SUMMARY

For assessing the prevalence of Zinc and vitamin A deficiency 500 pregnant women were examined. General information regarding family type, Economic status, age as well as educational status, and smoking habits of selected deficient subjects were recorded on self structured and Pre-tested questionnaire. Reproductive history including age at marriage, age at first child birth, period of menstrual cycle, bleeding during conception period as well as miscarriage, no. of infant death, term of previous delivery, birth weight of previous babies and teratogenicity was also recorded. Clinical symptoms were recorded with the help of medical officer.

Out of 500 pregnant women 100 zinc and vitamin A both deficient subjects were selected for supplement feeding trials. These 100 zinc and vitamin A deficient pregnant women were classified into four groups i.e. zinc syrup (group I), β-Carotene rich food supplement (group II), zinc syrup + β-carotene rich food (group III) and control group (IV) to whom no supplementation has been given. Per day consumption of zinc syrup (zinconea) was 2.5 ml. Zinc was present in the form of zinc Gluconate (non-toxic during pregnancy) and having 7.5 mg (50% of the RDA) elemental zinc. 1200 μg (50% of the RDA), β-carotene was fed in the form of Amaranth biscuits (2.8 g powdered amaranth). Total 4-5 (50-55g) sweet and salty Biscuits were given to group II and group III daily.

Each experimental group was having 25 subjects. Three supplements were fed for the period of around six months (from IInd
trimester till delivery). The weight of each subject was recorded before as well as after completion of the experimental trial. Weight gain, nutrient intake, serum zinc and serum retinol were measured before and at the end of supplementation trial (with in 24 hours after delivery).

In addition type of delivery (Normal or Caesarean), term of delivery (Normal, Preterm and Postterm) as well as newborn's Gestational age, birth weight, chest circumference, Head circumference, and length were recorded. Furthermore Infant's immune responses (Diarrheal and cough episodes) were also recorded under the period of three months.

Zinc deficiency was largely prevalent among the pregnant women during their second trimester of pregnancy. Out of the total 500 pregnant women, 328 (65.6%) were found zinc deficient (serum zinc level below 70μg/dl) and 122 (24.5%) pregnant women were suffered from vitamin A deficiency (serum retinol level below 20 μg/dl).

Among 500 pregnant women majority (44.6%) of the subjects were only zinc deficient and only 3.4 per cent subjects were only vitamin A deficient. Twenty one per cent (105) subjects were deficient in both the nutrient (zinc and vitamin A) and were selected for supplementation trial.

The maximum subjects (38%) were uneducated and minimum (7%) were only metric. Majority of subjects (50%) had monthly family income with in the range of Rs. 2000-4000 while minimum 22 per cent subjects had monthly income with in the range of Rs. 4100-6000. All the selected subjects were married and majority (70%) of them were living in Joint families where as 30 per cent respondents were living in nuclear families. Half of subjects (50%) were having medium family
size and only 20 per cent subjects were having large family size. Among all the subjects only 2 percent subjects were having smoking habit and preferred bidi smoking.

The pregnant mothers who got married at early age (between 15-18 years) were 53 per cent and who got married at the age of 19-20 years, were 38 per cent. Only 9 per cent of the subjects got married at the age of 22-25 years. About more than half of the respondents (55%) were at the age of 19-22 years, when they had first delivery and only 9 percent subject became mother at the age between 23-25 years. Majority (69%) of the subjects were having normal menstrual period (3-4 years). At the starting of pregnancy 97 per cent of the subjects did not have any kind of bleeding. Majority (40%) of the subjects were conceiving second time where as only 2 per cent subjects were conceived fifth time.

Most of the subjects (43%) were having only one child, Followed by 37 per cent and 19 per cent, having no child and two children respectively. Maximum (80%) subjects did not have any miscarriage. Ninety eight per cent of the subjects were having no infant death and only 2 per cent subjects were having 1 infant death. Out of 86 subjects 77.9 per cent were having hospital delivery and 22 per cent were delivered at home. Majority (83.7%) of the subjects were delivered full term babies followed by 13.9 per cent pre-term and 2.3 per cent post-term.

