CHAPTER- II

REVIEW OF LITERATURE

This chapter deals with a wide review of literature. The task of reviewing literature involves the identification, selection, critical analysis and reporting of existing information on the topic of interest.

The purpose of the review of literature is to obtain comprehensive knowledge and in depth information about iron deficiency anemia in general and other aspects of iron deficiency anemia.

For the purpose of logical sequence the chapter is divided into different sections.

Section I: Studies related to prevalence of anemia.

Section II: Studies related to iron deficiency anemia in general.

Section III: Studies related to nutritional and other health problems of tea garden women.

Section IV: It contains the following subsection in line with

- Prevalence
- Risk factors
- Sign and symptoms
- Diagnosis
- Therapeutic management of IDA.
Section I: Studies related to prevalence of anemia in general.

Mishra P (2012), conducted a cross-sectional study of analytical nature in one cluster (village) namely Barara drawn from a PHC Barara of the Ambala district between May to July 2010. A total of 598 women of reproductive age (15-45 years) were clinically examined. Sahli Haemoglobinometer method was used to examine the level of hemoglobin (Hgb). The result shows that prevalence rate of any anemia was 96.8%. The majority of anemic women were in the category of mild (75.3 %) to moderate (16.9%) and severe anemia was 7.8%. Though the most affected age group was 21-25 years but the difference noted was not statistically significant .The study substantiates the existence of mild to moderate form of anemia among women of reproductive age and underlines the need for iron supplementation to all reproductive women especially during the antenatal period with more attention to the most affected regions.

Pushpa O Lokare et al (2012) conducted a study to observe the prevalence of anemia and the various socio demographic factors associated with anemia among pregnant women at an urban health center in Aurangabad India. A total of 352 pregnant women were selected using a systematic random sampling technique. The study concluded that overall prevalence of anemia among the pregnant women was found to be 87.21%. Factors such as religion, level of education of women and their husbands and socioeconomic status were found to be significantly associated with the prevalence of anemia in pregnancy ($P < 0.05$).
Low socioeconomic class, illiteracy, Hindu religion were significantly associated with high prevalence of anemia during pregnancy in Indian women.

Maurício S Leite et al (2013) conducted a study to survey the health and nutritional status of indigenous children < 5 years of age based on a representative sample of major Brazilian geopolitical regions. Evaluation of hemoglobin levels was conducted for 5,397 children (88.1% of the total sample). The overall prevalence of anemia was 51.2%. Higher risk of presenting anemia was documented for boys, lower maternal schooling, lower household socioeconomic status, poorer sanitary conditions, presence of maternal anemia, and anthropometric deficits. Regional differences were observed, with the highest rate being observed in the North.

The prevalence rates of anemia in indigenous children were approximately double than those reported for non-indigenous Brazilian children in the same age group. Similarly notable differences in the occurrence of anemia in indigenous and non-indigenous children have been reported for other countries. Deeper knowledge about the etiology of anemia in indigenous children in Brazil is essential to its proper treatment and prevention.

Meseret Alm et al (2013) conducted a cross-sectional study at Azezo Health Center from February to May 2011. Red blood cell morphology, Hgb level determination and intestinal parasites were assessed following the standard procedures. Socio-demographic data was collected by using a structured
questionnaire. Among the 384 study participants, the prevalence of anemia was 83 (21.6%). More than half of the pregnant women i.e 64.8% attended antenatal care in the third trimester (between 13 and 28 weeks of gestation). Majority of the pregnant women i.e 373 (97.1%) had normocytic normochromic red cell morphology. The majority of anemic cases 49 % were of the mild type (Hgb 10.0–10.9g/dl) followed by 46% cases of moderate anemia (7–9.9g/dl) and 5% severe anemia (Hgb< 7g/ dl). Pregnant women with age >34years, rural residence, history of malaria attack, hookworm infection and absence of iron supplements are significantly associated with increased risk of anemia. The most prevalent intestinal parasite among pregnant women was hookworm (4.7%).

Selomon Assefa et al (2014), conducted a cross-sectional household survey on 423 children, aged 6–14 years, selected through systematic random sampling method. Sociodemographic and anthropometric data were collected using a pre-tested questionnaire. Capillary blood was taken from the fingertip of each child and hemoglobin was measured using HaemoCue digital photometer. All the necessary safety measures were taken during blood collection. Anthropometric indicators were measured using WHO’s guideline. A total of 404 children were studied. The mean age was 10.21(SD±1.89) years. The proportion of females was 217(53.7%). The mean hemoglobin level for both sexes was 11.59(SD±1.97 g/dl). The current prevalence of anemia was 152(37.6%), out of which 73(18.1%) had mild while 79(19.6%) of them had moderate anemia. The prevalence of anemia among the age group of 6–11 years was 118(40.5%) while
the prevalence among the group of 12–14 years old children was 34(30.1%). Among the selected variables in the logistic regression analysis, low family income \([\text{OR} = 4.925, 95\% \text{ CI}(1.063,22.820)]\), mothers’ education \([\text{OR} = 4.621, 95\% \text{ CI}(1.383,15.439)]\), intake of plant food \([\text{OR} = 3.847, 95\% \text{ CI}(2.068, 7.157)]\) and intake of animal food \([\text{OR} = 2.37, 95\% \text{ CI}(1.040,5.402)]\) were significantly and independently associated with anemia.

**Section II: Studies related to iron deficiency anemia in general.**

**V R Edgerton et al (1979)** studied the effects of iron-deficiency anemia on workers’ productivity in a tea plantation in Sri Lanka. The quantity of tea picked per day was studied before and after iron supplementation or placebo treatment. After one month's treatment significantly more tea was picked when the hemoglobin (Hb%) concentration was increased by iron supplementation than when it was not. The degree of improvement was greater in more-anemic subjects (those with concentrations of 6.0-9.0 g Hb/dl). The level of physical activity of anemic subjects in their everyday environment was also recorded for 24 hours continuously both before and after treatment. After three weeks these levels were significantly greater in the iron-treated than matched placebo-treated subjects. The economic implications of increased work productivity with iron treatment are evident, particularly in developing countries. These results also provide strong evidence for the clinical impression that people with iron-deficiency anemia suffer from tiredness and weakness.
Cook JD (1982), reported that prevalence of iron deficiency has remained relatively constant while there has been continuing refinement in its laboratory recognition, especially with the recent introduction of serum ferritin and FEP measurements. The optimal laboratory approach to diagnosing iron deficiency depends on the clinical setting. In the office or outpatient clinic, iron depletion is best recognized by the serum ferritin, although the TS, FEP, and MCV are helpful in gauging its severity. In hospitalized patients with overt anemia, the TS, FEP, and MCV are much less helpful because similar changes are seen in the anemia of chronic disease. Examination of marrow iron remains the method of choice, especially in patients with infection, chronic disease, malignancy, or liver disease, although in many clinical situations the same information can be obtained from a serum ferritin. Serial measurements of serum ferritin have been particularly useful in monitoring patients at high risk of iron deficiency such as those with rheumatoid arthritis, chronic inflammatory bowel disease, or chronic renal failure.

Pablo Vazquez-Seoane (1985) stated that Iron deficiency was the most common single nutrient deficiency in the world. Studies in the United States have shown that the prevalence of overt iron-deficiency anemia were 5 to 15 per cent in American infants and children 9 to 36 months old. Although iron-deficiency anemia was most prevalent among the poor, owing to feeding practices and dietary inadequacy of foods rich in iron, which tend to be
expensive, it cuts across socioeconomic barriers. It is particularly frequent during the second year of life because of exhaustion of transplacental iron reserves, rapid growth, and consumption of large amounts of iron-poor milk.

**Tomas Walter et al (1989),** reported in their double-blind, placebo-control prospective cohort study of 196 infants from birth to 15 months of age, assessment was made at 12 months of age of the relationship between iron status and psychomotor development, the effect of a short-term (10-day) trial of oral iron vs placebo, and the effect of long-term (3 months) oral iron therapy. Development was assessed with the mental and psychomotor indices and the infant behavior record of the Bayley Scales of Infant Development in 39 anemic, 30 control, and 127 nonanemic iron-deficient children. Anemic infants had significantly lower Mental and Psychomotor Developmental Index scores than control infants or nonanemic iron-deficient infants (one-way analysis of variance, $P < .0001$). Control infants and nonanemic iron-deficient infants performed comparably. No difference was noted between the effect of oral administration of iron or placebo after 10 days or after 3 months of iron therapy. Among anemic infants a hemoglobin concentration $< 10.5$ g/dL and duration of anemia of $> 3$ months were correlated with significantly lower motor and mental scores ($P < .05$). Anemic infants failed specifically in language capabilities and body balance-coordination skills when compared with controls.

