Chapter - 5

SUMMARY AND CONCLUSIONS
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Iron deficiency anaemia is found throughout the world. It is currently estimated to affect more than 500 million people. It is a major public health problem particularly in the developing countries like India, where agricultural productivity is of prime economic importance. Work capacity and work output depend on the quality and quantity of their calorie and nutrient intakes and the resulting nutritional status. Productivity by the labour force in the developing countries is generally low. This has been attributed to their poor physique resulting from chronic malnutrition. Nutrition reviews point out that among the nutritional diseases, iron deficiency anaemia is a major concern in many developing countries. Severe anaemia is claimed to impair work capacity, learning abilities and immune functions. The only way to improve iron intake is either by supplementation or fortification. Since, iron supplementation can be an effective way of combating anaemia and increase the work output of population groups, the present study was planned to focus on the effect of iron supplementation on nutritional, somatic, biochemical and physiological parameters in the Ag. farm workers.

Ag. farm workers of both the sexes in the age range of 20-60 yrs formed the subjects of the study. The subjects were normally healthy and ambulatory without any complaints of chronic sickness. Also subjects who were ready to cooperate throughout the study period were enrolled for the study. A total of 363 Ag. farm workers participated in the study, from the surrounding villages of Papanaidupet (20 km from Tirupati town). Subjects were divided into four age groups decade
The study was carried out in three stages. In the first stage of the study, general information, dietary data, nutrient intakes, somatic measurements, biochemical parameters and daily physical activity were collected from the subjects. During the second stage of the study, from each of the above age and sex groups 15 subjects were selected for the experimental study (60 females + 60 males). Same number (60 females + 60 males) of well matched controls (N.Ag. workers) were also selected. BMR, work capacity and pulse rate were assessed additionally for expt. and control subjects. In the third stage of the study, expt. subjects were supplemented with 60 mg of elemental iron in the form of Fersolate tablets for one month. After the supplemental period, nutrient intakes, body weights, BMI, SFe, Hb, BMR, work capacity and PEPRs were repeated on the expt. group.

The results were computerised to obtain mean, SD, percentages, 't' test, analysis of variance, correlation and regression analysis that are required to interpret the data. The results were discussed in the light of the existing research information and speculative explanations.

The results are summarized as follows

**Dietary Pattern and Nutritional Status**

* The dietary pattern of the Ag. farm workers consists of breakfast, lunch and supper. In addition to this the N.Ag. workers take mid-morning and evening snack.
* For the N.Ag. workers dhal, vegetable and buttermilk is a must in their diet.

* Rice is the staple food. Use of other millets are negligible. Wheat and Ragi are not regularly used. Consumption of foods rich in protein particularly that of animal origin is limited. The frequency consumption of green leafy vegetables and fruits are low in both the Ag. and N.Ag. workers.

* Frequency consumption of milk is poor in the Ag. farm workers.

* Nutrient intakes are lower than RDA in both the Ag. and N.Ag. workers.

* The intake of nutrients are significantly higher in the N.Ag. workers than the Ag. workers of both the sexes.

* The intake of calories are higher in the 40-49 yrs age group of the Ag. and N.Ag. females, whereas in males, the higher nutrient intakes are observed in the 30-39 yrs age group compared to other age groups.

* The per cent deficits of nutrients observed in both Ag. and N.Ag. females are - calories 14-21%, protein 11-31% and iron 40-46%, where as in the Ag. and N.Ag. males the per cent deficit of nutrients are calories 25-30%, protein 16-24% and iron 36-41%. Thus the most limiting nutrient in their diets is iron.
Somatic Measurements

* It is interesting to note that the mean heights of the Ag. and N.Ag. workers of both the sexes of this area are significantly higher than the reference height.

* Body wts., BMI, SFS, body fat and LBM are significantly lower in the Ag. female workers than that of the N.Ag. female workers.

