CHAPTER 1

INTRODUCTION
Nutritional anemia: its understanding:

Iron-Deficiency Anemia (IDA) is by far the most widespread nutrient deficiency linked condition in the world affecting more than 2 billion persons. (ACC/SCN, 2000).

Anemia is essentially an imbalance of supply and demand for tissue oxygenation. It occurs when a number of circulating red blood cells is insufficient to provide optimum delivery of oxygen to meet the demand of metabolically active tissue. (Melanie Huff www.mc.edu/campus/users/huff00/).

Hemoglobin is the substance in red blood cells that carries oxygen to the cells of the body. The body’s cells need oxygen to function and enable a person to perform all physical and mental activities. When hemoglobin levels are low, as in a person who has anemia, less oxygen reaches the cells to support the body’s activities. Such a situation forces the heart and lungs to work harder to compensate for the blood’s low capacity to carry oxygen. (Melanie Huff www.mc.edu/campus/users/huff00/).

In normal individuals, 2/3 of total body iron is available for hemoglobin formation. The remaining 1/3 gets deposited as hemosiderin and ferritin. (Singla, et al., 1979, Agarwal, et al., 1983).
The World Health Organization (WHO) has outlined criteria for the diagnosis of anemia for various ages and sex groups (Table 1.1) (DeMaeyer, et al., 1989).

Table 1.1 WHO Criteria for the Diagnosis of Anemia. (DeMaeyer, et al., 1989).

<table>
<thead>
<tr>
<th>Age / Sex Group</th>
<th>Hb (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children 6 months –6 years</td>
<td>&lt;11</td>
</tr>
<tr>
<td>Children 6 – 14 years</td>
<td>&lt;12</td>
</tr>
<tr>
<td>Adult males</td>
<td>&lt;13</td>
</tr>
<tr>
<td>Adult females (non pregnant)</td>
<td>&lt;12</td>
</tr>
<tr>
<td>Adult females (pregnant)</td>
<td>&lt;11</td>
</tr>
</tbody>
</table>

Causes of Anemia, as reported by Gillespie and Johnston, (1998) are reproduced in Table 1.2 involve poor diet habits, inadequate knowledge of nutrition & hygiene and worm infestation.

**Iron Deficiency:**

Is defined as a condition in which there are no mobilizing iron stores, causing a compromised supply of iron to tissues, including the red cells. It varies greatly with each stage of the life cycle, in general growing children (up to 2 yr of age), pregnant and lactating women and adolescents (second growth spurt) are the most
vulnerable. In iron deficiency hemosiderin and ferritin (iron stores) decrease; supply of iron to the transport protein (apotransferritin) gets compromised, resulting in decrease in transferrin saturation and increase in transferrin receptors. (Baker and DeMaeyer, 2009).

Table 1.2 - Causes of Anemia (source: Gillespie and Johnston, 1998.).

<table>
<thead>
<tr>
<th>Direct Causes</th>
<th>Components (in order of importance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor, insufficient, or abnormal red blood cell production</td>
<td>Poor dietary intake and / or absorption of iron and vitamins (A, B-12, folic acid, and B6, C and riboflavin) and copper. Increased needs for nutrients due to growth or disease (diarrhea).HIV/AIDS, Other infectious diseases (tuberculosis, malaria).Genetic blood diseases (sickle cell trait, thalassemia).</td>
</tr>
<tr>
<td>Excessive RBC destruction</td>
<td>Malaria</td>
</tr>
<tr>
<td>Excessive RBC loss</td>
<td>Helminth (worm) infections (hookworm, schistosomiasis). Bacterial or viral infections (peptic ulcers, gastritis, diarrhea).Reproduction (excessive blood loss during menstruation, delivery and postpartum period; too many pregnancies; shortened postpartum amenorrhea).Contraceptive intrauterine devices).</td>
</tr>
</tbody>
</table>
Knowledge and behavior
Poor knowledge among health workers about anemia iron supplementation, and other anemia prevention and control interventions. Poor knowledge among vulnerable groups about the importance of and anemia prevention and control interventions. Cultural taboos or biases (e.g., women eating after others). Practices that restrict food intake, including poor infant breast feeding practices and inadequate introduction of complementary foods. Poor compliance with recommended behaviors (iron supplementation; malaria, tuberculosis, and other medication regimens; use of family planning; use of sanitation facilities; HIV prevention behaviors).

