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Original Article

Study of zinc supplementation in children suffering from acute diarrhoea in Kanti children's hospital

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ABSTRACT

The purpose of this study was to evaluate the effectiveness of zinc supplementation in reducing frequency of diarrhea in children. An observational study was done among 37 patients in Kanti Children's Hospital, from December 2009 to May 2010. The patients were distributed in three groups. Information was taken according to the designed proforma and data was analyzed by using SPSS 16.0. At the fifth day, the average frequency of stool passing per day was 3.69 ± 1.377 (for ORS group) and 2.33 ± 0.985 (ORS and zinc for 5days) and 2.33 ± 0.492 (ORS and zinc for 10 days). At tenth day the average frequency of passing stool was 2.46 ± 0.519 (for ORS group), 2.08 ± 0.515 (for ORS and 5days zinc) and 2.33 ± 0.492 (for ORS and 10days zinc). The average frequency of diarrhoea in children of all three groups was around two episodes per day at the tenth day. Comparison of the average frequency of diarrhoea of children in three groups showed significant difference (P= 0.002) only at 5th day; however acute diarrhoea disappeared in all groups at tenth day. About 21 patients taking zinc developed vomiting. Other effects like fatigue, stomach upset were rarely observed.

Keywords: Acute diarrhoea, Zinc, ORS

INTRODUCTION

Diarrhoea is too frequent passage of poorly formed stools. In pathological terms, it occurs due to passage of excess water in faeces [1]. Diarrhea can range in severity from an acute self-limited episode to a severe, life-threatening illness [2]. Liquid stools are usually passed more than three times a day. However, it is the recent change in consistency and character of stools rather than the number of stools that is more important [3].

Acute diarrhea is a diarrhea acute in onset and persisting for less than 2 weeks and is most commonly caused by infectious agents, bacterial toxins (either preformed or produced in the gut), or drugs. Community outbreaks (including nursing homes, schools, and cruise ships) suggest a viral etiology or a common food source. Similar recent illnesses in family members suggest an infectious origin. Ingestion of improperly stored or prepared food implicates food poisoning. Exposure to unpurified water may result in infection with *Giardia* or *Cryptosporidium*. Diarrhoea after recent travel abroad suggests "traveler's diarrhea" [2]. The pathogenesis of traveler's diarrhoea is based upon the transmission of fecally contaminated sources that contain enterotoxins that are not inactivated by cooking or processing [4]. Currently, international health agencies recommend zinc as an important adjunct therapy to treat diarrhoea in developing countries where zinc deficiency is highly prevalent and diet is poor in zinc. The recommendation is to provide 20 mg elemental zinc daily for 10 days during each episode of diarrhea [5].

Diarrhoeal diseases constitute a major cause of morbidity and mortality worldwide; especially in developing countries. Acute diarrhoea is a leading cause of death in children below five in developing countries [6]. Oral rehydration salts (ORS) and oral rehydration therapy (ORT), adopted by UNICEF and WHO in the late 1970s, have been successful in helping manage diarrhoea among children. It is

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estimated that in the 1990s, more than 1 million deaths related to diarrhoea may have been prevented each year, largely attributable to the promotion and use of these therapies [7].

Two recent advances in managing diarrhoeal disease – newly formulated oral rehydration salts (ORS) containing lower concentrations of glucose and salt, and use of zinc supplementation – can drastically reduce the number of child deaths [8]. Most people are affected by diarrhoea at some time in their lives. It is often accompanied by stomach pains, feeling sick and vomiting. Diarrhoea normally only lasts for a few days, but it can be very stressful when it occurs. Globally, seven children die of diarrhoea every minute, mainly due to poor quality drinking water and malnutrition, which still affects the majority of the world population [9]. Rotavirus is an important pathogen in developing countries as well as developed countries, and is associated with poor hygienic conditions. It is the single most important causal agent of acute watery diarrhea leading to severe dehydration. Rotavirus disease is characterized by vomiting, fever, and profuse watery diarrhea; this combination rapidly results in dehydration and necessitates a visit to treatment centre, if accessible [10]. Zinc deficiency play a role in childhood diarrhoea and zinc supplementation might be of benefit either for improving outcomes or as prophylaxis against diarrhoea. Possible mechanisms for the effect of zinc treatment on diarrhoea are as follows:

- Improved absorption of water and electrolytes by the intestine
- Faster regeneration of gut epithelium
- Increased levels of enterocyte brush border enzymes, and
- Enhanced immune response, leading to early clearance of diarrhoeal pathogens from the intestine **[**19].

