

OUTCOME OF ZINC SUPPLEMENTATION IN CHILDREN (6–60 MONTHS) PRESENTING WITH ACUTE GASTROENTERITIS AT TERTIARY CARE HOSPITAL, LARKANA

Dr. Zubair Ahmed Jakhro^{*1}, Prof Dr. Shankar Lal², Dr. Dileejan Mugheri³,
Dr. Aijaz Ali Tunio⁴, Dr Mubashara Khan⁵, Dr. Sohail Ahmed⁶

^{*1,5,6}Chandka Medical College Hospital Larkana (SMBBMU Larkana) FCPS-II Pediatrics Trainee MBBS FCPS-II Pediatric

²Chandka Medical College hospital Larkana (SMBBMU Larkana) Professor pediatric CMC SMBBMU Larkana MBBS, FCPS(Pediatrics), DCH

³Chandka Medical College Hospital Larkana (SMBBMU Larkana) Associate Professor Pediatrics CMC (SMBBMU Larkana) MBBS, FCPS Pediatrics, DCH

⁴Chandka Medical College Hospital Larkana (SMBBMU Larkana) Assistant professor pediatrics CMC SMBBMU Larkana MBBS, MD, MCPS

¹zubijx@gmail.com, ²shankarlal-sangat@yahoo.com, ³dileejanmugheri@yahoo.com,
⁴tunioaijaz85@gmail.com, ⁵khanmubashara546@gmail.com

DOI: <https://doi.org/10.5281/zenodo.18440160>

Keywords

Zinc Supplementation, Diarrhoea, Acute Gastroenteritis

Article History

Received: 20 March 2025

Accepted: 04 May 2025

Published: 19 May 2025

Copyright@Author

Corresponding Author: *

Dr. Zubair Ahmed Jakhro

Abstract

OBJECTIVE

To determine the outcome of zinc supplementation in children (6–60 months) presenting with acute gastroenteritis at Tertiary Care Hospital, Larkana.

METHODOLOGY

This descriptive study was conducted from 1st August 2024 to December 2024 at [study setting]. A total of 171 children aged 6–60 months presenting with three or more watery stools within 24 hours were enrolled using non-probability consecutive sampling. All participants received oral zinc supplementation. The primary study endpoints were cessation of diarrhoea on day 1 and relapse of diarrhoea by day 14. Data were analysed using the Chi-square test or Fisher's exact test, as appropriate, and a p -value ≤ 0.05 was considered statistically significant.

RESULTS

The mean age was 33.6 ± 16.01 months while 110 (64.3%) were male. Diarrhoea ceased within 24 hours in 36 (21.1%). Relapse occurred in 7 (19.4%) of those with initial cessation. Early cessation was significantly associated with younger age (23.5 ± 10.5 vs 36.3 ± 16.2 months; $p < 0.001$) and urban residence ($p < 0.001$), whereas no significant association was observed with gender ($p = 0.65$).

CONCLUSION

Zinc supplementation exhibited the presence of an observable effect in early cessation of diarrhoea in children with acute gastroenteritis, and there was relapse in a small proportion of those who improved initially. It was found that early cessation was significantly associated with age and residential status, but not gender. These findings reflected the observed outcomes within the studied population.

INTRODUCTION

Though diarrhoeal diseases are a significant issue in the community, the occurrence of diarrhoea-related deaths has decreased by 90% since the 1980s. About 500,000 children perished due to diarrhoea in 2018. Most deaths from diarrhoea among children could be avoided if children received high-quality case management with the care that has been recommended by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF); this care includes oral rehydration solutions and supplemental zinc [1,2]. The zinc recommendation is based on studies that have shown that administration of supplemental zinc results in a shorter duration of diarrhoea, reduces the number of stools and stool output, reduces the risk of persistent diarrhoea, and may reduce the risk of subsequent illness and increase weight gain [3,4].

