

*Summary and conclusion*

## V SUMMARY AND CONCLUSION

Pregnancy is one of the most critical and risky periods in a woman's life cycle. Women need to attain good nutritional status before, during and after pregnancy to optimize general health and reduce the risk of birth defects and chronic diseases in their children when they enter into adulthood. An adverse gestational event, such as a conception culminating in spontaneous abortion or still birth, is an unwelcome, but not an unusual pregnancy outcome. Maternal micronutrient deficiency has been related to adverse fetal effects. Maternal malnutrition, which includes folic acid deficiency, is a major concern for all developing countries including India.

Folate deficiency is associated with many adverse outcomes, including increased risk of Neural Tube Defects (NTDs). The incidence of NTDs varies from 0.5-11 per 1000 live births in different parts of India. NTDs are the most common of the central nervous system malformations and the burden of the disease is very high in low socio economic countries.

The main types of NTDs are spina bifida (including meningomyelocele and meningocele). Though the etiology of NTDs is multifactorial, yet there have been many studies highlighting the role of increasing maternal folate levels in the prevention of NTDs. Studies have reported that maternal diets were not able to meet the recommended allowances and the synthetic form had better bioavailability compared to food sources and fortified foods.

The evidence that periconceptional supplementation of folic acid may prevent the occurrence of NTD has raised the hope for the primary prevention of NTDs in the population at large. Women know and may associate folic acid with pregnancy and less with pre-pregnancy and do not take it preconceptionally. Greater emphasis is therefore necessary on periconceptional

use to improve folic acid uptake by mothers who delivered babies with NTDs and for women planning pregnancy. Therefore promotion of folic acid intake by general practitioners, primary health care professionals, nutritionists and researchers is essential to overcome birth defects in pregnant women and for women planning pregnancy. The present study entitled 'Neural Tube Defects (NTDs) and effect of counseling and folic acid supplementation' is undertaken with the following objectives to

- ❖ Study the prevalence of NTDs in Erode town in Tamil Nadu
- ❖ Study the possible influence of maternal factors on NTDs and the problems faced by the pregnant mothers of NTD cases
- ❖ Counseling women planning pregnancy to prevent occurrence of NTDs and
- ❖ Evaluate the efficacy of periconceptional supplementation of folate alone as well as in combination with multivitamin or iron in preventing the recurrence of NTDs

The study was carried out in four phases:

### **Phase 1**

Erode town in Tamil Nadu state was selected to study the prevalence of NTDs in sixty registered hospitals and one Government headquarters hospital through the records maintained for a period of five years (2000-2004). The available information such as age, parity, weeks of gestation and literacy level of mothers, gender and birth weight of newborns, type and time of identification of defect, type of delivery and registration of pregnancy were collected. From the data collected, the exact Confidence Interval was calculated for each rate and the annual incidence rates per 10,000 live births of NTDs identified during 2000-2004 associated with fetal defects were calculated.

## **Phase 2**

In the second phase of the study, 126 readily available cases registered with NTDs in various hospitals in Erode during 2003 and 2004 were considered by convenience sampling. Based on the willingness and co-operation extended, information was obtained from 116 women using the formulated interview schedule regarding socio economic background, maternal factors and obstetric history during their NTD affected pregnancy.

## **Phase 3**

Fifty women in the age group of 20-30 years aspiring to have their first child and willing to cooperate were included for counseling. Details on the general socio economic status were collected using an interview schedule. Anthropometric measurements, clinical examination and consumption pattern of folic acid rich foods were studied for all the selected women. Food and nutrient intake and estimation of blood haemoglobin and serum folate levels were carried out on a sub sample of ten women before and after three months of counseling. The fifty women were counseled about the significance of folic acid using the developed educational materials like folders, hand outs, posters and CD scripts. The initial knowledge about folic acid was assessed by administering a proforma before and after three months of counseling and the scores were documented and analysed to assess the impact of counseling.

