# MATERNAL AND CORD PLASMA ZINC AND THEIR RELATIONSHIP WITH BIRTH WEIGHT

DILJOT MALHOTRA • G. I. DHALL • R. NATH

SUMMARY

**The objective of the study was to estimate maternal and cord plasma zinc in women without any obstetric or medical complication and correlate it with the birth weight. Maternal and cord plasma zinc was determined in fifty uncomplicated primigravidae after 37 completed weeks of gestation. Fifteen non pregnant women served as controls. The maternal zinc level (74.22 ± 22.03 $\mu g/dl$) was 28 percent lower than in non pregnant controls (103.7 ± 13.45 $\mu g/dl$), whereas cord plasma zinc level (143.94 ± 28.27 $\mu g/dl$) was 48 percent higher than maternal zinc value. There was an inverse correlation between maternal plasma zinc and birth weight of the newborn (4 = -0.32; p = 0.02). No such correlation was observed with cord plasma zinc levels (r = 0.21, p = 0.090. Further studies need to be done to determine whether this inverse correlation between maternal plasma zinc and birth weight is a cause-effect relationship or both are the outcome of another phenomenon. Maternal plasma zinc alone is not a reliable predictor of foetal growth in utero (r-square = 0.09).**

## *INTRODUCTION*

Impaired foetal growth is a complex problem for the obstetrician. Although, there is an exhaustive list of causes of intrauterine growth retardation, yet the 'idiopathic' group forms a large category. This group continues to be a dilemma especially in the developing world, where majority of the cases of intrauterine growth retardation are thought to be idiopathic (Lechtig et al, 1977).

The role of zinc as an essential element in humans was documented in 1961 (Prasad et al, 1971), but in recent times there has been a renewed interest in the role of zinc in the field of obstetrics. Anaemia, growth retardation, congenital malformations, prematurity and abnormalities of labour have associated with zinc deficiency (Jameson, 1976).

We, therefore, decided to determine if zinc has any role to play in foetal growth

*Dept. of Obst. & Gynec. & Biochem. R. G. I. M. E. R., Chandigarh.*

*Accepted for Publication on 20.10.1993.*

bnormality in this population. The aim of he present investigation was to find out aternal and foetal plasma zinc levels and orrelate the same to the foetal birth weight.

## ATERIAL AND METHODS

Fifty primigravida who were non-smokers, etween the ages of 18 and 30 and in whom naemia, multifoetal pregnancy, diabetes ellitus, renal disease, hypertension, hepatic isease, heart disease and antepartum aemorrhage were excluded by history, xamination and relevant investigations ere included in the study group. They ere recruited from the antenatal clinic of ehru Hospital of The Postgraduate nstitute of Medical Education and Research, tertiary care centre in Northern India.

The background data of all the subjects as recorded. At the first contact, a dietary ssessment was made by a 24 hour recall ethod (Eaton et al, 1984). The subjects were belled as vegetarian if the consumption of eat products was less than once a fortnight. hey were classified into various socio-eco- omic strata on the basis of occupation, in- ome and education (Kuppuswamy, 1962). one of the subjects was taking any zinc ontaining supplement. Five ml maternal eripheral venous blood sample was obtained fter 37 completed weeks of gestation etween 9-11 am. No patient was fasting at e time of sampling. Samples were collected heparinized metal free polystyrene tubes hich were centrifuged immediately at 1000 m. The separated plasma was stored in apped, metal free polystyrene tubes at -20°C. he patients were followed up till they elivered in hospital, when five ml of cord ood was collected in heparinized tubes dealt with similarly. The newborns were eighed naked immediately after birth to the arest 100 g on an infant weighing scale. he same balance was used for all wborns. Fifteen non-pregnant healthy women of North Indian origin served as controls.

Zinc was estimated by atomic absorption spectrophotometer (Perkin Elmer model 4000). The plasma samples were allowed to come to room temperature and then a known quantity of samples was diluted with double distilled water immediately before estimation. The instrumental gas flow setting and aspiration rate were adjusted. The estimation was made by direct aspiration into the flame. The zinc standards were prepared in glycerol water (5/95 by volume) (Smith and Butrimontz, 1979). The baseline readings were taken before and after each sample and it was reset as required.

