V. SUMMARY AND CONCLUSIONS

The study covered a total of 2063 expectant mothers, 1264 in the low and 799 in the high income groups over a period of five years. The findings of the study are as under:

The nutritional profile and obstetric performance of the mothers:

1. The mean food intake of randomly selected 66 mothers from the low and 54 mothers from the high income group indicated that the mean daily intake of the mothers in the low income group was grossly inadequate. Although the intake of cereals, pulses and green leafy vegetables by the mothers in the high income group was less than the allowances recommended by the ICMR, their intake was adequate with reference to all the nutrients, except energy. Further more, the mothers were not able to consume the quantities recommended by the ICMR for cereals and green leafy vegetables. In view of the fact that the vitamin and mineral requirements were adequately met, and only the energy requirement was less by 200 k. calories, the recommended allowances for cereals and green leafy vegetables call for a downward revision, probably with a slight increase in the other energy density foods to meet the energy requirements.
2. The clinical examination of the expectant mothers brought to light the high prevalence of angular stomatitis and xerophthalmia (10.6 per cent), oedema (40 per cent), and anaemia (63 per cent) among the low income, inadequately fed group. In contrast, there was only one per cent of oedema and nine per cent of cases with anaemia in the high income, well fed group.

3. The biochemical investigations revealed that the expectant mothers in the low and high income groups showed mean levels of: (a) total serum protein, 5.42g/100ml and 7.02g/100ml respectively, (b) serum albumin 2.74g/100ml and 3.85g/100ml respectively and (c) serum globulin 2.79g/100ml and 3.17g/100ml respectively. The mean haemoglobin level was 8.74g/100ml for the low income inadequately fed group, against 10.64g/100ml for the high income well fed group. Mean serum iron levels recorded by the latter was 64.2ug, while the former recorded a mean value of only 38.1ug, indicating high risk.

Mean values for the total iron binding capacity and percentage saturation of transferrin were higher for the high income well fed mothers.
Mean serum retinal value of the high income well fed mothers was 12.36mg/100ml against the 13.66mg/100ml of the low income inadequately fed mothers.

Mean urinary osteogen levels were 32.6mg for the low income inadequately fed group and 62.6mg for the other group. This is important as urinary osteogen levels indicate fetal viability.

Similarly, the high income well fed group registered a mean osteopenia level of 2.9mg against 1.6mg recorded by the low income inadequately fed group.

Mean serum folate level was 7.8mg/dl for the high income well fed group against 3.7mg/dl for the inadequately fed group as assessed by microbiological assay. A more accurate and less variable quantitative index of folate nutrition, namely red cell folate assay also indicated that the mean value was 180.65ng/ml and 129.95ng/ml for the well fed and inadequately fed group respectively. A significant positive correlation was observed between serum folate and red cell folate levels.
5. Mothers in the high income well fed group had registered a mean weight gain of 8.14 kg during pregnancy, while their counterparts in the low income inadequately fed group had recorded only 5.9 kg. The mean heights were 150.71 cm and 148.96 cm respectively.

6. Regarding the weeks of gestation, 30.9 per cent of the mothers from the low income inadequately fed group had below 36 weeks, against only 15.35 per cent in the high income well fed group. The gestation weeks appeared to be slightly higher for female babies than for males in both the groups.

7. Maternal deaths were 0.8 per cent in the low income inadequately fed group, against nil in the high income well fed group. The nature of delivery, whether normal or complicated, appeared to be independent of the nutritional status and economic conditions. However, complications of nutritional origin were higher among the low income inadequately fed group than among the other group. A higher proportion of the high income well fed mothers appeared to have 6–9 hours duration of labour, than their counterparts in the low income inadequately fed group, which might be due to the heavier babies they delivered. The mean birth spacing was 11.2 months for the low income group against 21.7 months for the high income.
The vicious circle of poverty, malnutrition, lack of education, high infant mortality and ignorancefacts were the major causes for the shorter interbirth intervals. The number of previous pregnancies undergone by the mothers in low income group was almost double that of the high income group. Miscarriages, still births and neonatal deaths were higher in the low income group than in the high income group. Calculation of the economies of pregnancy wastage for the nation revealed a loss of nutrients equivalent to K.48,386000 every year.

8. An index has been evolved to assess the risk levels of expectant mothers. An attempt has also been made to evolve guidelines for interpretation of serum levels of certain nutrients.

9. Infants born to the high income group had recorded a higher mean crown heel length of 48.37 cm and birth weight of 3.2 kg against the 47.86 cm and 2.81 kg in the low income group. The head, chest and midarm values were consistently higher for the infants born to the well fed than those born to the low income mothers. There was a positive correlation between birth weights of infants and weight gains
of the mothers during pregnancy. Similar positive correlations were observed between protein intake and weight gain of the mothers, haemoglobin levels and birth weights of the infants, creatinine levels in the amniotic fluid of the mothers and birth weights of the infants, birth weights and maternal heights, and birth heights and maternal heights in both the groups.

