Anaemia among the Adolescent Girls and Expectant Mothers

By

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I INTRODUCTION

Great changes in the year 1990's March and great change is needed if a century of unprecidentent progress is not to end in a decade of decline and despair for half of the nations of the world. In many countries, poverty, malnutrition and ill health still remain as challenges preventing progress. India is no exception. We are today 843 millions. With this tremendous human resource it should be possible to make progress in all facets of life. However, our country is still struggling even for fulfilling the have needs, if its population.

Although the reasons are many and complex, over shadouring all reasons is the fact that a considerable majority of our population do not enjoy optimal nutrient intake (UNICEF, 1990).

Ramalingaswami (1986) points out that poverty and inadequate diet lead to specific nutritional deficiencies that exist in India. They are protein energy malnutrition, xeropthalmia, nutritional anaemia and iodine deficiency disorders. Among these nutritional disorders anaemia is more prevalent and affects all age groups (WHO, 1985).

According to Demaeyar (1985) anaemia is a most prevalent problem in the world affecting more than 700 million persons. The prevalence of iron deficiency anaemia by region, age and sex as estimated by WHO shows that, in the developed region containing 1200 million population 11 per cent of population from 15-40 years were found to be anaemic and 14 per cent of pregnant women were found to be anaemic. In the case of the developing regions accomdating 3800 million 59 per cent of the expectant mothers were anaemic. Taking developed and developing countries, it was found that 8 per cent of the population in developed countries was found to be anaemic, out of whom adolescent girls occupied 11 per cent and expectant mothers occupied 14 per cent. In case of developing countries 30 per cent of the population was found to be anaemic, out of whom 47 per cent were adolescent girls and 51 per cent were expectant mothers (Sood, 1991).

Friere (1989) warns that even iron deficiency affects health. It is well reognised that in India there is a very high prevalence of anaemia, related to iron deficiency. According to Chakravarthy **et al.** (1989) anaemia is a major nutritional prfoblem with significant impact on the health and productivity of the population.

Rao (1991) stresses that iron deficiency anaemia is more prevalent among the vulnerable groups. The most vulnerable groups are pregnant women and adolescent girls.

Both Well **et al.** (1984) points out that iron deficiency anaemia is most common among women because their requirement for iron is greater and their iron intake is less as a result of the lower food consumption.

According to (WHO, 1986) women in the period of reproduction and expectancy require a daily absorption of iron which is approximately three times that required by an adult male. Dudex (1987) points out that adolescence is a period of physical, emotional social and sexual maturation and the nutritional intake should be such that it supports adequate growth and development, especially with reference to energy, protein, calcium and iron. Generally the growth spurt begin in females around age 10 to 11, peaks at age 12 and completed by age 15. When mensturation begins there will be excess loss of iron which has to be replaced to compensate monthly losses and the requirement for increased iron remains until menopause (Rajagopalan, 1986).

According to Bhasker Rao (1986) the adolescent is a teenager, neither a child nor an adult of 13 to 18 years. The adolescents form 22 per cent of India's population and hence need our immediate attention. Thangaraj (1986) puts forth that the teenage girls continues to be malnourished even at a period when her nutritional need is great. Due to mensturation, teenage girls constantly lose iron, which is not supplemented in the diet. This makes them anaemic and their health status further deteriorates. So Pisharoti (1986) advises that adolescent girls should receive much greater attention than at present for enriching the health of the mother and the child.

According to Thangaraj (1986) and (Sen **et al.,** 1992) higher infant mortality in India, is noticed among the teenage pregnant girls. Female mortality is higher at all ages and particularly during 5-10 years and 15-25 years not withstanding the fact that female child is biologically stronger at birth. Appavoo (1986) stresses that complications during pregnancy and child birth are high among adolescents. Incidence of low birth weight is highest among the adolescent primies and younger the girl, the greater her vulnerability is. Rao (1991) points out that during pregnancy inadequate intake of food as well as poor bioavailability of dietary iron in the habitual cereal based diets and also due to the absence of certain other nutrients like vitamin C and due to certain substances like phytates and tannins in Indian diets causes anaemia. The adverse effect is that the pregnant women aer anaemic because of the increased need for iron and the prevalence of anaemia is between 15 to 90 per cent in third trimester of pregnancy (Badhri Narayani **et al.,** 1991).

Foetus is in a sense a parasite on the mother and draws its nourishment from her diet. If the iron intake of the expectant mothers are inadequate than her body reserves are drawn upon and depleted. The incidence of prematurity rises with a decrease in nutritional status of pregnant women (Antia, 1989). Thus the pregnant women are prone to be anaemic and the body reserves are used by foetus because full term foetus requires 300 mg of iron and for the maternal tissues and the increased in blood volume an additional of 500 mg is required. The relative small amount of dietary iron and the diminished stores of iron are inadequate to meet the increased iron requirement for the synthesis of enough maternal and foetal Haemoglobin (Kumar and Kumar, 1988). Saxena **et al.** (1989) point out that these inadequate reserves and intake causes a high incidence of premature birth, low birth weight and perinatal mortality. In India one third of the babies are of low birth weight. These babies are found to be more likely to die from infections diseases, diarrhoea and respiratory infection. Wantabe (1989) stresses that anaemia causes maternal mortality and morbidity in India. This inturn causes decreased growth and intellectual development of children (Chakravarthy **et al.,** 1988) Rossister (1986) puts forth that maternal mortality is highest among very young mothers. In the "Maternal mortality survey" the safer age group is 20 - 24 years and the worst group is 35 years and above.

According to WHO (1986) anaemia reduce resistance to fatigue and as a result work out put increases leading to diseases and if not treated, severest form can lead to death. In order to reduce the mortality and morbidity "The National Nutritional Anaemia Control Programme" was initiated by the Government of India in the 4th 5 year plan and is being continued till now. The objective of the programme is to decreases the prevalence and incidence of anaemia in adolescent girls expectant mothers and the preschool children. This programme is implemented through the primary health centres and its sub-centres. The cther centres are like the function aries of integrated child development service programme, under the department of women and child development. Ministry of Food and Civil supplies is responsible for promoting consumption of iron rich foods (Sood, 1991 and Espinoza, 1991). These programmes have been in operation fod more than a decade now.

Thus there is a need for assessing the improvement in the iron nutritional status through estimation of the prescence of anaemia and to find out whether the problem has decreased or increased over the years.

The main objectives of the study are:

1. To find out the existence of anaemia among selected adolescent girls and expectant mothers.
2. To study factors that lead to anaemia.
3. To find out how the iron status affects the health.

It is hoped that the study will throw some light on these crucial facts affecting our women population.

Review of Literature

II REVIEW OF LITERATURE

The literature pertaining to the study on anaemia among adolescent girls and expectant mothers is dealt under the following headings:

A. Nutritional problems Existing in India.

B. Prevalence of Anaemia Among the Vulnerable Groups

C. Factors Responsible for Anaemia

1. General
2. Adolescent Girls
3. Expectant Mothers

D. Consequences of Anaemia

1. General
2. Adolescent Girls
3. Expectant Mothers

E. Need for Combating Anaemia

A. NUTRITIONAL PROBLEMS EXISTING IN INDIA

Nutritional status, or the state of balance between nutrient supply and demand has a significant impact on both health and disease. For the 'well' client, an optimum nutritional status helps maintain health, promotes normal growth and development and protects against diseases, during illness. Conversely, a poor nutritional status increases morbidity and mortality (Dudex, 1989).

Nutritional status is the condition of health of the individual as influenced by the utilization of the nutrients. It can be determined by the correlation of information obtained through a careful physical examination and appropriate laboratory investigation (Robinson **et al.**, 1986).

Malnutrition is a general term that literally means 'bad' nutrition and may be caused by nutritional excesses or deficiencies. Mild nutritional deficiencies in general can interfere with the ability to function, the quality of life and the sense of well being (Dudex, 1987).

Protein Energy Malnutrition describes a range of clinical disorders. At one end marasumus is due to a continued restriction of both dietary energy and protein, as well as other nutrients. At the other end is Kwashiokor, due to quantitative and qualitative deficiency of protein, but in which energy intake may be adequate (Passmore **et al.**, 1987).

According to (Vileri **et al.**, 1988) weaned infants and children under the age of five years, the elderly pregnant and lactating women and adolescents are also vulnerable groups for some of the same reasons like poverty, famine and limited avavilability of foods.

Malnutrition in adolescent girls occur due to anorexia nervous where there is a self imposed starvation of severe self imposed dieting characterised by dramatic weight loss (Dudex, 1989).

Vitamin A deficiency is often associated with protein Energy malnutrition (Dudex, 1988) Vitamin A deficiency causes changes in the eyes, mucous membranes of the respiratory alimentary and genito urinary tracts and the stress (Anita, 1989).

Accoridng to (Swaminathan, 1986) riboflavin deficiency is another common deficiency and is more prevalent among children belonging to low socio economic groups.

Calcium deficiency may be related to an inadequate calcium intake or may occur secondary to mal-absorption syndrome. Vitamin-D deficiency, or endrocine disorders. Along standing deficiency of calcium which causes loss of calcium from the bones in order to maintain serum calcium levels, can result in osteomalacia and osteoporpsis in middle aged and elderly women (Dudex, 1989).

Osteoporosis occur in women during post menopausal period and calcium deficiency induces muscle weakness bone pain and impaired mineralization of bone (Solomons, 1988).

According to Dudex (1989) idoine deficiency is most prevalent among the people who live in the hilly areas when the soil is lacking in iodine.

Nutritional anaemia is a world wide problem however its prevalence is highest in developing countries especially among pregnant women and adolescent girls. According to (Rao, 1982) although etiology anaemia may involve deficiencies of iron, folic acid, vitamin B 12 and protein. Studies have shown that iron deficiency is by far the most common nutritional deficiency responsible for anaemia (Subadraseshadri, 1990).

B. PREVALENCE OF ANAEMIA AMONG DIFFERENT AGE GROUPS

Prevalence of anaemia is most common among the vulnerable groups. About 43 per cent of young children and 51 per cent of pregnant women are globally affected by anaemia. Iron deficiency anaemia affects about 700 - 800 million people world wide (WHO, 1989).

According to Balakrishnan (1988) incidence of iron deficiency anaemia is world wide including the affluent countries about 50 per cent of the pregnant women have haemoglobin less than 10 g per cent during the second half of pregnancy.

Iron deficiency anaemia is more prevalent in the developing than an industrialised and developed world. Thirty six per cent or about 1400 million persons out of an estimated population of 3800 million in the developing countries suffer from nutritional anaemia as against 8 per cent or just a 100 million persons out of 1200 million in the developed countries (Mangalani **et al.,** 1990).

Large population surveys in rural, India indicate that the prevalence of anaemia in India according to WHO criteria ranges from 38 - 72 per cent depending upon age and sex (Rao, 1991).

Despite India's marvellous increase in food production her nutrition problems countinue to be formidable. Among the nutritional deficiency diseases, the prevalence of anaemia is high. The over all proportion of anaemia in India was estimated to be as high as 80 to 90 per cent among expectant and 29 per cent among school age children (Murthy **et al.,** 1989).

Iron deficiency is the state in which the amount of iron in the body is less than that required for normal formation of haemoglobin, iron enzymes and other functioning iron compounds (National Research Council, 1989).

In India, Anaemia during pregnancy was caused predominanty by iron deficiency followed by the folate deficiency. A study involving pregnant women in rural community revealed that 75 per cent had anaemia but an earlier study on 1000 women in sourthern India showed a lower rate of 33 per cent. In a study conducted by (Diwan, 1991) anaemia was found in 88 per cent of the expectant mothers.

In many tropical areas 70 to 80 per cent of pregnant women were found to be anaemic (Barbin, 1991).

In India the overall incidence of anaemia among the adolescent girls was around 25 per cent irrespective of urban rural residence status. In the upper income group girls too, anaemia was seen in 17 per cent (Leela Raman, 1990). Using WHO criteria it was estimated that 10-20 per cent and 40 per cent of the urban and rural slum dwellers were mildly anaemic (Veena Chamanhalli **et al.**, 1991).

Therefore Iron deficiency anaemia is widely prevalent throughout the world. Incidence in various countries ranges from about 5 to 15 per cent in males. 10 to 50 per cent in women and 15 to 92 per cent in children (Robinson **et al.**, 1986).

C. FACTORS RESPONSIBLE FOR ANAEMIA

1. General

Iron deficiency is the most important cause of Anaemia. About 80 per cent of the total anaemic cases are due to iron deficiency and the rest are due to deficiency of nutrients like folate and Vitamin B12 (Shobana Muratee, 1990).

Anaemia occurs due to the following reasons

1. Blood loss (most common cause in adults).
2. Deficiency of iron in the diet during the period of accelerated demand.
3. Inadequate absorption of iron.
4. Nutrition deficiencies such as severe protein depletion (Robinson **et al.,** 1986).

The main causes of iron deficiency anaemia is inadequate food intake as well as poor bioavilability of dietary iron in the habitual cereal based diets according to (Rao, 1991).

According to (Dwyer, 1988) iron deficiency is most prevalent and severe in populations in developing countries subsisting on predominantly vegetables cereal and legume diets. Meat content of diet is the factor best associated with good iron status.

The amount of iron which is absorbed from food depends on the form of iron and on other constituents of the diet. The addition of small quantities of green vegetables, fruits and meat to unbalanced diets is perhaps valuable in promoting the absorption of inorganic iron (Passmore **et al.,** 1986).

There are two distinct types of dietary iron-heme and non heam iron. Haem iron is a constituent of haemoglobin and myoglobin and therefore is present in meat, fish and poultry as well as in blood products. Haem iron accountd for a relatively small fraction of total iron intake usually less than 1-2 mg of iron per day, or approximately 10-15 per cent of the dietary iron consumed in industrialized countries. In many developing countries, heam iron intake is lower or even negligible. The second type of dietary iron non haem iron is a more important source, it is found to varying degrees in all foods of plant origin (Demaeyer, 1989).

Iron deficiency can arise either due to inadequate intake or poor absorption of dietary iron or due to excessive losses of iron from the body. Iron intake is closely related to energy intake. In view of the widespread energy deficiency in our population, particularly among preschools children and women, dietary inadequacy of iron and may also be widespread (Rao, 1983).

On an average bio availability of iron is 10 to 30 per cent from the food of animal origin and only 1 to 5 per cent from vegetable foods (Subramaniam, 1988).

High bran and phytate intake over a long period would induce changes in the intestines or its microflora leading to a inhibitory effect of dietary iron absorption. Such changes might occur in populations in developing countries with a usually very high dietary intake of phytates (Mats Brune **et al.,** 1989).

It has been demonstrated that tea drinking reduces the iron absorption from the gut in healthy adults (5 - 6) and in patients with thalassemia when tea is consumed often or frequently it will causes anaemia (Hadar Mishav **et al.,** 1985).

Hook worm disease, malaria and other infections if present further aggravate iron deficiency anaemia and increase its prevalence (Rao, 1991).

2. Factors responsible for Anaemia in Adolescent Girls:

Normally the haemoglobin concentration in both boys and girls at the age 6 is almost identical. From 6-12 there is a slight rise in haemoglobin concentration in both boys and girls, from 12.8 g/dl for boys and 13.2 g/dl for girls. The haemoglobin concentration in girls during the rest of adolescence is slightly lower, whereas in that of the boys it reaches 15 g/dl by 18th year compared to 12.9 g/dl in girls (Mclareman and David Burman, 1982).

