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Original article

Correlation between Zinc and Copper level of Pregnant Mother with birth weight of Neonate.

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Abstract:

Background: Micronutrient deficiency especially deficiency of zinc and copper during pregnancy strongly affect fetal growth as well as length of gestation. Low maternal plasma zinc and copper concentration may have some role in causing LBW and Preterm delivery. Objectives: To measure serum zinc and copper level in preterm delivery mother and their respective neonates to observe their relationship with low birth weight. Method: This cross sectional study was carried out in the Department of Physiology, Sir Salimullah Medical College Mitford Hospital, Dhaka, during the period of 1st January 2009 to 31st December 2009. A total number of 108 subjects were included in this study, and were divided into control group (n=54), sub-divided into normal fullterm mother(n=27) and their respective neonates(n=27). Another 54 were preterm group, considered as study group, were subdivided into preterm mothers(n=27) and their respective neonates (n=27). Age ranged of preterm and full term mother were between 20-40 years. All the subjects belonged to lower socioeconomic status. Serum zinc and copper level was estimated by spectrophotometric method, to observe its level in these groups of study subjects. Again, anthropometric data of the preterm and full term mother and birth weight of their respective neonates were measure to observe their nutritional status. Correlation of maternal serum zinc and copper concentration with that of neonatal blood and also with birth weight of the neonates were done to observe their relationship. Statistical analysis was done by using appropriate method as applicable. Results: Low maternal serum Zn and Cu level was positively correlated with preterm delivery and low birth weight of neonates. Conclusions: Hypozincemia and hypocupremia may be responsible for low birth weight in relation with preterm delivery.

Key Words: Zinc, Copper, Preterm , Low birth weight

Introduction:

A fetus is considered viable when it has reached a gestational age of 23-24 weeks and a weight of 600 gm or more. Micronutrient deficiency especially deficiency of zinc and copper during pregnancy strongly affect fetal growth as well as length of gestation[1]. Adequate maternal Zn and Cu are essential for normal embryogenesis. Pregnant women are at higher risk of acquired Zn and Cu deficiency because of high uptake of Zn and Cu by the fetus and associated tissue[2]. In developing countries Zn and Cu deficiency causing greater risk of producing LBW (<2500 gm). LBW represents two outcome- preterm birth and small for gestational age (SGA) [3]. An infant born before 37 weeks of gestation can be small for gestational age.[4]. 70-80% cases of LBW are due to intrauterine growth retardation. Infant born with IUGR have higher mortality rates and are at higher risk of growth retardation, poor cognitive development, increase morbidity and impaired immunity later in life [5,6,7]

The mothers nutrition from the moment of conception is an important factor in the development of the infants metabolic pathway and future well being.[2]. IUGR occurs due to changes in maternal nutritional status. Neonatal outcome in LBW infants in Bangladesh suggest that preterm delivery, associated with neonatal death[3]. Furthermore, different studies demonstrated that maternal micronutrient deficiency especially deficiency of zinc and copper may be responsible for the increased incidence and outcome of low birth weight infants[8,9]. Moreover, low birth weight is an important determinant of infant morbidity and mortality [10]. It is suggested that neonatal mortality is significantly higher in babies who born before 34 weeks (30.4%) as compared to that in babies who born after 34 weeks(3.4%)[11]

Prolonged nutritional deprivation of the fetus may cause intrauterine growth restriction and initiation of preterm labor. Micronutrients Zn and cu deficiency causes structural and biochemical abnormalities that contributed to intrauterine growth retardation and malformed fetal outcome. Some study has been done regarding this matter in abroad[12]. But no published data is available in our country on this aspect. For this, the present study was aimed at to observe serum Zn and Cu status in pregnant mother and to observe their relationship with low birth weight infant as the underlying cause of preterm delivery in our country. The output of the study may be helpful to create awareness about the low birth weight neonates and to take appropriate measure for the improvement of pregnancy outcome by observing serum Zn and Cu status of pregnant women to prevent the risk of complication in pregnancy. Moreover, it can provide information to clinician or obstetrician for better management of these patients.

