A STUDY ON EFFECTIVENESS OF NUTRITIONAL INTERVENTION IN TREATING IRON DEFICIENCY ANEMIA AND IMPROVING INTELLIGENCE AMONG ADOLESCENT GIRLS

Thesis submitted in
Partial fulfilment for the award of
Degree of Doctor of Philosophy in Nursing

By
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Under the Guidance of
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DECLARATION

I, declare that the thesis entitled A STUDY ON EFFECTIVENESS OF NUTRITIONAL INTERVENTION IN TREATING IRON DEFICIENCY ANEMIA AND IMPROVING INTELLIGENCE AMONG ADOLESCENT GIRLS, submitted for the Degree of Doctor of Philosophy is the record of research work carried out by me during the period from 2008 to 2016 under the guidance of Dr. Mrs. Nalini Jeyavantha Santha M.Sc., (N), Ph.D., and has not formed the basis for award of any degree, diploma, associate-ship, fellowship or other titles in this university or any other university or other similar institution of higher learning.

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Prof.Dr. Mrs. Nalini Jeyavantha Santha
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ABSTRACT

A study to assess the effectiveness of nutritional intervention in treating iron deficiency anemia and improving intelligence among adolescent girls in selected schools of Bangalore.

Background of the study

Anemia affects 50% of the population in India. Iron deficiency anemia is the most common form of malnutrition among children and adolescents. The iron requirement of the body increases during this period. Iron deficiency and iron deficiency anemia among girls and boys appears to be more during the adolescent period due to growth spurt and in girls it remains during their reproductive life. Anemia is associated with lowered physical activity, poor academic performance and impaired cognitive development among adolescents. Nutritional intervention will help in improving hemoglobin level and intellectual level among adolescent girl with anemia.

OBJECTIVES

1. To assess the iron deficiency anemia and intelligence among adolescent girls with anemia.
2. To find out the effectiveness of nutritional intervention on iron deficiency anemia and intelligence among adolescent girls with anemia.
3. To find out the relationship between iron deficiency anemia and intelligence among adolescent girls with anemia.
4. To find out the association between the demographic variables and post test hemoglobin level and intelligence level of adolescent girls with anemia.

**Methods:**

True experimental pre test and post test control group design was used. By using simple random technique, JSS High School, B.E.S High School, Brilliant’s High School and Vivekananda High School were selected.

Samples were adolescent girls with iron deficiency anemia and who fulfilled the eligibility criteria. By using stratified sampling technique, 20 samples were selected from 12 to 13 years, 20 samples from >13 to 14 years and 20 samples from >14 to 15 years in JSS High School, B.E.S High School, Brilliant’s High School and Vivekananda High School. Totally 240 samples were selected. The experimental group was exposed to nutritional intervention. Improving hemoglobin level and intelligence level were main outcome variables, assessed by anemia signs and symptoms by an observation checklist for signs and symptoms of anemia, hemoglobin level by cynmet hemoglobin method, peripheral blood smear by Wedge blood smear test and intelligence level by Malins Intelligence scale for intelligence. Descriptive and inferential statistics were used to analyze the findings.
Results

Major findings of the present study were,

a. In experimental group, 50.8% had mild anemia, 49.2% had moderate anemia in pretest. 40% of adolescent girls had normal hemoglobin level, 33.3% had mild anemia and 26.7% of adolescent girls had moderate anemia in post test II.

b. In control group, 45% of adolescent girls had mild anemia and 55% of adolescent girls had moderate anemia in pretest. 2.5% had normal hemoglobin level, 46.7% had mild anemia and 50.8% of adolescent girls had moderate anemia in post test II.

c. Regarding intelligence, 36.7% of adolescent girls with anemia had borderline, 52.5% had average, 8.3% had superior and 2.5% had very superior intelligence in pretest. 26.7% of adolescent girls with anemia had borderline, 45% had average, 20% had superior and 8.3% had very superior intelligence in post test II in the experimental group.

d. In control group, 35.8% of adolescent girls with anemia had borderline, 51.7% had average, 9.2% had superior and 3.3% had very superior intelligence in pretest and post test II. There is a significant reduction in post intervention II mean scores of anemic sign in experimental group than the control group [‘t’ = 15.767, P<0.001].
e. There is a significant improvement in post intervention II mean scores of hemoglobin level in experimental group than the control group. The mean difference of hemoglobin level was 2.47gm/dl [\( t' = 15.265, \ P<0.001 \)].

f. There is a significant improvement in post intervention II mean value of intelligence level in experimental group than the control group [\( t' = 31.788, \ P<0.001 \)].

g. There is a negative correlation between anemic sign and hemoglobin level in the experimental group \( r = -0.91 \) (at \( P<0.01 \)).

h. There is a positive correlation between hemoglobin level and intelligence level in the experimental group \( r = 0.841 \) (at \( P<0.01 \)).

i. There is a significant association between age in years, educational status, mother’s educational status, father’s occupational status, history of gastritis, peptic ulcer and post hemoglobin level.

j. There is a significant association between mother’s educational status and post intelligence level.

The present study findings concluded that, nutritional intervention was effective in treating anemia and improving intelligence among adolescent girls with anemia.
Recommendations

Nutritional intervention is more effective and can be utilized in community health settings to curb the serious health problem of iron deficiency anemia among adolescent girls.
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CHAPTER - I

INTRODUCTION

Anemia is one of the most common micronutrient deficiencies and a major global problem affecting 20 to 70 percent of the population in various countries. Nutritional anemia is an important public health problem affecting many people in India. The prevalence of anemia is high in all vulnerable groups and in almost all states of the country, irrespective of both rural and urban areas. The most prevalent nutritional and hematologic disorders among adolescent girls are iron deficiency anemia caused by a lack of sufficient iron for the synthesis of hemoglobin (Parathasarathy, 2008).

The term anemia indicates a low red cell count and a below normal hemoglobin or hematocrit level. Anemia can be defined as a reduction in hemoglobin concentration, hematocrit or red cell mass. According to the WHO grading of anemia, hemoglobin level (Hb) between 10gm/dl to 12gm/dl is known as mild anemia, Hb level between 7gm/dl and 10gm/dl is known as moderate anemia and Hb level below 7gm/dl is known as severe anemia.

According to WHO/UNICEF/UNC (2012) anemia affects 1.62 billion people globally in which 24.8% are anemic adolescents. Iron deficiency anemia is a significant and an important issue in children between 10 to 20 years, which affects more than 15% of adolescents. Anemia is one of the
most common health problems in India which is much more prevalent in the rural than in the urban areas.

Nutrition is one of the significant indicators of the health and the overall status of adolescents. Adolescence is a period of transition between childhood and adulthood, is a golden period, period of dreams and a period to live out their role models, a time of rapid physical, cognitive, social and emotional maturation as the boy prepares for manhood and the girl prepares for womanhood. In this period, adolescence begins with the gradual appearance of secondary sex characteristics at about 11 to 12 years and cessation of body growth occurs at 18 to 20 years (Vijaya Lakshmi, 2013).

The World Health Organization (WHO) defines adolescence both in terms of age (spanning the ages between 10 and 19 years) and in terms of a phase of life marked by special attributes. There are three main stages of adolescence can be discerned (i) Early adolescence (9 – 13 years), (ii) Mid adolescence (14 –15 years), (iii) Late adolescence (16 – 19 years). Adequate nutrition is more important for the growth of an adolescent. Poor nutrition causes micronutrient deficiency on particularly under-nutrition, obesity, anorexia and delay in the onset of puberty.

Damayanthi, Seema, Jayanth Kumar (2015), carried out a study to assess the prevalence of anemia among 220 adolescents aged between 10-19yrs (both male and female) in Bangalore. Hemoglobin was estimated by
using Sahli’s hemoglobinometer. The overall prevalence of anemia was 47.7%. The majority of the adolescents had moderate anemia (60%), mild anemia (38.1%) and severe anemia (1.9%). There was a significant association between anemia and its factors such as menorrhagia, history of passing of worm in the stools which were statistically significant.

In developing countries, adolescent girls constitute a vulnerable group, where they traditionally marry at an early age and exposed to a greater risk of reproductive morbidity and mortality rate, high incidence of low birth weight babies, high perinatal mortality and high fertility rates. 17% of adolescent girls are considered to be at nutritional risk due to the rapid growth and changes in biological, social, psychological and cognitive aspects. Iron deficiency anemia is the most common problem among adolescent girls due to lack of nutrient intake and poor dietary habit.

Anemia can be classified according to the red blood cell changes. The classifications are (i) hypochromic, microcytic – iron deficiency anemia and thalassemia (ii) normochromic, macrocytic – vitamin B_{12} or folate deficiency, myelodysplasia, polychromatophilic, (iii) macrocytic – hemolysis, (iv) normochromic, normocytic – chronic disorders, renal failure diseases of the bone marrow, (v) leucoerythroblastic – myelofibrosis, leukemia, metastatic carcinoma (Warrell, 2013).
Red blood cells (RBC) are highly specialized for their oxygen transport function. Each one contains about 280 million hemoglobin molecules. A hemoglobin molecule consists of a protein called globin and nonprotein pigments called hemes. Each heme contains an iron ion that can combine reversibly with one oxygen molecule. The oxygen is transported to other tissues of the body. In the tissues, the iron-oxygen reaction reverses. The hemoglobin releases oxygen, which diffuses into the interstitial fluid and from there into cells. Normal values for hemoglobin are 14 to 20g/100 ml of blood in infants, 12 to 15g/100 ml in adult females, and 14 to 16.5g/100ml in adult males. A healthy male has about 5.4 million/mm$^3$ of red blood cells of blood and a healthy female has about 4.8 million. The process of erythrocyte formation is called erythropoiesis. Normally, erythropoiesis and red blood destruction proceeds at the same pace. If the oxygen carrying capacity of the blood falls, because erythropoiesis is not keeping up with RBC destruction, negative feedback system steps up erythrocyte production. The controlled condition is the rate of oxygen delivery to body tissues. Oxygen delivery may fall due to anemia, a lower than normal of RBCs or quantity of hemoglobin, or circulatory problems that reduce blood flow to tissues (Tortora, 1992).

Iron deficiency anemia is caused by insufficient iron supply, increased demand of iron, insufficient iron intake, impaired iron absorption and blood
loss. Insufficient intake of dietary iron and socioeconomic status is the common cause for iron deficiency anemia. The signs and symptoms of anemia are unusual tiredness, dizziness, headache, paleness of conjunctiva, nail and skin, weakness, irritability, fatigue, anorexia, flattened and brittle nails, pica, reduced muscular endurance, shortness of breath and palpitations, delayed growth and development (Marlow, 2002).

Wang (2013) had done a correlational study on iron deficiency and fatigue in adolescent females with heavy menstrual bleeding. The study populations were 11 to 17 year-old menstruating females. Ruta Menorrhagia Severity Score and Fatigue Severity Scale were used to evaluate the degree of menstrual blood loss and the symptoms of fatigue. A total of 48 adolescents with heavy menstrual bleeding (HMB) and 102 healthy adolescents were included as study participants. Iron deficiency and fatigue were common in young women with heavy menstrual bleeding (HMB). Both fatigue severity scores and menorrhagia severity scores were significantly higher in young women with HMB as compared to healthy controls. In adolescents with heavy menstrual bleeding (HMB), 87.5% had ferritin levels ≤40 ng ml$^{-1}$, and 29.2% had ferritin levels ≤15 ng ml$^{-1}$.

Iron plays an important role in the brain development. Iron deficiency caused irreversible effects on brain development and behavior of an adolescent. Iron deficiency anemia adolescents have lack of concentration,
impaired thinking, memory, short attention span, poor stamina, poor school performance and behavioral problems. Five to ten point deficiency occurs in intelligence quotient in anemic adolescent girls (American Society of Hematology).

Complications of iron deficiency anemia are delayed growth and development, shortened attention span, learning disabilities, decreased social interaction, lead poisoning, infections and behavioral problems.

An essential nursing responsibility is instructing the parents about consumption of iron rich diet. A primary nursing objective is to prevent nutritional anemia through family education. Diet education of teenagers is especially difficult, because teenage girls are particularly prone to follow a weight reduction. Emphasis should be given about the consumption of iron rich foods in treating iron deficiency anemia and its prevention. The nurse has an important role in treating iron deficiency anemia and reducing the morbidity rate.
NEED FOR THE STUDY

Globally iron deficiency anemia is one of the most prevalent nutritional problem and a widespread public health problem in developing countries. More than two billion populations in the world are affected by iron deficiency anemia (Nirmala and Sathya, 2011).

Worldwide the adolescent population was 1.2 billion aged between 10 and 19 years. India is the second most populous country in the world with total population of over 1220 million and adolescents form a large section of the population at the rate of 22.5%, that is, about 275 million as per the census data.

Sharma, Malhotra, & Gupta, (2008) stated that adolescence have a greater influence by peer group, mass media, socio economic and cultural factors, internal factors such as physiological needs, body image, self concept, food preference and personal values, beliefs towards their health and nutrition. Adolescent girls have a desire to be thin and try to reduce weight even when there is no need. So they look for a diet which can help them to reduce weight. Due to this about 10% of adolescents have low iron stores and related anemia.

Adolescents of 11 to 17 years age group have a peak incidence rate. The occurrence of various symptoms and signs depends on the severity of anemia, which are due to diminished supply of oxygen to different tissue
and organs. Initial symptoms are fatigue and lassitude, breathlessness on exertion, headache and pallor. Iron deficient children are restless, disruptive, irritable, poor attention span, memory, concentration, cognitive impairment and academic performance because of poor synthesis of iron content, distribution of iron in the brain cells and catabolism of neurotransmitters (dopamine, norepinephrine, and serotonin) caused by reduction in activity of monoaminooxidase and aldehyde oxidase enzymes (Nelson, 2005). The USAID/OMNI/PCD reported that iron supplementation resulted in significant improvement in school measurements of verbal and other measurable skills among primary school children and adolescents.

NFHS-III (2011-2012) had undertaken a study to estimate the prevalence of anemia among adolescents in seven states of India. 72% of adolescent girls are being anemic in Assam, 69.7% in Haryana and 68.4% in Jharkhand. A total of 84% girls and 92.2% women were anemic with severe anemia in 9.2% and 7.3% respectively; 39.2% and 27.3% in Madhya Pradesh had severe anemia. The prevalence of anemia in young girls at Karnataka was 34.82% and higher in rural areas.

As per WHO Global Database on Anemia in Geneva (2013), anemia affects 1.62 billion in the general population (95%, CI: 1.50-1.74 billion), which corresponds to 24.8% of the pediatric population (95%, CI: 22.9-26.7%. The highest prevalence was 47.4% in adolescent age group (95%,
CI: 45.7-49.1). The World Health Organization estimated that about 30% of the world’s population suffers from anemia. The highest prevalence in adolescents was 30-55%.

The WHO (2014) estimated the worldwide prevalence of anemia by regions and population groups. Globally, the prevalence of anemia fell from 33% to 29% in adolescent between 1995 and 2011. The prevalence was higher in South East Asia (46%) and Central and West Africa (48%). In the Middle East region, the prevalence of anemia is ranged from 14% to 42% among adolescence (INACG, 2014). Iron deficiency is the most prevalent nutritional deficiency in the United States affecting 9 to 16% of female adolescents (Sekhae, 2015). The United states Department of Health and Human Services has set a target of reducing iron deficiency by 10 percent in 2020.

In India, 55% of women and 70% of children and adolescent suffer from anemia (Millennium Development Goals, 2015). UNICEF 2015 reported that 56% of female adolescents had anemia in India.

Treatment of iron deficiency anemia with medicinal iron either in the form of pills or tablets, administration of hormones, erythropoietin and chelation therapy has been used for a long time, produces some side effects such as constipation, diarrhea, vomiting and discolouration of teeth. The other alternative therapy in treating anemia is consumption of iron rich
diet. Foods rich in iron include red meat, beans, dark green leafy vegetables, dried fruits and iron fortified cereals. Vitamin ‘C’ enhances absorption of iron in the food (Wongs, 2005).

Rice flakes are simple breakfast in many part of South India, is a powerhouse of iron. Rice flakes are rich in vitamins and minerals like niacin, vitamin D, calcium, fiber, iron, thiamine and riboflavin. Eating rice flakes regularly can prevent iron deficiency anemia. It helps to improve hemoglobin level and also builds immunity. Jaggery is very healthy because of its wholesome sugar, and its non chemical refinement. Jaggery is rich in iron, sucrose, minerals, salts, and fiber. Consumption of jaggery helps to reduce iron deficiency anemia, eases premenstrual syndrome by releasing endorphins, which offer relief in pre-menstrual syndrome and boosts immunity (Sreelakshmi, 2005).

Amla or Indian gooseberry is one of the important indigenous fruits of the Indian subcontinent. Amla is well known for its medicinal and nutritional qualities. Amla fruit is acidic, cooling, diuretic and laxative. It is used for treating anemia, diarrhea, dysentery, fever, common cold and jaundice (Singh, 2003).

If iron deficiency anemia is not treated, it will lead to complications. People who have anemia are more likely to have heart problems. Anemia leads to arrhythmias, heart failure, damage to other organs due to lack of
oxygen supply, severe loss of fluid can be life threatening (National Heart Lung and Blood disorders).

The nurse has a major role in identifying the prevalence of anemia among high risk populations. An important nursing goal is educating the adolescent girls and parents about iron deficiency anemia and its prevention. Parents and adolescents should also be counseled about the dietary intake of iron. They can be taught about the iron rich foods and then help them to plan meals with iron rich foods. When guiding parents and adolescents, the nurse must take into consideration their financial resources and their cultural food preferences. If the parents and adolescents are resistant to dietary change, the nurse can explain how a diet containing iron can improve the health of all family members. The prevalence of anemia is higher among adolescent girls. So many studied had proven that iron deficiency anemia had highest prevalence rate in developing and developed countries among adolescents. In Karnataka, the prevalence of iron deficiency anemia is higher. So many studies had proven that iron supplementation will increase hemoglobin, memory, concentration and good academic performance. But studies related to the effectiveness of iron rich foods in treating iron deficiency anemia are very less. So the investigator decided to find out the effectiveness of nutritional balls containing iron rich foods (rice flakes and jaggery) along with amla.
rich in vitamin ‘C’ (for absorption) in treating iron deficiency anemia and assessing the improvement in intelligence.

**STATEMENT OF THE PROBLEM**

A study on effectiveness of nutritional intervention in treating iron deficiency anemia and improving intelligence among adolescent girls.

**OBJECTIVES**

1. To assess the iron deficiency anemia and intelligence among adolescent girls with anemia.

2. To find out the effectiveness of nutritional intervention on iron deficiency anemia and intelligence among adolescent girls with anemia.

3. To find out the relationship between iron deficiency anemia and intelligence among adolescent girls with anemia.

4. To find out the association between the demographic variables and post test hemoglobin level and intelligence level of adolescent girls with anemia.
EMPIRICAL HYPOTHESIS

Hypothesis was tested at 0.05 level of significance.

H₁ - The mean post test anemic sign of adolescent girls with anemia in experimental group who had nutritional intervention will be significantly lower than the mean pre test anemic sign.

H₂ - The mean post test anemic sign of adolescent girls with anemia in the experimental group who had nutritional intervention will be significantly lower than the mean post test anemic sign of the control group.

H₃ - The mean post test hemoglobin level of adolescent girls with anemia in experimental group who had nutritional intervention will be significantly higher than the mean pre test hemoglobin level.

H₄ - The mean post test hemoglobin level of adolescent girls with anemia in the experimental group who had nutritional intervention will be significantly higher than the mean post test hemoglobin level of the control group.

H₅ - The mean post test intelligence level of adolescent girls with anemia in experimental group who had nutritional intervention will be significantly higher than the mean pre test intelligence level.
H₆ - The mean post test intelligence level of adolescent girls with anemia in the experimental group who had nutritional intervention will be significantly higher than the mean post test intelligence level of the control group.

H₇ - There will be a significant relationship between anemic sign and hemoglobin level of adolescent girls with anemia.

H₈ - There will be a significant relationship between the hemoglobin level and intelligence level of adolescent girls with anemia.

H₉ - There will be a significant association between the post test hemoglobin level and selected demographic variables of adolescent girls with anemia in the experimental and control group.

H₁₀ - There will be a significant association between the post test intelligence level and selected demographic variables of adolescent girls with anemia in the experimental and control group.

**OPERATIONAL DEFINITIONS**

**Effectiveness**

It refers to the outcome of administering nutritional intervention on hemoglobin and intelligence among adolescent girls which will be measured by monitoring the anemic status by using observation checklist on signs and symptoms of anemia, estimation of hemoglobin by cynmet hemoglobin estimation method, peripheral blood smear by wedge blood smear test and to assess the intelligence by using MALIN’S intelligence evaluation method.
scale. It is the difference in the mean post test hemoglobin level and intelligence score between the experimental and the control group.

**Nutritional intervention**

It refers to the administration of 100 gms of nutritional ball which is made by the mixture of 60 gms of roasted rice flakes and 40 gms of jaggery. It provides 13.14 mgs of iron. For the absorption of iron, vitamin C that is 4gms of amla fruit powder was given. The researcher had administered the nutritional ball from Monday to Friday in the afternoon (12pm - 2pm) with the supervision of the school teacher for eight weeks period.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of foodstuffs</th>
<th>Iron</th>
<th>Vitamin C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rice flakes (60 gms)</td>
<td>12mg</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Jaggery (40 gms)</td>
<td>1.1mg</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Amla fruit powder (4 gms)</td>
<td>0.048 mg</td>
<td>24 mg</td>
</tr>
</tbody>
</table>

**Recommended daily intake of Iron and Vitamin C for adolescent girls**

Iron – 10mgs to 15mgs/day

Vitamin C – 20-30mgs

100gms of Nutritional Ball provides 13.14 mgs of iron and 24 mgs of Vitamin C
Iron Deficiency Anemia

Iron deficiency anemia is characterized by a defect in hemoglobin synthesis, resulting in red blood cells that are abnormally small (microcytic) and contain a decreased amount of hemoglobin.

In this study, Iron deficiency anemia is characterized by positive signs of anemia as measured by observation checklist on signs and symptoms of anemia, hemoglobin level less than 12 grams percentage (WHO) as measured by cynmet hemoglobin method, peripheral blood smear by wedge blood smear test to identify hypochromic and microcytic anemia.

Cynmet Hemoglobin Method

Blood is diluted with a dilute solution of potassium ferricyanide and potassium cyanide at a slightly alkaline pH. The ferricyanide converts the hemoglobin to methemoglobin. The cyanide then reacts with the methemoglobin to form the stable cyanmethemoglobin. The color intensity is measured in a spectrophotometer at a wavelength of 540 mm. The optical density is proportional to the concentration of hemoglobin (Heiserman, 2015).
In this study, 20 micro liter (µl) of blood is added to tubes containing 5ml of drabkins solution mixed level and analyzed with a photoelectric calories meter using optical density as a comparative measure.

**Intelligence**

Intelligence consists of the application of such intellectual capacities as observing, understanding and thinking, remembering, in handling a situation or accomplishing a task.

It includes the assessment of verbal and performance of the adolescent girls. In verbal, general information, arithmetic, similarities and digit span were assessed and in performance, picture completion, coding, object assembly and maize were assessed.

**General information**

In this study, 24 questions were used to assess the general knowledge of adolescent girls with anemia about nature, geography and historical event.

**Arithmetic**

13 arithmetic questions were asked with time limitation to adolescent girls with anemia to assess the mathematical reasoning and computation skills.
Similarities

12 items were used to assess the knowledge of adolescent girls with anemia on detecting relationships or likeness among two words.

Digit span

In this study, adolescent girls were orally given sequence of numbers and asked to repeat them, either as heard and in reverse order.

Picture completion

Adolescent girls were shown with 20 art work of common objects with a missing part, and asked to identify the missing part by pointing and/or naming.

Object assembly

In this, piece of the object will be given to the adolescent girl with anemia and they have to put the pieces into a jigsaw like puzzle together correctly.

Coding

In this study, adolescent girl with anemia learning to use a coding system in which non-sense symbols represent numbers. The task is time-limited with bonuses for speed.

