

# Serum Zinc Level in Children with Acute Lower Respiratory Tract Infection

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## ABSTRACT

**Background:** Pediatric respiratory disease remains an important cause of morbidity in both the developing and the developed world. Pneumonias and inflammatory process develops in alveoli and interstitium as a response to infection-causing factors such as bacteria and viruses. Since pneumonia in infancy is difficult to discriminate from acute bronchiolitis, the term acute lower respiratory tract infection (ALRTI) inclusive of these both diseases is used. Zinc is a micronutrient with important roles in growth and in the immune, nervous and reproductive systems. Regular dietary intake of zinc is necessary because the human body cannot produce zinc and does not have an adequate mechanism for storing or releasing it.

**Objective:** was to evaluate serum zinc level in children with ALRTI.

**Patients and Methods:** Serum zinc level in children with ALRTI. 80 patients (subdivided into 3 groups according to severity of infection) compared to 20 normal individuals were included in this study.

**Results:** there was highly statistical significant difference between all patients and control groups as regard serum zinc level (mean of serum vitamin D level in patients and control groups were  $56.413 \pm 29.474$  and  $90.135 \pm 17.345$  respectively,  $p < 0.0001$ ).

**Conclusion:** Zinc deficiency occurs in the majority of recurrent respiratory infection in children and therefore a decreased serum zinc level is considered an additional risk factor for recurrent respiratory infection.

**Keywords:** Zinc Level, Children, Lower Respiratory Tract Infection.

## INTRODUCTION

Acute lower respiratory tract infection predominantly pneumonia is a substantial cause of morbidity and mortality<sup>(1)</sup>.

It is the leading cause of mortality and a common cause of morbidity in children below five years of age. In developing countries an estimated 146–159 million new episodes of pneumonia are observed per year<sup>(2)</sup>.

Zinc is an essential antioxidant mineral that is involved in numerous aspects of cellular metabolism. A potent antioxidant can act against inflammation and prevent the resulting tissue injury<sup>(3)</sup>.

Zinc deficient children are at increased risk of restricted growth, developing diarrheal diseases and respiratory tract infections. It is thought to decrease susceptibility to ALRTI by regulating various immune functions including protecting the health and integrity of respiratory cells during lung inflammation and injury. Supplementation of zinc could reduce the risk of pneumonia and the risk and duration of diarrhea, dysentery and malaria deaths among all infectious diseases, and they accounted for 3.9 million deaths worldwide<sup>(4)</sup>.

Zinc deficiency decreases the ability of the body to respond to infection and also adversely affects

both cell-mediated and humeral immune responses. It has a fundamental role in cellular metabolism, with profound effects on the immune system and the intestinal mucosa<sup>(5,6)</sup>.

In 2009, a systematic review of studies evaluating preventive effects of zinc supplementation on the morbidity burden of ALRI noted an overall reduction of 15-21% in the incidence of ALRI among zinc-supplemented preschool children<sup>(7)</sup>.

This study was performed to evaluate the relation between zinc deficiency and acute lower respiratory tract infections in children.

## SUBJECTS AND METHODS

### Subjects:

This study was conducted in collaboration between the Clinical Pathology and Pediatric departments at Bab Al-Shearia University Hospital, Faculty of Medicine, Al-Azhar University.

**The study was approved by the Ethics Board of Al-Azhar University.**

All patients were collected from Pediatric department at Bab Al-Shearia University Hospital over a period from 8th January 2018 to 5th March 2018, with appropriate consent to participate in this study after

explanation to the parents of patients how much it is helpful in diagnosis and treatment and also explaining to them that it is just a blood sample collection. Those children were divided into 2 groups: (patients group) and (control group). The patients group was subdivided into 3 subgroups according to severity of infection as follows:

- Subgroup B: comprised 30 patients suffering from mild ALRTI.
- Subgroup C: comprised 30 patients suffering from moderate ALRTI.
- Subgroup D: comprised 20 patients suffering from severe ALRTI.

Control group (A) comprised 20 apparently healthy children with no evidence of acute lower respiratory tract infection or history of recurrent respiratory tract infection.

**Inclusion criteria**

Children admitted with ALRTI from 2 months to 5 years from Pediatric department at Bab Al-Shearia University Hospital with evidence of acute lower respiratory tract infections.

