The Effect of Zinc as an Adjuvant Therapy on Pneumonia in Hospitalized Children.

Taghreed M. Farahat[1], Nagwa N. Hegazy[1], Ayah M. Barakat[1], Ahmed A. Khattab[2], Dina M. Matbagy[1*]

[1] Family Medicine Department, Faculty of Medicine, Menofoufia University.

[2] Pediatric Departments, the Faculty of Medicine, and Menofoufia University.

Abstract:

Background: Pneumonia is considered the leading cause of child mortality and morbidity in developing countries. Although research has shown that zinc supplementation can help prevent pneumonia, its therapeutic efficacy has yet to be established. **Objectives**: to determine the prevalence of zinc deficiency in hospitalized children with pneumonia included in the study and the effect of zinc supplementation as an adjuvant on pneumonia outcome in hospitalized young children. **Methods:** A double-blind, randomized controlled trial was carried out on 80 hospitalized children with acute pneumonia aged 2-60 months who were admitted to the pediatric department of Menoufia University Hospital in Egypt. Prior to intervention, baseline data, detailed medical history, and clinical assessments were done. Serum zinc levels were also measured in all patients. Following enrollment, the children were randomly assigned to either zinc supplementation or a placebo. **Results:** Among 80 children with pneumonia, 17.5% had deficient zinc levels. This study found a statistically significant difference between the Zinc and placebo groups in terms of the mean days to disappearance of chest in-drawing (P=0.001), duration to symptoms resolution (P=0.002), and mean duration of hospitalization (P=0.004), all of which were shorter in the Zinc group than in the control group. There was also a statistically significant difference between the two groups in the mean duration of tachypnea (P=0.026) and the time to normal bilateral air entry (P=0.043). **Conclusion:** Zinc supplementation as an adjuvant improved the duration of symptom resolution and reduced the length of stay in hospitalized children.

Keywords: Hospital stay, Symptom resolution, Zinc group.

Introduction:

Pneumonia is the leading cause of death among children less than five years of age, despite effective vaccines and environmental and nutritional interventions.(1) According to the World Health Organization (WHO), pneumonia is the most significant cause of mortality due to infection in children globally in 2019. Pneumonia kills 740,180 children under the age of five, accounting for around 60% of all child deaths.(2)

Nearly 95% of fatalities in underdeveloped nations are caused by

*Corresponding author: Dinamostafa189@gmail.com

pneumonia**.** [3] According to WHO statistics in Egypt, the cause of death in children under five years old was approximately 11% from pneumonia in 2013.[4]

Zinc is a micronutrient with biological activities related to the immune system and recovery from lower respiratory tract infections; zinc levels in children from low- and middle-income countries are frequently lower than required.[5,6]

The significance of Zinc in infection defense and response is well understood, particularly in younger people. Zinc is known to impact all immune systems, whether humoral or cell-mediated.[7]

A plausible biological mechanism for the involvement of Zinc in this condition exists, which we summarize in Figure 1. Its supplementation, alone or as an adjuvant to medicines currently used to treat active infection, could be beneficial due to its effect on many critical factors in regulating a severe immune response during infection.[8]

Zn has a crucial role in immune response, including activating polymorphonuclear cells, macrophages, natural killer cells, T cells, antibody production, the balance of T helper lymphocytes, and immune defense-specific protein synthesis.[9] Plasma Zn decreases during the acute phase response because of the mobilization and sequestration of Zn to metallothionein, and hence, Zn supplementation in the treatment of severe pneumonia might be associated with a robust immune response and, consequently, a better prognosis.[10]