Methods:

The present cross sectional study was carried out in the Department of Physiology, Sir Salimullah Medical College, Mitford Hospital, Dhaka, during the period of 1st January 2009 to 31st December 2009. A total number of 108 subjects were included in this study, and all of them belonged to lower socioeconomic status. Among them 54 were full term delivery mother with their respective neonates (group B), treated as control group. Of them 27 were full term mother (B_1) and 27 were neonates of the respective mother (B_2). Again, another 54 were preterm delivery mothers with their respective neonates (group C), and treated as study group. Of them 27 were preterm mother (C_1) and 27 were neonates of the respective mother (C_2). Age ranged of preterm and full term mother were from 20-40 years. Protocol of this study was approved by the ethical committee of SSMC. Subjects having history of any microbial and metabolic diseases were excluded from the study. All the pregnant mothers were collected from emergency labor ward in Sir Salimullah Medical College, Mitford Hospital and non-pregnant women were selected from personal contact. After selection of the subjects, the objectives and benefits of the study were explained and written informed consent was taken from the subjects. All ethical norms were maintained. Institutional permission was taken from the Director of the Hospital. Detail personal, dietary, medical, family, socio economic, occupational histories were taken and a thorough clinical examination were done and all information was recorded in a standard prefixed questionnaire. With all aseptic precautions 5ml of maternal blood were drawn from medial cubital vein by disposable syringe and 5 ml of neonatal blood were collected from placental end of cord immediately after delivery. Blood was centrifuged at 3000 rpm for 20 minutes. After that supernatant serum was collected in labeled eppendroff tube and from it 1 ml of serum was transferred in a plain glass test tube for estimation of serum total protein and albumin by standard laboratory technique in the laboratory of Physiology Department, SSMC, Dhaka. Another 1 ml was taken in deionized tube for estimation of serum copper level by spectrophotometric method in the laboratory of Atomic Energy Commission. The statistical analysis was done by Independent-samples t test and Pearson's correlation by using SPSS, Version-15.

Results:

Anthropometric data of the subjects are presented in Table I. This table shows that Mean (±SD) weight of group C_2 was significantly ($p<0.001$) lower in comparison to that of group B_2. In the present study birth weight of group C_2 was significantly ($p<0.001$) lower than that of group B_2. Whereas, the weights of full term neonates were within normal reference range.

Table I

Birth weight of the neonates in two groups (n=54)

Groups	n	Weight (Kg)
Group B_2	27	3.03 ± 0.31 (2.5-3.5)
Group C_2	27	2.22 ± 0.25 (2.0-2.5)

Statistical analysis

	p value
B_2 vs C_2	0.001***

Results are expressed as Mean ± SD. Statistical analysis was done by unpaired "t" test. Figures in parentheses indicate ranges.

Group B_2 = Full term neonates

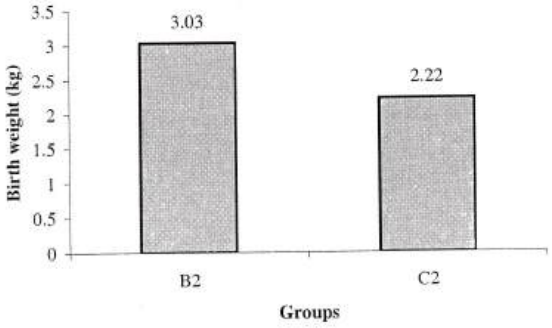
Group C_2 = Preterm neonates

n = Total number of subjects.

*** = Significant at p<0.001.

Figure 1

Mean birth weight of the neonates in two groups (n=54)



Group B_2 = Full term neonates

Group C_2 = Preterm neonates

Correlation of maternal serum zinc (Zn) and copper (Cu) concentration with the birth weight of their neonates.