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 [5,6]. It is thought that zinc deficiency might play a role in childhood diarrhoea, and zinc supplementation might be of benefit either for improving outcomes or as prophylaxis against diarrhoea [7,8]. Possible mechanisms for the effect of zinc treatment on diarrhoea include 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 [9,10].

In the randomised controlled trials of zinc supplementation that evaluated prevention of diarrhoea, significantly lower incidences of diarrhoea occurred in the zinc groups than in the controls [11]. Furthermore, zinc supplements given for 14 days during and after diarrhoea can reduce the incidence of diarrhoea in the subsequent 2–3 months [12,13]. The World Health Organization (WHO) has recommended that zinc be used in the treatment of persistent diarrhoea, which means trials on persistent diarrhoea are no longer appropriate [14,15].

Boran et al found cessation of diarrhoea at day and relapse of diarrhoea was 20% and 14.5% [16].

Although Pakistan is one of the first nations to incorporate zinc in their protocol of treating diarrhoea in children, it is only 2% of Pakistani children with diarrhoea who obtain zinc as a part of acute diarrhoea treatment. A lack of awareness about the role of oral zinc in paediatric diarrhoea is one of the underlying causes. Another important reason is the paucity of local data reinforcing the role of zinc in alleviating acute paediatric diarrhoea. The aim of this study is to establish substantial evidence regarding the role of zinc in improving the symptom of diarrhoea in acute gastroenteritis.

METHODOLOGY

This descriptive study was conducted at the Department of Paediatrics, Children Hospital, Shaheed Mohtarma Benazir Bhutto Medical University (SMBBMU), Larkana, after approval from the Institutional Ethical Review Committee. The non-probability consecutive sampling method was used to recruit 171 children of the either gender between the ages of 6 and 60 months who had brought themselves to the hospital with acute gastroenteritis, which was a case of over 3 loose or watery stools in 24 hours with not more than seven days in duration. Inclusion criteria included all children within the defined age range meeting the diagnostic criteria of acute watery diarrhoea. The frequency of stools was $>3/\text{day}$, while children with a history of malabsorption, sepsis, meningitis, encephalitis, pneumonia, HIV, recent measles (within 6 weeks), cholera, bloody diarrhoea, congenital anomalies of the urinary tract, or malignancies were excluded. The primary intervention was oral zinc supplementation administered as zinc sulphate syrup for 14 days, with age-appropriate doses (15 mg for 6–12 months and 30 mg for 12–60 months). The principal diagnostic measures included cessation of diarrhoea on day 1 post-admission and relapse of diarrhoea between day 1 to day 14. Data were collected after obtaining written informed consent from the parents or

guardians of the participants using a structured proforma by trained paediatricians with relevant clinical experience who conducted daily hospital evaluations and weekly telephonic follow-ups. During each assessment information regarding frequency of stool, stool character, compliance with zinc supplementation, and the re-appearance of symptoms were recorded. The sample size of 171 was calculated using an expected prevalence of cessation of diarrhoea at day 1 in acute gastroenteritis to be 20%¹⁶, a 6% margin of error, and a 95% confidence level. Data analysis was performed using SPSS version 26.0. Categorical variables were summarised as frequencies and percentages, while continuous variables were expressed as mean $\pm$ standard deviation. The chi-square test was used to assess associations between categorical variables. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 171 participants were included in the study. The mean age of the participants was 33.64 ± 16.01 months. The mean duration of diarrhoea at presentation was 4.70 ± 1.80 days while the mean monthly family income was PKR $32,514.62 \pm 18,417.49$. Males constituted most of the study population (64.3%), while females accounted for 35.7%. Most participants belonged to urban areas (57.9%), whereas 42.1% were from rural settings. Regarding educational status, nearly half of the participants had secondary-level education (49.1%), followed by primary

education (19.9%), higher education (19.3%), and illiteracy (11.7%). Most of the participants were employed (71.3%). Diarrhoea cessation on day 1 was observed in 36 participants (21.1%). Among these participants who achieved cessation, relapse of diarrhoea within 1 to 14 days was reported in 7 individuals, accounting for 19.4% of those with initial cessation (**Table I**).