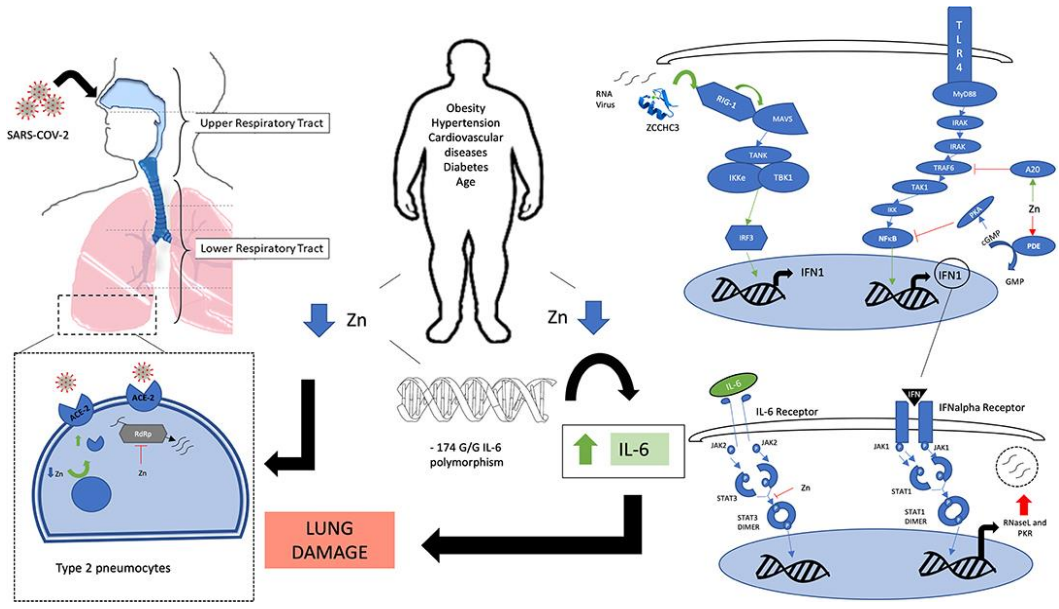

Figure a Legend: A schematic view of the involvement of Zinc in various signaling pathways.[8]

The evidence for zinc use as an adjunctive therapy in children with severe pneumonia is controversial. While some clinical trials demonstrated that Zinc supplementation benefits severe pneumonia and reduces hospital stays, other studies have found no clinical benefit to patients. The mixed findings require more research to understand Zinc's role in treating pneumonia.

The study aimed to determine the prevalence of zinc deficiency among hospitalized children with pneumonia and assess the impact of adjuvant zinc supplementation on pneumonia outcomes.

Patient and methods:

Study design and setting:

This study was an interventional study (double-blinded, placebo-controlled randomized clinical trial) that included children of both genders aged two months to less than five years who were admitted to the wards of Menoufia University Hospital's pediatric department with a clinical diagnosis of pneumonia between May 2021 and June 2022.

Ethical consideration:

The Research Ethics Committee of Menoufia University Faculty of Medicine approved the study. FAML 15 IBR approval number and date 8/2020. Each parent provided informed written consent after a simple and clear explanation of the research goals, potential benefits, and the right to withdraw from the study at any time. All data collected was kept confidential and was only used for research purposes.

Sampling technique and Sample size calculation:

At a power of 80% and confidence level of 95%, the sample size was calculated according to (Rerksuppaphol & Rerksuppaphol 2019), who conducted a similar study and discovered that the hospital stay for children who received zinc supplementation was shorter (mean (SD): 3.8 (1.3) days and 6.1 (3.2) days, respectively; P0.001) than the placebo group. [11]

Using the following equation from the point power program

$$\mathbf{n} \geq \frac{\left(z1-\frac{\alpha}{2}+Z1-\beta\right)^2 (\sigma_1^2+\frac{\sigma_2^2}{r})}{(\mu_1-\mu_2)2}$$

Alpha (α): type 1 error rate

Beta (β): type 2 error rate

μ_1: expected mean of the outcome in group 1

$\sigma 1$: expected standard deviation of the outcome in group 1

μ_2: expected mean of the outcome in group 2

$\sigma 2$: expected standard deviation of the outcome in group 2

r: sample size ratio Group2/Group1

The sample size was calculated to be 38 subjects, but it was increased to 80 to avoid patient dropout and to provide a more significant number of cases for the intervention program. As a result, each group had 40 participants, with a ratio of (1:1).

There were ninety-five children admitted to the pediatric ward with pneumonia during the study period; six of these children's parents refused to participate in the study, and nine of the children were omitted because they didn't match the inclusion criteria. There was a 93% response rate.

The attending pediatric physicians made decisions about their admission and general pneumonia management. The presence of cough or difficulty breathing associated with fast breathing (a respiratory rate of more than 50 breaths per minute for children aged 2-12 months, and more than 40 breaths per minute for children older than 12 months) or chest indrawing in children aged 2-59 months was used to confirm pneumonia diagnoses, according to the revised WHO guidelines. **(12)**

The radiological finding of a consolidation confirmed this. Patients with congenital renal or cardiac disease, severe malnutrition (as defined by WHO), concurrent diarrhea, severe anemia (Hemoglobin < 8 g/dl), chronic cough, complicated pneumonia who admitted or transferred to pediatric ICU, congenital lung anomalies, confirmed tuberculosis, recurrent wheezing, and children taking zinc supplements were excluded.

After enrolment, a third party who was not affiliated with the study randomly assigned the children to receive zinc supplementation or a placebo.

First (zinc group) (n=40): The children received oral zinc sulfate 10 mg (1 ml/ kg in children younger than 12 months and 20 mg/kg every 12 hours for children 13-59 months).**(13)** The dose was given under the supervision of a pediatric physician.

Second (placebo group) (n=40): received a placebo with a similar appearance and taste to the supplement.