The results are shown in Table II and Figure II, III.

Maternal serum Zn and Cu concentration were positively correlated with birth weight of their respective neonates. Though, the results were not statistically (p> 0.05) significant except in serum Zn concentration with the birth weight of their neonates in group C (p<0.01).

Table II

Correlation of maternal serum zinc (Zn) and copper (Cu) concentration with the birth weight of their neonates (n=108)

	Group B		Group C	
	r value	p value	r value	p value
Zn	0.025	0.901^{ns}	0.514	0.006**
Cu	0.166	0.407^{ns}	0.270	0.173^{ns}

r value was done by Pearson's correlation.

Group B: (Control)

Group B_1 = Healthy full term delivery mother

Group B_2 = Full term neonates of the respective mother

Group C: (Study)

Group C_1 = Preterm delivery mother

Group C_2 = Preterm neonates of the respective mother

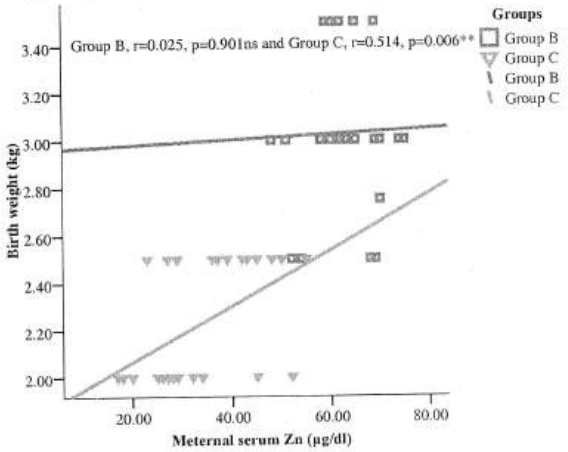
n = Total number of subjects

ns = Not significant.

**=Significant at 0.01 level

Figure II

Correlation of maternal serum zinc (Zn) concentration with the birth weight of their neonates in group B (n=54) and group C (n=54)



Group B: (Control)

Group B_1 = Healthy full term delivery mother

Group B_2 = Full term neonates of the respective mother

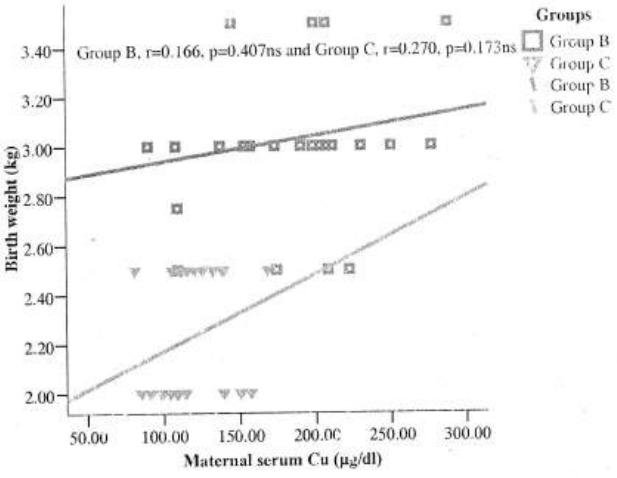
Group C: (Study)

Group C_1 = Preterm delivery mother

Group C_2 = Preterm neonates of the respective mother

Figure III

Correlation of maternal serum copper (Cu) concentration with the birth weight of their neonates in group B (n=54) and group C (n=54)



Group B: (Control)

Group B_1 = Healthy full term delivery mother

Group B_2 = Full term neonates of the respective mother

Group C: (Study)

Group C_1 = Preterm delivery mother
Group C_2 = Preterm neonates of the respective mother

Correlation of maternal zinc (Zn) and copper (Cu) concentration with Zn and Cu concentration of neonatal blood in group B and group C.

The results are shown in Table III and Figure IV, V.
Maternal serum zinc concentration was positively correlated with Zn concentration of neonatal blood. And maternal serum copper concentration was negatively correlated with copper concentration of neonatal blood. Though, the results were not statistically significant.

