ORIGINAL ARTICLE

Role of Zinc Supplementation in Young Children with Acute Watery Diarrhoea

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ABSTRACT

Objective: The objective of this study is to find out the role of zinc supplementation in young children with acute watery diarrhoea.
Setting: Department of Paediatrics, Lahore General Hospital Lahore.
Duration: March 2007 to March 2008.
Study design: Quasi-experimental study.
Method: Sample was taken by none Probability convenience technique and 300 children of both sexes aging 6 month to 02 years of acute water diarrhoea were included. These cases were divided into two groups, first 150 patients as study group who were given 20mg of zinc daily and next 150 patients as control group who were treated without zinc supplementation. Reduction of stools on follow up at day 7 and day 14 was compared between two groups.
Results: Total number of patients in our study was 300. The mean age in study group was 13.1 ± 6.3 months and in control group was 13.1 ± 6.4 months. The mean stool frequency on first follow up visit in study group was 3.2 ± 1.5 stools and in control group was 4.2 ± 1.6 stools. The mean stool frequency on second follow up visit in study group was 2.5 ± 2.0 stools in control group was 3.6 ± 2.3 stools. In the distribution of final results, in study group 122 (81.3%) patients improved and 28 (18.7%) not improved after two weeks of treatment. In control group 107 (71.3%) patients improved and 43 (28.7%) patients did not.
Conclusion: Zinc supplementation is an effective in reducing frequency and severity of acute watery diarrhoea in children.
Key words: Zinc supplementation, Acute watery diarrhoea, ORS.

INTRODUCTION

Acute watery diarrhoea is the passage of liquid or watery stool or frequent passage of stool. Acute watery diarrhoea is more common in young children with highest occurrence rate in infants of 6-12 month age group. Acute diarrhoea occurs more frequently in summer and equally effect both sexes[1]. It is estimated that over 1 billion episodes of diarrhoea occurs every year worldwide and causes more than 3.5 million deaths annually[2]. Globally, 4% of all deaths and 5% of health loss occurs due to diarrhoea. It is responsible for 2.2 million deaths per year, worldwide[3]. In Pakistan, mortality from diarrhoea is 200,0000 deaths per year (600 deaths per day) and upto 5-6 episodes occur in each child annually[4]. Rotavirus, Enterotoxigenic E.Coli and Vibrio cholerae are the most common pathogens causing acute diarrhoea in our country. Acidosis, shock, septecemia and electrolyte derangements are the major complications[5.6].

Conventionally, diarrhoea is managed by rehydrating the patient according to the degree of dehydration, either by oral-rehydration solution or intravenous fluids[7]. Use of zinc, anti-emetics and provision of adequate nutrition are other aspects of diarrhoea management[4.7]. Antibiotics are not routinely recommended in acute diarrhoea except in selective conditions like cholera and shigellosis[7]. These treatment modalities may cause adverse effects like increase in stool output and paralytic ileus[4].

Rotavirus is the leading cause of acute diarrhoea worldwide and a major cause of morbidity and mortality in children of developing countries. It is said to infect almost all children under 5 years.[8] Acute diarrhoea is also caused by astrovirus, novovirus, certain parasites and bacteria.

Acute diarrhoea is a major problem of Pakistani children and is associated with poor hygiene and sanitation. Malnourished and immunocompromised children are at highest risk. Lack of breast feeding, unhygienic bottle-feeding practices, and uneducated mothers put infants at risk[9].

Zinc is a trace element essential for growth and developing, cellular immunity and metalloenzymes. It stabilizes cell membrane. Zinc deficiency is more common in malnourished and immunocompromised children and causes severe and prolonged diarrhoea, dry scaly skin and hair loss[10].

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Among children in developing countries illnesses, especially those of prolonged duration, are important causes of growth retardation and death[11,12,13,14,15]. Episodes of diarrhea, which usually resolve within a few days in a healthy child, persist longer in children with malnutrition, [16,17] impaired cellular immunity[17,18,19] or recurrent diarrhea[20].

Two recent advances in the managing diarrhea disease include newly formulated oral rehydration salts (ORS) containing lower concentrations of glucose and salt and zinc supplementation in acute diarrhoea drastically reduce mortality and duration and severity of diarrhoea episode.[21] It is estimated that more than 1 million deaths related to diarrhoea may have been prevented each year, largely by use of these two therapies.

