Section: Pediatrics

Original Research Article

# SERUM ZINC LEVELS AND THE SPECTRUM OF DIARRHEA IN CHILDREN (6 MONTHS TO 5 YEARS): ACUTE, CHRONIC, AND PERSISTENT PRESENTATIONS

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**ABSTRACT**

Diarrhea causes an estimated 2.5 million child deaths in developing countries each year. It is the third leading killer of children in India today and is responsible for 13% of all deaths in children less than five years of age and kills an estimated 300,000 children in India each year. Diarrhea is one of the clinical manifestations of zinc deficiency in humans. 25 children (aged 6 months-5 years) of either sex suffering from diarrhea and admitted in paediatric ward and emergency of RDJMMCH, Muzaffarpur were selected for the study. Serum zinc levels were estimated by colorimetric kit method and compared with those of 25 healthy age-matched controls. It was observed that the serum zinc levels were significantly lower in children suffering from diarrhea (39.26 ± 12.18 vs. 78.60 ± 11.63 µg/dl, $p<0.05$). However, there was a negligible correlation between diarrhea and gender. Thus, diarrhea is associated with an increased loss of zinc in feces so that children with diarrhea would be at an increased risk of zinc deficiency. Zinc supplementation is now being recommended by WHO, UNICEF, and countries around the world for the supportive treatment of all diarrhea episodes among children, and this should be encouraged in routine clinical practice.

**Keywords:** Diarrhea, Zinc, Children, Deficiency, Supplementation.

## INTRODUCTION

Diarrhea causes an estimated 2.5 million child deaths in developing countries each year. It is the third leading killer of children in India today and is responsible for 13% of all deaths in children less than five years of age and kills an estimated 300,000 children in India each year. Clinically, diarrhea is defined as passage of 3 or more loose or watery stools in 24 hours. For exclusively breastfed infants, a change in consistency of stool with increased frequency is regarded as diarrhea. When there are three diarrhea-free days between two episodes, they are considered as two separate episodes.[1] Types of diarrhea: Acute diarrhea- Diarrhea lasting < 2 weeks.[2] Persistent diarrhea- lasting 2- 4 weeks.[2] Persistent diarrhea is usually seen in infancy with more than 60% episodes occurring in infants < 6 months age and 90% before 1year of age.[3] Chronic diarrhea- Diarrhea lasting > 4 weeks.+.Zinc deficiency is common in children from developing countries due to lack of intake of animal foods, high dietary phytate content, inadequate food intake and increased fecal losses during diarrhea. Zinc has a fundamental role in cellular metabolism, with profound effects on the immune system and the intestinal mucosa. Zinc supplementation has shown significant benefits in prevention and treatment of diarrhea.[4] In recent years, a number of other studies have corroborated these preliminary findings in children with both acute and persistent diarrhea. One of the first of these studies, in India, found that

children with acute diarrhea got better faster when they received a zinc supplement. This trial in New Delhi compared vitamin supplements with and without 20 mg elemental zinc administered daily to 937 children with acute diarrhea. The children who received zinc recovered more quickly and they had 23% less chance of continuing diarrhea on any day after starting the zinc supplement. The children receiving zinc also had fewer loose stools so that in this study the zinc reduced the severity of the diarrhea as well as hastening recovery. Other trials from different parts of the world from Papua New Guinea to Peru have shown similar benefits. The data from these studies has been pooled and the results demonstrate a consistent, significant and clinically important benefit of supplements containing oral zinc in children aged less than five years who have acute diarrhea. Children had a 15% faster recovery with zinc.[5]

Routine zinc supplementation given to low birth weight babies for a year has resulted in substantial reduction in mortality. WHO Task Force, 2001, and the National Task Force of Indian Academy of Pediatrics (IAP) have recommended use of zinc in the treatment of diarrhea. Improved dietary quality and intake, food fortification and cultivation of zinc dense plants are some ways of mitigating zinc deficiency.[6-9] Keeping in view the importance of zinc and its association with diarrhea, the present study was planned to evaluate serum zinc levels in children suffering from diarrhea.

## MATERIAL AND METHODS

**Study Area:** The study was conducted in the Department of Biochemistry in collaboration with the Department of Pediatrics, RDJM Medical college, Turki, Muzaffarpur.

**Study period:** Study was conducted from April 2023 to March 2024.

**Study Population:** 25 subjects in the age group of 6 months- 5 years who are admitted in Paediatric ward and emergency in medical collage of RDJM was selected for the study. Those children having Acute, Persistant and chronic diarrhea was included in the study.

25 healthy age-matched children were taken as control.

