized periodically during the study. The scale was adjusted to zero before each session and weight was recorded in kilograms.[40]

Body Mass Index (BMI):

Calculation of Body Mass Index (BMI in Kg/m2):

Weight in kg / (Height in m)^2 × 100

< 5th percentile for that age was considered as malnourished, between 5th - 85th percentile were considered as normal and > 85th percentile as high risk for overweight (BMI chart developed by the National Centre for Health Statistics in collaboration with the National Centre for Chronic Disease Prevention and Health Promotion-2000). [41]

Statistical analysis

The data was tabulated and master chart was prepared (Annexure V). Data collected in the questionnaire was coded and entered in Microsoft excel sheet. Data was analyzed using Statistical Package for Social Sciences (SPSS), version 21.0 and the prevalence of each risk factor was expressed in terms of percentages. Statistical analysis was done using Pearson's Chi- Square test to find out the association between Anaemia and risk factors. A probability value (p value) of less than 0.05 was considered as significant.

Chapter 5

Results

RESULTS

The present study was conducted in Government aided high schools in urban area Ramnagar and rural area Vantamuri which are the field practice areas of Department of Community Medicine, Jawaharlal Nehru Medical College, Belagavi on 800 students during the period of January 2014 to December 2014.

The data obtained was tabulated and analyzed under following headings as below:

1. **Profile of study participants**

2. **Prevalence of anaemia and Association of anaemia with socio-demographic variables and risk factors.**

I. PROFILE OF STUDY PARTICIPANTS

Table 1: Age wise distribution of the study participants (N=800)

Age (Years)	URBAN		RURAL	
	Number	Percentage	Number	Percentage
13	95	23.75	76	19
14	136	34	134	33.5
15	114	28.5	121	30.25
16	55	13.75	69	17.25
Total	**400**	**100**	**400**	**100**

In urban area 95 (23.7 5%) participants were of 13 years of age, 136 (34%) were 14 years, 114 (28.5%) were 15 years and 55 (13.75%) were 16 years old. In Rural area 76 (19%) participants were of 13 years of age, 134 (33.5%) were 14 years, 121 (30.25%) were 15 years and 69 (17.25%) were 16 years old.

Table 2: Distribution of the study participants according to sex (N = 800)

Gender	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Male	224	56	218	54.5
Female	176	44	182	45.5
Total	**400**	**100**	**400**	**100**

In urban area, boys were 224 (56 %) and girls were 176 (44 %). In Rural area, boys were 218 (54.5 %) and girls were 182 (45.5 %).

Table 3: Distribution of study participants according to the religion (N=800)

Religion	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Hindu	273	68.25	309	77.25
Muslim	116	29	78	19.5
Others	11	2.75	13	3.25
Total	**400**	**100**	**400**	**100**

In urban schools 273 (68.25%) of children were Hindus, 116 (29%) were Muslims and other religion constituted to 11 (2.75%) of them. In Rural schools 309 (77.25%) of children were Hindus, 78 (19.5%) were Muslims and other religion constituted to 13 (3.25%) of them.

Table 4: Distribution of female participants as per attainment of Menarche

Menarche	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Attained	114	64.8	117	64.3
Not Attained	62	35.2	65	35.7
Total	**176**	**100**	**182**	**100**

In Urban area, out of 176 girls, 114 (64.8%) had attained menarche and 62 (35.2% had not attained. In Rural area out of 182 girls, 117 (64.3%) had attained menarche and 65 (35.7%) had not attained.

Table 5: Distribution of school children according to their Mother's educational status.

Education	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Illiterate	84	21	122	30.5
Primary School	166	41.5	176	44
High school/Diploma	134	33.5	96	24
Graduate	16	4	6	1.5
Total	**400**	**100**	**400**	**100**

In Urban area, 84 (21%) of the mothers were illiterate, 166 (41.5%) educated up to primary school, 134 (33.5%) had completed high school or diploma and 16 (4%) were graduates. In rural area 122 (30.5%) of the mothers were illiterate, 176 (44%) completed primary schooling, 96(24%) completed high school or diploma and 6 (1.5%) were graduates.

Table 6: Distribution of school children according to their Father's educational status

Education	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Illiterate	29	7.25	70	17.5
Primary School	124	31	182	45.5
High school/Diploma	209	52.25	137	34.25
Graduate	38	9.5	11	2.75
Total	**400**	**100**	**400**	**100**

In Urban area, 29 (7.25%) of the Fathers were illiterate, 124 (31%) were educated up to primary school, 209 (52.25%) had completed high school or diploma and 38 (9.5%) were graduates. In rural area 70 (17.5%) of the fathers were illiterate, 182 (45.5%) completed primary schooling, 137 (34.25%) completed high school or diploma and 11(2.75%) were graduates**.**

Table 7: Distribution of school children according to their Father's occupation

OCCUPATION	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Profession/semi profession	58	14.5	11	2.75
Skilled worker	156	39	126	31.5
Semiskilled worker	84	21	104	26
Unskilled worker	98	24.5	155	38.75
Unemployed	4	1	4	1
Total	**400**	**100**	**400**	**100**

In our study, in urban schools, 58 (14.5%) of the fathers were in profession/semi-profession group. 156 (39%) of them were skilled workers, 84 (21%) were semi-skilled workers, 98 (24.5%) constituted unskilled workers and 4 (1%) were unemployed. In rural schools, 11 (2.75%) of the fathers were in profession/semi-profession group. 126 (31.5%) of them were skilled workers, 104 (26%) were semi-skilled workers, 155 (38.75%) constituted unskilled workers and 4 (1%) were unemployed.

Table 8: Distribution of school children according to their Mother's occupation

OCCUPATION	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Profession/semi profession	14	3.5	9	2.25
Skilled worker	20	5	16	4
Semiskilled worker	24	6	23	5.75
Unskilled worker	44	11	155	38.75
Unemployed/Housewives	298	74.5	197	49.25
Total	**400**	**100**	**400**	**100**

In the present study, in urban schools 14 (3.5%) of the mothers were in profession/semi-profession group. 20 (5%) of them were skilled workers, 24 (6%) were semi-skilled workers, 44 (11%) constituted unskilled workers and 298 (74.5%) were unemployed/housewives. In rural schools 9 (2.25%) of the mothers were in profession/semi-profession group. 16 (4%) of them were skilled workers, 23 (5.75%) were semi-skilled workers, 155 (38.75%) constituted unskilled workers and 197 (49.25%) were unemployed/housewives**.**

Table 9: Distribution of study participants according to socio economic status (Acc. to modified B.G. Prasad classification, 2014) (N = 800)

SOCIO ECONOMIC STATUS	URBAN		RURAL	
	Number	Percentage	Number	Percentage
Class I	11	2.75	0	0
Class II	103	25.75	34	8.5
Class III	143	35.75	131	32.75
Class IV	135	33.75	174	43.5
Class V	8	2	61	15.25
Total	**400**	**100**	**400**	**100**

In Urban area majority i.e. 143 (35.75%) belonged to Class III SES, 135 (33.75%) belonged to Class IV, 103 (25.75%) belonged to class II, 11 (2.75%) of them were from Class I and 8 (2%) were from Class V. In Rural area majority i.e. 174 (43.5%) belonged to Class IV SES, 131 (32.75%) belonged to Class III, 61 (15.25%) belonged to class V and 34 (8.5 %) of them were from Class II SES.

Table 10: Distribution of school children based on type of family

FAMILY	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Joint Family	121	30.25	252	63
Nuclear Family	279	69.75	148	37
Total	**400**	**100**	**400**	**100**

In this study among the urban school children 121(30.25%) of them were from joint family and 279(69.75%) of them were from nuclear family. In the Rural school children 252(63%) of them were from joint family and 148(37%) of them were from nuclear family.

2. PREVALENCE OF ANAEMIA AND ASSOCIATION OF ANAEMIA WITH SOCIO-DEMOGRAPHIC VARIABLES AND RISK FACTORS.

Table 11: Prevalence of Anaemia in Urban and rural school children

ANAEMIA	URBAN		RURAL	
	Number	Percentage	Number	Percentage
Present	172	43	211	52.75
Absent	228	57	189	47.25
Total	**400**	**100**	**400**	**100**
Z = 2.76		**p = 0.006**		

Prevalence of Anaemia in Urban area was found to be 43% and that in rural area it was 52.75%.This difference was found to be statistically significant, p=0.006.

GRAPH 1: Prevalence of Anaemia in Urban and rural school children

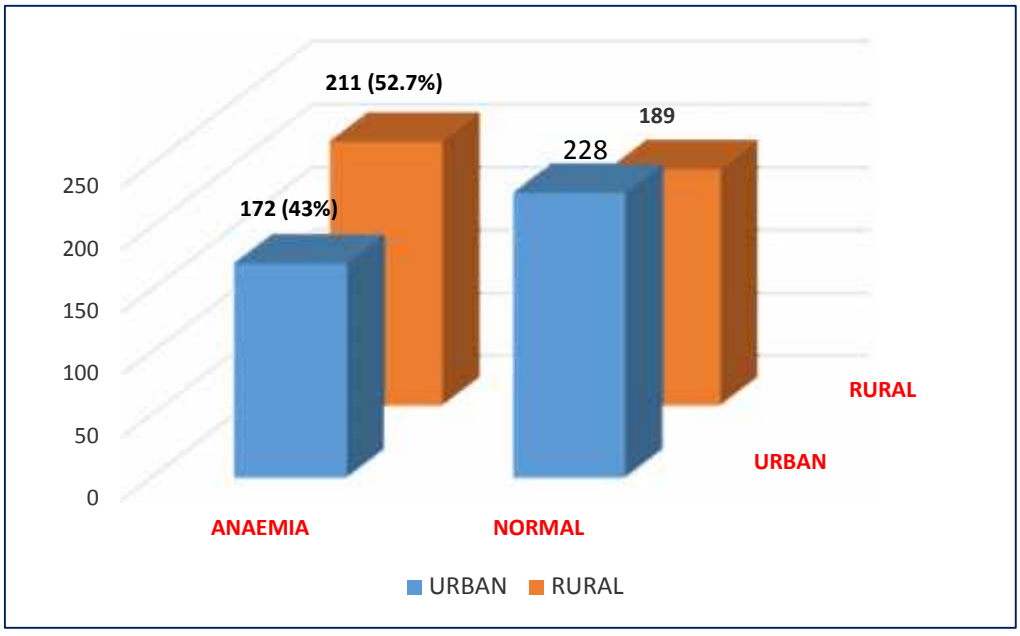


Table 12: Prevalence of Anaemia in girls of Urban and rural schools.

ANAEMIA	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Present	88	50	116	63.7
Absent	88	50	66	36.3
Total	**176**	**100**	**182**	**100**

Prevalence of Anaemia in urban high school girls was found to be 50% and the prevalence in rural high school girls was 63.7%. Mean haemoglobin level in urban girls was 11.14±1.56 and in rural girls it was 10.78±1.85.

Table 13: Prevalence of Anaemia in boys of Urban and rural schools.

ANAEMIA	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Present	84	37.5	95	43.58
Absent	140	62.5	123	56.42
Total	**224**	**100**	**218**	**100**

Prevalence of Anaemia in urban high school boys was found to be 37.5% and the prevalence in rural high school boys was 43.58%.Mean haemoglobin level in urban boys was 11.86±1.63 and in rural boys it was 11.4±1.76.