Pearson's Product Moment Correlation Test was used to evaluate the relationship between various parameters. The means of two groups were compared by unpaired t-test.

## RESULTS

The mean age and height of the subjects was 23.3 years (19-28 years) and 152 cm (140-161.25 cm) respectively. All subjects were vegetarian. Nine patients belonged to class I (upper), thirty one to class II (upper middle), eight to class III (lower middle) and only two belonged to class IV (lower). Eleven patients were from a rural background and thirtyone from urban background.

All patients were receiving 60 mg of elemental iron and 50 ug of folic acid daily. The average daily intake was 2050 Calories. The mean dietary zinc intake was 9.5 mg/day. This was calculated from the zinc concentration estimated in various food materials in this part of the country (Nath, 1989).

All patients had a vaginal delivery, seventeen of whom required forceps assistance. The mean gestationage at delivery was 38 weeks and 6 days (37 to 40 weeks and 6 days). The birth weight of the newborns ranged between 2260 and 3800 g (Mean 2963 ± 332 g). This weight conforms to the mean birth weight at this gestation at our institute. The mean birth weight of male (3011 ± 220 g) and female (28.93 ± 316 g) babies was not statistically different. Twenty five newborns were male and twenty five were female.

The mean values of plasma zinc are presented in Table I. A strong inverse correlation was obtained between maternal plasma zinc and the birth weight of the newborn (r = 0.32, P = 0.02) (Fig. 1). Interestingly, a positive correlation was observed between cord plasma zinc and the birth weight (r = 0.21, P = 0.096), though it was not statistically significant. There was no correlation between cord and maternal plasma zinc levels (P = 0.26).

The level of zinc was not significantly different in women giving birth to male or female babies (73.97 µg/dl 75.46 µg/dl, respectively). Similarly, the mean cord plasma zinc in male (120.82 µg/dl and female (113.07 µg/dl) newborns showed no significant difference.

**Table I**

**Zinc levels in plasma**

| Source | n | mean (µg/dl) | S. D. |
|---|---|---|---|
| Non-pregnant | 15 | 103.7 | 13.45 |
| Maternal* | 50 | 74.22 | 22.03 |
| Cord** | 50 | 143.94 | 28.27 |

* Maternal vs non pregnant P value : < 0.0001

** Maternal vs cord P value < 0.0001

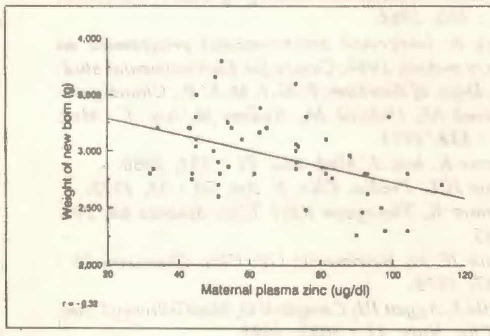


**Fig. 1 : Scatter graph showing regression of Maternal zinc over birth weight.**

## *DISCUSSION*

Our study group included women from all socio-economic classes, but the dietary intake of zinc was not significantly different in any group because meat products, which are a rich source of zinc were uniformly deficient in the diet of all women. The average daily zinc intake of our patients (9.5 mg) is lower than the recommended daily allowance (20 mg) (Recommended daily allowances, 1973). This may be attributed to the fact that we used recall method which is known to underestimate the intake (Eaton et al, 1984). Moreover, it has been pointed out that recommended daily allowance may be overstimated and merits further consideration (Tuttle et al, 1985).

The mean daily intake of 2050 Calories was also lower than the recommended daily allowance of 2550 Calories (Nutritional requirements, 1974). Similar lower intake has been found in an ongoing survey being carried out by our institute in this region.