Table II compares baseline characteristics between the children who cessation diarrhoea on day 1 ($n=36$) and those without cessation ($n=135$). The mean age of the cessation group (23.50 ± 10.53 months) compared to the non-cessation group (36.34 ± 16.17 months) (95% CI: -18.468 to 7.228; $p = 0.001$). The average duration of diarrhoea was slightly higher among children with cessation (4.81 days ± 2.21) compared to those without cessation (4.67 days ± 1.68); the difference was not statistically significant (95% C.I: -0.530 to 0.808; $p=0.682$). There was no significant difference in the gender distribution in the two groups, with the cessation group 61.1% and non-cessation group 65.2% ($p = 0.650$). In contrast, residential status showed a significant association, as a higher proportion of children with cessation belonged to urban areas (86.1%) compared to those without cessation (50.4%), while rural residence was more frequent among children without cessation (49.6% vs. 13.9%) (95% CI: 2.241-16.656; $p = 0.0001$).

Table I: Baseline Characteristics of Study Participants (n=171)	
Mean± Standard Deviation	95% Confidence Interval
Age in months = 33.64 ± 16.01	31.22~36.06
Duration of Diarrhoea in days = 4.70 ± 1.80	4.42~4.97
Family monthly Income in PKR= 32514.62 ± 18417.49	29734.37~35294.87
Frequency (%)	
Gender	
Male	110 (64.3)
Female	61 (35.7)
Residential Status	
Urban	99 (57.9)
Rural	72 (42.1)
Educational Status	
Illiterate	20 (11.7)
Primary	34 (19.9)
Secondary	84 (49.1)
Higher	33 (19.3)
Occupational Status	
Employed	122 (71.3)
Unemployed	49 (28.7)
Cessation of Diarrheal on Day 1	36 (21.1)
Relapse of diarrhoea 1 to 14 days After Cessation	7 (19.4)

Table II: Comparison of Baseline Characteristics with Cessation of Diarrhoea (n=171)					
Baseline Characteristics		Cessation of Diarrhoea		95% Confidence Internal	P-Value
		Yes (n=36)	No (n=135)		
Age in months		23.50 ± 10.53	36.34 ± 16.17	-18.468 ~ -7.228	0.000
Duration of Diarrhoea in days		4.81 ± 2.21	4.67 ± 1.68	-0.530 ~ 0.808	0.682
Gender	Male	22 (61.1)	88 (65.2)	0.393 ~ 1.791	0.650
	Female	14 (38.9)	47 (34.8)		
Residential Status	Urban	31 (86.1)	68 (50.4)	2.241 ~ 16.656	0.0001*
	Rural	5 (13.9)	67 (49.6)		

DISCUSSION

Acute gastroenteritis remains a serious diagnostic and treatment issue in the paediatrics care practice, especially in low and middle-income countries where laboratory confirmation of aetiology is not always possible at onset. Similar clinical manifestations of viral and bacterial diarrhoea necessitate the use of supportive and adjunctive treatments, which may be safely used to reduce disease duration and avoid complications. Zinc supplements have been accepted in the whole world because of the

proven effect of reducing the duration of diarrhoeal episodes and the degree of relapse, especially in a population where zinc deficiency is predominant [1,2].