Table 14: Distribution of school children according to severity of anaemia

Anaemia Grades	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Severe (<7 gm %)	9	2.25	17	4.25
Moderate (7-9.9 gm %)	48	12	75	18.75
Mild (10-11.9 gm %)	115	28.75	119	29.75
Normal (>12 gm %)	228	57	189	47.25
Total	**400**	**100**	**400**	**100**
χ 2 = 12.104		**Df = 3**	**p = 0.007**	

In urban schools the prevalence of severe anaemia was 2.25%, moderate anaemia 12%, mild anaemia was 28.75%. In rural schools the prevalence of severe anaemia was 4.25%, moderate anaemia 18.75%, mild anaemia was 29.75%. This difference was found to be statistically significant p=0.007

GRAPH 2: Distribution of school children according to severity of anaemia

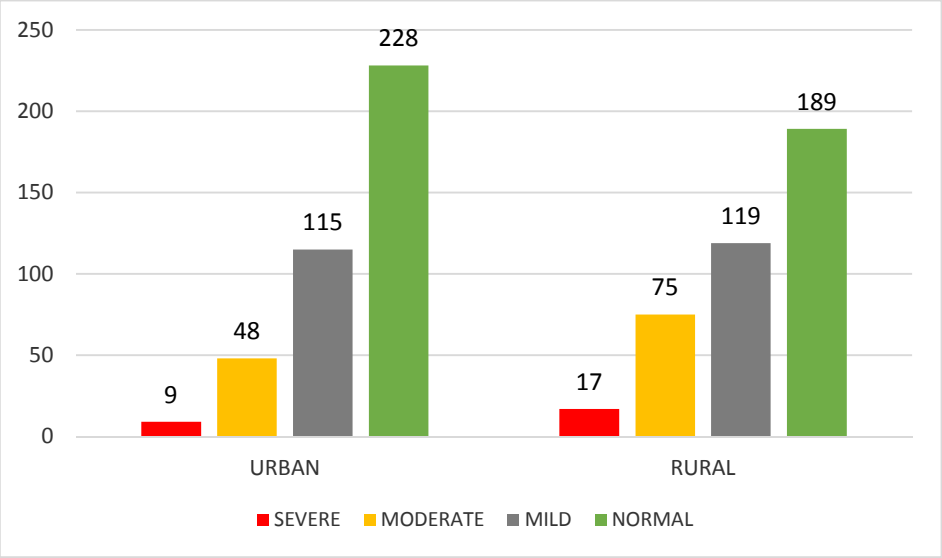


Table 15: Distribution of Girls according to severity of anaemia

Anaemia Grades	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Severe (<7 gm %)	6	3.40	10	5.5
Moderate (7-9.9 gm %)	29	16.48	41	22.5
Mild (10-11.9 gm %)	53	30.11	65	35.7
Normal (>12 gm %)	88	50	66	36.2
Total	**176**	**100**	**182**	**100**

In this study, in urban school girls the prevalence of severe anaemia was 3.4%, moderate anaemia constituted 16.48% and mild anaemia was seen in 30.11% of them. In rural school girls the prevalence of severe anaemia was 5.5%, moderate anaemia constituted to 22.5% and mild anaemia was seen in 35.7% of the girls.

Table 16: Distribution of Boys according to severity of anaemia

Anaemia Grades	URBAN		RURAL	
	Number	**Percentage**	**Number**	**Percentage**
Severe (<7 gm %)	3	1.34	7	3.2
Moderate (7-9.9 gm %)	19	8.5	34	15.6
Mild (10-11.9 gm %)	62	27.7	54	24.8
Normal (>12 gm %)	140	62.5	123	56.4
Total	**224**	**100**	**218**	**100**

In this study, in urban school boys the prevalence of severe anaemia was 1.34%, moderate anaemia constituted 8.5% and mild anaemia was seen in 27.7% of them. In rural school boys the prevalence of severe anaemia was 3.2%, moderate anaemia constituted 15.6% and mild anaemia was seen in 24.8%.

Table 17: Prevalence of anaemia based on consumption of Breakfast (BF)

BF BEFORE SCHOOL	URBAN		RURAL	
	NUMBER	ANAEMICS (%)	NUMBER	ANAEMICS (%)
Yes	256	75 (29.2)	175	75 (42.8)
No	144	97 (67.36)	225	136 (60.4)
TOTAL	**400**	**172**	**400**	**211**

In the present study it was observed that in urban children prevalence of anaemia was 29.2% in those who had breakfast before going to school and 67.3% in those who did not eat breakfast. In rural area the prevalence of anaemia in those who had breakfast was 42.8% and 60.4% among those who did not have breakfast.

GRAPH 3: Prevalence of anaemia based on consumption of Breakfast (BF)

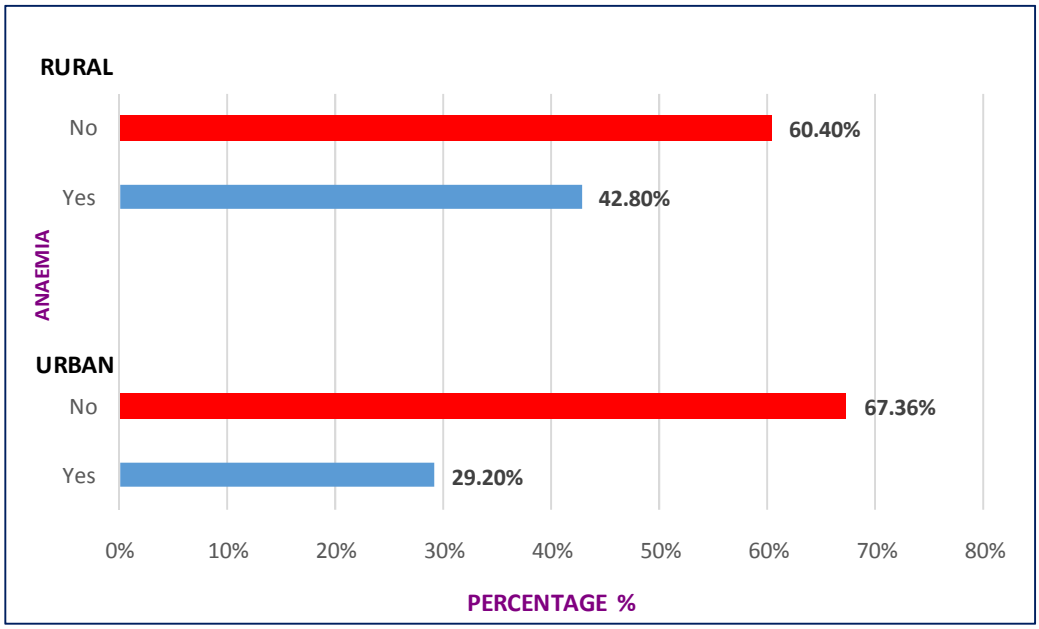


Table 18: Prevalence of anaemia based on history of consumption of anti-helminthic drugs

Anti-helminthic Treatment	URBAN		RURAL	
	Number	**Anaemics (%)**	**Number**	**Anaemics (%)**
Yes	123	25 (20.3)	95	40 (42.1)
No	277	147 (53.03)	305	171 (56.05)
Total	**400**	**172**	**400**	**211**

In urban area it was observed that prevalence of anaemia was 20.3% among those who had taken anti-helminthic drug when compared to prevalence among those who had not consumed (i.e. 53.03%). In rural areas the prevalence of anaemia was more than urban in those who consumed anti-helminthic drugs it was 42.1%. 56.05% prevalence was seen among those who had not taken the anti-helminthic treatment.

Table 19: Prevalence of anaemia based on use of sanitary facility

Sanitary Facility	URBAN		RURAL	
	Number	**Anaemics (%)**	**Number**	**Anaemics (%)**
Own latrines	290	115 (39.7)	116	56 (48.3)
Public latrines	98	47 (48)	93	40 (43)
Open air Defecation	12	10 (83.3)	191	115 (60.2)
TOTAL	**400**	**172**	**400**	**211**

In urban area 83.3% prevalence was seen among children who practiced open air defecation in comparison to those who followed better sanitary measures (prevalence i.e. 48% among public latrine users and 39.7% among those who used household latrines). This difference was found to be statistically significant p=0.006.

In rural area 60.2% prevalence was seen among children who followed open air defecation in comparison to those who followed better sanitary measures had less (prevalence i.e. 43% among public latrine users and 48.3% among those who used household latrines). This difference was found to be statistically significant p=0.013.

GRAPH 4: Prevalence of anemia based on use of Sanitary facility

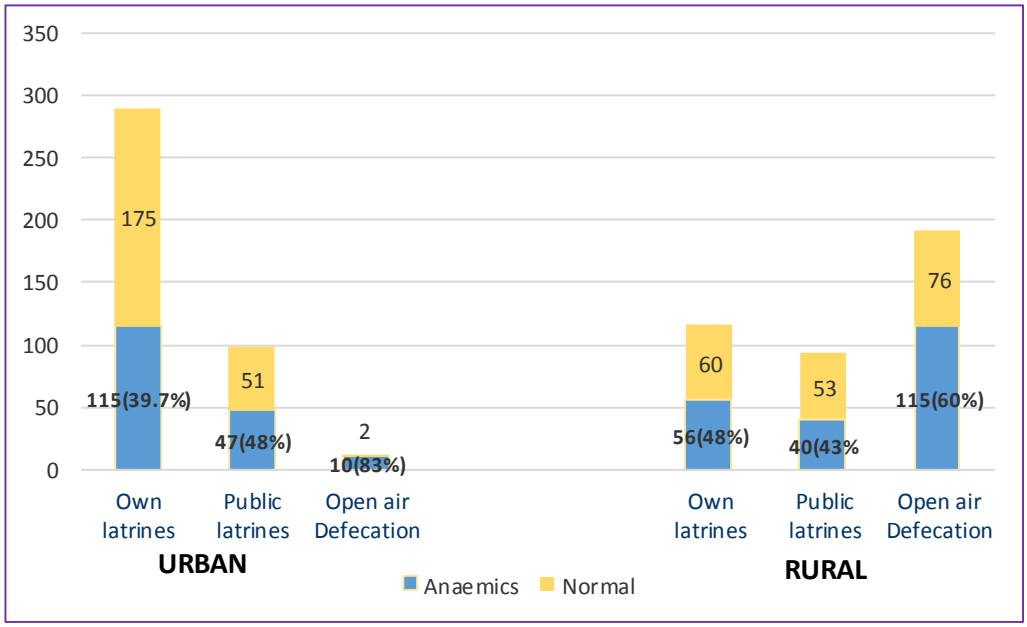


Table 20: Association of prevalence of anaemia with Body Mass Index (BMI)

BMI percentile	ANAEMIA-URBAN AREA			ANAEMIA-RURAL AREA		
	Present (%)	**Absent (%)**	**Total**	**Present (%)**	**Absent (%)**	**Total**
<5th	121 (63.4)	70 (56.6)	191	117 (68.6)	78 (31.4)	195
5th – 85th	44 (22.7)	50 (77.3)	194	90 (46.1)	106 (53.9)	196
>85th	7 (46.7)	8 (53.3)	15	4 (44.4)	5 (55.6)	9
TOTAL	**172**	**228**	**400**	**211**	**189**	**400**
χ 2 = 65.037 Df = 2 p <0.001				**χ 2 =8.03 Df =2 p=0.018**		

In urban area 63.4% prevalence was seen in thin children (BMI<5th percentile), 46.7% was seen at risk overweight children (BMI >85th percentile) and 22.7% was seen in normal children. This difference was found to be statistically significant, p<0.001. The trend in prevalence was also found to be statistically significant, trend chi-square=46.48, DF=1, p<0.001.