Anaemia is a major public health problem of the world today. The adolescent girls, who have attained their menarche are more prone to developing anaemia and nutritional deficiency signs. In the upper middle income group due to personal likes and dislikes and food taboos, the intake of green leafy vegetables and healthy foods are not adequate. Among the poor class, intake is poor mainly due to non availability of nutrients foods (Leela Raman, 1990).

Both adolescent males and females are susceptiable to anaemia. The demand for iron is increased both sexes and few adolescents consume the recommended amount of iron daily in their diets (Lewis, 1986).

Shubha da Kanani (1991) found that growth velocity was higher in the age group 11 to 14 years in adolescent girls belonging to slum as compared to the affluent girls, indicating catch up growth. Mean age of menarche was 12.9 years and mean haemoglobin level was 9 g/dl. Prevalence of anaemia was 97 per cent, anaemia being more prevalent in among 16 to 18 years old girls than in younger girls.

From 11 to 27 per cent of adolescent girls are not spared owing to rapid growth and hormone changes, coupled with poor eating habits may be iron deficient or anaemic (Hammonds, 1987).

The anaemia is common in all the age groups adolescent girls to the tune of 20 - 25 per cent irrespective of the social class (Leela Raman, 1990).

Iron deficiency in adolescent matured girls is higher both in urban slum and rural poor girls. Also iron deficiency showed an increase with increasing age especially in those attained menarche. The hyperferritinemia in adolescent girls has been attributed to repeated and chronic infections and infestations resulting in non utilisation of iron. Incidence of anaemia is more among the upper income group girls due to their poor intake of leafy green vegetables and pulses. Also fast foods, irregular food habits and attempt to curtail food intake to reduce weight appeared to be constant factors in these girls and related to the deficiency signs of anaemia (Leela Raman, 1990).

Anorexia nervosa is a psychiatric disorder seen primary in females with onset usually occurring in early adolescence. Most girls are from middle and upper class (Robinson **et al.**, 1986).

According to Leela Raman (1990) those who attain menarche at early age have a large percentage deficit in body weight. The deficit is of higher order till the age of 14 years in girls and who have not attained menarche.

Thus the need for iron is large for adolescent girls. Their average weight gain of 9 kg during the peak year of the growth spurt is almost as great as in boys. Although the concentration of haemoglobin changes very little during this period, the onset of menstruation imposes additional iron need and because of the period of rapid growth additional iron is needed which other wise leads to anaemia (Dallman, 1990).

3. Factors causing anaemia in Pregnancy

Pregnancy is a period of nutritional stress where there is a noticeable increase in the demand for iron (NIN, 1982). Anaemia during pregnancy has been claimed to be a result of deficiency of specific haemopoietic substances (Luwang and Gupta, 1986). Rang and Dale (1987) point out that the increased need is to 10 times greater than the requirement of a non pregnant women. Parthasarathy **et al.** (1986) put that this is to meet the requirement of the growing foetus, placenta, expanding maternal blood volume and the red cell mass.

The loss of iron involved in a normal pregnancy (iron content of placenta, uterus, and blood cells) and lactation (iron content of milkduring six months of lactation 175 kg) may total appromimately 900 mg. This entails an extra demand for absorption of adult 2 mg iron per day.

Even if there is an estimated saving from the omission of menstruation during pregnancy, the negative iron balance is still large. It is obvious that menstruation and pregnancy greatly increase a women a requirements for iron, it is not surprising that diet alone is often unable to meet the deficit (Passmore **et al.,** 1986). (Demaeyer, 1989).

According to (Dawn, 1989) from the beginning of the second trimester there is a major expansion in the maternal red cell mass in order to provide oxygen to the developing foetus.

Lewis (1986) points out that the expectant mother's need for iron increases one mg per day beyond the 18 mg RDA. The iron increases is necessary for transporation of greater nutrient load and greater oxygen demands related to tissue increase. During second to eighth month, the expectant mothers blood volume increases 20 to 30 per cent. The lack of menstruration some what offsets greater iron need, but absorption triples the pre pregnancy level. During the second half of pregnancy, iron needs become greater, since the placenta begins iron transfer to the foetus at that time.

Bora and Baroova (1991) comments that the low iron intake and poor absorption of iron from habitually consumed cereal based phytate and fibre rich diet were considered as major factors causing iron deficiency anaemia amount the tribal mothers.

Datta Banik (1975) puts that chronic infections prevent the utilization of iron and are additional contributory factors in causing anaemia. Hook worm infection in some areas aggravates the situation by increasing iron loss.

According to (INACG, 1990) malarian hookworm infestation if present complicate iron deficiency anaemia and can be more severe, with haemoglobin levels below 6.0 or even 4.0 g/dl.

Luwang **et al.** (1986) puts that those people especially adult women who are pregnant and who take lot of animal foods are less susceptible to be anaemic, when compared to those who do not take animal foods. But it has been found that pregnant women who take a lot of animal foods belong to the low income groups whereas those who do not take animal foods belong to middle or high income group. So both cases are prone to be anaemic due to in adequate intake food.

According to (Upadhyaya, 1986) iron deficiency anaemia has an inverse relationship with daily dietary protein intake. There is a positive significant correlation between the protein intake and haemoglobin level of the expactant women.

In general according to (INACG, 1990) reports women frequently enter pregnancy with inadequate iron stores and thus the increased demands associated with pregnancy result in anaemia.

Shanti Ghosh (1986) puts that the health and nutrition of the expectant mother her age, the number of children, she has had, the interval between them and the complications she gets during pregnancy, all have profound influence on child survival and optimum growth.

In Jawadu Hill tribals 65 per cent of pregnancy and nursing mothers were suffering from nutritional anaemia 60 per cent from worm infestation and as a result they are malnourished and are more susceptible to infection. They take same as the staple food which is deficient in protein iron and vitamin A. Therefore, about half of the number of pregnant women in our country are anaemic. One out of every four maternal deaths are due to anaemia complications of pregnancy, both foetal and maternal, can take place in an anaemic mother (Begum, 1989).

D. CONSEQUENCES OF ANAEMIA

1. General

Iron deficiency is associated with decreased work capacity, poor mental performance and impaired resistance to infection. Due to worm infestation pregnant women experience breathlessness and increased cardiac output at rest. At this stage, added stress from labour, spontaneous abortion and other major complications can result in maternal death (Shobana Muratee, 1990).

Patients with anaemia have a signfiicant reduction in the red cell mass and corresponding decrease in the oxygen carrying capacity of the blood. There is oxygen delivery to the tissues during exercise. The limitation of the physical activity and work output depends more on the speed with which the lowering of haemoglobin occurs than on the level of haemoglobin alone (Subramaniam, 1988).

Anaemia characterised by decreased levels of circulating haemoglobin and tissue iron contents in known to lead to several functional abnormalities with health consequences. Moderate to severe anaemia is known to have several functional consequencies like impaired maximal work capacity, decreased immunological competence, behavioural abnormalities and reduced learing ability among children. Iron deficiency anaemia with haemoglobin level below 10 g/dl is known to reduce cell mediated immunity (Rao, 1991).

The cardiac output and the heart rate of individuals with less than 7 g per 100 ml of haemoglobin is increased. If hypoxia is severe and prolonged, cardiac failure and pulmonary congestion are seen. The bone marrow in anemia is hypercellular and shows increased erythropoietic activity. This is reflected in the presence of reticulocytes in the blood of patients (Talwar **et al.**, 1989).

Anaemia with haemoglobin concentration below 11 g/dl is associated with decreased work capacity and mental performance and probably with impaired resistance to infection. Anaemic women are less tolerant to blood loss at delivery, particularly when haemoglobin level falls below 8.0 g/dl (Demaeyer, 1989 INACG, 1990).

Iron deficiency interferes with cell mediated immunity and bacterial activity (Park and Park, 1986). Chatterjee (1987) says that in anaemia the coronary flow is increased sharply in order to maintain the normal oxygen need of the cardiacmuscle, because the oxygen carrying capacity of the blood is decreased under such state. The increase in the coronary flow is related partly to the decreased viscosity of blood and mostly to the active vasodilation resulting in from anaemic hypoxia and metabllic hypoxia due to increased heart rates.

2. Consequences of Anaemia in Adolescent Girls

Leela Raman (1990) put that adolescents girls who enter pregnancy, if anaemic may have a high risk of mortality and morbidity. Anaemic causes about 20 per cent of maternal deaths, when the adolescents enter pregnancy even in younger age groups.

According to (Dudex, 1987) anorexia may affect one of every 100 teenage girls and young women; bulimia one of every 5 women in college. This leads to anaemia and as a result they are prone to complications like brain damage, permanent sterility, chronic invalidism, damage to vital organs, menstural cycle is affected and is not regular.

Balakrishnan (1988) puts that complications are that they are more susceptible to infections. In severe cases heart failure may occur, motor development delayed, anorexia and irritability cause additional feeding problems leading to further malnutrition. Severe iron deficiency interferes with normal functioning of the gastrointestinal tract; exudative enteropathy with further protein or iron losses may occur. Anaemia lessens resistance to fatigue and to disease and in the severest form can lead to death. Because of anaemia, poor hygiene of genitals around the menstural period can cause variety of infection. Adolescence is a period of high fertility and repeated pregnancies and child birth during that period adversely affects their health.

Ravinder Chadha (1991) puts that a high proportion of girls in the country are already anaemic before starting on their pregnancy. Prengnancy only serves to aggravate the pre-existing anaemia.

3. Consequence of Anaemia in Expectant Mothers

Resistance to infection is very low among anaemic pregnant women. In iron deficiency anaemia there is decrease in the hot resistance the cell medicated unmure response is impaired. Individuals who suffer from iron deficiency are more prone to all types of infections including fungal infections because of the reduced capacity of the epithelium membraneous cellular tissue that overs a free surface or lines a tube or cavity as well as mucosa to resist colonization by organisms (Subramaniam, 1988).

Anaemia in pregnancy leads to higher mortality and morbidity of expectant mothers, it results in low birth weight of 2 kg and related health complications of the new born and there is an inability to maintain body temperature (NIN, 1982).

A woman's pre pregnancy weight status and her weight gain during pregnancy have a major influence on the birth weight of her child. Pre-pregnancy weight status is positively associated with birth weight, particularly among under weight and normal weight women. An expectant woman's dietary practices and attitude towards weight gain during pregnancy may also be important determinants of dietary outcomes (Armstrong and Weigohn, 1991).

Rao (1991) puts that anaemia in pregnancy is knwown to cause increased maternal morbidity and mortality, increased in foetal morbidity and mortality, increased risk of low birth weight. It also impairs maximal work capacity, decreased immunological competence and poor pregnancy out come.

E. NEED FOR COMBATTING ANAEMIA

The need for combatting anaemia is to improve the iron status of the community and there by reducing the prevalence of anaemia and this can be brought about by increasing the iron content of the diet by inclusion of iron rich foods like green leafy vegetables (Rao, 1991).

Anaemia control can also produce socio-economic spin offs one reduces high maternal mortality, two reduces incidence of infection, three reduces hospital admissions, four reduces absenteism, five improves memory, concentration and learning capacity and six reduces infant mortality and increases chances of survival (Francis, 1988).

The need for combatting anaemia is that to produce an immediate increase in physical work. Output and leads over the longerterm to reduce morbidity and mortality, higher productivity, improved quality of leisure time increased capacity and a greater sense of well being (Manglani **et al.**, 1990).

The work output or work capacity is measured in terms of "elasticity" representing the percentage change in work output associated with a 1.5 per cent increase in work output (Levin, 1985).

Parasite infection must be eradicated so that blood loss can be avoided which otherwise aggravate anaemia. The permanent solution to this problem, the eradication of the parasites, is a difficult procedure involving effective treatment of the host, protection of individuals from reinfestation through wearing of foot wear to avoid exposure to beharzia contaminated waters, the construction and use of proper latrines, and molluscacidal treatment, where relevant (Selivyn Baker, 1977).

According to the National Nutritional Anaemia Programme the need for combatting anaemia are to reduce the prevalence of anaemia among the "high-risk" population groups by increasing the haemoglobin level, provision of iron and folate to these groups through MCH services, by launching an effective educational programme and by developing an alternate strategy to improve the intake of iron in food (Banerjee, 1989).

Anaemia can be combatted through a series of interventions.

1. Dark green leafy vegetables high in iron and vitamin C containing foods which enhance iron absorption.
2. Iron tablets especially for high risk groups such as pregnant women and young children.
3. Deworming for hookworm infestation and the use of footwear to prevent reinfestation.
4. Fortification with iron of a low cost commonly used food.

Recent studies conducted by World Bank (Thangraj, 1985) show that iron treatment increased productivity of employees by 20 per cent and has a high social cost benefit.

The ministry of Health and Family Welfare, Government of India instituted a prophylaxis programme against nutritional anaemia under which iron and folic acid supplement is given for a period of 100 days to beneficiaries namely pregnant and lactating women with haemoglobin 10 g/dl and above (ICMR, 1989).

According to Ravinder Chadha (1991) anaemia of pregnancy can be combatted through the conventional approach of providing iron folate tablets to pregnant women during the last trimester of pregnancy needs to be critically reexamined in the prevailing context of wide spread prevalence of anaemia in our children.

Sood (1989) puts that the beneficiaries of the phophylaxis programme are prioritised as follows.

The first priority goes to expectant mothers second priority goes to lactating women third priority to IVD users fourth priority to prischool children (1-5 years), fifth priority school children and Sixty priority to adolescent girls.

Methodology

III. METHODOLOGY

The methodology, for the study on anaemia among adolescent girls and expectant mothers, involved the following steps.

a. Selection of the area
b. Selection of the sample
c. Evolving the proforma
d. Conduct of the study and
e. Analysis of data.

a. Selection of the area

Government Hospital located in the city of Coimbatore and SKS hospital from Salem were selected for the conduct of the study on pregnant mothers. The hospitals were selected as adequate sample could be obtained and the selected expectant mothers took continuous medical checkup every month from these hospitals. The hospital authorities and the people who attended these hospitals were willing to co-operate and helped to collect the data required and were found easy to approach.

Avinashilingam Deemed University and Avinashilingam higher secondary school located in Coimbatore were selected for the conduct of the study on adolescent girls. This school was chosen because the school and the college authorities and the girls co-operated and helped to collect the data required.

b. Selection of the sample

One hundered and thirty three pregnant women from Coimbatore City and one hundered and twenty five women from Salem were selected at random making a total of 258 expectant mothers for the study. All the mothers selected for the study were in the third trimester of pregnancy. The need for iron is greater during this stage of pregnancy. All the expected women were in the age group of 17-35 years.

A subsample of 30 women who were willing to give blood for the estimation of the biochemical profile were selected from each area. These expectant mothers belonged to the age group of 17-35 years. This age group was selected as most women pass through the stages of pregnancy during this age interval.