One of the new researches based on its beneficial effects of zinc in infections, including pneumonia, it has been shown to be effective in the treatment of acute diarrhea in several randomized controlled trials including subsequent meta-analyses. Thus, an emerging body of clinical data indicates that zinc can be useful for treating acute diarrhea. And thus the recent studies have indicated that zinc acts as a K channel blocker of adenosine 3′, 5′-cyclic monophosphate–mediated chlorine secretion, but may not affect either Ca^{2+}- or guanosine 3′, 5′-cyclic monophosphate–mediated chlorine secretion. These data provide a strong rationale for further trials testing its efficacy in specific clinical settings and for more detailed physiologic studies examining how zinc exerts its anti-diarrheal effect [20].

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OBJECTIVES

General objective: To study the effect of zinc supplementation in reducing frequency of diarrhoea and severity of dehydration, in children

Specific objectives

1. To compare efficacy of zinc supplemented ORS to the ORS monotherapy in reducing frequency diarrhea among children.
2. Compare the effectiveness of two courses of zinc therapies i.e. 5 days and 10 days zinc therapy.
3. To access any side effects of zinc supplementation in children.

MATERIALS AND METHODOLOGY

STUDY TYPE: Observational type study

SITE OF STUDY: Kanti Children's Hospital, Maharajgunj, Kathmandu

STUDY POPULATION: Children between the age of 2 months to 5 years attending to Kanti Children's hospital with acute diarrhea

STUDY DURATION: December 2009 to May 2010

MONITORING PARAMETER:

- Demographic pattern
- Vitals [Pulse rate(PR), Respiratory rate (RR) , Temperature]
- Severity of dehydration
- Urine output
- Side effects of zinc
- Frequency of diarrhea

INCLUSION CRITERIA:

- Children more than 2 months and less than 5 years with acute diarrhoea.
- Absence of complication or co-morbidities.

EXCLUSION CRITERIA:

- Diarrhoea more than 2 weeks duration
- Unable to eat or drink
- Patients/ or their guardians not willing to participate.

OPERATIONAL MODALITY: The patients were distributed in three groups. The first group received ORS only for management of their diarrhoea. Second group was given ORS and zinc for 5 days and third group was given ORS and zinc combination for 10 days. Information was taken according to the designed questionnaire and data was analyzed using SPSS 16.0.

RESULT

Diarrheal incidence was found highest in 2 to 12 months and lowest in 49 to 60 months children. We found negative correlation between age (months) and average frequency of diarrhoea by using Pearson correlation (r = -0.3).

Age-wise distribution of patients		
Age grouping	No. of patients	Average episodes of diarrhoea before coming to hospital
2 months – 12 months	16	12.5
13 months – 24 months	13	9.15
25 months - 36 months	4	8.25
37 months – 48 months	3	8.33
49 months – 60 months	1	6
Total	37	

Twenty four patients were residents of Kathmandu valley. Thirteen patients living outside of Kathmandu valley also attended this hospital. In this study, there were more male child (n = 21) than female. The median respiration rate was found to be 30 per minute (normal respiration rate considered in child of 12 months to 60 months is <40 and <50 for child of 2-12 months old). The median value for temperature was 98.6. Pulse rate was increased by value of ten (mean pulse rate was 110, normal range is 80-100 per minute). 59.50% i.e. n=22 of children were having some dehydration, 12 children were lucky with no symptoms of dehydration but 3 children were suffering from severe dehydration [Fig 1].

