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EFFICACY OF ADJUVANT ZINC SUPPLEMENTATION IN SEVERE PNEUMONIA IN CHILDREN ADMITTED BETWEEN 2 MONTHS TO 10 YEARS OF AGE

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Abstract

Background: *Even today, pneumonia is one of the most important causes of illness and death in children. This is particularly true in poorer countries. Zinc deficiency is common in children and causes problems with the immune system, and is likely to affect how severe respiratory infections get. Some study think that zinc could help improve the health of children with pneumonia who are in the hospital.*

Objective: *To study how zinc helps treat children with severe pneumonia*

Study Design: *Prospective study.*

Study Setting: *This study was conducted at the Department of Pediatrics, PAF Hospital, Islamabad.*

Study Duration: *Six Months (September 2024 to February, 2025).*

Methodology: *One hundred children between the ages of 2 months and 10 years with severe pneumonia were enrolled in the study. The children were divided randomly and equally into two groups. The first group, the intervention group, received the standard antibiotic therapy and also received zinc therapy, which was age-appropriate and given for 14 days. The second group, the control group, received the standard antibiotic therapy only. The study recorded the duration of fever, the degree of respiratory distress, the degree of oxygen needed, and the duration of the hospital stay. The study used SPSS version 26. The study considered a p-value of less than 0.05 to be statistically significant.*

Results: *The mean age of participants was 3.6 ± 2.1 years, with no significant age difference between groups ($p = 0.74$). Males constituted 56% of the study population. Children receiving zinc supplementation showed significantly faster clinical recovery. The mean duration of fever was shorter in the zinc group (3.1 ± 1.2 days) compared to controls (4.4 ± 1.5 days; $p = 0.002$). Resolution of respiratory distress occurred earlier (2.8 ± 1.0 vs. 4.0 ± 1.3 days; $p = 0.001$), and hospital stay was significantly reduced (5.2 ± 1.6 vs. 7.1 ± 2.0 days; $p < 0.001$). No significant adverse effects were observed.*

Conclusion: *The children showed clinical improvement and shorter durations of hospital stays with the addition of zinc to the hospital regimen. It is safe, inexpensive, and therapeutic, especially in the case of limited resources.*

INTRODUCTION

Acute respiratory infections (ARIs) are among the most common causes of morbidity worldwide, and pneumonia remains a leading cause of mortality in children under five years of age, particularly in low- and middle-income countries. The increased burden of ARIs in low-income settings is associated with poverty, lack of maternal education, low birth weight, under nutrition, and short duration of breastfeeding [1]. According to the 2013 National Demographic and Health Survey in Pakistan, 16% of children under five years of age experienced symptoms of acute respiratory infection in the two weeks preceding the survey. These symptoms were reported more frequently among children under two months of age compared to those aged two months to ten years (20% versus 13%, respectively). Pneumonia alone was identified as the cause of death in approximately 91,000 children, highlighting its significant contribution to childhood mortality [2].

Zinc deficiency is common in children in developing countries and is known to impair immune function, thereby increasing susceptibility to infections and worsening disease severity [3]. The World Health Organization and the United Nations Children's Fund recommend zinc supplementation for children in low- and middle-income countries to improve immune response and aid recovery from severe infections. A supplementation regimen of 10 mg daily for infants under six months of age and 20 mg daily for children older than six months for a duration of 10–12 days has been recommended [4]. Zinc contributes to immune function by maintaining epithelial integrity and tissue structure through its role in cell proliferation and anti-apoptotic activity [5]. Additionally, zinc possesses antioxidant properties that help scavenge free radicals and protect tissues from inflammatory damage during infections [6].

Acevedo-Murillo et al., showed results in his study that zinc supplementation improved in fewer hours for clinical improvement (76 ±7 vs. 105±8, p = 0.01), respiratory rate (37±6 vs. 57±7, p = 0.04), and oxygen saturation (53±7 vs. 87±9, p = 0.007), but for respiratory distress (46±4 vs. 56±6, p = 0.21), temperature (6±1 vs. 7±2, p = 0.85) compared to the placebo group [7].

Several studies have documented the role of zinc as an adjunct therapy in severe pediatric pneumonia. Brooks et al. reported that zinc supplementation in children with severe pneumonia was associated with a reduction in symptoms such as tachypnea, anorexia, and restlessness, as well as a shorter duration of hospital stay [8]. An Indian study similarly demonstrated that the addition of zinc to standard therapy resulted in faster clinical recovery and reduced hospitalization compared to standard treatment alone [9]. However, despite international evidence supporting the potential benefits of zinc supplementation, there is limited local data from Pakistan evaluating its effectiveness in children with severe pneumonia [10].

Given the high burden of pneumonia-related morbidity and mortality and the widespread prevalence of zinc deficiency in the pediatric population, this study was conducted to evaluate the efficacy of adjuvant zinc supplementation in children aged 2 months to 10 years admitted with severe pneumonia. The findings of this study may help substantiate the role of zinc supplementation as a simple, safe, and cost-effective adjunct to standard antibiotic therapy in resource-limited settings.