Adolescent Girls with anemia

Adolescent age is the age group between 12 and 15 years and who had a low hemoglobin level of 7 to 12 grams/dl.
ASSUMPTIONS

1. Incidence of iron deficiency anemia is higher in adolescent girls.
2. Iron deficiency anemia impairs thinking, memory, concentration and behavioral problems in adolescence.
3. Assessment of iron deficiency anemia is an important function of the nurse.
4. Early assessment and treatment of iron deficiency anemia in adolescent girls may help in the reduction of morbidity and mortality.
5. Nutritional intervention improves hemoglobin level and intelligence.

DELIMITATIONS

1. The data collection period is limited to a period of six months.
2. The study sample is restricted to adolescent girls in the age group between 12 and 15 years.
3. Adolescent girls whose hemoglobin levels are less than 12gms percentage were chosen as study samples.

PROJECTED OUTCOME

1. The study findings will help the nursing personnel to confirm the effectiveness of nutritional intervention in improving the hemoglobin level and intelligence.
2. It also helps the nursing personnel to develop an approach to determine the level of intelligence through MALIN’S intelligence scale.
CONCEPTUAL FRAMEWORK

This is based on J.W Kenny’s open system model. All living organisms are open that, there is a continual exchange of matter, energy and information. Open system has varying degrees of interaction with the environment, from which the system receives the input and given back in the form of matter, energy and information.

The main concepts of the open system model are input, throughput, output and feedback. The open system theory input refers to energy, matter and information, throughput refers to processing, where the system transforms the energy, matter and information and output refers to the energy, matter and information that are processed. Feedback refers to the environmental responses to the system output used by the system.

In this study, adolescent girls suffer with iron deficiency anemia before the administration of nutritional intervention with amla powder.

Input:

The input was the administration of nutritional ball (mixture of 60 gms of roasted rice flakes with 40 gms of jaggery) along with 4gms of amla fruit powder to adolescent girls with anemia.

Throughput:

The throughput was the mechanism by which iron from nutritional ball is absorbed and combined with globin to form hemoglobin.
Output:

The output was the effectiveness of the nutritional ball in the improvement of hemoglobin and intelligence level of adolescent girls with anemia.
Assessment of anemic adolescent girls by demographic data such as age, educational level, educational level of the mother & father, family income, residence, menstrual history, history of gastritis and medicine, deworming. Anemic sign using observation checklist on signs and symptoms of anemia, hemoglobin level by cyanmet hemoglobin method, peripheral blood smear and intelligence by MALIN'S intelligence scale.

In Experimental Group
After deworming administration of nutritional ball (60gms of roasted rice flakes and 40gms of jaggery) and 4gms of amla fruit powder
Iron in nutritional ball is absorbed with the help of vitamin C in amla fruit powder and increases the hemoglobin status and improves the intelligence level of the anemic adolescent girls

In Control Group
No intervention for control group
No transformation in iron absorption and hemoglobin status
No Improvement in the hemoglobin level and intelligence level

* Feedback is excluded in the study

FIGURE 1: CONCEPTUAL FRAMEWORK BASED ON J.W.KENNY’S MODEL
CHAPTER II

REVIEW OF LITERATURE

Review of literature is an important step in which an exclusive and extensive research on the concerned topic is done to gather relevant information.

This chapter presents a review of selected literature relevant to the present study. Review of literature is an important step in the development of the research project. The investigator had carefully reviewed literature based on the objectives of the study. The present study aimed to explore the effectiveness of nutritional intervention in improving the hemoglobin and intelligence level of adolescent girls with anemia. Review further helps in developing the broad conceptual content in which the problem fits the methodology and construction of the tool, the development of an instrument module and analysis of the data.

An extensive review of related research and non research literature was undertaken and an attempt was used to organize the material.

The review of literature is organized under the following headings: Section I: Studies related to overview of iron deficiency anemia
   a. Prevalence of iron deficiency anemia
   b. Causes and Risk factors of iron deficiency anemia
   c. Signs and symptoms of iron deficiency anemia
Section II: Studies related to iron deficiency anemia and cognitive development.

Section III: Studies related to management of iron deficiency anemia

Section IV: Studies related to Nutritional intervention and for iron deficiency anemia

Section I: Studies related to overview of iron deficiency anemia

a. Studies related to prevalence of iron deficiency anemia

Devi, Deswal, & Verma, (2015) observed the prevalence of anemia among 320 adolescent girls in Haryana. The overall prevalence of anemia was 73%, in that 54% were found with mild anemia, 18% of girls had moderate anemia and 1% of girls were severely anemic among study subjects.

Nelima (2015) has done a study to determine factors associated with the prevalence of anemia among adolescent females aged 14-18 years in Kenya. A multistage sampling technique was used to select 230 adolescent girls. To assess anemia, blood and stool samples were taken. Questionnaires were used to collect the data. The prevalence was 17.4% had mild, 7.4% had moderate and 1.7% had severe anemia. The respondents who suffered from mild and moderate anemia were 93.5% of the total study participants.
Thomas, Chandra, Sharma, Jain, & Pemde, (2015) carried out a cross-sectional study among 200 adolescents aged between 10 to 18 years to determine the association between severity of anemia and demographic variables. Dietary intake and serum levels were analyzed. 30.5% and 79.5% had iron and folate deficiency respectively. There was a significant association observed between severity of anemia and serum levels, iron and folate intake, vegetarian diet, attainment of menarche and history of worm infestation.

Indian Council of Medical Research (2014) stated that the prevalence of anemia was high (90.1%) among 11 to 18 years of children with less than 7gms of hemoglobin level.

Murthy et al., (2014) had done a study on risk factors of iron deficiency anemia among 5 to 15 years children in Bangalore. 372 children participated in this study. Complete blood count and serum ferritin level were analyzed to find out iron deficiency anemia. The prevalence of iron deficiency anemia was 13.9% of which 9.1% had mild anemia. There was a significant correlation between lower body mass index (BMI), vegetarianism and anemia. No association was found between age, gender, socioeconomic status and anemia.

Deshpande, Karva, Agarkhedkar, & Deshpande, (2013) conducted a study on prevalence and its risk factors of anemia in adolescent girls. 1000
adolescent girls were included in the study between 12 and 15 years of age. The prevalence of anemia was high (30%) among low socioeconomic status adolescent girls. 2% of adolescent girls had mild anemia and 28% had moderate anemia.

Dubey et al., (2013) conducted a retrospective study in South-Western Nepal to determine the prevalence of anemia in adolescent females. Cynmet hemoglobin method was used for determination of hemoglobin level. Out of 1888 subjects, 793 adolescents were diagnosed as anemic. The prevalence of anemia among the adolescent population was 42%. 59.14% of adolescent girls were mildly anemic, 30.02% were moderately anemic and 8.82% were severely anemic.

Balci, Karabulut, Gurses, & Covut, (2012) conducted a study to estimate the prevalence and risk factors of anemia among adolescents in Turkey. 1120 adolescents (672 girls and 448 boys), aged 12 to 16 years participated in this study. The overall prevalence of anemia was 5.6%, 8.3% in adolescent girls and 1.6% in adolescent boys. This study concluded that there was a significant association between dietary habits, irregular dietary pattern and fear of gaining weight and anemia.

Biradar, Biradar, Alatagi, Wantamutte, & Malur, (2012) assessed the prevalence and the severity of anemia among adolescent girls in Belgaum. 840 adolescent girls (10-19 years of age) were included in this study. Data
were analyzed by collecting socio demographic variables and blood sample for estimation of hemoglobin level. The overall prevalence of anemia was 41.1%. In that 0.6% had severe anemia, 6.3% had moderate anemia and 34.6% had mild anemia. The prevalence of anemia was higher in girls who belong to low socioeconomic status.

Ramzi et al., (2011) conducted a cross sectional study among 363 adolescent girls. Socioeconomic, demographic and related risk factors were obtained by questionnaire. Hematological parameters and serum iron indices were estimated. The findings revealed that 5.8% had anemia and 8.5% had iron deficiency and 1.7% had iron deficiency anemia. 85.7% of the girls had mild anemia.

b. Studies related to causes and risk factors of iron deficiency anemia

Al-Zabedi et al., (2014) carried out a cross sectional study to assess the prevalence and risk factors of iron deficiency anemia (IDA) among 187 children aged below 15 years from rural areas. The overall prevalence of anemia and iron deficiency anemia was 48.7% and 34.2%. The study findings showed that there was a significant association between iron deficiency anemia and gender, parental education, income, parasitic infections.
Gupta, Parashar, Thakur, & Sharma, (2013), had done a study to find out the associated factors of anemia. The results showed that the prevalence of anemia was 21.4% among adolescent girls, 77.3% had mild anemia, 21.9% had moderate anemia and 0.5% had severe anemia. There was no association between BMI and onset of menarche with anemia, but the association was found between age, urban residence and anemia.

Queiroz et al., (2013) conducted a study on iron status and Helicobacter pylori infection in children. A total of 311 children had participated in this study. The prevalence of H.pylori infection was 27.7% being significant predictor of low ferritin and hemoglobin concentrations in children. The study concludes that H.pylori infection in children influences the serum ferritin and hemoglobin concentrations, markers of early depletion of iron stores and anemia respectively.

Vendt et al., (2011) had done a study to find out the relationship between iron deficiency and Helicobacter pylori (H.pylori) infection in school aged children. The results revealed 17% were suffering from iron deficiency and 5% had iron deficiency anemia. There was a positive correlation between H.pylori and iron deficiency anemia.

Kabir, Shahjalal, Saleh, & Obaid, (2010) carried out a study on dietary pattern, nutritional status, anemia and anemia related knowledge in
urban adolescent girls. Sixty-five adolescent girls aged between 15 and 19 years were randomly selected. The prevalence of anemia among the participants was 23%. 65% had adequate knowledge about the causes of anemia, 72.3% and 80% had knowledge about the prevention and treatment of anemia respectively. 73.8% were not aware about the sources of iron rich foods.

Bharati, Shome, Chakraborty, Bharati, & Pal, (2009) had done a study on socioeconomic determinants of anemia among adolescent girls. The highest prevalence of anemia (99.9%) was observed among the study subjects. The highest prevalence was observed between 15 and 19 years, illiterate household girls living in rural areas and low socioeconomic status.

Eftekhari, Khosravi, & Shidfar, (2009) conducted a study to investigate the association between iron (Fe) deficiency and weight status among adolescent girls. 431 adolescent girls aged between 13 and 20 years were included in the study. The findings revealed that 15.3% of subjects were at risk of overweight and 9.5% of them were overweight. Anemia was more prevalent among adolescent girls with overweight.

Chaudhary and Dhage (2008) estimated the prevalence of anemia and found to be 35.1% among adolescent girls and there was a significant association between socioeconomic status and literacy status of parents.
El-Hioue et al., (2008) conducted a study to determine the prevalence of anemia and its associated factors of iron deficiency anemia among children. 295 children aged between 6 and 16 years had participated. The results reviewed that the overall prevalence of anemia was 12.2% and 20.4% had iron deficiency anemia. There was a significant relationship between education of the mother and anemia.

Bulliya, Sethy, Mallick, & Kar, (2007) conducted a cross sectional study among 1937 healthy adolescent girls aged 11-19 years on the anemic status of adolescent girls in Orissa. The study findings revealed that the prevalence of anemia was high among adolescent girls (96.5%) with a hemoglobin level less than 12gms/dl. 45.2% had mild anemia, 46.9% had moderate anemia and 4.4% had severe anemia. There was a significant positive association between hemoglobin and pre-menarche, educational level of girls, family income, body mass index and mid-arm circumference.

Goel and Gupta (2007) conducted a study of prevalence of anemia among adolescents of an urban hilly community. A total of 870 adolescents participated in this study. 12.9% males, 13.3% females were identified with anemia by signs and symptoms. The overall prevalence of anemia was 13.1%. With regard to personal hygiene, history of worm infestation, 77.4%
males and 63.5% females had poor personal hygiene and 23% males had a history of worm infestation.

Kaur, Deshmukh, & Garg, (2006) had done a cross sectional study of epidemiological correlation of anemia among adolescent girls in the age group of 13 to 19 years. 630 subjects were included in this study. Hemoglobin estimation was done by using the cynmet hemoglobin method. The prevalence of anemia was 59.8% and that there was a significant association between low socioeconomic status, low iron intake, vegetarian diet, history of worm infestation and history of excessive menstrual bleeding and iron deficiency anemia.

Srihari, Eilander, Muthayya, Kurpad, & Seshadri, (2006) reviewed on nutritional status of Indian school children aged between 6 and 18 years from middle and high socioeconomic status at Bangalore. The result showed that the prevalence of anemia ranged from 19 to 88%, overweight was 8.5 to 29% and obesity was 1.5 to 7.4% among the subjects.

c. Studies related to signs and symptoms of iron deficiency anemia

Ranganath and Debata (2015) conducted a cross sectional study among 370 adolescent girls aged between 10 and 19 years in Bangalore. Data were collected by 24 hrs recall dietary recall method and assessed
the anemic status and relevant clinical examination. The findings were 44.7% had pallor and 78.1% had fatigue.

Jarjour and Jarjour (2013) carried out a study on low iron storage and anemia in postural tachycardia syndrome among adolescents. The results revealed that twenty four children had postural tachycardia syndrome (PTOS) aged between 12 and 18 years, 17 out of 24 were females. Patients with postural tachycardia syndrome had higher prevalence of low iron storage, iron deficiency and iron deficiency anemia.

Humphreys, Liang, Nemeth, Freels, & Braunschweig, (2009) conducted a cross sectional study on finding out the relationship between iron status and excess adiposity. The study findings indicated that the overweight among adolescent girls were at greater risk for iron deficiency.

Goel and Gupta (2007) observed the prevalence of anemia among adolescent aged 10 to 19 years. 870 students had participated in this study. Semi structured interview schedule was used to assess the demographic data and they were clinically examined for the signs and symptoms of anemia. The overall prevalence of anemia was 13.1%. Based on clinical examination, 12.9% males and 13.3% females had anemia. The prevalence was higher among 10 to 13 years of age in both males and females. 53.6% had menstrual problems like menorrhagia, polymenorrhea and irregular menstrual cycle, 23% boys and 84.6% girls had a history of
worm infestation and 77.4% boys, 63.5% girls had poor personal hygiene. The signs and symptoms of anemia such as headache, fatigue, dyspnoea, paresthesia and syncopal attacks were significantly higher in both genders.

Hegde, Rich, & Gayomali, (2006) stated that iron deficiency anemia is the most common form of nutritional anemia in both developed and developing countries. Mild anemic cases were asymptomatic, dyspnoea and fatigue were common in moderate anemic cases and severe iron deficiency can lead to left ventricular dysfunction and overt heart failure.

Mansson, Johansson, Wiklund, Baigi, & Marklund, (2005) assessed the symptom of anemia in adolescent girls. Study subjects were screened for anemia by blood investigation, questionnaire on the anemia and Interventional treatment of iron for three months. The result was 12% of the subjects had iron deficiency and 6.1% of subjects had abnormal value of one or more laboratory test. Symptoms of vertigo, dizziness were significantly more common in subjects with iron deficiency. After supplementation of iron there was a significant increase in serum ferritin levels, decrease in serum transferrin levels and significant reduction of vertigo, dizziness, irritability and depressive symptoms.

Kalayci, Kanber, Birinci, Yildiz, & Albayrak (2005) assessed the prevalence of anemia in celiac diseases. There were 135 adolescent with
iron deficiency anemia in group-I and 223 healthy adolescent without iron deficiency anemia in the group-II. This study concluded that the prevalence of celiac disease was high in iron deficiency anemia.

Section II: Studies related to iron deficiency anemia and cognitive development

Iron deficiency causes impairment in cognitive performance, lowered work capacity, lower immunity to infections. Iron is important for biological, neurological functioning and development. The biological basis of the behavioral and cognitive development delays observed in iron deficient adolescence is not completely understood, but includes abnormalities in neurotransmitter metabolism, decreased myelin formation and alteration in brain energy metabolism.

Ukkirapandian, Natarajan, Prassanaraghavan, Mohan, & Selvam, (2014) had done a descriptive cross sectional study on the effects of iron deficiency anemia on cognitive function. Mini Mental Status Examination (MMSE), Wechsler memory scale (WMS-IV), Digit symbol substitution test (DSST), Letter Digit Substitution Test (LDST) were used to assess the cognitive function. The results revealed no significant change in mean score of three cognitive function tests between the groups. MMSE had
shown significant decrease score in the anemic group when compared to control group.

More, Shivkumar, Gangane, & Shende, (2013) had found the effectiveness of iron deficiency on cognitive function among adolescents aged between 12 and 15 years. Serum concentration was measured and in cognitive function mathematics, one multi component test of memory, attention and verbal learning and intelligent quotient (IQ) of the subjects were analyzed. The results were scholastic performance, intelligent quotient and mental balance, attention and concentration, verbal memory and recognition were decreased in iron deficient adolescent girls.

Mubarak, Fadel, Said, & Hammar, (2010) had done a study on behavior and intelligent quotient (IQ) in anemic children. Fifty eight children were included in this study. Revised Behavior Problem Checklist (RBPCL) and Wechsler intelligence scale for children used to assess IQ and blood test for hematological evaluation. The study concluded that behavior problems and low intelligence were significantly higher among subjects with anemia. The association with hematological parameters varies according to the type of behavior and the type of anemia.

Baral and Onta (2009) carried out a cross sectional study among three hundred and eight adolescents. The overall prevalence of iron
deficiency anemia among study subjects was 65.6% with the distribution of 62.4% among rural adolescents, 70% among urban, 52.3% of male and 78.3% in females. Iron deficiency affects the growth and cognitive performance among adolescents.

Dissanayake, Kumarasiri, Nugegoda, & Dissanayake, (2009) conducted a cross sectional comparative study among adolescents aged between 13 and 15 years. This study highlighted that iron status does not play a major role in educational performance and intelligence of adolescents and concluded that several factors affect educational performance and intelligence.

Olson et al., (2009) conducted a study in association between anemia and cognitive development among 322 participants in the age group of 7 to 18 years. The result revealed that participants who have iron deficiency anemia had low performance in the performance of PNIT compared to the non anemic group.

Agaoglu, Torun, Unuvar, Sefil & Demir, (2007) conducted a study on the effects on iron deficiency anemia on cognitive function and intelligence in children. The results were totally intelligence quotient of the iron deficiency anemia children was 12.9 points lower than that of the control group and this was statistically significant (P<0.01). There were significant
differences in subtests of the WISC-R between the pre treatment, iron deficiency anemia group and the control group.

Sen and Kanani (2006) conducted a study on the functional impact of anemia on young adolescent girls aged about 9 to 14 years. Cognitive functions were assessed by using the modified Wechsler Intelligence Scale for children (WISC). The results showed that anemia prevalence was 67% and significantly lower scores in digit span and visual memory test in anemic compared to non anemic girls.

Sungthong, Mo-suwan, & Chongsuvivatwong, (2006) had found the effectiveness of hemoglobin and serum ferritin on cognitive function. 427 students participated in this study. Iron status was estimated by hemoglobin and serum ferritin concentration. Cognitive function was measured by IQ tests and school performance. The results found that increased cognitive function was associated with increased hemoglobin concentration in children with iron deficiency. Children with iron deficiency anemia have poorer cognitive function of IQ – 74.6 points, language scores 0.3 SD below average and mathematics score 0.5 SD below average. Non anemic subjects with a high hemoglobin level had significantly improved cognitive function of IQ – 86.5 points, language
scores 0.8 SD above average and mathematics score 1.1 SD above average.

Section III: Studies related to management of iron deficiency anemia

Jawarkar, Lokare, Kizhatil, & Jawarkar, (2015) conducted a study on the prevalence of anemia and effectiveness of iron supplementation among 350 anemic adolescent girls. All subjects received a single dose of anti helminthic and the participants who were anemic received iron and folic acid tablets for every day. Hemoglobin was estimated after three months. The overall prevalence of anemia in adolescent girls was found to be 55%. There was a significantly increased hemoglobin level from 10.57±1.09 to 11.78±0.99.

Gupta et al., (2014) reviewed on randomized clinical trial included 331 anemic adolescent girls. Participants were grouped into three categories. Category-I received iron and folic acid tablet weekly once (Iron and Folic Acid), category-II received iron and folic acid tablet weekly twice and category - III received iron and folic acid tablet every day. An Intent-to-treat approach was used to estimate the change in hemoglobin level and serum ferritin levels at the end. The result showed that there was a significant difference in hemoglobin level in a category-II (3.1g/dl) and category-I (2.4g/dl) as compared to category-III (2.3g/dl). Drug compliances were more in the category-III compared to other categories.
Deshmukh, Garg, & Bharambe, (2008) found out the effectiveness of a weekly iron supplementation among urban slum, rural and tribal area girls. Cluster sampling technique was used to select the subjects. Twelve and 10 adolescent girls from each cluster were included in this study. The hemoglobin level was estimated. The IFA tablet was administered. The overall prevalence of anemia was reduced significantly to 54.3% from 65.3%. The reduction was statistically significant in tribal girls (48.6% from 68.9% at p<0.01) and among rural girls (51.6% from 62.8%). But the reduction was not significant among urban slum girls.

Horjus, Aguayo, Roley, Pene, & Meershoek, (2005) assessed the effectiveness of weekly iron and folic acid (IFA) supplementation in girls aged between 10 and 18 years. Participants were divided into two groups. Group-I received 5 months intervention and group – II received 8 months intervention of 60 mg of elemental iron and 400 microgm of folic acid. Subjects received two doses of Tab.Mebendazole. The mean hemoglobin concentration was significantly higher among group-II participants than the group-I. The prevalence of anemia was lower in both groups.

**Section IV: Studies related to nutritional intervention and iron deficiency anemia**

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

Joseph and George (2015) assessed the effectiveness of ragi porridge in improving hemoglobin level among adolescents. Ragi porridge was given for three months. The mean post test hemoglobin level was higher (12.52gm/dl) than the mean pretest hemoglobin level (11.24gm/dl). The mean difference of hemoglobin level was 1.28gm/dl.

Sanap and Jadav (2014) carried out a study on the effectiveness of Poha Ladoo on the hemoglobin level in tribal anemic adolescent girls. 45 adolescent girls (13-18 years) were included in this study. Group-I consists of 15 girls followed with regular diet, group-II consists of 15 girls were provided with iron rich diet and group-III consist of 15 girls were administered with 100gm Poha Ladoo for three months. Poha Ladoo is a mixture of soybeans, besan flour, coconut, sesame, ghee and jaggery. The results showed that there was a significant difference in hemoglobin level (+2.29 g/100 ml) among group III participants. In group I and II the hemoglobin level was 0.24 and 0.64 g/100 ml respectively.
Priya, Malarvizhi, & Jothi, (2013) found out the effectiveness of beet-root juice on the hemoglobin level among adolescent girls. By using simple random sampling technique, 60 subjects were selected for the study and divided into experimental and control group. The freshly prepared beet-root juice was given to the subjects for 20 days. Hemoglobin level was estimated by cyanmet hemoglobin method. In experimental group, 60% had mild anemia, 40% had moderate anemia in the pretest. After supplementation of beet-root juice, 90% had normal hemoglobin level and 10% had moderate anemia in the post test. The result showed a highly significant improvement in hemoglobin level at p<0.001 in the experimental group.

Mageshwari and Sharmila (2012) found out the impact of the functional food supplement and nutritional status on the performance athletes. 50 adolescent girls participated in the study. 20 gms of toffee was administered for six weeks to the experimental group. A toffee was prepared from sweet potato, rice flakes, roasted Bengal gram, soya flour and ghee. The hemoglobin level was increased from 15.9gm/dl to 16.1gm/dl with ‘t’ value of 4.08. This showed that there was improvement in hemoglobin level after the administration of nutritional supplement.
Singh and Kochhar (2012) had found the effectiveness of supplementation of functional beverage on the anemic status among 30 participants aged between 15 and 18 years. Whey water (100ml), pearl millet (5gm), cauliflower leaf powder (2.5gm), banana and jaggery (20gm) were used to prepare functional beverage. The study participants were divided into experimental and control group. 200ml of functional beverage was administered for 3 months to the experimental group. Blood investigation was done. 77% of participants were anemic in pretest, after supplementation of functional beverage, 55% of subjects were anemic.