The nutritional profile of the nursing mothers and growth performance of the infants

From among these expectant mothers it was possible to follow 107 mothers from the low income and 122 mothers from high income and study details relating to their food intake, clinical and biochemical profile and growth performance of their infants. These findings are summarised below.

10. The food and nutrient intake of the low income nursing mothers was deficient in most of the foods and nutrients, while the nutrient intake of mothers from the high income was adequate though their cereal and green leafy vegetables intake was lower than the allowances recommended by ICMR (1979).
11. Anaemia and angular stomatitis continued to be the prominent signs of malnutrition during the nursing period particularly among the inadequately fed mothers. (38.3 and 48.6 per cent respectively) In contrast only five per cent of the nursing mothers from the well fed group manifested anaemia.

There was an increase in serum retinol from the levels during pregnancy, in both the groups. However the low income group still remained below normal acceptable levels of 20μg/100ml. A similar trend was noticed in the haemoglobin levels, 10.96g/100ml for high income and 10.12g/100ml for the low income.

12. The weight pattern during lactation indicated that mothers of the low income group had a non-pregnant weight of 44kg which increased by 1.5 kg during the 6th month of lactation and decreased thereafter to reach the non-pregnant weight of 44 kg. The mothers in the high income group exhibited a similar trend starting with 54 kg weight, and going up by 2.1kg by the sixth month and decreased slowly to reach 55 kg.
13. The maximum breast milk intake was 670 ml in the low income group and 652 ml in the high income group at the third month of nursing. Computation of the economic value of breast milk for a period of 12 months revealed that the mother from the low income group could save $0.11.25/month. The nutrient composition of milk revealed no difference between the two groups, for proximate principles and minerals.

It was heartening to note that there were more mothers in the low income group breast feeding their infants, than their counterparts in the high income group. The weanermeal period appeared to be positively correlated with the length of breast feeding. Thus breast feeding conferred a three fold advantage; (a) health of the child (b) nutritious food with cut external expenditure of money and (c) a natural means of increasing birth spacing.

14. The growth performance of infants from 0–12 months indicated that regardless of income, breast feeding was definitely beneficial up to six months and thereafter supplements were necessary. The breast fed infants of the well fed group recorded highest mean
height, weight, head, chest and midarm circumference measurements during the 3rd, 6th, 9th and 12th months. Until the first six months, the trend of growth of breast fed infants of the low income group was close to that of the high income counterparts. But there after they fell apart from both the breast fed and non breast fed infants of the high income group. The non breast fed infants started with lower mean height, head, chest and mid arm measurements and trailed behind their counterparts in the breast fed group. Breast fed infants of the high income mothers, attained a head/chest ratio of one by the sixth month. However, the infants of the low income mothers, both breast fed and non breast fed did not attain the ratio of one even by 12 months. Similarly the physical and motor development appeared to be faster for the breast fed infants when compared to their non breast fed counterparts.

In the low income group, 41.6 per cent of the non breast fed and 28.6 per cent of breast fed infants suffered from mild protein energy malnutrition. In addition, 20.6 per cent and 15.3 per cent of the infants suffered from xerosis of the conjunctive and
16.6 per cent and 3.8 per cent from anaemia.
On the other hand there was no evidence of malnutrition
among the infants of the high income mothers.

16. That 32.6 per cent of the breast fed and 33.3,
per cent of the non breast fed infants born to low
income mothers were infested with thread worms or
round worms was disturbing. None of the infants
born to the high income mothers had such problem.

17. Common cold, cough, diarrhoea and fever were the
most common ailments among infants. The prevalence
and degree of morbidity were higher among infants
in the low income group than among infants of the
well fed group.

18. As for the supplements, in most cases they were
delayed in the low income group, and when given,
it was only a part from the family pot and nothing
special to meet the needs of the young child. On
the other hand supplements were started as early
as the second or third month in the high income
families, where special foods such as fruit and
vegetable juice, mashed rice, dal and ghee were
given.
The Impact of the Applied Nutrition Programme

19. The impact of the Applied Nutrition Programme on 25 selected expectant mothers and their offsprings revealed that the mean home food and nutrient intakes was inadequate. The consumption of protein rich foods supplied through the AMP increased the protein intake to some extent. The mean weight gain during pregnancy was significantly higher for the mothers participating in the AMP when compared with those, not participating.

The mean haemoglobin levels of the expectant mothers both participating and not participating in AMP were similar at the start of the study. However after three months of feeding AMP supplements, the AMP mothers had improved their haemoglobin levels while the non AMP mothers showed actually decreased levels. The mean creatinine levels had increased for the AMP mothers and decreased for the non AMP mothers.

The anthropometric measurements of the newborn infants revealed that all the measurements registered by the infants of the AMP mothers were consistently higher than those recorded by the infants of the non AMP mothers.
These beneficial effects can be attributed to the improved maternal nutrition because of the AMP supplements.