Environmental
Contamination by heavy metals (lead).

Lack of access to services
Low use of antenatal and other services providing iron supplements. Lack of trained birth attendants to manage bleeding during delivery. Lack of access to sanitation services that mitigate helminth infestation. Lack of access to bed nets to prevent malaria transmission.

Poverty
Lack of income to buy foods with adequate amounts of absorbable iron or to obtain iron supplements, malaria treatment, insecticide-treated bed nets, shoes to prevent helminth.
According to WHO Technical Report Series (1972), nutritional anemia must then be defined as a condition in which the hemoglobin concentration is below the level that is considered normal, for a given individual, due to deficiency of one or more of the nutrients required for hemopoiesis, and, conversely, as a condition in which the hemoglobin concentration can be raised by increasing the amount of nutrient(s) absorbed.

In a community in which there is no anemia, Baker and DeMaeyer, (2009) have described, a frequency distribution curve of hemoglobin concentration, which follows a nearly normal or Gaussian distribution, but in a community with a high prevalence of anemia the frequency distribution curve remains skewed to the left.

Three Stages in iron deficiency have been reported by Adaman and Dan, (2005). It initially begins with depletion, where a fall in storage iron is observed as a decrease in serum ferritin which in turn reflects low iron in liver/spleen/bone marrow. This is followed by the second stage where there is a decrease in transport iron, hence low serum iron is observed with an increased total iron binding capacity and decreased transferrin saturation. Both these two stages are preanemic “Latent iron deficiency”. In the third stage, there is significant fall in supply of transport iron, thus restricting hemoglobin synthesis with increase in erythrocyte- porphyrin. As a result microcytosis appears, which is accompanied with a fall in hemoglobin, this fulfills the laboratory definition of anemia. Further
as mild iron deficiency develops very gradually, and is almost in equilibrium, this conditions lasting for months or years.

On the other hand Baker and DeMaeyer, (2009), have suggested that, when there is an excess of iron stores, it produces clinical and/or biochemical abnormalities, therefore a healthy, adequately nourished individual is normally in a state of nutritional balance in which the amount of any given nutrient absorbed from the diet is equal to the amount of nutrient broken down in metabolic processes and/or the amount lost from the body. This nutritional balance can be disturbed by one or more of a variety of factors, which leads to a relative or absolute deficiency of the nutrient such as, increased losses, increased requirements and decreased intake in the diet, decreased absorption and decreased utilization.

**Public Health Significance of Anemia:**

At the national level, anemia is considered a severe public health problem when its prevalence is equal to or greater than 40 percent. By the measures given in Table 1.3. Anemia is a severe public health problem in nearly all developing countries. Anemia prevalence rates in industrialized countries are typically in the normal to mild range.
Table 1.3 Public Health Significance of Anemia (source: WHO/UNICEF/UNU, 2001).

<table>
<thead>
<tr>
<th>Anemia Prevalence</th>
<th>Public Health Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 40%</td>
<td>Severe</td>
</tr>
<tr>
<td>20-39%</td>
<td>Moderate</td>
</tr>
<tr>
<td>5-19%</td>
<td>Mild</td>
</tr>
<tr>
<td>0-4.9%</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Prevalence of Anemia:

In India an estimated 131 million women of reproductive age (52 percent of this population) and 85 million children under age 4 (74 percent) are anemic. Combining these estimates with those for schoolchildren and adolescents, there were at least 360 million anemic individuals in India. (ACC/SCN, 2000).

Anemia is extremely common in Indian children. According to the National Family Health Survey (NFHS-2), (1998-99) overall, nearly three-quarters (74 percent) of the children have some level of anemia, including 23 percent who are mildly anemic (10.0–10.9 g/dl), 46 percent who are moderately anemic (7.0–9.9 g/dl), and 5 percent who are severely anemic (less than 7.0 g/dl). (MOHFW, 1998-1999).
National and regional surveys also indicate that the prevalence of anemia could be as high as, 85% in expectant mothers and 90% among adolescent girls in some populations (MOHFW, 1998-1999; ICMR, 2001).

The National Tenth Plan had set the goal of reducing the prevalence of anemia by 25% among children and pregnant and lactating women (Government of India, 2002).