Table III

Correlation of maternal serum zinc (Zn) and copper (Cu) concentration with Zn and Cu concentration of neonatal blood (n=108)

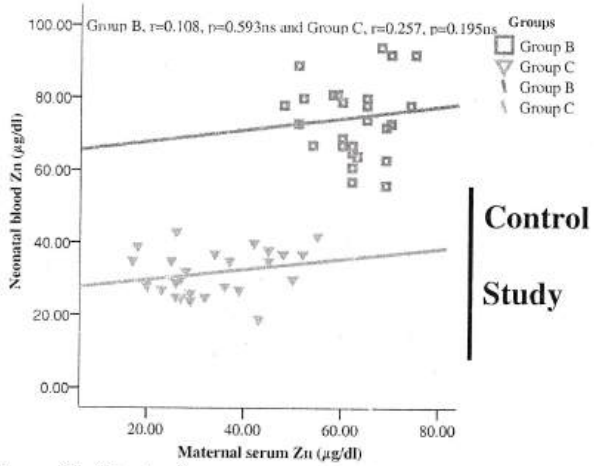
	Group B		Group C	
	r value	p value	r value	p value
Zn	0.108	0.593^{ns}	0.257	0.195^{ns}
Cu	-0.010	0.959^{ns}	-0.049	0.810^{ns}

r value was done by Pearson's correlation.

Group B: (Control)
Group B_1 = Healthy full term delivery mother
Group B_2 = Full term neonates of the respective mother
Group C: (Study)
Group C_1 = Preterm delivery mother
Group C_2 = Preterm neonates of the respective mother
n = Total number of subjects
ns = Not significant

Figure IV

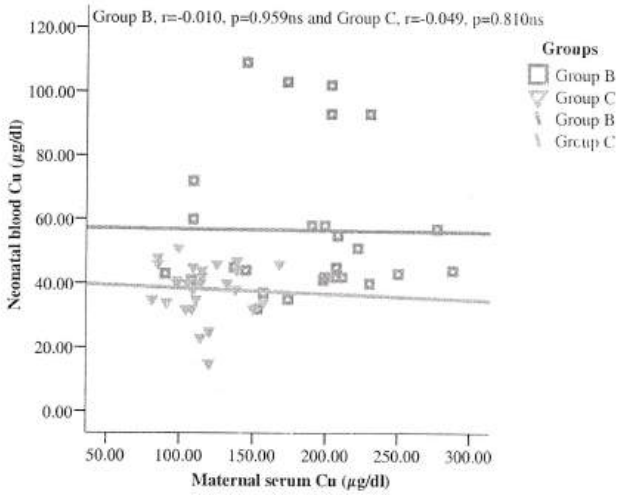
Correlation of maternal serum zinc (Zn) concentration with zinc concentration of neonatal blood in group B (n=54) and group C (n=54)



Group B: (Control)
Group B_1 = Healthy full term delivery mother
Group B_2 = Full term neonates of the respective mother
Group C: (Study),
Group C_1 = Preterm delivery mother
Group C_2 = Preterm neonates of the respective mother

Figure V

Correlation of maternal serum copper (Cu) concentration with copper concentration of neonatal blood in group B (n=54) and group C (n=54)



Group B: (Control)
Group B_1 = Healthy full term delivery mother
Group B_2 = Full term neonates of the respective mother
Group C: (Study)
Group C_1 = Preterm delivery mother
Group C_2 = Preterm neonates of the respective mother

Mean (±SD) serum zinc level was significantly ($p<0.001$) lower in group C_1 than that of group B_1. Again, Mean (± SD) serum zinc level was significantly ($p<0.001$) higher in group B_2 in comparison to that of group B_1. Whereas, this value was lower in group C_2 than that of group C_1 but it was not statistically significant. Again, serum Zn level was significantly ($p<0.001$) lower in group C_2 than that of group B_2. Mean (± SD) serum copper level was significantly ($p<0.001$) lower in group C_1 than that of group B_1. Again, serum copper level was significantly ($p<0.001$) lower in group B_2 and C_2 than those of their respective mother i.e group B_1 and C_1. Similarly, this value was significantly ($p<0.001$) lower in C_2 in comparison to that of B_2. (Table II)