**Impact of the prophylaxis against anaemia programme**

20. The intake of iron and folic acid was increased through the supplementation in the prophylaxis programme. The weight gain during pregnancy was higher for the mothers in all the supplemented groups when compared with the control. But the supervised group supplemented with 120 mg of ferrous sulphate and 200 mg of folic acid had recorded the highest mean weight gain of 7.33kg. The mean haemoglobin levels recorded by this group of expectant mothers was also the highest (11.97g/100ml). The values achieved by the 120mg + 200mcg unsupervised group and 200mg + 500mcg supervised group were close to this value. All the supplemented groups whether supervised or not, had recorded acceptable values of haemoglobin. The mean serum iron levels also indicated the same trend. While all the supplemented groups performed better than the control, the supervised 120mg + 200mcg group, the unsupervised group receiving 120 + 200 mg and the supervised group receiving 200mg + 500mcg performed better than the 200mg + 500mcg unsupervised group.
The beneficial effects of folic acid in addition to iron supplementation, was evident from the values obtained for serum and red cell folate. A supplementation of 200mg of folic acid appeared adequate. While the two levels of iron supplementation appeared to be effective in fighting anemia, 120mg ferrous sulphate supplementation was found to be the most suitable, because the 200mg ferrous sulphate had gastrointestinal upset and this meant loss of nutrients and psychologically adverse effects.

Impact of vitamin A and iron supplementation:

21. The serum vitamin A levels of the three groups of expectant mothers who received varying combinations of vitamin A and iron and control indicated that the vitamin A and iron supplemented group recorded higher values of serum vitamin A (31.1μg) than all the other groups. The vitamin A supplemented group recorded 30.2μg, iron supplemented group 17.75 μg and the control group recorded 15.3 μg. Vitamin A supplemented group recorded a serum iron level of 54.3μg, vitamin A and iron supplemented group 96.2μg, iron supplemented group 67.6μg and control 36.1μg. The highest mean haemoglobin level of 11.48g was recorded by the iron and vitamin A
supplemented group, 19.20g by the Iron supplemented, 9.77g by the vitamin A supplemented and 9.39g by the control group. The total iron binding capacity was similar and the highest percentage saturation level was obtained by the vitamin A and Iron supplemented group. Thus the supplementation of vitamin A improves in some way the haemopoietic activity in anaemic mothers.

Recommendations

Out of these results and conclusions, the following recommendations emerge:

1. Majority of low birth weight babies are born at term and are small for date, mainly because of maternal malnutrition during pregnancy. Hence appropriate nutritional care before conception should be emphasised. Socio-economic development of the currently underserved population must receive high priority in national plans.

2. Since the risk of low birth weight babies in expectant mothers can be averted by direct nutritional interventions and health services, and since both malnutrition and morbidity during pregnancy are amenable to correction, efforts must be made, through prenatal care and supplementation, to reduce the incidence of low birth weight.
3. Clinical examination and simple body measurements under field conditions must be undertaken to identify the groups and individual mothers affected. The use of the simple index evolved by the investigator for this purpose, should be popularised to identify the mothers at risk.

4. As and when the malnourished mothers are located, immediate remedial measures must be taken, including admitting of mothers needing urgent care to hospitals for medical help, feeding and education.

5. Supplementary feeding programmes should be continued for the vulnerable groups as a preventive measure, with built in health and nutrition education and food hygiene, for lasting results. The amount of ferrous sulphate could be reduced from 300mg to 120mg in the prophylaxis against anaemia programmes. Prophylaxis against vitamin A deficiency programmes could be extended to expectant mothers also.

6. Many disorders stem from wrong habits such as preferential feeding of the head of the family, late introduction of supplementary foods to infants, restrictions on certain nutritious foods and decline in breast feeding. Therefore a massive nutrition and health education programme, must be mounted and maintained in the urban and rural areas utilizing effective methods of mass communication.
7. The WHO and Government of India should develop an inexpensive, portable weighing device for expectant mothers. It should not be heavy, but reasonably accurate and practical for use at the periphery. Use of infantometers and detecte balances should be made a requirement in all the hospitals and intervention programmes.

8. The weaning period remains, as ever, a dangerous time for the majority of the children. The need to develop home prepared nutritious weaning foods is crucial. Government must undertake the responsibility of commercially producing and distributing through suitable programmes the already developed weaning foods.

9. Since family planning could be achieved by encouraging the mothers to delay the age at first pregnancy, reduce the number of children by adequate spacing between children and through effective breast feeding, these must be emphasised in the campaigns for small families.
10. In treating malnutrition, available resources mainly human resources, should be so distributed, that the persons at high risk have priority and receive appropriate care, while those not at risk receive the needed minimum but safe level of care. During the care of the high risk mother, advice and service regarding the spacing and or prevention of future pregnancies should be given. The curricula for the basis in service training of those who identify high risk cases, namely doctors, nurses, midwives and other health personal should be reviewed to ensure that they include preparation for this task.

11. Village level health workers should be given adequate training in detecting high risk cases. Traditional birth attendants should receive simple, practical training to make the deliveries they attend, safe.

12. The ICMR needs to revise the recommendations for the food allowances in the light of the observation that the quantities of cereals and green leafy vegetables are too high.