In rural area 68.6% prevalence was seen in thin children (BMI<5th percentile), 46.1% was seen at risk overweight children (BMI >85th percentile) and 44.4% was seen in normal children. This difference was found to be statistically significant, p=0.018. The trend in prevalence was also found to be statistically significant, trend chi-square=7.546, DF=1, p=0.006.

Table 21: Association of prevalence of Anaemia with attainment of menarche.

Attainment of menarche	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	Absent (%)	Total	Present (%)	Absent (%)	Total
Attained	76 (66.7)	38 (33.3)	114	95 (81.2)	22 (18.8)	117
Not attained	12 (19.4)	50 (80.6)	62	21 (32.3)	44 (67.6)	65
Total	88	88	176	116	66	182
	Z= 6.01	**p < 0.001**		**Z = 6.57**	**p < 0.001**	

Prevalence of anaemia in urban girls who have attained menarche was 66.7% and in those who have not attained, it was 19.4%.This difference was found to be statistically significant. Prevalence of anaemia in rural girls who have attained menarche was 81.2% and in those who have not attained, it was 32.3%. This difference was also found to be statistically significant p<0.001.

GRAPH 5: Prevalence of Anaemia with attainment of menarche.

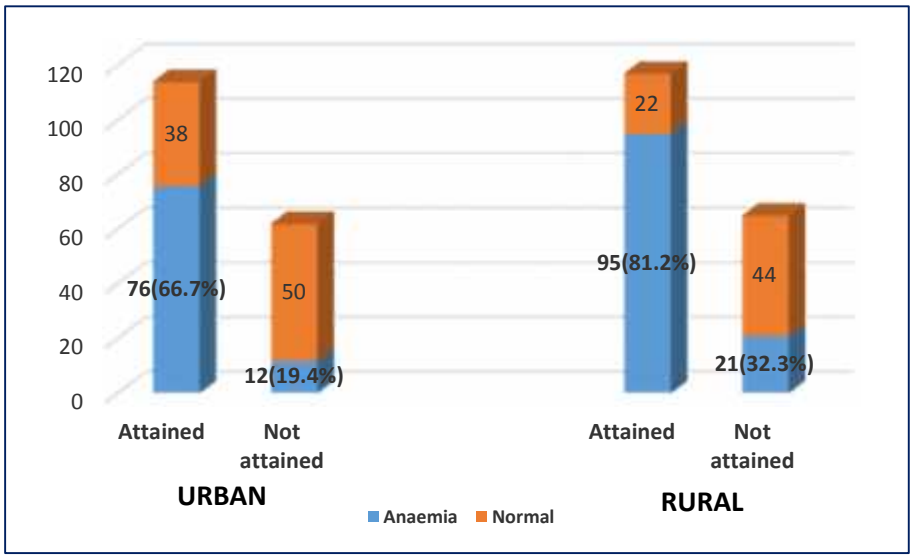


Table 22: Association of prevalence of Anaemia with type of family

FAMILY	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	**Absent (%)**	**Total**	**Present (%)**	**Absent (%)**	**Total**
Joint	64 (52.9)	57 (41.1)	121	126 (50)	126 (50)	252
Nuclear	108 (38.7)	171 (61.3)	279	85 (57.4)	53 (42.5)	148
TOTAL	**172**	**228**	**400**	**211**	**189**	**400**
Z = 2.63 p = 0.008				**Z=1.44 p=0.151**		

Prevalence of anaemia in urban children of joint family was 52.9% and in that of nuclear family was 38.7%.This difference was found to be statistically significant p=0.008.

Prevalence of anaemia in rural children of joint family was 50% and in that of nuclear family was 57.4%. This difference was not found to be statistically significant p=0151.

Table 23: Association of prevalence of anaemia with Mothers education.

Education	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	**Absent (%)**	**Total**	**Present (%)**	**Absent (%)**	**Total**
Illiterate	59 (70.2)	25 (29.8)	84	88 (72.1)	34 (27.9)	122
Primary school	92 (55.4)	74 (44.6)	166	101 (57.3)	75 (42.7)	176
High school	18 (13.4)	116 (86.6)	134	21 (21.8)	75 (78.2)	96
> High school	3 (18.7)	13 (81.3)	16	1 (16.6)	5 (83.4)	6
Total	**172**	**228**	**400**	**211**	**189**	**400**
χ 2 = 87.511 Df = 3 p < 0.001				**χ 2 = 59.755 Df = 3 p < 0.001**		

In our study, in urban area highest prevalence of 70.2% was seen in children of illiterate mothers, followed by 55.4% in those who had completed primary education, 13.4% and 18.7% among those who studied up to high school and above respectively. This difference was found to be statistically significant, $p<0.001$.

In rural area highest prevalence of 72.1% was seen in children of illiterate mothers, followed by 57.3% in those who had finished primary education, 21.8% and 16.6% among those who studied up to high school and above respectively. This difference was found to be statistically significant, $p<0.001$.

Table 24: Association of prevalence of anaemia with number of siblings

Siblings	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	**Absent (%)**	**Total**	**Present (%)**	**Absent (%)**	**Total**
1	6 (17.1)	29 (82.9)	35	24 (45.3)	29 (44.7)	53
2	35 (28)	90 (72)	125	45 (45)	55 (55)	100
3	102 (51.3)	97 (48.7)	199	103 (53.9)	88 (46.1)	191
≥4	29 (70.7)	12 (29.3)	41	39 (69.6)	17 (30.4)	56
Total	**172**	**228**	**400**	**211**	**189**	**400**
χ 2 = 39.421 Df = 3 p <0.001				**χ 2 =10.113 Df =3 p=0.018**		

In urban area prevalence of anaemia was 17.1% among those who had one sibling, 28% among two siblings, 51.3% and 70.7% among 3 and ≥4 siblings respectively. This difference was found to be statistically significant p<0.001.With increase in number of siblings, prevalence also increased, this trend was found to be statistically significant. Trend Chi-square=38.356, Df=1, p<0.001**.**

In rural area prevalence of anaemia was 45.3% among those who had one sibling, 45% among two siblings, 53.9% and 69.6% among 3 and ≥4 siblings respectively. This difference was found to be statistically significant p<0.001.With increase in number of siblings, prevalence also increased, this trend was found to be statistically significant. Trend Chi-square=8.104, Df=1, p=0.004.

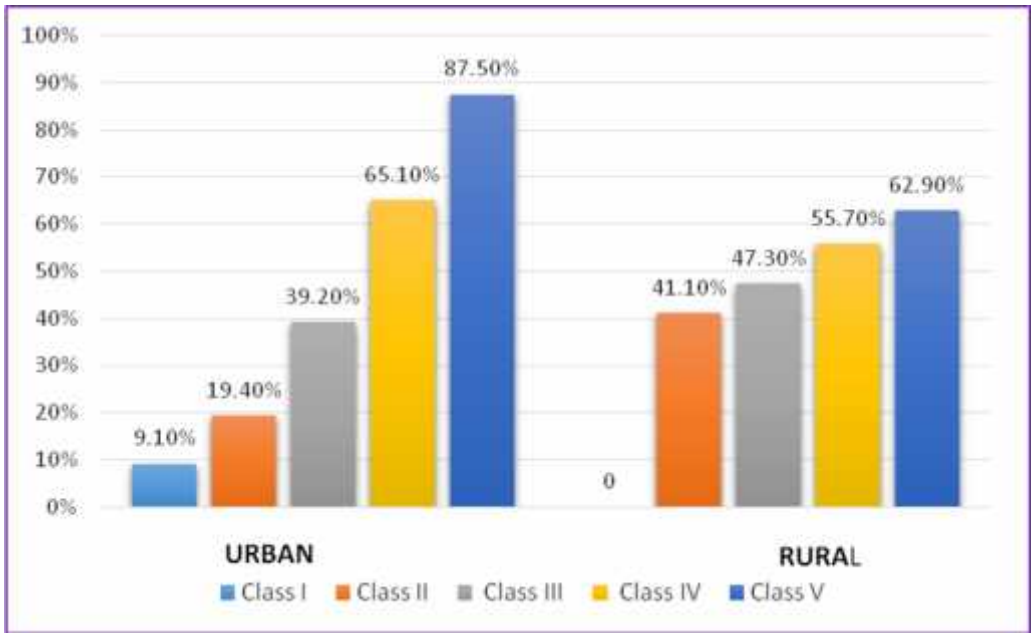
Table 25: Association of prevalence of Anaemia according to socio economic status (Acc. to modified B.G. Prasad classification, 2014) (N = 800)

SES	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	Absent (%)	Total	Present (%)	Absent (%)	Total
Class I	1(9.1)	10 (90.9)	11	0	0	0
Class II	20 (19.4)	83 (80.6)	103	14 (41.1)	20 (38.9)	34
Class III	56 (39.2)	87 (60.8)	143	62 (47.3)	69 (52.7)	131
Class IV	88 (65.1)	47 (34.9)	135	97 (55.7)	77 (44.3)	174
Class V	7 (87.5)	1 (12.5)	8	38 (62.9)	23 (37.1)	61
Total	**172**	**228**	**400**	**211**	**189**	**400**
χ 2 = 62.9 Df = 4 p < 0.001				**χ 2 = 6.22 Df = 3 p = 0.101**		

In Urban area, highest Anaemia prevalence of 87.5% was seen in Class V SES followed by prevalence of 65.1% in class IV, 38.9% in Class III, 19.4% in class II and least prevalence of 1% was seen in Class I SES. This difference was found to be statistically significant p<0.001. Prevalence of anaemia increased as the SES decreased, this trend was found to be statistically significant, chi-square trend=62.964, p<0.001.

In rural area highest Anaemia prevalence of 62.9% was seen in Class V SES followed by prevalence of 55.7% in class IV, 47.3% in Class III and 41.1% in class II SES. This difference was not statistically significant p=0.101.Prevalence of anaemia increased as the SES decreased, this trend was found to be statistically significant, chi-square trend=6.172, p=0.013.