An application for computers (GraphPad QuickCals, La Jolla, California, USA) was used to generate the randomization list in a 1:1 ratio and with a block size of 2. The data was entered as groups according to age (two-12 months, 13-24 months, and 25-60 months) to ensure age group matching. The randomization schedule was designed by an independent person who evaluated the packaging and labeling procedure to ensure blindness. All investigators, parents, children, and guardians were blinded throughout the study. After the survey was completed, the randomization codes were opened.

Data collection Baseline data, medical history, and clinical assessments were completed before the intervention. The researcher was responsible for evaluating the outcome through daily follow-up of the cases and reviewing the documented data in the patient's files recorded by the pediatric resident and the nursing staff; all are blinded regarding the group's distribution. Physical examinations were performed at the onset and next twice daily till release.

A clinical glass thermometer was used to assess the axillary temperature, and the respiration rate was recorded every 4 hours until the patients were discharged from the hospital. A fever was defined as a temperature of 37.5°C or more significant in the axilla. For the first time, the temperature decreased to within the normal range for two consecutive readings, which was considered the resolution of a fever. Daily monitoring of zinc intake was also performed.

The serum zinc levels were measured for all the patients within 24 hours of admission and, for the case group at their discharge from the hospital, or up to a maximum of 7 days. The serum zinc levels were determined by spectrophotometry using a direct Colorimetric Method with 5-Brom-PAPS. spectrum kits.

To define zinc deficiency, the suggested lower cut-off for serum zinc concentrations in young children was 9.8 µmol/L [63 µg/dL]. **(14)** A complete blood count was recorded from the patient file as it is routinely done for all admitted children. In addition, a chest radiograph was done for all participants.

The study's primary outcome was the time to the complete resolution of pneumonia, including the time from enrollment to the elimination of tachypnea, chest in-drawing, and abnormal air entry. The secondary outcome was the length of the patient's hospital stay.

Statistical analysis: Data collection, tabulation, and statistical analysis were performed using the SPSS (statistical package for social science) software program version 20 (IBM Corp., Armonk, New York, USA).

Quantitative data were presented as a mean and standard deviation (SD) and analyzed using an unpaired t-test to compare two groups with qualitative variables. The Mann-Whitney test compares means between two independent groups when the data is not normally distributed. Survival analysis compared the "time to event" of developing a dichotomous categorical outcome in independent groups when the result was not normally distributed. A probability value (P-value) of 0.05 was considered significant.

Results:

The study included 80 eligible children to participate according to the inclusion criteria, and nine were excluded because they did not meet the inclusion criteria. The eligible children were enrolled, and 40 were randomly assigned to take an oral zinc supplement, while the remaining 40 were given a placebo, which the authors needed to learn about because it was a randomized, double-masked, controlled trial.

The mean age in months was 12.906±11.23; nearly two-thirds (56.3%) of the children were males. Cough, dyspnea, and fever were the most common presenting symptoms before admission in 95%, 94%, and 77% of the children studied, respectively. There was no statistically significant difference between the zinc and placebo groups regarding the baseline demographic data and symptoms presented by the studied patients. (Table 1)

The overall prevalence of zinc deficiency among the studied children was 17.5%. (Figure 1)

There was no statistically significant difference between zinc and placebo groups regarding the clinical features, including duration of symptoms before admission, body temperature, heart rate, respiratory rate, and body weight at the time of hospital admission.

There was no statistically significant relation between zinc and placebo groups regarding laboratory investigations of the studied children during hospital admission, including hemoglobin, white blood cell, and platelet counts.

The mean serum zinc concentrations between the two groups did not statistically differ significantly (69.38±9.766 mg/dl in the zinc group and 73.38±11.38 mg/dl in placebo; P=0.096). (Table 2)

The study found a statistically significant difference between the zinc and placebo groups regarding the mean days to disappearance of the chest in-drawing group (2.47±1.21and 3.42±1.238, respectively; p=0.001).

All lower respiratory infection symptoms vanished significantly faster in the zinc group than in the control group (5.93±1.73 and 7.93±3.626, respectively; P=0.002). The mean duration of hospitalization in the zinc group was shorter than in the control group ((3.5±1.34 and 4.85±2.57, respectively; p=0.004).

There was also a statistically significant difference between the two groups in terms of the mean duration of tachypnea (32.47±11.24 in the Zinc group versus 39.97±17.61in the placebo group, p=0.026)

and the time to normal bilateral air entry (p=0.043). (Table 3).

