



TO STUDY THE ZINC LEVELS IN ACUTE DIARRHOEA IN PAEDIATRIC AGE GROUP

Paediatrics

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ABSTRACT

INTRODUCTION: Diarrhoea is the major cause of mortality in India for children <5 years of age. Association studies highlight the potential role of zinc in treatment of acute diarrhoea. Zinc deficiency is responsible for 4.4% of childhood deaths in under-developed nations. However, zinc supplementation has been shown to be effective in decreasing the prevalence and incidence of diarrhoea. In this regard, we aimed to estimate the serum zinc levels in children suffering from acute diarrhoea

AIMS: To assess the zinc levels in children with acute diarrhoea in paediatric age group.

OBJECTIVES: To assess the severity of diarrhoea in association with zinc levels.

MATERIALS AND METHODS: This Hospital Based Longitudinal Observational Study was done in the Department of Paediatrics at MMIMSR, Mullana over a period of one and a half year. Serum Zinc along with sodium, potassium and chloride levels were measured in cases of acute diarrhoea.

RESULTS: In this study, the prevalence of zinc deficiency in children with diarrhoea was 62% and was more prevalent in children <5 years of age. There was a negative correlation (p value 0.009) between serum zinc levels and dehydration. A negative correlation (p value <0.001) was also observed between zinc levels and sodium and chloride levels whereas levels of K did not show any significant difference with mean zinc values.

KEYWORDS

INTRODUCTION

Diarrhoea is defined as passage of unusually loose/watery stools, usually at frequency of at least three times in a period of 24 hour.^[1] Diarrhoea remains one of the frequent infectious diseases all over the world and still 3rd cause of mortality among children less than <5 years of age.^[1,2]

WHO recommends that acute diarrhoea should be mainly treated by adequate liquids, ORS maintenance and zinc supplements.^[3]

Zinc is an important trace element required for intestinal mucosal integrity, sodium and water transport and immune function.^[4] The role of zinc levels in acute paediatric diarrhoea has been studied evidently over the last few years in by all nations which shows a potential effect of zinc in reducing complications and mortality rates.^[5,6] Studies have suggested that zinc therapy should be considered beside Oral rehydration salts (ORS) to achieve maximum impact on diarrhoeal diseases. Clinical trials are recommended to support the zinc supplementation in developing countries.^[7]

The present study was designed to estimate serum levels of zinc in children with acute diarrhoea and also to correlate the zinc levels with severity of diarrhoea in the current study cohort.

AIMS

To assess the levels of zinc in children with acute diarrhoea in paediatric age group.

OBJECTIVE

To assess the severity of diarrhoea in association with zinc levels.

METHODS:-

This was a hospital based longitudinal observational study which included 100 children with acute gastroenteritis conducted between January, 2020 till June, 2021 in paediatrics department at MMIMSR, Mullana.

Inclusion Criteria

- Children of both sexes, with acute diarrhoea
- Children in the age group of 1 month – 18 years

Exclusion Criteria

- Children with persistent, recurrent or chronic diarrhoea

- Children with malnutrition due to other causes like cardiac, hepatic, metabolic, renal and degenerative diseases.
- Children who are on micronutrient supplementation.

A prior approval of The Institutional Ethics committee was obtained. The study didn't impose any financial burden on the parents or guardians of the study group and an informed written consent was taken from the parents/guardians of the participants before conducting the study. All participants were ensured confidentiality. The study was not funded by any agency.

Serum Zinc, sodium, potassium and chloride levels were assessed for each participant enrolled in this study. Total serum Zinc levels were estimated by Calorimetric zinc kit. Serum sodium, Potassium and Chloride levels are measured by **EasyLyte[®] automated analyser** by a process known as potentiometry.

Statistical Analysis:

The data was compiled and analyzed using MS Excel (R) office 365, Graph Pad prism 8.4.2 and SPSS version 25. Descriptive statistics were presented in the form of proportions/percentages for categorical variables and mean & standard deviation for continuous data variables. Fisher Exact test/Chi square test was used for the comparison of proportions (Categorical variables). Continuous variables were analyzed using the Mann Whitney test/student T test (Independent group/Unpaired data) and Wilcoxon sign rank test/ Paired T test (for paired data) based on the normality of the data. P value of <0.05 was considered significant.