GRAPH 6: Prevalence of Anaemia according to socio economic status (Acc. to modified B.G. Prasad classification, 2014) (N = 800)



GRAPH 7: Prevalence of anaemia with respect to number of siblings

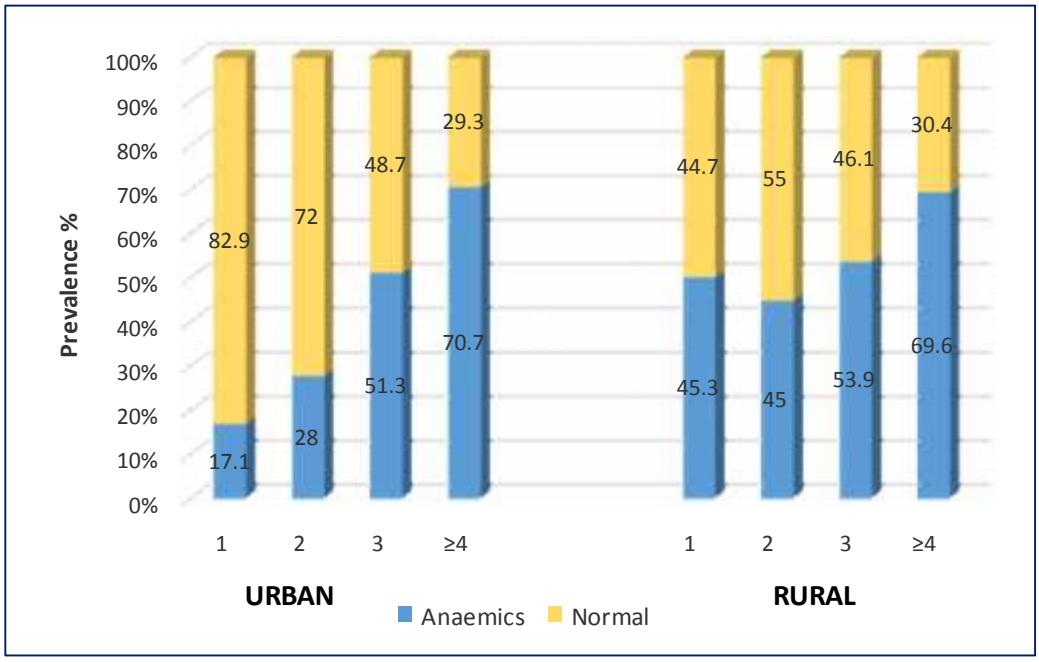


Table 26: Association of prevalence of anaemia based on type diet

DIET	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	**Absent (%)**	**Total**	**Present (%)**	**Absent (%)**	**Total**
Vegetarian	28 (62.2)	17 (37.8)	45	45 (79.8)	12 (20.2)	57
Mixed	144 (40.6)	211 (59.4)	355	166 (48.4)	177 (51.6)	343
Total	**172**	**228**	**400**	**211**	**189**	**400**
Z = 2.76 p=0.006				**Z = 4.28 p<0.001**		

The prevalence of anaemia was more in vegetarians both in urban and rural areas i.e. 62.2% and 79.8% respectively compared to that of mixed diet which was 40.6% in urban and 48.4% in rural. This difference was found to be statistically significant i.e. p<0.05 in both areas.

GRAPH 8: Prevalence of anaemia based on type diet.

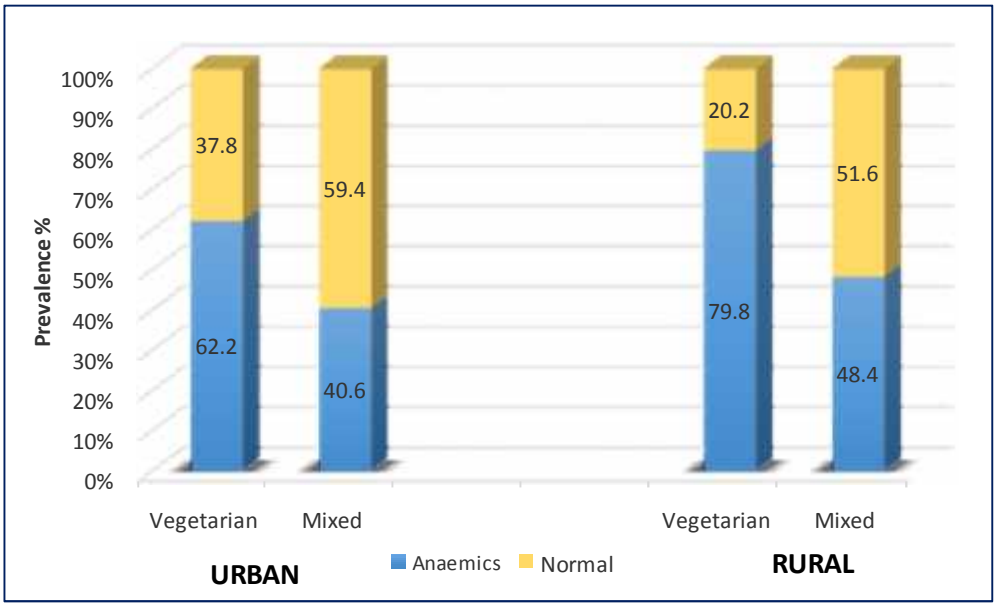


Table 27: Association of prevalence of anaemia with frequency of consumption of GLV

Freq. of GLV	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	**Absent (%)**	**Total**	**Present (%)**	**Absent (%)**	**Total**
Daily	62 (29)	152 (71)	214	75 (38.5)	120 (61.5)	195
Weekly	93 (58.9)	65 (41.1)	158	122 (65.2)	65 (34.8)	187
Monthly	17 (60.7)	11 (29.3)	28	14 (77.8)	4 (22.2)	18
Total	**172**	**228**	**400**	**211**	**189**	**400**
χ 2 = 32.022 Df = 1 p<0.001				**χ 2 = 31.1 DF=1 p <0.001**		

In the study it was noted that prevalence of anaemia was less among those who consumed Green leafy vegetables daily in both urban and rural areas, i.e. 29% and 38.5% respectively, compared to those who took weekly or on monthly basis. Prevalence of anaemia was 58.9% in those who consumed GLV on weekly basis and 60.7% on monthly basis in urban area and 65.2% and 77.8% were seen in rural children consuming GLV on weekly and monthly basis respectively. This difference was found to be statistically significant in both areas p<0.001. Decreased frequency of consumption of GLV tend to increase prevalence of anaemia. This trend was found to be statistically significant in both urban and rural areas (χ 2 = 36.98, P<0.001 for urban, χ 2 = 32.28, p<0.001 for rural).

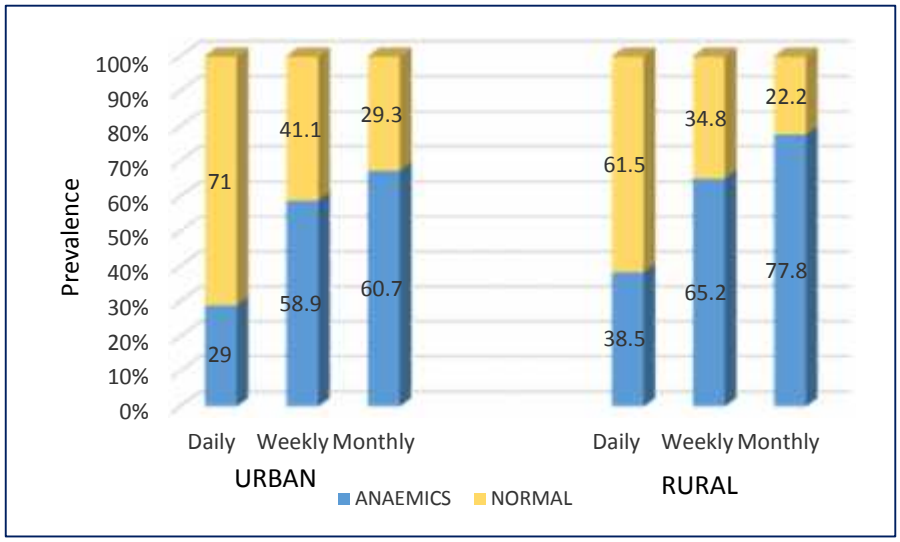
Table 28: Association of prevalence of anaemia with frequency of consumption of Fruits

Freq. of Fruits	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	**Absent (%)**	**Total**	**Present (%)**	**Absent (%)**	**Total**
Daily	12 (9)	122 (91)	134	45 (51.1)	43 (48.9)	88
Weekly	93 (59.6)	63 (40.4)	156	94 (56.6)	72 (43.4)	166
Monthly	61 (61.6)	38 (38.4)	99	60 (48.8)	63 (51.1)	123
Rarely	6 (54.5)	5 (45.5)	11	12 (52.2)	11 (47.8)	23
Total	**172**	**228**	**400**	**211**	**189**	**400**
χ 2 = 95.536 Df = 3 p <0.001				**χ 2 = 1.873 Df = 3 p=0.66**		

In Urban area prevalence of anaemia was 9% in those who consumed fruits daily and 59.6% on those who consumed weekly and 61.6% and 54.5% on those who consumed on monthly basis and rarely. The difference in prevalence was statistically significant on differnt frequency of consumption of fruits with p<0.001).As the frequency of consumption of fruits decreases prevalence increases and this trend is statistically significant (χ 2 = 65.249, Df = 1, p <0.001)

In rural area prevalence of anaemia was 51.1% in those who consumed fruits daily and 56.6% on those who consumed weekly and 48.8% and 52.2% on those who consumed on monthly basis and rarely. This difference was not statistically significant p=0.66.

GRAPH 9: Prevalence of anaemia with frequency of consumption of GLV



GRAPH 10: Prevalence of anaemia with frequency of consumption of Fruits

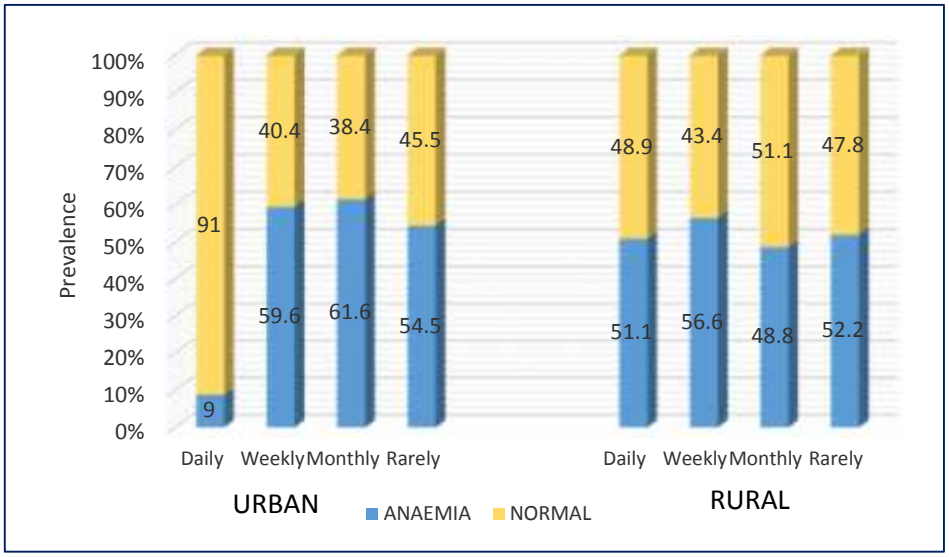


Table 29: Association of prevalence of anaemia with history of passing worms stools in past three months

H/o worms in stool	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	**Absent (%)**	**Total**	**Present (%)**	**Absent (%)**	**Total**
Yes	68 (81)	16 (19)	84	81 (68.6)	37 (31.4)	118
No	104 (32.9)	212 (67.1)	316	130 (46.1)	152 (53.9)	282
Total	**172**	**228**	**400**	**211**	**189**	**400**
Z = 7.90 p<0.001				**Z = 4.11 p<0.001**		

In urban area, it was seen that prevalence of anaemia was 81% among those who passed worms in stools and 32.9% among those who had no worm infestation. This difference was found to be statistically significant p<0.001.

In rural area, it was seen that prevalence of anaemia was 68.6% among those who passed worms in stools and 46.1% among those who had no worm infestation. This difference was found to be statistically significant p<0.001**.**

Table 30: Association of prevalence of anaemia with recent morbidity status (3 months).

Morbidity	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	**Absent (%)**	**Total**	**Present (%)**	**Absent (%)**	**Total**
Yes	34 (82.9)	7 (17.1)	41	33 (63.5)	19 (36.5)	52
No	138 (38.4)	221 (61.6)	359	178 (51.1)	170 (48.9)	348
TOTAL	**172**	**228**	**400**	**211**	**189**	**400**
Z=5.45 p<0.001				**Z=1.66 p=0.097**		

Among the 41 urban children who had recent morbidity, 82.9% (34) of them were anaemic which was higher compared to 38.4% anaemics children who did not have any recent morbidity. This difference was found to be statistically significant, $p<0.001$.

