Chapter - 1

INTRODUCTION
1. INTRODUCTION

"Of all occupations from which gain is secured, There is none better than agriculture, Nothing more productive, nothing more sweeter, Nothing more worthy of a Free Man"

- Cicero, de Officus

India is a large country with an area of 13 million square miles. The cultural unity of the Indian people springs largely from the agricultural character of the country. Even today, when industrialisation is progressing rapidly and large scale migration is taking place from rural areas to towns and cities, most of the population lives in villages and is dependent on land. The plough is still the symbol of life of the great masses of humanity and agriculture has been a kind of religion in the country. In fact, the peasantry, irrespective of its racial and caste sub-divisions, practices only this religion. Indian farmers are conservative, backward or indifferent. Mainly they depend on rice and jowar (in southern India especially in Andhra Pradesh) as staple food (Randhawa et al., 1961). Cereal contributes 60 to 80% of total daily calorie intake. Cereals and millets are normally consumed unrefined and have phytates which interfere with iron absorption (Apte and Venkatachalam, 1962; Hallberg, 1989; Brune et al., 1992; ICMR, 1992). So they are poor in health and nutritional status with anaemias as the major nutritional problem. Poor nutrition affects the work capacity and productivity (Satyanarayana, et al., 1977; Spurr et al., 1977; Walgemaugh et al., 1982, Agarwal et al., 1987). Iron deficiency is usually attributed to inadequate iron intakes; high demands in some population groups (Apte and Venkatachalam, 1963; Hallberg et al., 1966; Weaver and Sujatha, 1992).
Iron is an ubiquitous metal. But when we consider iron as a nutrient, ironically, man has been suffering from want of iron for centuries now (Colgan, 1991). It is a component of the Hb and myoglobin molecules and the cytochromes and other enzyme systems. It plays an essential role in coupled oxidations and reductions in such processes as oxygen transport and cellular respiration. Iron is also a structural component of enzymes critical in oxidative metabolism, DNA synthesis and neurotransmitter synthesis and catabolism (Dallman et al., 1979).

Iron deficiency (ID) is characterized by a reduced concentration of haemoglobin (Hb) in the blood (Krause, 1966; Basta, 1977; Hallberg, 1982). Anaemia is indicated by a reduction in the concentration of Hb in the peripheral blood below the accepted normal level for the specific age group and sex of the individual (Wintrobe et al., 1981; Linker, 1988). The state in which the supply of iron is inadequate to support optimal erythropoiesis in the development of red cell mass is defined as iron deficiency erythropoiesis, a condition that can also be called as Iron Deficiency Anaemia - IDA (Davidson et al., 1975).

IDA continues to be a major public health problem in India (Baker and De Maeyer, 1979; WHO, 1979; Reddy, 1991) and in the World (Cook, 1989; Walter, 1989). It is an extraordinary widespread health hazard throughout the world and is one of the deficiency states affecting varying sections of population of both developed and developing countries (Malhotra and Prahlad, 1984). It is the highest in developing countries like India (Layrisse et al., 1970; Basu et al., 1973; Finch et al., 1974). About 1400 millions from the developing countries and 100 millions from the developed countries are said to be suffering from ID (De
Maeyer, 1989). The incidence of anaemia is highest among Indian Women and children varying from 60 to 70 per cent (Rao et al., 1959; Das and Chattopadhay, 1982; Narasinga Rao, 1978, 1983). In India it is estimated that 39 per cent of men and 61 per cent of women were found to be suffering from anaemia (Shukla, 1982). South Asia and Africa have the highest overall regional prevalence rate. Except for adult males, the estimated prevalence of anaemia in all groups is more than 40 per cent in both the regions and is as high as 65 per cent in pregnant women in South Asia.