Agdeppa, Magsadia, & Capanzana, (2011) conducted a study to determine the effectiveness of fortified juice drink for improved iron and zinc status of school children. Intervention was given for three months. This study concluded that there was a significant reduction in the prevalence of anemia among experimental groups (100% to 13%) than the control group. The fortified juice drink was effective in reducing anemia.

Gupta and Kochar (2010) found out the effectiveness of iron and folic acid capsule with and without thandai on anemic adolescent girls. 54 anemic adolescent girls were included and divided into three groups. Each group contained 18 girls. Thandai is a mixture of groundnut with jaggery. Thandai along with Cofol-Z capsule (iron + folic) given to the subjects of group A, whereas in the subjects of B group, only Cozzfol-Z capsule was
given. The subjects of group C are as a control group. Supplementation was continued for six weeks. A questionnaire regarding general information was filled up. Hemoglobin content was measured at 0, 3rd and 6th week of supplementation. On supplementation, significant (p<0.05) improvement was found in mean Hb value which was three times higher in subjects of experimental group A (21.20%) than subjects of experimental group B (6.87 %). This iron and folic acid supplementation with thandi proved to be more effective in combating the problem of anemia during adolescence.

Jood, Gupta, Yadak, & Khetarpaul, (2008) carried out a study to find out the effectiveness of iron supplementation in improving nutritional status. 66 children, 10 to 12 years of age were included in this study. The experimental group was administered with 100g of cauliflower leaves powder supplements for four months that is in the form of biscuits. There was an increase in Hb, serum retinol, weight and height in the intervention group (14.61, 33.27, 4.48 and 7.06%). In pretest, 27.27% children had a deficient hemoglobin level and in post test, the value was increased to 42.42%.

Alaofe, Zee, & O'Brien, (2007) had determined the association between iron intake and iron deficiency. 100 adolescent girls aged 14 to 16
years were selected as study participants. 43% of subjects were anemic with a hemoglobin level of < 12 g/dl. The study finding revealed that absorbable iron intakes were highly and positively associated with hemoglobin and hematocrit level.

Tatala, Ndossi, Ash, & Mamiro, (2007) had evaluated the effectiveness of germinated finger millet based food recipe in anemic children to assess the anemia and iron status, hemoglobin, hematocrit, erythrocyte protoporphyrin and serum ferritin were estimated. After six months of supplementation with fortified beverage there was a significant increase in hemoglobin concentration in intervention group than in the non intervention group.

Moretti et al., (2006) had done a study to determine the effectiveness of extruded rice fortified with micronized ground ferric pyrophosphate in reducing iron deficiency. 6 to 13 year old children were assigned randomly in experimental and control group. The result showed that the prevalence of iron deficiency and iron deficiency anemia in the total population was 78% and 29% in the pretest. In post test iron deficiency anemia, decreased from 30% to 15% in the experimental group. There was no change (28% to 27%) in the control group.
Chen et al., (2005) reported in his study that fortified soya sauce was effective in improving iron status.

De-Almeida, De-Oliveira, Crott, & Baptista, (2005) reported that water fortified with iron (10mg) and ascorbic acid (100mg/l) is used as an adequate vehicle for improving iron supply in children and considered to be effective.

The above cited studies have focused and emphasized the need to assess the prevalence of iron deficiency anemia, causes, sign and symptoms, preventive measures, need for continuous monitoring of the adolescent girls and necessity to bring awareness regarding iron deficiency anemia among the target population. These research articles supported the researcher in various aspects like addition of knowledge, tool development, and Intervention construction, further to proceed with appropriate methodology and analysis.
CHAPTER III

RESEARCH METHODOLOGY

Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically.

This chapter includes the research approach, design, variables, study settings, population, sampling process, development of the instrument and their description, estimation of validity and reliability, ethical consideration, pilot study, data collection procedure and plan for data analysis.

RESEARCH APPROACH

The selection of research approach is a basic procedure for the study to be conducted. The approach selected for the present study was the quantitative approach. The present study was to assess the effectiveness of nutritional intervention in treating anemia and improving intelligence of adolescent girls with anemia.

RESEARCH DESIGN

According to Polit and Hungler, research design is defined as the researcher’s overall plan for obtaining answers to the research questions and testing the hypothesis. True experimental, pre and post test control group design was used for the study.
FIGURE 2: SCHEMATIC REPRESENTATION OF RESEARCH METHODOLOGY

Research Approach

Research Design
True Experimental, Pretest and Post test control group design

Setting of the Study (Simple random technique)
Selected schools at Bangalore, (JSS High School, B.E.S High School, Briliant's High School and Vivekananda High School)

Sample
Iron deficiency anemic adolescent girls in the age group of 12 to 15 years

Sample Size
240 adolescent girls with anemia

Sampling Technique
Stratified sampling technique

Instrument
- Demographic variables
- Clinical signs and symptoms of anemia
- Hemoglobin measurement by cyanmet hemoglobin method
- Peripheral blood smear
- Intelligence assessment by Malin’s

Control
(n = 120)

Pretest

No Intervention

Experimental
(n = 120)

Intervention
- Administration of 100gms Nutrition ball with 4gms of amla fruit powder

Post test - I on 9th & 10th week
Post test - II on 13th & 14th week

Analysis and Interpretation
- Descriptive statistics
- Inferential statistics
# Table 1: Description of Research Design

<table>
<thead>
<tr>
<th>Group</th>
<th>Measurement of Dependent Variable</th>
<th>Manipulation of Independent Variables</th>
<th>Measurement of Dependent Variable</th>
<th>Post test - I on 9th &amp; 10th week</th>
<th>Post test - II on 13th &amp; 14th week</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental</strong> Group R</td>
<td>$S_1H_1P_1I_1$</td>
<td>$X$</td>
<td>$S_2H_2I_2$</td>
<td>$S_3H_3I_3$</td>
<td></td>
</tr>
<tr>
<td><strong>Control</strong> Group R</td>
<td>$S_1H_1P_1I_1$</td>
<td>$_____$</td>
<td>$S_2H_2I_2$</td>
<td>$S_3H_3I_3$</td>
<td></td>
</tr>
</tbody>
</table>

**Keys:**

R – Randomization

$S_1H_1P_1I_1$ - Pretest assessment of anemia sign and symptoms ($S_1$) assessed by observation check list on anemia sign and symptoms, Hemoglobin level ($H_1$) by cynmet hemoglobin method, peripheral smear ($P_1$) by Wedge blood smear method and Intelligence level ($I_1$) assessed MALIN’S Intelligence scale.

$X$ – Administration of 100gms of Nutrition ball with 4gms of amla fruit powder for 8 weeks.
Post test - I, assessment of signs and symptoms of anemia ($S_2$), Hemoglobin level ($H_2$) and Intelligence level ($I_2$) were assessed by using the same instruments.

Post test - II, assessment of signs and symptoms of anemia ($S_3$), Hemoglobin level ($H_3$) and Intelligence level ($I_3$) were assessed by using the same instruments.

**VARIABLES OF THE STUDY**

**Independent Variable:** Nutritional intervention on adolescent girls with anemia was the independent variable of this study.

**Dependent Variable:** In this study, hemoglobin and intelligence level were the dependent variables.

**Setting of the Study**

Setting refers to a physical location and condition in which data collection takes place in this study. The present study has been conducted in selected schools at Bangalore. Bangalore South zone consists of 17 schools. The researcher had selected 4 schools out of 17 by using a simple random technique (Lottery method). Four schools were selected by having same criteria such as age, class, medium of instruction, students' strength, fees structure, socio economic status and physical facilities of the school. Two schools were assigned randomly to experimental group and
two schools were assigned randomly to control group. The geographical proximity of schools is 6-10 kms. All the students are coming from home.

**Setting 1: JSS high school**

This study was conducted at the JSS high school located in the south part of Bangalore. In JSS high school, 1346 students were studying from 6\textsuperscript{th} to 10\textsuperscript{th} standard and 543 students were studying from 7\textsuperscript{th} to 9\textsuperscript{th} standard. Each standard has sections from A to G. Out of that 244 students were girls. This school has good physical facilities like playground, drinking water supply and toilet facilities. Classrooms are well ventilated and are under close supervision.

**Setting 2:**

B.E.S high school was located in the south part of Bangalore. In B.E.S school, 1281 students were studying from 6\textsuperscript{th} to 10\textsuperscript{th} standard. Each standard has sections from A to F. 507 students were studying from 7\textsuperscript{th} to 9\textsuperscript{th} standard. Out of that, 299 students were girls. The school has good physical facilities like classrooms, playground, drinking water supply and toilet facilities.

**Setting 3:**

In Brilliant’s school, 1208 students were studying from 6\textsuperscript{th} to 10\textsuperscript{th} standard. Each standard has sections from A to E. 469 students were studying from 7\textsuperscript{th} to 9\textsuperscript{th} standard. Out of 469 students, 217 students were
girls. The school has good physical facilities like playground, drinking water supply and toilet facilities.

Setting 4:

In Vivekananda School, 1124 students were studying from 6\textsuperscript{th} to 10\textsuperscript{th} standard. 462 students were studying from 7\textsuperscript{th} to 9\textsuperscript{th} standard. Out of 469 students, 169 students were girls. Each standard has sections from A to E. The geographical proximity of the school is 8kms. The school has adequate facilities. All four schools were identical in the medium of instruction and students' strength.

Population

The population of this present study was adolescent girls with anemia aged 12-15 years in the JSS High School, B.E.S High School, Brilliant's High School and Vivekananda High School in Bangalore.

Sample

Sample consists of the subset of a population who is selected to participate in a research study.

The samples of the present study were the adolescent girls with anemia between the age group of 12 to 15 years who had fulfilled the inclusion and exclusion criteria.
Sample Size

Equal allocation of large proportions to test hypothesis method was computed with the criteria of proportions of both groups, 80% as power, alpha error of 5%, CI level 95%, and two tailed test. Based on the result, 106 was the minimum sample required for each arm. Based on sample size calculation, the required sample size is 106 in each group. But the investigator has taken 120 samples in the experimental group and 120 samples in the control group.

Sampling Technique

According to Polit and Hungler, sampling refers to the process of selecting a portion of population to represent the entire population.

Step 1

In the first phase, Bangalore city was divided into East, West, North and South zones. South zone of Bangalore was selected by lottery method.

In the second phase, South zone of Bangalore has 17 high schools. Among 17 schools, 10 were selected by having same criteria such as age, class, medium of instruction, students' strength, fees structure, socio economic status and physical facilities of the school. By using the lottery method, four schools were selected. Two schools were assigned randomly
to experimental group and two schools were assigned randomly to control group.

In the third phase, in JSS high school, 244 girls were studying in 7th, 8th and 9th standard. The investigator assessed the signs and symptoms of anemia by using observation checklist on signs and symptoms of anemia for 244 girls. Out of these, 129 girls were identified with signs and symptoms of anemia. By using cynmet hemoglobin method, 129 girls were checked for hemoglobin level. 122 had hemoglobin level of 7-12 gms/dl. Peripheral blood smear was taken for 122 girls to identify microcytic and hypochromic anemia by using wedge blood smear method. 83 girls had hypochromic microcytic anemia. Out of these 24 anemic adolescent girls belonged to the age group of 12 to 13 years, 26 anemic adolescent girls belonged to the age group of >13 to >14 years and 33 anemic adolescent girls belonged to the age group of >14 to 15 years. By using stratified sampling technique, 20 samples were selected from each age group.

In B.E.S high school, 299 girls were studying in 7th, 8th and 9th standard. The investigator collected demographic data and assessed the signs and symptoms of anemia by using observation checklist on signs and symptoms of anemia for 299 girls. 178 girls were identified with signs and symptoms of anemia. 178 girls were checked for hemoglobin level by cynmet haemoglobin method. Out of these, 171 had hemoglobin level of 7-12 gms/dl. Out of 171 girls, 116 had microcytic and hypochromic anemia
by checking their peripheral blood smears (Wedge blood smear method). Out of these, 33 anemic adolescent girls belonged to the age group of 12 to 13 years, 38 anemic adolescent girls belonged to the age group of >13 to >14 years and 45 anemic adolescent girls belonged to the age group of >14 to 15 years. By using stratified sampling technique, 20 samples were selected from each age group.

In Brilliant’s high school, 217 girls were studying in 7th, 8th and 9th standard. The investigator collected demographic data and assessed the signs and symptoms of anemia by using the observation checklist of anemia for 217 girls. 138 girls were identified with signs and symptoms of anemia. Out of 138 girls, 134 had hemoglobin level of 7-12 gms/dl assessed by using cynmet haemoglobin method. Peripheral blood smear was taken for 134 girls to identify microcytic and hypochromic anemia. Out of 134, 90 girls had hypochromic microcytic anemia. Out of these 28 anemic adolescent girls belonged to the age group of 12 to 13 years, 31 anemic adolescent girls belonged to the age group of >13 to >14 years and 31 anemic adolescent girls belonged to the age group of >14 to 15 years. By using stratified sampling technique, 20 samples were selected from each age group.

In Vivekananda high school, 169 girls were studying in 7th, 8th and 9th standard. The investigator collected demographic data and assessed
the signs and symptoms of anemia by the observation checklist on signs and symptoms of anemia for 169 girls. 121 girls were identified with signs and symptoms of anemia. By using cynmet haemoglobin method, 121 girls were checked for hemoglobin level. Out of these, 115 had hemoglobin level of 7-12 gms/dl. Out of 115 girls, 79 had microcytic and hypochromic anemia by checking their peripheral blood smear. Out of these, 23 anemic adolescent girls belonged to the age group of 12 to 13 years, 24 anemic adolescent girls belonged to the age group of >13 to >14 years and 32 anemic adolescent girls belonged to the age group of >14 to 15 years. By using stratified sampling technique, 20 samples were selected from each age group.

Table2: Details of samples collected from selected schools

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of the school</th>
<th>Total no. of girls</th>
<th>Screened by signs and symptoms of anemia</th>
<th>Screened by Hemoglobin level</th>
<th>Screened by peripheral blood smear</th>
<th>Samples selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JSS High School</td>
<td>244</td>
<td>129</td>
<td>122</td>
<td>83</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>B.E.S High School</td>
<td>299</td>
<td>178</td>
<td>171</td>
<td>116</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>Briliant's High School</td>
<td>217</td>
<td>138</td>
<td>134</td>
<td>90</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>Vivekananda High School</td>
<td>169</td>
<td>121</td>
<td>115</td>
<td>79</td>
<td>60</td>
</tr>
</tbody>
</table>
Criteria for Sample Selection

The sample was selected based on the following inclusion and exclusion criteria.

**Inclusion Criteria**

- Age group was 12 – 15 years.
- Adolescent girls who were anemic, Hb level of 7 to 12gms/dl.
- Adolescent girls who have hypochromic and microcytic anemia by assessing the peripheral blood smear.

**Exclusion Criteria**

- Adolescent girls who had Hb level below 7gms/dl
- Adolescent girls affected with other infections like tuberculosis, gastro intestinal disturbances and hematological problems.
- Adolescent girls who were already on treatment with iron and folic acid tablets.
FIGURE 3: METHOD OF SAMPLE SELECTION

Samples included in the study:
- Age group was 12–16 years
- Adolescent girls who are anemic
- Hb level is 7 to 12gms/dl
- Hypochromic and microcytic anemia by peripheral blood smear

Total No of girls:
- JSS High School: 244 girls
- B.E.S High School: 299 girls
- Brilliant's High School: 217 girls
- Vivekananda High School: 169 girls

Selected by inclusion criteria:
- 17 schools
- 10 schools which have same criteria
- 4 schools were selected (Simple random technique)

Samples excluded from the study:
- Hb level is below 7 gms/dl
- Already on treatment with iron and folic acid
- Infections and hematological problems

By observing signs & symptom of anemia:
- 129 girls
- 178 girls
- 138 girls
- 121 girls

Hemoglobin level 7 to 12gms/dl:
- 122 girls
- 171 girls
- 134 girls
- 115 girls

Peripheral blood smear:
- 83 girls
- 116 girls
- 90 girls
- 79 girls

Stratified sampling technique:
- 12-13: 24 girls
- >13-14: 25 girls
- >14-15: 35 girls
- >13-14: 33 girls
- >13-14: 39 girls
- >14-15: 45 girls

Experimental group: Allocated to Nutritional Intervention

Control group: Allocated to Routine Care

Data Interpretation
Research Tool and Techniques

Tool Development and Construction

The investigator prepared instruments based on the objectives of the study. The following steps were adopted prior to the development of the tool.

1. Extensive review of literature from various resources such as textbooks, journals, Medline search etc., was utilized to select or construct the most appropriate tool for the present study.

2. Personal experience of the investigator was used.

3. Consultation and discussion with experts from nursing practice, research, psychologists, nutritionalist and biostatistics was done. Initially observation checklist was prepared by system-wise clinical signs and symptoms. Based on expert’s suggestions, it was modified into subjective and objective data.

4. Preparation of blue print.

TOOL

The instrument used in this research study consisted of four sections.

PART –I

It comprised of demographic variables such as name, age, educational status, mother’s educational status, father’s educational status, mother’s occupation, father’s occupation, religion, dietary pattern, no. of family members, type of family, age at menarche, menstrual bleeding, deworming, history of gastritis, ulcer and personal hygiene.
PART – II

Observational checklist on signs and symptoms of anemia was used to assess the signs and symptoms of iron deficiency anemia. The checklist consists of 15 items of subjective data and 10 items of objective data. A score of 1 was given for the presence of signs and symptoms and a score of 0 was given for absence of signs and symptoms.

**Scoring interpretation:** Total score is 25. Based on the scores obtained the subjects were arbitrarily grouped into 3 groups as below.
6 – 12 (25 - 50%): mild anemic status; 13- 19 (51 - 75%): moderate anemic status; 20 - 25 (76 - 100%): severe anemic status.

PART III

It consists of bio – physiological approach to estimate the haemoglobin status among adolescent girls using cynmet haemoglobin method.

**Scoring interpretation**
As per the WHO classification, the subjects were grouped as follows
Mild anemia - (10.1 – 12 gm/dl); Moderate anemia- (7 – 10 gm/dl).

PART IV

It consists of bio – physiological approach to estimate the Peripheral blood smear among adolescent girls to assess the hypochromic and microcytic anemia.
Blood smears were made from finger prick blood directly onto slide. Place a drop of blood, about 2-3 mm in diameter approximately 1 cm from one end of slide. Place the slide on a flat surface, and place the smooth clean edge of a second (spreader) slide on the specimen slide, just in front of the blood drop. Hold the spreader slide at a 30°- 45 angle, and draw it back against the drop of blood. Allow the blood to spread almost to the edges of the slide. Push the spread forward with one light, smooth moderate speed. A thin film of blood in the shape of tongue was made.

PART V

MALIN’S intelligence scale for Indian children was used to assess the intelligence of the adolescent girls. In MALIN’S scale, verbal response and performance were assessed. In verbal response, general information, arithmetic, similarities and digit span and in performance, picture completion, object assembly, coding and maize was used.

In verbal response: general information – consist of 24 questions, arithmetic -13 arithmetic questions were used, similarities- 12 items were used to detect relationships or likeness among two words and digit span- sequences of numbers were given and asked to repeat them.
In performance, picture completion - 20 art work of common objects with a missing part, object assembly - pieces of the object was given for arrangement, coding and maize.

Scoring interpretation

For general information, arithmetic and picture completion – score of 1 was given for correct response and a score of 0 was given for consecutive failures. For similarities – grade was given as 2, 1 and 0. For digit span – grade was given from 9 to 1. For Highest number of digits repeated without error, high score is given.

For object assembly –6 to 4 scores is given for perfect performance, 2 for inappropriate, 3 for half omitted and score 1 is given for two pieces of object joined properly. For coding – within 120 seconds the task has to be completed. 1 point was given for each correct square. For maize – 2 score for no errors, and 1 for not more than two errors.

Scoring interpretation

75 – 89 = Borderline or dull; 90 – 109 = Average, 110 – 125 = Superior, 126 – 139 = Very superior and Above 140 = Genius.
Table 3: Details of data collection instruments in the study

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Name of the Tool</th>
<th>Variables Measured</th>
<th>Selected/developed by investigator</th>
<th>No. of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Demographic data</td>
<td>Age, educational status, educational status of the mother and father, religion, income of the family, area of residence, diet, type of family, no. of family members, age at menarche, history of menstrual bleeding, worm infestation, deworming drugs, history of gastritis, peptic ulcer, surgery and medicine, personal hygiene.</td>
<td>Developed</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Observation checklist on signs and symptoms of anemia</td>
<td>Anemic signs and symptoms</td>
<td>Developed</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Cynmet Hemoglobin method</td>
<td>Hemoglobin level</td>
<td>Selected</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Wedge blood smear test</td>
<td>Peripheral blood smear</td>
<td>Selected</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>MALIN’S Intelligence scale</td>
<td>General information, arithmetic, similarities and digit span, picture completion, object assembly, coding and maize</td>
<td>Selected</td>
<td>70</td>
</tr>
</tbody>
</table>
NUTRITIONAL INTERVENTION

It refers to the administration of 100 gms of nutritional ball which is made by the mixture of 60 gms of roasted rice flakes and 40 gms of jaggery. It provides 13.14 mgs of iron. For the absorption of iron, vitamin C that is 4gms of amla fruit powder was given.

The nutritional ball is prepared by roasting rice flakes. The jaggery is made as a sauce by mixing with water and boiled. Then rice flakes and jaggery sauce is mixed and as a ball.

Validity

The validity of the tool was established by submitting the tool to 13 experts from the field of nursing, nutritionalist, psychologist and medicine for their opinion and suggestion. Based on their valuable suggestions, tool was reformed and also validity was established. The overall content validity index for the tool was 0.75. For Malin’s Intelligence scale, construct validity was obtained.

Reliability

The reliability of measuring tool is a major criterion in assessing the accuracy. The reliability was established by intra rater reliability for the physiological measurement. Calibration of instruments was done and found to be reliable. Karl Pearson’s correlation coefficient formula was used. The obtained ‘r’ value for observation checklist on signs and
symptoms of anemia was 0.91, for hemoglobin level was 0.87, 0.84 for peripheral blood smear and for Malin’s intelligence scale was 0.91.

**Pilot Study**

In order to test the relevance and practicability of the study, a pilot study was conducted from January 2013 to March 2013. Twenty four iron deficiency anemic adolescent girls (12 samples in experimental and 12 samples in control group) were selected in Dayananda Sagar high school in Bangalore. The pilot study was conducted in the same manner in which the final study would be done.

Pilot study findings have revealed that post test mean scores of hemoglobin (11.41 ± 3.38) among experimental group is higher than the post test mean of hemoglobin among control group (9.63 ± 3.19). The post test mean score of intelligence level among experimental group (89.99 ± 9.43) is higher than the post test mean score of intelligence level in control group (87.01 ± 9.33). The results concluded that, there was a significant difference between the post test mean score of hemoglobin and intelligence level between experimental and control group. Samples of the pilot study are not included in the main study. The Findings further suggested that, nutritional intervention is feasible, practicable and cost effective. No issues (or) problems arouse in implementing the intervention.
Data Collection Procedure

Data collection for the main study was done from the month of June 2013 to February 2014. Before conducting the study, the investigator obtained permission from the head mistress of the school, written consent was obtained from the parents and oral consent from the adolescent girls.

Phase I

In the first phase, Bangalore city was divided into East, West, North and South zones. South zone of Bangalore was selected by using lottery method.

In the second phase, South zone of Bangalore has 17 high schools. Among 17 schools, 10 were selected by having same criteria such as age, class, medium of instruction, students' strength, fee structure, socio economic status and physical facilities of the school. By using the lottery method, four schools were selected. Two schools were randomly assigned to experimental group and two schools were assigned randomly to control group.

Phase II

Data collection from experimental group

By using simple random sampling method, JSS high school, B.E.S high school were randomly selected for experimental group. Data were
collected from 1st week of June (4/6/13) to 2nd of the week November (11/11/13).