Among the 52 rural children who had recent morbidity, 63.5% (34) of them were anaemic which was higher compared to 51.1% anaemics in children who did not have any recent morbidity. This difference was not found to be statistically significant, $p=0.097$.

Table 31: Association of prevalence of anaemia with respect to presence of clinical pallor

Pallor	ANAEMIA IN URBAN			ANAEMIA IN RURAL		
	Present (%)	**Absent (%)**	**Total**	**Present (%)**	**Absent (%)**	**Total**
Yes	126 (67)	62 (33)	188	139 (63.8)	79 (36.2)	218
No	46 (21.7)	166 (78.3)	212	72 (36.9)	110 (63.1)	182
TOTAL	**172**	**228**	**400**	**211**	**189**	**400**
Z=7.96 p<0.001				**Z=4.82 p<0.001**		

In the present study it was observed that in urban area 67% of the clinically pale children were found to be anaemic and 21.7% of them had no pallor. This difference was found to be statistically significant, p<0.001.

In rural area 63.8% of the clinically pale children were found to be anaemic and 36.9% of them had no pallor. This difference was also found to be statistically significant, p<0.001

Table 32: Distribution of symptoms among anaemic children

SYMPTOMS	URBAN	RURAL
	Anaemics (%)	Anaemics (%)
Tiredness	35 (20.4)	38 (18)
Breathlessness	8 (4.6)	10 (4.7)
Palpitations	5 (2.9)	5 (2.3)
Pica	0	1 (0.5)
No symptoms	124 (72.1)	157 (74.4)
TOTAL	172	211

In this study majority of the urban anaemic children were asymptomatic (i.e.72.1%), 20.4% of them had tiredness, 4.6% complained of breathlessness and 2.9% had palpitations.

Majority of the rural anaemic children were also asymptomatic i.e.74.4%, 18% of them had tiredness, 4.7% complained of breathlessness and 2.3% had palpitations and 0.5% had pica.

Chapter 6

Discussion

DISCUSSION

The present study was conducted in Government aided high schools in urban area Ramnagar and rural area Vantamuri which are the field practice areas of Department of Community Medicine, Jawaharlal Nehru Medical College, Belagavi on 800 students during the period of January 2014 to December 2014**.**

I. PROFILE OF STUDY PARTICIPANTS

TABLE 1 and 2

In the present study, in high schools of urban area, 56% of the children were boys and 44% of them were girls. Maximum number (34%) of children were in the age group of 14 years and minimum (13.75%) were in the age group of 16 years. A study conducted in Rishikesh, Uttrakhand had enrolled 53% of boys and 47% girls[26], which was similar to our study.

In high schools of rural area 54.5% of the children were boys and 45.5% of them were girls. Maximum number (33.5%) of children were in the age group of 14 years and minimum (17.25%) were in the age group of 16 years. In a study conducted in Ahmednagar, Maharashtra 47% of children were boys and 53% of them were girls.[42]

TABLE 3 and 4

In our study majority (68.25%) of the children belonged to Hindu religion in schools of urban area as well as rural area (77.25%). Among total 176 girls of urban high schools, 64.8% had attained menarche. 64.3% of girls (182) had

attained menarche from rural schools. Percentage of girls attaining menarche was similar in both the areas.

In a study conducted in Chennai, Tamilnadu 86.5% of adolescent girls had attained menarche.[43] Another study conducted in rural area of Hassan district showed that 71% of the adolescent girls had attained menarche.[44] These studies showed similar proportion of post-menarchal girls to that of ours.

TABLE 5 & 6

In Present study most (41.5%) of the mothers of urban school children had studied up to primary level, 4% had completed their graduation and 21% were illiterates. It was similar in case of mothers of rural school children, where maximum (44%) had studied up to primary level, 30.5% being illiterates and only 1.5% graduates. In case of fathers of urban children, majority (52.25%) of them had studied up to high school/diploma, where as 7.25% were illiterate. In rural area majority of fathers i.e. 45.5% of them had studied up to primary level and 17.5% were illiterate.

A study from urban area Meerut, constituted 27.1% of children whose mothers had primary level education and 51.5% of them were illiterates.[26] In a study conducted by National nutrition monitoring bureau in nine states in India it was seen that majority (55.5%) of the parents were educated more than primary level which goes along with our study and on contrast 41.9% were illiterate.[45] This may be because south India has better education level compared to north. Another study conducted in rural Kenitra, Morocco showed that 76.9% of mothers and 63% of the fathers had studied up to primary level.[31]

TABLE 7 & 8

In our study, 74.5% of urban area mothers were either housewives/unemployed and 25.5% were working, among them majority (11%) of them were unskilled workers and 3.5% were in some profession/semi-profession. When compared to our rural area mothers, around 49.5% of them were housewives/unemployed and 51.75% were working. Most (38.75%) of them were unskilled workers and 2.2% were in some profession/semi-profession. This difference was mostly seen because a large number of rural population follow farming and female members of the family also involving in it is not so uncommon. Some of the mothers in rural area also do daily labour (coolie) for their living.

In the present study majority (39%) of urban area fathers were skilled workers, 14.5% were in some profession/semi-profession and only 1% unemployed. When compared to fathers of children in rural area, around 38.75% of them were unskilled workers, 31.5% were skilled workers and only 2.75% in some profession/semi-profession. Urban areas give more opportunity for skilled based and professional based jobs than rural area. Higher education of urban population than rural also makes them eligible for such kind of occupation. Moreover farming is a bread and butter for rural people hence constituting majority of them in unskilled occupation.

A study conducted in urban slum Multannagar, Meerut had 16.9% working mothers 83% housewives.[36] In a study conducted by National nutrition monitoring bureau in nine states in India it was seen that majority (45.5%) of the

parents practiced agriculture, 27% were labourers and 24% were skilled workers.[45] Another study of rural China, had 51% of their mothers doing full time farming and 10% doing other jobs. 33.3% of their fathers following farming and 16.7% doing job other than farming.[46]

TABLE 9

In the present study, majority of urban participants belonged to class III SES (35.7%) followed by class IV (33.75%) and the least belonged to class I (2.75%).In case of rural area, in our study most of them belonged to SES class IV(43.5%) followed by Class III(32.75%) and none in class I. Most common being Class III and IV in both areas, but better SES in urban areas is due to better job opportunities and better educational status than the rural area.

A study conducted in urban Meerut had similar distribution of SES as to that of our study. Majority i.e.43.5% belonged to Class III followed by SES class II and Class IV. Class I SES constituted 2.75% of participants.[47] A study of rural area of Hassan had majority of its participants in SES class IV and Class V (34.7% each), followed by Class III SES (21.6%), with none in Class I SES.[44] This distribution was similar to that of our rural participants.

TABLE 10

In this study among urban school children, 121 (30.25%) of them were from joint family and 279 (69.75%) of them were from nuclear family. In Rural school children 252 (63%) of them were from joint family and 148(37%) of them were from nuclear family. Due to rampant urbanization for improving the

standard of living most of the families become nuclear in urban areas, where as in rural area majority of them stay together and practice their ancestral occupation (e.g.: Agriculture), leading to increased number of joint families.

A study conducted in Chennai, Tamilnadu also had large (85.3%) participants belonging to nuclear family which was similar to our study.[43] In a study conducted by National nutrition monitoring bureau in rural areas of nine states in India, it was seen that majority (62.9%) of the participants belonged to nuclear family which was in contrary to our findings in rural area.[45]

2. PREVALENCE OF ANAEMIA AND ASSOCIATION WITH SOCIO-DEMOGRAPHIC VARIABLES AND RISK FACTORS.

TABLE 11, 12 & 13

In our study prevalence of anaemia in Urban area high school children was found to be 43% and that in rural area it was 52.75%. The prevalence of anaemia was more in rural area than urban area and this difference was found to be statistically significant, p=0.006. Prevalence of anaemia in urban high school girls was found to be 50% and the prevalence in rural high school girls was 63.7%. Prevalence of anaemia in urban high school boys was found to be 37.5% and the prevalence in rural high school boys was 43.58 %.

Classification of Public health significance of anaemia in populations on the basis of prevalence estimated from blood levels of haemoglobin.[48]

Category of public health significance	Prevalence of anaemia (%)
Severe	40 or higher
Moderate	20.0 – 39.9
Mild	5.0 – 19.9
Normal	4.9 or lower

As per WHO guidelines the urban and rural areas in our study fall in to communities of severe public health significance.

A study conducted at Rishikesh, Uttrakhand showed prevalence of 56.5% in school children, with increased prevalence (66.6%) among girls than boys (33.4%)[26]. These findings were similar to our urban participants with slightly lower (50%) prevalence in girls of our study.

Prevalence of 52.8% was seen in a study conducted in Kattankulathur, Tamilnadu among school children of 8-16 years.38% prevalence was seen among boys and 67.7% was seen among girls[25]. Another study conducted among urban school children in Punjab showed 51.5% prevalence of anaemia[24]. These findings are in par with urban children of our study.

A study done in urban Meerut, among adolescent boys showed prevalence of anaemia to be 42.8%.[47] Another study conducted in Multannagar, Meerut showed prevalence of 31.6% among adolescent boys and 52.8% among girls.[36] On contrary in our study boys had prevalence of 37.5%, the difference in the prevalence may be due to different study areas, different cut off used for anaemia and different age group which included 10-19 years.

A study conducted in Chennai, Tamilnadu among adolescent school girls showed prevalence of 78.5%.[43] In our study the prevalence was found to be 63.7%, which may be because of less percentage of participants who had attained menarche when compared to Chennai study (86.75% vs 64.8%). It was found that prevalence of anaemia significantly increased with attainment of menarche. The overall prevalence of anemia among school-going adolescent girls of urban Kathmandu, Nepal was 54.4%.[49]

An urban rural comparison study in Chandigarh showed that anaemia was significantly less among urban school children as compared to rural children, (14.61% vs 25.4%). Both girls (34.8%) and boys (15.3%) of rural group were significantly more anaemic than girls (21.5%) and boys (6%) of urban group.[28] Yet another study conducted in Bangalore, prevalence of 14.6% was seen in urban areas and 12.3% in rural areas.[38] These prevalence rates are way too less compared to that of our urban and rural children. This difference may be because majority of the participants involved in those studies were from higher SES compared to that of ours. An explanation for the low anemia prevalence in Bangalore could be the impact of integrated child health programs that have been in place since 2003 (Akshara Dasoha, 2003). Specifically, these include the

regular oral administration of Albendazole (400 mg) and vitamin A of 200 000 IU twice yearly, as well as a free daily lunch. Indeed, the Akshara Dasoha scheme as proposed (2003) was more comprehensive, as it also envisioned the supplementation of Fe and folate. However, though in our setting Weekly Iron Folic Acid Programme is in to force, evaluation of such programmes yet to be considered and further studies on it would help in concluding.

TABLE 14

In our study, in urban schools the prevalence of severe anaemia was 2.25%, moderate anaemia 12%, mild anaemia was 28.75%. In rural schools the prevalence of severe anaemia was 4.25%, moderate anaemia 18.75%, mild anaemia was 29.75%. This difference was found to be statistically significant (p=0.007).