Children suffering from severe dehydration suffered from thirst, skin turger, sunken eyes as well as weakness and were hospitalized. Children suffering from no dehydration had none of these symptoms and children suffering from some dehydration had mild thirst and slightly sunken eyes with no skin turger. Knowledge of severity of dehydration by recognizing the clinical signs and proper use of ORS for the treatment of dehydration must be also known to guardians. Two patients were having no urine output since last 24 hours and the symptoms and signs like thirst, dry mucosa etc were present due to significant depletion of body water [Fig 2]. In this study, 21.6% patient taking zinc suffered from the vomiting. Other effects like fatigue, stomach upset were rarely observed [Fig 3].

Comparison of the average frequency of diarrhea of children in three groups showed significant difference (P= 0.002) only at 5^{th} day, however the average frequency of diarrhoea in the 5^{th} days was same in both groups taking zinc for 5 days and for 10 days. There was no significant difference in the frequency of diarrhea in the third day and at tenth day in all these three groups. At the third day the average frequency of stool passing per day was 4 ± 1.354 for ORS group, 3.42 ± 1.730 for ORS ± five days zinc and 2.83 ± 1.403 for ORS and ten days zinc group. At the fifth day the average frequency of stool passing per day was 3.69 ± 1.377 (for ORS group) and 2.33 ± 0.985 (for ORS and 5days zinc) and 2.33 ± 0.492 (for ORS and 10 days zinc), but at the tenth day the average frequency of passing stool was 2.46 ± 0.519 (for ORS group), 2.08 ± 0.515 (for ORS and 5days zinc) and 2.33 ± 0.492 (for ORS and 10days zinc) [Fig 4].

DISCUSSION

Diarrhoea is defined as the passage of loose, liquid or watery stools. These liquid stools are usually passed more than three times a day [3]. In this study, 12 children were lucky with no symptoms of dehydration but 3 children were suffering from severe dehydration. Children suffering from severe dehydration suffered from thirst, skin turger, sunken eyes as well as weakness and were hospitalized. Children suffering from no dehydration had none of these symptoms and

children suffering from some dehydration had mild thirst and slightly sunken eyes with no skin turger. Knowledge of severity of dehydration by recognizing the clinical signs and proper use of ORS for the treatment was provided to guardians. If dehydration remains untreated, tachycardia, hypotension, and shock may occur leading to death. Infants are particularly susceptible to the ill effects of dehydration because of their greater baseline fluid requirements (due to a higher metabolic rate), higher evaporative losses, and inability to communicate thirst or seek fluid. Monitoring of urine output is very important as decreased urine output may lead to renal failure. Two patients had no urine output for one day in our study.

Comparison of the average frequency of diarrhea of children in three groups showed significant difference (P= 0.002) only at 5th day, however the average frequency of diarrhoea in the 5th days was same in both groups taking zinc for 5 days and for 10 days. Thus, it is seen in our study that zinc plays role in faster decrease in frequency of diarrheal episodes. However, there was no significant difference in the frequency of diarrhea at tenth day in all these three groups. For recommendation of zinc as adjunct to the management of acute diarrhoea in children need to carry out more studies in large population. In the study done by P Boran, G Tokuc, E Vagas et al. on impact of zinc supplementation in children with acute diarrhoea in Turkey, the similar result was obtained as the number of stools after starting supplementation was 5.8±3.7 and 5.1±3.9 on day 1, 2.9±1.6 and 3.0±2.2 on day second, and 1.8±1.1 and 1.6±0.9 on day third in the zinc and control groups, respectively [19]. The consequences of severe human zinc deficiency have been known since the 1960's, which are highly prevalent in developing countries. There was no prompt use of antibiotics in Kanti Children' Hospital, as in private clinics. This is a very good practice as misuse of antibiotic may lead to problem of resistance. To improve the programmatic use of zinc, further evaluations of the zinc salts used, the dose, the frequency and duration of supplementation, plasma zinc level and its acceptability are required. The mechanism of action of the zinc in diarrhea should also be studied in detail.

Vomiting was a major side-effect observed in our study. Administration of zinc, even for a short time, can cause stomach cramps, nausea, and vomiting. For patients who had vomiting, zinc was restarted only after the frequency of vomiting decreased. An occasional vomiting does not need treatment. In such cases the children can easily tolerate sips of water or oral rehydration solution. If a child vomits during oral rehydration therapy, it is best to stop ORT for ten minutes and then restart ORT again. We observed that this guideline was being followed in Kanti Children's Hospital. ORT therapy was stopped for a while and the mothers were encouraged to give sufficient liquid by spoon to their children during observation of these cases in the ward in the data collection time.