Many regional and local studies have estimated the prevalence of anemia to be high among Indian children. Some of the recent studies by are shown in the table below. (Table 1.4) compiled from Anupama Manjula and Aravindan. (http://krpcds.org/report/Aravindan.pdf).
Table 1.4 Regional and Local studies. (Source: http://krpcds.org/report/Aravindan.pdf).

<table>
<thead>
<tr>
<th>Year</th>
<th>Group studied</th>
<th>Prevalence %</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>Scheduled caste children 1–2 yrs in Punjab</td>
<td>73.3</td>
<td>Sidhu, 1996</td>
</tr>
<tr>
<td>1996</td>
<td>Scheduled caste children 4-5 yrs in Punjab</td>
<td>37.8</td>
<td>Sidhu, 1996</td>
</tr>
<tr>
<td>1997</td>
<td>Rural primary school children in Maharashtra</td>
<td>32.5</td>
<td>Awate, et al., 1997</td>
</tr>
<tr>
<td>2000</td>
<td>Tribal schoolchildren - Madhya Pradesh</td>
<td>30.3%</td>
<td>Chakma, et al., 2000</td>
</tr>
<tr>
<td>2001</td>
<td>Adolescent girls (10-18 yrs) Rural Meerut</td>
<td>34.5</td>
<td>Rawat, et al., 2001</td>
</tr>
<tr>
<td>2003</td>
<td>School children of urban slums in Delhi</td>
<td>41.8</td>
<td>Gomber, et al., 2003</td>
</tr>
</tbody>
</table>

Consequences of Anemia:

In Iron-deficient animals and humans have been observed to have an altered hormonal production and metabolism, including changes in neurotransmitter and thyroid hormones that are associated with neurologic, muscular and temperature regulatory alterations (Binkin and Yip, 1997). Historically hypothermia and have depressed thyroid function was reported in both animal and human studies on iron deficiency. (Brown, et al., 1967).
The immune system is also adversely affected, even before the level of frank anemia is reached. (Kapil and Bhavana, 2002). Defects in cell-mediated immunity and inability to kill bacteria have been well demonstrated by Lokeshwar, et al., (1990).

Further minimal work capacity, work output and endurance are impaired. Aerobic capacity in anemic children is reduced and anaerobic metabolism makes a greater contribution to the stress of exercise, resulting in early fatigue. (Kapil and Bhavana, 2002).

Even mild iron deficiency results in poor attentiveness, memory and academic performance in the areas of vocabulary, reading and knowledge. Children with iron deficiency perform less well on standardized scholastic tests and have impaired motor development. (Kapil and Bhavana, 2002). Observational Studies by Chen, (2004) found that, infants with moderate iron deficiency have test scores that are 0.5 to 1.5 standard deviations lower than infants with sufficient iron stores.

Earlier Rao and Gopalan, (1972) have reported that weights of children with iron deficiency anemia are below normal at the time of diagnosis and rapid weight gain followed iron therapy.
The relationship between nutrition and economic development:

According to Chen, (2004), nutrition status is the outcome of economic development and nutrition plays a role in accelerating economic development. Good nutrition is the material basis for Human Resource Development of a country or a community; nutrition is an issue of survival, health and development for current and succeeding generations.

Ross and Chen, (2002) calculated, if the rate of anemia among children remains at its current level (21.7% China) the value of lost productivity over the next ten years will be 2.4 trillion yuan. If the childhood anemia were to be reduced by 30% over the next ten years to 15.2%, the net present value of future productivity gained would be 348 billion yuan.

According to Sanghvi, (1996), iron deficiency costs India about 5 % of its gross national product annually from losses of lives, resources, and productivity.

The implication for educational performance and future productivity of such a deficit have been reviewed by Ross and Hurton, (1998), who estimated that anemic children would suffer 2.5% future productivity loss. Unlike the effect of anemia in adults, the loss is not restricted to manual labor but applies to any economic activity.
Benefits and risks of iron supplementation:

Iannotti, et al., (2006) reviewed 26 randomized, controlled trials of preventive, oral iron supplementation in young children (aged < 59 months) living in developing countries, to ascertain the associated health benefits and risks. The outcomes investigated were anemia, development, growth, morbidity, and mortality. The authors did report studies where hemoglobin concentration was improved, on iron supplementation, among iron-deficient or anemic children. However since the prevalence of iron deficiency among infants and young children living in developing countries, is high, the risk is mainly because of its chemical properties— namely, the oxidative potential of iron, as it is not easily eliminated from the body, can also cause harm through oxidative stress, further interference with the absorption or metabolism of other nutrients, and suppression of critical enzymatic activities was a risk to health.

