



## Original Article

# Effect of Zinc Supplementation on Duration of Acute Watery Diarrhoea in Children aged Six Months to Five Years

Dilruba Sultana,<sup>1</sup> Be-Nazir Ahmmad,<sup>2</sup> Abul Kashem,<sup>3</sup> Md. Fazlul Kader,<sup>4</sup> Mrinal Kanti Das,<sup>5</sup> Md. Belal Uddin,<sup>6</sup> Md. Sanaul Haque Mia<sup>7</sup>

### Abstract

**Background:** Diarrheal disease is one of the leading causes of morbidity and mortality among young children under five years of age in developing countries. The longer duration of diarrhea increases the chance of morbidity and mortality. Zinc supplementation decreases the duration of diarrhea. It is a straightforward, acceptable, low-cost, and effective treatment that could easily be affordable in our country.

**Objective:** This study aimed to determine the effect of zinc supplementation on the duration of acute watery diarrhea.

**Materials and Methods:** A total of 106 subjects were included in this study over six months, from December 2014 to May 2015. Detailed information was obtained from each patient. A total of 106 patients were taken. Among them, 53 patients (group A) were given zinc with Oral Rehydration Salts (ORS), and 53 patients (Group B) were given ORS only. However, three patients in each group were lost during follow-up. Data were analyzed by using a standard statistical method (SPSS version 16.0).

**Results:** The duration of diarrhea was three days in 56% of patients in the zinc-supplemented group, but it was only 20% in the control group. The frequency of stool gradually decreased over five days. It was more marked in zinc supplemented group. The p-value was 0.001. Vomiting occurred in 30% of patients in zinc supplemented group, and in the control group, it was only 20%. The p-value was 0.5. So we conclude that oral zinc administration in acute watery diarrhea (AWD) decreases the duration and causes early recovery and may be considered in the management of AWD.

**Conclusion:** Oral zinc administration in acute watery diarrhea decreases the duration and frequency of diarrhea in children aged six months to five years by changing the natural course of acute diarrheal disease.

**Keywords:** Acute watery diarrhea, ORS, zinc, World Health Organization (WHO).

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### Introduction

In developing countries, diarrhea is a leading cause of morbidity and mortality among children

less than five years of age.<sup>1</sup> Under five years of age, diarrhea is responsible for 15% of all death and accounts for about 1.4 million infant death

<sup>1</sup> Junior Consultant, Department of Pediatrics, Rajshahi Medical College, Rajshahi, Bangladesh.

<sup>2</sup> Assistant Professor, Department of Pediatrics, Rajshahi Medical College, Rajshahi, Bangladesh.

<sup>3</sup> Assistant Professor, Department of Pediatrics, Rajshahi Medical College, Rajshahi, Bangladesh.

<sup>4</sup> Assistant Professor, Department of Pediatrics, Rajshahi Medical College, Rajshahi, Bangladesh.

<sup>5</sup> Assistant Professor, Department of Pediatrics, Rajshahi Medical College, Rajshahi, Bangladesh.

<sup>6</sup> Professor and Head, Department of Pediatrics, Barind Medical College, Rajshahi, Bangladesh.

<sup>7</sup> Professor and Head, Department of Pediatrics, Islami Bank Medical College Rajshahi, Rajshahi, Bangladesh.

worldwide annually.<sup>2,3</sup> According to WHO and UNICEF, in developing countries, almost 2.5 billion episodes of diarrhea occur in children <5 years of age annually. Among them, 38% are in South Asia.<sup>4</sup> Severe diarrhea can quickly cause life-threatening dehydration. Though ORS can reduce mortality from diarrhea by preventing dehydration, it is unable to reduce the volume, frequency, or duration of diarrhea.<sup>5</sup>

WHO and UNICEF took two significant steps to reduce this burden by recommending the use of oral rehydration salt (ORS) and supplementation with zinc for up to two weeks in 2004.<sup>6,7</sup> Zinc is able to reduce the duration and severity of the episode<sup>8</sup>, and It can also reduce the incidence of diarrhea in subsequent two or three months if given for total 14 days.<sup>9</sup> There is a significant and beneficial effect on the clinical course of acute diarrhea by reducing both its duration and severity.<sup>10</sup> A systematic review showed that zinc supplementation reduced the mean duration of acute diarrhea.<sup>11</sup> In rural Bangladesh, a two-year community-based trial showed that zinc and ORS together had a 23% shorter duration of diarrhea episodes than children living in areas where ORS therapy alone was the accepted treatment. In zinc-supplemented areas, children had a 51% lower risk of death than in areas where zinc was not available.<sup>12</sup>