**Am J Clin Nutr (1992),** reported from the Centers for Disease Control, anemia and iron-deficiency anemia (anemia with serum ferritin concentrations less than
12 micrograms/L) were assessed in greater than 800 inner-city gravidas at entry to prenatal care. Iron-deficiency anemia was associated with significantly lower energy and iron intakes early in pregnancy and a lower mean corpuscular volume. The odds of low birth weight were tripled and of preterm delivery more than doubled with iron deficiency, but were not increased with anemia from other causes. When vaginal bleeding at or before entry to care accompanied anemia, the odds of a preterm delivery were increased fivefold for iron-deficiency anemia and doubled for other anemia. Inadequate pregnancy weight gain was more prevalent among those with iron-deficiency anemia and in those with anemia of other etiologies. The prevalence of iron-deficiency anemia (3.5%), however, was lower than anticipated for an inner-city, minority population in whom most anemia’s had been attributed clinically to iron deficiency

Anne C. Looker et al (1997), conducted a survey among 24,894 persons aged 1 year and older examined in the third National Health and Nutrition Examination Survey (1988-1994). The survey result concluded that Nine percent of toddlers aged 1 to 2 years and 9% to 11% of adolescent girls and women of childbearing age were iron deficient; of these, iron deficiency anemia was found in 3% and 2% to 5%, respectively. These prevalence correspond to approximately 700,000 toddlers and 7.8 million women with iron deficiency; of these, approximately 240,000 toddlers and 3.3 million women have iron deficiency anemia. Iron deficiency occurred in not more than 7% of older children or those older than 50
years, and in not more than 1% of teenage boys and young men. Among women of childbearing age, iron deficiency was more likely in those who are minority, low income, and multifarious. Iron deficiency and iron deficiency anemia are still relatively common in toddlers, adolescent girls, and women of childbearing age.

Reyes López A (1997), revealed that chronic gastrointestinal bleeding is the most common cause of iron deficiency anemia (IDA) in the general population. The objectives of this study were to determine the most frequent gastrointestinal lesions in IDA, the frequency and localization of potentially bleeding lesions, the value of the clinical history in diagnosis, the value of fecal occult blood testing, and the most appropriate diagnostic procedure for these patients. Upper GI endoscopy found at least one lesion in 50 patients (72%), 13 in association with a colonic lesion (26%). Colonoscopy detected at least one lesion in 31 patients (45%), among whom 11 had another upper GI lesion (35.5%). Barium enema was positive in 4 out of 24 patients (17%). Barium contrast study of the small intestine detected lesions in 1 out of 7 patients (14%), and arteriography in 1 out of 4 patients (25%). The most common upper GI lesions were of peptic origin (esophagitis in 10, gastro duodenal erosions in 10, and peptic ulcer in 8). Neoplasms (17 cancers and 3 polyps) were the most common colonic lesion. Thirteen out of 38 patients (34%) with a potentially bleeding benign upper GI lesion had another lesion in the colon. The fecal occult blood test was positive in 9 out of 10 patients with colonic cancer and in 5 out of 9 with gastric cancer.
Nonsteroid anti-inflammatory drug use did not correlate with the presence, location or type of lesion. The reliability of the clinically suspected origin of bleeding was 96% sensitivity, 43% specificity and 74% positive predictive value in group A, and 34%, 93% and 80% respectively in group B. Lesions that cause chronic bleeding were more frequently located in the upper digestive tract than in the colon. There was a high prevalence of neoplasm in patients with IDA.

Chapple A (1998) stated that Menorrhagia is thought to be the commonest cause of iron deficiency anemia in women of reproductive age living in Britain. However, it has been suggested that the high prevalence of iron deficiency anemia in women of South Asian descent living in Britain is due to religious and cultural restrictions on certain foods. While lack of iron in the diet, or poor iron absorption may well be reasons for this prevalence of iron deficiency anemia, there may be other complex reasons why South Asian women suffer particularly from this complaint. This study aimed to explore reasons for the relatively high level of iron deficiency anemia found in South Asian women living in Britain. A qualitative study using semi-structured interviews with women of Indian and Pakistani descent living in a town in North West England. It appears that some South Asian women value a relatively heavy menstrual blood flow because such blood is thought to be 'dirty' and 'impure' and because a scanty period is thought to result in abdominal weight gain and pain. When menstrual blood loss is thought to be 'excessive', women tend to avoid 'hot'
foods such as meat, fish and eggs, thus denying themselves a valuable source of iron. When South Asian women believed that they have a serious problem of menorrhagia they may not seek medical help because of the shortage of female general practitioners.

**Jere D. Haas et al (2001)** studied the causal relationship between iron deficiency and physical work capacity and it was evaluated through a systematic review of the research literature, including animal and human studies. Iron deficiency was examined along a continuum from severe iron-deficiency anemia (SIDA) to moderate iron-deficiency anemia (MIDA) to iron deficiency without anemia (IDNA). Work capacity was assessed by aerobic capacity, endurance, energetic efficiency, voluntary activity and work productivity.

**John Beared (2003)**, revealed that Iron deficiency anemia in early life is related to altered behavioral and neural development. Studies in human infants suggest that this is an irreversible effect that may be related to changes in chemistry of neurotransmitters, organization and morphology of neuronal networks, and neurobiology of myelination. The acquisition of iron by the brain is an age-related and brain-region-dependent process with tightly controlled rates of movement of iron across the blood-brain barrier. Dopamine receptors and transporters are altered as are behaviors related to this neurotransmitter. The growing body of evidence suggests that brain iron deficiency in early life has multiple consequences in neurochemistry and neurobiology.
Montresor et al (2004) conducted a comparative cross-sectional study in Ethiopia showed a very low sensitivity in detecting anemia among pregnant mothers. Sensitivity for the hemoglobin values <9 g/dL was 42.9% and for values <10 g/dL was 33.3% whereas sensitivity for the hemoglobin values <11 g/dL was 43.5%. However specificity remained relatively high in all three categories. Underestimation of the high hemoglobin levels is also reported by all.

Coban E, Ozdogan M (2004), reported that the major form of glycohemoglobin is hemoglobin A1C (HbA1c). The HbA1c fraction is abnormally elevated in chronic hyperglycemic diabetic patients and correlates positively with glycemic control. Previous studies suggest that iron deficiency anemia (IDA) affects the levels of HbA1c. The aim of this study was to determine the effect of IDA on HbA1c levels in non-diabetic patients. The population studied consisted of 50 patients (30 women, 20 men, mean age 35.7 +/- 11.9 years) with IDA and 50 healthy subjects that were matched for age and sex. Patients who had glucose tolerance abnormalities (impaired glucose tolerance or diabetes mellitus), hemoglobinopathies, hemolytic anemia, chronic alcohol ingestion and chronic renal failure were excluded from the study. Hematologic investigations, fasting and postprandial glucose and HbA1c levels were measured in all subjects before iron therapy. All patients with IDA were treated with iron 100 mg/day for 3 months. The laboratory investigation after iron therapy was repeated. Before iron treatment, the mean HbA1c (7.4 +/-
0.8%) level in patients with IDA was higher than in a healthy group (5.9% +/- 0.5) (p < 0.001). In patients with IDA, HbA1c decreased significantly after iron treatment from a mean of 7.4% +/- 0.8 to 6.2% +/- 0.6 (p < 0.001). Iron deficiency must be corrected before any diagnostic or therapeutic decision is made based on HbA1c.

Barduagni et al (2005), reported a very low positive predictive value (PPV) for the color scale (26.7%) in a study which assessed the prevalence of anemia among school children in Northern Egypt suggesting that high number of healthy individuals can be labeled as anemic. Similar results were reported by van den Broek et al. in a study assessing the potential of WHO color scale in anemia screening of pregnant mothers.

Maguire JL (2007), Conducted a case-control study of patients who were selected from the stroke registry at the Hospital for Sick Children (Toronto, Ontario, Canada) and control subjects selected from a database of healthy children who were prospectively enrolled in an outpatient setting. Children were aged 12 to 38 months and were previously healthy with no identifiable risk factors for stroke. Age, gender, mean corpuscular volume, platelet count, and hemoglobin and ferritin levels were collected. Iron-deficiency anemia was defined as a hemoglobin level of <110 g/L, mean corpuscular volume <73 fL, and serum ferritin level <12 microg/L. Stroke was defined according to clinical and radiologic criteria. The Case (n = 15) and control (n = 143) subjects were similar with respect to median age and percentage of boys. Case patients had a
lower median hemoglobin level and mean corpuscular volume and a higher median platelet count. Iron-deficiency anemia was significantly more common among case patients (8 [53%] of 15) than control subjects (13 [9%] of 143). The study concluded that previously healthy children with stroke were 10 times more likely to have iron-deficiency anemia than healthy children without stroke.