A study conducted in rural and urban areas of Morang district, Nepal showed 3.2% prevalence of moderate anaemia and 50.8% prevalence of mild anaemia in urban area, 3.8% and 46.7% of moderate and mild anaemia respectively in rural area.[33]

TABLE 15

In urban school girls of our study the prevalence of severe anaemia was 3.4%, moderate anaemia constituted 16.48%, mild anaemia was seen in 30.11% of them. In rural school girls the prevalence of severe anaemia was 5.5%, moderate anaemia constituted 22.5%, mild anaemia was seen in 35.7%.

A study conducted in Chennai, Tamilnadu showed 37.8% prevalence of mild anaemia, 35% and 6% prevalence of moderate and severe anaemia respectively.[43] A study conducted in rural Hassan had 54.92% of mild anaemic girls, 40.1% and 4.9% of moderate and severe anaemic girls.[44] A study conducted in adolescents of rural Dehradun showed 51.7% of mild anaemia, 3.1% and 0.7% of severe anaemia respectively.[50]

TABLE 16

In urban school boys the prevalence of severe anaemia was 1.34%, moderate anaemia constituted 8.5%, mild anaemia was seen in 27.7% of them. In rural school boys the prevalence of severe anaemia was 3.2%, moderate anaemia constituted 15.6%, mild anaemia was seen in 24.8 %.

In a study conducted in tribal ashram Ahmednagar, Maharhastra prevalence of mild anaemia among boys was 44.5%, 16.4% constituted moderate anaemia and 4% of severe anaemics.[42] A study conducted in urban area, Multan nagar, Meerut majority (30%) of the boys were mild anaemics, 1.1% and 0.5% moderate and severe anaemics.[36] Yet another study conducted in adolescent boys of urban Meerut had 19.8% prevalence of mild anaemia, 16.8% of moderate anaemia and 6.2% of severe anaemia.[47]

TABLE 17

In the present study it was seen that prevalence of anaemia was more among those who did not have breakfast before going to school in both urban and rural areas i.e. 67.3% and 60.4% respectively. Skipping of breakfast can be a

strong factor for undernutrition, which in turn is a causal route for anaemia. Majority of the schools opens as early as 8 to 9 am, where majority of the children tend to miss the breakfast for sake of being on time. School opening timings of around 10am may provide a considerable time for the children to have the breakfast before coming to school

A study conducted in Menoufiya, Egypt showed 42.9% prevalence of anaemia among those children who did have their breakfast daily.[51] Another study in Multan nagar, Meerut[36] and International Centre For Research on Women (ICRW) [52] also documented that anaemia to be significantly more in those who eat two or fewer meals per day.

TABLE 18

In present study, urban area showed prevalence of 20.3% among those who had taken anti-helminthic drug and this prevalence increased among those who had not consumed (i.e. 53.03%). In rural areas the prevalence of anaemia was more than urban in those who consumed anti-helminthic drugs prevalence was 42.1% when compared to 56.05% among those who had not taken the drug. This difference may be because many factors are associated with anaemia in rural area and the duration of deworming is not as frequent as that of urban area.

A study conducted in Chennai[43] also showed that frequent deworming reduces the prevalence of anaemia significantly.

TABLE 19

In the present study, in urban area 83.3% prevalence was seen among children who followed open air defecation and those who followed better sanitary measures had less prevalence i.e. 48% among public latrine users and 39.7% among those who used household latrines. This difference was found to be statistically significant (p=0.006). In rural area 60.2% prevalence was seen among children who practiced open air defecation and those who followed better sanitary measures had less prevalence. This difference was found to be statistically significant (p=0.013).

A study conducted in Egypt[51] also showed decreased prevalence of anaemia, when sanitary disposal of sewage was done.

In our study, in urban area among only the 12 who practiced open air defecation (OAD), 75% prevalence was seen among those who wore footwear and 87.5% was seen among those who did not wear. In rural areal 84.8% prevalence was seen among those who did not wear footwear during defecation compared to 25.3% among the children who had the habit of wearing footwear. Large number of children in our rural areas practiced open air defecation, and also no usage of footwear for the same increased the risk for anaemia. Unhygienic surroundings helps in the spread of intestinal parasites infestations, other infections and thus anaemia. Good sanitary facility would reduce the burden of anaemia among children to a larger extent. Setting up of public latrines (PL) can also be an option, where there was decreased prevalence among them who used sanitary privy in urban area.

TABLE 20

In our study, in urban area 63.4% prevalence of anaemia was seen in thin children (BMI<5th percentile), 46.7% was seen in overweight children (BMI >85th percentile) and 22.7% was seen in normal children. This difference was found to be statistically significant (p<0.001). The trend in prevalence was also found to be statistically significant (Trend chi-square=46.48, DF=1, p<0.001).

In our rural area, 68.6% prevalence was seen in thin children (BMI<5th percentile), 46.1% was seen in at risk overweight children (BMI >85th percentile) and 44.4% was seen in normal children. This difference was found to be statistically significant (p=0.018). The trend in prevalence was also found to be statistically significant (Trend chi-square=7.546, DF=1, p=0.006). Most of the undernourished children developed anaemia in both the areas.

A study conducted in Multan nagar, Meerut also showed increased prevalence of anaemia in BMI<5th percentile in both girls and boys (61.8%, 44.78%) compared to that of normal children (47.8%, 23.9%).[36] A study conducted in urban Meerut among adolescent boys also showed increased prevalence of anaemia in undernourished group (45.2%) compared to normal (40%)[47]. These findings are similar to that of ours.

A study conducted in Chandigarh also showed increased prevalence (35.7%) among girls with BMI <5th percentile compared to > 5th percentile (21.9%). Even in boys, prevalence of 14.4% was seen among undernourished compared to 6.7% among well-nourished group. This difference was found to be statistically significant (P<0.005).[28]

TABLE 21

In the present study prevalence of anaemia in urban girls who have attained menarche was 66.7% and in those who have not attained, it was 19.4%.This difference was found to be statistically significant. Prevalence of anaemia in rural girls who have attained menarche was 81.2% and in those who have not attained, it was 32.3%. This difference was also found to be statistically significant $p<0.001$.Increased prevalence was seen in both rural and urban girls attaining menarche, but it was seen more in rural girls, may be due decreased awareness of these girls regarding menstrual related problems and an indirect neglect for seeking treatment for it.

A study conducted in rural area of Hassan district, showed higher (71.1%) prevalence of anaemia among girls who had attained menarche compared to those (28.8%) who had not attained.[44] This finding is similar to the prevalence of anaemia in our study.

A study from urban school children of Punjab showed prevalence of 36.4% among menarcheal girls.[24] Another study from Rishikesh, Uttrakhand, India witnessed a prevalence of 36.5% prevalence of anaemia among menarcheal girls.[26] These findings in context to ours showed decreased prevalence may be because the proportion of girls (5-15 years) attaining menarche was less in their study compared to ours.

TABLE 22

In our study prevalence of anaemia in urban children was more in joint family i.e. 52.9% than that of nuclear family (38.7%).This difference was found to be statistically significant p=0.008, whereas prevalence of anaemia in rural children of joint family was 50% and in that of nuclear family was 57.4%. This difference was not found to be statistically significant (p=0.151). Higher prevalence in joint family than nuclear family in urban area may be because of availability of quantitatively as well as qualitatively adequate food in nuclear families. In case of rural areas the difference was not significant may be because of involvement of various other factors which have more impact on causation of anaemia.

In a study conducted in urban Meerut prevalence was more in joint families than nuclear ones (52.7% vs 31.5%), which was found to be significant, p<0.001.[29] Another study conducted in rural Chennai showed a significant higher prevalence (85.3%) in nuclear families than joint family.[43] This differed from the findings of anaemia in rural area in our study because majority of participants of their study belonged to higher SES class compared to that of our study.

TABLE 23

In our study, in urban area highest prevalence of 70.2% was seen in children of illiterate mothers, followed by 55.4% in those who had completed primary education, 13.4% and 18.7% among those who studied up to high school and above respectively. This difference was found to be statistically significant, (p<0.001).

In rural area highest prevalence of 72.1% was seen in children of illiterate mothers, followed by 57.3% in those who had completed primary education, 21.8% and 16.6% among those who studied up to high school and above respectively. This difference was found to be statistically significant, p<0.001. There was similar distribution of prevalence of anaemia in both urban and rural areas based on mothers education. Illiterate mothers attribute to anaemia among their children. Lack of knowledge regarding nutrition, medical care, child care and the ways to combat them are generally seen among less educated mothers. Awareness, holds the key, which can be imparted to them, for prevention of such instances further.

A study conducted in urban Meerut[29] also showed similar findings to that of our study.45.6% prevalence of anaemia was seen among children of illiterate mothers. As level of education improved, prevalence decreased. A study conducted in Chennai, Tamilnadu also showed significant association of anaemia with mothers literacy status[43].

TABLE 24

In urban area prevalence of anaemia was 17.1% among those who had one sibling, 28% among two siblings, 51.3% and 70.7% among 3 and ≥4 siblings respectively. This difference was found to be statistically significant p<0.001.With increase in number of siblings, prevalence also increased. In rural area prevalence of anaemia was 45.3% among those who had one sibling, 45% among two siblings, 53.9% and 69.6% among 3 and ≥4 siblings respectively. This difference was found to be statistically significant p<0.001.With increase in

number of siblings, prevalence of anemia also increased. This may be because most of our study population belong to class III and Class IV SES and increase in number of family members, leads to sharing and hence inadequate nutrition among children.

A study conducted in Menoufiya, Egypt showed lower prevalence of anaemia as birth order of the child increased, this was in contrary to our study[51]. This may be due do geographical differences, quality of health care in that area compared to that of ours.

TABLE 25

In our study, in urban area highest anaemia prevalence of 87.5% was seen in Class V SES followed by prevalence of 65.1% in class IV, least prevalence of 1% was seen in children belonging to Class I SES. This difference was found to be statistically significant $p<0.001$.Prevalence of anaemia increased as the SES decreased, this trend was found to be statistically significant, chi-square trend=62.964, $p<0.001$. Similarly in rural area highest Anaemia prevalence of 62.9% was seen in Class V SES and 41.1% in class II SES. This difference was not statistically significant $p=0.101$.Prevalence of anaemia increased as the SES decreased, this trend was found to be statistically significant, chi-square trend=6.172, $p=0.013$.Both urban and rural population showed similar trend, purchasing power and standard of living plays a vital role in the causal of anaemia.

An urban study in Meerut[47], another study in Multan nagar[36] also showed similar trend of prevalence of anaemia in relation to SES as that of our study. A

study in rural Dehradun also showed increased prevalence in SES class V (51.3%) [50].

TABLE 26

In the present study, prevalence of anaemia was more in vegetarians both in urban and rural areas i.e. 62.2% and 79.8% respectively compared to that of mixed diet which was 40.6% in urban and 48.4% in rural. This difference was found to be statistically significant i.e. $p<0.05$ in both areas. Prevalence of anaemia more being in vegetarians is because of decreased iron and vitamin B12 in their diet, as these content are more in animal foods.

A study conducted in Rishikesh, Maharhastra[26] and urban Meerut[24] showed increased prevalence (65.2% and 41.7%) of anaemia among vegetarians, these findings were on par with that of ours.

TABLE 27

In this study it was noted that prevalence of anaemia was less among those who consumed Green leafy vegetables daily in both urban and rural areas, i.e. 29% and 38.5% respectively, compared to those who took weekly or on monthly basis. Prevalence of anaemia was 58.9% in those who consumed GLV on weekly basis and 60.7% on monthly basis in urban area and 65.2% and 77.8% were seen in rural children consuming GLV on weekly and monthly basis respectively. Decreased frequency of consumption of GLV tend to increase prevalence of anaemia. This trend was found to be statistically significant. GLV

are rich source of iron, hence IDA is less seen among those who consume it more frequently.