In addition these authors also reported a study in a malaria-endemic population of Zanzibar, where significant increases in serious adverse events were associated with iron supplementation, whereas, in Nepal, no effects of iron supplementation, on mortality in young children were found. Thus it was concluded that more research is needed in populations affected by HIV and tuberculosis also iron supplementation in preventive programs may need to be targeted through identification of iron-deficient children (Iannotti, et al., 2006).
Hence Iannotti *et al.*, (loc.cit.) suggest, in their review that these studies highlight the need for more investigation, particularly in young children, since approximately one-third of the world’s population is infected with *Mycobacterium tuberculosis*, the pathogen that causes tuberculosis and the incidence of tuberculosis has increased dramatically with the HIV/AIDS epidemic (World Health Organization. Tuberculosis, 2006).

Cronje, *et al.*, 2005. In their research showed that iron enhanced the growth of *M. tuberculosis* in mice. Earlier Gangaidzo, *et al.*, (2001), had reported that loading of iron in macrophages where the T.B. bacterium grows may both facilitate its acquisition of iron and inhibit cellular defense systems.

On the other hand in a study reported by Das, *et al.*, (2003) on anemia, in adult males with pulmonary tuberculosis, showed no differences were observed in the recovery rates between iron-supplemented and placebo groups.

According to Baker and DeMaeyer, (2009), there is in existence most of the required scientific knowledge, and a reasonable operational plan of approach, which could enable nutritional anemia to be controlled and eventually largely eradicated the world over. What is now needed is for each National Health Authority to determine the prevalence of anemia in their country, the nature and severity of the deficiencies involved and the best ways of dealing with the problem. Because numerous conditions such as types of diet, social customs,
extent of parasitism, etc., are likely to vary from country to country, and even within regions in one country, it cannot be assumed that “giving iron pills” or “adding iron to the diet” will be the solution. It is, therefore, essential that in each country (or, where there are differences within countries, in each region) a logical experimental approach be adopted to determine the best way of dealing with the anemia either by supplementation, or fortification, or a combination of both.

Iron deficiency is the most commonly recognized form of nutritional deficiency in developing countries as well as in affluent societies. Iron requirements during early development; have now been well defined and hence greater attention is being paid not only to preventing deficiency but also to avoiding unnecessary supplementation. (Dallman, et al., 1980).

Dallman, et al., (1980) reported that Finch, (1977) had undertaken studies, which suggested that the form of iron in the diet is at least as important as the amount, and that the age at which iron is administered influences its effectiveness.

Vijayalakshmi, et al., (2003) have identified different strategies to fight iron deficiencies such as, distribution of iron supplements, fortification of staple foods such as salt or flour; and food-based approaches which are used in combination with nutrition education programs.
The project sponsors in the past have favored supplementation and fortification strategies (Ruel, 2001), these approaches are beset with many problems. Supplementation of iron, for example, is difficult to supervise, particularly in regions where infrastructure is missing (ACC/SCN, 2000).

Fortification of food, although a cost-effective way to increase nutrient availability to large population groups, requires effective management that includes advocacy, communications, regulation and quality control, along with monitoring and evaluation (FAO/ILSI, 1997).

For developing countries, researchers agree that poor quality rather than quantity of diets is the key determinant of impaired micronutrient status, including iron deficiency (Allen, 1993; World Bank, 1994).

Much less is known concerning the efficiency of food-based approaches to reduce anemia based on non heme iron intake from plant sources compared to heme iron intake from animal sources (Ruel and Levin, 2000).

Vijayalakshmi and Amirthaveni, (1999) have reported certain advantages associated with food-based approaches, they are considered to be more sustainable, the foods provide several essential micronutrients, simultaneously addressing a combination of deficiency problems, physiological interactions between vitamins and minerals in foods can enhance the body’s ability to absorb
essential micronutrients and foods can be used in a wide range of forms whole, processed, fortified, or a combination thereof to overcome micronutrient deficiencies.

