Zinc Status in Well Nourished Bangladeshi Children Suffering from Acute Lower Respiratory Infection

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This study was done to investigate the association of zinc status of well nourished Bangladeshi children with Acute Lower Respiratory Infection (ALRI). In this case control study, simultaneous estimation of serum and hair zinc was performed in 35 well nourished children, aged 6-60 months suffering from ALRI and 38 normal matched controls. Serum zinc was low in children suffering from ALRI as compared to control (90 ± 51 µg/dL vs 176 ± 98 µg/dL, OR: 6, 95% CI: 1.83, 19.66; P <0.05) children. Hair zinc was also found significantly low in children suffering from ALRI as compared to control (158 ± 48 µg/g vs 247 ± 154 µg/g , OR: 3, 95% CI: 1.46, 10.04, P < 0.05). We conclude that Bangladeshi children suffering from pneumonia, have decreased levels of serum and hair zinc.

Keywords: *Acute lower respiratory infection, Bangladeshi, Children, Zinc.*

Acute lower respiratory infection (ALRI), particulary pneumonia is now one of the most important causes of childhood mortality in developing countries like Bangladesh. The increased susceptibility to ALRI particularly in malnourished children of developing countries is postulated to be due to reduction in cellular immunity(1). One of the reasons for reduced immunological competence in malnourished children may be zinc deficiency(2,3). However, relatively well nourished children of developing countries also suffer from ALRI and it is possible that they have impaired immunity due to zinc deficiency.

The present study was therefore carried out to assess zinc status by simultaneous estimation of serum and hair zinc in well nourished Bangladeshi children suffering from ALRI, in order to find association of ALRI with zinc status, with the hypothesis of low zinc status in children suffering from ALRI.

Subjects and Methods

This case control study was performed on 35 well nourished children (6-60 mo) suffering from ALRI, having weight for age and weight for height more than 90% of NCHS median. ALRI was defined according to WHO guidelines(4). Children having clinical conditions other than ALRI, currently or during last three months, were excluded from the study.

Thirty eight apparently healthy well nourished children of almost similar age and nutritional and socioeconomic status were enrolled in the study as control group. ALRI was used synonymously with pneumonia. Informed consent from the parents or guardians of the children was obtained. The duration of the study was from January 1999 to November 2000. The study was approved

by the ethical review committee of Dhaka Shishu Hospital.

Sample Collection and Preparation

Hair sample from each individual (approximately 1 g) was collected from different areas of scalp by clean stainless steel scissors. They were dried accordingly to recognized procedures from which samples were prepared by wet ashing procedure(5). For serum zinc 5 mL of venous blood was collected in deionized vials, stored at –20ºC until sent for analysis. Sample preparation for serum zinc was done by standard procedure by treating with 10% glycerol, spectroscopic graded salts of the element and suprapure acid followed by proper heating of pre-digested samples until ashing procedure was completed. Measurement of zinc concentrations from the prepared samples were done by flame atomic absorption spectrophotometry using Perkin elmer spectrophotometer model No. 3110 with wavelength of 213.9 nm. Serum zinc was considered low if the value was <100 µg/dL and hair zinc was considered low if it was <150 µg/g. Analytic process was done in Chemistry Division of Bangladesh Atomic Energy Commission, Dhaka.

Statistical Analysis

Odds ratio (OR), 95% confidence interval (CI) of OR and standard error of OR were calculated. An odds ratio was considered statistically valid and meaningful if the upper and lower limits of confidence interval do not include unity. The value of OR was considered significant if the probability (P) was <0.05.

Results

Both control and ALRI groups were matched for age, sex, and anthropometry (*Table I*).

Table II shows that serum zinc was significantly lower in the ALRI group than control (OR = 6; CI 95%: 1.83, 19.62; P <0.05). Serum zinc concentration in ALRI ranged from 40 µg/dL to maximum 130 µg/dL, and in control 90 µg/dL to 220 µg/dL.