Three hundered adolescent girls from Avinashilingam Deemed University and Avinashilingam Higher Secondary School were selected at random, to enable the investigator to study the iron status of adolsecent girls during the two stages of adolescence namely 13-15 years and 16-18 years 210 girls from 13-15 years and 90 girls from 16-18 years. A subsample of thirty adolescent girls who were willing to give blood for assessing the biochemical profile were selected. Adolescence is the period when the girls attain their puberty and menstural cycle starts and this is the period when there is an increased need for iron. Hence these age groups were chosen.

c. Evolving the proforma

Interview schedule was chosen for the study as this is a more accurate method than others because the data can be collected on the spot and clarification if any could be made on the spot. A detailed interview schedule was prepared for administration for expectant mothers and adolescent girls by the investigator, to elicit information on the following headings.

1. Socioeconomic information
2. Clinical assessment
3. Dietary History
4. History of previous pregnancy in expectant mothers.

The proforma prepared is given in appendix I.

1. Socioeconomic information

In the socioeconomic information, the details regarding general back ground, occupation, family size and total income were collected.

2. Clinical assessment

The clinical assessment was done for finding out the health status and it was done to find out whether there is any malnourishment, vitamin A deficiency. B complex deficiencies, dental caries and such other nutritional problems. The assistance of a medical doctor was sought for this purpose.

3. Dietary history

The dietary history was recorded to find out the nutritional status. The frequency about the intake of iron rich foods were recorded and from this the nutritional status was found using calculations.

4. History of previous pregnancy among the expectant mothers

The history of previous pregnancy was found out and information regarding the age at marriage, age at first conception, para of pregnancy, complications if any, special foods included, avoided and food cravings during pregnancy were also obtained.

d. Conduct of the study

The investigator, contacted the hospital and the school authorities for developing a good rapport and then with the help of the authorities and other medical personnel the study was conducted. Conduct of the study involved the following steps.

a. Collection of data regarding Health status
b. Recording food and nutrient intake
c. Conducting clinical examination
d. Biochemical profile of the sample
e. Recording height and weights.

a. Collection of data regarding health status

The health status during the immediate past three months were collected from all the adolescent girls and expectant mothers. For finding out the health status the health problems like diarrhoea, dysentery, fever and vomiting were recorded. Here the duration and frequency of occurrence of these problems were found out. Then information regarding their medical treatment taken were found out. The kind of treatments taken like taking tablets and syrups and type of tablets and syrups they take were found out along with dosage and duration.

b. Recording food and nutrient intake

The information regarding the food consumption pattern was obtained through 24 hour recall method and the quantity of food and nutrient intake calculated. This excuse was carried for thirty adolescents and sixty expectant mothers.

The information was gathered from the subsamples with help of the standard cups and showing them and asking them to say how much cup they take and from that the amount of raw ingredients taken were found out and the amount of the food and nutrient taken by them were calculated using the food composition tables of ICMR (1989) and Ready reconer of ICMR.

c. Conducting clinical examination

Clinical examination was done for all the adolescent girls and expectant mothers. Clinical examination was conducted to find out the nutritional status and degree of nutritional deficiencies. The information was gathered by developing a good rapport and advising them on measures to prevent the nutritional deficiencies. This clinical examination was done with the help of the medical specialist and the nutritional deficiencies like malnourishment, anaemia, vitamin A deficiency, B complex deficiencies, Dental caries were all recorded.

d. Biochemical profile of the sample

The biochemical profile with reference to iron was carried out and the following parameters were estimated using blood.

i. Estimation of Haemoglobin

ii. Estimation of red blood cell count.

iii. Estimation of packed cell volume or Haematocrit.

iv. Estimation of serum iron.

v. Estimation of total iron binding capacity.

vi. Determination of Erythrocyte volume.

a. Mean corpuscular Haemoglobin

b. Mean corpuscular volume

c. Mean corpuscular Haemoglobin concentration.

vii. Estimation of unsaturated iron binding capacity.

viii. Estimation of percentage saturation of transferrin.

i. Estimation of Haemoglobin

Haemoglobin estimation was carried out for all the adolescent girls and expectant mothers using cyanmethamoglobin method suggested by (Varely, 1988).

Exactly 5 ml of the Drabkin's diluent solution is measured into a dry test tube from a burette or a pipette. Exactly 0.02 ml of blood is transferred from a standard heamoglobin pipette into a diluent solution. The blood and the diluent are thoroughly mixed by rotating the tube. Ten minutes time is allowed for the formation of cyanmethaemoglobin.The reading are taken in photoelectric calorimeter at 540 mu.

Details of the procedure are given in appendix II.

ii. Estimation of Red Blood Cell Count

The red blood cell estimation was done for the subsamples and the instrument used for this purpose is the Neubauer - Haemocytometer (Chatterjee, 1987).

The blood is drawn upto the mark 0.5 and the rest of the bulb is filled by sucking up diluting solution and the resulting solution was used for placing it on Neubauer Haemocytometer and the RBC count recorded.

Details are given in appendix III.

iii. Estimation of Packed Cell Volume

The packed cell volume or haematocrit of blood was determined using capillary tube and micro haematocrit centrifuge.

Blood from fingertip is collected by EDTA and is allowed to run about 1/2 to 3/4th length of the tube. The tube is sealed on the opposite using sealing wax plasticine. The tubes are than transferred to the high speed microhaematocrit centrifuge and placed in grooves of the centrifuge head. They are centrifuged for five minutes at 11,000 rpm and read on the reader which gives the direct haematocrit volume in volume per cent (Appendix IV).

iv. Estimation of Serum iron

Serum iron estimation was carried out using the Ramsay's Dipyridyl method. The principle is that, mix equal volume of serum, 0.1 M sodium sulphite and dipyridyl reagent in a glass stoppered tube which can be centrifuged. Heat in boiling water for five minutes, cool and 1 ml of chloroform, stopper and shake vigorously for thirty seconds. Remove the stopper and centrifuge for five minutes at 300 rpm. If the supernatant fluid is not completely clear repeat the shaking and centrifuging.

Details are given in appendix V.

v. Estimation of Total Iron Binding Capacity

Total iron binding capacity was estimated using the Ramsay's Dipyridyl method (Varley, 1988).

Added 4 ml of the ferric chloride solution to 2 ml of serum centrifuged and pipetted off 4 ml of the supernatent fluid for iron determination.

Details are given in appendix VI.

The other parameters like trithiocyte volume, unsaturated iron binding capacity and percentage saturation were calculated by using the above parameters (Wintrobe **et al.,** 1981) (Appendix VII).

e. Recording Heights and weights

Heights and weights were taken for all the adolescent girls as well as expectant mothers.

Height

The height was measured using the measuring tape. The subject was asked to stand straight on the flat platform with head erect and arms lying down straight and then the subject is asked to remove the chappels and the heights were noted and measured nearest to 0.1 cm using the measuring tape and the height was compared with the normal heights for the particular age group (Appendix VIII).

Weight

Weight was measured using the bathroom scale. The subject is asked to stand erect with light clothing and without chappels and with arms down. The weight was measured nearest to 0.250 kg and was compared with the standard weights for an individual given in ICMR (1989). "Desirable weight is that weight that is normal for an individual of a given height and body frame (Robinson **et al.,** 1986) (Appendix VIII).

5. Analysis of the data

The data collected were consolidated and analysed to find out the nutritional and iron status in two different categories studies. Test of significance was done to find out whether there was any significant difference in these categories.

$$t = \frac{\bar{x}_1 \times \bar{x}_2}{S} \sqrt{\frac{n_1 \times n_2}{n_1 + n_2}}$$

$$S = \sqrt{\frac{(n_1-1)\, s_1^2 + (n_2-1)\, s_2^2}{n_1 + n_2 - 2}} \qquad \text{(Appendix IX)}$$

The data thus analysed is present in the next chapter.

Results and Discussion

RESULTS AND DISCUSSION

The results of the study on "Anaemia among adolescent girls and expectant mothers" are discussed under the following heads.

A. Family background of the selected adolescent girls and expectant mothers

B. Health status of the adolescent girls and expectant mothers

C. Nutritional Status of the adolescent girls and expectant mothers

   a. Clinical examination of the adolescent girls and expectant mothers

   b. Mean food and nutrient intake of the selected anaemic adolescent girls and expectant mothers

   c. Biochemical profile of the adolescent girls and expectant mothers.

   1. Haemoglobin levels

   2. Haemoglobin, red blood cell count, packed cell volume, serum iron, total iron binding capacity for the adolescent girls.

   3. Erythrocyte volume, unsaturated iron binding capacity, percentage saturation of transferrin for adolescent girls.

4. Haemoglobin, Red blood cell count, packed cell volume, serum iron, total iron binding capacity for the expectant mothers.
5. Erythrocyte volume, unsaturated iron binding capacity percentage saturation of transferrin for expectant mothers.

D. Details regarding the expectant mothers during pregnancy.

A. FAMILY BACKGROUND OF THE SELECTED ADOLESCENT GIRLS AND EXPECTANT MOTHERS

Table I gives details regarding the occupation of the parents/husbands of adolescent girls and expectant mothers selected for the present study.

TABLE I

OCCUPATIONAL STATUS OF THE SELECTED FAMILIES

Occupation	Parent of Adolescent girls		Parents/Husbands Expectant mothers	
	N	Per cent	N	Per cent
Daily wages	39	13	213	82
Petti business	100	33	5	2
White collar jobs	129	43	5	2
Others	32	11	35	14
Total	300	100	258	100

Out of the a 300 adolescent girls surveyed, parents of 39 girls were daily wage earners accounting to about 13 per cent. Parents of 100 girls were doing petti business accounting for 33 per cent. Parents of 129 girls were doing white collar jobs working out to about 43 per cent and parents of 82 girls were doing other types of jobs like fitting, welding and others apart from the above accounting to 11 per cent of the total.

Out of 258 expectant mothers surveyed husbands of 213 were daily wage earners working out to about 82 per cent. Five of the husbands of expectant mothers were doing petti business (about 2 per cent) and another five of the husbands of expectant mothers were doing white collar jobs (2 per cent) and husbands of 35 expectant mothers were doing other types of jobs apart from the above, working out to 14 per cent.

Table II gives the details regarding the number of members in the families of the selected adolescent girls and expectant mothers.

TABLE II

FAMILY SIZE OF THE SELECTED ADOLESCENT GIRLS AND EXPECTANT MOTHERS

Size of the Family	Adolescent girls		Expectant mothers	
	N	Per cent	N	Per cent
1 - 2	Nil	Nil	80	31
3 - 4	176	58.7	143	55
5 and above	124	41.3	35	14
Total	300	100	258	100

About 176 families of the adolescent girls had 3-4 members (58.7 per cent) and 124 families had 5 members and above working out to 41.3 per cent.

In the case of expectant mothers there were 1-2 members in 80 families, 3-4 members in 143 families and 5 members and above in 35 families.

Table III presents the total family income of the adolescent girls / expectant mothers selected for the study.

TABLE III

INCOME OF THE SELECTED FAMILIES

Income range per month in Rupees	Adolescent girls		Expectant mothers	
	N	Per cent	N	Per cent
0 - 300	Nil	Nil	59	22.9
301 - 500	Nil	Nil	79	30.6
501 - 700	143	48	71	27.5
701 - 900	110	37	22	8.5
901 and above	47	15	27	10.5
Total	300	100	258	100

None of the parents of adolescent girls earned an income less than Rs.500 per month. About 48 per cent of the parents earned an income ranging from Rs.501 - 700 per month and 37 per cent of parents earned an income varying from Rs.701-900 per month and 15 per cent of the parents earned an income ranging from Rs.901 per month and above.

In the case of expectant mothers, 27.9 per cent of the families had an income less than Rupees 300 per month, 30.6 per cent of families had an income varying from Rupees 301 to 500, 27.5 per cent of families had an income ranging from Rs.501-700 while 8.5 per cent of the families earned an income varying from rupees 701-900 and 10.7 per cent of families had an income ranging from rupees 901 and above.

Thus it is obvious that all the adolescent girls and expectant mothers hailed from low socio economic groups.

Table IV give the age distribution of the selected sample.

TABLE IV

AGE DISTRIBUTION

Groups	Adolescent girls		Expectant mothers	
	N	Per cent	N	Per cent
ADOLESCENT GIRLS				
13-15 years	210	70	Nil	Nil
16-18 years	90	30	Nil	Nil
EXPECTANT MOTHERS				
Upto 19	Nil	Nil	26	10
20-25	Nil	Nil	159	62
26-30	Nil	Nil	63	24
31 and above	Nil	Nil	10	4
Total	300	100	258	100

The survey carried out among the 300 adolescent girls indicated that 70 per cent of the girls were in the age group of 13-15 years and 30 per cent of the girls were in the age group of 16-18 years.

In the case of expectant mothers out of 258, 10 per cent were in the age group of 17 to 19 years, 62 per cent in the age group of 20-25 years, 24 per cent of them in age group of 26-30 years and 4 per cent were above the age of 31 years.

Table V presents details regarding nature of work of the adolescent girls and expectant mothers.

TABLE V

NATURE OF WORK OF THE SELECTED SUBJECTS

Nature of work	Adolescent girls		Expectant mothers	
	N	Per cent	N	Per cent
Light	91	31	202	78.3
Moderate	133	44	40	15.5
Heavy	76	25	16	6.2
Total	300	100	258	100

Among the adolescent girls 31 per cent were involved in light work 44.3 per cent of them in moderate work and 25.3 per cent of them in heavy work.

In case of expectant mothers, out of 258 samples, 78.3 per cent were doing light work, 15.5 per cent were doing moderate work and only 6.2 per cent of them were doing heavy work.

Thus it so happens that one third of the adolescent girls and three fourths of the expectant mothers were doing light work.

Table VI gives information regarding the health status of the adolescent girls and expectant mothers in the preceeding three months of the study.

B. HEALTH STATUS OF THE ADOLESCENT GIRLS AND EXPECTANT MOTHERS

TABLE VI

HEALTH STATUS OF THE SELECTED SUBJECTS

Health Problems	* Nature	Adolescent girls		Expectant mothers	
		N	Per cent	N	Per cent
Diarrhoea	Mild	10	3.3	16	6.2
	Moderate	Nil	Nil	10	3.9
	Severe	Nil	Nil	4	1.6
Dysentry	Mild	11	3.7	3	1.0
	Moderate	Nil	Nil	Nil	Nil
	Severe	Nil	Nil	Nil	Nil
Fever	Mild	26	8.7	18	6.9
	Moderate	Nil	Nil	9	3.5
	Severe	Nil	Nil	3	1.2
Vomitting	Mild	22	7.3	4	1.6
	Moderate	Nil	Nil	4	1.6
	Severe	Nil	Nil	Nil	Nil
No problem		231	77	187	72.5
Total		300	100	258	100

* Mild denotes - morbidity for 1-3 days
Moderate denotes - morbidity for 4-6 days
Severe denotes - morbidity for 7 days and above

Out of 300 adolescent girls surveyed 3.3 per cent had mild diarrhoea, 3.7 per cent had mild dysentry, 8.7 per cent had mild fever and 7.3 per cent had mild vomitting. None of them had moderate or severe diarrhoea, dysentry, fever and vomitting, and the rest 77 per cent had no problem.

In case of 258 expectant mothers, mild forms of diarrhoea, dysentry, fever and vomiting were seen in 6.2 per cent , 1 per cent, 6.9 per cent and 1.6 per cent respectively. Moderate form of diarrhoea fever and vomiting were seen in 3.9 per cent, 3.5 per cent and 1.6 per cent respectively. None of them had moderate dysentry. Severe form of diarrhoea and fever were seen among 1.6 per cent and 1.2 per cent respectively. None of them had severe dysentry or vomiting and a majority of 72.5 per cent had no problem.