In JSS high school, 244 girls were studying in 7th, 8th and 9th standard. The investigator assessed the signs and symptoms of anemia by using observation checklist on signs and symptoms of anemia for 244 girls. Out of these, 129 girls were identified with signs and symptoms of anemia. By using cynmet hemoglobin method, 129 girls were checked for hemoglobin level. 122 had hemoglobin level of 7-12 gms/dl. Peripheral blood smear was taken for 122 girls to identify microcytic and hypochromic anemia by using wedge blood smear method. 83 girls had hypochromic microcytic anemia. Out of these, 24 anemic adolescent girls belonged to the age group of 12 to 13 years, 26 anemic adolescent girls belonged to the age group of >13 to >14 years and 33 anemic adolescent girls belonged to the age group of >14 to 15 years. By using stratified sampling technique, 20 samples were selected from each age group.

In B.E.S high school, 299 girls were studying in 7th, 8th and 9th standard. The investigator assessed the signs and symptoms of anemia by using observation checklist on signs and symptoms of anemia for 299 girls. 178 girls were identified with signs and symptoms of anemia. 178 girls were checked for hemoglobin level by cynmet haemoglobin method. Out of these, 171 had hemoglobin level of 7-12 gms/dl. Out of 171 girls, 116 had microcytic and hypochromic anemia by checking their peripheral blood
smears (Wedge blood smear). Out of these, 33 anemic adolescent girls belonged to the age group of 12 to 13 years, 38 anemic adolescent girls belonged to the age group of >13 to >14 years and 45 anemic adolescent girls belonged to the age group of >14 to 15 years. By using stratified sampling technique, 20 samples were selected from each age group.

Pretest was conducted in JSS and B.E.S high school for four week period. The investigator assessed the signs and symptoms of anemia by using observation checklist for signs and symptoms of anemia, peripheral blood smear was done by using wedge blood smear test and collected demographic data.

Demographic data was collected and psychologist assessed the intelligence among 10 adolescent girls with anemia every day by using MALIN’S intelligence scale for two weeks. The subjects were dewormed by Tab. Albendazole 400mg. The time schedule for data collection was from 12noon to 2pm on all the days except Saturdays, Sundays and government holidays. The nutritional intervention was given for eight weeks to the experimental group. Each sample was given about 100 gm of nutritional ball which is made by the mixture of 60 gms of roasted rice flakes and 40 gms of jaggery. It provides 13.14 mgs of iron. For the absorption of iron, 4 gms of amla fruit powder containing 24 mgs of vitamin C was given every day except Saturdays, Sundays and government
holidays for eight weeks (from the seventh week to the fourteenth week of data collection). Between 12noon to 2 pm, the investigator was visiting the school and gathered the students in one classroom to administer the nutritional balls to subjects under the supervision of the researcher and teacher.

On ninth week and tenth week, post test-I was conducted. Signs and symptoms of anemia were assessed by observation checklist on signs and symptoms of anemia, hemoglobin level by cymnet haemoglobin method and psychologist assessed the intelligence by using Malin’s intelligence scale among 10 adolescent girls with anemia per day.

At thirteenth and fourteenth week, post test-II was conducted. Signs and symptoms of anemia were assessed by observation checklist on signs and symptoms of anemia, hemoglobin level by cymnet haemoglobin method and psychologist assessed the intelligence by using Mallin’s intelligence scale among 10 adolescent girls with anemia per day.

**Phase III**

**Data collection from a control group**

By using simple random sampling technique, Brilliant’s high school and Vivekananda high school were selected for control group. Data were collected from 2\(^{nd}\) week of September to 2\(^{nd}\) of week February.
In Brilliant’s high school, 217 girls were studying in 7th, 8th and 9th standard. The investigator assessed the signs and symptoms of anemia by using the observation checklist on signs and symptoms of anemia for 217 girls. 138 girls were identified with signs and symptoms of anemia. Out of 138 girls, 134 had hemoglobin level of 7-12 gms/dl by using by cynmet haemoglobin method. Peripheral blood smear was taken for 134 girls to identify microcytic and hypochromic anemia. Out of 134, 90 girls had hypochromic microcytic anemia. Out of these, 28 anemic adolescent girls belonged to the age group of 12 to 13 years, 31 anemic adolescent girls belonged to the age group of >13 to >14 years and 31 anemic adolescent girls belonged to the age group of >14 to 15 years. By using stratified sampling technique, 20 samples were selected from each age group.

In Vivekananda high school, 169 girls were studying in 7th, 8th and 9th standard. The investigator assessed the signs and symptoms of anemia by using the observation checklist on signs and symptoms of anemia for 169 girls. 121 girls were identified with signs and symptoms of anemia. By using cynmet haemoglobin method, 121 girls were checked for hemoglobin level. Out of these, 115 had hemoglobin level of 7-12gms/dl. Out of 115 girls, 79 had microcytic and hypochromic anemia by checking their peripheral blood smears. Out of these, 23 anemic adolescent girls belonged to the age group of 12 to 13 years, 24 anemic adolescent girls belonged to the age group of >13 to >14 years and 32 anemic adolescent
girls belonged to the age group of >14 to 15 years. By using stratified sampling technique, 20 samples were selected from each age group.

Pretest was conducted in Brilliant’s high school and Vivekananda high school for four weeks. The investigator assessed the signs and symptoms of anemia by using observation checklist for signs and symptoms of anemia, peripheral blood smear was done by using wedge blood smear test and collected demographic data.

Demographic data was collected and psychologist assessed the intelligence among 10 adolescent girls with anemia every day by using MALIN’S intelligence scale for two weeks. The time schedule for data collection was from 12noon to 2pm on all the days except Saturdays, Sundays and government holidays.

The control group was maintained by regular dietary practices. No intervention was given and then the post test-I was done on the ninth and tenth week and the post test-II was done on the thirteenth and fourteenth week. Signs and symptoms of anemia was assessed by using observation checklist on sign and symptoms of anemia, hemoglobin level were checked by using by cynmet haemoglobin method and psychologist assessed the intelligence by Malin’s intelligence scale. Data were collected from 10 adolescent girls with anemia per day.
Table 4: Data collection procedure for Experimental group and Control group

**Experimental group**

<table>
<thead>
<tr>
<th>School</th>
<th>Period</th>
<th>No. of subjects</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>JSS high school and B.E.S high school</td>
<td>6/6/13 to 1/7/13</td>
<td>543 samples (30 – 31 samples/day)</td>
<td>Assessed sign and symptoms of anemia by using observation checklist on signs and symptoms of anemia</td>
</tr>
<tr>
<td></td>
<td>2/7/13 to 17/7/13</td>
<td>307 (25 – 26 samples/day)</td>
<td>Assessed hemoglobin level by cynmet hemoglobin method and peripheral smear by wedge blood smear test</td>
</tr>
<tr>
<td>JSS high school</td>
<td>18/7/13 to 25/7/13</td>
<td>60 (10 samples/day)</td>
<td>Assessed intelligence level by Malin’s Intelligence scale</td>
</tr>
<tr>
<td></td>
<td>26/7/13</td>
<td>60 samples</td>
<td>Deworming by Tab. Albendazole 400mg</td>
</tr>
<tr>
<td></td>
<td>29/7/13 to 20/9/13</td>
<td>60 samples</td>
<td>Administered 100gms of Nutritional ball with 4gms of amla fruit powder</td>
</tr>
<tr>
<td></td>
<td>23/9/13 to 30/9/13</td>
<td>60 samples (10 samples/day)</td>
<td>Post test –I Signs and symptoms of anemia, Hemoglobin level and intelligence level by Malin’s Intelligence scales</td>
</tr>
<tr>
<td></td>
<td>22/10/13 to 29/10/13</td>
<td>60 samples (10 samples/day)</td>
<td>Post test –II Signs and symptoms of anemia, Hemoglobin level and intelligence level by Malin’s Intelligence scale</td>
</tr>
<tr>
<td>School</td>
<td>Dates</td>
<td>Samples/Day</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------</td>
<td>-------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>B.E.S high school</td>
<td>29/7/13 to 5/8/13</td>
<td>60 (10 samples/day)</td>
<td>Assessed intelligence level by Malin’s Intelligence scale</td>
</tr>
<tr>
<td></td>
<td>6/8/13</td>
<td>60 samples</td>
<td>Deworming by Tab. Albendazole 400mg</td>
</tr>
<tr>
<td></td>
<td>7/8/13 to 3/10/13</td>
<td>60 samples</td>
<td>Administered 100gms of Nutritional ball with 4gms of amla fruit powder</td>
</tr>
</tbody>
</table>
|                        | 4/10/13 to 11/10/13| 60 samples (10 samples/day) | Post test –I  
Signs and symptoms of anemia, Hemoglobin level and intelligence level by Malin’s Intelligence scale |
|                        | 4/11/13 to 11/11/13| 60 samples (10 samples/day) | Post test –II  
Signs and symptoms of anemia, Hemoglobin level and intelligence level by Malin’s Intelligence scale |

**Control group**

<table>
<thead>
<tr>
<th>School</th>
<th>Dates</th>
<th>Samples/Day</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vivekananda high school and Briliant’s high school</td>
<td>13/9/13 to 1/10/13</td>
<td>386 (30 samples/day)</td>
<td>Assessed sign and symptoms of anemia by using observation checklist on signs and symptoms of anemia</td>
</tr>
<tr>
<td></td>
<td>3/10/13 to 24/10/13</td>
<td>259 (25 - 26 samples/day)</td>
<td>Assessed hemoglobin level by cynmet hemoglobin method and peripheral smear by wedge blood smear test</td>
</tr>
<tr>
<td>Vivekananda high school</td>
<td>25/10/13 to 2/11/13</td>
<td>60 (10 samples/day)</td>
<td>Assessed intelligence level by Malin’s Intelligence scale</td>
</tr>
<tr>
<td></td>
<td>4/11/13 to 1/1/14</td>
<td>60 samples</td>
<td>No intervention</td>
</tr>
<tr>
<td>Date Range</td>
<td>Samples (10 samples/day)</td>
<td>Post Test –I/II</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2/1/14 to 9/1/14</td>
<td>60 samples</td>
<td></td>
<td>Signs and symptoms of anemia, Hemoglobin level and intelligence level by Malin’s Intelligence scale</td>
</tr>
<tr>
<td>3/2/14 to 10/2/14</td>
<td>60 samples</td>
<td></td>
<td>Signs and symptoms of anemia, Hemoglobin level and intelligence level by Malin’s Intelligence scale</td>
</tr>
<tr>
<td>Briliant’s high school</td>
<td>60 (10 samples/day)</td>
<td></td>
<td>Assessed intelligence level by Malin’s Intelligence scale</td>
</tr>
<tr>
<td>12/11/13 to 3/1/13</td>
<td>60 samples</td>
<td></td>
<td>No intervention</td>
</tr>
<tr>
<td>6/1/14 to 13/1/14</td>
<td>60 samples</td>
<td></td>
<td>Signs and symptoms of anemia, Hemoglobin level and intelligence level by Malin’s Intelligence scale</td>
</tr>
<tr>
<td>5/2/14 to 12/2/14</td>
<td>60 samples</td>
<td></td>
<td>Signs and symptoms of anemia, Hemoglobin level and intelligence level by Malin’s Intelligence scale</td>
</tr>
</tbody>
</table>

**Plan for Data Analysis**

Data analysis was done according to the objectives of the study. Both descriptive and inferential statistics were used.
Descriptive Statistics

Frequencies, percentage for demographic variables, mean and standard deviation was used for anemic sign, hemoglobin and intelligence level.

Inferential Statistics

The Paired ‘t’ test was used to determine the difference between pre test and post test and Independent t’ test was used to determine the difference between experimental group and control group in terms of effectiveness of nutritional intervention. Repeated measures anova was used to know the difference between the groups and Chi- square was used to determine the association between hemoglobin, intelligence and selected variables.

Ethical consideration

Before conducting the study, the investigator obtained permission from the head mistress of the school, written consent was obtained from the parents and oral consent from the adolescent girls.

Beneficence

- The intervention used in the study, was not harmful, the right to protection from exploitation.
- Assurance was given to the study participants that, the research activities will not disturb their routine activities.
Respect for human dignity

The right to self determination

- Prior permission was sought from the higher authorities in concerned study settings before commencing the study.
- Before written consent is obtained, the purpose, nature and proposed outcome of the research was explained to the parents of the study participants.
- Oral consent was obtained from the participants and the confidentiality of their responses was assured.

The right to full disclosure

- Participants were informed to withdraw from the study at any stage without being subjected to pay penalty.
- The purpose of the research was explained to them thoroughly and the research was available to provide information and support as needed.

Justice

- The right to privacy
- The participants were informed that, the data (or) information would be removed after the final analysis of the research has been computed.
- Anonymity and privacy of the participants would be maintained.
CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

This chapter deals with the description of the subjects, analysis and interpretation of data collected. The data collected is tabulated and presented as follows:

Organization of the findings

The analysis of the data is organized and presented under the following headings.

Section – I:

1. Distribution of subjects on demographic variables

Section- II: To assess the iron deficiency anemia and intelligence among adolescent girls with anemia.

2. Pretest and post test anemic sign in experimental and control group of adolescent girls with anemia.

3. Pretest and post test hemoglobin level in experimental and control group of adolescent girls with anemia.

4. Distribution of samples according to the peripheral smear.

5. Pretest and post test intelligence level in experimental and control group of adolescent girls with anemia.

6. Area wise distribution of pretest and posttest intelligence level in the experimental and control group of adolescent girls with anemia.
Section – III

7. Comparison of pre test and post test-II anemic sign in the experimental and control group of adolescent girls with anemia.
8. Comparison of pre test and post test anemic sign between the experimental and control group of adolescent girls with anemia.
9. Comparison of pre test and post test-II hemoglobin level in the experimental and control group of adolescent girls with anemia.
10. Comparison of pre test and post test hemoglobin level between the experimental and control group of adolescent girls with anemia.
11. Comparison of pretest and post test-II of intelligence level in the experimental and control group of adolescent girls with anemia.
12. Comparison of pretest and post test of intelligence level between the experimental and control group of adolescent girls with anemia.

SECTION IV

SECTION V

15. Association between demographic variables and post test hemoglobin level in the experimental group of adolescent girls with anemia.

16. Association between demographic variables and post test hemoglobin level in the control group of adolescent girls with anemia.

17. Association between demographic variables and post test intelligence scale in the experimental group of adolescent girls with anemia.

18. Association between demographic variables and post test intelligence scale in the control group of adolescent girls with anemia.
### TABLE 5:
Distribution of samples according to the demographic data in the experimental and control group. (n=240)

<table>
<thead>
<tr>
<th>Demographic variables</th>
<th>Group</th>
<th>Chi square/ Significance</th>
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<td></td>
<td>Experiment n=120</td>
<td>Control n=120</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td><strong>Age in years</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 to 13 yrs</td>
<td>40</td>
<td>33.3</td>
</tr>
<tr>
<td>&gt;13 to 14 yrs</td>
<td>40</td>
<td>33.3</td>
</tr>
<tr>
<td>&gt;14 to 15 yrs</td>
<td>40</td>
<td>33.3</td>
</tr>
<tr>
<td><strong>Educational status</strong></td>
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<td></td>
</tr>
<tr>
<td>7&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>40</td>
<td>33.3</td>
</tr>
<tr>
<td>8&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>40</td>
<td>33.3</td>
</tr>
<tr>
<td>9&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>40</td>
<td>33.3</td>
</tr>
<tr>
<td><strong>Father's education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>5</td>
<td>4.2</td>
</tr>
<tr>
<td>Primary education</td>
<td>8</td>
<td>6.7</td>
</tr>
<tr>
<td>Secondary education</td>
<td>10</td>
<td>8.3</td>
</tr>
<tr>
<td>Higher secondary education</td>
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<td>29.2</td>
</tr>
<tr>
<td>Degree and above</td>
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<td>51.7</td>
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<td></td>
<td>Illiterate</td>
<td>6.7</td>
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<tr>
<td>-------------------------</td>
<td>------------</td>
<td>-----</td>
</tr>
<tr>
<td>Mother’s education</td>
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<td></td>
</tr>
<tr>
<td>Primary education</td>
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<td>10</td>
</tr>
<tr>
<td>Secondary education</td>
<td>16</td>
<td>13.3</td>
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<tr>
<td>Higher secondary education</td>
<td>38</td>
<td>31.7</td>
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<tr>
<td>Degree and above</td>
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<td>38.3</td>
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<td></td>
<td>1.930&lt;sup&gt;NS&lt;/sup&gt;</td>
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</tr>
<tr>
<td>Father’s occupation</td>
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<td></td>
</tr>
<tr>
<td>Government employee</td>
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<td>20</td>
</tr>
<tr>
<td>Private employee</td>
<td>32</td>
<td>26.7</td>
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<tr>
<td>Self employed</td>
<td>36</td>
<td>30</td>
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<tr>
<td>Daily wages</td>
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<td>Mother’s occupation</td>
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<tr>
<td>Government employee</td>
<td>13</td>
<td>10.8</td>
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<td>Private employee</td>
<td>54</td>
<td>45</td>
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<td>Self employed</td>
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<td>Daily wages</td>
<td>16</td>
<td>13.3</td>
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<td>Unemployed</td>
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<td>2.546&lt;sup&gt;NS&lt;/sup&gt;</td>
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<td>Religion</td>
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<td>Hindu</td>
<td>87</td>
<td>72.5</td>
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<td>Christian</td>
<td>20</td>
<td>16.7</td>
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<td>Muslim</td>
<td>13</td>
<td>10.8</td>
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<td>1.465&lt;sup&gt;NS&lt;/sup&gt;</td>
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<tr>
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<td>Income of the family</td>
<td>Below Rs.10,000</td>
<td>&gt; Rs.10,000 - Rs.20,000</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10.8</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>23</td>
</tr>
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<td>7.5</td>
<td>19.2</td>
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<tr>
<th>Area of residence</th>
<th>Rural</th>
<th>105</th>
<th>87.5</th>
<th>114</th>
<th>4.227</th>
<th>1</th>
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<td>Urban</td>
<td>15</td>
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<td>6</td>
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<td></td>
<td>Semi urban</td>
<td>0</td>
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<tr>
<th>Diet</th>
<th>Vegetarian</th>
<th>26</th>
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<th>17</th>
<th>2.295NS</th>
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<tr>
<td></td>
<td>Non – vegetarian</td>
<td>94</td>
<td>78.3</td>
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<th>Type of family</th>
<th>Nuclear family</th>
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<td>Joint family</td>
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<td>6.7</td>
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<th>No of family members</th>
<th>3</th>
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<th>18.3</th>
<th>36</th>
<th>4.966NS</th>
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<tbody>
<tr>
<td></td>
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<td>66</td>
<td>55</td>
<td>54</td>
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<td></td>
<td>5</td>
<td>18</td>
<td>15</td>
<td>19</td>
<td></td>
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<tr>
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<td>&gt;5</td>
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<td>11</td>
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<th>Age at Menarche</th>
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<th>12</th>
<th>11.569</th>
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<td>30.8</td>
<td>32</td>
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<td></td>
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<tr>
<td></td>
<td>&gt;12 to 13 years</td>
<td>31</td>
<td>25.8</td>
<td>48</td>
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<td></td>
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<tr>
<td></td>
<td>&gt;13 to 14 years</td>
<td>11</td>
<td>9.2</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>After 14 years</td>
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<td>10</td>
<td>15</td>
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<td></td>
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<tr>
<td>History of menstrual bleeding</td>
<td>Normal and regular</td>
<td>Menorrhagia</td>
<td>Polymenorrhea</td>
<td>Irregular menstrual cycle</td>
<td>Nil</td>
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<td>-------------------</td>
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<td>--------------</td>
<td>--------------------------</td>
<td>-----</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td></td>
<td>62</td>
<td>7</td>
<td>4</td>
<td>18</td>
<td>29</td>
<td>13.927</td>
<td></td>
</tr>
<tr>
<td></td>
<td>51.7</td>
<td>5.8</td>
<td>3.3</td>
<td>15</td>
<td>24.2</td>
<td>DF=4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>5</td>
<td>3</td>
<td>30</td>
<td>12</td>
<td>P&lt;0.01**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>58.3</td>
<td>4.2</td>
<td>2.5</td>
<td>25</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When was the last deworming drugs taken?</th>
<th>Before one month</th>
<th>Before 3 months</th>
<th>Before 6 months</th>
<th>Not at all</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>3</td>
<td>20</td>
<td>95</td>
<td>2.548NS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>History of gastritis, peptic ulcer, surgery and medicine</th>
<th>Yes</th>
<th>No</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>118</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>1.7</td>
<td>98.3</td>
<td>98.3</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>116</td>
<td>116</td>
</tr>
<tr>
<td></td>
<td>3.3</td>
<td>96.7</td>
<td>96.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Personal hygiene</th>
<th>Hygienic</th>
<th>Non hygienic</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>117</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>97.5</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>118</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>98.3</td>
<td>1.7</td>
<td></td>
</tr>
</tbody>
</table>

NS-Non significant, ** significant at 0.01 level, * significant at 0.05 level

Table 5 summarizes that 40(33.3%) were in the age group of 12 to 13 years, >13 to 14 years and >14 to 15 years both in the experimental and control group.
Regarding educational status, 40 (33.3%) were studying 7th, 8th and 9th standard both in the experimental and control group.

Related to father’s educational status, 62 (51.7%) in the experimental group and 66 (55%) in the control group were graduates. With regard to mother’s educational status, 46 (38.3%) in the experimental group and 43 (35.8%) in the control group were graduates.

Regarding the father’s occupational status, 36 (30%) were self-employed in the experimental group and 42 (35%) were private employees in the control group. Regarding mother’s occupational status, 54 (45%) in the experimental group and 49 (40.8%) in the control group were private employees.

With regard to religion, 87 (72.5%) in the experimental group and 79 out of 120 (65.8%) in the control group were Hindus. The obtained chi-square between experimental and control group in relation to age, educational status of the subject, educational status of the father and mother, occupational status of the father, mother and religion (0.0, 0.0, 2.084, 1.93, 3.317, 2.546 and 1.465 respectively) were not significant. So the experimental and control group were similar.

The majority of the subjects 48 (40%) had an income of above Rs.30,000 in the experimental group and 62 (51.7%) had an income of Rs.
20,000– Rs.30,000 in the control group. Related to area of residence, the majority of the subjects 105 (87.5%) in the experimental group and 114 (95%) in the control group belong to rural area. The obtained chi square between experimental and control group in income of the family (11.811) was significant at P<0.01 and area of residence (4.227) was significant at P<0.05. So the experimental and control group were not similar.

Regarding dietary pattern, 94 (78.3%) in the experimental group and 103 (85.8%) in the control group were non vegetarians. With regard to type of family, 112 (93.3%) in the experimental group and 117 (97.5%) in the control group were from nuclear families.

Majority of the subjects, 66 (55%) in the experimental group and 54 out of 120 (45%) in the control group were having 4 members in their family. The obtained chi square between experimental and control group in relation to dietary pattern, type of family and family size (2.295, 2.382 and 4.966) were not significant. So the experimental and control group were similar.

Majority of study participants, 37 (30.8%) attained menarche before 12 years in the experimental group and 48 (40%) attained menarche >12 to 13 years in the control group. The obtained chi square was 11.569 between experimental and control group in relation to attainment of menarche was significant at P<0.01. So the experimental and control group were not similar.
Regarding menstrual cycle, 62 (51.7%) in the experimental group and 70 (58.3%) in the control group were having normal and regular menstrual cycle. The obtained chi square between experimental and control group in relation to menstrual cycle was 13.927 which was significant at P<0.01. So the experimental and control group were not similar.

Regarding deworming drugs, 95 (79.2%) in the experimental group and 91 (75.8%) in the control group had never taken deworming drugs. Regarding history of gastritis and medicine, 118 (98.3%) in the experimental group and 116 (96.7%) in the control group had no history of gastritis. 117 (97.5%) in the experimental group and 118 (98.3%) in the control group had good hygienic practice. The obtained chi square between experimental and control group in relation to history of deworming drugs, history of gastritis and medicine and personal hygiene (2.548, 0.684 and 0.204) were not significant. So the experimental and control group were similar.
SECTION II

Objective 1: To assess the iron deficiency anemia and intelligence among adolescent girls with anemia.