The study conducted by Bhatnager and his colleague's shows effect of zinc treatment as an adjunct to oral rehydration therapy on stool output and diarrhoeal duration in children with acute non-cholera diarrhoea with dehydration was evaluated. Zinc treatment reduced total stool output and stool output per day of diarrhoea. The risk of continued diarrhoea was lower and the proportion of diarrhoeal episodes lasting >5 days or >7 days was less in the zinc group. The study demonstrated a beneficial effect of zinc administered during acute diarrhoea on stool output, diarrhoeal duration, and proportion of episodes lasting more than 7 days. The effects were significant to merit routine use of zinc during acute diarrhoea developing countries.[22] Zinc supplementation was effective in reducing diarrhoeal morbidity at the community level and it was operationally feasible.[23] Majority of studies on zinc supplement have been done in developed world where the etiological profile of diarrhoea is quite different from that of developing countries. Thus, although zinc supplement may look promising but their effect needs to be substantiated in our population before they are included in the routine management of acute diarrhoea. This study is designed to evaluate the impact of zinc supplementation on acute watery diarrhoea.

METHOD

Three hundred admitted patients of acute watery diarrhoea and fulfilling the inclusion criteria were selected from Department of Paediatrics, Lahore General Hospital Lahore. Informed consent was obtained from parents of all the patients. The diagnosis was confirmed on the basis of history, duration and frequency of diarrhoea. The patient's age, sex and address were obtained. The history of diarrhoea (duration and frequency) and associated relevant history (fluid intake and feeding status) were also taken. The clinical examination was done and these cases were divided into two groups, first 150 patients as study group and next 150 patients as control group. In study group patients were given 20mg of zinc daily while in control group patients were treated without zinc supplementation. At discharge patients were given desired drug for home use and the patients were followed twice after 7 days and 14 days and reduction of diarrhoea i.e. stools per day was noted. All the data were collected on a specified proforma.

The collected information were entered into SPSS version 10 and analyzed accordingly. The quantitative variables like age, weight, duration of diarrhoea, stool frequency, fluid intake, hospital stay, stool frequency on first follow up visit, and stool frequency on second follow up visit were presented as mean and standard deviation. The qualitative variables like sex, feeding status, drugs, dehydration, treatment and result were presented as frequency and percentages. Student's 't' test was applied on hospital stay, stool frequency at first follow up visit (7 days) and stool frequency at second follow up visit (14 days). Chi square test was applied on final results to see the significance difference of improvement between the two groups. P value of <-0.05 was considered as significant.

RESULT

The mean age in study group was 13.1±6.3 months and mean age in control group was 13.3±6.4 months. In study group there were 99(66%) patients in the age range of 6-12 months, 22(14.7%) patients in the age range of 13-18 months and 29 (19.3%) patients in the range group of 19-24 months. In control group there were 101(67.3%) patients in the age group of 6-12 months, 19(12.7%) patients in the age group of 13-18 years and 30(20%) patients in the age group of 19-24 years (table 1).

In the distribution of sex, in study group there were 78(52%) male patients and 72(48%) female patients. In control group, there were 84(56%) male patients and 66(44%) female patients.

The mean weight in study group was 7.9±1.9 kg and in control group was also 7.9±1.9 kg. In study group there were 34(22.7%) patients in the weight range of 4.0-6.0 kg, 48(32%) patients in the weight range of 6.1-8.0 kg, 54(36%) patients in the weight range of 8.1-10.0 kg and 14(9.3%) patients in the weight range of 10.1-12.0 kg. In control group, there were 32(21.3%) patients in the weight range of 4.0-6.0 kg, 42(28%) patients in the weight range of 8.1-10.0 kg and 18(12%) patients of 10.1-12.0 kg.

The mean duration of diarrhoea in study group was 4.7±3.6 days in control group 4.4±3.2 days. In

study group there were 80 (53.3%) patients of duration diarrhoea of 1-3 days, 31(20.7%) patients of 4-6 days, 11 (7.3%) patients of 7-9 days, 24(16%) patients of 10-12 days and 4(2.7%) patients of 13-15 days. In control group there were 84(56%) patients of duration of diarrhoea of 1-3 days, 30(20%) patients of 4-6 days, 17 (11.3%) patients of 7-9 days and 19(12.7%) patients of 10-12 days (table 2).

The mean frequency of stool in study group was 11.0±3.4 stools and in control group was10.8 ± 3.1 stools. In study group there were 2(2%) patients of frequency of stool of up to 5 stools, 74 (49.7%) patients of 6-10 stools, 63(42%) patients of 11-15 stools, and 10(6.7%) patients of 16-20 stools. In control group there was 1 (0.7%) patient of frequency of diarrhoea of up to 5 stools, 74(49.3%) patients of 6-10 stools, 68(15.3%) patients of 11-15 stools and 7(4.7%) patients of 16-20 stools.