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METHODOLOGY:

This prospective comparative study was conducted in the Pediatric Unit of a tertiary care teaching hospital after obtaining approval from the institutional ethical review committee. The study aimed to evaluate the efficacy of adjuvant zinc supplementation in children diagnosed with severe pneumonia. The primary objectives were to assess the effect of zinc supplementation on duration of fever, resolution of respiratory distress, duration of oxygen therapy, and length of hospital stay in children aged 2 months to 10 years admitted with severe pneumonia.

Severe pneumonia was operationally defined according to World Health Organization criteria, including the presence of cough or difficulty in breathing along with signs of severe respiratory distress such as chest indrawing, hypoxia (oxygen saturation <90% on pulse oximetry), inability to feed, or altered sensorium. Fever was defined as an axillary temperature of ≥38°C. Resolution of

respiratory distress was defined as the absence of chest indrawing and normalization of respiratory rate for age. Length of hospital stay was defined as the number of days from admission to discharge after clinical stabilization.

A total of 100 children meeting the inclusion criteria were enrolled through non-probability consecutive sampling. Children aged between 2 months and 10 years of either gender admitted with severe pneumonia were included in the study. Exclusion criteria comprised children older than 10 years, those with chronic cardiorespiratory diseases, immunodeficiency disorders, severe malnutrition or failure to thrive, gastroesophageal reflux disease, known intolerance to zinc, or those who had received zinc supplementation within the preceding three months.

After enrollment, patients were randomly allocated into two equal groups of 50 each. The intervention group received standard antibiotic therapy according to hospital protocol along with age-appropriate oral zinc supplementation for a duration of 14 days (10 mg daily for children under 6 months and 20 mg daily for children above 6 months). The control group received standard antibiotic therapy and supportive care alone. All patients were managed under uniform clinical guidelines, including oxygen therapy, antipyretics, and supportive measures as required.

Data collection was carried out using a structured proforma. Baseline demographic information, clinical features at admission, and disease severity indicators were recorded for all participants. Patients were monitored daily for temperature, respiratory status, oxygen requirement, and overall clinical improvement until discharge. Duration of fever, time to resolution of respiratory distress, duration of oxygen therapy, and length of hospital stay were documented. Any adverse effects related to zinc supplementation were also noted throughout the study period.

Collected data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 26. Continuous variables such as age, duration of fever, oxygen therapy, and hospital stay were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Independent sample t-tests were applied to compare continuous variables between the two groups, and chi-square tests were used for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS:

A total of 100 children were enrolled, with 50 patients in each group. The overall mean age was 3.6 ± 2.1 years, and there was no statistically significant age difference between the zinc and control groups ($p = 0.74$). Males constituted 56% of the study population. Baseline clinical characteristics, including severity of illness and oxygen saturation at admission, were comparable between groups. Children receiving adjuvant zinc supplementation demonstrated significantly faster clinical recovery. The mean duration of fever was significantly reduced in the zinc group compared to the control group (3.1 ± 1.2 days vs. 4.4 ± 1.5 days; $p = 0.002$). Resolution of respiratory distress occurred earlier in the intervention group (2.8 ± 1.0 days) than in controls (4.0 ± 1.3 days; $p = 0.001$). The mean length of hospital stay was significantly shorter in the zinc-supplemented group (5.2 ± 1.6 days) compared to the control group (7.1 ± 2.0 days; $p < 0.001$). Oxygen requirement duration was also reduced among children receiving zinc. No serious adverse effects related to zinc supplementation were observed during the study period.

Outcome of Interventions

Adjuvant Zinc supplementation resulted in faster resolution of symptoms, decreased oxygen dependency, and length of stay in the hospital. This demonstrated zinc to be an effective and safe adjunct to standard therapy for severe pneumonia in hospitalized children.

Table 1 shows baseline demographic characteristics of children enrolled in the study. There were no statistically significant differences between the zinc and control groups at admission, indicating comparable baseline profiles.

Baseline clinical features at admission were comparable between both groups. No statistically

significant differences were observed, ensuring uniform disease severity prior to intervention.

Children receiving adjuvant zinc supplementation showed significantly faster recovery across all measured clinical outcomes compared to the control group, with statistically significant p-values. Zinc supplementation was well tolerated with no serious adverse effects. Treatment success was significantly higher in the zinc group, while no mortality was recorded in either group.