The present study reported cessation of diarrhoea during the first 24 hours of zinc supplementation in 21.1% of children. Among these children who achieved early cessation, relapse of diarrhoea within 1 to 14 days after stopping the supplement was observed in 19.4% of cases. The clinical implications of these findings are that the early resolution of symptoms decreases chances of

dehydration, hospitalisation, and burdens of caregiving. The frequency of early cessation is quite similar to that of Boran et al., where they found diarrhoea cessation on day 1 in 20% of children under zinc, and the relapse rate was 14.5% [16]. Controlled trials have indicated that zinc supplementation has a significant effect of decreasing the number of recurrent diarrhoeal episodes ($p < 0.05$) [11,12]. In a systematic Cochrane review, it was found that the duration of diarrhoea and the probability of a prolonged episode were significantly shorter in zinc-treated children ($p < 0.001$) [17]. Likewise, Mayo-Wilson et al. found a significant effect on diarrhoeal morbidity and recurrence with zinc supplementation ($p < 0.01$) in children [18]. The minor disparity in relapse rate could be explained by differences in the length of follow-up, environmental hygiene, nutrition and adherence to supplementation.

Trivedi et al. also found a lower mean length of diarrhoea of 3.2 ± 1.1 days, as compared to 4.8 ± 1.4 days in children who did not receive zinc, which was statistically significant ($p < 0.05$) [6]. Likewise, Patel et al. reported that the total diarrhoeal duration decreased to a mean of 3.6 days, as compared to 5.1 days in children who were treated without zinc ($p = 0.001$) [10]. The average number of days with diarrhoea in the current study was 4.81 ± 2.21 days in children who stopped the diarrhoea on the first day and 4.67 ± 1.68 days in those who did not, with no significant difference ($p = 0.682$).

The age-wise analysis in the current study showed that children who experienced diarrhoea cessation at day one was much younger than those who did not (23.50 ± 10.53 months vs. 36.34 ± 16.17 months; $p < 0.001$). This observation indicates an increased therapeutic effect of zinc supplementation in younger children and is like a finding of multicentre studies by Fischer Walker et al. demonstrating a greater clinical effect of zinc in younger children probably because of greater zinc deficiency at baseline and relatively incomplete immune defences [12].

Residential status was also found to be significantly associated with early cessation of

diarrhoea, where children living in urban environments had higher cessation rates than those living in rural environments (86.1% vs 50.4%; $p = 0.0001$). Conversely, gender was not significantly related to early cessation of diarrhoea in the current study ($p = 0.650$) which is in line with the previous literature on similar cessation of diarrhoea to zinc supplementation in male and female children [11].

The clinical value of zinc supplementation has biological plausibility. Zinc supplements intestinal epithelial regeneration, enhances water and electrolyte absorption, enhances activity of brush border enzymes and enhances mucosal immune defence mechanisms, thus promoting expeditious recovery and decreasing relapses of infection [9]. Nevertheless, there is still no chance of total relapse prevention under the resource-limited conditions, which are reported in past research [13].

The strengths of the study are that it has a sufficient sample size, clear outcome measures, and statistically significant analysis of factors related to early diarrhoeal cessation. It also offers useful local information, which is not provided by the national evidence that proves the effectiveness of zinc supplementation despite its incorporation in the standard treatment regimen [15]. However, there are some limitations that should be mentioned. The single-centre design has a limitation in generalisability, and a lack of a control group makes it impossible to draw strong causal conclusions. Moreover, there was no evaluation of baseline serum levels of zinc, and the use of caregiver-reported results in the follow-up can also lead to recall bias. The findings justify the use of zinc as an adjunctive intervention in the treatment of acute gastroenteritis in children.

CONCLUSION

Zinc supplementation exhibited the presence of an observable effect in early cessation of diarrhoea in children with acute gastroenteritis, and there was relapse in a small proportion of those who improved initially. It was found that early cessation was significantly associated with age and residential status, but not gender. These

findings reflected the observed outcomes within the studied population.

