

EFFECT OF ZINC AS A SUPPLEMENT ON DURATION OF HOSPITALIZATION IN CHILDREN SUFFERING WITH SEVERE PNEUMONIA 2 MONTHS TO 5 YEARS OF AGE

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Abstract

Objective- To assess the effect of supplemental zinc on hospitalization duration in children 2 months to 5 years of age with severe pneumonia.

Background- The most significant cause of mortality in children in Pakistan is acute respiratory illness, with 20%–30% of deaths in children under 5 years attributed to this condition. Zinc deficiency is prevalent in children aged 2 months to 5 years in the developing world and is associated with various clinical problems. Studies indicate that zinc supplements for treating severe pneumonia may improve recovery time and reduce in-patient hospital stay duration.

Materials and Methods- It is a Randomized control trial and sampling technique is Non probability consecutive sampling, done in Pediatrics Department, Dr. Ziauddin Hospital, Karachi, from 4th March 2021 – 3rd August. The study enrolled 140 children (2 months to 5 years) randomly into Group-A (Interventional) and Group-B (Conventional) for severe pneumonia treatment. Both received intravenous antibiotics. Group-A also got daily zinc supplements (10mg for <6 months, 20mg for 6 months to 5 years) for 14 days, following WHO guidelines. Patients already taking zinc supplements, allergy, suspected tuberculosis and SAM were excluded. The mean length of stay between the two groups was assessed using pooled-t test, and clinical investigations were evaluated independently. Correlations between clinical variables and length of stay were analyzed using the Pearson correlation coefficient. A significance level of ≤ 0.05 was used to determine statistical significance.

Results- In Interventional, there were 58.6% male and 41.4% female patients while in conventional, there were 48.6% male and 51.4% female patients. Mean hospitalization stay in group A was 3.57 ± 1.63 days which is less than mean hospitalization stay in group B i.e., 4.20 ± 1.56 days. We found significant mean difference for mean hospital stay duration among study groups ($p=0.022$).

Conclusion- The incorporation of zinc into the conventional therapy for management of severe pneumonia effectively reduces duration of hospitalization in young children.

Key Words- supplemental zinc, hospitalization, Children, Severe pneumonia.

I. INTRODUCTION

Pneumonia is defined as “a serious lung parenchymal infection or inflammation, airway obstruction from abnormal production of secretions, swelling, and cellular debris” (1,2). The most significant cause of mortality in children in Pakistan is acute respiratory illness, with 20% – 30% of deaths in children under 5 years attributed to this condition (3). Respiratory Distress is characterized by a respiration rate exceeding 50 breaths per minute for ages 2-11 months and a rate exceeding 40 breaths per minute for ages 1-5 years.

The clinical diagnosis of pneumonia relies on features such as cough, difficulty in breathing, increased respiratory rate, chest indrawings, grunting, flaring of alae nasi, and subcostal recessions. X-ray findings typically reveal multiple small nodular opacities and infiltrates, often presenting bilaterally. The management of pneumonia involves the administration of intravenous fluids, antipyretics, antimicrobial agents, and supportive measures, including oxygen supplementation (5,6).

Deficiency of the micronutrient Zinc is prevalent in children aged 2 months to 5 years in the developing world. This deficiency is associated with various clinical problems, such as growth retardation, diarrhea, acute respiratory infections, and immune system dysfunction (10). Research indicates that the use of zinc supplements for treating severe pneumonia not only improves recovery time but also reduces in-patient hospital stay duration (12,13). While numerous national and international studies demonstrate the efficacy of zinc supplementation in reducing hospital stay duration in children with pneumonia, the literature has shown inconsistent findings (14-16).

Through our study, we aim to shed light on the benefits of zinc supplementation on the duration of hospitalization in children under 5 years of age with pneumonia at our center. By contributing new insights to the existing knowledge on this subject, we hope to improve overall patient health by decreasing

hospital stays and alleviating the admission burden in low-resource settings.

Material and methods:

This study was a Randomized control trial done in Pediatrics department, Dr. Ziauddin Hospital, Karachi. The study period was 6 months, from March 4, 2021, to August 3, 2021. The sample size was calculated using the mean \pm SD of 3 ± 12 days of hospitalization in the group supplemented by zinc and 7 ± 32 days in the conventional group of pneumonia patients, with a power ($1-\beta$) of 90%. Our calculated total sample size appeared to be 14.7 children in either group, using the WHO sample size calculation software with a confidence level of 95%. Due to the fairly high prevalence of the disease, we intended to collect 70 patients per group, totaling 140. By tossing a coin, the patients were divided into two groups: Group-A (Interventional) and Group-B (Conventional), with heads assigned to the interventional group and tails to the conventional group. Group-A additionally received a daily zinc supplement with the recommended dose of 10mg per day for children less than 6 months of age and 20mg per day for children aged 6 months to 5 years for 14 days, as per WHO recommendations., while children in Group B received conventional treatment, i.e., intravenous antibiotics according to departmental protocols.

