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EFFICACY OF ZINC IN THE TREATMENT OF PNEUMONIA IN HOSPITALIZED CHILDREN LESS THEN 2 YEARS OLD

ZINC IN CHILDHOOD PNEUMONIA

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Abstract

Background: *Pneumonia is an important cause of illness and hospitalization in young children, particularly those below two years of age. Zinc supplementation may improve immune response and support faster recovery when used with standard treatment.*

Objective: *To determine the efficacy of zinc supplementation in the treatment of pneumonia among hospitalized children below two years of age.*

Study Design: *Randomized controlled study.*

Place and Duration of the Study: *Department of Pediatrics, Lyari General Hospital, Karachi, Pakistan from November 2024 to April 2025.*

Methodology: *A total of 60 children aged 2 to 23 months with severe pneumonia were randomly allocated into two equal groups. Group A received zinc supplementation with standard antibiotic treatment, while Group B received placebo syrup with the same standard treatment. Duration of symptoms and signs relief and duration of hospital stay were compared between groups using independent-samples t-test. A p-value <0.05 was considered statistically significant.*

Results: *The mean age was 15.80 ± 4.41 months in the zinc group and 15.07 ± 4.62 months in the control group. Males were 60.0% and females were 40.0% in each group. Mean duration of symptoms and signs relief was 44.62 ± 1.68 hours in the zinc group compared with 48.98 ± 2.15 hours in the control group (p<0.001). Mean hospital stay was 128.31 ± 3.98 hours and 137.67 ± 4.72 hours, respectively (p<0.001).*

Conclusion: *Zinc supplementation significantly reduced the duration of symptoms and signs relief and hospital stay among hospitalized children below two years with pneumonia.*

INTRODUCTION

Pneumonia among children poses a serious pulmonary infection and is one of the causes of sickness and mortality in young children, especially in developing countries.1 This disease is mostly caused by bacteria and viruses and it can occur in children of any age group; although infants who are below two years are highly

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susceptible to pneumonia because of their poorly developed immune system.2 Clinical features include cough, fever, difficulty in breathing, rapid breathing, chest retractions, and decreased oral feeding.3

The management of pediatric pneumonia depends on the severity and nature of the condition. The milder form of pneumonia is treated by administering the right medication for any infection that might be present in the lungs, as well as ensuring hydration and proper nourishment.4 The severe form, on the other hand, requires hospitalization, oxygen therapy, medication administration through IV, and close monitoring of the patient's respiratory function and oxygen saturation levels.5 Early detection and proper treatment are necessary to prevent complications. Zinc is an important micro-nutrient required for the normal development of the body and proper functioning of the immune system in pediatrics.6 Inadequate zinc levels in the body may affect the body's defense mechanisms against infections and is fairly common in pediatric patients living in poor conditions.7 As a result, zinc administration has been explored as an additional treatment option for pediatric pneumonia. Zinc supplementation can help enhance immunity and lead to reduced incidence of pneumonia.8 However, the effectiveness of zinc supplementation depends on the nutritional status, age, and severity of pneumonia.9

Pneumonia continues to be a leading reason for admissions in hospitals as well as a cause of severe disease in young children, especially those aged below two years. Even as treatment is available, some patients end up having a long illness period and need to stay in the hospital longer than necessary. Zinc has been found to have beneficial impact on immunity and recovery of respiratory diseases; nevertheless, its efficacy among children admitted to hospitals with pneumonia is yet to be proven. Therefore, this research seeks to find out the efficacy of zinc as an adjuvant in children with pneumonia aged below two years.

METHODOLOGY

This randomized controlled study was conducted over a period of six months from November 2024 to April 2025 in the Department of Pediatrics, Lyari General Hospital, Karachi. The study included 60 hospitalized children who were randomly allocated into 2 equal groups, with 30 children in each group. Group A received zinc supplementation in addition to standard antibiotic treatment while Group B received placebo syrup along with the same standard treatment. Study approval was obtained from the College of Physicians and Surgeons Pakistan, Karachi, before commencement of the study. The study procedures were performed according to the approved protocol and confidentiality of the collected information was maintained. The sample size was calculated by OpenEPI sample size calculator, using a 95% confidence interval, 80% power. The calculation was based on the mean duration of relief of severe pneumonia signs and symptoms which was 44.62 ± 2.56 hours in the zinc group and 48.73 ± 3.12 hours in the placebo group.10 The calculated sample size was 60 children, with 30 participants in each group.