## **Phase 4**

Among the 116 mothers, with previous history of NTD affected pregnancies registered in Erode town during the study period, 30 women who were willing to cooperate and have another baby were selected for supplementation study. The selected women were divided into three groups viz., folic acid (group A), folic acid and multivitamin (group B) and folic acid and iron (group C) each consisting of ten women and were supplemented daily

in the form of tablets periconceptionally and continued until three months after conception under the supervision and guidance of gynaecologists. Information regarding the socio economic background, obstetric history, dietary pattern and food and nutrient intake of the selected women were collected and studied. The impact of supplementation was assessed through nutritional status and knowledge of the subjects, biochemical assessment of serum folate and haemoglobin level, foetal biometrics, pregnancy outcome and anthropometric assessment of the new borns. Further, an attempt was made to identify the socio economic and maternal factors associated with serum folate level using Factor Analysis.

The following pages epitomize the important findings of the study.

#### **A. Prevalence of NTDs in Erode town**

- The incidence rate of NTDs was found to be 2.74 per 1000 live births during the study period in Erode town.
- Among the reported NTD cases, the annual incidence rates per 10,000 live births for anencephaly were 10.65, followed by 9.08 for meningocele, 5.68 for meningomyelocele and 1.94 for encephalocele during the study period.
- The study revealed that greater number of female neonates was found to be affected by NTDs than males and the difference was statistically not significant.
- The incidence of NTD affected pregnancy decreased with increasing maternal age significantly.
- The prevalence rates of NTDs were found to decrease with increasing maternal literacy level significantly.

- There was a high incidence of NTDs reported among first para of pregnancy and decreased with parity in all the four type of NTDs.
- NTD rates were higher with lower gestational age at delivery.
- The study of incidence rates of reported NTDs by birth weight revealed that NTDs were a likely cause of early miscarriages and NTD rates were higher with low birth weight.
- Majority of the NTD cases were delivered earlier by inducing or by caesarean. However, in meningocele cases, majority of infants (51.1%) were delivered normally.
- Among 262 reported NTDs in Erode town during the study period, 12 cases did not register their pregnancy due to lack of awareness regarding the nutritional significance during pregnancy.

**B. Possible influence of maternal factors on NTDs and problems faced by the women**

- Majority of the selected women got married at an age of 19-21 years (50.9%)
- The association between family type and prevalence of NTDs showed that majority of the reported cases (66.4%) belonged to joint family system.
- Study of family size and types of NTDs revealed that more number of NTDs were reported (50.9%) among the family size of five and above.
- Socio economic status of the selected women influenced the types of NTDs as evident from the fact that prevalence of NTDs was more among low and middle income groups.
- Low maternal education was an important factor affecting the prevalence of NTDs among the selected women.

- Consanguinity and prevalence of NTDs were not related to each other.
- The higher incidence of NTDs was reported among first para compared to second and third para of pregnancy which was statistically significant.
- Birth spacing was not found to be significantly associated with prevalence and types of NTDs as revealed by chi-square analysis.
- Majority of the women (51.2%) identified the defect only after 30 weeks of gestation. This type of delayed diagnosis would not help to undertake any preventive strategy but lead to pregnancy wastage and other losses.
- Vomiting, nausea, giddiness, aversion to certain foods and loss of appetite were the most common physiological problems reported by the selected women during their NTD affected pregnancy.
- The most common psychological problems reported by the women during their NTD affected pregnancy included financial problems and maternal concern about the well being of the baby.
- Among the 116 selected women, 26 did not take any supplements either preconceptionally or during their pregnancy. Among those who took the supplements (90 cases) a majority (55.2%) took only from second trimester onwards. This may be the major cause for NTD affected pregnancy.
- Study of outcome of NTD affected pregnancy revealed that a majority of the pregnancies (51.7%) were terminated after identification of defect according to doctor's advice. A majority of the women (41%) delivered their babies during 35-39 weeks of gestation. The findings further revealed that majority of the women (41.4%) spent Rs.3000-5000 as medical expenses for their NTD affected pregnancy. It is also noted that 45.7 per cent of NTD affected infants were still born, 28.4 per cent survived less than a day, 8.6 per cent survived less than a week and 17.3 per cent survived for 2-3 months.