The mean fluid intake in study group was 68.7 ± 22.7 mls and in control group was 54.5 ± 25.6 mls. In study group there were 15(10%) patients of no oral fluid intake(ORS etc), 59 (39.3%) patients of up to 50 mls, 73(48.7%) patients of 50-100 mls and 3 (2%) patients of more than 100 mls. In control group there was 4(2.7%) patients of no fluid intake, 73(48.7%) patients of up to 50 mls, 72(48%) patients of 50-100 mls and 1(0.7%) patient of more than 100 mls.

In the distribution of feeding status, in study group there were 10(6.7%) patients on breast feeding and breast feeding and fresh milk, 2 (2%) patients of breast feeding and cereals, 1(0.7%) patients of bottle feeding, 2 (1.3%) patients of bottle feeding and cereals, 8(5.3%) patients of fresh mild and cereals, 15 (10%) patients on fresh milk, 14(9.3%) patients of mixed and 87(58%) patients on mixed and cereals. In control group there were 3(2%) patients on breast feeding, 9 (6%) patients on breast feeding and fresh milk, 4(2.7%) patients of breast feeding and cereals, 1(0.7%) patients of bottle feeding, 7(4.7%) patients of fresh mild and cereals, 16(10.7%) patients on fresh milk, 21(14%) patients of mixed, 2(1.3%) patients on mixed and fresh milk and 87 (58.%) patients on mixed and cereals.

In study group there were 40(26.7%) patients on no drug, 83(55.3%) patients on antibiotics, 20(13.3%) patients on kaolin and pectin and 7(4.7%) patients on antibiotics and kaolin and pectin. In control group there were 39(26%) patients on no drug, 78(52%) patients on antibiotics, 32(21.3%) patients on kaolin and pectin and 1(0.7%) patients on antibiotics and kaolin and pectin.

In study group 21(14%) patients had no dehydration, 88(58.7%) patients had some dehydration and 41(27.3%) patients had severe dehydration. In control group 30(20%) patients had no dehydration, 72(48%) patients had some dehydration and 48(32%) patients had severe dehydration.

In study group 2(1.3%) patients were on antibiotics, 40(26.7%) patients were on antibiotics and intravenous fluid, 86(57.3%) patients were on intravenous fluid and ORS and 22(14.7%) patients on ORS. In control group 50(33.3%) patients were on antibiotics and intravenous fluid, 77(51.3%) patients were on intravenous fluid on ORS and 23(15.3%) patients on ORS.

The mean hospital stay in study group was 1.9±0.9 days and in control group 1.8±1.0 days (P 0.3). The mean stool frequency on first follow up visit in study group was 3.2±1.5 stools and in control group was 4.2±1.6 stools (P 0.8) (table 3). The mean stool frequency on second follow up visit in study group was 3.5±2.9 stools and in control group was 3.6±2.8 stools (table 4).

In the distribution of final results, in study group 122(81.3%) patients improved and 28(18.7%) patients did not. In control group 107(71.3%) patients improved and 43(28.7%) patients did not improved (P 0.001) (table 5).

DISCUSSION

Acute diarrhoea is a major cause of mortality and morbidity in developing countries and is estimated to kill around 8-10 million children annually in the world. It accounts for about 25% of total admission in children wards and carries the mortality of 5-10% in the community. The incidence and mortality is especially high in infancy and more so in the presence of malnutrition and lack of breast-feeding. Every child has about 3-6 episodes of diarrhoea each year and maximum in first year[24].

Table 1: Distribution of patients by age

Age	Study Group (n=150)		Control Group (n=150)	
	=n	%age	=n	%age
6-12	99	66.0	101	67.3
13-18	22	14.7	19	12.7
19-24	29	19.3	30	20.0
Mean±SD	13.1±6.3		13.1±6.4	

Acute diarrhoea is a major problem of Pakistani children and is associated with poor hygiene and sanitation. Lack of breast feeding, Unhygienic bottle-feeding practices, and uneducated mothers put infants at risk[9].