* Body wts., BMI, SFS and body fat are significantly lower in the Ag. male workers than that of the N.Ag. male workers.

* SFS and body fat are found to be significantly higher in females compared to males.

* In females of 40-49 yrs age group, SFS, body fat and LBM are observed to be higher than the other age groups in both the Ag. and N.Ag. workers.

* In males of 30-39 yrs age group, SFS and body fat are observed to be higher than the other age groups in both the Ag. and N.Ag. workers.

* LBM is significantly higher in males compared to females in both the activity groups.

* In accordance to the grades of BMI, in the Ag. workers 44.9 to 60.16% of the females and 51.81 to 69.49% of the males are in chronic energy deficiency stage. The percentage of the subjects in chronic energy deficiency is less in N.Ag. workers compared to Ag. workers. In the N.Ag. workers, 6.8 to 20% of females and 10 to 20% of males are in chronic energy deficiency stage.
Biochemical Status

* Ag. workers suffer from low levels of SFe and Hb indicating a greater prevalence of anaemia than the N.Ag. workers.

* SFe and Hb levels are found to be significantly higher in the males than that of the females both in the Ag. and N.Ag. workers.

* 65.2% of the Ag. females and 82.5% of the Ag. males show low levels of SFe, whereas, in the N.Ag. workers, 23.3% of the females and 26.7% of the males are at low levels of SFe.

* 30.3% of the Ag. females and 74.5% of the Ag. males show deficient levels of Hb. However, in the N.Ag. workers, only 8.3% of females and 15% of males are at deficient levels of Hb.

* 10.1% of the Ag. females and 6.0% of the Ag. males show spoon shaped nails.

* Formation of spoon shaped nails seemed to occur only when both Hb and SFe levels are low simultaneously.

Physiological Status

* BMR is significantly higher for males than in females.

* N.Ag. workers have a significantly higher BMR than the Ag. farm workers in both the sexes.

* A significant decrease in BMR with age is observed.

* Significant differences are observed between the expt. BMR and BMR 'A' and expt. BMR and BMR 'B'.
* The mean total EE is significantly higher in the Ag. workers than that of the N.Ag. workers of both the sexes.

* An increase in the total EE in the females with age upto 49 yrs both in the Ag. and N.Ag. females is observed.

* Ag. workers are at negative energy balance (a deficit of 204 to 245 Kcal/day).

* A significant decrement with age is observed in work capacity in the Ag. and N.Ag. workers of both the sexes.

* Work capacity is significantly higher in the N.Ag. workers compared to the Ag. workers of both the sexes. This is because of the higher nutrient intakes in the N.Ag. workers.

* PEPRs show an increment with age.

Supplemental Study

* Supplementation with iron shows a significant improvement in nutrient intakes, body wts., BMI, SFe, Hb, BMR and work capacity in all the age groups of the Ag. workers in both the sexes.

* A significant decrease in PEPR is observed after iron supplementation in both the sexes of the Ag. workers.
Interrelationships Between the Different Parameters

* Significant and positive correlations are found between calorie intake and BMR; calorie intake and work capacity; protein intake and work capacity; iron intake and work capacity; calorie intake and body weight; BMI and BMR; BMI and SFe; BMI and Hb; body wt. and work capacity; LBM and O₂ consumption; SFe and BMR; Hb and BMR; SFe and work capacity; Hb and work capacity; SFe and Hb; BMR and work capacity in the Ag. (before and after suppl.) and N.Ag. workers of both the sexes.

* Significant and negative correlations are observed between - calorie intake and PEPR; SFe and PEPR; Hb and PEPR in an the Ag. (before and after suppl.) and N.Ag. workers of both the sexes.

* BMR shows an increase with the level of SFe and Hb.

* Predictive equations for BMR are obtained using SFe and Hb levels.