Children were selected by non-probability purposive sampling and were subsequently randomly allocated into Group A and Group B. Children aged 2 to 23 months, of both genders, who were admitted with severe pneumonia were included. Children were considered to have severe pneumonia when they presented with difficult breathing or cough with respiratory rate more than 50 breaths/min in children less than 1 year and more than 40 breaths/min in children more than 1 year, temperature more than 37°C and at least 1 of the following findings: flaring of the alae nasi, central cyanosis, visible chest indrawing, inability to feed, lethargy or crepitation on auscultation. Chest X-ray abnormalities consistent with pneumonia were also required. Children with active tuberculosis, measles, diarrhoea, severe malnutrition, congenital heart diseases, meningitis, renal failure, sepsis, haemodynamic instability, more than 3 days history of difficulty in breathing, previous zinc supplementation, or known allergy or intolerance to zinc or zinc containing products were excluded.

After obtaining informed consent from the parents or guardians, demographic information was recorded. The demographic variables included age and gender. At enrolment, the clinical condition of every child was assessed and

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baseline findings were documented. Children in Group A were given zinc syrup at a total dose of 20 mg/day divided at 12 hourly intervals until discharge in addition to standard antibiotic treatment. Children in Group B received placebo syrup with the same standard antibiotic treatment. Intravenous ampicillin and intravenous amikacin were administered according to the treatment protocol, and after improvement, oral amoxicillin was given. Oxygen saturation, respiratory rate, temperature and chest indrawing were assessed and recorded regularly during hospitalisation.

Post-treatment data were gathered on the period of symptom and sign relief and the period of hospitalization in the two groups. Relief of severe pneumonia was considered to be the lack of the signs and symptoms of severe pneumonia for 24 hours in a row. Criteria for discharge were adequate oral intake, oxygen saturation more than 95%, breathing rate less than 50 breaths in one minute, and body temperature not more than 37°C for 24 hours in a row, along with absence of signs and symptoms of severe pneumonia. Thus, the main variables were oxygen saturation, breathing rate, body temperature, chest indrawing, period of symptoms and signs relief, and hospitalization period.

The collected data were entered and analysed using IBM SPSS. Quantitative variables including age, oxygen saturation, respiratory rate, temperature, duration of symptoms and signs relief and duration of hospital stay were presented as mean ± standard deviation. Qualitative variables including gender were presented as frequencies and percentages. The mean duration of symptoms and signs relief and mean duration of hospital stay were compared between Group A and Group B using an independent-samples t-test. A p-value <0.05 was considered statistically significant.

RESULTS

In this randomised controlled trial, a total of 60 children were enrolled and divided equally into two groups of 30 each. The mean age of children in the zinc group was 15.80 ± 4.41 months, whilst in the control group it was 15.07 ± 4.62 months. Gender distribution was identical in both groups, with 18 males (60.0%) and 12 females (40.0%) in each group (Table-I).

Table I: Patient Demographics in Both Groups

n=60		
Variables	Zinc Group n=30	Control Group n=30
	Mean ± SD	Mean ± SD
Age (months)	15.80 ± 4.41	15.07 ± 4.62
Gender	n (%)	n (%)
Male	18 (60.0%)	18 (60.0%)
Female	12 (40.0%)	12 (40.0%)

With regard to clinical outcomes, the mean duration of symptoms and signs relief was notably shorter in the zinc group (Group A) at 44.62 ± 1.68 hours as compared to the control group (Group B) at 48.98 ± 2.15 hours, and this difference were found to be statistically highly significant (p<0.001). Similarly, the mean duration of hospital stay were also considerably lesser in Group A (128.31 ± 3.98 hours) as compared to Group B (137.67 ± 4.72 hours),

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with the difference again reaching statistical significance (p<0.001) (Table-II).