E Tympa-Psirropoulou et al (2008) stated that Iron deficiency anemia (IDA) is a common problem all over the world, which attacks mainly pregnant women, infants and children. The aim of the study was to estimate the prevalence of IDA in children 12–24 months old in a specific area of Thessalia, located in the central part of Greece, and to identify the environmental risk factors associated with it. They have conducted in the first part of this cross-sectional and case-control study, the hemoglobin (Hb) levels of 938 children were estimated by a mobile photometer analyzer. In the second part of the study, children with Hb < 11 gr/dl were compared with matched random selected controls in hematological, anthropometric and environmental parameters. The estimated laboratory values were Hb, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, zinc protoporphyrin, serum iron, serum ferritin, transferring saturation, total iron binding capacity and Hb electrophoresis. Finally 75 children (34 boys, 41 girls, mean age 17.51±3.5 months), who were found with IDA, constituted the case group while 75 healthy children constituted the control group.
The study reported the prevalence of IDA in the region was 7.99%. At the same time, a number of children with stigma of b thalassaemia (2.13%) was discovered, something that had escaped identification. There were no differences due to the method of determination (mobile or laboratory) in the values of Hb between the two groups. Significant differences were recorded (p<0.001) in all hematological and anthropometric parameters except for head circumference. Regarding environmental factors, significant differences were found in the following parameters: ratio rooms/number of family members (p=0.01), number of family members (p=0.01), number of children in the family (p<0.001), birth rate (p<0.001), education and profession of the parents (p<0.001), source of drinking water and sewage system (p<0.001), duration of breast feeding (p<0.001), milk consumption by the child during the period of the reported research (p<0.001), child's health status according to the mother (p<0.001), and frequency of seeking pediatric care (p=0.02). Although the prevalence of IDA in this area of Greece is similar to the one observed in the rest of the developed world, it still consists a public health problem.

Shahid Beheshti(2010) stated that Anemia, particularly Iron Deficiency Anemia (IDA), is the most common hematological disorder during pregnancy with considerable complications in both mothers and fetuses. All published papers in main national and international databases were systematically searched for some specific keywords to find the related studies between the years 1993 and 2007. All published studies which had reported the prevalence
of anemia were included in the study except studies on refugees, patients undergoing hemodialysis, patients with thalassemia or cancer or other selective subpopulations. Two trained reviewers independently assessed the inclusion/exclusion criteria and the quality of the selected papers, summarized them and eventually analyzed the data. Meta analysis shows that ten eligible papers including 11,037 participants were entered into the analysis. The maximum and minimum reported prevalence rates of anemia during pregnancy were 4.3% and 21.5%, respectively. The overall estimate of anemia prevalence in Iranian pregnant women was 13.6 (95% CI: 8.3 - 18.9). Excluding the only out-layer from the meta-analysis, the overall estimated prevalence was 12.4% (95% CI: 9.6% - 17.9%). Findings concluded that the prevalence of anemia in Iranian women during pregnancy is considerably lower than that of most EMRO countries or the one reported by WHO for Iran (> 40%) which had been performed on a small group 16 years ago. The lower prevalence rate of anemia in pregnant women versus the regional rates could be due to the Global Health, Institute of Population Health (Welch).

**Kevin Pottie (2010)** Iron-deficiency anemia is the most common nutritional disorder in the world. Subgroups of immigrants and refugees have higher prevalence of iron-deficiency anemia than the Canadian-born population has. Growing children and women of reproductive age are at highest risk for iron deficiency and related morbidity. Researcher conducted an evidence review to identify actions to be taken by primary care practitioners to prevent morbidity
from iron-deficiency anemia among newly arriving immigrants and refugees. Systematically assessed evidence on the screening and treatment of iron-deficiency anemia including benefits and harms, applicability, clinical considerations, and implementation issues. The quality of the evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach.

Results: Prevalence of anemia is high in subgroups of newly arriving immigrants and refugees (women >15% and children >20%). Screening and treating iron-deficiency anemia in children can improve cognitive development to a modest degree. Screening and treating female patients of reproductive age can improve hemoglobin and function (work productivity). Iron-deficiency anemia in children is often a combination of inadequate diet, low iron stores at birth, and frequent infections leading to anorexia and poor food intake. High parity, malaria, and hemoglobinopathies increase the risk of anemia.

Aspuru K et al (2011) stated that iron is necessary for the normal development of multiple vital processes. Iron deficiency (ID) may be caused by several diseases, even by physiological situations that increase requirements for this mineral. One of its possible causes is a poor dietary iron intake, which is infrequent in developed countries, but quite common in developing areas. In these countries, dietary ID is highly prevalent and comprises a real public health problem and a challenge for health authorities. ID, with or without anemia, can cause important symptoms that are not only physical, but can also include a
decreased intellectual performance. All this, together with a high prevalence, can even have negative implications for a community’s economic and social development.

Elham Bidabadi (2012) The relationship between iron deficiency anemia and febrile convulsions has been examined in several studies with conflicting results. The authors aimed to evaluate the relation, if any, of iron status with first febrile convulsion.

In this case–control study, the authors assessed 200 children with a diagnosis of first febrile convulsion, aged between 6 months and 5 years, during March 2005 to September 2006. The control group consisted of febrile children without convulsion; controls were matched to the cases by gender and age. The patients and controls were 22.86±12.86 and 21.91±13.58 months of mean age, respectively. The amount of RBC, serum iron, and plasma ferritin were significantly higher, and TIBC was significantly lower among the cases with first febrile convulsions than in the controls. The amount of Hb, Hct, MCV, MCH, and MCHC were also higher among cases than controls, but differences were not statistically significant. Iron deficiency anemia was less frequent among the cases with febrile convulsion, as compared to the controls, and its difference was not statistically significant; but there is not a protective effect of iron deficiency against development of febrile convulsion (odd ratio=1.175). The mean of temperature peak on admission was significantly higher in the febrile convulsion group (38.74±0.76°C) compared with the controls (38.2±
0.67°C) \((P<0.0001)\). The results of this study suggest that iron deficiency anemia was less frequent among the cases with febrile convulsion, as compared to the controls, and there is not a protective effect of iron deficiency against febrile convulsions.

Yu Qin et al (2013) this study aimed to investigate the relationship of anemia and body mass index among adult women in Jiangsu Province, China. Data were collected in a sub-national cross-sectional survey, and 1,537 women aged 20 years and above were included in the analyses. Subjects were classified by body mass index (BMI) categories as underweight, normal weight, overweight and obese according to the Chinese standard. Central obesity was defined as a waist circumference \( \geq 80 \) cm. Anemia was defined as hemoglobin concentration \(<12 \) g/dl. Prevalence ratios (PRs) of the relationship between anemia and BMI or waist circumference were calculated using Poisson regression. Overall, 31.1% of the Chinese women were anemic. The prevalence of overweight, obesity and central obesity was 34.2%, 5.8% and 36.2%, respectively. The obese group had the highest concentrations of hemoglobin compared with other BMI groups. After adjustment for confounders, overweight and obese women had a lower PR for anemia (PR: 0.72, 95% CI: 0.62-0.89; PR: 0.59, 95% CI: 0.43-0.79). Central obesity was inversely associated with anemia.
Section III: Studies related to nutritional and other health problems of tea garden women.

Hazarika NC et al (2002), reported in their study that hypertension is emerging as a major public health problem in India. In Assam, reports from hospitals in tea gardens reveal a high prevalence of hypertension among workers in tea gardens. They have, collected the samples by systematic sampling, 1015 individuals (512 men and 503 women) 30 years or more in age, who were interviewed and clinically examined for hypertension. Blood pressure of all the study participants was measured using a standardized technique. Risk factors considered for hypertension included age, gender, marital status, occupation, alcohol consumption (locally prepared), extra salt intake, smoking history, khaini (a form of tobacco quid containing a mixture of tobacco and lime) intake, body mass index and waist-hip ratio. The overall prevalence of hypertension was 60.8%. Increasing age, consumption of locally prepared alcohol, intake of extra salt in food and beverages and the habit of taking khaini were found to increase the risk of hypertension. Multivariate logistic regression models showed that the independent determinants of hypertension were age, gender, consumption of locally prepared alcohol and intake of extra salt. Gender-specific and age-stratified analyses showed the association of increased risk with intake of khaini in women only, while consumption of locally prepared alcohol was an important risk factor for hypertension in both men and women. The disease burden of hypertension among workers in tea gardens is large, despite the community not
being obese. Interventions directed at these workers as well as studies to determine the reasons for the high prevalence of hypertension are required.

G.K Medhi et al (2003), conducted a study to compare morbidity, disability (ADL-IADL disability) along with behavioral and biological correlates of diseases and disability of two elderly population groups (tea garden workers and urban dwellers) living in the same geographical location.

Two hundred and ninety three and 230 elderly from urban setting and tea garden respectively aged > 60 years were included in the study. Subjects were physically examined and activity of daily living instrumental activity of daily living (ADL-IADL) was assessed. Diagnosis of diseases was made on the basis of clinical evaluation, diagnosis and/or treatment of diseases done earlier elsewhere, available investigation reports, and electrocardiography.