There is a positive Correlation between serum zinc and time of symptom resolution (r= - 0.550; p= <0.001 and between serum zinc and duration of hospitalization (r= - 0.497; p= <0.001) (Figure 2)

Discussion:

This study examined 80 children aged 2-60 months who were diagnosed with pneumonia and admitted to the pediatric department of Menoufia University Hospital. The current study showed that the prevalence of zinc deficiency among the studied children was 17.5%.

It was similar to Ali et al.'s study titled "Assessment of the Role of Zinc in the Prevention of COVID-19 Infections and Mortality," which reported that the prevalence of zinc deficiency in the Asian population was 17.5%.[15] It was lower than that in Baiju Kumar's study, which detected that 24.80% of children aged 2 to 59 months were found to have zinc deficiency.[3]

Yuan *et al.,* who studied the effect of zinc supplementation on infants with severe pneumonia, reported a higher prevalence of zinc deficiency than in the present study (76.0%).[16]

This difference may be because Yuan *et al.* study was done on infants with severe pneumonia in the pediatric intensive care unit (ICU), while the current study was done on children admitted to the ward with less severe disease. In addition, the difference may also be attributed to the change in the sample size, differences in dietary habits, and nutritional status of the subjects between different studies.

The present study showed that the studied children were in the age group 2-48 months; the mean age was 12.906±11.23 months, and more than half of them were males.

These findings were consistent with those of Shaheen *et al.,* who studied blood zinc levels in Benha children with lower respiratory tract infections and reported that there were more male patients (53%) than female patients.[17]

There is a male transcendence. These findings corroborated Rady et al.'s findings, who reported that male patients were more adversely affected by lower respiratory contamination than female patients. [18]

This study showed no statistically significant difference in child weight between the zinc and placebo groups. This was similar to Ekemen Keleş *et al.,* who studied the serum Zinc levels in pediatric patients with COVID-19 and found no statistical difference between hospitalized

patients for height and weight (p = 0.608, p = 0.187) in both groups.[19]

However, this was in contrast to Acevedo-Murillo *et al.*, who found that the children in the placebo group were less in weight and height, which could be a confounding variable, although they were five months younger, and that would explain the disparities.[20]

The baseline characteristics of both groups need to be similar at the start of the randomized controlled trial, so, in the current study, there was no statistically significant difference between zinc and placebo groups regarding the respiratory rate, temperature, and heart rate of the studied children at the time of hospital admission.

In this study, there was a statistically significant difference between the zinc and placebo groups regarding the duration of hospitalization. This was in agreement with Laghari *et al.*, who studied the therapeutic role of zinc supplementation in children hospitalized with pneumonia and found that the zinc-supplemented group's average hospital stay was significantly shorter than the non-zinc groups.[21]

This was in contrast to Tie *et al.*, who conducted a meta-analysis of randomized-controlled trials about Zinc as an adjunct to antibiotics for the treatment of severe pneumonia in children under the age of five and found that there was no significant difference between the zinc group and the placebo group in terms of reduction in time to recovery, hospital length of stay, treatment failure.[10]

The varied results from studies could be attributed to the differences in population characteristics, intervention of Zn supplementation, outcome measures, and location and period of the study, all of which could confound the effect of Zn in the treatment of severe pneumonia.

There was a significant difference between the zinc and placebo group regarding symptom resolution time, P = 0.002. This was agreed with Hashemian *et al.*, who studied the efficacy of Zinc as adjuvant therapy in the treatment of severe pneumonia in hospitalized children and reported that those who received Zinc had significantly lower fever durations (2.1 days vs. 2.84 days, P < 0.05) and tachypnea durations (1.75 days versus 2.1 days, P = 0.011). [22]

In a trial to measure the biologically plausible action of Zinc in this condition, there was a positive Correlation between serum zinc and time of symptom resolution (r= - 0.550; p= <0.001 and between serum

zinc and duration of hospitalization (r= -0.497; p= <0.001).

This was agreed upon by Saied *et al.*, who showed that zinc supplementation was correlated with a significantly shorter duration of hospitalization in days compared to the control group.[23]

According to current results, Zinc effectively treats respiratory tract infection (RTI) because it shortens the symptom's duration and lessens the disease's severity. It is well known that Zinc inhibits angiotensin-converting enzyme 2 (ACE2), reducing susceptibility to infection. [24]

The study's limitations were a small sample size, zinc intake from food wasn't assessed or controlled during the study, and blood cultures were not used to categorize the etiology of pneumonia.

Further studies in a variety of settings are needed to determine the optimal dosage required and to establish whether zinc supplementation could enhance recovery and improve clinical outcomes in children who do not have a zinc deficit.

Conclusion: Compared to the control group, administering zinc supplementation as an adjuvant in treating pneumonia in children younger than five significantly shortened the hospitalization stay, the duration of symptom resolution, and the clinical indicators, such as the duration of tachypnea and chest indrawing.