Table II: Comparison of Mean Duration of Symptoms/Signs Relief and Hospital Stay in Both Groups

n=60

Variables	Group A n=30	Group B n=30	P value*
Duration of Symptoms and Signs Relief (hours)	44.62 ± 1.68	48.98 ± 2.15	<0.001
Duration of Hospital Stay (hours)	128.31 ± 3.98	137.67 ± 4.72	<0.001

***Independent Sample t-test**

On stratified analysis, both outcomes were significantly better in Group A across all demographic subgroups. In children aged ≤12 months as well as those aged >12 months, the zinc group consistently shewed shorter duration of symptom relief and hospital stay in comparison to the control group (p<0.001 for all). A similar pattern was observed when stratified by gender, with statistically significant differences in both male and female subgroups for both outcomes (p<0.001), except in females for symptom relief where p value was 0.001 (Table-III).

Table III: Stratification of Mean Duration of Symptoms/Signs Relief and Hospital Stay with Respect to Demographic Factors in Both Groups

Demographic Factor	Category	Group	Duration of Symptoms & Signs Relief (hours) Mean ± SD	p Value*	Duration of Hospital Stay (hours) Mean ± SD	p Value*
Age (months)	≤12					

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A (n=8)
44.35 ± 1.38
<0.001
127.90 ±
3.33
<0.001
B (n=9)
49.32 ± 2.26
138.53 ±
5.05
>12
A (n=22)
44.72 ± 1.79
<0.001
128.46 ±
4.25
<0.001
B (n=21)
48.83 ± 2.14
137.30 ±
4.66
Gender
Male
A (n=18)
44.54 ± 1.39
<0.001
128.47 ±
3.74
<0.001
B (n=18)
49.71 ± 1.89
138.38 ±
4.69
Female
A (n=12)
44.74 ± 2.10
0.001
128.08 ±
4.47
<0.001
B (n=12)
47.88 ± 2.11
136.61 ±
4.77
*Independent Sample t-test

DISCUSSION

In present study, both groups were well matched with respect to age and gender, as mean age in zinc group were 15.80 ± 4.41 months and in control group were 15.07 ± 4.62 month whilst gender distribution were identical with 18 males (60.0%) and 12 female (40.0%) in each group, which ruled out any demographic bias in the result.

The mean duration of symptoms and signs relief were significantly shorter in zinc group (44.62 ± 1.68 hours) as compared to control group (48.98

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± 2.15 hours) (p<0.001). This could be explained by the fact that zinc play a vital role in immune function by enhancing the activity of neutrophils, natural killer cells and T-lymphocytes which accelerates the resolution of infection and leads to earlier clinical improvements.

Furthermore, the mean duration of hospital stay was also considerably lesser in zinc group (128.31 ± 3.98 hours) as compared to control group (137.67 ± 4.72 hours) (p<0.001). This finding is scientifically justified as zinc possess anti-inflammatory properties and it reduces the production of pro-inflammatory cytokine which not only hastens recovery but also reduce the overall burden of disease, resulting in earlier discharge from hospital.