Table No 6:
Pretest and post test anemic sign in experimental and control group of adolescent girls with anemia. (n=240)

<table>
<thead>
<tr>
<th>Anemic sign</th>
<th>Experimental group (n=120)</th>
<th>Control group (n=120)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Anemic sign (&lt;6)</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Mild Anemic sign (6-12)</td>
<td>71</td>
<td>59.2</td>
</tr>
<tr>
<td>Moderate Anemic sign (13-19)</td>
<td>49</td>
<td>40.8</td>
</tr>
<tr>
<td>Post test - I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Anemic sign (&lt;6)</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td>Mild Anemic sign (6-12)</td>
<td>42</td>
<td>35</td>
</tr>
<tr>
<td>Moderate Anemic sign (13-19)</td>
<td>42</td>
<td>35</td>
</tr>
<tr>
<td>Post test – II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Anemic sign (&lt;6)</td>
<td>49</td>
<td>40.8</td>
</tr>
<tr>
<td>Mild Anemic sign (6-12)</td>
<td>38</td>
<td>31.7</td>
</tr>
<tr>
<td>Moderate Anemic sign (13-19)</td>
<td>33</td>
<td>27.5</td>
</tr>
</tbody>
</table>
In the experimental group, 59.2% had mild anemic sign and 40.8% had moderate anemic sign in the pretest. Whereas in the control group, 55.8% had mild anemic sign and 44.2% of adolescent girls had moderate anemic sign in the pretest.

In the experimental group, 30% had no anemic sign and 35% of adolescent girls had mild and moderate anemic sign in the post test –I. Whereas in the control group, 2.5% had no anemic sign, 58.3% of adolescent girls had a mild anemic sign and 39.2% of adolescent girls had moderate anemic sign in the post test –I.

In the experimental group, 40.8% had no anemic sign, 31.7% had mild anemic sign and 27.5% had moderately anemic sign in the post test-II. Whereas in the control group, 4.17% had no anemic sign, 56.7% had mild anemic sign and 39.2% of adolescent girls had moderate anemic sign in the post test-II.
Table No 7:
Pretest and post test hemoglobin level in experimental and control group of adolescent girls with anemia. (n=240)

<table>
<thead>
<tr>
<th>Anemic sign</th>
<th>Experimental group (n-120)</th>
<th>Control group (n-120)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (above 12 gm/dl)</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Mild Anemia (10-12 gm/dl)</td>
<td>61</td>
<td>50.8</td>
</tr>
<tr>
<td>Moderate Anemia (10-12 gm/dl)</td>
<td>59</td>
<td>49.2</td>
</tr>
<tr>
<td>Post test - I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (above 12 gm/dl)</td>
<td>34</td>
<td>28.3</td>
</tr>
<tr>
<td>Mild Anemia (10-12 gm/dl)</td>
<td>42</td>
<td>35</td>
</tr>
<tr>
<td>Moderate Anemia (10-12 gm/dl)</td>
<td>44</td>
<td>36.7</td>
</tr>
<tr>
<td>Post test – II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (above 12 gm/dl)</td>
<td>48</td>
<td>40</td>
</tr>
<tr>
<td>Mild Anemia (10-12 gm/dl)</td>
<td>40</td>
<td>33.3</td>
</tr>
<tr>
<td>Moderate Anemia (10-12 gm/dl)</td>
<td>32</td>
<td>26.7</td>
</tr>
</tbody>
</table>
In the experimental group, 50.8% had mild anemia and 49.2% had moderate anemia in the pretest, whereas in the control group, 45% had mild anemia and 55% of adolescent girls had moderate anemia in the pretest.

In the experimental group, 28.3% had a normal hemoglobin level, 35% had mild anemia and 36.7% of adolescent girls had moderate anemia in the post test-I, whereas in the control group, 45% of adolescent girls had mild anemia and 55% of adolescent girls had moderate anemia in post test-I.

In the experimental group, 40% had normal hemoglobin level, 33.3% had mild anemia and 26.7% of adolescent girls had moderate anemia in the post test-II. In the control group, 2.5% had normal hemoglobin levels, 46.7% had mild anemia and 50.8% of adolescent girls had moderate anemia in the post test-II.
Table No 8:
Distribution of samples according to the peripheral smear

<table>
<thead>
<tr>
<th>Peripheral smear</th>
<th>No of adolescent girls</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normochromic Normocytic</td>
<td>123</td>
<td>22.7</td>
</tr>
<tr>
<td>Hypochromic Microcytic</td>
<td>368</td>
<td>67.9</td>
</tr>
<tr>
<td>Normochromic Macrocytic</td>
<td>51</td>
<td>9.4</td>
</tr>
</tbody>
</table>

Out of 542 adolescent girls, 67.9% (368) had hypochromic microcytic anemia, 22.7% (123) had normochromic normocytic anemia, and 9.4% (51) had normochromic macrocytic anemia.
Table No 9:
Pre and Post test scores of Intelligence level among adolescent girls with anemia. (n=240)

<table>
<thead>
<tr>
<th>Intelligence level</th>
<th>Experimental group (n=120)</th>
<th>Control group (n=120)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td><strong>PRE TEST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borderline (75-89)</td>
<td>44</td>
<td>36.7</td>
</tr>
<tr>
<td>Average (90-109)</td>
<td>63</td>
<td>52.58</td>
</tr>
<tr>
<td>Superior (110-125)</td>
<td>10</td>
<td>8.3</td>
</tr>
<tr>
<td>Very superior (126-139)</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>POST TEST –I</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borderline (75-89)</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td>Average (90-109)</td>
<td>58</td>
<td>48.3</td>
</tr>
<tr>
<td>Superior (110-125)</td>
<td>18</td>
<td>15</td>
</tr>
<tr>
<td>Very superior (126-139)</td>
<td>8</td>
<td>6.7</td>
</tr>
<tr>
<td><strong>POST TEST - II</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borderline (75-89)</td>
<td>32</td>
<td>26.7</td>
</tr>
<tr>
<td>Average (90-109)</td>
<td>54</td>
<td>45</td>
</tr>
<tr>
<td>Superior (110-125)</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>Very superior (126-139)</td>
<td>10</td>
<td>8.3</td>
</tr>
</tbody>
</table>
In the experimental group, 36.7% had borderline intelligence, 52.58% had average intelligence, 8.3% had superior and 2.5% of adolescent girls had very superior intelligence in the pretest, whereas in the control group, 35.8% had borderline intelligence, 51.7% had average intelligence, 9.2% and 3.3% of adolescent girls had superior and very superior intelligence in the pretest respectively.

In the experimental group, 30% of adolescent girls had borderline intelligence, 48.3% had average intelligence, 15% had superior and 6.7% had very superior intelligence in the post test I.

In the experimental group, 26.7% of adolescent girls had borderline intelligence, 45% had average intelligence, 20% had superior and 8.3% had very superior intelligence in the post test II. The control group had no change in post test I and post test II intelligence level.
Table No 10:
Area wise distribution of Pre and Post Intelligence level in the Experimental and control group of anemic adolescent girls. (n=240)

<table>
<thead>
<tr>
<th>Area wise</th>
<th>Experimental group (n=120)</th>
<th>Control Group (n=120)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td><strong>PRE TEST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Information</td>
<td>103.23</td>
<td>10.159</td>
</tr>
<tr>
<td>Arithmetic</td>
<td>102.03</td>
<td>10.101</td>
</tr>
<tr>
<td>Similarities</td>
<td>91.15</td>
<td>9.547</td>
</tr>
<tr>
<td>Digit span</td>
<td>86.88</td>
<td>9.321</td>
</tr>
<tr>
<td>Picture comprehension</td>
<td>97.78</td>
<td>9.888</td>
</tr>
<tr>
<td>Object assembly</td>
<td>94.18</td>
<td>9.704</td>
</tr>
<tr>
<td>Coding</td>
<td>92.96</td>
<td>9.641</td>
</tr>
<tr>
<td>Maize</td>
<td>78.22</td>
<td>8.849</td>
</tr>
<tr>
<td><strong>POST TEST I</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Information</td>
<td>104.45</td>
<td>10.220</td>
</tr>
<tr>
<td>Arithmetic</td>
<td>108.44</td>
<td>10.414</td>
</tr>
<tr>
<td>Similarities</td>
<td>93.29</td>
<td>9.658</td>
</tr>
<tr>
<td>Digit span</td>
<td>95.05</td>
<td>9.749</td>
</tr>
<tr>
<td>Picture comprehension</td>
<td>99.12</td>
<td>9.955</td>
</tr>
<tr>
<td>Object assembly</td>
<td>95.02</td>
<td>9.747</td>
</tr>
<tr>
<td>Coding</td>
<td>94.28</td>
<td>9.719</td>
</tr>
<tr>
<td>Maize</td>
<td>80.27</td>
<td>8.959</td>
</tr>
<tr>
<td><strong>POST TEST II</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Information</td>
<td>104.59</td>
<td>10.221</td>
</tr>
<tr>
<td>Arithmetic</td>
<td>111.09</td>
<td>10.540</td>
</tr>
<tr>
<td>Similarities</td>
<td>94.30</td>
<td>9.711</td>
</tr>
<tr>
<td>Digit span</td>
<td>98.25</td>
<td>9.912</td>
</tr>
<tr>
<td>Picture comprehension</td>
<td>100.55</td>
<td>10.027</td>
</tr>
<tr>
<td>Object assembly</td>
<td>96.15</td>
<td>9.805</td>
</tr>
<tr>
<td>Coding</td>
<td>95.11</td>
<td>9.752</td>
</tr>
<tr>
<td>Maize</td>
<td>81.46</td>
<td>9.025</td>
</tr>
</tbody>
</table>
Table 10 indicates that in the experimental group, the pretest mean of general information was 103.23 ± 10.159 and in the control group the pretest mean was 102.28 ± 10.113. In the experimental group, the arithmetic pretest mean was 102.03 ± 10.101 and in the control group the pretest mean was 105.16 ± 10.255.

In the experimental group, the pretest mean value for similarities was 91.15 ± 9.547, whereas in the control group the pretest mean value was 92.27 ± 9.615. In the experimental group, area of digit span the pretest mean value was 86.88 ± 9.321 and in the control group the pretest mean value was 92.04 ± 9.593.

In the experimental group, the pretest mean in the area of picture comprehension was 97.78 ± 9.888, whereas in the control group the pretest mean was 96.59 ± 9.828. In the experimental group for object assembly the pretest mean was 94.18 ± 9.704 and in the control group the pretest mean was 92.49 ± 9.612.

In the experimental group, the pretest mean for coding was 92.96 ± 9.641 and in the control group the pretest mean value was 91.19 ± 9.549. In the experimental group, the pretest mean for maize was 78.22 ± 8.849, whereas in the control group the pretest mean was 79.14 ± 8.896.
In the experimental group, the obtained post test - I mean value in the area of general information was 104.45 ± 10.22, arithmetic mean was 108.44 ± 10.414, and the obtained mean value in the area of similarities was 93.29 ± 9.658, mean value of digit span was 95.05 ± 9.749, for picture comprehension mean value was 99.12 ± 9.955. The mean value obtained in the area of object assembly was 95.02 ± 9.747, the obtained mean value of coding was 94.28 ± 9.719 and mean value for maize was 80.27 ± 8.959.

In experimental group, the obtained post test - II mean value in the area of general information was 104.59 ± 10.221, for arithmetic was 111.09 ± 10.54, the mean value obtained in the area of similarities was 94.30 ± 9.711, mean value of digit span was 98.25 ± 9.912, for picture comprehension obtained mean value was 100.55 ± 10.027. The mean value obtained in the area of object assembly was 96.15 ± 9.805, the obtained mean value of coding was 95.11 ± 9.752 and mean value for maize was 81.46 ± 9.025. There was no change in post test-I and post test-II intelligence level of the control group.
SECTION – III

Objective 2: To find out the effectiveness of nutritional intervention on iron deficiency anemia and intelligence among anemic adolescent girls.

Table No 11:
Comparison of pretest and post test –II anemic sign in the experimental group among control group of adolescent girls with anemia. (n=120)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Paired t-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental Group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre test</td>
<td>9.47</td>
<td>3.076</td>
<td>2.923</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td>Post test –II</td>
<td>5.88</td>
<td>2.423</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Control Group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre test</td>
<td>9.62</td>
<td>3.101</td>
<td>0.209</td>
<td>0.850</td>
</tr>
<tr>
<td>Post test –II</td>
<td>9.53</td>
<td>3.087</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P<0.01** Highly significant

The mean post test-II anemic sign (5.88) was lower than the pretest anemic sign (9.47) in the experimental group. There was a significant difference in anemic sign between the post test-II and pretest in the experimental group which was statistically highly significant (t=.2.923, p < 0.01). So the researcher accepts H₁ hypothesis which was the mean post
test anemic sign of adolescent girls with anemia in experimental group who had nutritional intervention was significantly lower than the mean pretest anemic sign.
Fig 4: Line diagram showing mean distribution of anemic sign in pretest and post test –II of adolescent girls with anemia in the experimental group.
Table No 12:
Comparison of pretest and post test anemic sign between the experimental and control group of adolescent girls with anemia. (n=240)

<table>
<thead>
<tr>
<th>ANEMIC SIGN</th>
<th>Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Independent T value</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>Experiment</td>
<td>9.47</td>
<td>3.076</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>9.62</td>
<td>3.101</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>9.55</td>
<td>3.088</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post test-I</td>
<td>Experiment</td>
<td>7.53</td>
<td>2.743</td>
<td>9.756 **</td>
<td>F(2,476) =36.75 P&lt;0.01**</td>
</tr>
<tr>
<td>(9th &amp; 10th week)</td>
<td>Control</td>
<td>9.69</td>
<td>3.113</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>8.61</td>
<td>2.928</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post test-II</td>
<td>Experiment</td>
<td>5.88</td>
<td>2.423</td>
<td>15.767 ***</td>
<td></td>
</tr>
<tr>
<td>(13th &amp; 14th week)</td>
<td>Control</td>
<td>9.53</td>
<td>3.087</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>7.71</td>
<td>2.755</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P < 0.001 level*** - Very Highly Significant; P<0.01** Highly significant

It summarizes that mean pretest anemic sign in the experimental group was 9.47 ± 3.076 and the post test-I, post test-II mean value was 7.53 ± 2.743 and 5.88 ± 2.423 respectively.

The mean pre test anemic sign in the control group was 9.62 ± 3.101 and the post test- I, post test II mean value was 9.69 ± 3.113 and 9.53 ± 3.087 respectively.
Comparing between the experimental and control group in the post test-I anemic sign, the obtained ‘t’ value was 9.756 and in the post test-II anemic sign, the ‘t’ value was 15.767 which was very highly significant at P<0.001.

Repeated anova was used to compare the total mean difference between the pretest, post test-I and post test - II anemic sign level. The obtained ‘F’ ratio was 36.75, which was statistically significant P<0.01 level.

This revealed that there was a significant reduction in anemic sign of adolescent girls with anemia in the experimental group than in the control group. So, the researcher accepted the research hypothesis H₂ which was the mean post test anemic sign of adolescent girls with anemia in the experimental group who had nutritional intervention was significantly lower than the mean post test anemic sign of the control group.
Fig 5: Bar diagram showing mean distribution of anemic sign in pretest and post test of adolescent girls with anemia in the experimental group and control group.
Table No 13:

Comparison of pretest and post test -II hemoglobin level in the experimental group among control group of adolescent girls with anemia. (n=120)

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Paired t-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre test</td>
<td>9.69</td>
<td>3.112</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post test –II</td>
<td>12.16</td>
<td>3.487</td>
<td>3.031</td>
<td>P&lt;0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Group</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre test</td>
<td>9.76</td>
<td>3.123</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post test –II</td>
<td>9.79</td>
<td>3.129</td>
<td>0.414</td>
<td>0.764</td>
</tr>
</tbody>
</table>

**P<0.01** Highly significant

The mean post test–II hemoglobin level (12.16) was higher than the mean pretest hemoglobin level (9.69) in the experimental group. There was a significant difference in hemoglobin level between the pre test and post test-II in the experimental group which was statistically highly significant (t=3.031, p < 0.01). The mean post test hemoglobin level of adolescent girls with anemia in experimental group who had nutritional intervention was significantly higher than the mean pre test hemoglobin level. So the researcher accepts H₃ hypothesis.
Fig 6: Line diagram showing mean distribution of hemoglobin level in pretest and post test –II of adolescent girls with anemia in the experimental group.
Table No 14:
Comparison of pre test and post test hemoglobin level between the Experimental group and Control group of adolescent girls with anemia.

\[(n=240)\]

<table>
<thead>
<tr>
<th>Hemoglobin level</th>
<th>Group</th>
<th>Mean</th>
<th>Std deviation</th>
<th>Independent T value</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>Experiment</td>
<td>9.69</td>
<td>3.112</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>9.76</td>
<td>3.123</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>9.725</td>
<td>3.112</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post test -I</td>
<td>Experiment</td>
<td>11.68</td>
<td>3.418</td>
<td></td>
<td>12.292</td>
</tr>
<tr>
<td>(9\textsuperscript{th} &amp; 10\textsuperscript{th} week)</td>
<td>Control</td>
<td>9.79</td>
<td>3.129</td>
<td></td>
<td>P&lt;0.001***</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>10.35</td>
<td>3.181</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post test -II</td>
<td>Experiment</td>
<td>12.16</td>
<td>3.487</td>
<td></td>
<td>15.265</td>
</tr>
<tr>
<td>(13\textsuperscript{th} &amp; 14\textsuperscript{th} week)</td>
<td>Control</td>
<td>9.79</td>
<td>3.129</td>
<td></td>
<td>P&lt;0.001***</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>10.99</td>
<td>2.217</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P < 0.001 level*** - Very Highly Significant; P<0.01** Highly Significant

Table-14 summarizes that mean pretest hemoglobin level in the experimental group was 9.69 ± 3.112 and the post test-I, post test-II mean value was 11.68 ± 3.418 and 12.16 ± 3.487 respectively.

The mean pretest hemoglobin in the control group was 9.76 ± 3.123 and the post test-I, post test -II mean value was 9.79 ± 3.129.
Comparing between the experimental and control group in the post test-I hemoglobin level, the obtained ‘t’ value was 12.292 which was very highly significant at P<0.001. In the post test-II hemoglobin level, the ‘t’ value was 15.265 which was very highly significant at P<0.001.

Repeated anova was used to compare the total mean difference between the pretest, post test-I and post test - II hemoglobin level. The obtained ‘F’ ratio was 38.65, which was statistically significant P<0.01 level.

This revealed that there was significant progress in hemoglobin level of adolescent girls with anemia in the experimental group than the control group. Hence, it was concluded that the mean post test hemoglobin level of adolescent girls with anemia in the experimental group who had nutritional intervention was significantly higher than the mean post test hemoglobin level of the control group. So the researcher accepted the research hypothesis H₄.
Fig 7: Bar diagram showing mean distribution of hemoglobin level in pretest and post test of adolescent girls with anemia in the experimental group and control group.
Table No 15:

Comparison of pretest and post test -II intelligence level in the experimental group among control group of adolescent girls with anemia.  (n=120)

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Paired t-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre test</td>
<td>93.91</td>
<td>9.690</td>
<td>2.010</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>Post test –II</td>
<td>98.52</td>
<td>9.926</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Group</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre test</td>
<td>93.3</td>
<td>9.659</td>
<td>0.129</td>
<td>0.981</td>
</tr>
<tr>
<td>Post test –II</td>
<td>93.3</td>
<td>9.659</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P<0.05* is significant

The mean post test–II intelligence level (98.52) was higher than the mean pretest intelligence level (93.91) in the experimental group. There was a significant difference in intelligence level between the pretest and post test-II in the experimental group which was statistically highly significant (t=.2.010, p < 0.05). So the researcher accepts H₃ hypothesis which was the mean post test intelligence level of adolescent girls with anemia in experimental group who had nutritional intervention was significantly higher than the mean pre test intelligence level of adolescent girls with anemia.
Fig 8: Line diagram showing mean distribution of intelligence level in pretest and post test –II of adolescent girls with anemia in the experimental group.
Table No 16:
Comparison of pre test and post test intelligence level between the experimental and control group of adolescent girls with anemia. (n=240)

<table>
<thead>
<tr>
<th>Intelligence level</th>
<th>Group</th>
<th>Mean</th>
<th>Std deviation</th>
<th>Independent T value</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>Experiment</td>
<td>93.91</td>
<td>9.690</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>93.30</td>
<td>9.659</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>93.61</td>
<td>9.67</td>
<td></td>
<td>F(2,476)=21.615* P&lt;0.01**</td>
</tr>
<tr>
<td>Post test- I (9th &amp; 10th week)</td>
<td>Experiment</td>
<td>97.26</td>
<td>9.861</td>
<td>12.792</td>
<td>P&lt;0.001***</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>93.30</td>
<td>9.659</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>95.28</td>
<td>9.76</td>
<td></td>
<td>P&lt;0.001***</td>
</tr>
<tr>
<td>Post test-II (13th &amp; 14th week)</td>
<td>Experiment</td>
<td>98.52</td>
<td>9.926</td>
<td>31.788</td>
<td>P&lt;0.001***</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>93.30</td>
<td>9.659</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>95.91</td>
<td>9.792</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P < 0.001 level*** - Very Highly Significant; P<0.01** Highly Significant

It summarizes that mean pretest intelligence score in the experimental group was 93.91 ± 9.690 and the post test- I, post test II mean value was 97.26 ± 9.861 and 98.52 ± 9.926 respectively.
The mean pretest intelligence in the control group was 93.30 ± 9.659 and there was no change in the post test-I, post test II mean value respectively.

Comparing between the experimental group and control group of post test-I intelligence level, the obtained ‘t’ value was 12.792 significant at P<0.001 and in the post test-II intelligence level, the obtained ‘t’ value was 31.788 which was very highly significant at P<0.001.

Repeated anova measure used to compare the total mean difference between the pretest, post test-I and post test-II intelligence level. The obtained ‘F’ ratio was 21.615, was significant P<0.01 level and indicated that the nutritional intervention is effective.

Hence, it was concluded that the mean post test intelligence level of adolescent girls with anemia in the experimental group who had nutritional intervention was significantly higher than the mean post test intelligence level of the control group. So, the researcher accepted H₆ research hypothesis.
Fig 9: Bar diagram showing mean distribution of intelligence level in pretest and post test of adolescent girls with anemia in the experimental group and control group.
SECTION – IV

Objective 3: To find out the relationship between iron deficiency anemia and intelligence of adolescent girls with anemia.

Table No 17:
Correlation between post test-II anemic sign and post test-II hemoglobin level in the experimental group.

<table>
<thead>
<tr>
<th>Variables</th>
<th>r-value</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemic sign and Hemoglobin level</td>
<td>-0.91</td>
<td>P&lt;0.01**</td>
</tr>
</tbody>
</table>

P<0.01** Highly Significant

Correlation analysis between anemic sign and hemoglobin level was -0.91 at P<0.01 level. The result showed that there was a significant negative relationship. This reveals when the hemoglobin level increases, there was a decrease in anemic sign. Hence there was a significant negative relationship between anemic sign and hemoglobin level. So the research hypothesis $H_7$ was accepted.
Table No 18:
Correlation between post test-II hemoglobin level and post test-II intelligence score in the experimental group.

<table>
<thead>
<tr>
<th>Variables</th>
<th>r-value</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin level and Intelligence level</td>
<td>0.84</td>
<td>P&lt;0.01**</td>
</tr>
</tbody>
</table>

P<0.01** Highly Significant

Correlation analysis between hemoglobin level and intelligence score was 0.84 at P<0.01 level. The results showed that there was a significant relationship between hemoglobin level and intelligence. So the research hypothesis H₈ was accepted.
SECTION V
Objective 4: To find out the association between demographic variables and posttest iron deficiency anemia and intelligence level of adolescent girls with anemia.

