

Estimation of Serum Zinc Levels in Children Admitted with Pneumonia

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Abstract:

Background: Pneumonia, particularly in poor nations, is a major cause of illness and mortality in children under 5 years old. The goal of the study is to determine whether zinc deficiency and other dietary components are associated with pneumonia in kids between the ages of 6 months and 5 years old.

Methods: n=40 children between the ages of 6 months and 5 years old who met the World Health Organization's definition of pneumonia were among the cases. The control group also comprised n=40 siblings of admitted children in the same age group. To uncover several potential risk factors, a thorough case history was acquired and a physical examination was carried out using a predetermined proforma. The serum zinc levels were determined using colorimetric techniques and a semi-automatic analyzer with 5-Bromo-PAS.

Results: Mean serum zinc level in children with Pneumonia (cases) is compared with that of a control group. There is a significant difference between children with pneumonia and controls in serum zinc levels. The distribution of the zinc levels in children has been depicted in graph 1. The mean serum zinc level in children with pneumonia is 59.86 ± 8.54 $\mu\text{g/dl}$. The mean serum zinc level in age, sex, and nutrition-matched controls is 80.12 ± 7.65 $\mu\text{g/dl}$. The mean serum zinc level is significantly lower in children with pneumonia than their matched controls p-value was <0.001 .

Conclusion: This study suggests that linked variables like malnutrition, and low serum zinc levels contribute to the mortality and morbidity of the illness in a developing nation like India where the prevalence of pneumonia is alarmingly high. Addressing these issues will assist to decrease the prevalence of pneumonia and the financial burden on the nation because they are deficient states.

Keywords: Pediatric Pneumonia, Zinc level, Nutritional risk factors, Anaemia

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Introduction

The overall number of children dying below the age of five years has decreased dramatically in the past three decades. However, still, the global decline in the

death rate has not been uniform. Numerous children in low-income countries continue to die from infectious diseases. Coexisting malnutrition exacerbates this issue both act

in concert to kill a large number of children who are still young. More than 10 million children are born each year. In poor nations, children under the age of five frequently pass away. [1] Inflammation of the lung parenchyma is what is meant by the term pneumonia. The most frequent cause of mortality in children is pneumonia, which claims the lives of almost 1.2 million children under the age of five every year. [1] It is responsible for 18% of all under-five mortality, including those from non-infectious causes. Sub-Saharan Africa and South Asia have higher rates of pneumonia. [1] In South Asia, there are 0.36 bouts of pneumonia per child every year, compared to 0.26 worldwide and 0.03 in affluent nations. [2] This demonstrates the presence of microorganisms and pneumonia risk factors such as crowded living conditions and malnutrition.

Pneumonia is caused by several social, economic, and environmental variables. Pneumonia is influenced by socioeconomic position, severe malnutrition, and absence of breastfeeding, especially in the first few months of life. [3] Most environmental risk factors for pneumonia are quite difficult to eliminate, however other dietary risk factors just require a minor adjustment. [4] According to estimates, up to half of the pneumonia-related fatalities are caused by malnutrition. While protein energy malnutrition and vitamin A are given a lot of attention, it has been suggested that zinc may have a significant role in reducing pneumonia-related morbidity and death. [7] Children in underdeveloped nations frequently suffer from zinc insufficiency due to insufficient dietary consumption, particularly from animal sources, and low zinc bioavailability in local diets. Lack of zinc weakens the immune system and raises the risk of life-threatening illnesses like pneumonia. [4] The lack of zinc throughout childhood has been linked to many negative functional outcomes, including linear growth, motor

development, and susceptibility to infectious illnesses, according to observational studies and randomized controlled trials. [5]

In addition to treating and preventing diarrhoea, zinc is said to prevent pneumonia. The body's immune response may also be significantly boosted by it, starting with the mobilization and sequestration of zinc to metallothionein-rich tissue, rapid up-regulation of immune defense-specific protein synthesis, activation of immune defense activity like macrophages, lymphocytes, and natural killer cells, and antibody-dependent cytotoxicity. Children with healthy zinc levels may have stronger immunological responses than those with inadequate zinc levels. [6] With this background, we in the current study tried to evaluate the serum zinc levels in cases of pediatric pneumonia and compare it to the normal controls.

Material and Methods

This cross-sectional study was conducted in the Department of Pediatrics, Prathima Institute of Medical Sciences, Naganoor, Karimnagar, Telangana State. Institutional Ethical committee approval was obtained for the study. Written consent was obtained from the parents of the patients included in the study.

Inclusion criteria

1. All children with clinical and radiological evidence of pneumonia in the age group of 6 months to 5 years were admitted during the study period.
2. Clinical evidence: severe pneumonia according to WHO classification. [7]
3. Radiological evidence: chest x-ray reported as pneumonia in children with clinical evidence.