Conflict of interest:

We have no conflict of interest to declare.

The author fully funds this work.

References

1. Alamneh YM, Adane F. Magnitude and Predictors of Pneumonia among Under-Five Children in Ethiopia: A Systematic Review and Meta-Analysis. J Environ Public Health. 2020;2020:1606-783.
2. WHO. Pneumonia [Internet] 2019 [Available from https:// www.who.int/news-room/fact-sheets/detail/. Last access Nov 2023
3. Baiju Kumar DRK, Gupta N, Laheriasarai D. A case-control study to assess whether giving zinc sulfate to children aged 2 to 59 months improved their clinical symptoms of pneumonia—European Journal of Molecular & Clinical Medicine (EJMCM).7:20-30.
4. Ahmed Ali Hassan A, Guirguis Ragheb S, Talaat Mohamed A. Parents' Care About Pneumonia Among Preschool Children. Egyptian Journal of Health Care. 2018 Dec 1; 9(4): 427-42.
5. Afolami I. Efficacy of biofortified (yellow) cassava on serum retinol in preschool Nigerian children: Wageningen University and Research; 2021.

6. Gupta S, Brazier AKM, Lowe NM. Zinc deficiency in low- and middle-income countries: prevalence and approaches for mitigation. J Hum Nutr Diet. 2020; 33: 624-43.
7. Abd El-Ghaffar YS, Shouman AE, Hakim SA, El Gendy YGA, Wahdan MMM. Effect of Zinc Supplementation in Children Less Than 5 Years on Diarrhea Attacks: A Randomized Controlled Trial. Glob Pediatr Health. 2022;9:232-66.
8. Mayor-Ibarguren A, Robles-Marhuenda Á. A hypothesis for the possible role of Zinc in the immunological pathways related to COVID-19 infection. Frontiers in immunology. 2020:1736.
9. Bonaventura, P, Benedetti, G, Albarede , F, et al. (2015) Zinc and its role in immunity and inflammation. Autoimmun Rev 14, 277–285.
10. Tie HT, Tan Q, Luo MZ, Li Q, Yu JL, Wu QC. Zinc as an adjunct to antibiotics for treating severe pneumonia in children <5 years: a meta-analysis of randomized controlled trials. Br J Nutr. 2016; 115: 807-16.
11. Rerksuppaphol S, Rerksuppaphol L. A randomized controlled trial of zinc supplementation in the treatment of acute respiratory tract infection in Thai children. Pediatr Rep. 2019;11: 7954-78.
12. WHO Guidelines Approved by the Guidelines Review Committee. Revised WHO Classification and Treatment of Pneumonia in Children at Health Facilities: Evidence Summaries. Geneva: World Health Organization. Last access Nov 2023
13. Sowmya N, Chetty S. Using zinc sulfate to improve pneumonia symptoms in children under 5 years of age: A case-control study. International Journal of Forensic Medicine. 2021;3(1):1-3. Copyright © World Health Organization 2014.; 2014.
14. Vuralli D, Tumer L, Hasanoglu A. Zinc deficiency in the pediatric age group is common but underevaluated. World J Pediatr. 2017;13:360-6.
15. Ali N, Fariha KA, Islam F, Mohanto NC, Ahmad I, Hosen MJ, *et al.* Assessment of the role of Zinc in preventing COVID-19 infections and mortality: A retrospective study in the Asian and European population. J Med Virol. 2021;93:4326-33
16. Yuan X, Qian SY, Li Z, Zhang ZZ. Effect of zinc supplementation on infants with severe pneumonia. World J Pediatr. 2016;12:166-9.
17. Shaheen A, Fayed S, Sobeh A, Kamel A. Blood Zinc Level in Benha Children

with Lower Respiratory Tract Infections. Benha Journal of Applied Sciences. 2021;6:43-6.

