Original Research Article

**Efficacy of zinc therapy in acute diarrhea in children**

Suman Chirla¹*, Satish Datla²

1Department of Pediatrics, NRI Medical college, Visakhapatnam, Andhra Pradesh, India
2Department of Pediatrics, GSL Medical college, Rajahmundry, Andhra Pradesh, India

Received: 27 July 2018
Accepted: 31 August 2018

*Correspondence:
Dr. Suman Chirla,
E-mail: drchirlasuman@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

**ABSTRACT**

**Background:** Diarrhoea is a major public health problem in developing countries. An estimate of 1.5 billion episodes of diarrhoea occurs each year and 3 million children under the age of 5 years die due to diarrhoea. Its effect is particularly devastating on children below 2 years of age, with eighty percent (80%) of deaths due to diarrhoea occurring during the first 2 years of life. Diarrhoeal diseases constitute 18% of under five deaths in Asia-Pacific countries.

**Methods:** The present study was carried out in Anil Neerukonda hospital, Visakhapatnam from July’2015 to July’2017 over a period of 2 years. A detailed clinical study of 100 children between the age group of 6 months to 5 years with acute diarrhoea was done. Zinc was given to 50% of cases and was not given to the rest of 50%. Duration of hospital stay (in days) and duration of diarrhoeal episodes (in days) were compared in both the groups.

**Results:** Incidence of acute gastroenteritis was maximum below 2 years of age (77%). Patients administered with Zinc had significantly less duration of hospital stay 3.35 days vs. 5.34 days (in patients who were not administered zinc) with t=8.170 and a strongly significant p<0.001.

**Conclusions:** Incidence of acute gastroenteritis is maximum below 2 years of age. Patients in zinc group had significantly less duration of hospital stay and less proportion diarrhoeal episodes on follow up compared to the non-zinc group.

**Keywords:** Acute gastroenteritis, Diarrhea, Zinc

**INTRODUCTION**

Diarrhoea is a major public health problem in developing countries. An estimate of 1.5 billion episodes of diarrhoea occur each year and 3 million children under the age of 5 years die due to diarrhoea.¹ Its effect is particularly devastating on children below 2 years of age, with eighty percent (80%) of deaths due to diarrhoea occurring during the first 2 years of life.² Diarrhoeal diseases constitute 18% of under five deaths in Asia-Pacific countries.³ Accurate data on the global extent of the problem of diarrhoeal diseases are difficult to obtain, but an analysis of the findings of 27 active surveillance studies conducted for one year or more done in 1983 suggests that around 750 million children below 5 years of age in Asia, Africa and Latin America suffer from acute diarrhoea each year.² From the same study, it is estimated that between 3 and 6 million in this age group die annually from acute diarrhoea; 80% of these deaths occur in the first 2 year of life. Such repeated attacks of diarrhoea lead to malnutrition and growth retardation because of associated food restriction by mothers, anorexia and malabsorption.² Two recent studies presented global estimates of child deaths due to diarrhoea that were equal to 2.5 million and 2.1 million.⁴⁵ A third review has estimated that 22% of all deaths...
among under-5s in sub-Saharan Africa and 23% in south Asia were caused by diarrhoeal diseases in the year 2000.\textsuperscript{6} Diarrhoea is a particularly deadly illness for young children, with acute diarrhoea liable to cause death within a day or less if left untreated.\textsuperscript{7} In India the situation is no different. Diarrhoeal diseases remain a serious threat to child survival, with an estimated 9% of children suffering from this condition in India. India also has the highest rate of severely underweight children of any country in the Asia-Pacific region. Diarrhoeal diseases account for 15.4% of under 6 population in India which includes 16.5% of rural and 12.4% of urban population.\textsuperscript{7} In India, diarrhoeal diseases account for 1.7 episodes per child per year in under 5 population.\textsuperscript{8}

\section*{METHODS}

The present study was carried out in Anil Neerukonda hospital, Visakhapatnam from July’2015 to July’2017 over a period of 2 years. A detailed clinical study of 100 children between the age group of 6 months to 5 years with acute gastroenteritis was done.

\textbf{Inclusion criteria}

- Passage of liquid or watery stools with increased frequency and volume.
- Duration of illness of less than 2 weeks at the time of admission.
- Age group of between 6 months to 5 years.

\textbf{Exclusion criteria}

- Children with non-infectious causes of diarrhea
- Children suffering from dysentery.
- Children with congenital lactose intolerance and those on lactose free diets.
- Intolerance to cows’ milk.
- Deaths due to gastroenteritis.

Zinc was given to 50% of cases and was not given to the rest of 50%. The dose of zinc administered was 10mg OD for 14 days for children less than 1 year of age and 20mg OD for 14 days for children more than 1 year of age. Duration of hospital stay (in days) and duration of diarrheal episodes (in days) were compared in both the groups.

\textbf{Statistical methods}\textsuperscript{9,11}

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in Number (%).

Significance is assessed at 5 % level of significance. Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups Inter group analysis) 95% Confidence Interval has been computed to find the significant features. Confidence Interval with lower limit more than 50% is associated with statistical significance.