They concluded that Hypertension (urban - 68% and tea garden - 81.4%), musculoskeletal diseases (urban - 62.5% and teagarden - 67.5%), COPD and other respiratory problems (urban - 30.4% and tea garden - 32.2%), cataract (urban 40.3% and tea garden - 33%), gastro-intestinal problems (urban - 13% and tea garden - 6.5%) were more commonly observed health problems among community dwellings elderly across both the groups. However in contrast to urban group, serious NCDs like Ischemic Heart Disease (IHD), diabetes were yet to emerge as health problems among tea garden dwellers. Infectious
mORBIdities, under nutrition and disability (ADL-IADL disability) were more pronounced among tea garden dwellers. Utilization of health service by teagarden elderly was very low in comparison to the urban elderly. Both tea garden men and women had very high rates of risk factors like use of non-smoked tobacco and consumption of alcohol. On the other hand, smoking and obesity was more common in urban group. Most morbidities and disabilities were associated with identifiable risk factors, such as obesity, tobacco (smoked and non-smoked) and alcohol consumption. Educational status was also found to be an important determinant of diseases and disability of elderly population.

Prabir Kumar Manna1 et al (2003), conducted a study aimed to assess the influence of socioeconomic factors on antenatal care and delivery practices of the mother of North Bengal. A community based study was carried out among 1772 families of the 7 blocks of the two districts. Various socio economic factors were considered for the antenatal care and delivery practices. We also tried to find out the relationship between antenatal check up with perinatal mortality. The study shows that the muslim mothers, Scheduled tribe mothers, non-educated and mothers with higher age group are less interested about ANC. Family income 2000/- month showing 62.42% ANC coverage. Study found that only 7.11% mother used Govt hospital and 2.65% used private clinic. The mother with medical problems and obstetric problems has high ANC coverage. So, socioeconomic factors significantly influence the antenatal coverage and delivery practices.
Sarmishtha Biswas et al (2005), conducted a study to determine the nutritional status of tea workers on closed, recently reopened (sick), and normally functioning gardens. Six tea gardens in the Dooars Region, Jalpaiguri District, West Bengal, India were selected for the study. 120 families (609 individuals) were surveyed in their homes on the labor lines of six tea gardens. Based on World Health Organization criteria for Body Mass Index, all four open gardens surveyed can be labeled as “starving communities” or “at critical risk for mortality from starvation.” Based on daily caloric intake, 42.5% of the closed garden populations classify as Below Poverty Line (BPL), followed by 40% BPL in sick gardens, both of which are significantly higher than the national average. The study concluded that Malnutrition exists on all six gardens surveyed. Even workers on sick and open gardens endure extreme lean periods due to decreased or delayed wage payments and food rations, as well as in consistently provided benefits that are due by law.

Medhi GK et al (2006), Conducted a cross sectional study to assess tobacco use (both smoking and non-smoked tobacco) and alcohol use among tea garden youths of Assam, India during the period 2002-2003. A total of 650 tea plantation youth age 15-24 years (255 males, 395 females) from eight randomly selected tea plantations, Dibrugarh District, Assam, were interviewed to collect information on alcohol and tobacco use using a pre-designed, pre-tested questionnaire. Nearly 59% of the respondents had no
formal education. Fifty-eight percent of the youth used at least one substance and 27.4% were concurrent users of both alcohol and tobacco. The smoking rate was only 2.2% (4.7% in males, 0.5% in females). However, 52.5% of the study population used non-smoked tobacco (56.9% males, 49.6% females). The prevalence of alcohol consumption was 32.2% (43.9% males, 24.6% females). A higher rate of alcohol and tobacco use was found among the respondents who had no formal education or were school dropouts. A higher rate of alcohol and tobacco use were seen among respondents in whom both parents were illiterate. Working as a manual worker in the tea industry is significantly associated (p<0.01) with higher rates of alcohol and tobacco use. They recommend a vigorous campaign against tobacco and alcohol use among tea plantation youth to reduce the health risks associated with the use of these two substances.

Mittal PC et al (2006), conducted a study among the 500 Oraon tribals, including 200 men and 150 women aged 20-45 years, and 150 children aged 6-12 years and they were surveyed for their dietary intake by 24-hour recall and semi-quantitative food frequency questionnaire methodology and anthropometry, and a description of food-related traditions. The study revealed that diet of all Oraon groups was deficient in all food groups. The Oraons’ knowledge of contraception, vaccinations, proper diet and supplements needed for successful pregnancy was severely deficient. Study concluded a remarkable finding of this study on the Oraon tribals is that the BMI of children was
substantially below that of adult men and women.

**Bhupen kumar baruah et al (2011)** stated that adverse effects of hazardous chemical used in tea garden as well as the significant potential risk to the human life and its supporting systems are not properly recognized till low in Assam. Injudicious uses of chemical fertilizer, pesticides in the tea gardens have become a cause for serious concern as it has adverse effect on soil and water environment and its population. The study reveals that there a significant difference observed between two garden groups and environment awareness results indicate that there were significant differences among different levels of education. The study concluded that increase in age and educational level would improve the level of awareness among the labors.

**Kakoli Hazarika (2012),** who conducted a study on Tea tribes are lagging behind in the process of urbanization. The study reported that tea industry is a labour intensive industry and highly dependent on a large workforce. It is the only sector where majority of the workers were female. Picking and plucking is the most crucial operation in obtaining the finest quality tea leaf. It has always been said that women are the best at this type of work due to their small hands and dexterous skills. Hence, demands for women in tea plantation is always higher. 67% of the women are daily wage labourer.

**Dipali Basumotary and Phonidhar Goyari’s report (2013),** who conducted a study on educational status of Tea plantation women workers in Assam. They revealed that
a large portion of tea plantation workers in India are still women, most of them are illiterate. There are several socio economic factors which are directly and indirectly responsible for the high drop outs and low literacy rate among female workers in sample areas. Economic condition of the family is one of the main reasons behind low literacy among female workers. Poverty leads to low literacy rate among the women workers. In those days meager income of their parents was not able to Support family and hence expenditure of their education was out of question.

**Section IV: Studies related to other aspects of Iron Deficiency Anemia.**

**Studies related to prevalence of Iron Deficiency Anemia**

*Sikosana PL et al (1998)* conducted a cross sectional study to determine the prevalence of iron deficiency and iron deficiency anemia (IDA) in selected population groups in Zimbabwe. Blood samples were collected for quantitative measurement of ferritin in serum and hemoglobin estimation as part of a full blood count. Thirty clusters were randomly selected from 28 enumeration districts. The multistage sampling technique was applied. The total sample consisted of 3,151 study participants made up of 746 pregnant women, 800 lactating women, 811 adult males and 799 pre-school children. Up to 202 results could not be used in the analysis. R Stoltzfus, emphasizes that haemoglobin concentration is the key indicator for IDA surveillance. Serum ferritin levels measured against 10 mg/dl for females and 15 ng/dl for males as standards below which there is IDA. Serum ferritin levels of over 300 mg/dl above which there is iron overload. Hemoglobin levels were based on the
World Health Organization standards of 11 g/dl below which pregnant women and preschool children were considered to have IDA, 13 g/dl for adult males and 12 g/dl for lactating women. The proportion of individual households with protected water supplies, sanitation and levels of education as they influence the prevalence of IDA. Dietary habits with regards their influence on iron availability. The overall prevalence of IDA was 24.1% of the total study sample. Of the preschool children surveyed 17.7% had IDA, 33.0% of pregnant women, 29.6% of lactating women and 16.5% of adult males had IDA. Of the population 9.1% surveyed had evidence of iron depletion on the basis of serum ferritin levels. More of the pregnant women had iron depletion, 14.8%, compared to adult males with 2.2%.

**Franziska Staubli Asobayire et al (2001)** reported that iron deficiency is highly prevalent in most developing countries. However, its detection is often obscured by infections and inflammatory disorders that are common in the same populations. The aim of this study was to estimate the prevalence of iron deficiency with or without concurrent anemia in different population groups from Côte d'Ivoire and to evaluate the influence of infectious and inflammatory disorders on iron-status indexes. They have collected blood samples from 1573 children, women, and men were analyzed for hemoglobin, serum ferritin, zinc protoporphyrin, and serum transferrin receptor. They revealed that the prevalence of iron deficiency was 41–63% in the women and children and 13% in the men. The detection of iron deficiency and IDA was obscured by the high
prevalence of inflammatory disorders. They concluded that iron deficiency and IDA are highly prevalent in the women and children in Côte d'Ivoire. Iron deficiency was detected in \( \approx 50\% \) of anemic women and children, which indicates that hemoglobin alone is not a good indicator of iron status when inflammatory disorders are highly prevalent.

**Sally Grantham-McGregor (2001)**, Studies on the effect of iron deficiency on children’s cognition and behavior are selectively reviewed, looking for evidence of a causal relationship. Most correlation studies have found associations between iron-deficiency anemia and poor cognitive and motor development and behavioral problems. Longitudinal studies consistently indicate that children anemic in infancy continue to have poorer cognition, school achievement, and more behavior problems into middle childhood. However, the possible confounding effects of poor socioeconomic backgrounds prevent causal inferences from being made. In anemic children \(< 2 \text{ y old}\), short-term trials of iron treatment have generally failed to benefit development.