### **C. Impact of counseling selected women aspiring for pregnancy**

- Socio economic profile of 50 selected married women aspiring for pregnancy revealed that majority belonged to 25-30 years of age group, 84 per cent of the women were married between 21-25 years, 62 per cent of the women belonged to joint family type, 54 per cent of the women belonged to middle income group and 62 per cent were graduates involved in sedentary work.
- Among the selected women, 88 per cent were non-vegetarians. Consumption pattern of folic acid rich foods by the selected women revealed that they did not consume these foods on a regular basis, instead they consumed folic acid rich foods once a week, twice a week or once in 15 days.
- Only 20 per cent of the selected women consumed folic acid and multivitamin tablets for a period of three months periconceptionally.
- The food intake of the selected women (10 samples) revealed that, intake of the foods like pulses, vegetables, fruits and milk improved significantly after counseling. However such intake did not meet the recommended dietary allowances except for milk.
- The mean nutrient intake of the selected women showed that the intake of all nutrients had improved after counseling significantly except beta carotene. Further, it is noted that the mean energy intake alone was more than the RDA.
- The mean height of the selected women was lower than the standard height whereas the mean weight was higher than the Indian reference woman's weight of 50 kg and the mean BMI was within the normal range. The classification of the selected women according to their BMI, indicated that eight per cent were in grade I Chronic Energy Deficiency,

14 per cent were in lower weight category and six per cent were in grade I obesity.

- The clinical examination of the selected women indicated that general weakness, frequent cold and pale colour of nails and conjunctiva were the most common signs and symptoms noticed among majority of them.
- Haemoglobin levels of the selected women before counseling showed that 20 per cent were moderately anemic and 30 per cent were mildly anaemic. However after counseling the haemoglobin levels of the selected women improved and it was found that, no one was moderately anaemic. Further the mean haemoglobin levels increased significantly after counseling.
- Twenty per cent of the selected women were in medium risk group of serum folate level (3.0-5.9 ng/ml) before counseling. But after counseling, all the selected women had acceptable levels of serum folate. The mean serum folate level of the selected women had also increased significantly after counseling.
- The counseling of selected women during periconceptional period helped remarkably in raising the levels of haemoglobin and serum folate which might help them to prevent a risky pregnancy.
- There was a positive correlation between iron intake and haemoglobin levels and dietary folate intake and serum folate levels before and after counseling of the selected women.
- The counseling also improved the nutritional knowledge scores of the selected women.

#### **D. Evaluation of the impact of periconceptional supplementation of folate in preventing the recurrence of NTDs**

The impact of periconceptional supplementation of folate in preventing the recurrence of NTDs had been studied with respect to socio economic profile and obstetric history, information regarding current pregnancy, impact of supplementation of serum folate and haemoglobin levels and outcome of pregnancy of the 30 selected women of three experimental groups A, B and C and the findings are summarized as follows:

##### **Socio economic profile and previous obstetric history**

- Majority (20) of the women belonged to the age group of 20-25 years and a majority (17) were married between the ages of 21-25 years. Majority (22) of the women in all the three groups belonged to joint family type and had a family size more than five. Educational status of all the three groups was up to secondary school level among majority (13) of the women. Most of the women (21 and 9) belonged to middle and low income groups respectively.
- More number of women (21) in all the three groups had non-consanguineous marriage.
- Information regarding NTD affected pregnancy of the three experimental groups revealed that more NTDs occurrence was noticed among lower parity and in the age group of less than 20 years and 21-23 years. Among women with second parity, majority (5) of them had spontaneous abortions and had a birth spacing of one year and less than one year.
- The most common type of NTDs in group A and B was anencephaly and in group C it was meningocele.

- Four, three and four women in groups A, B, and C respectively had their delivery after full term and this was due to the late identification of the defect and lack of awareness among the women. The period of survival of the NTD affected infants after delivery revealed that one woman in group B and four in group C survived between 2-7 days and the remaining infants survived only for one day or less than one day.
- The most common physiological problems faced by the mothers included vomiting and nausea, giddiness and loss of appetite. Few mothers in group A and B also reported that they suffered from fever and gestational diabetes. The common psychological problems expressed by the mothers included maternal concern about the well being of the baby, recent adverse events and financial problems.
- Majority (ten) of the women in groups A and B identified the NTDs occurrence and terminated the pregnancy during 20-24 weeks of gestation. But in group C majority (4) of them identified and terminated only after 30 weeks of gestation.
- None of the women in all the three experimental groups took supplements, periconceptionally. After conception, majority (12) of the women in group A and B had the supplements only during second trimester. However in group C majority (5) of the women did not take any supplements. Further majority (6) of the women who took supplements in groups B and C consumed a combination of iron and multivitamin tablets and some women in group A took multivitamin tablets alone.
- Outcome of NTD affected pregnancy among the three experimental groups revealed that majority of them had undergone medical termination and had spent Rs.5000-10,000 as cost of their pregnancy.
- The preponderance of female neonates with NTDs was more likely than males as reported by the study.