Out of the 86 pervious total births maximum (59.34%) were normal weight babies and 40.6 per cent were low birth weight (LBW) babies. Maximum (96.5%) subjects were delivered normal baby and only 3.4 per cent subjects delivered teratogenic babies (having
congenital malformation).

The most common symptoms were mental lathery, Anorexia and behavioral disturbances present in 86 per cent, 85 per cent and 84 per cent of the pregnant women respectively. Among all the studied vitamin A and Zinc deficient subjects about half (61%) were showing roughness of skin there by indicating that they were suffering from zinc and vitamin A deficiency. Skin Pigmentation was very clearly seen in 36 percent of the respondents where as small percentage (1%) was showing the symptoms of phrynoderma and clouding of cornea. Symptom of hypogeurea was also very clear which was present in 30 per cent of the subjects. Pre-eclampsia and skin Lesions were noticed in 8 per cent and 6 per cent of the subjects respectively.

Impaired wound healing, low smell sensitivity and night blindness were present in 5 per cent, 3 per cent and 2 per cent of the respondents respectively.

Most of the subjects (78%) were vegetarian followed by 20 per cent ovatarian and 2 per cent non vegetarian. Majority of the subjects (73%, 48%, 42%) were consumed less than 50 per cent to zinc, vitamin A and Energy RDA respectively, which indicates on overall poor intake.

Maximum subjects (44%) had height between 151-155 cm and weight (40%) between 35-40 kg. Out of total subjects maximum subjects were having BMI >18.5 i.e. Underweight category and minimum subjects were having BMI between the range of 18.5-22.9 i.e. is normal. Among all the selected subjects no one was found in obese category.

Before commencing the feeding trial, the average zinc intake in
subjects of group I, group II and group III were close to each other and respective values were 7.15+1.71, 7.34+1.70 and 6.58+1.09 mg/day. After completion of feeding trial, the mean zinc intake increased to 14.66+1.71, 7.34+ 1.70 and 14.08+ 1.9 mg/day in group I, Group II and Group III respectively. The observed increase of Zinc intake with in subjects of group I (zinc supplemented) and III (zinc + β carotene supplemented) were significant and group II (β carotene supplemented) and group IV (control) were non significant after completion of feeding trial.

The Mean vitamin A intake before starting the feeding trial of group I, group II and group III were 334.16± 63.76, 333.00±78.23 and 340.36±82.97 μg/day respectively. The Mean vitamin A intake of group I was reduced to 333.52± 74.04 μg /day, where as the mean vitamin A intake of group II and group III was increased to 637.32±79.82 and 652.16±76.91 μg/day respectively. After completion of feeding trail, there was a non-significant difference in mean vitamin A intake of subjects with in group I (zinc supplemented) and group IV (control) where as significant difference was found in group II (β carotene supplemented) and group III (zinc + β carotene supplemented).

Mean serum zinc levels of the Subjects were ranging 55.91±8.55, 52.92±6.73 and 55.81±9.58 μg/dl in group I, group II and group III respectively. In these respective groups the values of serum zinc increased to 64.12±6.25, 53.18±5.45, 68.32±6.84 μg/dl, after completion of feeding trial. Maximum per cent (24.73%) increased was observed in group III (Zinc+ β-carotene supplemented), followed by group I (16.0%) and group II (.93%). A Significant increased in serum zinc was observed in group I, group II and group III. However, non
significant change was noticed in the subjects of control group to whom no supplementation was fed.

Before starting the Supplementation trial the mean serum retinol of the subjects of group I, group II, group III and group IV were 15.73±1.87, 16.18±1.51 and 16.30±2.13 and 16.25±2.06 μg/dl respectively. After feeding different supplements in respective groups mean values of serum retinol were increased to 16.43±1.28, 19.86±1.40 and 23.48±2.94 μg/day and decreased to 15.00±2.22 μg/day in control group. After completion of supplementation trial, there was a significant difference in mean serum retinol levels of subjects within group I, group II and group III, where as non-significant difference was found in control group, to whom no supplementation was given.