Table III depicts that hair zinc was also lower in ALRI (OR 3, 95% CI of OR 1.45, 10.04, P <0.05). Hair zinc concentration in ALRI ranged from 70 µg/g to 230 µg/g against 115 µg to 420 µg/g in control.

Discussion

So far direct assessment of zinc of Bangladeshi children suffering from pneumonia has not been performed. However, estimation of zinc in any single compartment

TABLE I–*Comparison of Baseline Characteristics (mean ± SD) of the Two Groups.*

	Group A (Control) (n = 38)	Group B (ALRI) (n = 35)
Age (mo)	32 ± 6.52	30 ± 6.64
Sex (M/F)	22/16	20/15
Weight for age*	98.64 ± 10.54	94.63 ± 8.62
Weight for height*	92.92 ± 8.35	90.52 ± 8.29
Height for age*	96.38 ± 9.90	95.35 ± 9.35

** % of NCHS median*

TABLE II–*Serum Zinc in the Two Groups.*

Group	Serum zinc (µg/dL)	Children (n) with serum zinc <100µg/dL
Control (n = 38)	176 ± 98	5 (13%)
ALRI (n = 35)	90 ± 51	18 (54%)
OR = 6, 95% CI of OR = 1.83, 19.62, P < 0.05		

To convert zinc concentration to µmol/1, multiply by 0.153

TABLE III–*Hair Zinc in the Two Groups.*

Group	Hair zinc (µg/g)	Children (n) with hair zinc <150 µg/g
Group A Control (n = 38)	249 ± 154	8 (4%)
Group B ALRI (n = 35)	158 ± 48	16 (46%)
OR = 3, 95% CI of OR = 1.46, 10.04, P < 0.05		

for reliable assessment of zinc remains to be a major dilemma, as there is no single specific, sensitive, noninvasive assay of zinc in tissue or body fluid, that can confidently and comprehensively assess zinc status of the body. Serum zinc which indicates zinc status of the moment, changes with the food spacing and many clinical disorders are known to be accompanied by decreased plasma or serum zinc content(6). Serum concentration of zinc decreases sharply in inflammation and infection and may reflect a normal protective mechanism because, lower concentration of zinc are associated with both optimal phagocytic function and depressed microbial virulence(7). Hair zinc, however is stable, does not fluctuate easily and the length of hair sampled can depict store of 3-4 months(8). Its popularity lies in the fact that it can be collected easily and nontraumatically which suits children, can be stored easily and most trace elements have higher concentration in hair than other body compartment, which helps in the analytic process. Low hair zinc in children is always an indicator of low zinc status in children, while normal or high hair zinc may or may not be associated with low zinc status(9). The low zinc status associated with low hair zinc in children is due to relatively high demand for zinc in infancy combined with relatively low body stores of zinc in hair of children which expose children more susceptible to lower dietary supply of zinc than those of adults. Low zinc status becomes more obvious and reliable, when low hair zinc is associated with low serum zinc in same individual, indicating chronic ongoing low zinc status(10).

In our study, the children were not malnourished indicating zinc deficiency can occur without significant malnutrition and susceptibility to ALRI can occur due to impaired cell mediated immunity due to zinc deficiency, without associated malnutrition. There are few published literature on relationship of respiratory tract infection with zinc status. Lomback, *et al.*(11) in Germany and Vanwouwe, *et al.*(12) in Netherland found reduced hair zinc in children with chronic respiratory infection while Bondestam, *et al.*(13) in Sweden found significant association of low serum zinc in children with undue susceptibility to infections like recurrent upper and lower respiratory infections.

From the study, we conclude that zinc status as assessed by simultaneous estimation of serum and hair zinc is significantly low in Bangladeshi children suffering from ALRI, which is one of the most important causes of high childhood mortality of developing countries like Bangladesh. However the study is hospital based and the number of patient in our study was small and we believe that larger study is warranted to confirm these findings.

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Key Message

- Well nourished Bangladeshi children suffering from acute lower respiratory infection are found to have low zinc status, assessed by simultaneous estimation of serum and hair zinc.

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Competing interests: Nil.

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