Zinc is a trace element essential for growth and development. Zinc deficiency causes sever and prolonged diarrhoea, dry scaly skin and hair loss.[10]

In a study conducted by Gupta DN and his colleagues shows the effect of zinc supplementation on diarrhoea incidence and to discover any

operational constraints of zinc supplementation at the community level was evaluated. The incidence of diarrhoea was significantly less during the supplemented period in the zinc group. A significant difference was also noted during the follow up period. In the zinc group, children <2 years of age had significantly less diarrhoea during supplementation and the follow up period. Multiple episodes of diarrhoea were significantly less in the zinc group. Approximately 85% of the surveillance workers made weekly visits to the houses and 96% of mothers administered syrup weekly to their children. Around 80% of mother's were aware of the possible benefits of zinc supplementation. Weekly zinc supplementation was effective in reducing diarrhoeal morbidity at the community level and it was operationally feasible[23].

In our study the mean age of the patients in study group was 13.1 ± 6.3 months and in control group was 13.1+-6.4 months. As compared with the study of Reither et al [25] the mean age of the patients was 10 months, which is comparable with our study.

Table 2: Distribution of patients by duration of diarrhoea

Duration (days)	Study Group (n=150)		Control Group (n=150)	
	=n	%age	=n	%age
1-3	80	53.3	84	56.0
4-6	31	20.7	30	20.0
7-9	11	7.3	17	11.3
10-12	24	16.0	19	12.7
13-15	4	2.7	0	0
Mean±SD	4.7±3.6		4.4±3.2	

In our study the mean duration of diarrhoea in study group was 4.7±3.6 days and in control group 4.4±3.2 days. As compared with the study of Bhandari et al[21] the mean duration of diarrhoea was 4.3 days in group I and 3.9 days in group II, which is comparable with our study.

In our study the mean frequency of stool in study group was 11.0±3.4 stools and in control group was 10.8±3.1 stools. As compared with the study of Bhandari et al[21] the mean frequency of stool was 10 stools in group I and 13 stools in group II, which is also comparable with our study.

Table 3: Distribution of patients by stool frequency on 1st follow up visit

Stool frequency	Study Group (n=150)		Control Group (n=150)	
	=n	%age	=n	%age
1-3	55	36.7	57	38.0
4-6	89	59.3	89	59.3
7-9	6	4.0	4	2.7
Mean±SD	4.2±1.7		4.2±1.6	

P 0.9

The mean stool frequency on first follow up (i.e. 7days) visit in study group was 3.2±1.5 stools and in control group was 4.2±1.6 stools. As compared with the study of Sazawal et al[26] on first follow up visit the stool frequency in the zinc-supplementation group the mean (±SD) number of watery stool per day was 3.1±9.9, as compared with 5.1±14.9 in the control group, which is almost same and comparable with our study.

Table 4: Distribution of patients by stool frequency on 2nd follow up visit

Stool frequency	Study Group (n=150)		Control Group (n=150)	
	=n	%age	=n	%age
1-3	122	81.3	117	78.0
4-6	4	2.7	6	4.0
7-9	12	8.0	13	8.7
>9	12	8.0	14	9.3
Mean±SD	3.5±2.9		3.6±2.8	

P 0.8

The mean stool frequency on second follow up visit in study group was 2.5±2.0 stools and in control group was 3.6±2.3 stools. As compared with the study of Sazawal et al[26] on second follow up visit the stool frequency in the zinc-supplementation group the mean (±SD) number of watery stools per day was 2.1± 5.9, as compared with 3.1± 4.9 in the control group, which is almost some and comparable with our study.

In the distribution of final results, in study group there were 81.3% patients improved and in control group there were 71.3% patients improved. As compared with the study of Sazawal et al[26] in the zinc-supplementation group 86% patients improved, which is comparable with our study.

Table 5: Distribution of patients by results

Results	Study Group (n=150)		Control Group (n=150)	
	=n	%age	=n	%age
Improved	122	81.3	107	71.3
Not improved	28	18.7	43	28.7
Total	150	100.0	150	100.0

P 0.001

Zinc treatment reduced total stool output and stool output per day of diarrhoea. The risk of continued diarrhoea was lower and the proportion of diarrhoeal episodes lasting >7 days was less in the zinc group. The study demonstrated a beneficial effect of zinc administered during acute diarrhoea on stool output, diarrhoeal duration, and proportion of episodes lasting more than 7 days. The effects are

large enough to merit routine use of zinc during acute diarrhoea in developing countries[26].

CONCLUSION

Zinc supplementation reduces the duration and frequency of acute watery diarrhoea as compared to children without zinc supplementation. The study indicates that zinc supplementation is effective in reducing frequency and severity of diarrhoea in children.

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