Mean Gain in weight of all selected pregnant women from the enrolment till the end of supplementation trial of group I, group II, group III and group IV were 9.90±45, 10.00±44, 10.87±67, 9.25±68 kg respectively. Significant observation was found in gain in weight among all the groups. Maximum gain in weight was found in zinc+ β-carotene supplemented group (III).

In group I, group II, group III and group IV, the mean gestational age of newborn were 38.61±1.24, 38.29±1.08, 39.53 and 37.22±1.80 weeks respectively. Significant (P<.01) variations of Gestational age of newborn were found among the respective groups.

Mean Birth weight of newborn in group I, group II and group III and control group were 2.62+.17, 2.60+.19, 2.74+.16 and 2.38 + .16 Kg respectively. Significant (p<.01) variation was observed among all the groups. Maximum (60%) Low birth weight babies (LBW) were found in control group, to whom no supplementation was fed. Where as
minimum (4%) LBW babies were found in Zinc+β-carotene supplemented group.

In group I, group II, group III and in group IV, the mean chest circumference of newborns were 34.81±1.01, 34.78±1.09, 35.03±.59 and 33.03±.59 and 33.27±1.93 cm respectively. There was a significant variation (p<.01) of chest circumference among all the groups. No baby was found low Chest circumference in Zinc and β-carotene supplement fed group, where as maximum (36%) low chest circumference was present in control group, to whom no supplementation was given.

Among the newborn of group I, group II, group III and control group, the mean head circumference were 33.92+.94, 33.64+1.18, 34.62+.84 and 32.68+1.12 cm respectively. There was significant difference (P<.01) among all the four groups (Anova). Highest percentage (92%) of low head circumference (LHC) was present in control group and minimum (24.0%) was present in group III, to whom Zinc + β-carotene supplements were given.

Mean length of newborn in group I, group II, group III and group IV were 47.64+2.03, 47.32+1.95, 48.78+1.74 and 44.52+1.94 cm respectively. Significant difference was observed among all the groups [P<.01 (Anova)] Maximum normal length newborns were present in zinc and β-carotene supplement fed group and no baby was found normal length in control group, to whom no supplementation was given.

Maximum (72.2%) pre-term deliveries were present among the subjects of Control group, whom no supplementation was provided where as minimum (5.6%) was found in group III, which was zinc and β-carotene supplement fed group. Significant difference of term of
delivery was observed among all the groups.

Highest percentage (48.8%) of caesarean delivery was found in group IV (control) and lowest (4%) was present in group III (zinc + β carotene supplemented). Maximum (96%) normal deliveries were present in group III (zinc + β carotene supplemented) and minimum (56%) were found in group IV, to whom no supplementation was provided.

Incidences of diarrhea and cough were recorded in infants of selected subjects under three months observations. Maximum episodes (24% and 16%) of diarrhea and cough were found in the infants of group IV (control), and minimum (84% and 88%) were found in zinc and β-carotene supplemented group.

Per cent change of serum zinc was positively correlated with the per cent change in serum retinol (P=.754), birth weight (P=.379) length (P=.200) and gestational age (P=.372) of newborn. Furthermore, percent change in serum retinol was also positively correlated with the percent change of serum zinc (p=.754), birth weight (P=.288) head circumference (P=.248), chest circumference (P=.273), length (P=.274) and gestational age (P=.237) of newborn.

Relative risk of different adverse pregnancy and newborn outcomes i.e. caesarean delivery, preterm delivery, low birth weight (LBW), low head circumference and low chest circumference were 1.78 (1.23-2.56 CI), 2.09 (1.34-3.25), 2.40 (1.47-3.90) 9.50 (2.46-36.55) and 1.54 (1.14-2.07 CI) respectively. Significant difference (P=.001, .001, .000, .001 and .004) of respective outcome was observed between zinc and β-carotene supplemented group and control group.