REFERENCES

- Kosek M, Bern C, Guerrant RL. The global burden of diarrhoeal disease, as estimated from studies published between 1992 and 2000. *Bull World Health Organ.* 2003;81:197–204.
- Black RE, Morris SS, Bryce J. Where and why are 10 million children dying every year? *Lancet.* 2003;361(9376):2226–2234.
- Amjad A, Imran A, Shahram N, Zakar R, Usman A, Zakar MZ, et al. Trends of caesarean section deliveries in Pakistan: secondary data analysis from Demographic and Health Surveys, 1990–2018. *BMC Pregnancy Childbirth.* 2020;20(1):753.
- World Health Organization, United Nations Children's Fund. Clinical management of acute diarrhoea. Geneva: WHO/UNICEF; 2004.
- World Health Organization. WHO recommendations on the management of diarrhoea and pneumonia in HIV-infected infants and children: integrated management of childhood illness (IMCI). Geneva: World Health Organization; 2010.
- Trivedi SS, Chudasama RK, Patel N. Effect of zinc supplementation in children with acute diarrhea: randomized double blind controlled trial. *Gastroenterol Res.* 2009;2(3):168.
- Patel A, Mamtani M, Dibley MJ, Badhoniya N, Kulkarni H. Therapeutic value of zinc supplementation in acute and persistent diarrhea: a systematic review. *PLoS One.* 2010;5(4):e10386.
- Amjad A, Amjad U, Zakar R, Usman A, Zakar MZ, Fischer F. Factors associated with caesarean deliveries among child-bearing women in Pakistan: secondary analysis of data from the demographic and health survey, 2012–13. *BMC Pregnancy Childbirth.* 2018;18(1):113.
- Habib A, Kureishy S, Soofi S, Hussain I, Rizvi A, Ahmed I, et al. Prevalence and risk factors for iron deficiency anemia among children under five and women of reproductive age in Pakistan: findings from the National Nutrition Survey 2018. *Nutrients.* 2023;15(15):3361.
- Patel HN, Shah RB, Gajjar BM. Evaluation of the role of zinc supplementation in treatment of diarrhoea in paediatric patients: a randomized open-label study. *Drugs Ther Perspect.* 2015;31(1):34–38.
- Patro B, Szymański H, Szajewska H. Oral zinc for the treatment of acute gastroenteritis in Polish children: a randomized, double-blind, placebo-controlled trial. *J Pediatr.* 2010;157(6):984–988.
- Fischer Walker CL, Bhutta ZA, Bhandari N, Teka T, Shahid F, Taneja S, et al. Zinc supplementation for the treatment of diarrhea in infants in Pakistan, India and Ethiopia. *J Pediatr Gastroenterol Nutr.* 2006;43(3):357–363.
- Ahmed I, Tahir A, Malik FR. Zinc supplementation in malnourished children under 5 years with acute diarrhea. *J Rawalpindi Med Coll.* 2012;16(2).
- Jiang CX, Xu CD, Yang CQ. Therapeutic effects of zinc supplement as adjunctive therapy in infants and young children with rotavirus enteritis. *Zhongguo Dang Dai Er Ke Za Zhi.* 2016;18(9):826–830.
- Crisinel PA, Verga ME, Kouame KS, Pittet A, Rey-Bellet CG, Fontaine O, et al. Demonstration of the effectiveness of zinc in diarrhoea of children living in Switzerland. *Eur J Pediatr.* 2015;174(8):1061–1067.
- Boran P, Tokuc G, Vagas E, Oktem S, Gokduman MK. Impact of zinc supplementation in children with acute diarrhoea in Turkey. *Arch Dis Child.* 2006;91(4):296–299.
- Lazzerini M, Wanzira H. Oral zinc for treating diarrhoea in children. *Cochrane Database Syst Rev.* 2016;(12).

Mayo-Wilson E, Junior JA, Imdad A, Dean S, Chan XH, Chan ES, et al. Zinc supplementation for preventing mortality, morbidity, and growth failure in children aged 6 months to 12 years of age. Cochrane Database Syst Rev. 2014;(5).

Walker CL, Fontaine O, Young MW, Black RE. Zinc and low osmolarity oral rehydration salts for diarrhoea: a renewed call to action. Bull World Health Organ. 2009;87(10):780-6.