To sum up, Ag. farm workers are the most vulnerable group in view of the marked deficits in gross nutrient intakes, somatic, biochemical and physiological profiles when compared with the N.Ag. workers. Using BMI as one of the criteria it is distressing to note that, 45 to 70% of the Ag. farm workers are under chronically undernourished grade, whereas only 7 to 20% of the N.Ag. workers are in the same grade. Since, BMI has a significant association with many other parameters of nutritional status this measurement has a greater relevance in identifying the state of undernutrition.
Undernutrition affects the somatic measurements (decrease in body wt., body fat, LBM and BMI) and biochemical status (low levels of Hb and SFe), it leads to a decrease in BMR and work capacity. Decrease in BMR in chronic undernutrition is an adaptive mechanism. Chronic undernutrition and anaemia decrease the work capacity. For blood formation iron is a major component. Maximal or sub-maximal work capacity depends upon the blood Hb level. Maximum O₂ transport is observed in non anaemic subjects. Normal levels of Hb and SFe decrease PEPR. This may be due to increment in Hb and SFe level by a decrement in blood flow.

The present study showed that Ag. workers do have a calorie gap (112 to 276 Kcal/day in females and 97 to 402 Kcal/day in males). In the present study, iron suppl. increased dietary intake of calories, protein and as well as iron and helped in reducing the anaemia. Due to an increase in the dietary intake, the body wt, BMI, SFe and Hb also showed a significant improvement. Improvement of these Parameters thus helped in better physical work capacity and BMR. This indicates that iron is one of the limiting nutrients in addition to calorie gap. For planning any nutritional programs these parameters can help us to find out the people at risk. India's main occupation is agriculture and most of the population in the villages are agricultural farm workers. Government should take interest in supplementing this risk group with calories, protein and iron for better work output. Government/ICAR should take this as a pilot study and plan to implement a nutritional program to the Ag. farm workers. Government promulgated a number of programms for the vulnerable groups pregnant and lactating women, adolescent girls, children and the like. The situation now is that the Ag. farm workers form such a segment of the vulnerable population and 90% of the population survive as Ag. labourers. Hence, either the government should
see to establish low cost and highly nutritious food through canteens in
government Ag. farms or see that spot supply of food in the fields by landlords
as in the past is encouraged. Staple foods such as rice and wheat or sugar and
salt, like iodine should be fortified with iron and popularise for improving the
nutrient intakes. This will help the Ag. labourers for better work output and to
improve their own health. In addition, with improved work output and better
production the country's economy also improves.

"Feed the Agricultural Labourer with Optimal
Nutrients and he Feeds the Nation,
And improves the Country's Economy".
Present Findings for Future Studies

1. The present study in Ag. workers showed that there is a positive correlation between work capacity and BMR, and also that BMR is related to iron nutriture. Hence, further studies are required to be carried out in heavy workers like stone-cutters, mine workers, Blacksmiths etc. to plan out strategies to improve the work capacity of these groups.

2. So far no quantitative relationship between biochemical and clinical symptoms i.e. Sfe and Hb to spoon shaped nails, palor of the tongue etc., have been established. However for the first time an attempt is made to see the clinical symptoms of anaemia for example. Spoon shaped nails occur at what levels of SFe and Hb. It has been seen that when Sfe and Hb were as low 35 to 50 μg/dl of SFe and 6.12 to 10.71 g/dl of Hb spoon shaped nails occur. To confirm this further research on this is required.

3. For the first time basing on SFe and Hb, predictive equations for BMR are formulated. Further, studies are required to confirm this.

4. A decrease of iron and calories showed a significant decrease in BMR and work capacity and when only iron supplementation was given BMR and work capacity improved significantly. A similar calorie supplementation can also be tried to see to what extent BMR and work capacity can further be improved or to confirm that only iron supplementation is enough.

5. Work capacity showed an increase with body weights. But because of small number in some groups the significance is not clear. So, with a purposive larger sample of different body weights the same can be studied to know at what body wts. (lowest and highest body wts.) optimal work output can be achieved.