RESULTS:

Table 1: Demographic Profile Of The Study Participants

Age Groups	Frequency	%
<1 yr	14	14.0%
1 - 5 yrs	41	41.0%
6 - 10 yrs	17	17.0%
11 - 15 yrs	22	22.0%
>15 yrs	6	6.0%
Total	100	100%
Mean ± SD	6.16 ± 5.19	
Min – Max	0.1 - 17.0	
Median (IQR)	4.50 (1.50 - 11)	

Table 2: Prevalence Of Zinc Deficiency In The Study Along With Gender Distribution

Sex	Total cases	ZINC			
		<60mcg/dl		60-120mcg/dl	
		Frequency	%	Frequency	%
Female	48	31	64.6%	17	35.4%
Male	52	31	59.6%	21	40.4%
Total	100	62	62.0%	38	38.0%

Table 3: Comparison Of Zinc Values With Type Of Dehydration

Type of dehydration	Total cases	ZINC				p value
		<60mcg/dl		60-120mcg/dl		
		Frequency	%	Frequency	%	
No Dehydration	42	19	45.2%	23	54.8%	0.009*
Some Dehydration	50	36	72.0%	14	28.0%	
Severe Dehydration	8	7	87.5%	1	12.5%	
Total	100	62	62.0%	38	38.0%	

*signifies significant p value <0.05

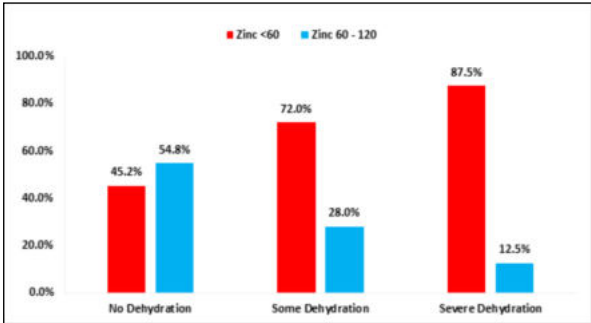


Fig 1

It was observed that for the patients with no dehydration, 45.2% patients had decreased zinc levels while 54.8% patients had normal zinc levels. For the patients with some dehydration, 72% patients had decreased zinc levels while 28% patients had normal zinc levels. And for the patients with severe dehydration, 87.5% patients had decreased zinc levels while 12.5% patients had normal zinc levels.

Table 4: Mean Values Of Na, Cl, K And Zinc Level Of The Patients Under The Study

	Mean ± SD	Min – Max	Median (IQR)
NA	139.07 ± 5.20	121 – 152	139 (136 - 142)
K	4.14 ± 0.62	2.7 - 5.6	4 (3.60 - 4.60)
CL	105.61 ± 5.13	90 – 116	105 (102 - 109)
ZINC	58.58 ± 11.33	32 – 88	56.50 (50.12 - 66)

Table 5: Comparison Of Mean Values Of Na, Cl, K With Serum Zinc levels

	ZINC						p value
	ZINC =<60mcg/dl			ZINC = 60-120mcg/dl			
	Mean±SD	Min-Max	Median (IQR)	Mean±SD	Min - Max	Median (IQR)	
NA	140.53±5.58	121-152	141.50 (137-144)	136.68 ±3.41	130-144	138 (133.50 -139)	<0.001**
K	4.13±0.59	2.7-5.4	4.15 (3.60-4.60)	4.16±0.68	3.2-5.6	4 (3.68-4.73)	0.949
CL	107.19±5.07	90-116	107 (104-111.25)	103.02 ±4.13	90-109	103.5 (100-106)	<0.001**

**signifies highly significant p value <0.001

Table 6

Correlations			
	NA	K	CL
ZINC Pearson Correlation	-.377**	0.058	-.453**

p value	<0.001*	0.564	<0.001*
N	100	100	100

**signifies highly significant p value <0.001

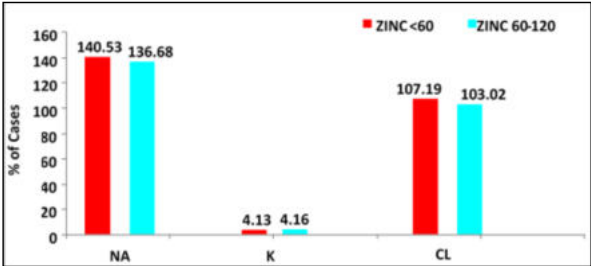


Fig. 2

It was observed that relation of Na and Cl with mean value of zinc was statically significant.