- The analysis of biometrics of the NTD affected fetuses of the three experimental groups showed that majority of them had their biometrics below the standard values framed and prescribed by the Mediscan Prenatal Diagnosis and Foetal Therapy Centre, Chennai.

### **Information regarding current pregnancy**

Food consumption pattern, food and nutrient intake, anthropometric measurements and nutritional knowledge of the experimental groups during the current pregnancy were assessed and the findings are summarised.

- Consumption pattern of folic acid rich foods by the experimental groups revealed that among cereals, bajra and jowar were consumed only during summer season. Among pulses, red gram dhal and roasted bengal gram dhal were consumed twice a week and coconut (fresh) and tomato were included daily in different forms. However, chicken and hen's egg were included once a week by the women. Further milk and curds were included daily by all the women.
- The mean food intake of all the food groups was less than the RDA in the three groups both before and after counseling except for pulses, fats and oils and sugar and jaggery. However, significant improvement was noticed in fruits in group A and vegetables in group B and C. Further, the analysis showed that counseling had good impact in improving the intake of folic acid rich foods among all the three groups.
- The mean nutrient intake of the experimental groups revealed that, the intake of all the nutrients increased among all the groups after counseling. Fat intake alone was more than RDA both before and after counseling among all the groups. Further, mean food intake of pulses, fruits and vegetables increased after counseling which in turn improved

the nutrient intake with regard to protein, iron, folate and vitamin C in the diet of the experimental groups.

- Group B women registered a higher mean weight gain during pregnancy followed by women of group A and C . A comparison revealed that, the difference between group A and B was statistically significant at five per cent level.
- BMI grades of experimental groups showed that 90 per cent of group A and 80 per cent of group B women had normal BMI during the periconceptual period. But in group C, 80 per cent of the women were categorised under grade I obesity.
- The counseling had good impact in improving the nutritional knowledge of all the women among the three groups particularly about the recommended intake of folic acid, consequences of folic acid deficiency and importance of folic acid intake.

#### **Impact of periconceptual supplementation of folate and its combinations on the serum folate levels and haemoglobin levels**

- The mean serum folate levels of all the three experimental groups showed better improvement after supplementation. Women of group B (folic acid and multivitamins) had registered higher serum folate levels after supplementation, followed by group A (folic acid) and group C (folic acid and iron). Further, supplementation among the three groups showed statistically significant difference at five per cent level.
- All the women of the three groups with medium and high-risk category of serum folate levels moved to acceptable serum folate levels after the supplementation. This showed the beneficial effect of periconceptual folic acid supplementation in improving the serum folate levels among the experimental groups.

- A comparison of mean serum folate levels of the experimental groups after supplementation revealed that difference in serum folate levels between groups B and C was found to be statistically significant at five per cent level.
- A positive correlation between total folate intake and serum folate levels in all the experimental groups before and after supplementation was observed through correlation analysis.
- It is observed that the mean haemoglobin levels of all the three experimental groups increased after supplementation with folic acid and combinations. Among the three experimental groups, group C had registered better haemoglobin levels, followed by groups B and A.
- The findings also revealed that among the three experimental groups, a considerable movement had been noticed from moderate anemia to mild anemia and mild anemia to acceptable level. This showed the beneficial effect of folic acid supplementation on the haemoglobin levels among all the three groups.
- A comparison of mean haemoglobin levels of experimental groups after supplementation showed significant difference in the haemoglobin levels between groups C and A.
- A positive correlation between iron intake and haemoglobin levels in all the three experimental groups before and after supplementation was also observed through correlation analysis.
- The results of Factor Analysis revealed that among the six socio economic and maternal factors chosen, three socio economic factors, namely family type, family size and educational status were closely associated with serum folate levels among all the three experimental groups before supplementation.