CONCLUSION

In this study, by comparing the average frequency of diarrhoea of children of three groups, we found that zinc supplementation in addition with ORS caused faster decrease in diarrheal episodes in children as there was significant reduction in frequency of diarrhoea at 5th day; however acute diarrhoea disappeared in all groups at tenth day. Further study in larger population is recommended.

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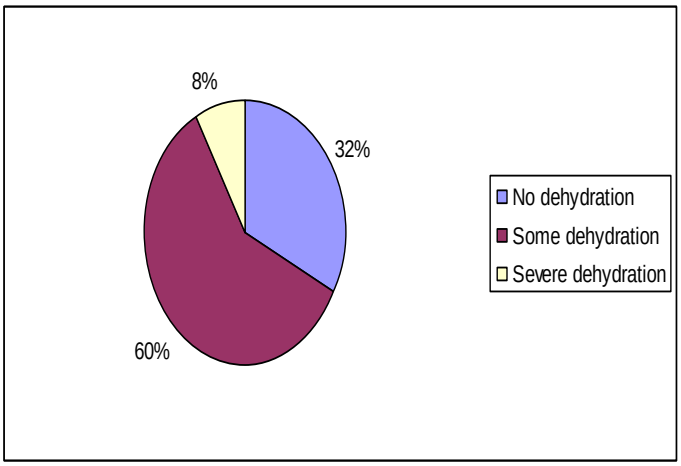