It is clear from table VI that mild from of diarrhoea, dysentry, fever and vomiting are frequent in both adolescent girls and expectant mothers, while three fourths of them escaped severe forms of such health problems.

Table VII highlights details regarding the medical treatment availed by the adolescent girls and expectant mothers.

TABLE VII

MEDICAL TREATMENT AVAILABLE FOR THE SELECTED SUBJECTS*

Age Groups	Treatment							
	Rarely		Once in 2-3 months		Home treatment		No treatment	
	N	percent	N	percent	N	percent	N	percent
ADOLESCENT GIRLS								
13-15 years	52	24.8	45	21.4	3	1.4	17	5.7
16-18 years	11	12.2	16	17.8	Nil	Nil	Nil	Nil
EXPECTANT MOTHERS	66	25.6	38	14.7	3	1.2	Nil	Nil
Total	129	62.6	99	53.9	6	2.6	17	5.7

* Includes data regarding only those who had health problems.

Out of 300 adolescent girls surveyed 24.8 per cent of the girls from the age group of 13-18 years took medical treatment rarely, 21.4 per cent took treatment once in 2.3 months and 1.4 per cent took home treatment. In the case of girls from the age group of 16-19 years 12.2 per cent took medical treatment rarely and 17.8 per cent took treatment once in 2 to 3 months. In case of expectant mothers 25.6

percent took medical treatment daily, 3 percent took treatment once in two to three months, 1.2 took home treatment.

It was heartening to note that at 5.7 per cent of the adolescent girls did not need any treatment.

Table VIII shows details regarding the intake of iron/calcium tablets and iron syrups by adolescent girls and expectant mothers.

TABLE VIII

INTAKE OF IRON/CALCIUM TABLETS AND IRON SYRUPS BY THE SELECTED SUBJECTS

Medicinal supple-ments	Amount	Duration of consumption (in days)	Adolescent girls		Expectant mothers	
			N	percent	N	percent
Tablets						
Iron	80 mg	60	17	5.7	Nil	Nil
	90 mg	90	18	6.0	NIl	Nil
	100 mg	90	Nil	Nil	128	49.6
Calcium	100 mg	60	4	1.3	5	1.9
Syrups	2 tsp	60	8	3.0	5	1.9
Iron	3 tsp	60	Nil	Nil	2	1
No supple-ment			253	84	118	45.6
Total			300	100	258	100

From table VIII it is clear that out of 300 adolescent girls only 5.7 per cent of them took iron tablets for 60 days and 6 per cent took for 90 days, calcium tablets were taken only by 1.3 per cent of them who took the same for 60 days. Iron syrups were consumed by only 3 per cent of them and they took 2 teaspoons per day. The rest 84 per cent did not take any supplements.

In case of expectant mothers 49.6 per cent took iron tablets for 90 days, calcium tablets were taken by 1.9 per cent for 90 days. Only 1.9 per cent took iron syrups of 2 teaspoons per day for 60 days and 1.0 per cent took 3 teaspoons for 60 days. It was obvious that 45.6 per cent did not take any tablets or syrups, during a period when their iron requirements were great.

C. NUTRITIONAL STATUS OF THE ADOLESCENT GIRLS AND EXPECTANT MOTHERS

Table IX gives information regarding the frequency of consumption of iron rich foods by adolescent girls and expectant mothers.

Out of 300 adolescent girls surveyed 22.1 per cent took cereals rich in iron daily, like ragi, riceflakes and puffed rice, forty one per cent took once in a way, 17 per cent took rarely and 19.9 per cent did not take of the iron rich

TABLE IX

FREQUENCY OF FOOD INTAKE BY THE SELECTED SUBJECTS

Items	Adolescent girls				Expectant mothers			
	Daily (percent)	once in a way (percent)	Rarely (percent)	Not at all (percent)	Daily (percent)	once in a way (percent)	Rarely (percent)	Not at all (percent)
Cerels rich in Iron	22.1	41.0	17.0	19.9	20.0	32.0	21.0	27.0
Leafy vegetables	14.3	51.0	18.9	15.8	7.7	34.2	20.2	37.9
Other vegetables	15.6	47.2	16.3	20.9	4.80	24.1	37.8	33.3
Fruits	15.2	51.0	14.6	19.2	4.1	38.1	22.8	35.0
Meat and poultry	15.4	51.0	11.3	22.3	1.0	13	23	63
Miscellaneous	8.0	51.0	13.0	28.0	0.0	7	31.0	62

cereals at all. In the case of leafy vegetables, like agathi, amaranthus, fenugreek leaves, curry leaves, drum stick leaves, mint leaves kuppamenikeerai and manathakali, only 14.3 per cent took some greens or the other daily, 57 per cent took once in a way, 18.9 per cent took rarely and 15.8 per cent did not take any green leafy vegetables. The other vegetables like bittergourd, drumstick, broad beans and sundakkai, were consumed by 15.6 per cent daily while 47.2 per cent took them once in a way, 16.3 per cent took rarely and 20.9 per cent did not take any of these. Fruits that were rich in iron like dates, amla, tomatoripe and raisins, were consumed daily by 15.2 per cent while 51 per cent consumed the same once in a way, 14.6 per cent took rarely and 19.2 per cent did not take any of these fruits. In case of meat and poultry, 15.4 per cent took daily while 51 per cent took that once in a way, 11.3 per cent took rarely and 22.3 per cent did not take any of these.

In the case of 258 expectant mothers 20 per cent took cereals daily, 32 per cent took once in a way, 21 per cent rarely and 27 per cent did not take any cereals. Consumption of leafy vegetables was a daily affair for 7.7 per cent. 34.2 per cent took once in a way, 20.0 per cent rarely and 37.9 per cent did not take any leafy vegetables. 4.8 per cent took other vegetables daily, 24.1 per cent took once in a way, 22.8 per cent rarely and 35 per cent did not take fruits. Meat and poultry was consumed by one per cent daily, 13 per cent in a frequently of once in a way, 23 per cent rarely and 63 per cent did not take meat and poultry at all.

Thus, on the whole 41-51 per cent of the adolescent girls and only 1-20 per cent of the expectant mothers were consuming the iron rich foods regularly. The rest were not in the habit of regularly consuming these foods and this probably is one of the reasons for iron deficiency.

Table X gives information about the range and mean heights of the adolescent girls and expectant mothers along with the values suggested by ICMR 1989, APPENDIX VIII gives the individual heights of the subjects studied.

In the age group of 13-15 years 71.4 per cent recorded heights less than 155 cm, 17.6 per cent recorded values ranging between 155 to 160 cm and 10 per cent recorded values 161 cms and above. In the age group of 16-18 years, 68.9 per cent recorded heights less than 165 cms, 21.1 per cent recorded values ranging between 155 to 160 cms and 7 per cent recorded values of 161 cms and above.

Among the 13-15 year old adolescent girls only 17.6 per cent had registered desirable height in the range of 155-161 cms. Among the 16-18 years old girls only 21.1 per cent had registered a desirable height in the range of 155-161 cms.

TABLE X

RANGE AND MEAN HEIGHTS OF THE SELECTED SUBJECTS

Age groups	Heights in cms: Less than 155 cms N	percent	Between 155-160 cm N	percent	Above 161 cms N	percent	Mean $\pm$SD	't' value	ICMR values in cms 1989
Adolescent girls 13-15 years	150	71.4	37	17.6	23	11	152.2$\pm$5.63		155-161
								1.95NS	
				.95NS					
16-18 years	62	68.9	19	21.1	9	10	155.9$\pm$2.51		162-164
Expectant mothers	76	30.0	163	63	19	7	148.02$\pm$1.99		-

NS - Statistically not significant

In the case of expectant mothers 30 per cent recorded heights less than 155 cms, 63 per cent recorded values ranging between 155 to 160 cms and 7 per cent recorded values 161 cms and above.

The mean height of the adolescent girls of 13-15 years was 152.2 $\pm$ 5.63 compared with 155.9 $\pm$ 2.51 in the age group of 16-18 years. Statistical analysis of the data revealed that the differences in height between the two groups of adolescents was not statistically significant indicating that maximum growth has already taken place in the younger group of 13-15 years.

Table XI gives data regarding the range and mean weights of the adolescent girls and expectant mothers along with the standard values suggested by ICMR 1989.

Out of 300 adolescent girls in the age group of 13-15 years, 77.1 per cent had a weight below 45 kg, 7.7 per cent between 46-50 kg, 7 per cent between 51-55 kg and 3.3 per cent above 56 kg. In the age group of 16-18 years, 57.8 per cent had a weight less than 45 kg, 17.8 per cent between 46-50 kg, 17.8 per cent 51-55 kg and 6.6 per cent above 56 kg.

It was interesting to note that while the differences in heights between 13-15 year olds and 16-18 year olds was not statistically significant, the differences in weights between

TABLE XI

RANGES AND MEAN WEIGHTS OF THE SELECTED SUBJECTS

Age groups	Weights in kg: Less than 45 kg N	percent	46 - 50 kg N	percent	51 - 55 kg N	percent	Above 56 kg and N	percent	Mean $\pm$SD	't' value	ICMR values in kg 1989
Adolescent girls 13-15 years	162	77.1	16	7.7	25	11.9	7	3.3	44.03$\pm$3.78	11.9 **	44-51kg
16-18 years	52	57.8	16	17.8	16	17.8	6	6.6	47$\pm$4.22		53-54kg
Expectant mothers	86	33.3	52	20.2	67	26	53	20.5	50.32$\pm$5.20		62 (50+12)

* * Statistically significant at one percent level

these two groups were statistically significant at one per cent level indicating that adolescent girls put on weight in their latter teens.

Table XII gives details regarding the clinical assessment of the adolescent girls and expectant mothers.

TABLE XII

CLINICAL ASSESSMENT OF THE SELECTED SUBJECTS

Details	Adoloescent girls				Expectant mothers	
	13-15 years		16-18 years			
	N	percent	N	percent	N	percent
Under nourished	20	10	5	5.6	76	29.5
Anaemia	81	39	33	36.7	244	94.6
Vitamin A deficiency	Nil	Nil	Nil	Nil	Nil	Nil
B complex deficiency	1	1	6	6.6	40	15.5

Out of 300 adolescent girls 10 per cent from 13-15 years of age were under nourished. They were considered under nourished based on poor musculature, nutritional oedema and gross muscular wasting. Thirty nine per cent of them had anaemia. Vitamin A deficiency was not present in any of them and 1 per cent had vitamin B complex

FIGURE 1 SHOWS THE CLINICAL ASSESSMENT OF THE SELECTED SUBJECTS (ADOLESCENT GIRLS)

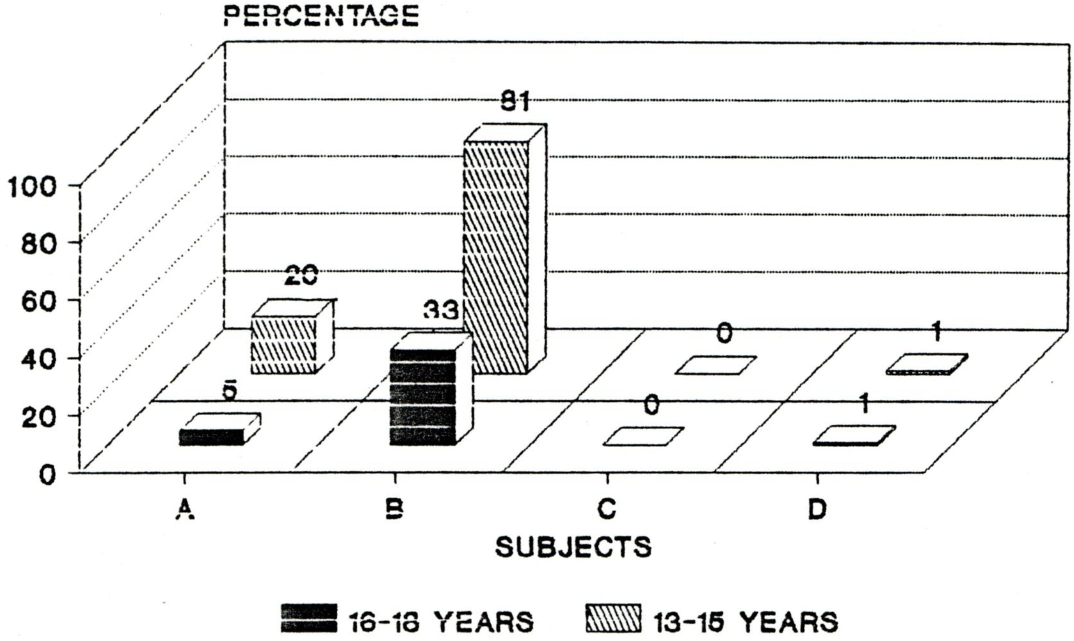
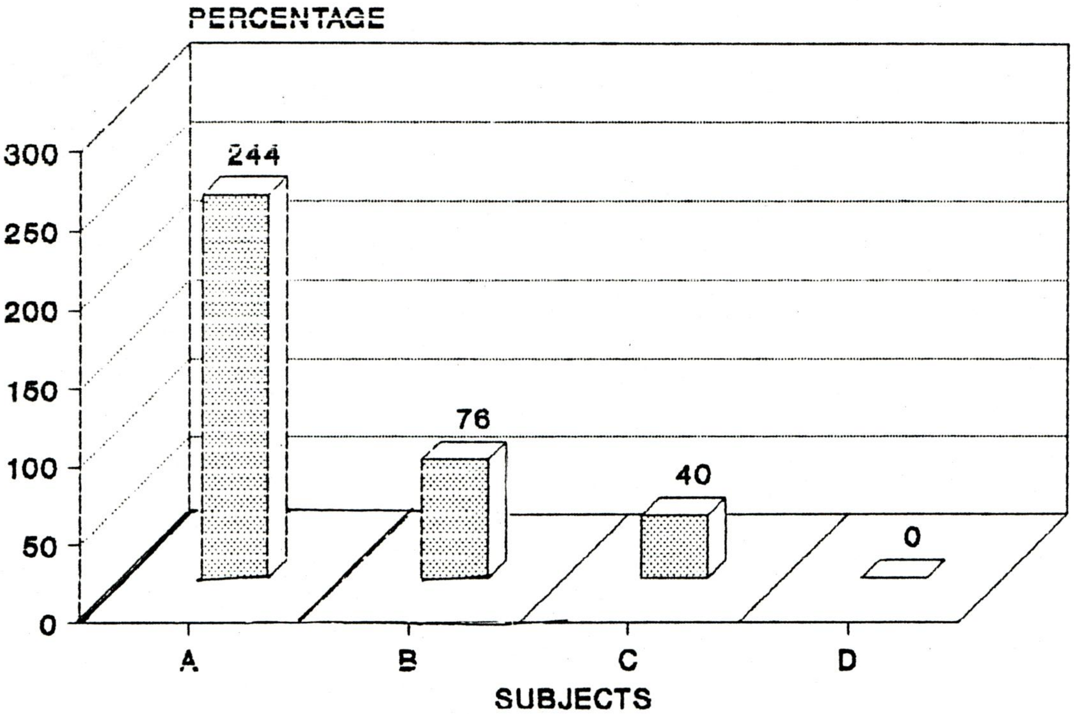


FIGURE 2 SHOWS THE CLINICAL ASSESSMENT OF THE EXPECTANT MOTHERS



A - Under nourished C - Vitamin A deficiencies
B - Anaemia D - B Complex deficiencies

deficiencies. In the case of 16-18 years, 5.6 per cent were under nourished, 36.7 per cent suffered from anaemia, none of them had vitamin A deficiencies and 6.6 per cent had B complex deficiencies.