Criteria for inclusion:

The criteria for inclusion in the study encompassed both male and female children aged between 2 months to 5 years. Patients admitted with severe pneumonia, as defined by operational guidelines aligned with the Integrated Management of Neonatal and Childhood Illness (IMNCI) framework, were included. Informed consent from parents/guardians was a prerequisite for inclusion.

Criteria for exclusion:

Patients below 2 months or above 5 years were not considered. Those who were already undergoing zinc supplementation or exhibited any zinc allergy or intolerance were also excluded. Suspected tuberculosis, defined by a pyrexia of more than a 2-week period, a cough lasting more than 14 days, and a known tuberculosis history in the family, led to exclusion. Children with other known illnesses such as measles, severe acute malnutrition, diarrhea, congenital heart conditions, chronic lung conditions like cystic fibrosis and reactive airway disease, immune deficiencies, and aspiration pneumonia were also excluded from the study.

Data Analysis:

All data were analyzed and compiled through the Statistical Package for Social Sciences (SPSS) Version 21. For qualitative variables like gender, we computed the frequency and percentage. Likewise, for quantitative variables like age, temperature etc, Mean \pm SD were calculated. Difference in mean length of stay between the conventional and interventional group were assessed by Pooled-t test if data distribution was normal and homogenous and if distribution does not fulfill the above criteria, then Mann-Whitney U test was applied. Further difference between both groups with respect to clinical investigations was independently assessed by pooled t test. All clinical numerical were correlated with length of stay by Pearson correlation coefficient. P value of ≤ 0.05 was considered as significant.

RESULTS

Total 140 patient of either gender with age 2 months to 5 years, meeting inclusion criteria of study were included in the study to assess the effect of supplemental zinc on duration of hospitalization in children. Patients were assigned to either Group-A or Group-B in 1:1 ratio. Female gender was observed to be 29 (41.4%) vs. 36 (51.4%) for the Group-A and B, respectively.

Table-1 represents the frequency distribution of gender and detailed descriptive statistics of patient's age and weight according to study groups.

Mostly observed symptom were nasal flaring and chest indrawings in both groups which were observed all of the patients in both the groups. No patient had convulsions in Group-A while it was observed in only 1 of Group-B.

The discharge rate was 82.9% vs. 77.1% for the patients in Group-A and B, respectively. Only 1.4% patients were died in Group-A and 4.3% in Group-B. Table-2 represents frequency distribution of symptoms and outcomes. Table-3 represents mean comparison for duration of hospital stay among males, females, age groups, weight groups, and outcomes. The mean hospital stay was 3.57 ± 1.63 days vs. 4.2 ± 1.56 days; $p=0.021$, for the Group-A and B, respectively. Duration of hospital stay was longer in Group-B for male patients, with mean value of days vs. 3.29 ± 1.32 days vs. 4.2 ± 1.17 days; $p=0.003$ for Group-A and B, respectively. Duration of hospital stay was longer in Group-B for patients with age ≤ 24 months, with mean value of days vs. 3.43 ± 1.53 days vs. 4.2 ± 1.59 days; $p=0.010$ for Group-A and B, respectively. Similarly, Duration of hospital stay was longer in Group-B for patients with weight ≤ 10 kg, with mean value of days vs. 3.42 ± 1.63 days vs. 4.12 ± 1.62 days; $p=0.050$ for Group-A and B, respectively.

TABLE – 1: Descriptive statistics of Gender, Age, and Weight

	Study Group	
	Group A	Group B
Total (N)	70	70
Gender		
Male	41(58.6%)	34(48.6%)
Female	29(41.4%)	36(51.4%)
Age (months)		
Mean	21.45	16.01
Standard deviation	13.53	10.43
Median	24	12
Interquartile range	26	15
Range	57	46
Minimum	3	2
Maximum	60	48
Weight (kg)		
Mean	10.38	8.77
Standard deviation	3.85	3.55
Median	10	8.95
Interquartile range	5	4.63
Range	21	19
Minimum	4	3
Maximum	25	20

TABLE – 2: Frequency Distribution of Symptoms and Outcome

	Study Group	
	Group A	Group B
Total (N)	70	70
Symptoms		
Nasal Flaring	70(100%)	70(100%)
Chest Indrawings	70(100%)	70(100%)
Cyanosis	7(10%)	6(8.6%)
Inability To Feed	7(10%)	6(8.6%)
Convulsions	0(0%)	1(1.4%)
Outcome		
Discharged	58(82.9%)	54(77.1%)
Discharged on Request	5(7.1%)	11(15.7%)
Expired	1(1.4%)	3(4.3%)
Left against medical advice	6(8.6%)	2(2.9%)

TABLE – 3: Mean Compassion for Duration of Hospital Stay According to Gender, Age, Weight and Outcomes