**Karimi M et al (2002)** stated that Iron-deficiency anemia (IDA) is a public health problem in the developing and even industrialized countries. Pregnant women and children under 5 years of age are among the high-risk population. The main objectives in this study were to obtain the prevalence of IDA in pregnant women by routine methods and by serum ferritin. They analysed the blood of 270 healthy pregnant mothers, 16 weeks of gestational age. A series of determinations were conducted to determine hemoglobin concentration (Hb);
red blood cells count (RBC); serum ferritin and other indexes. Then a questionnaire for epidemiological data, type of diet, level of education, laboratory data, etc. was filled. The result showed that the mean values (SD) of hematological indexes were as follows: Hb 12.07±1.5 g/dl; serum ferritin 24.87±19.32 ng/ml; mean corpuscular hemoglobin concentration (MCHC) 31.9±1.4 g/dl; mean corpuscular volume (MCV) 82.2±9 fl and mean corpuscular hemoglobin (MCH) 26.4±3.2 pg. 28.5% of the subjects were anemic at the time of the study according to serum ferritin (SF < 12 ng/ml) and 16.7% of the mothers had low serum Hemoglobin (Hb<11 g/dl) (P=0.005). There was a positive correlation (r=0.76; P=0.01) between Hb concentration and serum ferritin levels. They concluded that prevalence of IDA was 28.5%, which is the same as the prevalence found in other developing countries (25-35%).

**Binay Kumar Shah et al (2002)** the present study was conducted to determine the prevalence of anemia in adolescent Nepalese girls in a semi urban setting. A total of 209 apparently healthy girls between the ages of 11-18 years were recruited and information collected on menarcheal status and socio-demographic profile. All girls were subjected to anthropometric examination and hematocrit estimation. Anemia was defined as hematocrit less than 36, as per WHO cut-off. The overall prevalence of anemia was found to be 68.8%. This prevalence was not related to girls’ age, body mass index, menarcheal status, and socio-demographic factors including parental education or occupation (p = 0.05) the prevalence of anemia in adolescent girls was 68.8%
The hematocrit values ranged from 24 to 42 (median 34; mean 33.4; SE 0.23; 95% CI 32.9, 33.9). The prevalence of anemia was maximum (76.9%, 10/13), in the age category of 11-12 y, and least (63.6%, 42/66) at 14-16 yr (P > 0.05).

Prevalence of anemia was not found to be associated with parental education or occupation and type of dwelling unit (Table I). Relationship of prevalence of anemia with personal characteristics such as type of diet consumed, passage of worms and menarcheal status is also depicted in Table I.

The mean weight and height of all girls was 42.8 ± 6.2 kg (median 44.0, range 27-59, 95% CI 42.0, 43.7) and 150.1 ± 6.7 cm (median 150.0, range 127-168.0, 95% CI 149.2, 151.0) respectively. Body mass index (BMI) ranged from 14.2-26.6 (median 19.0). Most of the girls (n = 121) had a normal BMI (between 18.5 to 25), while 87 (41.6%) had a BMI of less than or equal to 18.5. Only one girl had a BMI of more than 25. Prevalence of anemia in girls with BMI >18.5 (n = 122) was 65.5% as compared to 71.3% in those with a BMI ≤18.5 (P = 0.37). Hematocrit in the two categories was also comparable i.e., 33.3 ± 3.2 and 33.6 ± 3.7 respectively (P = 0.59).

Eur J Clin Nutr. 2004, conducted a study among 648 randomly selected adolescent schoolgirls aged 12-18 y. The prevalence of anemia (Hb <120 g/l) was 21.1%; only one girl had an Hb less than 70 g/l. Ferritin levels were available from a subsample of 206 girls. The prevalence of iron deficiency
ferritin <12 microg/l) was 19.8, and 30.4% of anemic girls were iron deficient. Malaria and schistosomiasis were the main risk factors for anemia in younger girls (12-13 y), while menstruation was the principal risk factor in older girls (14-18 y). The study concluded that iron deficiency and anemia in school-attending girls in western Kenya were more prevalent than in developed countries, but considerably less prevalent than in preschool children and pregnant women from the same study area. The study findings are consistent with other recent school-based surveys from western Kenya, but not with recent community- and school-based cross-sectional surveys from other parts of sub-Saharan Africa. It deserves further study to determine if adolescent girls not attending school are at higher risk of anemia.

Leenstra et al (2004) reported that Anemia is a major public health concern in preschool children and pregnant women in the developing world. While many studies have examined these two at-risk groups, there is a paucity of data on anemia in adolescents living in developing countries in the complex ecologic context of poverty, parasitism, and malnutrition. Study evaluated the prevalence, severity, and risk factors of anemia in adolescent schoolgirls in an area with intense malaria transmission in western Kenya. Two cross-sectional surveys were conducted, using a multistage random sample design. Public primary schools in an area with intense malaria transmission in western Kenya. A total of 648 randomly selected adolescent schoolgirls’ aged 12–18 years. The prevalence of anemia (Hb <120 g/l) was 21.1%; only one girl had an Hb less
than 70 g/l. Ferritin levels were available from a subsample of 206 girls. The prevalence of iron deficiency (ferritin <12 μg/l) was 19.8, and 30.4% of anemic girls were iron deficient. Malaria and schistosomiasis were the main risk factors for anemia in younger girls (12–13 years), while menstruation was the principal risk factor in older girls (14–18 years).

**Ximena Duque (2007)**, conducted a survey with a representative sample of children younger than 2 years of age, beneficiaries, and users of health care services provided by IMSS through its regular regimen (located in urban populations) and its Oportunidades program (services offered in rural areas). A subsample of 4,955 clinically healthy children was studied to determine their micronutrient status. A venous blood sample was drawn to determine hemoglobin, serum ferritin, and percent of transferrin saturation, zinc, and folic acid. Descriptive statistics include point estimates and 95% confidence intervals for the sample and projections for the larger population from which the sample was drawn. Twenty percent of children younger than 2 years of age had anemia, and 27.8% (rural) to 32.6% (urban) had iron deficiency; more than 50% of anemia was not associated with low ferritin concentrations. Iron stores were more depleted as age increased. Low serum zinc and folic acid deficiencies were 28% and 10%, respectively, in the urban areas, and 13% and 8%, respectively, in rural areas. The prevalence of simultaneous iron and zinc deficiencies was 9.2% and 2.7% in urban and rural areas. Children with anemia
have higher percentages of folic acid deficiency than children with normal iron status.

**Akramipour R (2008)** stated that Iron deficiency anemia is a major health problem in developing countries. Anemia reduces physical work capacity and cognitive function and adversely affects learning and scholastic performance in schoolgirls entering adolescence. A cross-sectional study was conducted to determine the prevalence of iron deficiency, iron deficiency anemia and anemia among adolescent school girls aged 14-20 years from 20 different high schools located in three educational areas of Kermanshah, the capital of Kermanshah province in Western Iran. The prevalence of anemia (Hb<12 mg/dl) among adolescent school girls was 21.4%. Iron deficiency using a ferritin level <12 microg/l was found in 23.7% of studied girls. There were 47 girls (12.2%) with iron deficiency anemia (Hb<12 g/dl and ferritin <20 microg/l). Around 57.3% of anemic girls were iron deficient. There were no significant differences between the presence of anemia and the level of education of parents.

**Mary-Jane N. Ofojekwu (2012),** reported that Low hemoglobin (Hb) and iron deficiency among child bearing females have been linked to decreased immune system function, impaired cognitive functioning and complications in pregnancy. A total of 106 blood samples from apparently healthy nulliparous female students were assessed for Hb and serum iron concentrations using the cyanmethemoglobin and bathophenanthroline methods, respectively, to evaluate changes that may occur in these parameters at different phases of the
reproductive cycle. The mean (SD) Hb values during the ovulatory, menstrual, and follicular phases were 13.27 (1.14) g/dL, 12.05 (1.31) g/dL, and 12.23 (1.56) g/dL, respectively. The prevalence of anemia (Hb<12 g/dL) was reported among 21 (19.8%) subjects, and 31 subjects declined to complete their samples collection. The mean serum iron concentrations during the 3 phases were 92.98 (18.25) μg/dL, 79.90 (13.14) μg/dL and 70.85 (18.65) μg/dL, respectively. A total of 28 (26.4%) study participants showed iron deficiency (serum level, <65 μg/dL). These variations in the values of Hb and serum iron concentrations were statistically significant in the 3 phases. Positive correlation was observed between the hemoglobin and serum iron concentrations within the phases, with the exception of a few cases that showed negative correlations.