Among locally grown and consumed foods, concentration of zinc
ranged from 0.5mg/100g (refined wheat flour) to 3.55 mg/100g (Bengal gram). Mean zinc content was highest in legumes (2.75±.625mg/100g) followed by in cereals (1.37±.560mg/100g) and vegetables (0.25±.101mg/100g) and lowest in fruits (0.23±.212mg/100g). The maximum and minimum zinc content among locally consumed but not grown foods was found in gingelly seeds (6.04mg/100g) and cumin seeds (1.92mg/100g). The variations in zinc content in food of present study in comparison to the values given by Gopalan et al. (1971) might have been attributed to the fact that the zinc content of plants is directly related to the amount of zinc in the soil where they cultivate, and therefore zinc content is affected by geographic origin (Carmen et al, 2003).

Among all the studied food samples maximum β-carotene was found in coriander leaves (6922±1.00 µg/100g) and minimum in rice (9.00±1.00 µg/100g). Variations in β-carotene content in foods of the present study in comparison to the values given by Gopalan et al., (1971) might have been attributed to the factors such as difference in variety of samples, climate conditions, fertility of soil and maturity of vegetables.

**CONCLUSION AND SUGGESTIONS**

During pregnancy, 21 (105) per cent women were found deficient in zinc as well as in Vitamin A. Among these subjects 100 were selected for the trial. Out of the total 500 studied pregnant women only 31 percent pregnant women were found normal, making the individual prevalence of zinc and vitamin A deficiency 65.6 and 24.5 per cent during II trimester of pregnancy.

Increased in serum zinc and retinol values in all experimental
group of zinc and vitamin A deficient subjects were measured after supplementing various supplements i.e. zinc syrup and β-carotene rich food supplements. On feeding all the supplements separately favoured improvement in above blood parameters and overcoming zinc and vitamin A deficiency during pregnancy but maximum increased in above parameters were found in the subjects, supplemented with β-carotene supplements along with zinc when compared to β-carotene and zinc alone.

Beneficial effect of supplementation of zinc and β-carotene was observed in all the pregnancy (term and type of delivery), newborn (birth weight, head circumference, chest circumference length and gestational age) and infant (diarrheal and cough episodes) outcomes. Maximum positive effect was found in zinc+β-carotene supplementation with in combination in comparison to zinc and β-carotene supplementation alone.

Positive co-relation was observed among percent change in serum zinc and retinol on birth weight, head circumference, chest circumference length and Gestational age of newborn. Maximum risk of all adverse pregnancy (Preterm and caesarean delivery) and newborn (low birth weight, low head circumference and low chest circumference) outcomes was present in control group to whom no supplementation was given.

Zinc content in commonly consumed and grown foods and in commonly but not grown foods were found less than the values given by NIN but β-carotene content in studied foods was found nearby the values given by NIN.

Thus this can be concluded that Vitamin A deficiency with a
serum retinol <20 µg/dl and zinc deficiency with a serum zinc <70 µg/dl appear to be an important problem in pregnancy, particularly in communities of low socio-economic status, significantly associated with preterm and caesarean delivery, low birth weight, low head circumference, low chest circumference and low length of new born and susceptibility to infections. Their effect on length of the baby needs further study.

In the end, this is further concluded that to reduce zinc and vitamin A deficiency during pregnancy, zinc supplementation along with vitamin A in the form of β-carotene can be a better approach due to the reason that vitamin A is teratogenic in pregnancy. Zinc is essential for the metabolism of vitamin A and vice versa. Formation of retinol binding protein (RBP) is zinc dependent. Further researches are still required to find out the mechanism by which vitamin A improves the zinc status. Effect of β-carotene supplementation on pregnancy outcomes is also a wide area of Research.

This study further suggests that zinc and β-carotene supplements may improve preterm and caesarean delivery, low birth weight, low head circumference, low chest circumference, low length and diarrheal and cough episodes.

Although, these findings need to be confirmed in further studies with larger sample size and optimal micronutrient could be encouraged.