18. Rady HI, Rabie WA, Rasslan HA, El Ayadi AA. Blood zinc levels in children hospitalized with pneumonia: a cross-sectional study. Egyptian Journal of Chest Diseases and Tuberculosis. 2013;62:697-700.
19. Ekemen Keleş Y, Yılmaz Çiftdoğan D, Çolak A, Kara Aksay A, Üstündag G, Şahin A, *et al.* Serum zinc levels in pediatric patients with COVID-19. Eur J Pediatr. 2022;181:1575-84.
20. Acevedo-Murillo JA, García León ML, Firo-Reyes V, Santiago-Cordova JL, Gonzalez-Rodriguez AP, Wong-Chew RM. Zinc supplementation promotes a Th1 response and improves clinical symptoms in fewer hours in children with pneumonia younger than 5 years old. A randomized controlled clinical trial. Frontiers in pediatrics. 2019 Nov 14;7:431.
21. Laghari GS, Hussain Z, Taimur M, Jamil N. Therapeutic Role of Zinc Supplementation in Children Hospitalized with Pneumonia. Cureus. 2019;11:44-75.
22. Hashemian H, Alizadeh H, Leyli EK. Efficacy of Zinc as adjuvant therapy in the treatment of severe pneumonia in hospitalized children: a randomized clinical trial. Archives of Pediatric Infectious Diseases. 2021;9:87-95.
23. Saied A, El Borolossy RM, Ramzy MA, Sabri NA. Effect of Zinc versus vitamin A supplementation on pediatric patients with community-acquired pneumonia. Frontiers in Pharmacology. 2022 Aug 30; 13:933998.
24. McPherson SW, Keunen JE, Bird AC, Chew EY, van Kuijk FJ. Investigate Oral Zinc as a Prophylactic Treatment for Those at Risk for COVID-19. Am J Ophthalmol. 2020;216:5-6.

Table 1. Baseline Demographic data and presenting symptoms of the studied patients.

Parameter	**Total Participants**	**Zinc group**	**Placebo group**	**Test of significance**	***P*** value
	n= 80 100.0%	n= 40 50.0%	n= 40 50.0%		
Age (months) Mean ±SD Min- Max	12.906±11.23 2-48	12.638±9.61 2.0-36.0	13.175±12.77 3-48	U= 0.696	0.486
Number of children Mean ±SD Min- Max	2.33±0.987 1-4	2.28±1.012 1-4	2.38±0.952 1-4	U= 0.574	0.566
Child order Mean ±SD Min- Max	2.23±1.03 1-4	2.15±1.075 1-4	2.3±0.992 1-4	U= 0.752	0.452
Gender **Female** **Male**	35 (43.8) 45(56.3)	22(55.0) 18(45.0)	13(32.5) 27(67.5)	χ^2 = 4.114	FE *P*= 0.071
Socioeconomic status Low Medium High	8(10.0) 62(77.5) 10(12.5)	6(15.0) 27(67.5) 7(17.5)	2(5.0) 35(87.5) 3(7.5)	χ^2 = 4.632	0.099
Parental relation	All married.				
Parental Smoking Yes No	63(78.8) 17(21.3)	30(75.0) 10(25.0)	33(82.5) 7(17.5)	χ^2 = 0.672	FE *P*= 0.586
Smoking beside children Yes No Total number	16(25.4) 47(74.6) 63(100.0)	7(17.5) 23(57.5) 10(25.0)	9(22.5) 24(60.0) 7(17.5)	χ^2 = 0.801	0.670
Consanguinity Yes No	17(21.3) 63(78.8)	9(22.5) 31(77.5)	8(20.0) 32(80.0)	χ^2 = 0.075	FE *P*= 1.000
Fever Yes No	61(76.2) 19(23.8)	33(82.5) 7(17.5)	28(70.0) 12(30.0)	χ^2 = 1.726	FE *P*= 0.293
Cough Yes No	76(95.0) 4(5.0)	38(95.0) 2(5.0)	38(95.0) 2(5.0)	χ^2 = 0.000	FE *P*= 1.000
Dyspnea Yes No	75(93.8) 5(6.2)	36(90.0) 4(10.0)	39(97.5) 1(2.5)	χ^2 = 1.920	FE *P*= 0.359
Non-respiratory symptoms Vomiting Diarrhea Fatigue & tiredness	11(34.4) 5((15.6) 16(50.0)	5(23.8) 3(14.3) 13(61.9)	6(54.5) 2(18.2) 3(27.3)	χ^2 = 3.786	0.151

SD: Standard deviation **U:** Mann-Whitney test χ^2: **Chi square test** **Min-Max**.: Minimum- Maximum