A study done in rural Meerut[53] and a study of Chennai[43] also have pointed out low prevalence of anaemia among those who consume more GLV.

TABLE 28

In Urban area prevalence of anaemia was 9% in those who consumed fruits daily and 59.6% on those who consumed weekly and 61.6% and 54.5% on those who consumed on monthly basis and rarely. As the frequency of consumption of fruits decreases prevalence increases and this trend is statistically significant. In rural area prevalence of anaemia was 51.1% in those who consumed fruits daily and 56.6% in those who consumed weekly and 48.8% and 52.2% in those who consumed fruit on monthly basis and rarely. This difference was not statistically significant p=0.66. Frequency of consumption of fruits and anaemia prevalence had a trend in urban but not in rural area.

Vitamin C present in the fruits helps the body to absorb iron. The iron in non-meat based food is not absorbed as the iron in meat based food, so taking source of Vit C with or after meals will alter chemical make-up of iron and help in its absorption.[54] A study conducted in Multan nagar Meerut[36] and Chennai[43] also showed decreased prevalence of anaemia among those who consumed fruits daily.

TABLE 29

In urban area, it was seen that prevalence of anaemia was 81% among those who passed worms in stools and 32.9% among those who had no worm infestation. This difference was found to be statistically significant p<0.001. In rural area, it was seen that prevalence of anaemia was 68.6% among those who passed worms in stools and 46.1% among those who had no worm infestation. This difference was found to be statistically significant p<0.001. Worm Infestation hence tends to have similar effect on anemia in both rural and urban areas.

A study conducted in rural Vietnam[55] also showed increased prevalence with worm infestation. A study conducted in Menoufiya, Egypt[51] showed prevalence of 40% of anaemia among those who passed worms in stools, which was contrary to our findings.

TABLE 30

Among the 41 urban children who had h/o morbidity 82.9% (34) of them were anaemic, which was higher compared to 38.4% anaemics who had no morbidity. This difference was found to be statistically significant, p<0.001. Among the 52 rural children who had h/o morbidity 63.5% (34) of them were anaemic which was higher compared to 51.1% anaemics who had no morbidity. This difference was not found to be statistically significant, p=0.097. Larger percentage of children with h/o have anaemia in urban area compared to rural area. This may be because of the overcrowding in urban areas which helps for spread of various infections.

A study done at Davangere city, Karnataka also showed that severity of anaemia increases as number of morbid episodes increases.[56]

TABLE 31

In this study it was seen that in urban area 67% of the clinically pale children were found to be anaemic. In rural area 63.8% of the clinically pale children were found to be anaemic. This suggested that clinical determination of pallor was seen in equal amount in urban and in rural areas. Corrective measures can be started just on the basis of pallor at the community level, so as to replenish the iron stores as soon as possible.

A Study conducted in rural Hassan[44] showed 57.7% prevalence of anaemia among those in whom pallor was present, which is similar to our study.

TABLE 32

In this study majority of the urban anaemic children were asymptomatic i.e.72.1%, 20.4% of them had tiredness, 4.6% complained of breathlessness and 2.9% had palpitations. Majority of the rural anaemic children were also asymptomatic i.e.74.4%, 18% of them had tiredness, 4.7% complained of breathlessness and 2.3% had palpitations and 0.5% had pica.

In a study conducted in Fathegarh, Punjab 28% of anaemics had weakness, 48% had tiredness, 6% had dizziness and 60% had shortness of breath[37]. On contrary the children in our study were less symptomatic, it may be because of small sample size in their study (100) and also around 50% of them

were in moderate and severe anaemia category, which explain the increased presence of symptoms.

In urban children prevalence of anaemia was more among children who washed hands only with water after defecation i.e. 84.6%, 60% among those who used ash to wash and 36.4% among those who washed with soap and water. In rural children prevalence of anaemia was more among children who washed hands only with water after defecation i.e. 80.7%, 70% among those who used ash to wash and 33.3% among those who washed with soap and water. Unhygienic washing practices have shown to increase prevalence of anaemia, as they are the source for spread of many infections, which may lead to anaemia.

In our study prevalence of anaemia was more (66.6%) among those who did not wash hands before eating in urban area compared to that of rural area (58.2%).

A study conducted in Multan nagar, Meerut[36] also showed similar findings to that of ours in both boys and girls and was found to be statistically significant. Following hygienic methods always forms sanitation barrier, and hence decreased chance of morbidity.

Chapter 7

Conclusion

CONCLUSION

The present community based study, reported a higher prevalence of anaemia among rural high school children compared to the urban counterpart. Prevalence of anaemia was more among girls in both urban and rural areas. The urban and rural areas in our study fall in to communities of severe public health significance (prevalence >40%)

There was a higher prevalence of mild anemia as compared to moderate and severe anemia in both boys and girls of urban and rural areas. The prevalence of anemia was high among girls who had attained menarche in rural area compared to urban.

Risk factors for Anaemia included low education status of parents, low socio-economic status, undernourishment, vegetarians, missing of breakfast before going to school, decreased consumption of Green leafy vegetables, fruits and meat, recurrent infections, open air defecation, unhygienic sanitary hand washing practices and lack of seeking health care.

Chapter 8

Limitations

LIMITATIONS

The limitations of the study were:

1. Study included high schools only. Hence early & late adolescents were not studied.

2. Detailed dietary assessment could not be done, which is an important risk factor for Nutritional anaemia.

3. Only the burden of anaemia could be assessed, laboratory tests to know type of anemia was not done

Chapter 9

Recommendations

RECOMMENDATIONS

Based on the findings of our study, following recommendations are being suggested for decreasing the burden of anaemia:

- Weekly Iron and Folic acid Supplementation Programme should be evaluated on regular basis with training of teachers for the same.

- Periodic surveys should be done in schools on anemia for updating prevalence and haemoglobin estimation should be done yearly as a part of school health Programme.

- Promoting awareness among home makers will be helpful in reduction of prevalence of anaemia. Health programs for housewives on utilization of easily available and affordable iron rich diet and use of kitchen garden need to be promoted.

- Though initiation of Iron fortification has been done, it should be in commonly reachable vehicles like salt, sugar and available for all, which doesn't demand individual co-operation.

- Ensuring adequate food consumption and regular intake of iron rich and vitamin C rich foods during early childhood period, deworming the child periodically, food fortification, supplementary feeding and nutrition education of parents are some of the strategies that can prevent nutritional anaemia in children

- Measures aimed at preventing transmission–for example, providing safe water and sanitation facilities, and promoting hand-washing, use of latrines and wearing footwear should also be included in the deworming Programme.

- Processes for involving teachers, parents and local communities in planning and maintaining order are important for the sustainability of activities

Chapter 10

Summary

SUMMARY

The present study was a community based cross sectional study undertaken to compare the prevalence of anaemia in urban and rural areas and also to know various factors influencing anaemia in rural and urban areas.

The study was conducted in Government aided high schools in urban area Ramnagar and rural area Vantamuri which are the field practice areas of Department of Community Medicine, Jawaharlal Nehru Medical College, Belagavi on 800 students during the period of January 2014 to December 2014.

The prevalence of anaemia was more in school children in rural area than that of urban area (52.75% vs 43%). Prevalence of Anaemia in urban high school girls was found to be 50% and in rural girls it was 63.7%. Prevalence of Anaemia in urban high school boys was found to be 37.5% and in rural boys was 43.58 %.

Prevalence of anaemia was more among rural girls (81.2%) who have attained menarche compared to the urban (66.7%) counterpart.

In the Urban setting the prevalence of severe anaemia was 2.25%, moderate anaemia 12%, mild anaemia was 28.75%. In rural schools the prevalence of severe anaemia was 4.25%, moderate anaemia 18.75% and mild anaemia was 29.75%.

In urban school girls of our study the prevalence of severe anaemia was found to be 3.4%, moderate anaemia constituted 16.48%, mild anaemia was seen in 30.11% of them. In rural school girls the prevalence of severe anaemia was 5.5%, moderate anaemia constituted 22.5%, mild anaemia was seen in 35.7%.

In urban school boys the prevalence of severe anaemia was 1.34%, moderate anaemia constituted 8.5%, mild anaemia was seen in 27.7% of them. In rural school boys the prevalence of severe anaemia was 3.2%, moderate anaemia constituted 15.6% and mild anaemia was seen in 24.8 %.

In urban area 63.4% prevalence of anaemia was seen in undernourished children i.e. BMI<5th percentile, similarly in rural area 68.6% prevalence was seen in undernourished children. Majority of undernourished children had anaemia in both urban and rural setting.

Prevalence of anaemia in urban children was more in joint family (52.9%) than that of nuclear family (38.7%), whereas prevalence of anaemia was more in rural children of nuclear family (57.4%) than that of joint family (50%).

In urban area prevalence of anaemia was more i.e. 70.8% and 69.7% among 3rd and more than 3rd order child respectively. Similarly, in rural area also prevalence of anaemia was more among 3rd (62.5%) and more than 3rd order child (72.5%).

Urban area showed highest anaemia prevalence of 87.5% among Class V SES followed by prevalence of 65.1% in class IV, least prevalence of 1% was seen in Class I SES. Similarly in rural area highest anaemia prevalence of 62.9% was seen in Class V SES and 41.1% in class II SES. Prevalence of anaemia significantly increased as the SES decreased in both areas.

-It was seen that prevalence of anaemia was more among those who did not have breakfast before going to school in both urban and rural areas i.e. 67.3%

and 60.4% respectively. Prevalence of anaemia was more in vegetarians both in urban and rural areas i.e. 62.2% and 79.8% respectively compared to that of mixed diet which was 40.6% in urban and 48.4% in rural.

Prevalence of anaemia was less among those who consumed Green leafy vegetables daily in both urban and rural areas, i.e. 29% and 38.5% respectively, compared to those who took weekly or on monthly basis. Decreased frequency of consumption of GLV tend to increase prevalence of anaemia.

Urban area showed a least prevalence of 9% in those who consumed fruits daily and 59.6%, 61.6% and 54.5% in those who consumed it weekly, monthly and rarely respectively. In rural area prevalence of anaemia was 51.1% in those who consumed fruits daily and 56.6%, 48.8% and 52.2% in those who consumed it weekly, monthly and rarely respectively. Frequency of consumption of fruits and anaemia prevalence had a trend in urban but not in rural area.

Prevalence of anaemia was 81% among those who passed worms in stools (past 3 months) in urban area compared to 68.6% in rural area. In urban area, prevalence of 53.03% was seen among those who had not taken anti-helminthic drugs, whereas in rural areas the prevalence of anaemia was more than in urban area. Prevalence of anaemia was 42.1% in those who took anti-helminthic drugs and 56.05% was seen among those who had not taken any anti-helminthic treatment.

It was seen that in urban area 67% of the clinically pale children were anaemic. In rural area 63.8% of the clinically pale children were anaemic.

In urban area 83.3% prevalence was seen among children who followed open air defecation, 48% among public latrine users and 39.7% among those who used household latrines. In rural area 60.2% prevalence was seen among children who followed open air defecation and those who followed better sanitary measures had less prevalence.

In urban area 87.5% prevalence was seen among those who did not wear footwear during open air defecation compared to 84.8% in rural area.