In the case of 258 expectant mothers, 29.5 per cent were found to be under nourished 94.6 per cent were found to suffer from anaemia none of them had vitamin A deficiencies and 15.5 per cent had B complex deficiencies. Fig.1 and 2 shows the percentage of clinical assessment.

Table XIII gives data regarding the mean food intake by the adolescent girls and expectant mothers.

From the table it is clear that in the case of adolescent girls, the intake was surplus by 38 per cent in case of pulses and 73 per cent surplus in case of fruits. In case of cereals there was a deficit to the tune of 55 per cent, green leafy vegetables 92 per cent, roots and tubers 32 per cent, other vegetables 80 per cent, meat and poultry 65 per cent and milk and its products 10 per cent.

In case of expectant mothers there was 10 per cent surplus intake with reference to pulses. In case of cereals there was a deficit to the tune of 57 per cent, green leafy vegetables 80 per cent, roots and tubers 80 per cent, other

TABLE XIII

MEAN FOOD INTAKE BY THE SELECTED SUBJECTS

Food items	Adolescent girls 13-18 years			Expectant mothers		
	Mean intake (in g)	percent + surplus - deficit	RDA ICMR VALUES (1984)	Mean intake (in g)	percent + surplus - deficit	RDA ICMR VALUES (1984)
Cerels	135	-55	300	150	-57	350
Pulses	62	+38	45	76	+10	70
Green leafy vegetables	10	-92	125	30	-80	150
Roots and tubers	34	-33	50	15	-80	75
Other vegetables	15	-80	75	18	-76	75
Fruits	52	+73	30	14	-53	30
Meat and poultry	21	-65	60	10	-83	60
Milk and its products	180	-10	200	77	-49	150

vegetables 76 per cent, fruits 53 per cent, meat and poultry 83 per cent and milk and its products 49 per cent.

The intake of iron rich foods were very meagre in the diets of both adolescent girls and expectant mothers.

Table XIV high lights details regarding the nutrient intake by the adolescent girls and expectant mothers.

In the case of 30 subsamples in adolescent girls from the age group of 13-18 years, the intake with reference to energy was surplus by 3 per cent, protein 3 per cent, fat 80 per cent, calcium 33 per cent, thiamine 88 per cent, riboflavin 33 per cent and ascorbic acid 65 per cent. However intake of iron less by 37 per cent and retinol 3 per cent.

In case of expectant mothers, the energy intake energy was surplus by 5 per cent, fat 40 per cent, thiamine 5.7 per cent, riboflavin 25 per cent and ascorbic acid 99 per cent. The intake was less by 35 per cent for protein 30 per cent for calcium 53 per cent for iron and 7 per cent for retinol.

Thus while the nutrient intake was less than desirable levels in both the groups, the deficits were more predominant among the expectant mothers. Fig 3, 4, 5, 6 gives the mean nutrient intake of the adolescent girls and expectant mothers.

TABLE XIV

MEAN NUTRIENT INTAKE OF THE SELECTED SUBJECTS

Nutrients	Adolescent girls 13-18 years			Expectant mothers		
	Mean intake	percent + surplus - deficit	RDA ICMR VALUES (1989)	Mean intake	percent + surplus - deficit	RDA ICMR VALUES (1989)
Energy (K cal)	2125	+3	2060	2197	+5	2100
Protein (g)	62	+3	61	42	-35	65
Fat (g)	45	+80	25	42	+40	30
Calcium (g)	0.8	+33	0.6	0.7	-30	1
Iron (mg)	18.8	-37	30	17.9	-53	38
Retinol (ug)	580	-3	600	559	-7	600
Thiamine (mg)	0.44	+88	0.5	0.74	+5.7	0.7
Riboflavin (mg)	0.8	+33	0.6	1	+25	0.8
Ascorbic acid (mg)	65	+65	40	79	+99	0.40

FIGURE 3 SHOWS MEAN NUTRIENT INTAKE BY ADOLESCENT GIRLS

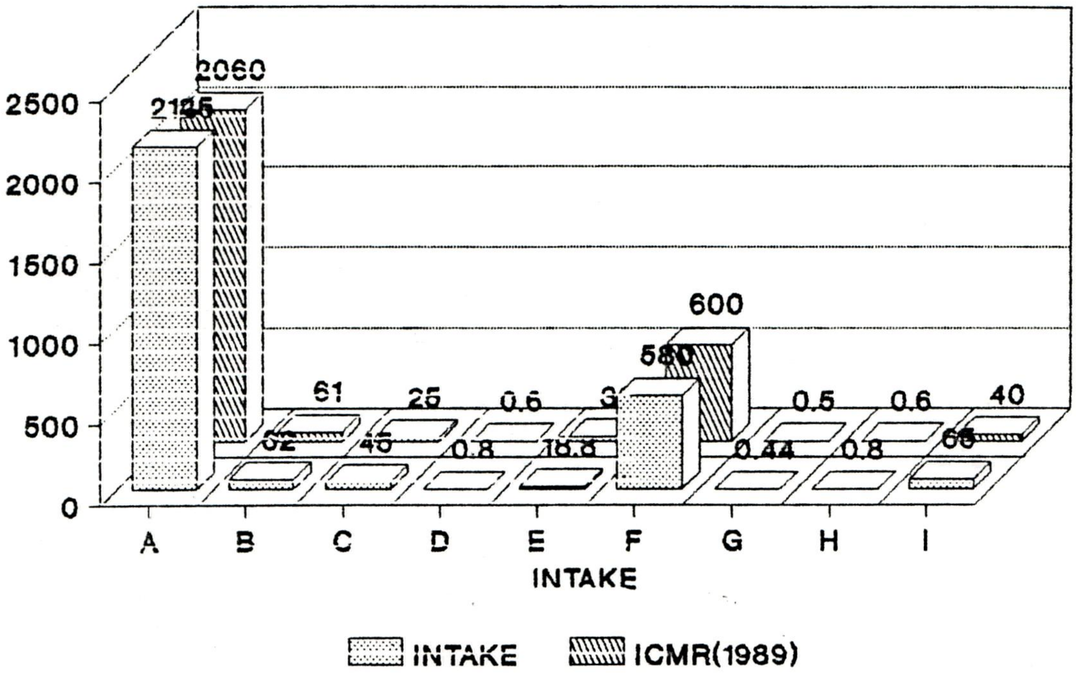
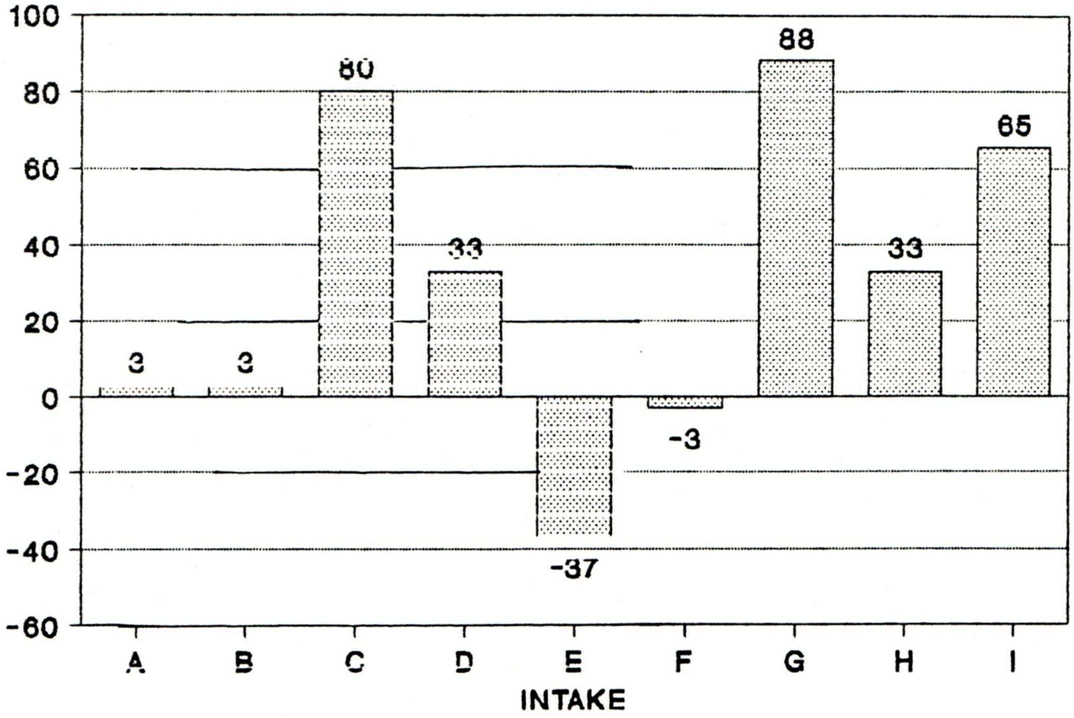


FIGURE 4 SHOWS MEAN NUTRIENT INTAKE BY ADOLESCENT GIRLS



A - Calories
B - Protein
C - Fat
D - Calcium
E - Iron
F - Retinol
G - Thiamine
H - Riboflavin
I - Ascorbic acid

FIGURE 5 SHOWS MEAN NUTRIENT INTAKE BY EXPECTANT MOTHERS

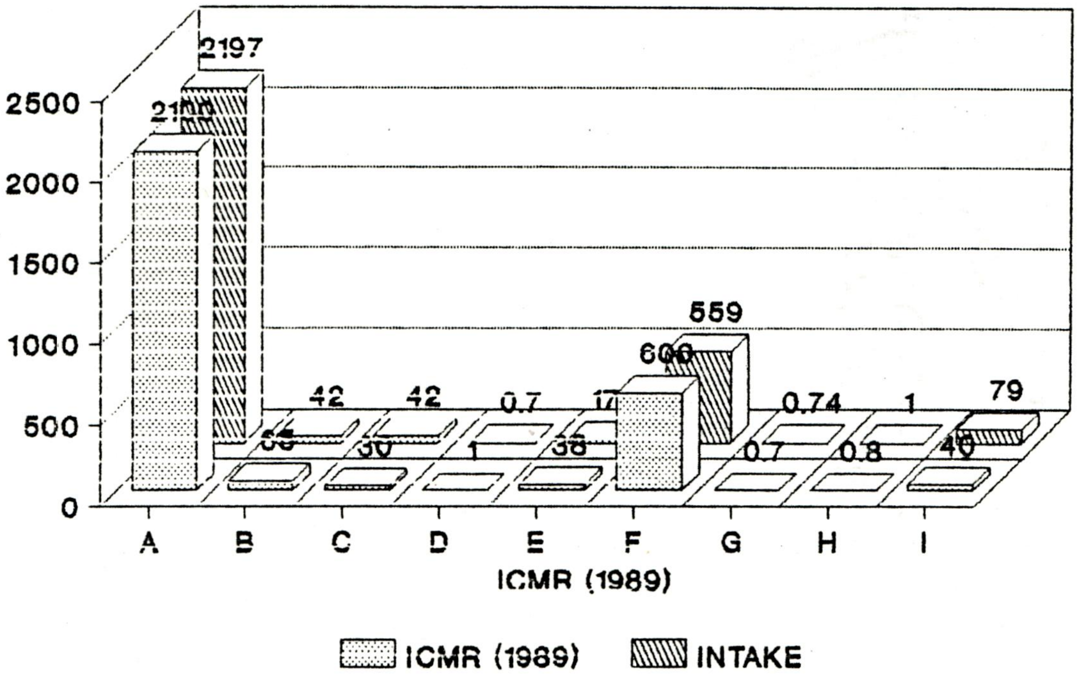
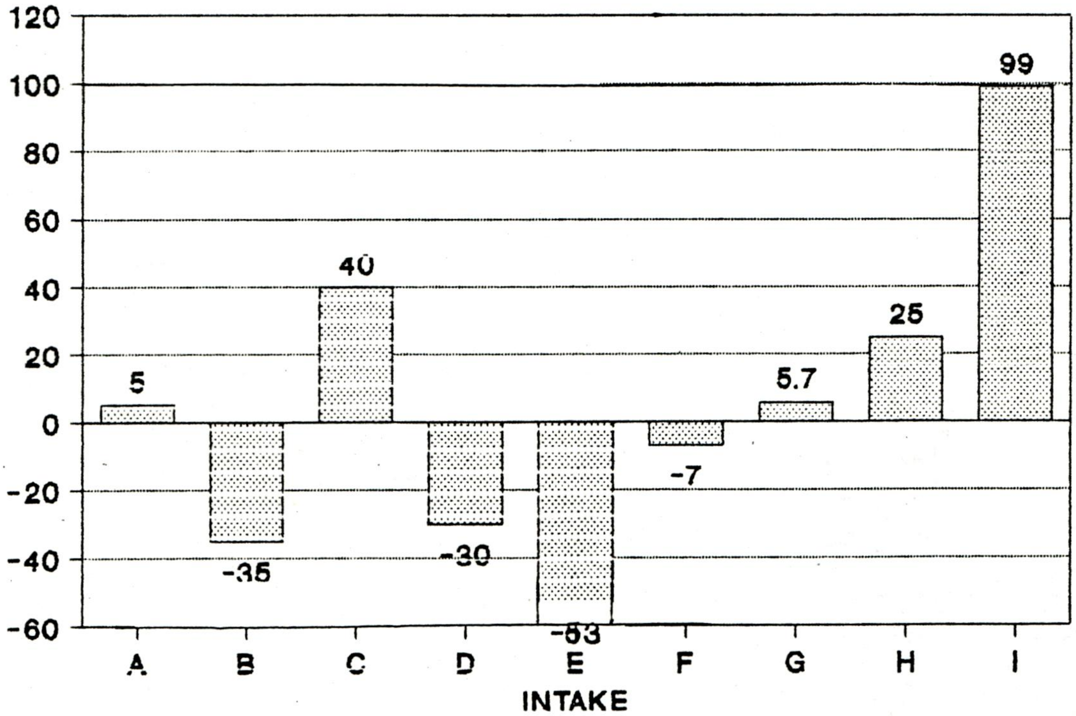


FIGURE 6 SHOWS MEAN NUTRIENT INTAKE BY EXPECTANT MOTHERS



A - Calories
B - Protein
C - Fat
D - Calcium
E - Iron
F - Retinol
G - Thiamine
H - Riboflavin
I - Ascorbic acid

C. Bio chemical profile of the adolescent girls and expectant mothers

1. Haemoglobin levels

Table XV gives details regarding the haemoglobin levels of the adolescent girls and expectant mothers.