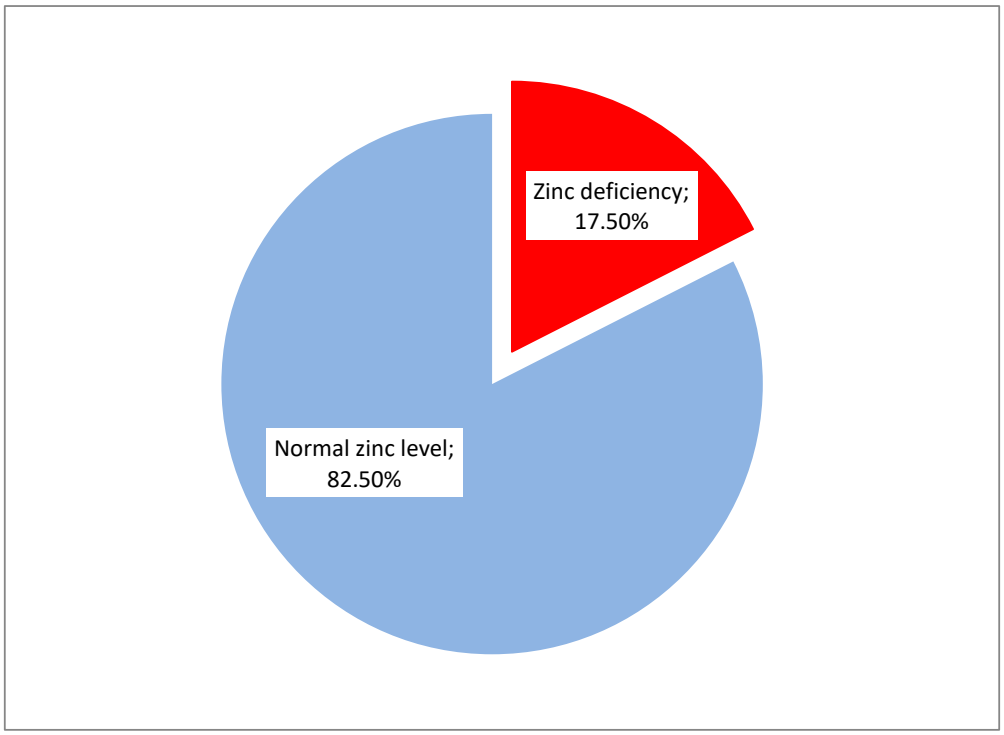

Figure (1). Prevalence of zinc deficiency among the studied children.

Table 2. Clinical features and laboratory investigation of the studied groups and the comparison between them.

Parameter	Study groups		Test of significance	*P* value
	Zinc group (n = 40)	Placebo group (n = 40)		
Clinical features				
Body temperature, °C				0.401
Mean ±SD	38.66±0.86	38.51±0.78	t-test	
Min- Max	37.1-40.0	37.2-40.0	0.839	
Heart rate, beats/min				
Mean ±SD	146.8±12.9	147.0±15.6	t-test	0.888
Min- Max	125-170	120-177	0.140	
Respiratory rate, breaths/min				
Mean ±SD	58.1±6.47	58.68±8.98	t-test	0.716
Min- Max	45-80	45-80	0.363	
Body weight				
Mean ±SD	8.98±2.54	8.7±3.12	t-test	0.435
Min- Max	5.3-15.0	5-15.0	0.781	
Duration of symptoms before admission, days				
Mean ±SD	2.65±1.189	2.8±2.27	U=	0.264
Min- Max	1-7	1-10	1.117	
WBCs count, ×103/mm^3				
Mean ±SD	11.18±3.73	10.52±3.73	t-test	0.582
Min- Max	4.8-20.0	4.1-18.7	0.550	
Platelets, ×103/mm^3				
Mean ±SD	449.9±94.13	422.58±84.71	t-test	0.170
Min- Max	225-649	244-649	1.372	
Zinc level, mg/dL,				
Mean ±SD	69.38±9.766	73.38 ±11.38	t=	0.096
Min- Max	50-90	51-100	1.687	

SD: Standard deviation **U:** Mann-Whitney test **t- test:** student t-test **Min-Max**.: Minimum- Maximum

Table (3). Outcomes of zinc supplementation compared with placebo for the studied children.

Parameter	Study groups		Test of significance (U)	*P* value
	Zinc group (n = 40)	Placebo group (n = 40)		
Duration of tachypnea (hours)				
Mean ±SD	32.47±11.24	39.97±17.61	2.270	0.026
Min- Max	11-48	13-70		
Duration of chest indrawing(days)				
Mean ±SD	2.47±1.21	3.42±1.238	3.458	0.001
Min- Max	1-4	1-5		
Time to normal bilateral air entry(days)				
Mean ±SD	2.82±1.41	2.7±1.067	2.053	0.043
Min- Max	1-5	1-4		
Duration of fever (hours)				
Mean ±SD	35.12±19.24	33.15±13.54	0.531	0.597
Min- Max	7-72	13-60		
Duration of hospitalization(days)				
Mean ±SD	3.5±1.34	4.85±2.57	2.939	0.004
Min- Max	1-6	2-14		
Time of symptom resolution (days)				
Mean ±SD	5.93±1.73	7.93±3.626	3.148	0.002
Min- Max	3-9	4-20		