By inhibiting the basolateral potassium (K<sup>+</sup>) channel, zinc inhibits cAMP-induced chloride-dependent fluid secretion.<sup>13,14</sup> Zinc also improves the absorption of water and electrolytes, improves regeneration of intestinal epithelium, increases the level of brush border enzyme, and enhances immune response.<sup>15</sup> Zinc plays an important role in reducing the risk, severity, and duration of diarrheal disease by modulating the host resistance to infectious agents and it also plays a critical role

in polyribosome, metalloenzymes, and cellular function, giving credence to the belief that it plays a central role in cellular growth and immune system function.<sup>16</sup>

A significant proportion of children suffering from diarrhea are malnourished with depleted micronutrient stores. As diarrhea leads to loss of zinc, children with marginal nutritional status are at the greatest risk of developing zinc depletion during a diarrheal episode.<sup>17, 18</sup>

## Materials and Methods

It was a clinical trial done with maintained ethical concerns in the Department of Pediatrics Rajshahi Medical College Hospital, Rajshahi, over a period of six months from December 2014 to May 2015. The sample size was 106 infants or children, male and female, aged six months to five years, who visited the ORT corner in the outpatient department with acute watery diarrhea having no or some sign of dehydration during the study period were included. Those who had severe dehydration and associated co-morbidities such as malnutrition, bronchopneumonia, or complications like encephalitis/ electrolyte imbalance/ metabolic acidosis, Etc., were excluded from the study. Patients were recruited as case/ control by lottery for the first patient then the rest were taken alternatively. Relevant history and physical examination findings were recorded in a preformed data sheet. The control group received standard management with ORS and, if needed, paracetamol and the intervention group received syrup zinc at a dose of 0.3-1 mg/kg/day along with standard management. Follow-up was done every alternate day and assessed till the diarrhea was resolved. Collected data were analyzed by using computer SPSS version 16. Statistical analysis was done according to the objectives of the study.

## Results

The findings of the study are presented here.

**Table-1: Frequency of diarrhea on the first day**

Frequency	Zinc supplemented				Total N (%)	P- value
	Zinc supplemented		Control			
	Group A (n=50)		Group B (n=50)			
	Number	%	Number	%		
≤ 7 times	3	6	4	8	7	0.054
7-14 times	31	62	19	38	50	
≥ 14 times	16	32	27	54	43	

In group- A, 62% of patients presented with a frequency of 7-14 times on the first day. In the control group, 38% of patients showed the same frequency. The result is not significant.

**Table-2: Impact of zinc supplementation on frequency of stool/day during follow-up as per mean SD.**

### Day-1

Age in month	N	Zinc-supplemented group (n=50)	N	Control (n=50)	P value
6-12	27	11.40±4.43	24	15.00±5.41	0.012
13-36	22	14.59±9.47	19	15.36±7.52	0.775
37-60	1	13.0±0.00	7	14.28±5.12	0.822
Total	50	12.84±3.10	50	15.04±6.15	0.426

### Day-3

Age in month	N	Zinc-supplemented group (n=50)	N	Control (n=50)	P value
6-12	27	3.74±3.22	24	8.16±3.71	0.001
13-36	22	3.50±3.05	19	8.52±4.80	0.001
37-60	1	6.0±0.00	7	9.00±4.65	0.569
Total	50	3.68±3.10	50	8.42±4.20	0.224

## Day-5

Age in month	N	Zinc-supplemented group (n=50)	N	Control (n=50)	P value
6-12	27	0.81±1.41	24	3.62±2.41	0.001
13-36	22	0.63±1.29	19	3.15±3.00	0.001
37-60	1	4.00±0.00	7	4.14±3.23	0.968
Total	50	0.81±1.41	50	3.62±2.00	0.062

The frequency of stool decreases from day 1 to 5. It is more marked in zinc supplemented group than in the control group; the p-value is 0.001.

