Zinc Supplementation in Malnourished Children Under 5 Years with Acute Diarrhea

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Abstract
Background: To evaluate the effectiveness of zinc supplementation in malnourished children from 2 months to 5 years of age presenting with acute diarrhoea.

Methods: In this case control study, malnourished children, with acute diarrhoea from 2 months to 5 years of age, were divided into two groups. Group 1 receiving oral zinc (10 mg/day for children <6 months and 20 mg/day for > 6 months) and Group 2 children not receiving zinc (control group).

Results: Total of 72 cases were enrolled in the study, out of which 45 (62%) children were male and 27 (38%) were female and 72 patients were in control group. Statistically significant differences were found in the duration of diarrhoea improvement (p-value = 0.03), frequency of stools in 24 hours after the enrolment (p-value = 0.001) and stool volume (p-value = 0.06) between children in oral zinc supplementation group and controls.

Conclusion: The duration of diarrhoea improvement, frequency of diarrhoeal episodes and stool volume decrease significantly with oral zinc supplementation as compared to no zinc supplementation among malnourished children with acute diarrhoea.

Key Words: Malnourished, Acute diarrhoea, Zinc supplementation

Introduction

In developing countries, diarrhoeal diseases are one of the leading causes of childhood morbidity and mortality. Every year around 10 million children under 5 die, about half of these deaths are associated with under nutrition and about 2 million with diarrhoea, out of a total of 2.5 billion episodes of diarrhoea.1,2 A cross sectional survey in one of the most populated city of Pakistan has revealed that 41 percent of all childhood (under five years of age) deaths were due to diarrhoea.3

Multiple reports, all from the developing countries, have linked diarrhoea and abnormal zinc status, including increased stool zinc loss, negative zinc balance, and reduced tissue levels of zinc.4,5

The exact mechanism of action of zinc is still not clear, but it is postulated that it has effects on cell growth, differentiation and DNA synthesis, increased absorption through acceleration of regeneration of gut epithelium, increased gut enzymes and overall immune function.6 During supplementation trials with zinc, the major effect has been shown to be on diarrhoea related morbidity.7-10 The duration of diarrhoea and its severity can be reduced in malnourished children by daily zinc supplementation.11

Patients and Methods

In this case controlled study a structured proforma was used to collect data prospectively from all malnourished children from 2 months to 5 years of age, who presented in emergency & OPD of Paediatric Departments of FFH, RWP and Children hospital, PIMS, Islamabad from 1st June 2010 to 30th June 2011. Patients were randomly divided into two groups, with one group (72 patients) receiving oral zinc (10 mg/day for children < 6 months, & 20 mg/day for > 6 months), while the other group (72 patients) was control group.

Results

Majority of the children (62%) were male with a male to female ratio of 1.6: 1. The highest proportion of children (34.1%) were 6 to 12 months of age, whereas the lowest proportion of children (8.3%) were 3 to 5 years of age. Control group had 72 patients, majority (62%) were male with a male to female ratio of 1.6: 1.

Mean (SD) weight for age z-score of all the enrolled children was -2.93 (± 1.69). The mean (SD) height for age z-score was -1.94 (± 1.78). According to the classification of World Health Organization, all (72) children were categorized as underweight. Sixty one percent were in severe underweight category. Majority (63.9%) of the children were stunted; they
had height for age z-score less than -2 standard deviation. 21 (29.9%) children were severely stunted; their height for age z-score was less than -3 standard deviation. Majority of female patients were severely underweight. Prevalence rates of stunting and severe stunting were almost equal proportions in males and females (Table 1 & 2).

The mean (SD) duration of diarrhea at the time of presentation among all the children was 4.1 (± 2.7) days. Frequency of diarrhoeal episodes in 24 hours among all the children was 9.3 (± 4.7). A statistically significant difference was found in duration of diarrhoea between zinc and control groups (p-value = 0.03). The mean (SD) duration of diarrhoea was 3.2 (± 1.1) days in zinc group. However, the mean (SD) duration of diarrhoea improvement was higher, that is 3.8 (± 1.8) days in control group. Majority of children, 55 (76.4%), in zinc group improved within first three days of treatment whereas majority of children, 45 (62.5%) in control group improved after 4 days. This difference was statistically significant (p-value = 0.005) (Table 3).

The mean (SD) frequency of diarrhea episodes in 24 hours was 2.8 (± 1.2) in zinc group. However, the mean (SD) frequency of diarrhoeal episodes in control group was higher 3.7 (± 1.9) and this difference was statistically significant (p-value = 0.001). More than 80% children (n = 60) in zinc group had frequency of diarrhoeal episodes less than 5 in 24 hours whereas 44 (61.1%) children in control group had less than 5 episodes in 24 hours (p-value = 0.002). The mean (SD) stool volume in zinc group was lower, (58 ± 29.3 gms) compared to control group (67.5 ± 32.5 gms) (Table 3).

**Table 1: Nutritional status of cases stratified by age (n = 72)**

<table>
<thead>
<tr>
<th>Age categories</th>
<th>Underweight</th>
<th>Severe Underweight</th>
<th>Stunting</th>
<th>Severe Stunting</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 6 months (16)</td>
<td>16 (100%)</td>
<td>10 (62.5%)</td>
<td>09 (56.5%)</td>
<td>06 (34.4%)</td>
</tr>
<tr>
<td>6 to 12 months (25)</td>
<td>25 (100%)</td>
<td>18 (73.5%)</td>
<td>17 (67.3%)</td>
<td>09 (38.8%)</td>
</tr>
<tr>
<td>13 to 24 months (19)</td>
<td>19 (100%)</td>
<td>13 (62.2%)</td>
<td>12 (64.9%)</td>
<td>05 (24.3%)</td>
</tr>
<tr>
<td>More than 24 months (12)</td>
<td>12 (100%)</td>
<td>05 (38.5%)</td>
<td>06 (50.0%)</td>
<td>02 (15.4%)</td>
</tr>
</tbody>
</table>

**Discussion**

Diarrheal illnesses in young children continue to be a leading cause of morbidity and mortality worldwide. Numerous randomised controlled trials have shown the therapeutic benefits of zinc supplementation during diarrhoea. World Health Organization and UNICEF have recommended the therapeutic use of oral zinc supplementation for 10-14 days at a dose of 10 mg daily in infants less than 6 months old and 20 mg daily in older children.

Our results showed that the malnourished children presenting with acute diarrhoea and receiving oral zinc supplementation improved earlier than children without zinc supplementation (p-value = 0.03). The mean duration of diarrhoea improvement among malnourished children with zinc supplementation was 3.2 (± 1.1) days whereas in malnourished children without zinc supplementation it was 3.8 (± 1.8) days (Table 3). In several trials, duration of diarrhoea is considered as one of the primary outcome to demonstrate the effect of zinc supplementation.
supplementation on acute diarrhoea in children. The duration of diarrhea, in those taking zinc supplementation, decreases significantly. Zinc supplementation also reduces diarrhoeal episodes and stool volume 5,7,13-18

Diarrhoea and malnutrition remain major health problems among children of developing countries. Malnourished children are often zinc deficient and marginal body zinc stores may be further depleted during diarrhoea through fecal zinc losses, which may be as high as 159 mg/kg/d. It has been shown that zinc supplementation during nutritional rehabilitation of the severely malnourished children results in rapid weight gain. 19-21

**Conclusion**

Duration of diarrhoea improvement, frequency of diarrhoeal episodes and stool volume decrease significantly with oral zinc supplementation among malnourished children with acute diarrhoea.

**References**