Claudia Ott(2012) reported that iron-deficiency anemia is described to be a common problem in patients with inflammatory bowel disease (IBD), which is frequently associated with a reduced quality of life. The main aim of this study was to assess the prevalence of iron deficiency anemia in a population-based cohort at time of first diagnosis and during the early course of the disease. In anemic patients, they further investigated all laboratory results to differentiate between iron deficiency and other reasons for anemia. All patients with any kind of anemia were interviewed separately according to symptoms of iron-deficiency anemia and administration of iron. The result shows that in total, we evaluated hemoglobin values of 279 patients (183 Crohn's disease, 90 ulcerative colitis, and 6 indeterminate colitis). Lab data which allowed further
differentiation of the type of anemia were available in 70% of anemic patients; in 34.4% values of iron, ferritin and transferrin saturation had been measured.

At time of first diagnosis, an iron-deficiency anemia was diagnosed in 26 of 68 patients with anemia (38.2%, 20 CD, 4 UC, and 2 IC patients), but only 9 patients (34.6%) received subsequent iron therapy. After one year, 27 patients were identified to have an iron-deficiency anemia (19 CD, 8 UC), 20 of them were treated with iron (71.4%). The findings shows that 9 patients with proven iron-deficiency anemia at time of first diagnosis and subsequent administration of iron, 5 (55.5%) had iron-deficiency anemia despite permanent treatment after one year. In total, 38 patients (54.3%) did not receive any iron substitution at all despite of proven iron-deficiency anemia, and only 13 patients of 74 patients were treated with intravenous iron (17.6%).

Jeffery L. Miller (2013), stated that Iron deficiency anemia arises when the balance of iron intake, iron stores, and the body’s loss of iron are insufficient to fully support production of erythrocytes. Iron deficiency anemia rarely causes death, but the impact on human health is significant. In the developed world, this disease is easily identified and treated, but frequently overlooked by physicians. In contrast, it is a health problem that affects major portions of the population in underdeveloped countries. Overall, the prevention and successful treatment for iron deficiency anemia remains woefully insufficient worldwide, especially among underprivileged women and children

Studies related to Risk factors of Iron Deficiency Anemia
A A Adish et al (1999), conducted a cross sectional study to determine risk factors for anemia in preschool children in Tigray province, northern Ethiopia. Study was conducted among 2373 children aged 6-60 months provided blood to assess anemia. The result shows that Anemia was highly prevalent (42%) and constituted an important nutritional problem in the region. In a sub-sample of 230 anemic children, 56% had a low red blood cell (RBC) count, and 43% had a serum ferritin of less than 12 microgl (-1) indicating that the anemia was largely due to iron deficiency. Unlike other regions in developing countries, hookworm (0.4%) and malaria (0.0%) were rare and contributed little to the anemia. Even though their diet lacked variety, the amount of iron consumed through cereal-based staple foods was adequate. However, the iron in these foods was not readily available and their diets were probably high in iron absorption inhibitors and low in enhancers. Dietary factors associated with anemia included frequent consumption of inhibitors, such as fenugreek and coffee, and poor health in the child such as diarrhea and stunting. The study concluded that underlying causes of anemia were lack of safe water and inadequate human waste management, maternal illiteracy and mother being ill, and having no food reserves. The root cause of these factors was poverty.

Al-Quaiz JM (2001), conducted a case control study to determine the risk factors for iron deficiency anemia among Saudi women of childbearing age at the primary health care clinics of King Khalid University Hospital in Riyadh over a 6-month period. Inclusion criteria included women of childbearing age
and hemoglobin level < 120 g/l. Iron deficiency anemia was defined as having iron deficiency and low hemoglobin level < 120 g/l. Controls had hemoglobin level > 120 g/l and were matched with the cases for socio-demographic characteristics. The study concluded that Eighty-seven patients and 203 controls were enrolled in the study. Low frequency of eating meat, vegetables or drinking juices right with vitamin C increased the risk of having iron deficiency anemia by 2-4 fold (odds ratio = 2.06, 95% confidence interval 1.20-3.54), (odds ratio = 2.86, 95% confidence interval 1.65-4.98) and (odds ratio = 3.75, confidence interval 2.20 - 6.42). Menstrual period duration of > 8 days, history of clots or flooding increased the odds of having iron deficiency anemia by 3-6 folds. The odds of being iron deficient in patients on non-steroidal anti-inflammatory drugs and antacid were 6-9 fold. Important risk factors for iron deficiency anemia among Saudi women of childbearing age are dietary habits, menorrhagia and history of ingestion of non-steroidal anti-inflammatory drugs or antacids.

Aikawa R, et al (2006), conducted a cross-sectional survey to assess the prevalence of anemia in rural Vietnam and to determine its risk factors. The total number of participants was 439. The result of the study shows that the prevalence of anemia (haemoglobin (Hb) <11.0 g dl(-1)) was 43.2% and of severe anemia (Hb <8.0 g dl(-1)) was 0.5%. Taking iron tablets, the consumption of eggs and the preference for Western medicine significantly and positively correlated with Hb concentration in the pregnant women in a multiple
regression analysis. Pregnancy duration and hookworm infestation significantly and negatively correlated with Hb concentration in the pregnant women. The study concluded that the prevalence of anemia in rural Vietnam has remained as high as that found in the national anemia survey in 2000.

Shersten killip, M.D, (2007), stated that the prevalence of iron deficiency anemia is 2 percent in adult men, 9 to 12 percent in non-Hispanic white women, and nearly 20 percent in black and Mexican-American women. Nine percent of patients older than 65 years with iron deficiency anemia have a gastrointestinal cancer when evaluated. The U.S. Preventive Services Task Force currently recommends screening for iron deficiency anemia in pregnant women but not in other groups. Routine iron supplementation is recommended for high-risk infants six to 12 months of age. In children, adolescents, and women of reproductive age, a trial of iron is a reasonable approach if the review of symptoms, history, and physical examination are negative; however, the hemoglobin should be checked at one month. If there is not a 1 to 2 g per dL (10 to 20 g per L) increase in the hemoglobin level in that time, possibilities include malabsorption of oral iron, continued bleeding, or unknown lesion. For other patients, an endoscopic evaluation is recommended beginning with colonoscopy if the patient is older than 50.

Bijan Khikari et al (2007) conducted a randomized, cross sectional study among the 6-59 months old children. weight and height of the children were measured and birth weight and height was taken from growth charts. Blood
samples were taken from 337 randomly selected samples. The result showed that 43.9% of the children had anemia and 29.1% had iron deficiency anemia. The highest prevalence of iron deficiency anemia was in 12-24 months age group. In urban areas, infants 6-11 months of age had the highest prevalence of iron deficiency anemia.

Ahmad Sherji (2010), conducted a case-control study was to find association between iron deficiency anemia and febrile seizures in children. This multicentre study was conducted in Department of Pediatrics HIT Hospital Taxila Cantt. Three hundred and ten children aged between 6 months to 6 years were included in the study. One hundred and fifty-seven children who presented with febrile seizures were cases, while, 153 children who presented with febrile illnesses without seizures were recruited as controls. All patients were assessed for iron deficiency anemia by measuring hemoglobin level, serum ferritin level, Mean Corpuscular Hemoglobin Concentration (MCHC) and Mean Corpuscular Volume (MCV). Patients with iron deficiency anemia amongst controls and cases were documented. Percentages and Odds ratio were derived from the collected data. Results:31.85% of cases (50 out of 157) had iron deficiency anemia whereas, 19.6% of controls (30 out of 153) were found to have iron deficiency anemia as revealed by low levels of hemoglobin level, serum ferritin level, Mean Corpuscular Hemoglobin Concentration and Mean Corpuscular Volume. Odds ratio was 1.93. The study concluded that Patients with febrile
seizures are 1.93 times more likely to have iron deficiency anemia compared to febrile patients without seizures.

**Ahmed F, Al-Sumaie MA. (2011)** conducted a cross-sectional study was carried out to identify the risk factors of anemia and iron deficiency in Kuwaiti pregnant women. Pregnant women (n = 465) aged 18-47 years, of 4-39 weeks at gestation were recruited during antenatal visits from six health facilities in Kuwait. Socio-demographic, pregnancy-related and dietary information were collected. Hemoglobin, serum ferritin and serum C-reactive protein concentrations were determined. Logistic regression analysis revealed that iron deficiency and not taking iron-folate tablets or taking them occasionally were the two most important risk factors associated with anemia. Pregnant women with higher gestational age, short birth spacing (≤ 2 years), not taking iron-folate tablets or taking them occasionally, not consuming fruit juice, and consuming brown bread, tea and/or coffee were significant risk factors associated with iron deficiency. In conclusion, various factors including dietary habits appeared to be associated with poor iron status, which is the most important risk factor for anemia among Kuwaiti pregnant women.