TABLE XV

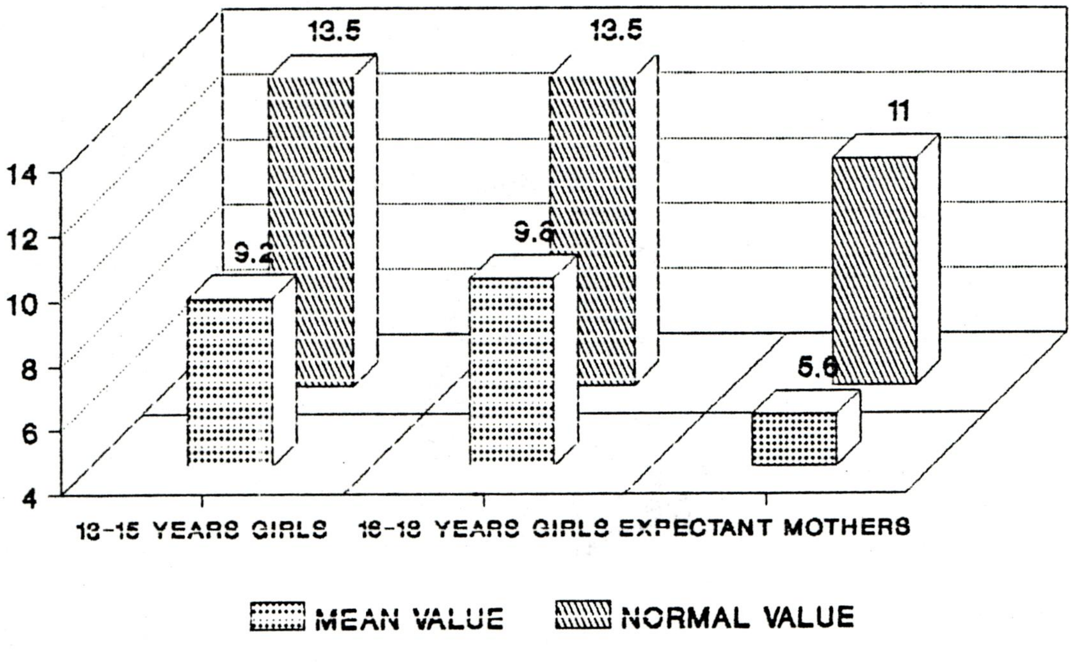
HAEMOGLOBIN LEVELS OF THE SELECTED SUBJECTS

*Haemoglobin level g/dl	Adolescent girls				Expectant-mothers	
	13 - 15 years		16 - 18 years			
	N	percent	N	percent	N	percent
10 g/dl and above	21	10	39	43	13	5
7 to 10 g/dl	190	90	51	57	103	40
below 7 g/dl	Nil	Nil	Nil	Nil	142	55
Total	210	100	90	100	258	100

* - WHO (1989) classification of haemoglobin values.

In case of 13 - 15 years 10 per-cent had a haemoglobin level of 10 g/dl and above, 90 per-cent had a haemoglobin level of 7 to 10 g/dl and none of them were below 7 g/dl. In case of 90 girls of 16 - 18 years 43 per-cent had a level of 10 g/dl and above, 57 per-cent had a level of 7 to 10 g/dl and none of them had levels below 7 g/dl.

FIGURE 7 SHOWS MEAN HAEMOGLOBIN VALUES
FOR ADOLESCENT GIRLS AND
EXPECTANT MOTHERS



In case of 258 expectant mothers 5 per cent had levels around 10 g/dl and above, 40 per cent between 7 to 10 g/dl and 55 per cent below 7 g/dl.

It is obvious that 90 per cent of the adolescent girls from 13-15 years and 57 per cent from 16-18 years were moderately anaemic and 55 per cent of the expectant mothers were severely anaemic. According to WHO (1989) when the haemoglobin level falls below 7 g/dl they are said to be severely anaemic.

A very low level of haemoglobin places the mother at risk of cardiac arrest and cause haemorrhage during delivery (Donald, 1985).

The fact that 90 per cent of the 13-15 years old adolescent girls were moderately anaemic 57 per cent of the 16-18 year adolescent girls were moderately anaemic and 95 per cent of the expectant mothers were moderately/severely anaemic indicates that inspite of the various programmes and measures undertaken, the magnitude of the problem still remains.

Fig.7 gives the mean haemoglobin value for adolescent girls and expectant mothers.

Haemoglobin level Red blood cell count, packed cell volume, serum iron total iron binding capacity.

Table XVI gives details regarding the mean values registered for biochemical parameters like Haemoglobin, Red blood cell count, packed cell volume, serum iron, and total iron binding capacity for adolescent girls. These values were recorded for a sub sample of 30.

TABLE XVI

MEAN VALUES REGISTERED FOR SELECTED BIOCHEMICAL PARAMETERS

Biochemical parameters	Adolescent girls(A) 13-15 years n = 18 Mean ± SD	Adolescent girls(B) 16-18 years n = 12 Mean ± SD	Comparison	't' value	Recommended values
Haemoglobin (g/dl)	9.2 ± 0.64	9.8 ± 0.44	A Vs B	1.209 NS	
Red blood Cell count (million/ cmm)	3.1 ± 0.39	3.3 ± 0.28		1.549 NS	
			A Vs B		
Packed Cell volume (%)	30.4 ± 3.91	31.9 ± 3.18		2.165 *	
Serum iron (ug/100 ml)	42.4 ± 12.1	40.5 ± 8.82		1.59 *	
Total iron binding capacity (ug/100 ml)	250.7±27.64	253.1 ± 60.02		4.6 * *	

NS Not significant

* Statistically significant at 5 percent level

* * Statistically significant at 1 percent level

The moderately anaemic adolescent girls of 13 - 15 years had a mean haemoglobin level of 9.2 ± 0.64 per cent against the adolescent girls of 16 - 18 years having a mean haemoglobin level of 9.8 ± 0.44 per cent. The mean blood cell count for girls of 13 - 15 years was found to be 3.1 ± 0.39 per cent compared to 3.3 ± 0.28 per cent in case of girls of age 16 - 18 years. The mean packed cell volume was found to be 30.4 ± 3.91 per cent for 13 - 15 years old girls when compared to 31.9 ± 3.18 in case of girls of age 16 - 18 years. Mean serum iron the level was found to be 42.4 ± 12.1 per cent for 13 - 15 years. This differs from that of the girls of 16-18 years where their mean serum iron was 40.5 ± 8.82 per cent. The mean total iron binding capacity was found to be 250.7 ± 27.64 per cent in case of 13 - 15 years when compared to 253.1 ± 60.02 per cent in case of girls of 16 - 18 years. The values registered for the adolescents was low compared to that of normal values except in case of total iron binding capacity.

To total iron binding capacity elevates more than 400 ug/dl and serum iron decreases simultaneously in iron depleted conditions (Soemantri **et al.,** 1985).

The low haemocrit value of 45-48 per cent is indicative of anaemia (Macleod, 1984).

3. Erythrocyte volume, unsaturated iron binding capacity, percentage saturation of transferrin.

Table XVII gives details regarding the mean values registered for biochemical parameters like. Mean corpuscular Haemoglobin, Mean Corpuscular volume, Mean corpuscular haemoglobin concentration, Unsaturated iron binding capacity and percentage saturation of Transferrin for adolescent girls.

TABLE XVII

MEAN VALUES REGISTERED FOR SELECTED BIOCHEMICAL PARAMETERS

Biochemical parameters	Adolescent girls(A) 13-15 years n = 18 Mean ± SD	Adolescent girls(B) 16-18 years n = 12 Mean ± SD	Comparison	't' value	Recommended values
Mean Corpus-cular haemo-globin in pg	30.3 ± 3.53	30.2 ± 3.26		0.144 NS	26-32 (pg) (Robinson **et al.,** 1986)
Mean Corpus-cular volume infl	99.9 ± 9.99	97.9 ± 10.43		1.72 NS	80-94 (fl) (Robinson **et al.,** 1986)
			A Vs B		
Mean Corpus-cular haemo-globin conc-entration g/dl	30.5 ± 2.64	30.9 ± 2.16		0.714 NS	32-36 (%) (Robinson **et al.,** 1986)
Unsaturated iron binding capacity ug/dl	200.2 ± 39.67	233.6 ± 65.7		12.8 **	340 ug/100 ml (Guthrie, 1986)
Percentage saturation of transfe-rrin %	19.3 ± 4.28	15.8 ± 6.08		3.96 **	15 (%) (Guthrie, 1986)

NS Non significant

** Significant at one per cent level

fl = Femtoliters

Pg = Pecograms

The mean corpuscular haemoglobin level was found to be 30.3 ± 3.53 in the age group of 13 - 15 years and 30.2 ± 3.26 for 16-18 year olds. The mean corpuscular volume was found to be 99.9 ± 9.99 per cent for 13 - 15 year old girls against 97.9 ± 10.43 per cent for 16 - 18 years old. The mean corpuscular haemoglobin concentration was found to be 30.5 ± 2.64 per cent for 13-15 years olds when compared to 30.9 ± 2.16 in case of 16 - 18 years old. The unsaturated iron binding capacity was found to be 200.2 ± 39.67 per cent for 13 - 15 years when compared to 233.6 ± 65.7 per cent for 16-18 years. The percentage saturation of transferrin was found to be 19.3 ± 4.28 in 13 - 15 years against 15.8 ± 6.08 in 16 - 18 years. It was clear that only in the case of unsaturated iron binding capacity, the level was lower than normal value, but the values for other parameters were same as that of the recommended values.

It was found that erythrocyte volume were not statistically significant except in case of unsaturated iron binding capacity and percentage saturation of transferrin where they were satistically significant at one per cent level.

This shows that the subjects selected for the study were anaemic.

4. Haemoglobin, Red blood cell count, Packed cell volume, Serum iron, total iron binding capacity.

Table XVIII gives details regarding the mean values registered for biochemical parameters like Haemoglobin, Red blood cell count, packed cell volume, Serum iron and total iron binding capacity for expectant mothers. These values were recorded for a sub sample of 60.

TABLE XVIII

MEAN VALUES FOR SELECTED BIOCHEMICAL PARAMETERS ON EXPECTANT MOTHERS

Biochemical parameters	Expectant mothers Mean ± SD	Recommended values
Haemoglobin (g/dl)	5.6 ± 1.17	11 g/dl (Passmore **et al.,** 1987)
Red blood cell count (million/cmm)	2.9 ± 0.72	4.2-5.6 millions/ cmm (Robinson **et al.,** 1986)
Packed cell volume (%)	21.6 ± 4.36	37-47 (%) (Robinson **et al.,** 1986)
Serum iron (ug/100 ml)	40.6 ± 4.89	60-160 ug/100 ml (Varley, 1988)
Total iron binding capacity (ug/100 ml)	385.2 ± 48.30	249-387 ug/100 ml (Varley, 1988)

The mean values for the selected biochemical parameters registered for expectant mothers were 5.6 $\pm$ 1.17 per cent for haemoglobin, 2.9 $\pm$ 0.72 per cent for mean red blood cell count 21.6 $\pm$ 4.36 per cent for mean packed cell volume 40.6 $\pm$ 4.89 per cent for mean serum iron and 385.2 $\pm$ 48.30 per cent for mean total iron binding capacity.

The fall of haemoglobin below normal values in anaemic conditions is usually accompanied by a fall in the red cell count below the normal values (Guthrie, 1986). Natu and Patnaik (1988) warms that a cut off point of less than 10 g per cent is indicative of "risk of pregnancy".

5. Mean corpuscular haemoglobin, mean corpuscular volume, mean corpuscular haemoglobin concentration, unsaturated iron binding capacity and percentage saturation of transferrin.

Table XIX given details regarding the mean values registered for other biochemical parameters like mean corpuscular haemoglobin, mean corpuscular volume, mean corpuscular heaemoglobin concentration, Unsaturated iron binding capacity, and percentage saturation of transferrin of the expectant mothers.

TABLE XIX

MEAN VALUES FOR SELECTED BIOCHEMICAL PARAMETERS ON EXPECTANT MOTHERS

Biochemical parameters	Expectant mothers Mean ± SD	Recommended values
Mean corpuscular haemoglobin (in pg)	20.2 ± 6.55	26-32 (pg) (Robinson **et al.**, 1986)
Mean corpuscular volume (in fl)	74.6 ± 21.91	80-94 (fl) (Robinson **et al.**, 1986)
Mean corpuscular haemoglobin concentration (%)	27.5 ± 3.06	32-36 (%) (Robinson **et al.**, 1986)
Unsaturated iron binding capacity (ug/dl)	345.6 ± 51.40	340 ug/100 ml (Guthrie, 1986)
Percentage saturation of transferrin (%)	10.7 ± 1.88	15 (%) (Guthrie, 1986)

The mean of the mean corpuscular haemoglobin in expectant mothers was found to be 20.2 ± 6.55 per cent, the mean of the mean corpuscular volume was found to be 74.6 ± 21.91 per cent. The mean of the mean corpuscular haemoglobin concentration was found to be 27.5 ± 3.06 per cent. The unsaturated iron binding capacity was 345.6 ± 51.40 per cent and percentage saturated of transferrin was 10.7 $\pm$ 1.88 per cent.

It was found that the registered values for the biochemical parameters were low when compared with that of normal recommended values except in case of the unsaturated iron binding capacity where the value was higher than the normal value. This shows that the subjects selected for the study were anaemic.

D. DETAILS REGARDING EXPECTANT MOTHERS DURING PREGNANCY

Table XX gives details regarding the age at marriage and age at first conception.

TABLE XX

AGE AT MARRIAGE AND FIRST CONCEPTION

Age in years	Age at Marriage		Age at first conception	
	N	Per cent	N	Per cent
17 - 19	146	56.6	79	31
20 - 22	82	31.8	123	47
23 - 25	30	11.6	56	22
26 and above	Nil	Nil	Nil	Nil
Total	258	100.00	258	100.00

Out of 258 expectant mothers 56.6 per cent were in the age group of 17 - 19 years and only 31.8 per cent were in the age group of 20 - 22 years while only 11.6 per cent were in the age group 23 - 25 years. As is obvious more than half of the expectant mothers entered pregnancy even before they were fully matured adults and this is bound to affect the health and growth of the foetus.

Looking at the age of first conception among the expectant mothers, out of 258 mothers 79 had their first conception at the age of 17 to 19 years working out to 31 per cent. 47 per cent had their first conception at the age of 20 - 22 years and 22 per cent had their first conception at the age group of 23 - 25 years. Demalyer, (1989) opives that 20 - 25 years is the best age group for the conception and if the first conception is below 18 years or above 30 years, this may lead to an increased mortality, morbidity or low birth weight of infant.

Para of Pregnancy and children delivered by the expectant mothers

Among the 258 expectant mothers 82.9 per cent were in the 1 - 3 para of pregnancy against only 17.1 per cent who were in the 4 - 6 para of pregnancy.

Out of 184 children delivered by the expectant mothers it was found that 58.9 per cent of the children were alive and 12.4 per cent of the children were dead. The rest of 28.9 per cent were in the first para of pregnancy.

Table XXI gives details regarding the foods avoided by the expectant mothers.

TABLE XXI

FOODS AVOIDED BY THE EXPECTANT MOTHERS

Items	N	Per cent
Papaya	101	39.2
Pineapple	74	28.7
Gingelly seeds	24	9.3
Others	6	2.3
No such taboos	53	20.5
Total	258	100.00

Out of 258 expectant mothers 39.2 per-cent avoided papaya, 28.7 per-cent avoided pineapple, 9.3 per-cent avoided gingelly seeds, 2.3 per-cent avoided other foods due to certain beliefs and rest of 20.5 per-cent did not have such taboos.