In both urban and rural children prevalence of anaemia was more among those who washed hands only with water after defecation i.e. 84.6% and 80.7%, and least among those who used soap to wash hands i.e. 36.4% and 33.3% respectively.

Prevalence of anaemia was more (66.6%) among those who did not wash hands before eating in urban area compared to that of rural area (58.2%).

In urban area among the children who had anaemia, 4.6% had clubbing, 6.9% had koilonychia, 6.3% had Platonychia, 4% had knuckle pigmentation, 2.3% had lymphadenopathy, 9.3% had glossitis, 15.6% had aphthous ulcers, 4.6% had Angular stomatitis and 19.7% suffered from some morbidity in past one month. In rural area among the anaemics 3.3% had clubbing, 2.3% had koilonychia, 1.8% had Platonychia, 3.3% had lymphadenopathy, 6.1% had glossitis, 7.5% had aphthous ulcers, 3.3% had Angular stomatitis and 15.6% suffered from some morbidity in past one month.

Chapter 9

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ANNEXURE I – ETHICAL CLEARANCE CERTIFICATE

K.L.E.SOCIETY'S
JAWAHARLAL NEHRU MEDICAL COLLEGE,
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Ref: MDC/DOME/ 91 **Date: 07/12/2013**

To,

PG student in MD. Community Medicine,
J.N.Medical College,
BELGAUM.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"PREVALENCE OF ANAEMIA AMONG SCHOOL CHILDREN IN RURAL AND URBAN AREAS OF BELGAUM-A COMPARATIVE STUDY,"** is ethical and justifiable.

The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr.Hema Dhumale)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belgaum.

(Dr.Ganga Pilli)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belgaum.

ANNEXURE II – CONSENT FORM

INFORMED CONSENT FORM

PREVALENCE OF ANAEMIA AMONG SCHOOL CHILDREN IN RURAL AND URBAN AREAS OF BELGAUM –A COMPARATIVE STUDY.

INVESTIGATOR: **_____**

GUIDE: **_____**

Introduction

Anaemia is a major public health problem and is a serious health concern during this development phase i.e the schooling phase, as it can adversely affect cognitive performance, behaviour, motor development, and scholastic performance. Children and Adolescents are at increased risk of developing anaemia because of their increased demand for nutrients during growth and puberty. The irreparable damage that anaemia can cause during childhood particularly in development makes this silent morbidity completely unacceptable. Therefore, this study is undertaken to find out the prevalence of anaemia among school children and you are invited to participate in the study. Participation in this study is completely voluntary.

Explanation of procedures

In this study your detailed clinical examination will be done and blood will be taken from you by a small prick for estimating Haemoglobin. You will have to answer a few questions about your general health information, socio-demographic details, diet patterns etc. The entire procedure may take 20 minutes.

Possible benefits

The investigator does not promise or guarantee that you will receive direct benefit being in the study. It will benefit the whole community and help the policy makers to design new programmes.

Possible risks

There are no risks involved for participation in the study

Confidentiality

Your identity will not be revealed. All information collected will be collected and coded so that no one will know your identity.

Withdrawal

Participation in this study is voluntary. If you don't not to wish to participate in this study, you will not lose benefits to which you are entitled.

Costs of participation

The cost of the study will be borne by the researcher. There will be no additional cost to you for participating in this study.

Authorization to publish results

The Researchers may use the information gathered from this study for presentation in scientific journals. However your identity will not be disclosed in such presentation or publication.

Legal rights

By signing this consent form, you are not waiving any of your legal rights.

Questions

If you have any questions about this study, you should contact If you have any questions about your rights as a study participant, you may contact Dr Ganga S. Pilli, Chairman, JNMC Institutional Ethics Committee on human subjects research at 0831 2741701.

CONSENT FORM

I have permitted the investigator to conduct the study. My signature below indicates my permission, and I have read (or been read) the information provided above, and I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the Principal/Guardian Signature of the Principal/Guardian

Name of the witness Signature of the witness

Name of the Researcher Signature of the Researcher

DATE:

PLACE:

ANNEXURE III - ASSENT FORM

I have read the information in this form. After understanding all details about the study, I agree to give assent to be included as a volunteer in the study titled "PREVALENCE OF ANAEMIA AMONG SCHOOL CHILDREN IN RURAL AND URBAN AREAS OF BELGAUM –A COMPARATIVE STUDY".

Name of the participant Signature of the participant

Name of person obtaining consent Signature of person obtaining consent

Name of witness Signature of witness

DATE:

PLACE:

ANNEXURE IV – PROFORMA

PREVALENCE OF ANAEMIA AMONG SCHOOL CHILDREN IN RURAL AND URBAN AREAS OF BELGAUM –A COMPARATIVE STUDY

I) SOCIO DEMOGRAPHIC DATA

Name : _____

Age : _____years

Sex :

If girl, then have u attained Menarche: a) Yes b)No

Area of residence : _____

1. Religion: 1. Hindu

2. Muslim

3. Christian

4. Others (specify).

2. Mother's Education : 1. Illiterate

2. Primary school

3. High school

4. Graduate

3. Father's education :1. Illiterate

2. Primary school

3. High school

4. Graduate

4. Occupation of Mother:

5. Occupation of Father :

6. Type of Family: 1. Joint

2. Nuclear

3. Broken family

4. Problem family

7. Birth order :

8. Number of siblings:

9. a. Monthly income of the family :

b. Total number of family members :

c. Monthly per capita income :

10. Care takers other than parent :

(During the absence of parent)

PERSONAL HISTORY

11. DIET:

A. Type: a) veg b)Mixed

B. Do you have your breakfast daily before going to school? : Y/N

C. Anything you eat in between school hours? :

D. Frequency of consumption of Green leafy vegetables:

a) Daily b) Weekly c) Monthly d) Rarely

E. Frequency of consumption of Meat:

a) Daily b) Weekly c) Monthly d) Rarely

F. Frequency of consumption of Fruits:

a) Daily b) Weekly c) Monthly d) Rarely

12. Appetite:

13. Bowel:

A. Do you have h/o passing dark coloured stools in past one month : Y/N

B. Do you have h/o passing worms in stools in past one month : Y/N

C. Do you take anti-helminthic treatment : Y/N

If yes, how regularly?

a) once in 3 months b) once in six months c) Don't know

14. Health:

A. Do you have any of the following ?

a) Tiredness b)Breathlessness c) Palpitations d) Pica

15. Any other complaints in the past one month? : a)yes b)No

If yes, specify:

16. **HOUSING AND SANITATION:**

A. Roof : a) Thatched b) Sheeted c)RCC d)Tiled

B. Walls : a) Brick b) Mud c)Plastered d)Stone

C. Water supply: a) Tap-water b) well water c) Other source

D. Sanitary facility: a) own latrine b) use Public latrines c) open air defaecation

If practising open air defaecation, then do you wear footwear on regular basis : Y/N

E. Do you wash your hands after defecation?: Y/N

If yes, then you wash with

a) Soap b) Ash c) only water

F. Do you wash your hands before eating regularly?: Y/N

II) **GENERAL PHYSICAL EXAMINATION:**

1. Height: _____cm
2. Weight: _____kg

Body Mass index (BMI) = _____kg/m2.

3. Pallor: a) Present b) Absent
4. Icterus: a) Present b) Absent
5. Cyanosis: a) Present b) Absent
6. Clubbing: a) Present b) Absent
7. Koilonychia: a) Present b) Absent
8. Platonychia: a) Present b) Absent
9. Knuckle pigmentation : a) Present b) Absent
10. Lymphadenopathy: a) Present b) Absent
11. Oedema: a) Present b) Absent

12. Oral examination

Glossitis : a) Present b) Absent

Aphthous ulcers: a) Present b) Absent

Angular stomatitis: a) Present b) Absent

III) **INVESTIGATION**

Date : Hb% (hemoglobin %) :

IV) Any morbidity in recent three months : Y/N

ANNEXURE Va – KEY TO MASTER CHART

A. Serial number

B. Place :

1. Urban

2. Rural

C. Age

D. Class

E. Sex

1. Male

2. Female

F. Attained Menarche?

0. Not Applicable

1. Yes

2. No

G. Religion:

1. Hindu

2. Muslim

3. Christian

4. Others

H. Mother's Education :

1. Illiterate

2. Primary School

3. High School/Diploma

4. Graduate

I. Father's education

1. Illiterate

2. Primary School

3. High School/Diploma

4. Graduate

J. Occupation of Mother

1. Profession/semi profession

2. Skilled worker

3. Semiskilled worker

4. Unskilled worker

5. Unemployed/ Housewife

K. Occupation of Father

1. Profession/semi profession

2. Skilled worker

3. Semiskilled worker

4. Unskilled worker

5. Unemployed

L. Type of Family:

1. Joint

2. Nuclear

M. Birth order :

1. First

2. Second

3. Third

4. > Third

N. Number of Siblings

1. One
2. Two
3. Three
4. ≥ Four

O. Socio Economic Status

1. Class I
2. Class II
3. Class III
4. Class IV
5. Class V

P. Diet :

1. Vegetarian
2. Mixed

Q. Do you have your breakfast daily before going to school?

1. Yes
2. No

R. Anything you eat in between school hours?

1. Yes
2. No

S. Frequency of consumption of Green leafy vegetables :

1) Daily 2) Weekly 3) Monthly 4) Rarely

T. Frequency of consumption of Meat :

0) NA 1) Daily 2) Weekly 3) Monthly 4) Rarely

U. Frequency of consumption of Fruits :

1) Daily 2) Weekly 3) Monthly 4) Rarely

V. Do you have h/o passing dark coloured stools in past one month :

1. Yes
2. No

W. Do you have h/o passing worms in stools in past one month :

1. Yes
2. No

X. Do you take anti-helminthic treatment :

1. Yes
2. No

Y. If yes to X, how regularly?

0. Not Applicable
1. Once in 3 month
2. Once in 6 months
3. Don't Know

Z. Do you have any of the following?

1. Tiredness
2. Breathlessness
3. Palpitations
4. Pica

AA. Roof:

1. Thatched
2. Sheeted
3. RCC
4. Tiled

AB. Walls:

1. Brick
2. Mud
3. Plastered
4. Stone

AC. Water supply:

1. Tap-water
2. well water
3. Other source

AD. Sanitary facility:

1. Household latrine
2. Public latrines
3. open air defecation

AE. If practicing open air defecation, then do you wear footwear on regular basis?

0. Not Applicable
1. Yes
2. No

AF. You wash your hands after defecation with?

1) Soap
2) Ash
3) Water only

AG. Do you wash your hands before eating regularly?

1. Yes
2. No

AH. Height: _____cm

AI. Weight: _____kg

AJ. Body Mass index (BMI) = _____kg/m2.

AK. Grading of BMI

1. < 5^{th} percentile
2. 5^{th}-85^{th} percentile
3. > 85^{th} percentile

AL. Pallor:

1. Present
2. Absent

AM. Clubbing:

1. Present
2. Absent

AN. Koilonychia:

1. Present
2. Absent

AO. Platonychia:

1. Present
2. Absent

AP. Knuckle pigmentation:

1. Present
2. Absent

AQ. Lymphadenopathy:

1. Present
2. Absent

AR. Glossitis:

1. Present
2. Absent

AS. Aphthous ulcers:

1. Present
2. Absent

AT. Angular stomatitis:

1. Present
2. Absent

AU. Hb% (hemoglobin %) :

AV. Any morbidity in recent three months:

1. Yes
2. No