Gillespie and Johnston, (1998) had stated that, the potential for food-based approaches to combat iron deficiencies seemed to be high. Food based approaches, therefore, may be the strategy of choice after therapeutic treatment through supplementation is no longer needed (Howson, et al., 1998).

A program in Denver, Colorado, known as the Integrated Nutrition Project, reported a change in lunchroom dietary behavior of students and also the attitudes of teachers toward nutrition education in the schools. Targeted behaviors that improved were increased fruit consumption and eating a greater variety of fruits. The study also demonstrated improved knowledge of the food guide pyramid, pyramid proportionality, whole grains and 5-A-Day. (Auld, et al., 1998).

A study in Taiwan demonstrated to Taiwanese education officials that their nutrition education program for elementary students could be fun and interesting, and even without examinations; students could gain knowledge, skills, motivation, attitudes and self-efficacy needed to adopt healthy eating patterns. (Ma and Contento, 1997).
Poh Bee Koon, *et al.*, (2006), evaluated a school-based nutrition intervention - Program ‘Sekolah Sihat’ conducted in Kuala Lumpur and Selangor, Malaysia. This Program which was implemented with an aim to promote healthy lifestyles in primary school children in Malaysia. Another objective of this study was to generate nutrition awareness and encourage children to make healthy food choices in addition capacity development of school children and teachers in nutrition.

Program Sekolah Sihat was piloted at 12 primary schools in Kuala Lumpur and Selangor, was an innovative nutrition education program that succeeded in improving children’s nutritional status, nutrition knowledge and food choices. This program also proved to be an innovative and practical approach to engage and build the capacity of school children and teachers in nutrition. The nutrition education components included nutrition modules, interactive CDs, a comic book as well as worksheets and other nutrition and health-related activities. Capacity development in nutrition included training workshops for school teachers and administrators through the concept of training the trainers. A total of 786 children were evaluated during baseline, while follow-up was done on 635 of the children, corresponding to a response rate of 80.8%. Measurements included anthropometry and questionnaire on nutrition knowledge, attitudes and practices was used. Results indicated an improvement in Nutrition knowledge significantly (p<0.001) from 64.6 ± 19.8 marks during baseline to 69.6 ± 20.8 marks at follow-up. More children were aware of the importance of breakfast, whereby 53.9% agreed that breakfast was important for health and not just to curb hunger in the
morning. An encouraging change in dietary habits was demonstrated by the reduction in snacking practice, as well as fast food consumption. Choice of food items and beverages during school breaks also improved. The proportion of children who were underweight or overweight decreased at follow-up.

A nutrition survey conducted in the rural Lindi District of Tanzania by Simon, et al., (1998) where in a 30 cluster sampling design, 660 households and a total of 2320 subjects aged 6 months to 65 yrs were examined. The results obtained revealed that, the most affected subjects were the pre-school children (aged <5 years) and school children (aged 5-14 years); 83.9% and 66.8% respectively with no differences between boys and girls. Moderate and severe anemia was more prevalent in the pre-school children than the rest of the population. The same trend was observed with regard to iron deficiency. Parasitic infections were only associated with anemia and iron deficiency in school children, adolescents and adult males and not pre-school children. A mainly cereal-based diet with additional legumes and green vegetables was found by in vitro studies to contain high amounts of total iron but low bioavailability.

During this research the Nutrition Intervention Strategy focused on modifications in food consumption pattern based approach of preschool and school children, no supplement, or fortification of food was prescribed to improve their overall food intake to enhance the iron absorption, further they were motivated to regularly deworm their children.
In India, as there is not only an economic but also a regional, social, cultural, religious diversity in food habits and food availability. There is a desperate need that not only of each state, but each city, town and village to develop their own strategy to combat nutritional deficiencies.

Thus the approach of the present Research Study was based on alternative prevention and control strategies such as a diet-based approach, only at a micro customized level; in a school where the parents were concerned and motivated that their child, in order to do well in studies, should be healthy. The children, if explained through fun activity methods would not only be able to improve their own eating pattern but that of their own families. Parents and grandparents when enrolled into this program would make changes in their family diet so therefore the postulation was that, if this program covered 500 students, 500 families would be covered and if each family had 5 members 2500 people would be covered directly or indirectly.

Baker and DeMaeyer, (2009) have stated that theoretically, it may also be possible to change existing food habits to increase the intake of a nutrient, but in practice this is extremely difficult.