SD: Standard deviation **U:** Mann-Whitney test **Min-Max.:** Minimum - Maximum

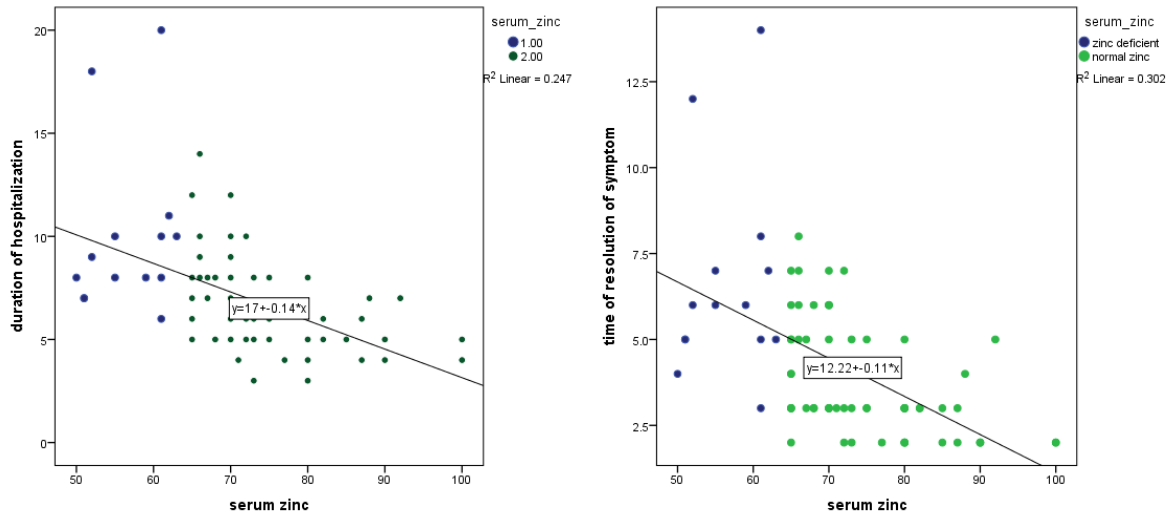

Figure (2): Correlation between serum zinc and duration of hospitalization and time of resolution of the symptoms.

الملخص العربي

تأثير الزنك كعلاج مساعد على الالتهاب الرئوي لدى الأطفال المحجوزة في المستشفى

تغريد محمد فرحات [١]، نجوى نشأت حجازي[١]، ايه مصطفى بركات [١]، احمد أنور خطاب [٢]، دينا مصطفى المطبعجي[١]

[١] قسم طب الاسرة كليه الطب جامعة المنوفية

[٢] قسم الاطفال كلية الطب جامهة المنوفية

الخلفية: يعد الالتهاب الرئوي السبب الرئيسي لوفيات الأطفال واعتلالهم في الدول النامية. على الرغم من أن الأبحاث أظهرت أن مكملات الزنك يمكن أن تساعد في الوقاية من الالتهاب الرئوي ، إلا أن فعاليتها العلاجية لم تثبت بعد. **الاهداف:** تحديد مدى انتشار نقص الزنك لدى الأطفال المصابين بالالتهاب الرئوي في المستشفيات وتأثير الزنك كعامل مساعد على نتائج الالتهاب الرئوي لدى الأطفال الصغار في المستشفيات. **طرق البحث:** أجريت دراسة تجريبية مزدوجة التعمية ذات شواهد على ٨٠ طفلا مصابين بالتهاب رئوي حاد تتراوح أعمارهم بين ٢-٦٠ شهرا تم إدخالهم إلى قسم الأطفال بمستشفى جامعة المنوفية في مصر. قبل التدخل ، تم اخذ البيانات الاساسيه والتاريخ الطبي بالتفصيل و الفحص الطبي. كما تم قياس مستويات الزنك في الدم في جميع المرضى. ومن ثم تم تقسيم الأطفال بشكل عشوائي إما لمجموعات مكملات الزنك أو مجموعات الدواء الوهميز. **النتائج** : من بين ٨٠ طفلا مصابا بالالتهاب الرئوي كان ١٧,٥ في المائه يعانون من نقص مستويات الزنك في الدم. وجدت هذه الدراسه فرقا ذات دلاله احصائية بين مجموعات الزنك و مجموعات الدواء الوهمي من حيث متوسط الايام لاختفاء اندلاع الصدر(P = 0.002) و متوسطه مده اختفاء الاعراض (P = 0.001) و متوسط مدة الاقامه بالمستشفى (P = 0.004), وكلها كانت اقصر في مجموعات الزنك . كان هناك أيضا فرق ذو دلالة إحصائية بين المجموعتين في متوسط مدة اختفاء النهجان (P = 0.026) ومتوسط الوقت للرجوع لمستوى الهواء الطبيعي في الرئتين (P = 0.04) . **الاستنتاج:** أدت مكملات الزنك كمادة مساعدة إلى تحسين مدة انتهاء الأعراض وتقليل مدة الإقامة لدى الأطفال في المستشفى .