Table 7: Comparison Between The Two Groups Of Dehydration According To The Mean Zinc Level

	No Dehydration			Dehydration			p value
	Mean ± SD	Min - Max	Median (IQR)	Mean ± SD	Min - Max	Median (IQR)	
ZINC	64.07±12.21	32-88	32.50 (56.75-72)	45.50±11.87	35-72	43.50 (36.25-48.75)	<0.001**

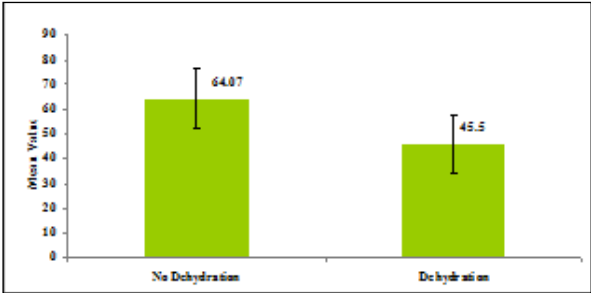


Fig. 3

The table and chart above show the comparison between the two groups i.e. patients with no dehydration and patients with dehydration according to the mean zinc level. It was also observed that for the patients with no dehydration, mean zinc level was 64.07±12.21 with minimum of 32 and maximum of 88 while for the patients with dehydration mean zinc level was 45.50±11.87 with minimum of 35 and maximum of 72.

In addition, it was observed that there was a significant difference in mean zinc levels when compared between the two groups (p value <0.001).

DISCUSSION:

In the present study 100 children were included which were divided based on their age (<1, 1-5, 6-10, 11-15, >15 years) with mean age of 6.16 ± 5.19 years. Maximum number of children were in the age group of 1-5 years (41%). A similar study was conducted by **Rerksuppaphol S et al.**^[8] which included 50 children aged less than 60 months, with acute diarrhoea with mean age of 25.8±15.0 months. The biological reference interval (BRI) of normal zinc ranges between 60-120 µg/dl. In present study, zinc deficiency was present in 62% (zinc level<60 µg/dl). Similar to our study, **Eskander AE et al.**^[9] reported zinc deficiency in 56.2% subjects and **Afolabi OF et al.**^[10] reported zinc deficiency in 47%.

On comparing levels of zinc between males and females, we observed that 59.6% males had low serum zinc levels, similar results were reported by **Rerksuppaphol et al.**^[8] wherein they found 54.5% of the male population had lower levels of zinc and in **Ikejiaku UP et al.**^[11]

Diarrhoeal losses often pertain to dehydration in the body and could thereby be associated with an increased zinc loss. In present study, we observed a highly significant association between levels of zinc and dehydration (p=0.009). Among patients with severe dehydration,

87.5% had decreased zinc levels, while among patients with moderate dehydration 72% had decreased zinc levels and even among patients with no dehydration there were 42.5% patients who had decreased zinc levels of $<60 \mu\text{g/dl}$. A statistically significant co-relation was observed between patients with dehydration and no dehydration for zinc levels. Similar to our results, **Ikejiaku UP et al.**^[11] and **Eskander AE et al.**^[9] concluded that serum zinc levels showed negative correlation with the severity of dehydration ($p=0.015$).

In the index study the mean level of zinc was $58.58 \pm 11.33 \mu\text{g/dl}$. **Rerksuppaphol et al.**^[8] observed mean zinc to be $69.2 \pm 18.5 \mu\text{g/dl}$ and **Eskander AE et al.**^[9] observed Mean $65.0 \pm 13.5 \mu\text{g/dl}$.

In the present study, subjects with zinc <60 and $60-120 \mu\text{g/dl}$ showed a highly significant negative correlation in their mean Na and Cl levels ($p \leq 0.001$ each) with mean Na being 140.53 ± 5.58 vs 136.68 ± 3.41 and mean Cl being 107.19 ± 5.07 vs 103.02 ± 4.13 . Contrary to our results, **Rerksuppaphol et al.**^[8] observed no significant difference in serum electrolytes for patients with abnormal and normal zinc levels.