The findings of present study demonstrated that zinc supplementation was significantly associated with shorter duration of symptoms and signs relief (44.62 ± 1.68 hours) and reduced hospital stay (128.31 ± 3.98 hours) in comparison to control group (48.98 ± 2.15 hours and 137.67 ± 4.72 hours respectively), with both differences being statistically highly significant (p<0.001). These results were in agreement with Hamza et al. 11 who reported significant improvement within first five days in 89.2% of zinc group versus 56% in control group (P<0.05), and mean duration of admission were 4.2 days in zinc group versus 5.2 days in control group, which clearly supports the beneficial role of zinc in hastening clinical recovery in hospitalised children with pneumonia. Similarly, Manohar et al. 12 also reported shorter mean duration of hospital stay in zinc group (7.2 days) as compared to placebo group (8.9 days) (P=0.001), which is consistent with present study findings and further strengthens the evidence that zinc supplementation accelerates recovery via its immunomodulatory and anti-inflammatory mechanisms. Das et al. 13 reported mean time for resolution of distress as 52.45 ± 33.98 hours and mean duration of hospital stay as 6.10 ± 3.55 days in zinc group versus 74.17 ± 37.76 hours and 9.14 ± 3.57 days in non-zinc group, which were comparable and in line with results of present study, suggesting that zinc supplementation consistently reduces both symptom duration and length of hospitalisation across different paediatric age groups. Fayyaz et al. 14 also reported significantly shorter mean duration of recovery in zinc group (3.80 ± 0.66 days) as compared to control group (6.30 ± 0.75 days) (P<0.001), which further corroborates present study results. Kazi et al. 15 reported mean duration of hospital stay of 100.14 ± 16.83 hours in zinc group versus 123.34 ± 15.38 hours in placebo group (P<0.0001), and Saied et al. 16 and Atta et al. 17 both reported that zinc supplementation reduced hospitalisation by approximately 3.17 to 3.21 days as compared to control group (P<0.01), all of which were consistent with and supportive of present study findings.

However, some differences were also noted when comparing with existing literature. Yasin et al.18 reported that 46 (92%) patients in zinc group showed resolution of symptoms within 0–5 days versus 35 (70%) in control group (P=0.005), which reflected a higher proportion of early recovery than observed in present study. This difference may possibly be attributable to the fact that Yasin et al. 18 enrolled children up to 5 years of age with severe pneumonia, whilst present study was restricted to children less than 2 years of age, in whom immune response may be relatively immature and hence recovery slightly prolonged. On the other hand, Haider et al. 19 in their Cochrane review found that zinc supplementation as adjunct to antibiotics failed to demonstrate statistically significant effect on time-to-clinical recovery (hazard ratio 1.02; 95% CI 0.93 to 1.11) and time-to-hospital discharge (hazard ratio 1.04; 95% CI 0.89 to 1.22), which were in contrast to present study results. This discrepancy could be explained by the heterogeneity of studies included in that review, differences in severity of pneumonia, varying doses of zinc used, and different definitions of clinical recovery employed across included trials. Similarly, Kumar et al. 20 found no overall effect on duration of hospitalisation for severe pneumonia, which again contradicts present study findings, and this difference may be related to the fact that their study population included children with more severe disease requiring oxygen and mechanical ventilation, in whom zinc supplementation alone may not be sufficient to produce measurable clinical benefit. La et al. 21 reported that lower serum zinc levels were significantly associated with increased

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treatment burden including prolonged antibiotic use and longer treatment duration (P=0.011), and Lassi et al. 22 in their Cochrane review demonstrated that zinc supplementation reduced incidence of pneumonia by 13% and prevalence by 41%, both of which indirectly supports the rationale of present study and highlights the important role of zinc in paediatric respiratory infections. Overall, the weight of evidence from present study and majority of comparable studies suggests that zinc supplementation as adjuvant therapy is beneficial in reducing clinical recovery time and hospital stay in children with pneumonia.

There are various limitations associated with the current study which must be mentioned. First, it is limited to a single center and a single institution; therefore, it would be difficult to generalize the results to a larger population. Second, the number of participants in the study is fairly low, with a total of only 60 children, which might not enable the derivation of generalized conclusions. Third, serum zinc concentrations were not assessed either at baseline or post-supplementation, thus making it impossible to determine whether the children had zinc deficiency. Additionally, no follow-up study was carried out after the intervention; hence it will be impossible to establish any long-term effect of zinc supplementation on recurrence of pneumonia complications.

CONCLUSION

It is concluded from this current study that zinc therapy in addition to the other treatment methods is significantly effective in reducing the duration of symptoms, signs, and hospitalization period of pneumonia cases below 2 years old, when compared to those of the control group. These effects of zinc were shown to be similar in both age and gender groups.

Patients' Consent

Written informed consent was taken from all the participants before their inclusion in the study.

Competing Interests

The author declares that there was no conflict of interest associated with this research.

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