**Exclusion criteria:**

1. Children more than five years of age.
2. Children less than 6 months of age.
3. Children with bloody diarrhea.
4. Children put on I/V drip containing zinc or on any zinc preparation.
5. Children having single episode of watery stool.

**Sample collection and estimation of serum zinc**

1 ml of venous blood was aseptically collected from cubital vein/femoral vein, centrifuged and serum was separated. Serum zinc levels were estimated by colorimetric kit method described by M. Saito (1982).[10]

## RESULTS AND DISCUSSION

In the present study, the percentage of diseased male and female children was 34% and 16% respectively (Figure 1). It was observed that the serum zinc levels were significantly lower in children suffering from diarrhea (39.26 ± 12.18 vs. 78.60 ± 11.63 µg/dl, $p<0.001$). The serum zinc levels as per age subgroups in healthy and diseased children are comprehensively represented in Fig. 2. However, as shown in Table 1, the association between serum zinc level in diseased male and diseased female children was not statistically significant. Thus, there was negligible correlation between diarrhea and gender; they are mutually independent variables.

Zinc deficiency may have adverse effects on physical growth and neurodevelopment particularly if the child is malnourished. A plausible link between malnutrition, diarrhea and zinc deficiency is depicted in Fig. 3. Zinc supplementation is a new addition to the diarrhea treatment strategy and one that promises to greatly improve diarrhea management. Two recent advances in managing diarrheal disease that can drastically reduce the number of child deaths include: 1) Newly formulated oral rehydration solution (ORS), containing lower concentrations of glucose and salts, to prevent dehydration and the need for intravenous therapy; and 2) Zinc supplementation to decrease the duration and severity of diarrhea and the likelihood of future diarrhea episodes in the 2-3 months following supplementation.[11]

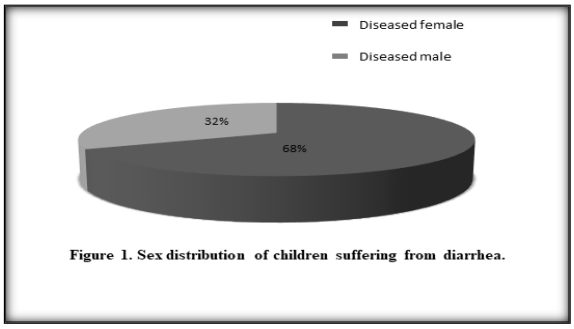


**Figure 1. Sex distribution of children suffering from diarrhea**

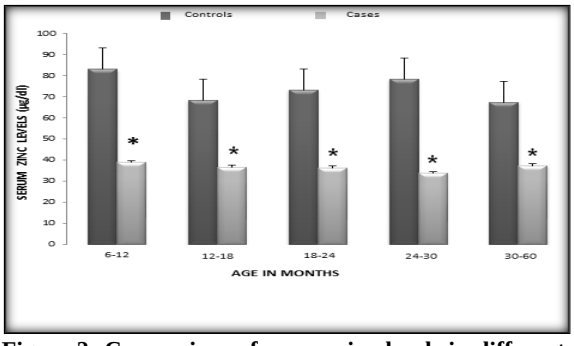


**Figure 2: Comparison of serum zinc levels in different age groups in healthy (control) and diseased (cases) children. *p<0.05.**

**Table 1: Comparison of serum zinc levels in diseased children based on sex**

| S.no | Group | No. of cases | Mean± SD (µg/dl) |
|---|---|---|---|
| 1 | Diseased males | 17 | 39.53±15.06 |
| 2 | Diseased females | 8 | 30.13±13.61 |
| p = 0.1793; p<0.05 has been considered to be significant | | | |

## CONCLUSION

**Conclusions and Future Perspectives**

The present study concluded that:

1. Serum zinc levels are significantly low in children suffering from diarrhea as compared to healthy controls.
2. There is negligible correlation between diarrhea and gender.

Certain limitations of the present study merit attention. The population size, i.e. the number of children should have been more in order to acquire more comprehensive data for analysis. A gender-wise sub-stratification would be even more informative, revealing the vulnerability (if any) of children with respect to gender. Along with zinc, other nutrients such as copper and vitamin A should also be estimated to assess its impact on diarrhea. Lastly, zinc supplements to the diarrheal children and re-evaluation in terms of recurrence and morbidity could provide more confirmatory evidence on the impact of zinc on diarrhea.

Child caregivers need additional assistance to recognize diarrhea correctly, and both caregivers and health care providers need updated training on current diarrhea treatment recommendations. To treat, prevent and minimize the incidence of diarrhea in infants and young children, the ORS is not the only solution. Additional therapy is required in the form of zinc supplementation for reduction in the duration and severity of diarrhea.

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