It was found out that out of 258 expectant mothers, 28.7 per cent avoided these foods for fear of abortion, 1.9 per cent avoided due to restriction by elders, 4.3 per cent did not take due to dislike and 65.1 per cent did not have such taboos.

Summary and Conclusion

SUMMARY AND CONCLUSION

The study on "Anaemia among adolescent girls and expectant mothers" was conducted in order to assess the extent of prevalence of iron deficiency among adolescent girls (13-18 years) and expectant mothers Three hundred adolescent girls and two hundred and fifty eight expectant mothers were selected for the study. The adolescent girls were selected from Avinashilingam Higher Secondary School and Avinashilingam Deemed University. The expectant mothers selected belonged to low socioeconomic group from Government hospital, Coimbatore and S.K.S.Hospital, Salem.

Information regarding socioeconomic background health status and food and nutrient intake was gathered through schedules prepared for the purpose. The biochemical parameters like haemoglobin, Red blood cell count, packed cell volume, serum iron, total iron binding capacity and erythrocyte volume, unsaturated iron binding capacity, percentage saturation of transferrin were estimated to assess the severity of anaemia in adolescent girls and expectant mothers.

The findings of the study are given in the following paragraphs.

1. In the case of parents of adolescent girls 43 per cent were found to do white collar jobs and others were involved in jobs like daily wage earness, petti business and others while in case of expectant mothers 82 per cent were found to be daily wage earners.
2. About 58.7 per cent of the families of adolescent girls 55 per cent of the families of expectant mothers had 3-4 members in their families indicating the trend for for a small family norm.
3. It is very clear that in case of adolescent girls 48 per cent of the families earned an income of rupees 501-700 only and in case of expectant mothers 30.6 per cent of the families earned an income of Rs.301-500 only, indicating the poor economic state of the families selected.
4. About 70 per cent of adolescent girls belonged to the age group of 13-15 years when compared to 30 per cent in the age group of 16-18 years. In case of expectant mothers 62 per cent belonged to the age group of 20-25 years.
5. It was found that 44 per cent of the adolescent girls were engaged in moderate work. In the case of expectant mothers 78.3 per cent were found to do light work.

6. In the case of adolescent girls only 3.3 per cent suffered from mild charrhoea, 3.7 per cent suffered from mild dysentry, 8.7 per cent suffered from mild fever and 7.3 per cent suffered from mild vomiting, while 6.2 per cent of expectant mothers had mild diarrhoea, 1 per cent had mild dysentry, 6.9 per cent had mild fever and 1.6 per cent had mild vomiting.
7. Survey revealed that 24.8 per cent of the adolescent girls of 13-15 years took treatment rarely, 17.8 per cent of the adolescent girls of 16-18 years took treatment once in two to three months and 25.6 per cent of expectant mothers took treatment rarely.
8. It was found that 6 per cent of adolescent girls took 90 mg of iron tablets for 90 days, 1.3 per cent took 100 mg calcium tablets for 60 days, 3 per cent took 2 teaspoons of iron syrups for 60 days. Among expectant mothers 49.6 per cent took 100 mg of iron tablets for 90 days, 1.9 per cent took calcium tablets of 100 mg for 60 days, 1.9 per cent took iron syrups for 60 days.
9. In case of adolescent girls of 13-15 years, 71.4 per cent recorded a height of less than 155 cms, 68.9 per cent of 16-18 years recorded a height of less than 155 cms, 63 per cent of expectant mothers had heights in the range of 155-160 cms.

10. It was clear that 77.1 per cent of 13-15 year old adolescent girls 57.8 per cent in the age group of 16-18 years and 33.3 per cent of expectant mothers weighed less than 45 kg.

11. In case of adolescent girls of 13-15 years 39 per cent had anaemia, among 16-18 year olds 46.7 per cent had anaemia and 94.6 per cent of expectant mothers had anaemia.

12. The food intakes were inadequate with respect to green leafy vegetables (92 per cent), roots and tubers (32 per cent), other vegetables (80 per cent), meat and poultry (65 per cent) and milk and its products (10 per cent) and surplus to the tune of 38 per cent in case of pulses and 73 per cent in case of fruits, amcng adolescent girls. The food intake were inadequate to the tune of 57 per cent in case of cereals 80 per cent in case of green leafy vegetables 80 per cent in case of roots and tubers, 76 per cent in case of other vegetables, 53 per cent in case of fruits, 83 per cent in case of meat and poultry and 49 per cent in case of milk and its products and surplus with respect to pulses by 10 per cent.

13. There was a deficit of 61 per cent in iron intake in case of adolescent girls and 53 per cent had deficit iron intake in case of expectant mothers.

14. The age of marriage was between 17 to 19 years for 56.6 per cent and 47 per cent of the expectant mothers had their first conception at the age of 20-25 years.
15. History of previous pregnancies revealed that about 82.9 per cent had their para of pregnancy between 1-3 and 58.9 per cent of the children alone were alive.
16. The biochemical parameters showed that 90 per cent of the girls in the age group 13-15 years had a haemoglobin level ranging from 7 to 10 g/dl and 55 per cent of expectant mothers were severely anaemic with the haemoglobin level of below 7 g/dl.
17. The mean haemoglobin level was 9.2 ± 0.64 per cent among 13-15 year old adolescent girls when compared to 9.8 ± 0.44 per cent among 16-18 year old girls. Red blood cell count was found to be 3.1 ± 0.39 per cent against 3.3 ± 0.28 per cent, Packed cell volume was found to be 30.4 ± 3.91 incase of 13-15 years compared to 31.9 ± 3.18 in case of 16-18 year old girls. Serum iron was 42.4 ± 12.1 per cent against 40.5 ± 8.82 per cent and total iron binding capacity was 250.7 ± 27.64 per cent against 253.1 ± 60.02 per cent. From these parameters other parameters like erythrocyte volume, unsaturated iron binding capacity and percentage saturation of transferrin were calculated.

Severe anaemia during pregnancy causes complications and there by affects health of the mother and the baby. Consequences of anaemia among adolescent girls and the ill-effects of this disease in the later period appear to be very severe. Hence clinical manifestations indicating iron deficiency, are important and efforts should be made to detect the deficiency early alone with steps to treat the problem to prevent further depletion of iron stores.

Endless efforts taken so far by the government and voluntary agencies does not seem to have greatly improved the situation and hence it is essential to implement corrective steps in order to make the programmes more successful during the future days to come.

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Appendix

APPENDIX I

QUESTIONNAIRE

AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN (DEEMED UNIVERSITY), COIMBATORE - 3

ANAEMIA AMONG ADOLESCENT GIRLS AND EXPECTANT MOTHERS

GENERAL BACKGROUND INFORMATION

1. Name of the investigator : VIDYA RAMAN
2. Name of the Subject :
3. Address :
4. Age :
5. Sex :
6. Whether anaemic or not
   Haemoglobin level :
7. Educational Status :
8. Type of Work
   Light/Moderate/Heavy :
9. Number of members of the family

S.No.	Name of the member	Sex	Age	Education	Occupation	Monthly income (Rs.)

10. Birth order of the subject :

11. Total family income/month :

12. Are you taking the following foods regularly

Foods	Daily	Once in a way	Fortnightly	Not at all	Quantity per day
CEREALS					
Ragi					
Rice flakes					
Puffed Rice					
PULSES					
Soybean					
Bengal Gram Dhal					
Roasted Bengal Gram Dhal					
Green Gram Dhal					
Horse Gram					
Peas (dried)					
GREEN LEAFY VEGETABLES					
Agathi					
Amaranthus					

Fenu Greek Leaves

Curry Leaves

Drumstick Leaves

Mint Leaves

Kuppameni Keerai

Manathakkali

ROOTS AND TUBERS

Beetroot

Onion small

Garlic

Carrot

Yam

OTHER VEGETABLES

Bitter gourd

Drumstick

Broad Beans

Sundakkai

CONDIMENTS AND SPICES

Asafoetida

Tamarind

Turmeric

FRUITS

Dates

Amla

Guava

Pineapple

Lemon

Orange

Tomato ripe

Raisins

MEAT AND POULTRY

Liver

Meat

Fish

Egg

MISCELLANEOUS

Jaggery

---

13. Do you drink Tea/Coffee : Yes/No

If yes indicate the frequency and quantity per day

Items	Frequency in times	Total Quantity Consumed (ml)
Tea		
Coffee		
Any others		

HEALTH STATUS

PAST HISTORY OF ILLNESS FOR 3 MONTHS

14. Do you suffer from Gastro intestinal tract disturbances like

Health problem	Number of times	Duration in days
Diarrhoea		
Dysentry		
Hookworm infestation		
Any other		

15. Do you regularly undergo treatment : Yes/No

    If so how often : Rarely/once in 2 3 months

    If not Why? :

16. Tonics consumed if any, specify

Item	Quantity	Frequency	Duration
Tablets			
Syrups			

CLINICAL ASSESSMENT

NAME :

AGE :

HEIGHT : Cm

WEIGHT : Kg

1. Appearance

a. Malnourishment

- Poor musculature
- Deficient subcutaneous fat
- Gross muscular wasting
- Nutritional Oedema
- Anaemia
- Moon face
- Sparseness of hair
- Easy plucability of hair

b. Xerosis or pigmentation of conjunctiva

- Xerosis of cornea
- Bitot's spots
- Dry or rough skin
- Crazy pavement of skin
- Hyper keratosis

c. Angular stomatitis

- Bleeding gums

- Red/Raw/Glazed tongue

- Tenderness of calf

d. Dental caries

PREGNANCY

PERSONAL HISTORY

1. Age at marriage :
2. Age at first conception :
3. Para of present pregnancy :

4. History of miscarriage : Yes/No
5. If yes, the number and at which pregnancy :
6. History of medical or induced abortion : Yes/No

   Number of times :
7. Number of children alive :
8. Number of children dead :
9. Reasons for death :

10. Any history of intra uterine death :

11. History of still birth : Yes/No
12. If yes, the number and at which para of pregnancy :
13. Details regarding neonatal deaths :

14. Stage of pregnancy at the time of study

I/II/III trimester :

15. Do you take any special foods : Yes/No

16. If yes, list the foods and give reasons :

17. Foods avoided during pregnancy specify :

Give reasons :

18. Cravings for food during pregnancy - specify :

APPENDIX II

HAEMOGLOBIN ESTIMATION BY CYANMETHAEMOGLOBIN METHOD

VARLEY 1988

PRINCIPLE

The haemoglobin is treated with a reagent containing potassium ferric cyanide, potassium cyanide and potassium dihydrogen phosphate. The ferriccyanide forms methaemoglobin which is converted to cyanmethaemoglobin by the cyanide.

REAGENTS

Drabkin's diluent solution.

a.	Potassium cyanide	- 0.05 g
b.	Potassium ferriccyanide	- 0.2 g
c.	Potassium dihydrogen phosphate	- 0.14 g
d.	Distilled water	- 1 litre.

The solution is preserved in a dark bottle and preferably under cold storage. Its preparation and handling should be done with great care. This solution should not be used after it forms a precipitate at the bottom of the storage bottle.

PROCEDURE

1. Exactly 5 ml of the Drabkin's diluent solution is measured into a dry test tube from a burette or a pipette with suction bulb.

2. Exactly 0.02 ml of blood is transferred from a standard heamoglobin pipette into a diluent solution. Usual care in filling and cleaning of loaded haemoglobin pipette must be observed.

3. The pipette is rinsed 3 times with a diluent solution without allowing the formation of airbubbles in the solution.

4. The blood and the diluent are thoroughly mixed by rotating the tube.

5. Ten minutes time is allowed for the formation of cyanmethaemoglobin.

6. 5 ml of diluent solution is used as blank.

7. Then readings are taken in photoelectric calorimeter at 540 mu.

8. Read the standard in the sameway.

CALCULATIONS

Gram haemoglobin per 100 ml blood.

$$= \frac{\text{Reading of unknown}}{\text{Reading of standard}} \times \text{Dilution factor} \times \frac{\text{Concentration of standard in mg per 100 ml}}{1000}$$

The dilution factor is 201 or 251 according to whether 4.0 or 5.0 ml of reagent in used.

APPENDIX III

RED BLOOD CELL COUNT ESTIMATION USING IMPROVED NEUBAUER HAEMOCYTOMETER

EQUIPMENT

Instrument used for the purpose of estimation of Red blood cell count is the improved Neubauer haemocytometer.

1. The instrument consists of a special glass slide (Counting chamber)
2. One graduated pipette for RBC count.
3. Another pipette for WBC count.
4. In addition to this diluting solution, cover slip is also required. Diluting solution used is Hayem's solution.

PROCEDURE

1. The RBC pipette has got 3 graduations. Two graduations 0.5 and 1, are present on the stem of the pipette and the third mark -101 is placed just above the bulb.
2. The blood is drawn upto the mark 0.5 and the rest of the bulb is filled by sucking up diluting solution upto the mark 101.
3. The bulb of the pipette is so constructed that it holds exactly 100 times the volume of fluid contained in the stem of the pipette upto mark 1.

4. Although the fluid is drawn upto 101, the dilution of the blood will be 100, because the last part of the fluid remains locked up in the stem and is not available for dilution.

5. As the blood drawn is upto the mark 0.5, the dilution will be 1:200.

COUNTING CHAMBER

1. The ruling area consists of 9 square milli meters.
2. The central square milli metre is ruled into 25 groups of 16 small squares, each group repeated by triple lines. The side of each small square is 1/20th mm.

METHOD OF COUNTING RED BLOOD CELLS

1. One drop of diluted blood from the red cell counting pipette is introduced in the counting chamber under the cover slip. Since the under surface of the cover slip is 1/10th mm high from the surface of the counting chamber, the volume of each small squre is 1/4,000th cu.mm.
2. Red cells are counted in the five groups of 16 small squares.
3. To avoid counting a corpuscle twice, those on a line are counted only when they are on the top and left lines or on the bottom and right lines.

CALCULATIONS

The number of red cells per cu.mm

$$= \frac{\text{Number of cells counted x dilution x 4000}}{\text{Number of small squares counted}}$$

When the dilution is 1:200 the formula reduces to

$$= \frac{\text{Number of cells counted x 200 x 4000}}{80}$$

= 10,000 x number of cells counted in 80 small squares.

APPENDIX IV

PACKED CELL VOLUME ESTIMATION BY WINTROBE MACRO METHOD

PRINCIPLE

The packed cell volume or haematocrit of blood is determined by using capillary tube and micro haematocrit centrifuge.

PROCEDURE

1. Blood from finger tip is collected in EDTA and is allowed to run about 1/2 to 3/4th length of the tube.
2. The tube is sealed on the opposite using sealing wax plasticine.
3. The tubes are then transferred to the high speed micro-haematocrit centrifuge and placed in grooves of the centrifuge head.
4. They are centrifuged for five minutes at 11,000 rpm and read on the reader which gives the direct haematocrit volume in volume per cent.

APPENDIX V

SERUM IRON ESTIMATION

DIPRIDYL METHOD (RAMSAY'S)

VARLEY - 1988

PRINCIPLE

Ferrous iron gives a pink colour with 2.2' dipyridyl. A solution of dipiyridyl in acetic acid is added to serum followed by a reducing agent. Proteins are removed by heating in boiling water and then centrifuging or filtering.

