Zinc deficiency in pregnant female albino rats may adversely affect birth weight of litters

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Abstract

Zinc deficiency during pregnancy may cause intra-uterine growth retardation in rats.

The present study was carried out in albino rats to substantiate the reports on zinc deficiency - effects. Female albino rats were divided into two groups of pregnant and non-pregnant rats. Pregnant rats were further divided into zinc treated (n=10) and control (n=10) groups. Blood samples were withdrawn on the day of conception and on the day of delivery from pregnant rats and on day 21 from non-pregnant rats.

Serum zinc levels were estimated by G.B.C. 902 double beam atomic absorption spectrophotometer. Data was analysed by Student's 't' test.

Following zinc therapy, serum zinc levels increased significantly ($p<0.001$). The mean birthweight of litters in zinc- treated dams was significantly higher than that in zinc-untreated control dams ($p<0.001$).

Zinc deficiency was responsible for a low birthweight in albino rats, and zinc supplementation improved birthweight in newborns.

Keywords: Zinc; birthweight; albino rats; litters.

Introduction

Zinc is a trace element, which was found to be essential for the growth of micro-organisms about a hundred years ago. Zinc was shown to be essential for the growth and well being of rats.[1] Zinc was shown to be essential for the growth of chicken, and its deficiency in hens
caused malformation of embryhos.[2] Zinc is a constituent of a number of metalloenzymes, and is required for both, RNA and DNA synthesis.[3] During pregnancy, there is a physiological decline in plasma zinc.[4] Low plasma zinc levels during pregnancy have been found to be associated with increased maternal morbidity, and increased risks to the foetus. Zinc deficiency during pregnancy may cause altered taste and smell, hypertension, breakthrough bleeding, prolongation of labour, and premature delivery. Zinc deficiency has been found to lead to abortions and premature delivery in guinea pigs.[6] Zinc deficiency may cause congenital malformations and intra-uterine growth retardation (IUGR) in
rats as well as human beings.[7,8] The present study was carried out to validate these reports.

Materials and methods

Forty adult virgin female albino rats weighing between 100-200g were divided into two groups of twenty rats each. Female albino rats of the second group when in normal oestrous cycle were mated with male albino rats overnight. The normal oestrous cycle was judged clinically by increased running activity, quivering of ears and lordosis in the presence of male rat. This was confirmed by microscopic examination of the vaginal smear under low power, by the presence of 100% cornified epithelium. Successful mating was confirmed by the presence of sperm plugs and sperm in vaginal smears.

Preparation of vaginal smear

Sterilized cotton swab made of tooth pick was moistened with normal saline, gently inserted and slightly rotated within the vagina. The swab was then pressed in a drop of saline on a microscopic slide and examined under low power.

The day after the night mating was considered day 0 of gestation. The pregnant female albino rats were then further divided into two subgroups - control and zinc-treated

Non pregnant female albino rats (n=20) -
Zinc-treated (n=10) and Control (n=10)
Pregnant female albino rats (n=20) --
Zinc-treated (n=10) and Control (n=10)

All the rats were kept under identical environmental conditions, and were given similar standard pallet diet. Zinc treatment was given by providing drinking water ad libitum, containing 25 mg of zinc per litre. Samples of blood were withdrawn from the control rats as well as zinc-treated rats before administration of zinc on day 0 of study. The second set of blood samples were withdrawn on the day of delivery from pregnant rats, and on day 21 from non-pregnant rats. In case of death of any rat, or heamolysis of blood samples, the rats were replaced, to keep the number of rats in each group at 20. Blood samples were collected according to Singhal *et al* [9] in sterilised plastic vials, and centrifuged at 4000 rpm for 10 min. Serum was separated. Serum zinc levels were estimated by GBC 902 double beam atomic absorption spectrophotometer. Litters born to pregnant dams were carefully weighed separately, and examined for evidence of congenital malformations. Statistical analysis of data was done by Student's 't' test.

Results

Pre-treatment serum zinc levels in non-pregnant albino rats were similar on day 0.

No significant changes in serum zinc were observed in non-pregnant albino rats on days 0 and 21. Following zinc therapy, serum zinc levels increased significantly, both in non-pregnant as well as pregnant albino rats, to similar levels ($p<0.001$). The mean birthweight of litters
in zinc-treated dams was significantly higher than that in zinc-treated control dams ($p<0.001$).

Table I: Relationship between serum zinc (ug/dl) in non-pregnant and pregnant albino rats and birthweight of litters (g).

(Data are $\pm$ s.e.m.)

Groups	*S. zinc (day 0)*	*S. zinc (day 21/post delivery)*	*Birth weight of litters*
Non-pregnant (I) (control) (n=10)	98.28 $\pm$ 6.28	98.45 $\pm$ 5.43	–
Non-pregnant (II) (zinc treated) (n=10)	97.65 $\pm$ 5.48	283.48 $\pm$ 12.36*a	–
Pregnant (III) (control) (n=10)	94.15 $\pm$ 4.36	72.75 $\pm$ 4.76a	5.13 $\pm$ 0.36 (n=42)
Pregnant (IV) (zinc treated) (n=10)	88.54 $\pm$ 9.25	272.69 $\pm$ 10.18*a	6.85 $\pm$ 0.27** (n=54)

* $p<0.001$ vs (I) and (III)

** $p<0.001$ vs (III)

a $p<0.001$ vs day 0

Discussion

In the present study, a decline in serum zinc levels was seen during pregnancy in female albino rats.

Zinc deficiency in rats during pregnancy was because of increased maternal and foetal demand, and reduced food intake, which is particularly severe just before delivery.[10] Following zinc therapy, serum zinc levels increased significantly. The mean birthweight of litters born to zinctreated dams was significantly higher as compared to those born to untreated control dams. There was useful store of zinc in pregnant female rats fed on zinc adequate diet. Rats fed on zinc deficient diet were able to increase placental zinc transfer, which was not adequate to maintain individual foetal zinc levels at an optimum value.[10] In one study, birthweight and plasma zinc of Rhesus monkeys were negatively correlated in zinc deficient mothers.[11]

It can thus be concluded that zinc deficiency was the factor responsible for a lowbirth weight in albino rats, and zinc therapy improved birthweight in newborn. Serum zinc levels are thus related to pregnancy outcome in albino rats.

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