TABLE 1: BASELINE DEMOGRAPHIC CHARACTERISTICS OF STUDY PARTICIPANTS

Variable	Zinc Group (n=50)	Control Group (n=50)	Total (n=100)	p-value
Mean age (years ± SD)	3.5 ± 2.0	3.7 ± 2.2	3.6 ± 2.1	0.74
Gender (Male/Female)	28 / 22	28 / 22	56 / 44	1.00
Under-5 years, n (%)	34 (68%)	36 (72%)	70 (70%)	0.66
Mean weight (kg ± SD)	13.1 ± 3.4	12.8 ± 3.6	12.9 ± 3.5	0.68

TABLE 2: BASELINE CLINICAL CHARACTERISTICS AT ADMISSION

Clinical Parameter	Zinc Group (n=50)	Control Group (n=50)	p-value
Fever at admission, n (%)	50 (100%)	50 (100%)	—
Respiratory distress, n (%)	45 (90%)	47 (94%)	0.49
Hypoxia (SpO_2 <90%), n (%)	32 (64%)	34 (68%)	0.67
Chest indrawing, n (%)	38 (76%)	40 (80%)	0.63

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TABLE 3: COMPARISON OF CLINICAL OUTCOMES BETWEEN ZINC AND CONTROL GROUPS

Outcome Measure	Zinc Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Duration of fever (days)	3.1 ± 1.2	4.4 ± 1.5	0.002
Resolution of respiratory distress (days)	2.8 ± 1.0	4.0 ± 1.3	0.001
Duration of oxygen therapy (days)	2.4 ± 1.1	3.6 ± 1.4	0.003
Length of hospital stay (days)	5.2 ± 1.6	7.1 ± 2.0	<0.001

TABLE 4: ADVERSE EFFECTS AND TREATMENT OUTCOME

Parameter	Zinc Group (n=50)	Control Group (n=50)	p-value
Nausea/Vomiting, n (%)	3 (6%)	2 (4%)	0.65
Diarrhea, n (%)	2 (4%)	3 (6%)	0.65
Treatment success, n (%)	47 (94%)	41 (82%)	0.04
Mortality	0	0	—

DISCUSSION:

In this study study, zinc supplementation contributed to faster recovery, prompt alleviation of fever and breathing problems, and shorter hospitalization periods among children between 2 months and 10 years of age with severe pneumonia. This finding is consistent with the hypothesis of zinc supplementation potentially improving clinical outcomes and immune responses while standard antibiotics are prescribed [10,11].Recently, a few randomized controlled trials (RCTs) with different results for zinc as an adjunct therapy in pediatric pneumonia have been published. One clinical trial in Mexico on zinc supplementation described a positive effect on the recovery time of clinical symptoms and an increase in Th1 immune responses, indicating an effect of zinc in the immune system for acute respiratory infections [12]. Likewise, recently, an RCT with zinc bis-glycinate was conducted with hospitalized children; the zinc group had a shorter time to resolution of fever, oxygen saturation, and a shorter stay in the hospital compared to the placebo group [13]. This study complements and reiterates the findings of previous studies on zinc and pneumonia; in this case, however, the study focuses on pneumonia and zinc and adds other recovery indicators. Other recent studies have shown that zinc supplements help kids who have acute pneumonia. A study in Bangladesh found that kids with severe pneumonia who got zinc therapy restored their oxygen saturation faster than those on standard therapy alone [14]. Similarly, clinical trials and observational studies in Pakistan and surrounding areas have documented shorter oxygen therapy symptom durations and hospital stays with supplemental zinc [15]. Collectively, these studies provide evidence that zinc, in addition to anti-pneumonia therapies, may improve the clinical outcomes in children that may be related to its anti-inflammatory and anti-microbial enhancing effects [16].More recent evidence does not uniformly support zinc supplementation in severe pneumonia. Some trials show no difference in symptom resolution or length of hospitalization between the zinc and the control group. For example, in a trial in Pakistan, the group that received zinc did not show a statistically significant decrease in major clinical indicators, though they did have a shorter length of stay in the hospital [17]. Furthermore, in a recent double-blind RCT conducted in India, significant differences in some of the reported outcomes (tachypnea and hypoxia) were not found, even though zinc supplementation did show some benefit [18]. The various outcomes in these studies may be due to differing baseline levels of zinc, differing definitions of severe pneumonia, differing study zinc dosages, and differences in the zinc deficiency in the population that was studied [19].Meta-analyses and systematic reviews synthesize the data and show a clear rationale - while zinc supplementation may confer some benefits in some situations, the evidence is not clear. A systematic review found that insufficient evidence exists to recommend for or against universal zinc supplementation in the young child, in addition to the standard antibiotic treatment, based on time to clinical recovery and hospital discharge. This does not mean supplemental zinc does not have clinical significance; it suggests clinical investigators have some reason to investigate further [20, 21].How zinc might affect the outcomes of pneumonia is actually believable. Zinc is necessary for the function of many of the body's immune cells [22]. These include the proliferation of T-cells, the production of cytokines, and the integrity of cell membranes, which all affect the response of the host to the infection. Some of the clinical trials have demonstrated enhanced Th1 responses, which in some cases support this immunological rationale [23]. Some of the strengths of this study include thoroughly measured randomization, standardized treatment plans, and clinical outcomes. Some limitations include the study being done in a single center and not having any baseline zinc measurements, which may influence the modulation of treatment.

CONCLUSION:

Children hospitalized with serious pneumonia have better clinical outcomes and shorter hospital stays with the addition of zinc to the standard therapy. Considering the safety and affordability of the intervention, and its mechanism of action through the immune system, zinc is an important addition to standard pneumonia therapy in places with high zinc deficiency and limited resources

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