**Pottie K (2012)** stated that Iron-deficiency anemia is the most common nutritional disorder in the world. Subgroups of immigrants and refugees have higher prevalence of iron-deficiency anemia than the Canadian-born population has. Growing children and women of reproductive age are at highest risk for iron deficiency and related morbidity. The result of the study shows that,
Prevalence of anemia is high in subgroups of newly arriving immigrants and refugees (women >15% and children >20%). Screening and treating iron-deficiency anemia in children can improve cognitive development to a modest degree. Screening and treating female patients of reproductive age can improve hemoglobin and function (work productivity). Iron-deficiency anemia in children is often a combination of inadequate diet, low iron stores at birth, and frequent infections leading to anorexia and poor food intake. High parity, malaria, and hemoglobinopathies increase the risk of anemia. Immigrant and refugee children and women of reproductive age are vulnerable to iron-deficiency anemia.

Zeina Makhoul et al (2012), conducted a cross sectional study to investigate risk factors associated with severe anemia [hemoglobin (Hb) < 8.0 g dl-1] and poor iron status among Nepali pregnant women. Socio-demographic, anthropometric, health and dietary data were collected from 3,531 women living in the southeastern plains of Nepal. Stool samples were analyzed for intestinal helminthes. Dark adaptation was assessed using the Night Vision Threshold Test (NVTT). Hb levels were measured in all subjects to detect anemia and the soluble transferrin receptor (sTfR) was measured among a subsample of 479 women. The iron status categories were: 1) normal (Hb≥11.0 g/dl and sTfR≤8.5 mg/l); 2) anemia without iron deficiency (Hb<11.0 g/dl and sTfR≤8.5 mg/l); 3) iron deficiency without anemia (Hb≥11.0 g/dl and sTfR>8.5 mg/l); and 4) iron deficiency anemia (IDA): (Hb<11.0 g/dl and sTfR>8.5 mg/l). Factors associated
with severe anemia and poor iron status were determined using logistic regression. Hookworm infection increased the risk for developing severe anemia [adjusted odds ratio (AOR): 4.26; 95% CI 1.67-10.89; p<0.01] and IDA [relative risk ratio (RRR): 2.18; 95% CI 1.14-4.16; p<0.05]. Impaired dark adaptation was a common risk factor for iron deficiency with and without anemia. Intake of iron supplements as tablets and/or tonic was protective against severe anemia, anemia without iron deficiency and IDA. Dietary heme iron was significantly associated with iron deficiency without anemia (RRR: 0.1; 95% CI 0.02-0.47; p<0.01). These results indicate the risk factors varied by classification and multiple approaches are needed to reduce anemia and associated nutrient deficiencies.

**Studies related to sign and symptoms of Iron Deficiency Anemia**

**Kfar-Saba (2004)** Stated that, chronic gastrointestinal (GI) bleeding is the leading cause of iron deficiency anemia (IDA) in men older than 50 years and post-menopausal women. There is a scarcity of data regarding IDA patients without GI symptoms or signs. A prospective study was conducted to determine the prevalence and the locations of the GI tract lesions in patients with asymptomatic IDA. Forty-eight patients with asymptomatic IDA (25 men older than 50 years and 23 post-menopausal women) underwent colonoscopy, gastroscopy and abdominal computed tomography (CT) with contrast agent. The result of the study shows that An anemia-causing lesion was found in 14 (29%) and 16 (33%) patients in the upper and the lower GI tract, respectively. The prevalence
of dual lesions (in both the upper and lower GI tract) was low (6%). In 14 (29%) patients, a malignancy, predominantly right-sided colon carcinoma, was responsible for the IDA. Only one patient had a lesion in the small bowel. In 14 (29%) patients, the work-up was negative. The study concluded that our prospective study demonstrates a high rate of malignancy, predominantly right-sided colon carcinoma, in men older than 50 years and post-menopausal women with asymptomatic IDA. This finding obligates a complete and rigorous GI tract examination in this group of patients, especially of the right colon.

**Cengiz Beyan et al (2009)**, conducted a study is to investigate the frequency and types of pica and the relationship of pica with patient characteristics. This descriptive prospective study was conducted between October 2005-December 2006. 119 patients with iron deficiency anemia (IDA) were included. The data were collected by using a standard questionnaire form. The result of the study shows that total of 119 IDA patients whose mean age was 37.0 ±11.5 (mean ± SD) (range 15-72 years) were investigated. Ninety-four of the cases had pure IDA, 19 additional vitamin B12 deficiencies and six pregnancies. The frequency of pica was 34.4% in the study group, 38.3% in pure IDA patients, 15.8% in iron and vitamin B12 deficiency patients and 33.3% in pregnant. Pica was more prevalent in pure IDA patients than those with additional vitamin B12 deficiency (p = 0.048). Age was not a significant factor in pica frequency. There was no relationship between the severity of anemia and the frequency of pica. No difference has been observed between complete blood count parameters of
IDA patients with and without pica, apart from a borderline difference in mean platelet volume (p = 0.057). The concluded that as a result, pica is a frequent finding in IDA, and patients with and without pica have similar characteristics.

keywords:

Studies related to diagnosis and treatment of Iron Deficiency Anemia

Gordon, H. Guya (2004) conducted a study to determine the diagnostic values of laboratory tests used in the diagnosis of iron-deficiency anemia; the authors conducted a systematic view of the relevant literature. Fifty-five studies included the results of laboratory tests and histologic examination of the bone marrow for at least 50% of an identifiable patient group. In these 55 studies, quality was assessed and descriptive information concerning the populations, the tests conducted, and the results were extracted, all in duplicate. The study shows that Serum ferritin radioimmunoassay was by far the most powerful test— with an area under the receiver operating characteristic curve of 0.95. Test differed for populations of patients with inflammatory, liver, or neoplastic disease and patients without these conditions. Likelihood ratio lines, which allow precise interpretation of results across the entire range of ferritin concentration values, were constructed for the individual populations. Conclusion: Serum ferritin radioimmunoassay is an extremely powerful test for the diagnosis of iron-deficiency anemia and, appropriately interpreted, can be applied to the complete range of patients.
Susan F. Clark (2009), stated that Iron deficiency anemia (IDA) still remains universally problematic worldwide. The primary focus of this review is to critique articles published over the past 18 months that describe strategies for the diagnosis and management of this prevalent condition. The medical community continues to lack consensus when identifying the optimal approach for the diagnosis and management of IDA. Biomarkers and cause-based diagnostics, which will provide direction in managing Iron Deficiency Anemia and distinguish between Iron Deficiency Anemia from the anemia of chronic disease.

Fernando Bermejo (2009), Iron deficiency (ID), with or without anemia, is often caused by digestive diseases and should always be investigated, except in very specific situations, as its causes could be serious diseases, such as cancer. Diagnosis of ID is not always easy. Low serum levels of ferritin or transferring saturation, imply a situation of absolute or functional ID. It is sometimes difficult to differentiate ID anemia from anemia of chronic diseases, which can coexist. In this case, other parameters, such as soluble transferring receptor activity can be very useful. After an initial evaluation by clinical history, urine analysis, and serological tests for celiac disease, gastro copy and colonoscopy are the key diagnostic tools for investigating the origin of ID, and will detect the most important and prevalent diseases. If both tests are normal and anemia is not severe, treatment with oral iron can be indicated, along with stopping any treatment with non-steroidal anti-inflammatory drugs. In the absence of
response to oral iron, or if the anemia is severe or clinical suspicion of important
disease persists. The clinician must insist on diagnostic evaluation. Repeat
endoscopic studies should be considered in many cases and if both still show
normal results, investigating the small bowel must be considered. The main
techniques in this case are capsule endoscopy, followed by enteroscopy.

Amy Zhu (2010) revealed that a substantial volume of the consultations
requested of gastroenterologists are directed towards the evaluation of anemia.
Since iron deficiency anemia often arises from bleeding gastrointestinal lesions,
many of which are malignant, establishment of a firm diagnosis usually
obligates an endoscopic evaluation. Although the laboratory tests used to make
the diagnosis have not changed in many decades, their interpretation has, and
this is possibly due to the availability of extensive testing in key populations.
Data supporting the use of the serum ferritin as the sole useful measure of iron
stores, setting the lower limit at 100 μg/l for some populations in order to
increase the sensitivity of the test. Trends of the commonly obtained red cell
indices mean corpuscular volume, and the red cell distribution width can
provide valuable diagnostic information. Once the diagnosis is established,
upper and lower gastrointestinal endoscopy is usually indicated. Nevertheless,
in many cases a gastrointestinal source is not found after routine evaluation.
Additional studies, including repeat upper and lower endoscopy and often
investigation of the small intestine may thus be required. Although oral iron is
inexpensive and usually effective, there are many gastrointestinal conditions
that warrant treatment of iron deficiency with intravenous iron.
Sant-Rayn S Pasricha (2010), stated that Iron deficiency anemia (IDA) remains prevalent in Australia and worldwide, especially among high-risk groups.

Iron Deficiency Anemia may be effectively diagnosed in most cases by full blood examination and serum ferritin level. Serum iron levels should not be used to diagnose iron deficiency.