Exclusion Criteria

1. Any child on zinc supplementation
2. Aspiration pneumonia
3. Chemical pneumonia

4. Persistent pneumonia
5. Neonates
6. Severe acute malnutrition
7. Co-existing illness
8. Chronic history/ Immunocompromised children

N=40 cases were selected for the current study based on the inclusion and exclusion criteria. Age and sex-matched controls n=40 from normal children admitted for non-respiratory complaints. Detailed case history and physical examination were done according to a predesigned proforma to elicit various potential risk factors. It was noticed that there had been a history of pertinent symptoms such as fever, cough, fast breathing, chest retractions, unwillingness to eat, lethargy, and wheezing. Malnutrition was rated using anthropometry and the IAP classification. By utilizing zinc-free plastic tubes to venepuncture 3 ml of venous blood, the plasma zinc content was calculated. Transport of the blood samples to the lab. Using a semi-automatic analyzer and the

colorimetric technique with 5-Bromo-PAPS, the content of serum zinc was determined. There was no deviance from the standard of care for research purposes throughout the whole study period.

Statistical analysis: In an excel spreadsheet, every information input on the data collecting form is recorded. SPSS Version 19 was utilized for statistical analysis. For continuous data, the mean and standard deviation were determined. For categorical data independent t-test. ANOVA one way was employed for comparing more than two groups.

Results

The age distribution in cases was studied most of the cases were belonging to the age group 13 – 24 months followed by the age group < 12 months and the least number of cases were in the age group of 25 – 60 months as depicted in table 1. Of the total n=40 cases studied in the population, n=22(55%) were males and n=18(45%) were females. The same number of males and females were also included in the control group.

Table 1: Age-wise distribution of cases and controls in the study

Age (months)	Case	percentage	Control	percentage
≤ 12	13	32.5	13	32.5
13-24	17	42.5	17	42.5
25-60	10	25.0	10	25.0
Total	40	100.0	40	100.0

Nutritional Status Nutritional status of children admitted with pneumonia is assessed at the time of admission. Weight for length/height was calculated and nutritional status was classified as described earlier. In the current study out of n= 40 cases, 57.5% were with normal nutritional status and 42.5% cases were

with moderate acute malnutrition (MAM) status based on the WHO classification of nutritional status (table 2). Similarly, in the control group, 87.5% of the subjects were with normal nutritional status. The p values were calculated as (<0.045) and are considered significant.

Table 2: Estimation of nutritional status between cases and controls in the study

Nutrition status	Cases	Percentage	Control	Percentage
Normal	23	57.5	35	87.5
Moderate acute malnutrition	17	42.5	05	12.5
Total	40	50	100	100.0

The mean serum zinc level in children with Pneumonia (cases) is compared with that of the control group. There is a significant difference between children with pneumonia and controls in serum zinc levels. The distribution of the zinc levels in children has been depicted in graph 1. The mean serum zinc level in children with

pneumonia is $59.86 \pm 8.54 \mu\text{g/dl}$. The mean serum zinc level in age, sex, and nutrition-matched controls is $80.12 \pm 7.65 \mu\text{g/dl}$. The mean serum zinc level is significantly lower in children with pneumonia than their matched controls p-value was <0.001 hence considered significant.