	Study Group		P-value
	Group A	Group B	
Overall	3.57 ± 1.63	4.2 ± 1.56	0.021 *
≤3 days	3.65 ± 1.3	4.07 ± 1.34	0.121
>3 days	3.39 ± 2.18	4.55 ± 2.09	0.093
Gender			
Male	3.29 ± 1.32	4.2 ± 1.17	0.003 *
Female	3.96 ± 1.95	4.19 ± 1.87	0.633
Age			
≤24 Months	3.43 ± 1.53	4.2 ± 1.59	0.010 *
>24 Months	3.94 ± 1.87	4.2 ± 1.3	0.780
Weight			
≤ 10 Kg	3.42 ± 1.63	4.12 ± 1.62	0.050 *
> 10 Kg	3.75 ± 1.64	4.34 ± 1.46	0.170
Outcomes			
Discharged	3.77 ± 1.62	4.29 ± 1.31	0.066
Discharged on Request	2.8 ± 1.09	4.27 ± 0	0.121
Expired	5 ± NA	3.66 ± 2.08	0.635
Left against medical advice	2 ± 1.26	2 ± 1.41	>0.999

*significant at 5%

Discussion

The treatment for pneumonia includes both supportive and specific management. Supportive management involves intravenous fluids, oxygen supplementation, and antipyretics. The specific treatment includes antimicrobial agents. (16,17)

Zinc is an essential element needed for cell immunity and metabolism. Therefore, its insufficiency may lead to vulnerability to infections and may also affect the integrity of the pulmonary epithelial cell lining. Researchers have used zinc as a supplement to observe its effects on various diseases, including pneumonia. Zinc also plays a crucial role in restoring the host defence mechanism against infection. (18,19)

In a study by Hamed AMM et al., it was shown that the mean age for lower respiratory tract infection is 20.6 months. This outcome differs from studies conducted in Nepal and Uganda by Basnet et al. (19) and Srinivasan et al. (20), respectively, who reported mean ages of 17.9±12.2 and 7.8±6.0 months for children under investigation. The mean age of the patients in the study by Hamed AMM et al. was also lower than that reported by Shah et al. (21) in their cases (108±60 months). The observed difference in the studied children may be attributed to a wide disparity in the contributing organisms. In our study, the mean age was 21.45±13.53 months and 16.01±10.43 months in the cases and the control groups, respectively.

Results from a double-blind, randomized, placebo-controlled trial of additional zinc supplementation with conventional antibiotics for radiologically confirmed acute pneumonia in 94 hospitalized children aged 6 to 36 months in Tanzania showed no noteworthy reduction in the duration of hospital admission or in the proportion of children hospitalized for less than 3 days and less than 5 days when compared with placebo. (20) Randomly assigning groups might be one of the reasons for the statistically noteworthy difference between the two groups in terms of factors influencing the disease, such as sex, age, and hospital admission. In 2016, a meta-analysis comprising nine studies failed to demonstrate the efficacy of zinc as an adjunctive therapy to antibiotics in children afflicted with pneumonia. There was no significant curtailment in the time of recovery, hospitalization stay, change of antibiotics, and treatment failure compared to placebo. (23)

Brooks et al. described that prescribing zinc to children aged 2 to 23 months suffering from pneumonia may lead to a notable reduction in the duration of hospital stay. (39) In a similar study held in India on 299 children aged 2–23 months and admitted due to pneumonia, it was shown that, in contrast to the comparison group, the symptoms of the disease resolved earlier, and the duration of hospital stay decreased significantly in the zinc-supplemented patients. (22)

The findings of our study were consistent with those of a meta-analysis of seven clinical trials in which the beneficial role of zinc, along with standard pneumonia therapy, was correlated with standard pneumonia therapy alone in 1,066 patients from underdeveloped countries admitted for pneumonia or lower respiratory tract infections. (22) Results of this study are proportional to the trial by Brooks et al. (24) in Bangladesh, where zinc supplementation with empiric antibiotic therapy notably shortened the duration of hospitalization for young children with lower respiratory tract infection.

Our study adds to the existing body of evidence supporting the potential therapeutic role of zinc supplementation in reducing hospitalization duration and improving recovery in children with severe pneumonia. The findings are in line with studies conducted in different countries, including India, China, and

Bangladesh, which have reported favorable outcomes with zinc supplementation.

Conclusion

In our study zinc supplementation was found to significantly reduce hospital stay duration. The analysis indicated a significant mean difference in hospital stay between the groups, with a p-value of 0.022. These results suggest that the addition of zinc supplementation to conventional therapy can lead to a shorter hospitalization period in children with severe pneumonia. Further research is needed to examine the effects of zinc supplementation on mortality rates in children with severe pneumonia. Additionally, investigating the influence of hemoglobin levels on treatment outcomes would be valuable, as it may uncover additional factors that impact the efficacy of zinc supplementation in improving patient outcomes.

Study Limitations:

The limitation of our study was that, it was conducted in a single centre and we only focused on the duration of hospitalization as an outcome measure.

Declaration:

The authors claim they have no interest, financial or whatsoever with regards to the content of this publication.

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Conflict Of Interest

Authors declared no conflict of interest.

Ethical Approval

Patients were enrolled after approval from the ethical review board of Dr. Ziauddin University Hospital (Reference Code: 3200121SSPED) granted on March 3rd 2021.

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