- The foetal biometrics of the experimental groups showed that none of the foetuses of the three groups reported to have abnormal foetal biometrics nor the groups showed any birth defects at 22 weeks of gestation.
- Regarding pregnancy outcome among the experimental groups, it is noticed that all the women in the three experimental groups had healthy pregnancy. Further, a majority (27) of women in all the three groups delivered at 39 weeks and 40 weeks of gestation. Forty per cent in group A, 50 per cent in group B and 30 per cent in group C had normal delivery and the remaining women in the three groups underwent caesarean. It was also noticed that majority of the infants in all the three groups were females.
- The overall anthropometric measurements of infants in all the three groups revealed the successful impact of folic acid supplementation on pregnant mothers and their infants.

## **Conclusion**

The need for micronutrient supplementation in developing countries is likely to be great because of widespread maternal malnutrition. Public health resources, however are limited and it is necessary that priority should be given to interventions that are both efficacious and effective. NTDs are an enigmatic problem that occurs as a result of poor dietary folate intake and low circulating concentrations of folate are one among the reason associated with an increased risk of adverse birth outcome. These necessitate an elaborate study on the effect of counseling and folic acid supplementation on women planning pregnancy and women who had NTD affected pregnancy. It is concluded that the incidence rate of NTDs was 2.74 per 1000 live births in Erode town during the study period and the trend of incidence rate of NTDs was found to increase year after year in all type of NTDs. The study further revealed that higher

incidence of NTDs was seen among first born children. Parity showed a significant association with the prevalence of NTDs. Periconceptional counseling improved blood haemoglobin and serum folate status and the food intake and selection of folic acid rich foods among the women planning pregnancy.

Current evidence showed that counseling and supplementation of folic acid and combinations had reduced the instances of NTDs in Erode town. Further all the selected women had favourable changes with respect to haemoglobin, serum folate level and knowledge scores due to counseling. The supplementation of folic acid and multivitamin showed good impact in improving the serum folate levels followed by folic acid and folic acid plus iron supplementation among the experimental groups. The study revealed that all the women in the three experimental groups delivered healthy children without birth defects and with normal foetal biometrics. The study also indicate the potential benefits of folic acid supplementation on various anthropometric measurements of newborn.

The study confirms the role of periconceptional folic acid supplementation and prevention of recurrence of NTDs in the Indian population. This study would enable appropriate intervention strategies to be developed, implemented and evaluated on prevention of NTDs which will help significantly to reduce the socio economic burden of the family and the country. For this, collaborative and committed effort of Government agencies, health care providers, nutritionists, research institutions and the community are essential. With increasing awareness on the role of periconceptional folic acid and counseling, it is possible that some decline in NTD affected births may be expected during the next decade in our country.

## **Recommendations for future action and research**

From the findings of the study the following recommendations are made for future action and research

- It will be beneficial to collect the data on the prevalence of NTDs from different areas of the country and estimate its trend on a regular basis.
- All women aspiring to become pregnant should necessarily consume a folic acid supplement of 4 mg on a daily basis beginning with two to three months prior to conception until the end of first trimester of pregnancy.
- Premarital counseling clinics should be started, where individuals with high risk of having NTD pregnancies could be screened and those who are found to be at risk could be counseled and managed.
- Obstetricians should educate prospective women regarding the risk of NTD affected pregnancies using print media and posters and create awareness among women about the need for folic acid.
- The Government should implement and the media should take part in mass campaigns against NTDs and educate on the importance of folic acid for all the women of reproductive age. Further the Government should make adequate arrangements to make folic acid supplements available in all health centers at nominal cost.
- Majority of the women are poorly informed on the beneficial effects of folic acid since most of the pregnancies are unplanned. Hence an alternative approach for universal fortification of a staple food with folic acid is the need of the hour. For this, the Government agencies, health care providers, nutritionists, research institutions and industrialists

should come forward and extend their full support for fortification programme.

- Ministry of Health, Government of India should plan a comprehensive strategy for the prevention of NTDs without delay.
- Nutritionists and research institutions can come forward to carry out studies on the various aspects of NTD affected pregnancies, effects of supplementation, education and evaluation of fortification of suitable foods. The outcome of the findings may be very valuable in the future efforts to prevent NTD affected pregnancies.