Although iron deficiency may be due to physiological demands in growing children, adolescents and pregnant women, the underlying cause(s) should be sought. Patients without a clear physiological explanation for iron deficiency (especially men and postmenopausal women) should be evaluated by gastroscopy/colonoscopy to exclude a source of gastrointestinal bleeding, particularly a malignant lesion. Patients with IDA should be assessed for celiac disease. Oral iron therapy, in appropriate doses and for a sufficient duration, is an effective first-line strategy for most patients. In selected patients for whom intravenous (IV) iron therapy is indicated, current formulations can be safely administered in outpatient treatment centers and are relatively inexpensive. Red cell transfusion is inappropriate therapy for IDA unless an immediate increase in oxygen delivery is required, such as when the patient is experiencing end-organ compromise (eg, angina pectoris or cardiac failure), or IDA is complicated by serious, acute ongoing bleeding. Consensus methods for administration of available IV iron products are needed to improve the
utilization of these formulations in Australia and reduce inappropriate transfusion.

**Breymann, et al (2010),** stated that Iron-deficiency anemia during pregnancy and postpartum occurs frequently and may lead to severe maternal and foetal complications. New treatment regimens include intravenous iron administration in particular clinical situations. The aim of the study was to determine optimal diagnostic and therapeutic approaches to iron-deficiency anemia during pregnancy and postpartum. The evidence from data available from published studies and recommendations regarding diagnosis and treatment were reviewed. As conclusions, recommendations are given by an expert panel. The results show that during pregnancy, oral iron therapy is given as first-line treatment. In cases with lack of efficacy, unwarranted side effects or very low hemoglobin values, intravenous iron treatment with iron carboxymaltose is a preferable alternative, although data regarding safety are limited. In the postpartum period, hemoglobin values less than 95 g/L are treated ideally by intravenous carboxymaltose, leading to more rapid hemoglobin recovery. The study concluded that new intravenous iron preparations such as iron carboxymaltose have an excellent efficacy, side effect profile and advantages as compared to oral iron preparations for particular clinical indications.

**Reveiz L, (2012)** reported that, when the blood has insufficient red cells, or the red cells carry insufficient hemoglobin to deliver adequate oxygen to the tissues, this is called anemia. There is normally a reduction in the hemoglobin
concentrations in the mother's blood during pregnancy, and this allows a better blood flow around the womb (uterus) and to the baby. This is sometime called physiological anemia and needs no treatment. True anemia, however, can be mild, moderate or severe and can cause weakness, tiredness and dizziness. Severe anemia makes women at risk of cardiac failure and is very common in low-income countries. Anemia has many causes including a shortage or iron, folic acid or vitamin B12. These are all required for making red cells and are available in a good diet. Iron shortage, however, is the most common cause of anemia during pregnancy. Iron treatment can be given by mouth (oral), by injection into the muscle (intramuscular) or injection into the vein (intravenous).

Yi-Bin Chen (2013) stated that, Anemia is a condition in which the body does not have enough healthy red blood cells. Iron helps make red blood cells. When body does not have enough iron, it will make fewer red blood cells or red blood cells that are too small. This is called iron deficiency anemia. Red blood cells bring oxygen to the body's tissues. Healthy red blood cells are made in your bone marrow. Red blood cells circulate through your body for 3 to 4 months. The body parts like spleen remove old blood cells. Iron is a key part of red blood cells. Without iron, the blood cannot carry oxygen effectively. Body normally gets iron through your diet. It also reuses iron from old red blood cells.

AMERICAN SOCIETY OF HEMATOLOGY (2013) stated that Iron-deficiency anemia is diagnosed by complete blood tests. Additional tests may be ordered to evaluate the levels of serum ferritin, iron, total iron-binding capacity,
and/or transferrin. In an individual who is anemic from iron deficiency, these tests usually show the following results:

- Low hemoglobin (Hg) and hematocrit (Hct)
- Low mean cellular volume (MCV)
- Low ferritin
- Low serum iron (FE)
- High transferrin or total iron-binding capacity (TIBC)
- Low iron saturation

The peripheral smear or blood slide may show small, oval-shaped cells with pale centers. In severe iron deficiency, the white blood count (WBC) may be low and the platelet count may be high or low.

Chaim Hershko et al. (2014) reported that, Endoscopic gastrointestinal workup fails to establish the cause of iron deficiency anemia (IDA) in a substantial proportion of patients. In patients referred for hematologic evaluation with unexplained or refractory IDA, screening for celiac disease, autoimmune gastritis, Helicobacter pylori, and hereditary forms of IDA is recommended. About 4% to 6% of patients with obscure refractory IDA have celiac disease, and autoimmune gastritis is encountered in 20% to 27% of patients. Stratification by age cohorts in autoimmune gastritis implies a disease presenting as IDA many years before the establishment of clinical cobalamin deficiency. Over 50% of patients with unexplained refractory IDA have active H pylori infection and, after excluding all other causes of IDA, 64% to 75% of
such patients are permanently cured by *H pylori* eradication. In young patients with a history suggestive of hereditary iron deficiency with serum ferritin higher than expected for IDA, mutations involving iron trafficking and regulation should be considered. Recognition of the respective roles of *H pylori*, autoimmune gastritis, celiac disease, and genetic defects in the pathogenesis of iron deficiency should have a strong impact on the current diagnostic workup and management of unexplained, or refractory, IDA.

**Jemal A Haidar (2009)** conducted a study from June to July 2005 and a systematically selected sub-sample of 970 of these subjects, 15 to 49 years old, were used in this analysis of nutritional anemia. Hemoglobin was measured from capillary blood using a portable HemoCue photometer. For serum ferritin, venous blood from antecubital veins was measured by an automated Elecsys 1020 using commercial kit. Diets were assessed via simplified food frequency questionnaire. The association of anemia to demographic and health variables was tested by chi-square and a stepwise backward logistic regression model was applied to test the significant associations observed in chi square test.

Mean hemoglobin ± SD was 11.5 ± 2.1 g/dL with a 29.4% prevalence of anemia. Mean serum ferritin was 58 ± 41.1 ug/L with a 32.1% prevalence of iron deficiency. The overall prevalence rate of iron deficiency anemia was 18.0%. Prevalence of anemia, iron deficiency, and iron deficiency anemia was highest among those 31-49 years old (*p* < 0.05). Intake of vegetables less than
once a day and meat less than once a week was common and was associated with increased anemia ($p = 0.001$). Although the prevalence of anemia was slightly higher among women with parasitic infestation the difference was not significant ($p = 0.9$). Anemia was significantly higher in women with history of illness and the association was retained even when the variable was adjusted for its confounding effect in the logistic regression models ($\text{AOR} = 0.3; 95\% \text{CI} = 0.17$ to 0.5) signifying that the most probable causes of anemia is nutrition related and to some extent chronic illnesses.

Anu Rammohan, (2011) Examined the influence of vegetarian diet on the risk of developing anemia among Indian women and suggest initiatives for addressing diet-related iron-deficiency anemia. Data on diet, social class, and hemoglobin levels from the nationally representative Indian National Family and Health Survey 2005/06 for a sample of 81,301 women aged 15–49 years using logistic regression models. The study resulted that after controlling for individual-level factors and household level socioeconomic characteristics, daily consumption of meat, fish, and eggs was associated with lower odds of being moderately or severely anemic. The analysis also revealed that economic characteristics such as being from higher wealth quintiles, being in paid employment, and rural residence reduced the odds of having iron-deficiency anemia among Indian women. As a large proportion of Indians subsist on iron-poor vegetarian diets for religious, economic, and cultural reasons, large-scale iron supplementation and fortification of commonly consumed vegetarian
foodstuffs constitute a feasible, culturally appropriate, and cost-effective strategy for addressing this major public health problem. Consumption of cheap iron-rich foodstuffs should be promoted. Effective poverty alleviation and hookworm prevention programs are also important. Large-scale cohort and intervention studies are urgently required to further define the influence of vegetarianism on iron deficiency anemia in India.

**Khalid Mahmood, (2012)** conducted a study on risk factors for iron deficiency anemia among the adult population of the Quetta valley has been investigated. Anemic adult patients, both males and females, who were admitted in the Sandeman Provincial Hospital, Quetta, were invited to participate in this study. After detailed history and examination, preliminary blood tests including full blood counts, platelets count, absolute blood values and blood film examination were done. A clinical diagnosis was made based upon the findings of history, examination and blood tests. In patients suspected to have iron deficiency anemia, serum iron studies (i.e. serum iron, Total iron binding capacity (TIBC) and serum ferritin) were done to confirm the diagnosis. Among the selected anemic patients, 60% were iron deficiency anemic, while 40% were non-iron deficiency anemic. Iron deficiency anemia was more common among females than males, as 70% patients were female and 30% were male. The risk factors were found to be pregnancy (40%), nutritional inadequacy (17%), menorrhagia (9%), hemorrhoids (9%), hook worms (8%), hematuria (2%) and blood loss due to various gastro-intestinal pathologies (15%).