\section*{RESULTS}

A total of 100 cases between the age group of 6 months to 5 years were enrolled in the study. All 100 cases selected were among the in patients of Anil Neerukonda hospital.

They were selected randomly, once they were fulfilling the criteria for inclusion in the study. The study period was from July 2015 to July 2018.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Age in years} & \textbf{Number} & \textbf{\%} \\
\hline
<1 & 45 & 45.0 \\
1-2 & 32 & 32.0 \\
2-3 & 10 & 10.0 \\
3-5 & 13 & 13.0 \\
Total & 100 & 100.0 \\
\hline
\end{tabular}
\caption{Table 1: Age distribution.}
\end{table}

\textbf{Age distribution}

In table 1, the Incidence of acute gastroenteritis was maximum below 2 years of age (77%), especially during second half of infancy (45%). The distribution of gastroenteritis in various age groups is shown in the table below.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Gender} & \textbf{Number} & \textbf{\%} \\
\hline
Male & 51 & 51.0 \\
Female & 49 & 49.0 \\
Total & 100 & 100.0 \\
\hline
\end{tabular}
\caption{Table 2: Gender distribution.}
\end{table}

\textbf{Gender distribution}

In Table 2, there was a male preponderance. Out of 100 cases, 51% were males and 49% were females. Hindus accounted for 72% of all cases followed by Muslims (26%) and Christians (2%).

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Duration of illness in days} & \textbf{Number (n = 100 )} & \textbf{\%} \\
\hline
1-2 & 56 & 56.0 \\
3-4 & 28 & 28.0 \\
>4 & 16 & 16.0 \\
\hline
\end{tabular}
\caption{Table 3: Duration of illness at the time of presentation.}
\end{table}

\textbf{Duration of Illness at the time of presentation}

In Table 3, Fifty six percent of children presented with 1-2 days of illness and 32 days in 44% of children at the time of admission as shown in the table below.
Diarrhoea is a major public health problem in developing countries. An estimate of 1.5 billion episodes of diarrhoea occur each year and 3 million children under the age of 5 years die due to diarrhoea. Carbohydrate intolerance has been shown to be common during and immediately following an episode of diarrhea, particularly in infancy and childhood. Zinc deficiency has been found to be widespread among children in developing countries, and occurs in most of Latin America, Africa, the Middle East and South Asia. Intestinal zinc losses during diarrhea aggravate pre-existing zinc deficiency. Convincing evidence for its clinical importance has come from recent randomized controlled trials of zinc during acute diarrhea.

### DISCUSSION

Diarrhoal diseases account for 15.4% of under 6 population in India which includes 16.5% of rural and 12.4% of urban population. The incidence of acute gastroenteritis has varied in different areas of India among hospitalised cases. The incidence of diarrhoea cases in this study was 17.41%. Srivatsava JR et al, Hazra et al, Khanduja et al, and Behera SK et al reported this to be 24.6%, 18.64%, 5.5% and 11.3%.

Patients administrated with zinc had significantly less duration of hospital stay (3.35 days vs 5.34 days) with t=8.170; p<0.001.

### Table 5: Impact of zinc supplementation on duration of diarrheal episodes during follow up.

| Zinc   | No. of patients | Follow up days | 1-6 days | ≥7 days | ≥14 days |
|--------|-----------------|----------------|----------|---------|----------|
| Given  | 48              |                | 43(89.6) | 4(8.3)  | 1(2.1)   |
| Not Given | 49             |                | 35(71.4) | 12(24.5)| 2(4.1)   |
| Total  | 97              |                | 78(80.4) | 16(16.5)| 3(3.1)   |
| Inference |                |                |          |         | p<0.055+ |

### Impact of zinc supplementation on duration of diarrheal episodes during follow up

All cases were followed till 14 days, out of which 3 cases were lost for follow up. In the Table V, the incidence of diarrhoea during follow up was lower in zinc supplemented as compared with those who did not receive zinc on follow up 86.6% of children in zinc group recovered within 6 days compared to 71.4% in the non-zinc group.

In one case who received zinc supplementation, diarrheal episodes lasted till 14 days. This case was bacterial culture positive for Vibrio Cholerae and had sugar intolerance. Two cases who did not receive zinc had diarrheal episodes up to 2 weeks.

### Table 4: Efficacy of zinc administration based on duration of hospital stay in days.

| Hospital stay in days | Zinc administration | Total |
|-----------------------|----------------------|-------|
|                       | Not given | Given |     |
| 1-2                   | 1 (2.0)   | 13 (26.0)| 14(14.0)|
| 3-4                   | 6 (12.0)  | 31 (62.0)| 37(37.0)|
| 5-7                   | 42 (84.0) | 5 (10.0) | 47(47.0)|
| >7                    | 1(2.0)    | 1 (2.0)  | 2(2.0)  |
| Total                 | 50 (100.0)| 50(100.0)| 100 (100.0)|
| Mean ± SD             | 5.34±1.00 | 3.35±1.37| 4.36±1.55|