Hence, it was precisely with this thought that the present research leading to the thesis was undertaken with the central aim being to highlight the need for every
pre-school and school in evaluating and imparting nutrition education to parents with a view to communicate behavioral change.

Further it was also assumed that such change would have a long-term effect as healthy eating habits, which can be inculcated in children from the beginning. This would definitely reflect in an improvement in their physical and mental performance and will translate to become an economic benefit rather than an economic loss to themselves and the nation.

The study was conducted with the permission of the school authorities, as well as the sanction of the school trustees. The Saifi Boy’s High School belongs to the, Daudi Bohra Community.

This Muslim community of Gujarat in western India traces its spiritual ancestry to early conversions to Ismaili Shiism during the reign of the Fatimid caliph-imam al-Mustansir (AH 427-487/1036-1094 CE). This community is split to form the Jafari Bohras, Daudi Bohras, Sulaymani Bohras, Aliyah Bohras, and other lesser-known groups. The word Bohra (also spelled Bohara or Vohra) is derived from the Gujarati vohorvu or vyavahar, meaning "to trade." The term "Bohra" applies most commonly to the Daudi Bohras, who are reputed to be the best organized and wealthiest of all Bohras. The present da’i, Muhammad Burhanuddin, has continued his predecessor's endeavors with particular emphasis on strengthening
the community's Islamic practices and on the promotion of Fatimid heritage.
(archive.mumineen.org/publications/oup/bohras.html).

**Enlightened Consent:**

After having clearly heard the reasons on the benefits of good nutrition and the need to overcome anemia in children and the interest of such blood collections before and after the nutrition intervention program, the trustees, school management and the parents gave their free and enlightened assent to undertake the present investigations.

**Confidentiality:**

Because of the aspect of data confidentiality, all the identities of the children were kept anonymous and code numbered by class.

A Hypothesis was formulated that if the children and parents are made to understand the importance of good nutrition and hygiene it will definitely impact their Physical, Nutritional, Clinical and Pathological status which will have positive effect on their productivity.
Hypothesis:

The present research project was designed to test the working hypothesis. ‘The number of anemic pre-school and school children will significantly decrease after the implementation of the Nutrition Intervention Program to parents, pre-school and school children with a view to Communicate Behavioral Change which will improve their health and mental performance’

As reported by Allen and Gillespie, in ACC/SCN, (2001). Communications for a behavioral change (CBC) is a self-explanatory strategy. Other terms used in the past have included nutrition information-education communications (IEC) or nutrition education; though the later has tended to imply a fairly didactic and often top-down approach that has seldom been effective in the long term. CBC has been drawn from the literature on social marketing to improve its relevance and effectiveness. It operates on the basis that new ideas, services or products can best be introduced if the intended beneficiary see them as fulfilling their own aspirations and well being. People will not accept new ideas and technologies designed solely from specialist’s concepts. Communications for a behavioral change follows a disciplined series of program development and implementation phases, each with steps designed to learn from the community itself;

Guidelines suggested by Allen and Gillespie, in ACC/SCN, (2001) for Communications for a Behavioral Change on nutrition has been derived, modified
and adopted for this study. The plan of action as described in the methodology was based on the several aspects described below:

**Focus on behavior** - This was considered very important throughout the implementation of the program. An orientation and interactive session was first organized for all parents to explain, what is anemia and its causes and consequences, it was followed by implementation of two questionnaire a) food preferences and b) Nutrition attitude and practice, to understand existing attitudes, perceptions and practices, the latter questionnaire was implemented again after the program was over. The blocks or obstacles that impede uptake of desired practices such as social, cultural, cost concerns, availability, poor service, lack of appeal, and how these constraints may be overcome was dealt with at every individual, small group and large group session.

**Take a systems approach to managing behavioral change** - An attempt was made to integrate the technical or clinical aspects of anemia by conducting a blood screening for hematological and biochemical parameters, anthropometric assessment, clinical examination (before and after the program) and of dietary assessment and counseling (monthly follow up for 3 months) to motivate a change. The purpose of this was to address truly behavioral and overall nutrition and health development objectives.
Appreciating that not all target audiences are the same and that even within one audience there are groups needed to be identified and addressed differently, for example - mothers, there may be important segments like nursing mothers, mothers of children who do not eat, mother’s who live in joint families, or who live in nuclear families, single divorced mothers, mothers who have more than 3 children with different dietary needs, the list is endless, this aspect was more intimately discussed at the time of individual counseling and solutions were sought and agreed upon between nutrition counselor and parent.