REAGENTS

1. 2.2' dipyridyl v/v
2. Acetic acid 12 per cent v/v
3. Sodium sulphite - 0.1 m
4. Chloroform
5. Standard solution containing 100 micrograms iron per ml.
6. Working standard

Dilute 3 ml of the solution to 100 ml with water to obtain a solution containing 3 microgram per ml.

TECHNIQUE

1. Mix equal volume of serum, 0.1 m sodium sulphite and dipyridyl reagent in a glass stoppered tube which can be centrifuged.

2. Heat in boiling water bath for five minutes.
3. Cool, add 1 ml of chloroform, stoppered and shake vigorously for thirty seconds.
4. Remove the stopper and centrifuge for five minutes at 300 rpm.
5. If the supernatant fluid is not completely clear repeat the shaking and centrifuging.
6. Read at 520 millimicrons or using a green filter.
7. As blank use water instead of serum.
8. For the standard put through the working standard in the same way.
9. Clean the tubes by placing them in boiling 5 N hydrochloric acid and then wash with distilled water and keep for this determination only.

CALCULATIONS

Micrograms of iron per 100 ml of serum.

$$= \frac{\text{Reading of unknown}}{\text{Reading of standard}} \times 300$$

APPENDIX VI

TOTAL IRON BINDING CAPACITY ESTIMATION RAMSAY'S DIPYRIDYL METHOD

VARLEY - 1988

PRINCIPLE

Transferrin is staturated 100 per cent by adding iron from outside in ferric form. After chelating the iron not bound to transferrin, the transferrin iron in estimated as in the case of serum iron. Transferrin normally is saturated to only 33 per cent by iron. Determination of transferrin solution provides a good index of iron in nutritional status.

REAGENTS

1. Ferric chloride solution containing 5 ug of iron per ml in 0.005 N hydrochloric acid. Prepare a stock solution containing 145 mg of ferric chloride per 100 ml of 0.5 N acid and dilute 1 to 100 with water.
2. Magnesium Carbonate, "light for adsorption".
3. Sodium sulphite, 0.2M, 2.52 grams of the anhydrous salt per 100 ml.
4. 2.2' dipyridyl, 0.2 per cent in acetic acid, 3 per cent v/v.
5. Chloroform and standard solutions as for the method.

TECHNIQUE

1. Add 4 ml of the ferric chloride solution to 2 ml of serum.
2. After standing for five minutes add 400 mg of magnesium carbonate (100 mg for each ml of ferric chloride).
3. Shake frequently and vigorously for thirty to sixty minutes.
4. Centrifuge and pipette off 4 ml of the supernatent fluid for iron determination.
5. If the dipyridyl method is used add 1 ml each of 0.2M sulphite and 0.2 per cent dipyridyl and proceed as described previously for determining serum iron.
6. The result gives the total iron binding capacity.
7. If the serum iron is determined at the same time the percentage saturation is easily calculated.

CALCULATIONS

Since in this case the volume of serum in the 4 ml and supernatent fluid is 1.33 ml, if the same proportions are used for the standard (ie., 2 ml of standard containing 8 ug iron per ml, 2 ml water and 1 ml each of dipyridyl and sulphite).

Total iron binding capacity in micrograms per 100 ml serum.

$$= \frac{\text{Reading of unknown}}{\text{Reading of Standard}} \times \frac{100}{1.33} \times 6 \text{ (ie) } \times 450$$

APPENDIX VII

DETERMINATION OF ERYTHROCYTE VALUES

SAMUEL - 1986

1. Mean Corpuscular Haemoglobin

$$= \frac{\text{Haemoglobin in g/100 ml of blood}}{\text{Red Blood cell in million}} \times 10 \text{ in fl.}$$

2. Mean Corpuscular Volume

$$= \frac{\text{Volume of packed cells/1000 ml}}{\text{Red Blood cell in million}} \times 10 \text{ in pg.}$$

3. Mean Corpuscular Haemoglobin Concentration

$$= \frac{\text{Haemoglobin in g/100 ml}}{\text{Volume of packed cells/100 ml}} \times 100 \text{ in per cent}$$

ESTIMATION OF UNSATURATED IRON BINDING CAPACITY

$$= \frac{\text{Unsaturated iron binding capacity}}{\text{Total iron binding capacity - Serum iron}} \ \mu\text{g/100 ml}$$

ESTIMATION OF PERCENTAGE SATURATION OF TRANSFERRIN

Percentage saturation

$$= \frac{\text{Serum Iron}}{\text{Total iron binding capacity}} \times 100 \%$$

APPENDIX VIII

ICMR (1989) REFERENCE BODY WEIGHTS AND WEIGHTS OF ADOLESCENT GIRLS AND EXPECTANT MOTHERS

Age Groups	Height (cm)	Weight (kg)
Adolescent girls		
13	155	44.0
14	159	48.0
15	161	51.4
16	162	53.0
17	163	54.0
18	164	54.4
Expectant mothers	Nil	62.0

APPENDIX IX

STATISTICAL ANALYSIS

ADOLESCENT GIRLS COMPARISON BETWEEN TWO GROUPS

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S} \sqrt{\frac{n_1 \times n_2}{n_1 + n_2}}$$

$$S = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}}$$

$\bar{x}_1$ - Mean level of the anaemic adolescent girl of 13-15 years.

$\bar{x}_2$ - Mean level of the anaemic adolescent girls of 16-18 years.

n_1 - Number of anaemic adolescent girls of 13-15 years.

n_2 - Number of anaemic adolescent girls of 16-18 years.

S_1 - Standard deviation of the anaemic adolescent of 13-15 years.

S_2 - Standard deviation of the anaemic adolescent girls of 16-18 years.

X_1 - 47

X_2 - 44.03

S - 1.97

n_1 - 210

n_2 - 90

$$t = \frac{47 - 44.03}{1.97} \times \sqrt{\frac{210 \times 90}{210 + 90}}$$

$$= \sqrt{\frac{(210 - 1)\ 3.78 + (90 - 1)\ 4.22}{210 + 90 - 2}}$$

$$= \frac{3.03}{1.97} \times 7.9$$

$$t = 11.9$$

APPENDIX IX

BLOOD ANALYSIS RESULTS OF THE EXPECTANT MOTHERS

S.No.	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
1.	6.49	3.1	25	45	355.5	20.9	80.7	26.0	310.5	12.6
2.	6.05	2.3	24	42	369.0	26.5	104.4	25.4	327.0	11.4
3.	5.50	3.5	20	36	391.5	15.7	57.1	27.5	355.5	9.2
4.	4.95	1.5	15	36	396.0	32.6	100.0	32.7	360.0	9.1
5.	6.38	2.5	21	45	360.0	25.6	84.0	30.5	315.0	12.5
6.	6.16	2.9	20	42	418.5	21.4	68.9	31.0	376.5	10.0
7.	3.30	1.2	10	33	526.5	27.5	83.3	33.0	493.5	6.3
8.	5.50	2.6	22	36	360.0	21.2	84.6	25.0	324.0	10.0
9.	6.05	3.8	21	42	382.5	16.1	55.3	29.1	340.5	10.9
10.	6.49	2.7	25	45	337.5	24.1	92.6	26.0	292.5	13.3
11.	6.05	3.5	20	42	414.0	17.4	57.1	30.5	372.0	10.1
12.	6.38	4.0	20	45	342.0	16.0	50.0	32.0	297.0	12.3
13.	6.49	3.9	28	45	342.0	16.6	71.8	23.2	297.0	13.2
14.	5.50	3.2	23	42	360.0	17.2	71.8	23.9	318.0	11.7
15.	5.94	2.8	20	39	333.0	21.1	71.4	29.5	294.0	11.7
16.	6.49	3.8	29	45	360.0	17.1	76.3	22.4	315.0	12.5
17.	6.49	2.3	25	45	351.0	28.2	108.7	25.9	306.0	12.8
18.	6.05	3.2	22	42	369.0	18.9	68.8	27.5	327.0	11.4
19.	6.38	3.8	21	45	382.5	16.7	55.3	30.4	337.5	11.8
20.	6.05	2.5	23	42	427.5	24.2	92.0	26.3	385.5	9.8
21.	6.38	4.1	25	45	360.0	15.5	60.9	25.5	315.0	12.5
22.	5.50	2.8	22	36	351.0	19.6	78.5	25.0	315.0	10.3
23.	5.72	3.4	21	39	391.5	16.8	61.7	27.2	352.5	9.9
24.	3.08	3.7	12	30	544.5	8.3	32.4	25.7	514.5	5.5
25.	6.49	2.0	29	45	409.5	32.5	145.0	22.4	364.5	10.9
26.	6.49	2.4	25	45	382.5	27.0	104.1	25.9	337.5	11.8
27.	6.38	3.4	20	45	400.5	18.7	58.8	31.9	355.5	11.2
28.	5.50	3.8	22	36	387.0	14.5	57.9	25.0	351.0	9.3
29.	4.40	2.9	15	33	405.0	15.1	51.7	29.3	372.0	8.2
30.	6.49	3.1	23	31	346.5	20.9	74.1	28.2	315.5	8.9
31.	5.60	2.8	18	45	396.0	20.0	64.3	31.1	351.0	11.4
32.	5.00	2.4	17	40	405.0	20.8	70.8	29.4	365.0	9.9
33.	6.50	3.1	20	49	331.5	20.9	64.5	32.5	282.5	14.8
34.	7.30	3.5	23	49	275.5	20.8	65.7	31.7	226.5	17.8
35.	6.80	2.0	20	35	319.0	34.0	100.0	34.0	284.5	10.9
36.	4.80	2.1	15	32	427.5	22.8	71.4	32.0	395.5	7.5
37.	7.30	2.3	25	39	328.0	31.7	108.7	29.2	289.0	11.9
38.	6.00	3.5	18	40	373.5	17.1	51.4	33.3	333.5	10.7
39.	5.50	2.2	19	36	360.0	25.0	86.0	28.9	324.0	10.0
40.	7.30	2.9	22	35	337.5	25.2	75.9	33.2	302.5	10.4
41.	6.00	3.1	20	39	396.0	19.4	64.5	30.0	357.0	9.8
42.	5.50	2.2	20	30	418.5	25.0	90.9	27.5	388.5	7.2
43.	7.30	1.5	20	25	274.5	48.6	133.3	36.5	249.5	9.1
44.	6.40	3.9	22	40	382.5	16.4	56.4	29.1	342.5	10.5

45.	6.10	2.6	23	39	391.5	23.5	88.5	26.5	352.5	9.9
46.	5.70	3.1	19	35	405.0	18.4	61.3	30.0	370.0	8.6
47.	6.10	3.8	21	28	396.0	16.1	55.3	29.0	368.0	7.1
48.	5.50	2.9	17	26	409.5	18.9	58.6	32.3	383.5	6.3
49.	5.00	2.0	15	29	423.0	25.0	75.0	33.3	394.0	6.9
50.	6.80	2.3	25	25	373.5	29.6	108.7	27.2	348.5	6.7
51.	7.30	2.7	27	30	301.5	27.1	100.0	27.0	271.5	9.9
52.	4.80	2.1	15	32	436.0	22.9	71.4	32.0	404.0	7.3
53.	6.00	3.4	21	39	405.0	17.7	61.8	28.6	366.0	9.6
54.	7.20	3.0	25	38	229.5	24.0	83.3	28.8	191.5	16.6
55.	7.30	3.2	25	43	297.0	22.8	78.1	29.2	254.0	14.5
56.	4.90	2.0	17	35	414.0	24.5	85.0	28.8	379.0	8.5
57.	4.40	1.5	15	30	477.0	29.0	100.0	29.3	447.0	6.3
58.	5.30	2.6	20	32	324.0	20.4	76.9	26.5	292.0	9.9
59.	6.00	3.1	23	40	315.0	19.4	74.2	26.1	273.0	12.7
60.	5.00	2.9	15	45	355.5	17.2	51.7	33.3	310.5	12.7

BLOOD ANALYSIS RESULTS OF THE ADOLESCENT GIRLS (13-18 YEARS)

S.No.	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
1.	10.0	3.0	35	51	225.0	33.3	116.6	28.6	174.0	22.7
2.	9.0	2.8	30	45	252.0	32.1	107.1	30.0	207.0	17.9
3.	9.0	2.9	33	54	247.5	31.0	113.8	27.3	193.5	21.8
4.	8.5	2.5	27	45	270.0	34.0	108.0	31.5	225.0	16.7
5.	8.5	2.3	25	39	285.8	36.9	108.6	34.0	246.8	13.6
6.	10.0	3.0	30	57	234.0	33.3	100.0	33.3	177.0	24.4
7.	9.5	2.8	31	45	247.5	33.9	110.7	30.6	202.5	18.2
8.	9.0	3.0	27	48	256.5	30.0	90.0	33.3	208.5	18.7
9.	8.5	3.2	27	45	301.5	26.5	84.4	31.5	256.5	14.9
10.	9.0	3.4	31	42	243.0	26.5	91.2	29.0	201.0	17.3
11.	8.5	3.9	25	33	270.0	29.3	86.2	34.0	237.0	12.2
12.	10.0	3.0	30	57	227.3	33.3	100.0	33.3	107.3	25.1
13.	9.0	3.7	33	57	238.5	24.3	89.2	27.3	181.5	23.9
14.	10.0	3.7	37	51	220.5	27.0	100.0	27.0	169.5	23.1
15.	8.5	3.2	27	45	307.5	26.5	84.4	31.5	256.5	14.9
16.	10.0	3.8	39	45	225.0	26.3	102.6	25.6	180.0	20.0
17.	8.5	2.9	29	36	265.5	29.3	100.0	29.3	229.5	13.6
18.	10.0	3.1	31	51	202.5	32.2	100.0	32.2	151.5	25.2
19.	8.5	3.6	25	45	256.5	23.6	69.4	34.0	211.5	17.5
20.	10.0	3.3	33	33	225.0	30.3	100.0	30.3	192.0	14.7
21.	10.0	3.0	30	33	234.0	33.3	100.0	33.3	201.0	14.1
22.	9.5	3.1	29	42	256.5	30.7	93.5	32.7	214.5	16.4
23.	10.0	3.5	32	30	391.5	28.5	91.4	31.2	361.5	7.7
24.	10.0	3.1	33	36	337.5	32.3	106.4	30.3	301.5	10.7
25.	10.0	3.0	32	30	324.0	33.3	106.6	31.3	294.0	9.3
26.	10.0	3.7	35	39	324.0	27.0	94.6	28.6	285.0	12.0
27.	10.0	3.5	37	45	301.5	28.6	105.7	27.0	256.5	14.9
28.	10.0	3.5	35	54	202.5	28.6	100.0	28.6	148.5	26.7
29.	10.0	2.8	30	42	225.0	35.7	107.1	33.3	183.0	18.7
30.	10.0	3.2	32	57	211.5	31.3	100.0	31.25	154.5	26.9

X_1 - Haemoglobin level
X_2 - Red blood cell count
X_3 - Packed cell volume
X_4 - Serum iron
X_5 - Total iron-binding capacity
X_6 - Mean corpusular haemoglobin
X_7 - Mean corpuscular volume
X_8 - Mean corpuscular haemoglobin concentration
X_9 - Un saturated iron-binding capacity
X_{10} - Percentage saturation of transferrin