TABLE No 19:
Association between demographic variables and post test –II hemoglobin level in the experimental group of adolescent girls with anemia.  \(n=120\)

<table>
<thead>
<tr>
<th>Experimental group</th>
<th>Median &amp; below Median</th>
<th>Above median</th>
<th>Chi square/ significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Age in years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 – 13 yrs</td>
<td>13</td>
<td>32.5</td>
<td>27</td>
</tr>
<tr>
<td>&gt;13 – 14 yrs</td>
<td>26</td>
<td>65</td>
<td>14</td>
</tr>
<tr>
<td>&gt;14 – 15 yrs</td>
<td>22</td>
<td>55</td>
<td>18</td>
</tr>
<tr>
<td>Educational status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7(^{th}) std</td>
<td>13</td>
<td>32.5</td>
<td>27</td>
</tr>
<tr>
<td>8(^{th}) std</td>
<td>26</td>
<td>65</td>
<td>14</td>
</tr>
<tr>
<td>9(^{th}) std</td>
<td>22</td>
<td>55</td>
<td>18</td>
</tr>
<tr>
<td>Mother's education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>5</td>
<td>62.5</td>
<td>3</td>
</tr>
<tr>
<td>Primary education</td>
<td>3</td>
<td>25</td>
<td>9</td>
</tr>
<tr>
<td>Secondary education</td>
<td>7</td>
<td>43.8</td>
<td>9</td>
</tr>
<tr>
<td>Higher secondary education</td>
<td>22</td>
<td>57.9</td>
<td>16</td>
</tr>
<tr>
<td>Degree and above</td>
<td>24</td>
<td>52.2</td>
<td>22</td>
</tr>
</tbody>
</table>
Income of the family

<table>
<thead>
<tr>
<th>Income of the family</th>
<th>Below Rs.10,000</th>
<th>4</th>
<th>33.3</th>
<th>8</th>
<th>66.7</th>
<th>2.149 NS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;Rs.11,000 –</td>
<td>7</td>
<td>53.8</td>
<td>6</td>
<td>46.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rs.20,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;Rs.20,000 –</td>
<td>23</td>
<td>48.9</td>
<td>24</td>
<td>51.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rs.20,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Above Rs.30,000</td>
<td>27</td>
<td>56.3</td>
<td>21</td>
<td>43.8</td>
<td></td>
</tr>
</tbody>
</table>

Area of residence

<table>
<thead>
<tr>
<th>Area of residence</th>
<th>Rural</th>
<th>52</th>
<th>49.5</th>
<th>53</th>
<th>50.5</th>
<th>0.576 NS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban</td>
<td>9</td>
<td>60</td>
<td>6</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

Diet

<table>
<thead>
<tr>
<th>Diet</th>
<th>Vegetarian</th>
<th>13</th>
<th>50</th>
<th>13</th>
<th>50</th>
<th>0.009 NS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non vegetarian</td>
<td>48</td>
<td>51.1</td>
<td>46</td>
<td>48.9</td>
<td></td>
</tr>
</tbody>
</table>

Age at Menarche

<table>
<thead>
<tr>
<th>Age at Menarche</th>
<th>Not attained</th>
<th>16</th>
<th>55.2</th>
<th>13</th>
<th>44.8</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before 12 years</td>
<td>15</td>
<td>40.5</td>
<td>22</td>
<td>59.5</td>
<td>3.607 NS</td>
</tr>
<tr>
<td></td>
<td>&gt;12 -13 years</td>
<td>19</td>
<td>61.3</td>
<td>12</td>
<td>38.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;13 -14 years</td>
<td>6</td>
<td>54.5</td>
<td>5</td>
<td>45.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After 14 years</td>
<td>5</td>
<td>41.7</td>
<td>7</td>
<td>58.3</td>
<td></td>
</tr>
</tbody>
</table>

History of Menstrual Bleeding

<table>
<thead>
<tr>
<th>History of Menstrual Bleeding</th>
<th>Normal and regular</th>
<th>32</th>
<th>48.5</th>
<th>30</th>
<th>51.5</th>
<th>7.654 NS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Menorrhagia</td>
<td>1</td>
<td>14.3</td>
<td>6</td>
<td>85.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Polymenorrhagia</td>
<td>4</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Irregular menstrual cycle</td>
<td>9</td>
<td>50</td>
<td>9</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nil</td>
<td>16</td>
<td>55.2</td>
<td>13</td>
<td>44.8</td>
<td></td>
</tr>
</tbody>
</table>

P<0.01** Highly significant, NS – Not Significant

In order to find out the association between the age in years, education status and post test-II hemoglobin level, chi square test was computed. The obtained chi square value was 8.869 at df 2 (P<0.01).
This showed that there was a significant association between age in years, education status and post test-II hemoglobin level of adolescent girls with anemia in the experimental group.

There was no significant association between father’s educational status, father’s occupation, mother’s occupation, religion, income of the family, area of residence, diet, type of family, number of family members, attainment of menarche, menstrual history, deworming, history of gastritis, peptic ulcer, personal hygiene and post test-II hemoglobin level of adolescent girls with anemia in the experimental group.
TABLE No 20:
Association between demographic variables and post test-II hemoglobin level in the control group of adolescent girls with anemia. (n=120)

<table>
<thead>
<tr>
<th>Control group</th>
<th>Median &amp; below Median</th>
<th>Above median</th>
<th>Chi square/ significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Age in years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 – 13 yrs</td>
<td>21</td>
<td>52.5</td>
<td>19</td>
</tr>
<tr>
<td>&gt;13 – 14 yrs</td>
<td>20</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>&gt;14 – 15 yrs</td>
<td>21</td>
<td>52.5</td>
<td>19</td>
</tr>
<tr>
<td>Educational status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>21</td>
<td>52.5</td>
<td>19</td>
</tr>
<tr>
<td>8&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>20</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>9&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>21</td>
<td>52.5</td>
<td>19</td>
</tr>
<tr>
<td>Mother’s education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>2</td>
<td>28.6</td>
<td>5</td>
</tr>
<tr>
<td>Primary education</td>
<td>2</td>
<td>14.3</td>
<td>12</td>
</tr>
<tr>
<td>Secondary education</td>
<td>12</td>
<td>52.2</td>
<td>11</td>
</tr>
<tr>
<td>Higher secondary education</td>
<td>21</td>
<td>63.6</td>
<td>12</td>
</tr>
<tr>
<td>Degree &amp; above</td>
<td>25</td>
<td>58.1</td>
<td>18</td>
</tr>
<tr>
<td>Father’s occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government employee</td>
<td>13</td>
<td>61.9</td>
<td>8</td>
</tr>
<tr>
<td>Private employee</td>
<td>27</td>
<td>64.3</td>
<td>15</td>
</tr>
<tr>
<td>Self employed</td>
<td>7</td>
<td>26.9</td>
<td>19</td>
</tr>
<tr>
<td>Daily wages</td>
<td>15</td>
<td>48.4</td>
<td>16</td>
</tr>
<tr>
<td>Unemployed</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Area of residence</td>
<td>Rural</td>
<td>Urban</td>
<td>Diet</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td>61</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>53.5</td>
<td>16.7</td>
<td>41.2</td>
</tr>
<tr>
<td></td>
<td>53</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>46.5</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3.098</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet</td>
<td>Vegetarian</td>
<td>7</td>
<td>41.2</td>
</tr>
<tr>
<td></td>
<td>Non vegetarian</td>
<td>55</td>
<td>53.4</td>
</tr>
</tbody>
</table>

| Age at Menarche   | Not attained | 7   | 58.3 | 5     | 41.7          |      | 5          | 46.5           |
|                  | Before 12 years | 11  | 34.4 | 21    | 65.6          |      | 21         | 34.4           |
|                  | >12 -13 years | 27  | 56.3 | 21    | 43.8          |      | 21         | 56.3           |
|                  | >13 -14 years | 7   | 53.8 | 6     | 46.2          |      | 6          | 53.8           |
|                  | After 14 years | 10  | 66.7 | 5     | 33.3          |      | 5          | 66.7           |
| Age at Menarche   |                |     |      |      |               |      |            |                |
|                   | Normal and regular | 37  | 50.7 | 33    | 49.3          |      | 33         | 50.7           |
| History of Menstrual Bleeding | Menorrhagia | 2   | 40   | 3     | 60            |      | 3          | 40             |
| History of Menstrual Bleeding | Polymenorrhea | 2   | 66.7 | 1     | 33.3          |      | 1          | 66.7           |
| History of Menstrual Bleeding | Irregular menstrual cycle | 14  | 46.7 | 16    | 53.3          |      | 16         | 46.7           |
| History of Menstrual Bleeding | Nil | 7   | 58.3 | 5     | 41.7          |      | 5          | 58.3           |
| History of Menstrual Bleeding |                |     |      |      |               |      |            |                |
| History of gastritis, peptic ulcer, surgery and medicines etc | Yes | 58  | 50   | 58    | 50            |      | 58         | 50             |
| History of gastritis, peptic ulcer, surgery and medicines etc | No | 4   | 100  | 0     | 0             |      | 0          | 100            |

P<0.01** Highly significant, P<0.05* - Significant, NS – Not Significant

In order to find out the association between the mother’s educational status, and post test-II hemoglobin level, chi square test was computed. The obtained chi square value was 11.946 at df 4(P<0.01). This showed that there was a significant association between mother’s education status.
and post test-II hemoglobin level in the control group. To find out the association between the father’s occupation and post hemoglobin level, chi square test was computed. The obtained chi square value was 10.06 significant at P<0.01. This showed that there was a significant association between father’s occupation and post test-II hemoglobin level in the control group.

To find out the association between the history of gastritis, peptic ulcer and post test-II hemoglobin level, chi square test was computed. The obtained chi square value was 3.87 significant at P<0.05. This showed that there was a significant association between history of gastritis, peptic ulcer and post test-II hemoglobin level in the control group.

There was no significant association between age in years, educational status, father’s educational status, mother’s occupation, religion, income of the family, area of residence, diet, type of family, number of family members, attainment of menarche, menstrual history, deworming, personal hygiene and post test-II hemoglobin level in the control group.
Table No 21:
Association between demographic variables and post test-II intelligence scale in the experimental group. (n=120)

<table>
<thead>
<tr>
<th>Experimental group</th>
<th>Median and below Median</th>
<th>Above median</th>
<th>Chi square/ significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Age in years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 – 13 yrs</td>
<td>18</td>
<td>45</td>
<td>22</td>
</tr>
<tr>
<td>&gt;13 – 14 yrs</td>
<td>18</td>
<td>45</td>
<td>22</td>
</tr>
<tr>
<td>&gt;14 – 15 yrs</td>
<td>24</td>
<td>60</td>
<td>16</td>
</tr>
<tr>
<td>Educational status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>18</td>
<td>45</td>
<td>22</td>
</tr>
<tr>
<td>8&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>18</td>
<td>45</td>
<td>22</td>
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<tr>
<td>9&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>24</td>
<td>60</td>
<td>16</td>
</tr>
<tr>
<td>Father’s education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>2</td>
<td>40</td>
<td>3</td>
</tr>
<tr>
<td>Primary education</td>
<td>4</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>Secondary education</td>
<td>3</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>Higher secondary education</td>
<td>17</td>
<td>48.6</td>
<td>18</td>
</tr>
<tr>
<td>Degree and above</td>
<td>34</td>
<td>54.8</td>
<td>28</td>
</tr>
<tr>
<td>Mother’s education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>4</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>Primary education</td>
<td>2</td>
<td>16.7</td>
<td>10</td>
</tr>
<tr>
<td>Secondary education</td>
<td>8</td>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td>Higher secondary education</td>
<td>25</td>
<td>65.8</td>
<td>13</td>
</tr>
<tr>
<td>Degree and above</td>
<td>21</td>
<td>45.7</td>
<td>25</td>
</tr>
<tr>
<td>Type of family</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint family</td>
<td>58</td>
<td>51.8</td>
<td>54</td>
</tr>
<tr>
<td>Nuclear family</td>
<td>2</td>
<td>25</td>
<td>6</td>
</tr>
</tbody>
</table>

P<0.05<sup>*</sup> - significant, NS – Not Significant
Table 21 shows the association between demographic variables and post test-II intelligence scale in the experimental group.

In order to find out the association between the mother’s educational status and intelligence, chi square test was computed. The obtained chi square value was 9.471 significant at P<0.05. There was a significant association between mother’s education and intelligence in the experimental group.

There was no significant association between age in years, educational status, father’s educational status, father’s occupation, mother’s occupation, religion, income of the family, area of residence, diet, type of family, number of family members, attainment of menarche, menstrual history, deworming, history of gastritis, peptic ulcer, personal hygiene and post test-II intelligence in the experimental group.
Table No 22:
Association between demographic variable and post test-II intelligence scale in the control group. (n=120)

<table>
<thead>
<tr>
<th>Control group</th>
<th>Median and below Median</th>
<th>Above median</th>
<th>Chi square/significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td><strong>Age in years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 – 13 yrs</td>
<td>19</td>
<td>47.5</td>
<td>21</td>
</tr>
<tr>
<td>&gt;13 – 14 yrs</td>
<td>16</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td>&gt;14 – 15 yrs</td>
<td>25</td>
<td>62.5</td>
<td>15</td>
</tr>
<tr>
<td><strong>Educational status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>19</td>
<td>47.5</td>
<td>21</td>
</tr>
<tr>
<td>8&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>16</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td>9&lt;sup&gt;th&lt;/sup&gt; std</td>
<td>25</td>
<td>62.5</td>
<td>15</td>
</tr>
<tr>
<td><strong>Father’s education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>1</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Primary education</td>
<td>3</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>Secondary education</td>
<td>8</td>
<td>53.3</td>
<td>7</td>
</tr>
<tr>
<td>Higher secondary education</td>
<td>16</td>
<td>55.2</td>
<td>13</td>
</tr>
<tr>
<td>Degree and above</td>
<td>32</td>
<td>48.5</td>
<td>34</td>
</tr>
<tr>
<td><strong>Mother’s education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>3</td>
<td>42.9</td>
<td>4</td>
</tr>
<tr>
<td>Primary education</td>
<td>10</td>
<td>71.4</td>
<td>4</td>
</tr>
<tr>
<td>Secondary education</td>
<td>10</td>
<td>43.5</td>
<td>13</td>
</tr>
<tr>
<td>Higher secondary education</td>
<td>15</td>
<td>45.5</td>
<td>18</td>
</tr>
<tr>
<td>Degree and above</td>
<td>22</td>
<td>51.2</td>
<td>21</td>
</tr>
<tr>
<td><strong>Type of Family</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint family</td>
<td>57</td>
<td>48.7</td>
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<tr>
<td>Nuclear family</td>
<td>3</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

NS – Not Significant
Table 22 shows the association between demographic variables and post test-II intelligence scale in the control group.

There was no significant association between age in years, educational status, father’s educational status, mother’s education, father’s occupation, mother’s occupation, religion, income of the family, area of residence, diet, type of family, number of family members, attainment of menarche, menstrual history, deworming, history of gastritis, peptic ulcer, personal hygiene and post test-II intelligence in the control group.
CHAPTER V

DISCUSSION

This chapter deals with the discussion, based on the objectives and the hypothesis of the study. The findings of the study are discussed in terms of iron deficiency anemic sign, hemoglobin level and intelligence level, then compared and contrasted with those of other similar studies conducted in different settings.

The present study was designed to assess the effectiveness of nutritional intervention in treating iron deficiency anemia and improving intelligence level of adolescent girls in selected schools at Bangalore. The design used for the study was true experimental, pre and post test control group design. Four schools were selected by using a simple random technique (lottery) method and then 240 adolescent girls with anemia in the age group of 12-15 years, who had fulfilled the inclusion criteria, were selected. By using stratified random sampling technique, 240 adolescent girls with anemia were selected in the experimental group and control group. Data collection was done during the period of June 2013 to February 2014. The instruments used for data collection were observation checklist of signs and symptoms of anemia to assess the sign and symptoms of anemia, cynmet hemoglobin method used to assess the hemoglobin level, wedge blood smear test used to assess the peripheral
blood smear and MALIN’S intelligence scale used to assess the intelligence level of the adolescent girls. A pilot study was conducted to assess the feasibility of the study. Nutritional ball was administered to the experimental group for about 8 weeks. Post test I was done on 9th & 10th week and post test II was done on 13th & 14th week. Descriptive and inferential statistics were used to analyze the findings.

**Distribution of samples with regard to demographic variables:**

**Age**

The majority of the study participants, 40 (33.3%) was in the age group of 12 to 13 years, >13 to 14 years and >14 to 15 years both in the experimental and control group.

Following literature is similar to the above findings

Assefa, Mossie, & Hamza, (2014) stated that the prevalence of anemia was high (30.1%) among 12-14 years. In that 18.1% had mild anemia and 19.6% had moderate anemia.

**Type of family**

With regard to type of family, 112 (93.3%) in the experimental group and 117 (97.5%) in the control group were from nuclear families.

Premalatha, Valarmathi, Srijayanth, Sundar, & Kalpana, (2012) found out that 78.75% of adolescent girls (13-17 years) who belong to nuclear families were anemic.
Regarding educational status, 40 (33.3%) were studying in 7th, 8th and 9th standard both in the experimental and control group.

Related to father’s educational status, 62 (51.7%) in the experimental group and 66 (55%) in the control group were graduates. With regard to mother’s educational status, 46 (38.3%) in the experimental group and 43 (35.8%) in the control group were graduates.

Regarding dietary pattern, 94 (78.3%) in the experimental group and 103 (85.8%) in the control group were non vegetarians.

Regarding the father’s occupational status, 36 (30%) were self employed in the experimental group and 42 (35%) were private employees in the control group. With regard to mother’s occupational status, 54 (45%) in the experimental group and 49 (40.8%) in the control group were private employees.

With regard to religion, 87 (72.5%) in the experimental group and 79 out of 120(65.8%) in the control group were Hindus.

The majority of the subjects, 66 (55%) in the experimental group and 54 out of 120 (45%) in the control group were having 4 members in their family.
The majority of the subjects 48 (40%) had an income of above Rs.30,000/month in the experimental group and 62 (51.7%) had an income of Rs.20,000 – Rs.30,000/month in the control group.

**Area of Residence**

Related to area of residence, majority of the subjects 105 (87.5%) in the experimental group and 114 (95%) in the control group belonged to rural area.

The following literature coincides with the above findings:

Dixit, Kant, Agarwal, & Singh, (2011) observed that subjects who belonged to rural area were all anemic than the urban adolescent girls (93.3%).

Regarding deworming drugs, 95 (79.2%) in the experimental group and 91 (75.8%) in the control group had never taken deworming drugs.

**Menarche and Menstrual cycle**

The majority of study participants 37 (30.8%) attained menarche before 12 years in the experimental group and 48 (40%) attained menarche >12 - 13 years in the control group. Regarding menstrual cycle, 62 (51.7%) in the experimental group and 70 (58.3%) in the control group were having normal and regular menstrual cycle.
Above finding was similar to the following literature

Rati and Jawadagi (2012) reported that anemia was higher in girls with regular menstruation (87.5%) than the girls who have more than 5 days of menstrual bleeding (6.25%).

A study conducted by Simhachalam et al., (2014) stated that 31.6% of adolescents were anemic before attainment of menarche and 48.3% had anemia after attainment of menarche.

Regarding the history of gastritis and medicine intake, 118 (98.3%) in the experimental group and 116 (96.7%) in the control group had no history of gastritis.117 (97.5%) in the experimental group and 118 (98.3%) in the control group had good hygienic practice.

**Objective 1: To assess the iron deficiency anemia and intelligence among adolescent girls with anemia.**

**Pretest and post test scores of anemic sign in experimental and control group of adolescent girls of anemia.**

In the experimental group, 59.2% had mild anemic sign and 40.8% had moderate anemic sign in the pretest, whereas in the control group, 55.8% had mild anemic sign and 44.2% of adolescent girls had moderate anemic sign in the pretest.
The above finding was supported by the following studies

Sabale, Kowli, & Chowdary, (2013) observed that 56.5% of adolescent girls were anemic. Among that 21.6% had mild anemia, 30.9% had moderate anemia and 50% had severe anemia. Most of the participants had symptoms of tiredness and palpitation.

In the experimental group, 30% had no anemic sign, 35% of adolescent girls had mild and moderate anemic sign in the post test-I. In the control group, 2.5% had no anemic sign, 58.3% had mild anemic sign and 39.2% of adolescent girls had moderate anemic sign in the post test-I.

In the experimental group posttest II, 40.8% had no anemic sign, 31.7% had mild anemic sign and 27.5% had moderate anemic sign. Whereas in the control group, 4.17% had no anemic sign, 56.7% had mild anemic sign and 39.2% of adolescent girls had moderate anemic sign in the post test-II.

**Pretest and post test scores of hemoglobin level in experimental and control group of adolescent girls with anemia.**

In the experimental group, 50.8% of adolescent girls had mild anemia, 49.2% of adolescent girls had moderate anemia in the pretest, whereas in the control group, 45% of adolescent girls had mild anemia and 55% of adolescent girls had moderate anemia in the pretest.
A studied carried by Goyal, Rawat, & Jha, (2015) on the prevalence of anemia among 770 adolescent girls. 48.18% of participants had anemia with mean hemoglobin level 11.35%. 34.53% had mild anemia, 10.13% had moderate anemia and 3.52% had severe anemia.

In the experimental group, 28.3% had normal hemoglobin level, 35% had mild anemia and 36.7% of adolescent girls had moderate anemia in the post test-I. In the control group, 45% of adolescent girls had mild anemia and 55% of adolescent girls had moderate anemia in post test-I.

In the experimental group, 40% had normal hemoglobin level, 33.3% had mild anemia and 26.7% of adolescent girls had moderate anemia in the post test-II. In the control group, 2.5% had normal hemoglobin level, 46.7% had mild anemia and 50.8% of adolescent girls had moderate anemia in the post test-II.

The above finding was supported by the following literature,

Mageshwari and Sharmila (2012) found out the impact of the functional food supplement and nutritional status. 20gms of toffee was administered for six weeks to the experimental group. A toffee was prepared from sweet potato, rice flakes, roasted Bengal gram, soya flour and ghee. The hemoglobin level was increased from 15.9 gm/dl to 16.1gm/dl with ‘t’ value of 4.08.
Pre and Post test scores of Intelligence level among adolescent girls with anemia.

In the experimental group, 36.7% had borderline intelligence, 52.5% had average intelligence, 8.3% had superior and 2.5% of adolescent girls had very superior intelligence in the pretest respectively. In the control group, 35.8% had borderline intelligence, 51.7% had average intelligence, 9.2% and 3.3% of adolescent girls had superior and very superior intelligence in the pretest respectively.

In the experimental group, 30% of adolescent girls had borderline intelligence, 48.3% had average intelligence, 15% had superior and 6.7% had very superior intelligence in the post test-I.

In the experimental group, 26.7% of adolescent girls had borderline intelligence, 45% had average intelligence, 20% had superior and 8.3% had very superior intelligence in the post test II. The control group had no change in posttest-I and post test-II intelligence level.

A study was done by Falkingham et al., (2010) on the effects of oral iron supplementation on intelligence among adolescents. The findings revealed that iron supplementation improved attention and concentration (SMD 0.59, 95% CI 0.29 to 0.90). In anemic groups, supplementation improved intelligence quotient (IQ) by 2.5 points (95% CI 1.24 to 3.76).
Halterman, Kaczorowski, Aligne, Auinger, & Szilagy, (2007) found out that iron deficiency anemic adolescent girls had low standardized maths scores.

**Objective 2: To find out the effectiveness of nutritional intervention on iron deficiency anemia and intelligence among adolescent girls with anemia.**

The comparison of pre test and post test anemic sign between the experimental and control group of adolescent girls with anemia.

The mean pretest anemic sign in the experimental group was 9.47 ± 3.076 and the post test- I, post test- II mean value was 7.53 ± 2.743 and 5.88 ± 2.423 respectively. The mean pre test anemic sign in the control group was 9.62 ± 3.101 and the post test- I, post test - II mean value was 9.69 ± 3.113 and 9.53 ± 3.087 respectively.