**Clearly define barriers to change, both attitudinal and environmental** - Environmental barriers may include the lack of purchasing power for certain foods, periods of feasting and fasting, A common attitudinal barrier to improved feeding practices is the mother’s feeling that she lacks control which derives from her low social status in the family where the mother-in-law is in charge. A feeling that, she lacks the confidence to overcome resistance from her child. Also mothers may feel that they lack the time to employ new practices. To overcome this barrier the grandparent were also involved in the small and large group nutrition counseling.

**Pin point potential motivators or enabling factors** - For example fathers, grandparents. Whose potential contribution is often undervalued particularly when it comes to influencing the choice of foods purchased and fed to the child.
Enforce rigorous discipline in the message development process - An effort was made to ensure that nutrition and health messages given out would motivate the desired action. This was done in all interactions with children, parents, teachers or canteen man. The nutritionist and doctors always tried to surmount all known obstacles convincingly. Meaningful health benefits were always offered if they modified their food habits and adopted a healthy lifestyle.

An effort was made to base all information given on sound research to ensure that the messages reach and frequencies are sufficient to achieve the required behavior change objectives. The choice of communication channels was location specific and included direct counseling, generation of word to mouth communication within the community, innovative use of available mass media where an exhibition on nutrition and health was organized by the preprimary school for the community.

Special attention to service personnel - such as teachers, canteen man was given to increase their nutrition and health awareness and also be in practice as the real motivators of behavioral change.

As anemia is a public health issue. It was recognized that for implementation of any effective program, it was important to achieve a balance between government initiatives and goals and initiatives that were developed locally with the target communities themselves.
As the program matured and dietary behavioral changes began, the communications were at various levels, it ranged from a mass media approach like large group sessions to small group sessions, to face to face interactions, relevant nutrition information was imparted in “fun manner” not only to children but also to parents.

Objectives developed for the program, thus were aimed to bring about this dietary change which would reflect in improvement in the hematological, biochemical, anthropometric, and clinical parameters as well as the academic performance and classroom attendance of the student.
Objectives:

a. To screen all the preschool and school children for the prevalence of anemia’s before and after the Nutrition Improvement Intervention Program.

b. To design and implement the Nutrition Improvement Intervention Program.

c. To study the impact of the Nutrition intervention program in anemic and non-anemic preschool and school children on:

   1. Hematological Parameters
   2. Biochemical level
   3. Dietary Intake
   4. Anthropometric Status
   5. Academic performance
   6. Attendance records

d. To study the impact of the Nutrition intervention program on Attitude and Practices of parents.

e. To correlate Hematological, Biochemical and Dietary Parameters before and after the Nutrition Intervention Program.
Nutrition Improvement Intervention Program.

Objectives:

a. To conduct an evaluation of the Attitude and Practices with regard to Healthy Eating Habits among parent before and after the Nutritional Intervention Program.

b. To create an awareness of anemia - the causes and effects of anemia among all preschool and school children and parents.

c. To propagate good eating practices among all.

d. To undertake a three-four month follow up among preschool and school children with regard to, assessing, calculating and suggesting dietary intake modifications.
Anemia Screening, before and after the Nutrition Improvement Intervention Program.

Objectives:

a. To conduct a blood screening of all preschool and school children.

b. To conduct a clinical assessment.

c. To conduct an anthropometric assessment.

Therefore the present research programme commenced with a pilot study where the nutrition intervention program as well as the blood screening pre and post was implemented. All difficulties with regard to participation, timing, method of communication, as well as school staff and management was addressed; suggestions trustee’s and parent were taken into consideration while planning the final research. This design included nutritional, anthropometric, hematological, biochemical and clinical parameters before (Phase 1) and after (Phase 3) the implementation of the nutrition intervention program. The academic and attendance records were to be compared in both phases.
As this research was done only in boys from nursery to 9th standard belonging to one community (Daudi Bohra), the research design was again implemented in a mixed community Udayachal (Godrej) Primary School which consisted of boys and girls from different communities studying in 1st to 4th standard. Data with regard to hematological and biochemical parameters was considered for this study. The next chapter elaborates the methodology developed and adapted for this research.