In the Indian community living in South Africa, 38.1 per cent of females and 44.3 per cent of males were found to be anaemic (Mayet, 1976). Fifty three per cent of women above 15 years of age in and around Hyderabad city suffer from IDA (NIN, 1983). High prevalence of anaemia was found in different cities of India in females in the age range of 15 to 24 yrs - in Hyderabad (69.2%), Calcutta (96.7%), Madras (20.7%) and New Delhi (63.7%) and equally high prevalence of anaemia in males of the same age group was found in two cities Calcutta (90.1%) and New Delhi (65.1%).

In Burma, prevalence of anaemia in non-pregnant non-lactating women is 5%, and 5 to 15% in all village women. The incidence of latent iron deficiency anaemia is low, being 0.6 to 4% in all women (Aung-Than-Batu et al., 1965). In Industrialized countries, the prevalence of IDA is much lower and usually varies between 2% and 8% (Hallberg et al., 1993).

About 12 per cent of males from Southern Germany were known to suffer from ID and anaemia (Seibold, 1970). The prevalence of ID and anaemia was
thought to be low in adult males due to a favorable iron balance (Bothwell et al., 1979). But, Baker (1978) reported that in certain parts of Asia the prevalence rate of anaemia in males is as high as 40 per cent and more. This was confirmed in a survey conducted by the investigators of NIN (1983) in and around Hyderabad (sub-urban) of India. Among 974 adult men surveyed, 298 (30.6%) were found to have low Hb levels. These figures confirm the high prevalence of ID, particularly in underdeveloped and tropical countries which is considered as partly responsible for the high mortality rates in these regions (WHO, 1959).

Iron deficiency is known to produce variety of physiological changes including achlorhydria and variable degrees of duodenal and mucosal changes (Oski, 1979). ID also has been shown to produce changes in mental capacities and behavior such as muscular weakness, anorexia, lassitude, difficulty in concentration, irritability (Conard, 1967; Underwood, 1976; Leibel, 1977; Bhagavan, 1978; Oppenheimer and Hendrickse, 1983), Learning disorders, decreased mental abilities in Children (Sulzar et al., 1973; Webb and Oski, 1973; Leibel, 1977; Sheshadri et al., 1982; Lozoff et al., 1982; ), deficient mental development in infants (Oski et al., 1983), low performance on basic skill tests in adolescents (Webb and Oski, 1973) and behavioral problem in adolescents (Webb and Oski, 1974). Other alterations like shortened attention span, Pica, shortness of breath, pale skin, fatigue, an irregular and rapid heart beat, loss of appetite, dyspnea, paresthesia will occur (Pollitt and Leibel, 1976; Briggs and Calloway, 1979; Weaver and Sujatha, 1992; Chatterjee, 1994; Evnonvell, 1995) and increased susceptibility to infection (Sherman, '92). Pulmonary efficiency is depressed in IDA (Cotes et al., 1971).
These include aberrations in activity - physical activity, work efficiency and work capacity and energy expenditure in adults. Work capacity and work output are also significantly decreased in ID (Karyadi, 1974; Finch et al., 1976; Hallberg, 1982; Scrimshaw, 1984).

A number of studies were carried out to show the effect of ID on work performance. Anaemia reduces maximum oxygen transport and may impair work performance (Sproale et al., 1960; Anderson and Barkve, 1970). Even mild anaemia in man has been shown to result in decreased near maximal work performance (Lifuntes and Viteri, 1972; Ekblom et al., 1972; Davies et al., 1973; Davies and Hareen, 1973). Even mild IDA may lead to a reduction in physical work capacity which was shown to be improved by the administration of iron (Hallberg, 1982).

A study in Indonesia by Karyadi (1974), showed a correlation between the work output of latex tappers and the haemoglobin concentration. Work output was significantly less (19%) in anaemic tappers than in non-anaemic tappers. After treatment of anaemia with iron, the output of the anaemic group increased to that of their non-anaemic colleagues. Ericsson (1970) in a double blind trial in apparently healthy subjects, found that oral supplementation of iron produced an increase in physical work capacity as measured by performance on a bicycle ergometer, even though there was no change in Hb concentration. Astrand and Rodahl (1970) stated that the physical work capacity depends to a large extent on the adequacy of the oxygen transport system. IDA was shown to lower the physical activity by reducing the availability of oxygen to the tissues which in turn was shown to lower the cardiac output. After performing the physical activity,
pulse rate and BP were shown to increase in anaemic participants and they had to strain more for performing exercises (Nirmala et al., 1989). Physical work capacity was shown to significantly reduce and locate levels increased by IDA, with a concomitant reduction in productivity (Gardner et al., 1977).