The mean post test-II anemic sign score (5.88) was lower than the mean pretest anemic sign score (9.47) in the experimental group. There was a significant difference in anemic sign between the pretest and post test-II in the experimental group which was statistically highly significant (t=.2.923, p < 0.01).

Comparing between the experimental group and control group in the post test-I anemic sign, the obtained ‘t’ value was 9.756 significant at
P<0.001 and in the post test-II anemic sign, the ‘t’ value was 15.767 which was very highly significant at P<0.001.

Repeated anova was used to compare the total mean difference between the pretest, post test I and II anemic sign level. The obtained ‘F’ ratio was 36.75, which was statistically significant at P<0.01 level. It indicates the nutritional intervention was effective in reducing anemic signs among adolescent girls with anemia.

The following literature was supported by the study of Revathi and Davi (2015). The researcher revealed that there were reduction of signs and symptoms of anemia such as fatigue, general weakness, paleness of eyes and lack of interest among intervention groups.

**Comparison of pre test and post test hemoglobin level in the Experimental group and Control group of adolescent girls with anemia.**

The mean pretest hemoglobin level in the experimental group was 9.69 ± 3.112 and the post test- I, post test -II mean value was 11.68 ± 3.418 and 12.16 ± 3.487. The mean pre test hemoglobin in the control group was 9.76 ± 3.123 and the post test- I, post test- II mean value was 9.79 ± 3.129.
The mean post test-II hemoglobin level (12.16) was higher than the mean pretest hemoglobin level (9.69) in the experimental group. There was a significant difference in hemoglobin level between the pretest and post test-II in the experimental group which was statistically highly significant (t=.3.031, p < 0.01).

Comparing between the experimental group and control group in the post test-I hemoglobin level, the obtained ‘t’ value was 12.292 which was very highly significant at P<0.001. In the post test-II hemoglobin level, the ‘t’ value was 15.265 which was very highly significant at P<0.001.

Repeated anova measures used to compare the total mean difference between the pre, post test-I and post test-II hemoglobin level. The obtained ‘F’ ratio was 38.65 at a P value <0.01 was significant. It indicated the nutritional intervention was effective in improving hemoglobin level among adolescent girls with anemia.

**Above finding was supported by the following literature,**

Angel and Devi (2012) assessed the effectiveness of health mix in treating anemia among 12 -15 old years girls. 50gms of health mix (garden cress seeds, rice flakes, Bajra, roasted Bengal gram, Samai, jaggery) was given for six months. The mean post test hemoglobin level was 11.11gm/dl significantly higher than the mean pretest hemoglobin level of 8.23gm/dl.
Revathi and Devi (2015) conducted a study on the effectiveness of iron rich health mix in treating anemia among anemic adolescent girls aged between 13 and 18 years. 80gms of Iron rich health mix (is a mixture of rice flakes, wheat, roasted Bengal gram, gingelly seeds and jaggery) were given for 90 days. There was significant improvement in hemoglobin level from 8.77 to 9.75% and there were reduction signs and symptoms of anemia (fatigue, general weakness, paleness of eyes and lack of interest) among intervention groups.

The comparison of pre test and post test intelligence level between the experimental and control group of adolescent girls with anemia.

The mean pretest intelligence score in the experimental group was 93.91 ± 9.690 and the post test-I, post test-II mean value was 97.26 ± 9.861 and 98.52 ± 9.926. The mean pretest intelligence in the control group was 93.30 ± 9.659 and there was no change in the post test-I, posttest -II mean value respectively.

The mean post test–II intelligence level (98.52) was higher than the mean pretest intelligence level (93.91) in the experimental group. There was a significant difference in intelligence level between the pretest and post test-II in the experimental group which was statistically highly significant (t= 2.010, p < 0.05).
Comparing between the experimental group and control group of post test-I intelligence level, the obtained ‘t’ value was 12.792 significant at P<0.001. In the post test-II intelligence level, the obtained ‘t’ value was 31.788 which was very highly significant at P<0.001.

Repeated anova measure used to compare the total mean difference between the pretest, posttest-I and posttest-II intelligence level. The obtained ‘F’ ratio was 21.615, significant at P<0.01 level and indicates that the nutritional intervention was effective in improving the intelligence level of adolescent girls with anemia.

The above finding was supported by the following statement Nelson (2004) stated iron is an essential structural component of the hemoglobin molecule, which transports oxygen from the lungs to the rest of the body. In iron-deficiency anemia, less production of hemoglobin due to iron deficiency is clearly at risk for both short-term and long-term cognitive impairment. Iron-deficiency anemia is associated with poor mental and motor development in childhood and poor cognition and school achievement.

Jain (2013) found the prevalence of anemia to be 77% among adolescents. Iron rich food was given for 4 months to interventional group. This study revealed that there was an increase in hemoglobin level and improvement in intelligence and school performance.
Hermoso et al., (2011) reviewed that there was a positive effect on cognitive and psychomotor development in adolescent with anemia after administration of fortified foods for 2 years.

**Objective 3: To find out the relationship between iron deficiency anemia and intelligence among adolescent girls with anemia.**

There was a significant correlation between post test –II anemic sign and post test –II hemoglobin level. The obtained ‘r’ value was -0.91. Hence there was a significant negative relationship between the post test –II anemic sign and post test –II hemoglobin level.

The following study coincides with the above study findings

Kaur and Kaur (2015) observed the prevalence of anemia and its correlational factors among adolescent girls in Haryana. 88% of subjects had anemia. Most of the subjects complained of anorexia, headache and breathlessness on exertion, lethargic feeling, pale conjunctiva, pale skin and flat nails. A positive significant (P<0.05) correlation was observed between hemoglobin and symptoms of anemia.

There was a significant correlation between post test –II hemoglobin level and post test –II intelligence level. The obtained ‘r’ value was 0.84. Hence there was a significant relationship between the post test –II hemoglobin and post test –II intelligence.

The following literature supported the above findings
Agaoglu et al., (2007) evaluated that effectiveness of iron supplementation and intelligence level. The findings revealed that highly significant increase of 4.8 points in total intelligent quotient was found after treatment in the iron deficiency anemic group at P<0.01 level. There was a significant difference in the subtest of WISC-R between the pretreatment iron deficiency group and the control group.

**Objective 4: To find out the association between the demographic variables and post test-II nutritional intervention on iron deficiency anemia and intelligence.**

Association between demographic variables and post test-II hemoglobin level in the experimental group and control group of adolescent girls with anemia.

In order to find out the association between the age in years, education status and post hemoglobin level, chi square test was computed. The obtained chi square value was 8.86 significant at P<0.01. There was a significant association between age in years, education status and post test-II hemoglobin level in the experimental group.

In order to find out the association between the mother’s educational status, father’s occupation, history of gastritis, peptic ulcer and post hemoglobin level chi square test was computed. The obtained chi square
value was 11.94, 10.06 significant at P<0.01 and 3.87, significant at P<0.05. It indicates that there was a significant association between mother’s education status, father’s occupation, history of gastritis, peptic ulcer and post test-II hemoglobin level in the control group.

There was no significant association between father’s educational status, mother’s occupation, religion, income of the family, area of residence, diet, type of family, number of family members, attainment of menarche, menstrual history, deworming, personal hygiene and post test-II hemoglobin level in the experimental group and control group.

A study conducted by Kulkarni, Durge, & Kasturwar, (2012) stated that anemia was associated with educational status and mother’s occupation. Shi et al (2005) stated that the prevalence of anemia was higher among girls (23.4%) than the boys (17.2%).

**Association between demographic variables and post test-II intelligence scale in the experimental group and control group of adolescent girls with anemia.**

In order to find out the association between the mother’s educational status and intelligence, chi square test was computed. The obtained chi square value was 9.471, significant at P<0.05. There was a significant
association between mother’s education and post test-II intelligence in the experimental group.

There was no significant association between age in years, educational status, father’s educational status, father’s occupation, mother’s occupation, religion, income of the family, area of residence, diet, type of family, number of family members, attainment of menarche, menstrual history, deworming, history of gastritis, peptic ulcer, personal hygiene and post test-II intelligence in the experimental and control group.

The following statement was given by Nelson (2004). Iron combines with proteins in the bone marrows to make hemoglobin, which is used to carry oxygen in the blood to the brain and tissues. Iron deficiency leads to less hemoglobin in children. Iron deficiency increase poor concentration, attention span, memory loss and reduce intelligence level.

The major strength in the present study is to identify adolescent girls who at risk for developing iron deficiency anemia because iron deficiency anemia is a major health problem in the country. The present study highlight that the nutritional ball can be made by using available resources in treating iron deficiency anemia.
CHAPTER VI

Summary, Conclusion, Implications and Recommendations

This chapter deals with summary of the study, the implications for nursing practice, the implications for nursing education, nursing research, nursing administration and the recommendations for further research.

Summary of the study

The aim of the study was to find out the effectiveness of nutritional intervention in treating iron deficiency anemia and improving intelligence among adolescent girls in Bangalore from June 2013 to February 2014. The focus of the study was to identify the variables including demographic variables, anemic sign, hemoglobin level and intelligence level after administering nutritional intervention.

The objectives were

1. To assess the iron deficiency anemia and intelligence among adolescent girls with anemia.

2. To find out the effectiveness of nutritional intervention on iron deficiency anemia and intelligence among adolescent girls with anemia.

3. To find out the relationship between iron deficiency anemia and intelligence among adolescent girls with anemia.
4. To find out the association between the demographic variables and post test hemoglobin level and intelligence level of adolescent girls with anemia.

The following hypothesis was set for the study. All hypothesis was tested at 0.05 level of significance.

H₁ - The mean post test anemic sign of adolescent girls with anemia in experimental group who had nutritional intervention will be significantly lower than the mean pre test anemic sign.

H₂ - The mean post test anemic sign of adolescent girls with anemia in the experimental group who had nutritional intervention will be significantly lower than the mean post test anemic sign of the control group.

H₃ - The mean post test hemoglobin level of adolescent girls with anemia in experimental group who had nutritional intervention will be significantly higher than the mean pre test hemoglobin level.

H₄ - The mean post test hemoglobin level of adolescent girls with anemia in the experimental group who had nutritional intervention will be significantly higher than the mean post test hemoglobin level of the control group.

H₅ - The mean post test intelligence level of adolescent girls with anemia in experimental group who had nutritional intervention will be significantly
higher than the mean pre test intelligence level of adolescent girls with anemia.

H₆ - The mean post test intelligence level of adolescent girls with anemia in the experimental group who had nutritional intervention will be significantly higher than the mean post test intelligence level of the control group.

H₇ - There will be a significant relationship between anemic sign and hemoglobin level of adolescent girls with anemia.

H₈ - There will be a significant relationship between the hemoglobin level and intelligence level of adolescent girls with anemia.

H₉ - There will be a significant association between the post test hemoglobin level and selected demographic variables of adolescent girls with anemia in the experimental and control group.

H₁₀ - There will be a significant association between the post test intelligence level and selected demographic variables of adolescent girls with anemia in the experimental and control group.

The purpose of the study was to develop a nutritional intervention to improve hemoglobin and intelligence level among anemic adolescent girls. J. W. Kenny’s theory was used as guiding frameworks for the study.

A quantitative evaluative research approach with true experimental pretest and post test control group design was used. Tools used for data
collection were observation checklist on signs and symptoms of anemia, bio-physiologic measures and MALIN’S intelligence scale. Totally 240 anemic adolescent girls were selected by stratified sampling technique. There were 120 participants in the experimental group from the JSS High School and B.E.S High School, 120 participants in control group from Briliant’s High School and Vivekananda High School respectively. A pilot study was carried to assess the feasibility and practicability of the study and to make necessary modification in methodology. After obtaining permission from schools to conduct the study and informed consent from the participants. Samples were selected by using the multistage random sampling technique. Participants of experimental group were exposed to Nutritional Intervention. Post test was conducted by assessing anemic signs and symptoms, hemoglobin and intelligence level. The content validity and reliability were determined which showed tools were reliable to administer for study participants.

Data were coded and tabulated for analysis. Descriptive and inferential statistics were used. Frequency, Percentage, Mean, Standard deviation were used to do descriptive statistics. ‘T’ test was used to check the difference between experimental and control on hemoglobin and intelligence level. Repeated anova measures were used to find out the variance between the variables. The association was assessed by using chi-square between demographic variables and hemoglobin and
intelligence level. Statistical methods were used to summarize the results and to test the hypothesis.

**Major Findings of the Study**

1. Demographic profile of the sample

   In the experimental and control group 40 (33.3%) of participants were in the age group of 12 to 13 years, >13 to 14 years and >14 to 15 years and educational status of 7\textsuperscript{th}, 8\textsuperscript{th} and 9\textsuperscript{th} standard.

   Regarding father’s educational status and mother’s educational status, 62 (51.7%) and 46 (38.3%) in the experimental group, 66 (55%) and 43 (35.8%) in the control group were graduates.

   The majority of the participants 48 (40%) had an income of above Rs.30,000/month in the experimental group and 62 (51.7%) had an income of Rs. 20,000 – Rs.30,000/month in the control group. The majority of the subjects 105 (87.5%) in the experimental group and 114 (95%) in the control group belonged to rural area.

   In the experimental group, 94 (78.3%) and 103 (85.8%) in the control group were non vegetarians. With regard to type of family, 112 (93.3%) in the experimental group and 117 (97.5%) in the control group were from nuclear family.

   The majority of the subjects, 37 (30.8%) attained menarche before 12 years in the experimental group and 48 (40%) attained menarche before
>12 to 13 years in the control group. 62 (51.7%) in the experimental group and 70 (58.3%) in the control group were having normal and regular menstrual cycle.

The majority of the subjects, 95 (79.2%) in the experimental group and 91 (75.8%) in the control group had never taken deworming drugs.

Regarding the history of gastritis and medicine intake, 118 (98.3%) in the experimental group and 116 (96.7%) in the control group had no history of gastritis.

**Pre and post test hemoglobin level in the experimental and control group of adolescent girls with anemia.**

In experimental group, 50.8% had mild anemia, 49.2% had moderate anemia in the pretest. 28.3% had normal hemoglobin level, 35% had mild anemia and 36.7% of adolescent girls had moderate anemia in the post test-I and 40% had normal hemoglobin level, 33.3% had mild anemia and 26.7% of adolescent girls had moderate anemia in the post test-II.

In the control group, 45% of adolescent girls had mild anemia and 55% of adolescent girls had moderate anemia in the pretest. There is no improvement in post test-I, only 2.5% had normal hemoglobin levels in post test-II.
Pre and Post test scores of Intelligence level of adolescent girls with anemia.

In the experimental group, 36.7% had borderline intelligence, 52.5% had average intelligence, 8.3% had superior and 2.5% of adolescent girls had very superior intelligence in the pretest. 30% of adolescent girls had borderline intelligence, 48.3% had average intelligence, 15% had superior and 6.7% had very superior intelligence in post test-I and 26.7% of adolescent girls had borderline intelligence, 45% had average intelligence, 20% had superior and 8.3% had very superior intelligence in post test-II.

In the control group, 35.8% had borderline intelligence, 51.7% had average intelligence, 9.2% and 3.3% of adolescent girls had superior and very superior intelligence in the pretest. There is no improvement in intelligence level in the post test-I and post test-II.

Comparison of pre and post test scores anemic sign in the experimental group and control group of adolescent girls with anemia.

There was a significant difference in anemic sign between the pretest and post test-II in the experimental group which was statistically highly significant (t=2.923, p < 0.01).
Comparing between the experimental group and control group in the post test-I anemic sign, the obtained ‘t’ value was 9.756 and in the post test-II anemic sign, the ‘t’ value was 15.767 which was very highly significant at P<0.001.

The obtained ‘F’ ratio was 36.75, which was statistically significant at P<0.01 level. It indicates the nutritional intervention is effective in reducing anemic sign.

The comparison of pre and post test scores hemoglobin level in the experimental group and the control group of adolescent girls with anemia.

There was a significant difference in hemoglobin level between the pre test and post test-II in the experimental group was statistically highly significant (t=3.031, p < 0.01).

Comparing between the experimental and control group in the post test-I hemoglobin level, the obtained ‘t’ value was 12.292 which was very highly significant at P<0.001. In the post test-II hemoglobin level, the ‘t’ value was 15.265 which was very highly significant at P<0.001.

The obtained ‘F’ ratio was 38.65 at a P value <0.01 was significant. It indicates the nutritional intervention is effective in improving hemoglobin level.
Comparison of pre test and post test intelligence level between the experimental and control group of adolescent girls with anemia.

There was a significant difference in intelligence level between the pretest and post test-II in the experimental group was statistically highly significant (t=.2.010, p < 0.05).

Comparing between the experimental group and control group of post test-I intelligence level, the obtained ‘t’ value was 12.792 significant at P<0.001 and in the post test-II intelligence level, the obtained ‘t’ value was 31.788 which was very highly significant at P<0.001.

The obtained ‘F’ ratio was 21.615, was significant P<0.01 level and indicates that the nutritional intervention is effective in improving intelligence level.

Correlation between post test-II hemoglobin level, post test-II anemic sign and post test-II intelligence level of the experimental and control group of adolescent girls with anemia.

There was a significant correlation between post test-II anemic sign and post test-II hemoglobin level. The obtained ‘r’ value was -0.91. Hence there was a significant negative relationship between anemic sign and hemoglobin level.
There was a significant correlation between post test-II hemoglobin level and post test-II intelligence level. The obtained ‘r’ value was 0.84. Hence there was a significant relationship between hemoglobin level and intelligence level.

Association between demographic variables and post test-II hemoglobin level in the experimental group and control group of adolescent girls with anemia.

There was a significant association between age in years, education status and post test-II hemoglobin level in the experimental group, the obtained chi square value was 8.86 significant at P<0.01.

There was a significant association between mother’s education status, father’s occupation, history of gastritis, peptic ulcer and post test-II hemoglobin level in the control group, the obtained chi square value was 11.94, 10.06 (significant at P<0.01) and 3.87 which was significant at P<0.05 respectively.

There was no significant association between father’s educational status, mother’s occupation, religion, income of the family, area of residence, diet, type of family, number of family members, attainment of menarche, menstrual history, deworming, personal hygiene and post test-II hemoglobin level in the experimental group and control group.
Association between demographic variables and post test-II intelligence scale in the experimental and control group of adolescent girls with anemia.

There was a significant association between mother’s education and post test-II intelligence in the experimental group, the obtained chi square value was 9.471, significant at P<0.05.

There was no significant association between age in years, educational status, father’s educational status, father’s occupation, mother’s occupation, religion, income of the family, area of residence, diet, type of family, number of family members, attainment of menarche, menstrual history, deworming, history of gastritis, peptic ulcer, personal hygiene and post test-II intelligence in the experimental and control group.

The following conclusions were drawn from the study
1. The study proved that the nutritional intervention improves hemoglobin level and intelligence level among adolescent girls with anemia.
2. There was a negative correlation between anemic sign and hemoglobin level.
3. There was a correlation between hemoglobin level and intelligence level.
4. There was an association between post test hemoglobin level and demographic variables such as age, educational status of mother, history of peptic ulcer and gastritis.

**Implications**

The findings of the present study support that nutritional intervention was very effective and is not harmful to health. The findings of the study have several implications for the following fields.

**Implications for Nursing Practice**

1. The study findings revealed that the nutritional intervention can be used to correct iron deficiency anemia among adolescent girls.

2. The study findings will help the nursing personnel to implement the effective use of nutritional intervention at the community level to correct iron deficiency anemia among adolescent girls.

3. A nurse has to play key role in identifying high risk adolescent girls to provide adequate information and importance of iron in the diet.

4. It will also help the nursing personnel to conduct regular health assessment at community level and outpatient department in pediatric hospital.

5. The study findings will help the nurse and nursing students to educate the parents, teachers and adolescent girls about the iron deficiency anemia and its symptoms.
6. Instructional module and pamphlets can be distributed in the outpatient department in the hospital and community health center on the use of nutritional ball which is made up of available iron rich foods such as ragi, rice flakes, green leafy vegetables and jaggery in improving anemic status.

**Implications for Nursing Education**

1. Implementing the importance of simple dietary management in the nursing curriculum will help the nursing student to be well equipped with management of iron deficiency anemia in the care of the adolescents with iron deficiency anemia.

2. The study enable the nursing personnel to give more emphasize on physical assessment as an approach to determine the level of iron deficiency anemia among adolescents.

3. Students are to be taught to do risk assessment on adolescent girls for iron deficiency anemia.

4. The continuing nursing education program needs to be implemented to learn updated information.

5. The study will help to conduct conference, seminar and panel discussion on dietary management of iron deficiency anemia.
Implications for Nursing Research

1. Extensive research can be done to identify the risk factors and methods of primary prevention.
2. Research can be conducted by supplementing other iron rich foods or other intervention strategies to predict and control iron deficiency anemia.
3. Meta analysis need to be conducted to find out appropriate evidence based interventions, measures to control and prevent the morbidity of iron deficiency anemia.
4. A collaborative research could be initiated to try various preventive measures to control iron deficiency anemia.
5. Epidemiological studies can be conducted in primary care settings to prevent iron deficiency anemia and its complication.

Implications for Nursing Administration

1. In service education can be conducted in hospitals and community health care settings to improve the knowledge in various aspects of detection and management of iron deficiency anemia.
2. The nurse administrators give more emphasize on conducting health checkups once in six months among adolescents in the schools to detect iron deficiency anemia.
3. To promote knowledge on detecting and treating iron deficiency anemia for school teachers and village health guides.
4. Instructional module, pamphlets, leaflets can be prepared on available dietary source of iron and prevention of iron deficiency anemia.

**Recommendations**

1. A longitudinal study can be conducted to assess iron deficiency anemia.

2. A similar evaluative research study can be conducted in community settings.

3. A similar study can be conducted on nutritional intervention by using other iron rich foods.

4. A comparative study can be conducted between the urban and rural population.

5. A similar study can be conducted with other age group.

**Limitations of the study**

The problems encountered during the data collection period was

1. Absence of study participants

2. Fear towards pain during blood withdrawal for hemoglobin estimation and peripheral blood smear. The investigator explained to the study participants that only mild pain will be experienced by them.

3. Difficulty in obtaining permission for conducting the study.

**Conclusion:**

1. With regard to the first objective, majority of the adolescent girls had mild iron deficiency anemia with the symptoms of tiredness, paleness of
conjunctiva, palpitations, headache and lack of concentration, 50% of the study subjects had an average intelligence level in the pretest of experimental and control group.

2. With regard to the second objective, after 8 weeks of nutritional intervention most of the adolescent girls had a normal hemoglobin level (above 12gm/dl) and symptoms of anemia also disappeared. Their intelligence level also increased. The study findings showed that the nutritional intervention was effective in treating iron deficiency anemia and improving intelligence. The hemoglobin level in pretest was 9.69 gm/dl which was increased to 12.16 gm/dl in post test-II. The mean difference of hemoglobin level was 2.47gm/dl.

3. With regard to the third objective, there was a significant negative correlation between anemic sign and hemoglobin level at p<0.01 level. There was a significant correlation between hemoglobin level and intelligence level at p<0.01 level.

4. Regarding fourth objective, there was a significant association between age, educational status of the participants and mother’s education and hemoglobin level. Intelligence is associated with mother’s educational status.
Summary

This study described the effectiveness of Nutritional Intervention on iron deficiency anemia and intelligence. This study motivated the participants to follow the proper dietary pattern to prevent iron deficiency anemia and its complications.
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Appendix - I

PART -I

DEMOGRAPHIC DATA

Anemia

Sample No:  

Group: E / C

Dear participants,

You are requested to read all the questions carefully and mark (√) against the right response. You need to select only one response for each question.