Efficacy of zinc administration based on duration of hospital stay in days

In Table IV, Zinc was given to 50% of children (for 14 days) and not given to the rest 50%. Efficacy of zinc in the treatment of diarrhoea was compared in terms of duration of hospital stay in these two groups. Patients administrated with Zinc had significantly less duration of hospital stay 3.35 days vs. 5.34 days (in patients who were not administrated zinc) with t=8.170 and a strongly significant p<0.001.
CONCLUSION

- Incidence of acute gastroenteritis is maximum below 2 years of age.
- Patients in zinc group had significantly less duration of hospital stay and less proportion diarrhoeal episodes on follow up compared to the non-zinc group.
- Zinc was given to 50% of children (for 14 days) and not given to the rest 50%. Patients administered with zinc had significantly less duration of hospital stay 3.35 days vs 5.34 days (in patients who were not administered zinc) with t=8.170 and a strongly significant p<0.001
- On follow up 86.6% of children in zinc group recovered within 6 days compared to 71.4% in the non-zinc group.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Bhatnagar S, Bhandari N, Mouli UC, Bhan MK. Consensus Statement of IAP National Task Force. Status Report on Management of Acute Diarrhea. Indian Pediatr. 2004;41:335-48.
2. Catherine P, Ranoa MD. Cost Reduction in the Treatment of Diarrheal Diseases by Oral Therapy. Phil J Microbiol Infect Dis. 1983;13(2):98-108.
3. Child Health Epidemiology Reference Group (CHERG) estimates available in World Health Organization, World Health Report. 2005.
4. Kosek M, Bern C, Guerrant R. The global burden of diarrhoeal disease as estimated from studies published between 1992 and 2000. Bull World Health Organ. 2003;81:197-204.
5. Parshar UD, Hummelman EG, Bresee JS, Miller MA, Glass RI. Global illness and deaths caused by rotavirus disease in children. Emerg Infect Dis. 2003;9:565-72. 6. Morris SS, Black RE, Tomskovic L. Predicting the distribution of under-five deaths by cause in countries without adequate vital registration systems. Int J Epidemiol. 2003;32:1041-51.
7. Estimation of the burden of diarrhoeal diseases in India. National Institute of Cholera and Enteric Diseases Kolkata. 2001.
8. WHO. Health situation in south-east asia region. Regional Office of SEAR, New Delhi. 1994-1997.
9. Bernard Rosner. Fundamentals of Biostatistics. 5th ed, Duxbury: 2000:80-240.
10. Venkataswamy Reddy M. Statistics for Mental Health Care Research. India: NIMHANS publication. 2002:108-44.
11. Sunder Rao PSS, Richard J. An Introduction to Biostatistics: a manual for students in health sciences. New Delhi: Prentice hall of India;86-160.
12. Riyaz A. Pediatric Gastroenterology and Hepatology. 3rd ed. Hyderabad, India: Parus; 2008:48-71,88-92.
13. Lee PC. Transient carbohydrate malabsorption and intolerance in diarrhea disease of infancy. Chronic Diarrhea of Children. 1984.
14. Heitlinger LA, Lebenthal E. Disorders of carbohydrate digestion and absorption: pediatric gastroenterology. Pediatr Clin North Am. 1988;2:239-53.
15. Khanduja PC, Bhargava SK. Aetiological aspect of diarrhoea in infants and children under 5 years. Indian J Pediatr. 1969;36:237.
16. Srivatsava JR, Verma V, Garg BK. Acute diarrhoea in childhood: a clinical and bacteriological study. Indian J Pediatr. 1968;35(244):217-25.
17. Hazra PK, Mohanty GP, Gupta JC. Infantile diarrhoea: a bacteriological and mycological study. Indian Pediatr. 1975;12:983-5.
18. Behera SK, Mohapatra SS. Incidence and mortality of hospitalized diarrhoea. Indian Pediatr cases. 1980;17:607-12.
19. Bhatnagar S, Bahl R, Sharma PK. Zinc with oral rehydration therapy reduces stool output and duration of diarrhea in hospitalized children: a randomized controlled trial. J Pediatr Gastroenterol Nutr. 2004;38(1):34-40.
20. Brown KH. Assessment of the risk of zinc deficiency in populations. Food Nutrition Bulletin. 2004;25(1):S130-S162.
21. World Health Organization. The world health report 2002: reducing risks, promoting healthy life. World Health Organization; 2002.
22. Baqui AH, Black RE, El Arifeen S, Yunus M, Chakraborty J, Ahmed S. Effect of zinc supplementation started during diarrhoea on morbidity and mortality in Bangladeshi children: community randomised trial. BMJ. 2002;325(7372):1059.
23. BhuttaZA. Therapeutic effects of oral zinc in acute and persistent diarrhoea in children in developing countries: pooled analysis of randomized controlled trials. Am J Clin Nutr. 2000;72(6):1516-22.
24. BhuttaZA, Black RE, Brown KH, Gardner JM, Gore S, Hidayat A, et al. Prevention of diarrhoea and pneumonia by zinc supplementation in children in developing countries: pooled analysis of randomized controlled trials. J Pediatr. 1999;135(6):689-97.
25. WHO. WHO-UNICEF Joint statement on the clinical management of acute diarrhea. World Health Assembly. Geneva. 2004.