Vijayalakshmi and Selvasundari (1983) stated that iron supplementation in anaemic subjects increased working capacity and reduced energy expenditure, BP and heart rate after exertion.

The body needs energy for maintaining body temperature, metabolic activity, supporting growth and for physical work. Energy expenditure from a physiological point of view is made up of three major components: (i) Basal metabolic Rate (BMR), (ii) Regulatory thermogenesis, (iii) Physical activity. The new simplified approach has only two principal components of energy expenditure - BMR and Physical activity (ICMR, 1992).

For a sedentary person, BMR accounts for about 60 - 70% of daily energy expenditure, the remaining 30 - 40% is from physical activity and from body heat produced after a meal (5-10% thermic effect). Physical activity is responsible for as much as 50 - 60% of total energy expenditure in people who include frequent aerobic exercise into their life style (Conway, 1996).

BMR is lowered during acute semi-starvation as well as in chronic undernutrition (Keys et al., 1950; Grande, 1964; Shetty, 1984). Prolonged undernutrition or starvation reduces BMR by about 10 to 20% (NIN report, 1991; Vijaya, 1994; Ramakrishna et al., 1994). Their Lean Body Mass (LBM) is reduced and this automatically reduces their BMR (Gaman and Sherrington, 1981).
In one of the studies of NIN (1988) results showed that undernourished men have energy savings during basal state and low activity levels like locomotion etc. In severe energy restriction there is also a decline in voluntary physical activity (Warwick and Garrow, 1979), and a fall in the Resting Metabolic Rate (RMR) per unit mass of lean tissue (Keys et al., 1950), which is more marked in the early stages of energy restriction (De Boer et al., 1986).

A study by Elia et al. (1984) during starvation showed that blood lactate levels rise during performing exercise and work efficiency decreased and no significant change in energy expenditure was observed (it may be due to small number n = 5).

Lower (26%) resting RMR was observed by Shetty (1984) in chronically undernourished subjects compared to healthy subjects. Satyanarayana et al. (1991) found that undernourished men had lower BMR values and used significantly lower amounts of oxygen.

Nutrition has been shown to have a significant role on BMR. Iron, calories, work capacity and BMR are interlinked. However, scanty information is available regarding iron nutriture and BMR. Generally 50-60 per cent of our population are anaemic and particularly so in the low income groups. India's main occupation is agriculture and a huge population (labour force) are involved in the food production front. If their work capacity could be improved, the health and economic status of the country itself can be changed.

There is scanty information on nutritional status, somatic measurements, activity schedule and BMR of the Ag. farm workers.
Hence, the present study was undertaken with agricultural farm workers, females and males, in the age group 20-60 years and with well matched non agricultural workers.

The following are the objectives of the study:

1. To assess the nutritional status of agricultural farm workers.

2. To assess whether the work capacity and BMR of the farm workers depends on the nutritional status.

3. To study whether iron supplementation improves nutritional status, work capacity and BMR of the agricultural farm workers.

4. Also to study how far the different methods of BMR - BMR using Mayo Foundation Normal Standards (BMR 'A') and BMR using ICMR proposed equations (BMR 'B'), compare with the BMR using Benedict Roth's apparatus (expt. BMR).

The data obtained was analysed using different statistical methods such as - mean and Standard Deviations, 't' test to find the significance of difference and also for difference to find significance of change where ever necessary, correlation - coefficient to find the significance of correlation between variables, ANOVA to find interaction effects and regression equations were used where ever they were found necessary.

For all these, software was available in the local computer centre. The results were discussed and summerised in this treatise.