1. Age
   (a) 12 to 13 yrs
   (b) >13 to 14 yrs
   (c) >14 to 15 yrs

2. Educational Status
   (a) 7th std
   (b) 8th std
   (c) 9th std
3. Educational Status of the father

(a) Illiterate
(b) Primary education
(c) Secondary education
(d) Higher Secondary education
(e) Degree and above

4. Occupational Status of the father

(a) Government employee
(b) Private employee
(c) Self employed
(d) Daily wages
(e) Unemployed

5. Educational Status of the mother

(a) Illiterate
(b) Primary education
(c) Secondary education
(d) Higher Secondary education
(e) Degree and above
6. Occupational Status of the mother
   (a) Government employee
   (b) Private employee
   (c) Self employed
   (d) Daily wages
   (e) Unemployed

7. Religion
   (a) Hindu
   (b) Christian
   (c) Muslim

8. Income of the family
   (a) Below Rs.10,000
   (b) >Rs.10,000 - Rs.20,000
   (c) >Rs.20,000 - Rs.30,000
   (d) Above Rs.30,000

9. Area of residence
   (a) Rural
   (b) Urban
   (c) Semi urban
10. Dietary pattern
(a) Vegetarian
(b) Non Vegetarian

11. Type of family
(a) Joint family
(b) Nuclear family

12. Number of family members
(a) 3
(b) 4
(c) 5
(d) >5

13. Age at menarche
(a) not attained
(b) before 12 years
(c) >12 – 13 years
(d) >13 – 14 years
(e) after 14 years
14. History of menstrual bleeding
(a) normal & regular
(b) menorrhagia
(c) polymenorrhea
(d) irregular menstrual cycle
(e) nil

15. When was the last deworming drug taken?
(a) before one month
(b) before 3 months
(c) before 6 months
(d) not at all

16. History of gastritis, peptic ulcer, surgery and medicines etc
(a) yes
(b) no

17. Personal hygiene
(a) hygienic
(b) non hygienic

18. Vital parameter:
Hb level in gms : pretest ----- post test-I ------ post test-II ------
PART – II

OBSERVATION CHECKLIST ON SIGNS AND SYMPTOMS OF ANEMIA

Dear participants,

Read all the questions carefully and mark (√) against the presence or absence of signs and symptoms of anemia. You need to select only one response for each question.

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>OBSERVATION CHECKLIST</th>
<th>PRESENT</th>
<th>ABSENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shortness of breath</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Palpitation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Dizziness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Syncopal attacks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Decreased appetite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Weakness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Taste disturbance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Tiredness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Fatigue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Blurring of vision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Restlessness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Irritable</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>Poor attention span</td>
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<tr>
<td>13</td>
<td></td>
<td>Poor concentration and academic performance</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Habit of eating pica</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Poor memory</td>
<td></td>
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<tr>
<td>16</td>
<td></td>
<td>Headache</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>OBJECTIVE DATA</strong></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>Increased respiratory rate</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>Increased pulse rate</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Sore throat</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>Dryness in the mouth and throat</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>Pale skin colour</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td>Pale Palpebral conjunctivae</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td>Pallor tongue</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>Pallor of nails</td>
<td></td>
</tr>
</tbody>
</table>
Appendix – II

MALIN’S INTELLIGENCE SCALE FOR INDIAN CHILDREN

I. GENERAL INFORMATION TEST:

Directions: read each question as stated and in the order given, if responses are not clear it is permissible to say: explain more: tell me more about it: or some such neutral non leading questions.

Scoring: discontinue after five consecutive failures and credit with items. Each item is scored 1 or 0.

TEST QUESTIONS

1. Where will you go to buy sugar (ribbons-girls)? (Market, kirana, local shop’s name etc.)
2. How many paise in a rupee?
3. How many days in a week?
4. Where does the sun set?
5. What are the seasons of the year (in India)? (at least cold, hot, rainy)
6. Which is the top or upper colour of the flag of our country? (Red, orange etc.)
7. When do we celebrate (keep) independence day? (if too close, substitute: what do we celebrate on January 26?)
8. What is the colour of the pearl? (White)
9. What is the work of the stomach? (Mixes, grinds, digest).

10. Why do we honour Gandhiji as the father of India? (Independence labours).

11. Why does oil float on water? (lighter)

12. What was the capital of old Moghul empire? (Agra, Delhi)

13. What is Sanskrit? (imply ancient or sacred Indian language)

14. How tall is the average (ordinary) Indian man? (5ft.4 inches-3 leeway)

15. In what part of the world do we find India? (Asia; Northern or Eastern Hemisphere).

16. Who composed the national anthem (Jana gana mana)?

17. Where is Singapore? (Malaysia: S.E. Asia; near Borneo, Australia etc).

18. How many are there in a lakh?

19. Who was the first European or foreign invader to come into India? (Alexander, Vasco da Gama).

20. What is the distance between Bombay and Calcutta? (1000 – 300 miles).

21. What is a Barometer? (measures airpressure, heights, predicts weather).
22. What (or, why) do we celebrate on Republic Day? (Constitution, abolition of monarchy, Notion of Independence not enough).

23. How do we get kerosene? (imply process from crude oil).

24. Who was Chenghis Khan? Chinese or Mongol – not Moghul – Ruler)

25. What is the meaning of V.P.P.? (Value payable parcel, or a correct description of it).

II. ARITHMETIC TEST

Directions: Problems 4 – 12 and 16 read to the subject and 13, 14, 15 are presented on cards to be read by the subject. Timing starts after stating the problem the first time. Repetitions are at the expenses of the subjects timing. Discontinue after 3 consecutive failures. No paper work allowed. Names and problem items can be adapted to local conditions and prices. Figures must not be changed. Second trails allowed within time limit.

Scoring: 1 or 0. Give credit for first three, if subject works out 4 and 5.

PROBLEMS – TIMINGS – ANSWERS

1. If I break this (pencil) in half, how many pieces will there be?

2. Prem has 4 rupees. Mummy gives him 2 more. How many has he?

3. Rita has 8 bananas and buys 6 more. How many has she?
4. Teacher has 12 books and sells. How many has she left?

5. If one pencil costs 7 p. what will 3 pencils cost?

6. A milkman has 25 bottles of milk, he sold all. How many bottles had he left?

7. A workman after finishing his job was given Rs. 36 for his pay. He had agreed for Rs. 4 each day. Tell me how many days he worked.

8. Let us say you want to buy some marbles (ribbons). They cost 30 (make this distinct from 13) paise a dozen. Now you have a rupee and want to buy 3 dozen. How much change will you receive? (10p).

9. Four boys (girls) have gathered 72 marbles (flowers). If they divide them equally, how much will each get (18)?

10. If 3 pencils cost 5 paise, what will 24 pencils cost? (40)

11. If bus fare is 20 paise for the first quarter mile and only 5 paise for each other quarter mile; what will be the fare for 2 miles? (55).

12. Prem and Raj start a marble game with 27 marbles each, they agree that at the end of each game, the loser must give up one third of what he has left.

13. 36 is two – thirds of what whole number? (54).
III. SIMILARITIES

Directions: Say: “in what way are a mango and a banana alike? If the subject fails or denies a similarity then coach him on all score grades and try the next cat and mouse. If he fails again explain for the last time and discontinue after 3 consecutive failures, or return to Analogies.

Scoring: Grade from 2 to 1 and 0. See below for grades.

TEST ITEMS
1. Mango – Banana (or other familiar fruits)
2. Cat – Mouse
3. Organ – Flute(similar instruments such as a Harmonium or mouth organ may be substituted)
4. Milk – Medicine
5. Ruler (e.g. foot) – Scale (weights)
6. Scissors – brass pot (vase)
7. Paper – Coal (charcoal)
8. Salt – Water
9. Mountain – Lake
10. Liberty – Justice
11. First – Last
12. Numbers 49 and 121
GRADES AND SCORING SAMPLES

1. Mango: 2 = fruits 1 = both round; have skin; seeds; food. 0 = Sweet, from tree.
2. Cat: 2 animals creatures; 1 = four legs; eyes; both eat. 0 = chase.
3. Organ: 2 = both wind and musical instruments 1 = play them both; have keys; tubes. Both give tunes. 0 = both give noise.
4. Milk: 2 = both are good for health; good to take; 1 = consumables (drink).
5. Ruler: 2 = both measure; 1 = both have numbers 0 = made of same thing.
6. Scissors: 2 = both made of metal utensil. 1 = made of iron, steel.
7. Paper: 2 = carbons; originate from trees. 1 = both burn.
8. Salt: 2 chemical compound; necessary for life. 1 = for cooking.
9. Mountain: 2 = geographical or natural features of landscape; common origin. 1 = both are scenery, landscape.
10. Liberty: 2 = social ideal, or rights, 1 = relate to Government; needed for the country, have to do with law 0 = mean pease.
11. First: 2 = extremes of position; position in a series or rank. 1 = both at the ends, 0 = both opposites, both numbers.
12. 49:2 = perfect squares or odd number square roots. 1 = both odd numbers; cannot be divided by 2. 0 = both are numbers.
IV. DIGIT SPAN

DIGIT SPAN FORWARDS

Directions: “I am going to say some numbers. Listen carefully and when I am finished repeat them after me” (on per second). If subject repeats trail I of a series then go on to next higher number in same trail. If he fails then give a second chance from trail II. Discontinue if fails on both trails of a given series.

Scoring: his score is the highest number of digits repeated without error. Thus if he only repeated five digits his score is 5. Total score combines forward and backward.

<table>
<thead>
<tr>
<th>Series</th>
<th>Trail 1</th>
<th>Trial II</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3-8-6</td>
<td>6-1-2</td>
</tr>
<tr>
<td>4</td>
<td>3-4-1-7</td>
<td>6-1-5-8</td>
</tr>
<tr>
<td>5</td>
<td>8-4-2-3-9</td>
<td>5-2-1-8-9</td>
</tr>
<tr>
<td>6</td>
<td>3-8-9-1-7-4</td>
<td>7-9-6-4-8-3</td>
</tr>
<tr>
<td>7</td>
<td>5-1-7-4-2-3-8</td>
<td>9-8-5-2-1-6-3</td>
</tr>
<tr>
<td>8</td>
<td>1-6-4-5-9-7-6-3</td>
<td>2-9-7-6-3-1-5-4</td>
</tr>
<tr>
<td>9</td>
<td>5-3-8-7-1-2-4-6-9</td>
<td>4-2-6-9-1-7-8-3-5</td>
</tr>
</tbody>
</table>
DIGIT SPAN BACKWARDS

Directions: “now I am going to say some more number but this when I stop you say them backwards.” Give an example and let the subject try. Scoring and directions as in the above.

<table>
<thead>
<tr>
<th>Series</th>
<th>Trail 1</th>
<th>Trail II</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2-5</td>
<td>6-3</td>
</tr>
<tr>
<td>3</td>
<td>5-7-4</td>
<td>2-5-9</td>
</tr>
<tr>
<td>4</td>
<td>7-2-9-6</td>
<td>8-4-9-3</td>
</tr>
<tr>
<td>5</td>
<td>4-1-3-5-7</td>
<td>9-7-8-5-2</td>
</tr>
<tr>
<td>6</td>
<td>1-6-5-2-9-8</td>
<td>3-6-7-1-9-4</td>
</tr>
<tr>
<td>7</td>
<td>8-5-9-2-3-4-2</td>
<td>4-5-7-9-2-8-1</td>
</tr>
<tr>
<td>8</td>
<td>6-9-1-6-3-2-5-8</td>
<td>3-1-7-9-5-4-8-2</td>
</tr>
</tbody>
</table>

V.  PICTURE COMPLETION

Directions: - before presenting the first card say: “I am going to show you some pictures in which there a part is missing. Look carefully at the card and tell me what important part is missing.” The subject can be helped in the first two cards but without getting score. Pointing to the missing part can also be credited. If s. point to, e.g. coat pocket, say “yes, but something else is missing.”
Timing and scoring: - Discontinue after 4 failures. 15 seconds are allowed follow each picture, and one point for each correct response expect with the five pictures when an extra bonus score is credited if at least 3 of the last five are correct. Total maximum score 20.

TEST PICTURES AND CORRECT RESPONSES

1. Comb.............tooth (teeth) 11. Rooster.............spurs
2. Fox.............ear 12. Screw.............slot (crack)
3. Girl.............mouth 13. Fish.............extra in (dorsal)
4. Table.............leg 14. Fly.............antennae
5. Cat.............whiskers 15. Profile.............eyebrow
6. hand.............fingernail 16. Cow.............hoof cleft
7. Scissors.............screw 17. Umbrella.............spokes


I. OBJECT ASSEMBLY

Directions: Bonus allowed for speed. See table below:

MANIKIN….120”….1-10” (7pts.)….11-15” (6pts.)…..16-20” (5pts.)…. 
21-120” (4 pts.)

Horse….180”…..1-15” (9 pts.)….16-20” (8 pts.)…..21-30”(7 pts.)….
31- 180” (6 pts.)

Face ….180”…..1-35” (9 pts.)….36-45” (8 pts.)…..46-70”(7 pts.)….
71- 180” (6 pts.)

Auto ….180”…..1-25” (9 pts.)….26-30” (8 pts.)…..31-45”(7 pts.)….
46 -180” (6 pts.)

1) MANIKIN: Directions: - Arrange pieces behind a screen according to 
give diagram. Then say: “These pieces will make a boy. Go ahead and put them together.”

Scoring Table: - Perfect performance – 4 pts. Or bonus. Imperfect performances: No time bouns ! 2. pts. If legs omitted or put as arm. 3 pts. If legs interchanged or inverted. 1 pt. if only trunk is correct.
2) **HORSE:** Directions same as for Manikin.

   **Scoring Table:** Perfect – 6 pts. Or bonus. Imperfect 5 pts. If only stomach midpiece inverted 4 pts. If midpiece omitted or legs interchanged. 3 pts. If midpiece inverted and legs 2 pts. If: omitted and: or 1 & 4. 1pt.for each two pieces joined properly.

3) **FACE:** Directions same as above EXPECT no name of the object is revealed.

   **Scoring Table:** Perfect – 6 pts. Or bouns. Imperfect: General ½ pt. per joint separate or joined to the whole. 5 pts. If eye inverted or hair pieces omitted. 4 pts . If nose omitted or mouth and child omitted. 3 pts. If large half omitted (2 pieces) 1 pt. if only large half and hair (3 pieces).

4) **AUTO:** Directions same as per face.

   **Scoring Table:** perfect – 6 pts. Or bouns. Imperfect: General 1 pt. for each proper joint as above. 5 pts. Door inverted or reserved. 4 pts. Omitting pieces 4 &5 or omitting 7 3 pts omitting 7 and inverting or reserving 4(door) also omitting 4, 5, 7 also interchanging 4 &5 with 6.
VII. CODING

101----110-----46 pts  71----80      -----49 pts.
91------110-----47 pts  70 or less -----50 pts.

Directions: - for subjects 8 years and above.

Use design B point to the key and say: - “look at these boxes or square. See how each has a number in the upper half and a mark in the lower half. Each number has its own special mark. Now look at the samples. Here is a 2. So put in this mark (here write the symbol) and try the others until I tell you to stop. “Start timing when the samples have been completed. Watch out the subject does not skip.

Timing & Scoring: - 120 seconds and 1 point for each correct square excluding the samples.

Note: - for left hand subjects an extra folded code so that they do not obscure their vision.

VIII. MAZES

Directions: show the samples and with a pencil demonstrate saying:

“imaging someone trying to get out of here. He cannot the lines and you cannot lift the pencil once you start” subjects above 8 years can start with C and be credited for A and B if not more than one error in C. subjects below 8 years start with A. if fails on A or B then show correct procedure.
Discontinue if 2 consecutive failures (0 scores). Timing printed beside each maze.


1-5. – No errors -3 pts. First error subtracts one point and the second error subtracts the second point but the third point is not subtracted until the maximum allowed errors have been passed, viz,

Nos. 1-2 allowed 3 errors

\[
\begin{align*}
3 & \ldots \ 5 \ , , \\
4 & \ , , \ 6 \ , , \\
5 & \ , , \ 8 \ , ,
\end{align*}
\]

Definition of errors:

1. Entering a major blind alley (wandering around in such a blind alley including lesser blind alleys does not increase the error nor or reentering it after going out).

2. Crossing any line. A while space should be visible between the printed line and the pencil line on the wrong side.

3. Lifting the pencil do not penalize twice if the lifting was done for example to return to the path after crossing a line. In which case the error of crossing the line is alone counted.
APPENDIX III

Participant information sheet

Principal Investigator:

Mrs. Kalaichelvi D,

I am a Ph.d candidate pursuing my Ph.D in Vinayaka Mission’s University, Salem, Tamilnadu.

Title of the study

A study on effectiveness of nutritional intervention in treating iron deficiency anemia and improving Intelligence among adolescent girls.

Purpose of the study

This research activity was intended to evaluate effectiveness of nutritional intervention in treating iron deficiency anemia and improving Intelligence among anemic adolescent girls.

Study participants/Participation

Investigator approaching the adolescent girls (you) who were identified with anemia and provide nutritional intervention to improve the hemoglobin level. You are being invited to participate in this study. The purpose of this form is to give you information on this research study and if you are allowing your child to participate in this study you have to sign, it means you are agreeing for your child to take part in the study. This form describes the purpose, procedure, benefits and risk of the research study.
You can clarify the term which you don’t understand. You may take this information sheet to your home and discuss with family members to participate or not to take part of your child in this research activity.

**Study Procedure**

The investigator will explain all procedure to you and you are allowed to clarify your doubts whenever it required. The investigator will collect the background information. Observation checklist will be administered to assess the signs and symptoms of anemia, hemoglobin level will be checked and peripheral blood smear test will be done to identify iron deficiency anemia. Intelligence level will be assessed by Malins Intelligence scale. Participants will be dewormed with Tab.Albendazole. Nutrition ball will be administered for eight weeks period. At 9th week hemoglobin level and intelligence level will be assessed.

**Nutritional Intervention**

The administration of 100 gms of nutritional ball which is made by the mixture of 60 gms of roasted rice flakes and 40 gms of jaggery. It provides 13.14 mgs of iron. For the absorption of iron, vitamin C that is 4gms of amla fruit powder was given.
Confidentiality

I wish to assure you that your confidentiality of the information will be respected. Your name will not be used in any reports of this work. Only a code number will appear on the observation checklist. Only the researcher will have the access to the records and assessment sheets. Data/Information collected as part of the research activity will be kept confidential and will be used only for the purpose of the research study.

Risks of the research

The investigator did not believe that there are any risks to taking part in this research.

Benefits of the research

This research activity offers individual benefits to the anemic adolescent girls by participating in this study. The investigator hopes that this research will help to improve the hemoglobin level and intelligence level.

Voluntary participation

Your participation in the study is voluntary. If you do agree to start helping with the study, at any time you may change your mind and ask not to be involved any further. If you decide to withdraw from the study, it is important that you inform the investigator.
APPENDIX – III (A)

INFORMED CONSENT FORM

Study Title:

Parent’s Name:

Participant’s Code No:

Age:

1. Confirm that I have read and understood the information sheet dated……………. for the above study and have had the opportunity to ask questions.

2. I understand that my child participation in the study is voluntary and that she is free to withdraw at anytime, without giving any reason.

3. I understand that the ethical committee and regulating authorities, will need my permission for participation of my child, their health record both in respect to the current study and any further research that may be conducted in relation to it.

4. I agree not to restrict the use of any data (or) results that may arise from this study provided such a use is only for scientific purposes.

5. I agree to take part in this study.

Signature of the parents:

Signature of Investigator:

Date:

Date:
APPENDIX - IV

Letter Seeking Experts Guidance for Content Validity of the Tool

From

Mrs. Kalaichelvi.D
Ph.D Scholar,
Vinayaka Missions University,
Salem.

To
____________________
____________________
____________________

Forwarded through the Guide

Sub: Requisition for expert opinion on content validity of the research tool.

I Mrs. Kalaichelvi.D, a Ph.D Scholar from Vinayaka Missions University, Salem have been selected the topic “A study on effectiveness of nutritional intervention in treating iron deficiency anemia and improving intelligence among adolescent girls Bangalore, Karnataka” in nursing under the guidance of Dr.C.Nalini Jeyavantha Santha M.Sc., (N), Ph.D., Principal, Sacred Heart College of Nursing, Madurai for the thesis to be submitted to the university.
APPENDIX – IV (A)

LIST OF EXPERTS WHO VALIDATED THE TOOL AND CONTENT

1. Dr. Nalini Jeyavantha santha, M.sc (N), Ph.D,
   Principal, Sacred Heart Nursing College,
   Ultra trust, Madurai-20.

2. Dr. Kasturi, M.sc (N), Ph.D,
   Principal,
   Oxford college of Nursing,
   Bangalore.

3. Dr. Chandrakala, M.sc (N), Ph.D,
   Vice principal, Sacred Heart Nursing College,
   Ultra trust, Madurai-20.

4. Dr. Lalitha, M.sc (N), Ph.D,
   HOD in Nursing,
   National Institute of Mental and Neuro Sciences,
   Bangalore.

5. Dr. Basavanthappa, M.sc (N), Ph.D,
   Principal,
   Raja Rajeswari College of Nursing,
   Bangalore.
6. Dr. V. N. Rajasekaran, Ph. D. M. D, D. T. M & H,
   Medical Director, Professor & Head of the Medicine Department,
   Meenakshi Mission Hospital,
   Madurai.

7. Dr. Raghunath M. B. B. S, M. Ch,
   Pediatrician,
   Sagar Hospital,
   Bangalore.

8. Dr. Ramachandran, M. B. B. S, D. Ch
   Pediatrician,
   Dindigul.

9. Prof. Dr. Manoj Kumar Sharma Ph.D (Psy)
   Psychology Department
   NIMHANS, Bangalore.

10. Ms. Ramya, M. Sc(Psy), M. Phil (Clin Psy),
    Clinical Psychologist,
    Bangalore.
11. Dr. Rajeswari, Ph.D (Ntn),
   Asst. Professor,
   Dayananda Sagar Institutions
   Bangalore.

12. Dr. Shanmugam, Ph.D
    Professor, Biostatistics Department,
    NIMHANS, Bangalore.

13. Mr. Kannan, M.phil,
    Professor, Bio-statistics Department,
    Madurai.
Appendix –V

Permission Letters from study setting

VIVEKANANDA HIGH SCHOOL
No.1, Jayanagar IV Block East, Bengaluru-560011
Phone No: 080-26633167, 41211099 (Fax) 080-26633167

26/08/2013

Mrs. D. Kalaichelvi, M.Sc (N), Ph.D. Scholar, Vinayaka Mission’s University, Salem, Tamilnadu, is permitted to do her research work in our institution regarding Nutritional Intervention in improving Hemoglobin level and Intelligence level among anemic adolescent girls, during September 2013 to February 2014.

Signature of the Head Mistress

HEAD MISTRESS
Vivekananda High School,
BANGALORE.
TO WHOM SO EVER IT MAY CONCERN

Mrs. D.Kalaichelvi, Ph.D scholar in Nursing is permitted to carry out her thesis titled, “A study on effectiveness of nutritional intervention in treating iron deficiency anemia and improving intelligence among adolescent girls” in our school.

There is no objection from our school to do research work and we extend our full co-operation for her research work.

HEAD MISTRESS
B.E.S High School,
BANGALORE - 11
Permission letter to conduct study

Sub: Permission to conduct Ph.D study

With reference to the above subject, Mrs. Kalaichelvi.D requested permission to conduct a study on “A study on effectiveness of nutritional intervention in treating iron deficiency anemia and improving intelligence among adolescent girls”. We hereby clarify that the study carries minimal risk and may be permitted to carry out the study.

Herein Mrs. Kalaichelvi.D is permitted to conduct the above mentioned study at our school.

Signature of the Head Mistress

HEAD MISTRESS
JSS High School,
BANGALORE 560011
From

Mrs. D. Kalaichelvi,
Ph.D scholar in Nursing,
Vinayaka Missions University,
Salem.

To

The Head Mistress,
Brilliant’s High School,
Bangalore.

Respected Madam,

Sub: Requesting permission to conduct Ph.D study

I myself Mrs. D. Kalaichelvi doing Ph.D in Nursing under Vinayaka Missions University at Salem. Title of the study is “A study on effectiveness of nutritional intervention in treating iron deficiency anemia and improving intelligence among adolescent girls”.

I would be highly obliged if you could give permission to conduct the study in your school.

Kindly do the needful.

Thanking you

Date: 11/9/13
Place: Bangalore

Yours sincerely,

Mrs. D. Kalaichelvi