**Table-3: Distribution of cases by their vomiting status after zinc supplementation**

Variables	Zinc supplemented group Group A (n=50)		Control group		P value
	Number	%	Number	%	
No vomiting	35	70	40	80	0.5
Vomiting	15	30	10	20	0.5
Total	50	100	50	100	

30% of patients developed vomiting in zinc supplemented group, and 20% of patients developed vomiting in the control group. The result is not significant; the p-value is 0.5.

**Table-4: Duration of diarrhea in the zinc-supplemented and control group**

Duration of diarrhea	Zinc supplemented Group A (n=50)		Control Group B (n=50)		Total N (%)	Mean±SD	P value
	Number	%	Number	%			
	≤ 3 days	28	56	10	20	38	1.26±0.44
4-5 days	20	40	33	66	53	1.62±0.48	0.001
6-7 days	02	04	7	14	9	1.77±0.44	
Total	50	100	50	100	100		

In zinc supplemented group, 56% of patients showed the shortest diarrhea duration (3 days); in the control group, only 20% of patients showed the same duration. The result is significant; zinc decreases the duration of diarrhea.

## Discussion

Diarrhea is more common in younger age groups (6-12 months), male patients are more affected, and most of the patients belong to lower-class families. Most of the mothers in both groups are

educated up to secondary, most of the children were not given zinc at home, and among the affected children, 58% experienced early weaning. Most of the patients showed an increased frequency of stool  $\geq 14$  days in both groups on first day. Vomiting develops in 30% of patients in the

case and 20% in the control group during the study period.

During supplementation trials with zinc, the major effect had been shown to be on the duration of diarrhea. It also decreases the frequency of diarrhea day by day. A meta-analysis of five studies of zinc for acute diarrhea found a summary estimate for a reduction in duration of 16%.<sup>8</sup> This study showed that supplementing children with zinc during acute watery diarrhea with the recommended dose significantly decreases the duration of diarrhea. In zinc supplemented group, 56% of patients showed the shortest diarrhea duration, whereas, in the control group, only 20% of patients showed the same duration. The reduction of diarrheal duration is consistent with earlier studies.<sup>19, 20</sup> Possible mechanisms for the effect of zinc treatment on the duration of diarrhea include improved absorption of water and electrolytes by the intestine, faster generation of the gut epithelium, and enhanced immune response, leading to early clearance of pathogens from the intestine.<sup>21,22</sup>

There is another meta-analysis of 22 studies conducted by Lukacik et al. showed the impact of zinc supplementation in children with acute and persistent diarrhea. There was a significant reduction in the mean duration of acute and persistent diarrhea.<sup>23</sup> There are similar studies conducted in Bangladesh and North India. Results of these studies showed that supplementation of zinc during acute diarrhea significantly reduces the duration of diarrhea.<sup>24</sup> A double-blind, placebo-controlled, randomized clinical trial was conducted in Brazilian children with acute diarrhea with zinc supplementation; the results showed that children receiving zinc had a shorter duration of diarrhea.<sup>25</sup> The result is similar to the present study.

The initial stool frequency was 7-14 or  $\geq 14$  times (Table-1), compared to after-treatment days 1, 3, and 5, and found a significant (p-value 0.001) decrement in stool frequency from 3 to 1 (table II). That is a 71% reduction in zinc supplemented group and 54% in the control group. A similar result was found in a study in Surat, where the

reduction in stool frequency per day was 62% in zinc supplemented group and 26% in the control group.<sup>26</sup>

### Limitations

The sample size was relatively small, with a shorter duration and limited ability to detect clinically significant differences between the two groups. The present study was hospital-based, and only patients of OPD were included.

### Conclusion

Oral zinc administration in acute watery diarrhea decreases the duration of diarrhea in children aged six months to five years by changing the natural course of acute diarrheal disease. It also decreases stool frequency day to day. Zinc supplementation is a simple, acceptable, and affordable strategy which should be considered in the management of acute watery diarrhea. Through, this we can decrease diarrhea-related morbidity and mortality.

**Conflict of interest:** None declared

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All correspondence to  
**Dr. Dilruba Sultana**  
Junior Consultant  
Department of Pediatrics  
Rajshahi Medical College, Rajshahi.  
E-mail: dilrubasultana24@yahoo.com