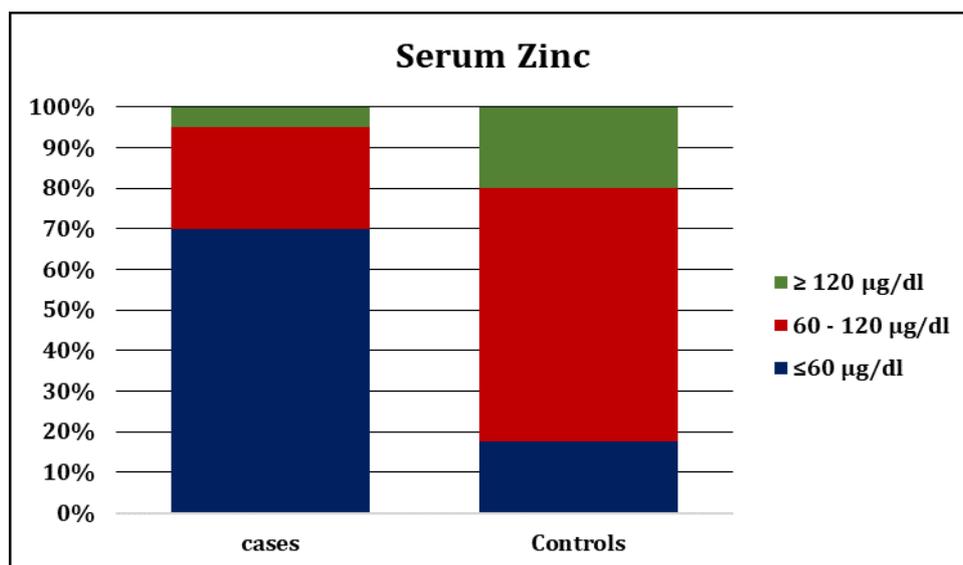


Figure 1: Distribution of zinc levels between cases and controls

The mean serum zinc level in different age groups of children with Pneumonia was compared. There is no significant difference between the mean serum zinc between the different age groups of children admitted with pneumonia. ($p=0.599$). The mean serum zinc value in children less than or equal to twelve months of age with pneumonia is $57.81 \mu\text{g/dl}$. In the control group, the mean serum zinc value is $72.36 \mu\text{g/dl}$. Mean serum zinc level in children admitted with pneumonia of both sexes compared. The mean serum zinc level in male children admitted with pneumonia is $62.15 \mu\text{g/dl}$. The zinc level in female children admitted with pneumonia is $58.81 \mu\text{g/dl}$. There is no significant difference between the mean serum zinc level of both sexes in children admitted with pneumonia ($p=0.593$) hence not significant. Mean serum zinc level compared between children admitted with pneumonia with normal nutrition and children admitted with pneumonia with

moderate acute malnutrition. The mean serum zinc level ($51.25 \mu\text{g/dl}$) in children admitted with pneumonia with moderate acute malnutrition is significantly lower than the mean serum zinc level ($61.02 \mu\text{g/dl}$) of children admitted with pneumonia with normal nutrition ($p=0.001$).

Discussion

One of the most prevalent infectious diseases in underdeveloped nations, pediatric pneumonia is a major contributor to avoidable child mortality. The WHO developed a plan for early diagnosis and efficient case management to address this worldwide issue, which had a significant influence on the death rate from pediatric pneumonia in poor nations. Even with these precautions, the death and morbidity rates associated with pediatric pneumonia remain exceedingly high. Therefore, finding other etiological variables that increase pneumonia severity is important. In the current study, we found there was

no significant difference between the mean serum zinc levels between the different age groups of children admitted with pneumonia. ($p=0.599$). This is similar to the findings of previous studies. [8, 9] In this study when compared to controls, the mean serum zinc levels in all age groups hospitalized with pneumonia are low. Except for children older than 25 months, it is statistically significant across the board. Even while the serum zinc level is low in this age group, it is not statistically significant, which may be because there aren't as many kids recruited at this age for research on serum zinc levels. Age is not a confounding factor in blood zinc in pneumonia, according to studies done on serum zinc levels in pneumonia and diarrhea. It has been found in all investigations, regardless of geographic location, including those from North India [8] and Turkey [9] except for one from Pakistan where Puspha et al., [9] found low blood zinc levels in infants. Male and female children selected for this study had similar mean blood zinc levels, with no discernible differences. In children hospitalized with pneumonia, there is no discernible difference in the mean blood zinc levels between the sexes. Children with pneumonia statistically had significantly lower mean serum zinc levels than controls in both male and female patients ($p=0.001$). The majority of the published data. [8-10] exhibited comparable findings. They all came to the same conclusion that there was no statistically significant difference in the levels of serum zinc in the two sexes. In this study, 44% of children have mild acute malnutrition, and of the total recruited children (including cases and controls) are in a normal nutritional state. The mean blood zinc level in children with mild acute malnutrition is considerably lower than in children with adequate nutrition, according to analysis within the pneumonia group ($p=0.01$). Children with mild acute malnutrition may have low mean blood zinc levels because of

insufficient dietary intake, which can cause zinc deficiency and other micronutrient deficiencies. Similar results were reported in research conducted by Kumar and colleagues. [8] To propose zinc supplementation in children with mild acute malnutrition, further research is required. Children with severe pneumonia have considerably lower mean serum zinc levels than matched controls ($p=0.001$). This finding is comparable to those of Kumar et al., [8] Secil Arica et al., [10] and Puspha et al., [9] More frequently, zinc deficiency is observed in poorer nations due to insufficient consumption of foods containing zinc or impaired absorption. [12] It is one of the top 10 variables contributing to the rise in disease among children in emerging nations. [12] Trials have demonstrated that giving children more zinc reduces the morbidity and mortality from infections. [13, 14] Since pneumonia is the infectious illness that kills children most frequently, research on the effects of zinc supplementation in pneumonia is widespread. Although zinc supplementation has often been demonstrated to reduce the incidence and preventative mortality owing to pneumonia. [14]

Conclusion

This study suggests that linked variables like malnutrition, and low serum zinc levels contribute to the mortality and morbidity of the illness in a developing nation like India where the prevalence of pneumonia is alarmingly high. Addressing these issues will assist to decrease the prevalence of pneumonia and the financial burden on the nation because they are deficient states.

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