Table IV

Serum zinc (Zn), copper (Cu) concentrations in different groups (n=108)

Groups	n	Zn (μg/dl)	Cu (μg/dl)
Group B_1	27	62.70 ± 7.18 (48.00-75.00)	186.00 ± 50.45 (90-288)
Group B_2	27	74.90 ± 10.89 (56-94)	56.56 ± 22.96 (32-109)
Group C_1	27	33.30 ±11.00 (17-55)	115.90 ± 22.03 (81-168)
Group C_2	27	31.74 ± 6.21 (19-43)	38.26 ± 8.28 (15-51)

Statistical analysis

	p value	
B_1 vs C_1	0.001***	0.001***
B_1 vs B_2	0.001***	0.001***
C_1 vs C_2	0.525^{ns}	0.001***
B_2 vs C_2	0.001***	0.001***

Results are expressed as Mean ± SD. Statistical analysis was done by unpaired "t" test. Figures in parentheses indicate ranges.

Group B_1 = Healthy full term delivery mother
Group B_2 = Full term neonates of the respective mother
Group C_1 = Preterm delivery mother
Group C_2 = Preterm neonates of the respective mother

n = Total number of subjects.

ns = Not significant.

*** = Significant at p<0.001.

** = Significant at p<0.01.

Discussion:

Low maternal plasma zinc and copper concentration are associated with increase risk of LBW and preterm delivery[13,14]. In the present study low birth weights have been documented in preterm neonates. Again, serum Zn and Cu deficiencies have been found both in preterm delivery mother and their neonates. These findings are consistent with those of some other researchers[15]. Pregnancy is associated with extraordinary metabolic demands on mother and developing fetus. Inadequate dietary intake before and during pregnancy causes poor maternal nutritional status and restricted fetal growth also high risk factor both for mother and fetus, which may be responsible for preterm delivery as well as for low birth weight of the neonates[1,16].

It has been suggested that micronutrient disorders later in fetal life may produce growth retardation and various abnormalities. Because zinc is an essential component of many enzyme systems implicated in many cell division and required for protein synthesis. Impairment of these process may retard fetal growth and reduce birth weight[17,18]. On the other hand copper deficiency is more frequent in preterm infants, especially of very low birth weight due to their reduced copper stores at birth and given the smaller relative size of the liver to synthesize cereloplasmin [19]. Hypocupremic in pregnancy may also be associated with low foetal cereloplasmin which may be responsible for poor carriage of copper in foetal blood[20]. Some other workers also observed that, low maternal plasma zinc and copper concentration is closely associated with LBW. They showed lower serum zinc and copper concentration, who delivered low birth weight babies in comparison to that who delivered normal weight babies.[15]

However, low birth weight of preterm neonates in this study may be due to their hypozincemia and hypocupremia, as evidenced by their measured values in cord blood. This hypozincemia and hypocupremia of preterm neonates of present study may be due to diffusion of small fraction of maternal serum Zn and Cu through the placenta, as evidenced by the maternal serum Zn concentration was positively correlated with Zn concentration of neonatal blood and maternal serum Cu concentration was negatively correlated with copper concentration of neonatal blood.

However, the exact mechanism involved for the low birth weight of the neonates in relation with preterm delivery due to Zn and Cu deficiency cannot be elucidated from this type of study due to some limitation, such as short duration of the study period and small sample size.

Conclusion:

Hypozincemia and hypocupremia during pregnancy may result decrease transfer of Zn and Cu from mother to foetus which may lead to poor foetal growth and consequently low birth weight of neonates.

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