The literature is replete, though conflicting about reports of associations between maternal blood zinc levels and birth weight of the offspring (Prema, 1980, Metcoff et al, 1981, Mukherjee et al, 1984, Simmer and Thompson, 1985, Tuttle et al, 1985). A negative correlation between midpregnancy maternal blood zinc levels and birth weight ras observed in two studies (Metcoff et al, 981, Mukherjee et al, 1983). As 70% of the oetal zinc stores are accumulated in the regnancy (Shaw, 1973) and most of the in-rease in foetal size occurs during this eriod, maternal zinc level at midpregnancy not likely to be a true indicator of total inc assimilated by the foetus.

In a study from India, higher maternal erum zinc levels were observed in babies reighing less than 2 kg (Prema, 1980). The uthors have not offered any possible expla-ation for this phenomenon. Moreover, as ney included both preterm and growth re-rded fetuses, this inverse correlation loses s relevance. In the present study, we have ncluded only uncomplicated full term regnancies. Thus, the subjects belong to a niform group and this inverse correlation ound by us is likely to be valid.

An explanation for this inverse corre-ation observed in the present study is n order. It seems odd that maternal plasma inc should be inversely proportional to he birth weight. Zinc is an essential race element which is required for nucleic cid and protein synthesis and human equirements for zinc increase during regnancy. Zinc plays a vital role in growth nd development before and after birth. o, zinc cannot be a causative agent in he genesis of foetal growth retardation.

Metcoff's (1981) explanation that the apid uptake of zinc by the foetus is esponsible for the lower maternal plasma inc levels seems untenable as given reason-ble zinc intake, there should be enough ody stores to maintain adequate blood vels even in the presence of increased emand. An alternative and more likely ex-anation would be that the higher maternal asma zinc levels and low birth weight are effect of another, hitherto unknown triggering mechanism which in addition to somehow affecting the growth of the foetus, also increases the maternal plasma zinc levels. Placental transfer of zinc is an active process. It is possible that some defect in placental transfer may produce two mutually unrelated effects - growth retardation and reduced placental transfer of zinc, thus resulting in higher maternal plasma zinc levels.

In conclusion, although, the relationship between maternal plasma zinc and birth weight is statistically significant, this should be taken only as an association and not as a cause and effect relationship. An R-square of only 0.09 in the above correlation means that there are many other factors affecting birth weight and maternal plasma zinc alone cannot be utilised as an indicator for predicting the foetal growth in utero.

## *REFERENCES*


1. *Eaton PM, Wharton PA, Wharton BA, J. Nutr. 52 : 457, 1984.*
2. *Handbook on Nutritional Requirements, 1974, Geneva, WHO.*
3. *Jameson S. Acta. Med. Scand. (Suppl) 593 : 21, 1976.*
4. *Kuppuswamy B. Manual of socio-economic scale (urban), 1962, New Delhi, Manasayan.*
5. *Lechtig A, Margen S, Farrel T, Delgado H, Yarbrough C, Martorell R, Klein RE : In : Perinatal Care Developing Countries, 1977, p 17, Uppsala, WHO.*
6. *Metcoff J, Costiloe JP, Crosby W. Am. J. Clin. Nutr. 32 : 856, 1981.*
7. *Mukherjee MD, Sandstead HH, Ratnaparkhi MV, Johnson LK, Milne DB, Stelling HP. Am. J. Clin. Nutr. 40 : 496, 1984.*
8. *Nath R. Integrated environmental programme on heavy metals, 1989, Centre for Environmental studies, Dept. of Biochem, P. G. I. M. E. R., Chandigarh.*
9. *Prasad AS, Halsted JA, Nadimi M. Am. J. Med. 31 : 532, 1971.*
10. *Prema K. Ind. J. Med. Res. 71 : 554, 1980.*
11. *Shaw JCL. Predia. Clin. N. Am. 20 : 33, 1973.*
12. *Simmer K, Thompson RPH. Clin. Science 68, 395, 1985.*
13. *Smith JC Jr, Butrimovitz GP. Clin. Chemistry 25 : 1487, 1979.*
14. *Tuttle S, Aggett PJ, Campbell D, MacGillivray I. Am. J. Clin. Nutr. 41 : 1032, 1985.*