In the current study we have observed, mean levels of zinc were apparently higher in patients who did not have dehydration (64.07 ± 12.21) than patients with dehydration (45.50 ± 11.87). A highly significant difference in mean levels of zinc was found when compared between the two groups ($p < 0.001$). Our results are in line with those reported by **Agarwal A et al.**^[12] They found a statistically significant difference between median of serum zinc levels in children with dehydration and without dehydration (69.64 vs $82.86 \mu\text{g/dl}$; $p < 0.001$). **Rerksuppaphol et al.**^[8] observed that among patients with low serum zinc levels, 63.6% had moderate dehydration while only 36.4% had minimal or no dehydration. A significant negative correlation was observed by **Eskander AE et al.**^[9], between zinc level and the diarrhoea severity parameters: severity of dehydration (p value < 0.001) and duration of hospitalization (p value < 0.01).

In the index study, among patients who had some dehydration mean zinc level was found to be $56.07 \pm 8.59 \mu\text{g/dl}$ and in patients who had severe dehydration mean zinc was $45.50 \pm 11.87 \mu\text{g/dl}$. These levels were lower than in patients who were non-dehydrated ($64.07 \pm 12.21 \mu\text{g/dl}$) but statistical significance could not be achieved.

CONCLUSION:

From the present study, it can be concluded that children who suffer from acute diarrhoea have lower levels of zinc. Hence, levels of zinc play an important role in diarrhoea. Lower levels of zinc are more prevalent in children <5 years of age. Both severe and moderate dehydration are significantly associated with lower levels of zinc hence it can be inferred that low zinc levels are associated with the severity of diarrhoea. Sodium and chloride levels are significantly negatively correlated with levels of zinc.

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Conflicts Of Interest: There are no conflicts of interest

Limitations:

In our study, the participants were relatively small in number. Thus, the result of this thesis cannot be generalized for a larger population. Therefore, complementary studies with larger sample size and diverse demographic profile are needed.

REFERENCES

1. World Health Organization. The treatment of diarrhoea: a manual for physicians and other senior health workers. 2005. Geneva, Switzerland: World Health Organization. 2013:2-14
2. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, et al.. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. The lancet. 2012 Dec 15; 380(9859):2095-128.
3. Boschi-Pinto C, Velebit L, Shibuya K. Estimating child mortality due to diarrhoea in developing countries. Bulletin of the World Health Organization. 2008; 86:710-7.
4. Ezzati M, Lopez AD, Rodgers AA, Murray CJ. Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors. World Health Organization; 2004.
5. Patel A. Zinc for Acute Diarrhoea and Amoxicillin for Pneumonia, Do They Work? Indian J Pediatr. 2015 Aug;82(8):703-6.
6. Sazawal S, Black RE, Jalla S, Mazumdar S, Sinha A, Bhan MK. Zinc supplementation reduces the incidence of acute lower respiratory infections in infants and preschool children: a double-blind, controlled trial. Paediatrics. 1998 Jul 1;102(1):1-5.
7. Khan WU, Sellen DW. Zinc supplementation in the management of diarrhoea. World Health Organization; 2011
8. Rerksuppaphol S, Na-Songkhla N, RERKSUPPAPHOL L. Serum Zinc Levels in Thai Children with Acute Diarrhoea. Journal of Clinical & Diagnostic Research. 2018 Jun 1;12(6).
9. Eskander AE, Sherif LS, Nabih M, Baroudy NRE, Marcos GC, Badawy EA, et al..

Serum Zinc Level and Its Correlation with Vesikari System Scoring in Acute Pediatric Diarrhoea. Open Access Maced J Med Sci. 2017 Aug 12;5(5):677-680.

10. Afolabi OF, Saka AO, Ojuawo A, Biliaminu SA. Serum zinc levels of hospitalized children with acute diarrhoea differ by the isolated viruses. Int J Health Sci (Qassim). 2019 Sep-Oct;13(5):4-10.
11. Ikejiaku UP, Anochie I, Nwolsia EC, Iregbu FU, Amamilo IB. Serum Zinc Levels of Under Five Children with Diarrhoeal Disease. Journal of Advances in Medicine and Medical Research. 2020; 32(24), 1-10.
12. Agarwal A, Gupta NK, Upadhyay A, Soni RK, Shah D, Jaiswal V. Serum Zinc Levels as a Predictor of Severity of Acute Diarrhoea. Indian J Pediatr. 2018 Mar;85(3):179-183.