Fig1

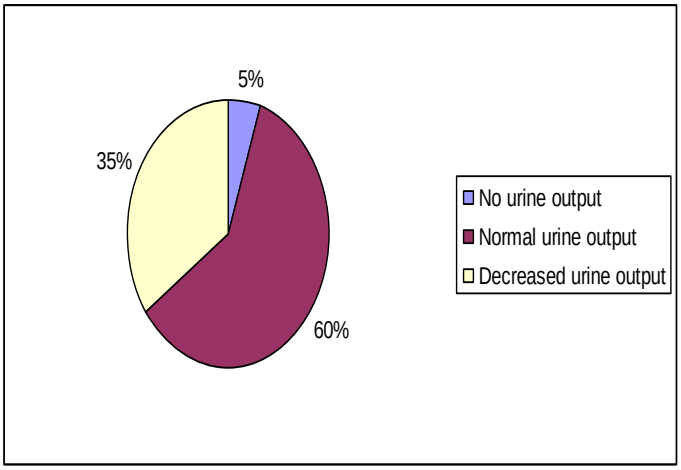
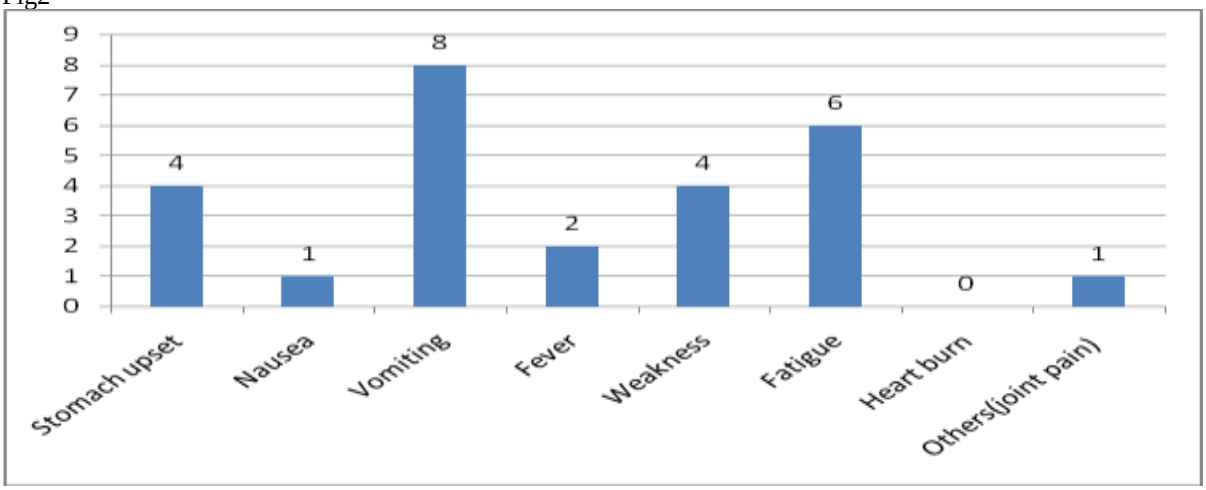
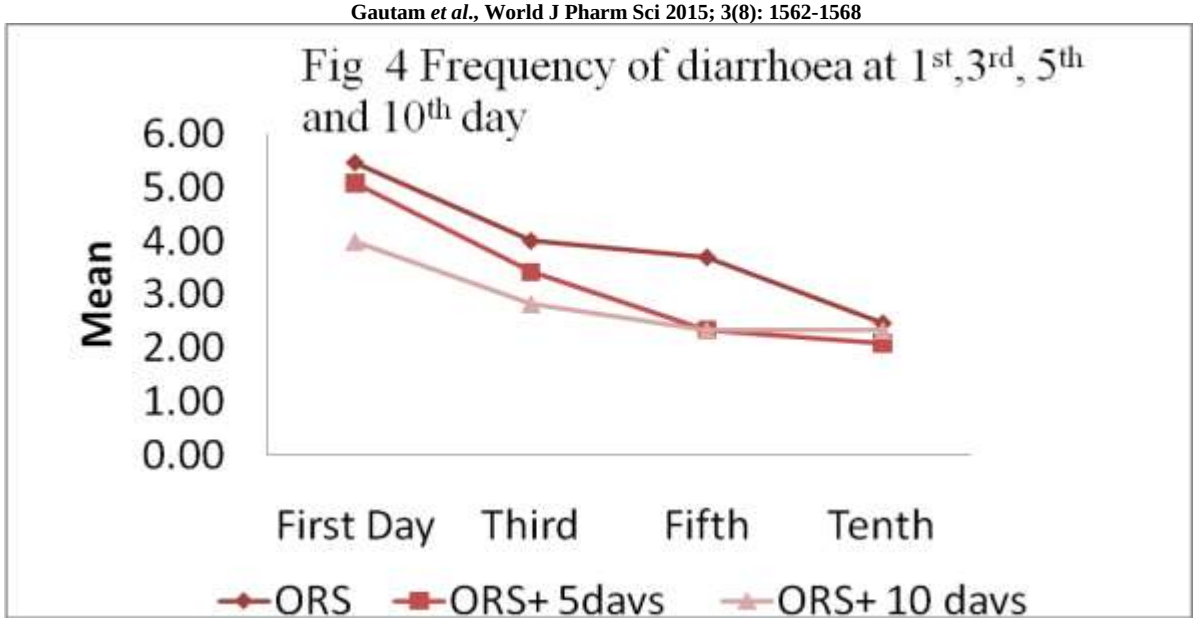


Fig2



Side-effects of Zinc therapy

Fig3



Comparison of decrease in frequency of diarrhoea using ANOVA table

SN	Days of medication	Groups	n	Mean	Standard deviation	P-value	F-value
1.	Decrease in diarrhoea at 1st day	0	13	5.46	2.025	0.199	1.66
		1	12	5.08	2.275		
		2	12	4	1.809		
		Total (N) = 37		4.86	2.084		
2.	Decrease in diarrhoea at 3rd day	0	13	4	1.354	0.167	1.89
		1	12	3.42	1.730		
		2	12	2.83	1.403		
		Total (N) = 37		3.43	1.537		
3.	Decrease in diarrhoea at 5th day	0	13	3.69	1.377	**0.002**	**7.39**
		1	12	2.33	0.985		
		2	12	2.33	0.492		
		Total (N) =37		2.81	1.198		
4.	Decrease in diarrhoea at 10th day	0	13	2.46	0.519	0.186	1.74
		1	12	2.08	0.515		
		2	12	2.33	0.492		
		Total (N) =37		2.30	0.520		

***** From ANOVA table *(Table value = 3.28)*

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