Diagnosis was based on:

- History of acute lower respiratory tract infection (including cough, fever, dyspnea ... etc).
- Clinical features of acute lower respiratory tract infection as per World Health Organization (WHO), 1990 criteria (including fever, increased respiratory rate, chest in drawing ... etc)

**Exclusion criteria:**

- Children less than 2 months and more than 5 years are excluded.
- Children with clinical diagnosis of Reactive airway disease/asthma.
- Children associated with underlying chronic illnesses.
- Children with Inborn Errors of Metabolism.
- Children on zinc supplementation.

**SAMPLES AND METHODS**

Full history and clinical examination.

Eight ml venous blood were withdrawn from all participants of the study and divided into two portions: the first portion (two ml) was put in EDTA tube for

CBC which was done using cell dyne Ruby automated cell counter. The second portion (six ml) was put in plain tube and left to clot for 30 minutes then serum was separated and divided into two aliquots, one for routine biochemical tests performed by Cobas c311& Intejra analyzer (Roche Diagnostics) while the other aliquot was stored freezed at - 20°C for estimation of serum Zinc level by PHOTOSPECTROMETRY technique using a commercially available colorimetric kit supplied by Egyptian company for Biotechnology, Spectrum.

**Statistical analysis**

- All results were analyzed using Statistical package for social science (SPSS V.15, IBM Corp. U.S.A).
- Descriptive statistics used for quantitative data were; Mean ±SD while categorized data were represented as numbers and percentages.
- Chi square test was used for comparison of sex.
- Friedman One way analysis of variance (ANOVA) and Fisher's least significant difference (LSD) were used to compare means of parametric data of different groups.
- Pearson correlation coefficient was used to check for correlation between two quantitative parametric data.
- For all analysis, a two-tailed test was used and p <0.05 was considered statistically significant.

**RESULTS**

As regard to zinc level, there was statistically highly significant difference (P-value < 0.0001) between different sub-groups of patient group (B, C and D) and control group (A) as regard zinc level, table (1).

Results show highly statistical significant difference (p-value < 0.001) between studied groups as regard Hb, CRP and RBS while there was statistical significant difference (p-value < 0.01) between studied groups as regard WBCs and no statistical significance difference (p-value 0.05 & 0.3 ) as regard ALT & creatinine, table (2).

**Table (1): Comparison between studied groups as regard Zn level**

Variables \ Groups		Group A	Group B	Group C	Group D	p-value
		(N = 20)	(N = 20)	(N = 20)	(N = 40)	
Zn level	Mean	90.1	85.8	50.4	33.1	< 0.001
	±SD	5.2	1.2	1.1	0.7	

**Table (2): Comparison between studied groups as regard Routine laboratory data**

Variables		Groups	Group A (N = 20)	Group B (N = 20)	Group C (N = 20)	Group D (N = 40)	p-value
Hb (g/dl)	Mean		12.5	10.2	9.9	9.5	< 0.001*
	±SD		1.9	0.9	0.6	0.6	
WBCs (x 10 <sup>3</sup> /ul)	Mean		7.8	9.5	9.6	10.2	0.01**
	±SD		1.9	2.8	2.9	2.7	
CRP (mg/dl)	Mean		3.5	9.3	18.4	34.5	< 0.001*
	±SD		1.1	1.5	2.8	5.8	
ALT (U/L)	Mean		22.4	25.6	22.2	19.1	0.05
	±SD		5.7	6.6	11.3	8.9	
Creat (mg/dl)	Mean		0.9	0.9	1.1	0.9	0.3
	±SD		0.2	0.3	0.2	0.3	
RBS (mg/dl)	Mean		90	94.4	115.8	94	< 0.001*
	±SD		7.8	11.8	5.7	12.1	

## DISCUSSION

Pursuant to data published by World Health Organization, 10.5 million children under the age of 2 across the world lose their lives due to preventable and curable 5 diseases every year. Respiratory tract infections are responsible for 28% of all these deaths<sup>(8)</sup>.

The burden of acute lower respiratory tract infections is 2 to 10 times more common in developing than in developed countries<sup>(9)</sup>.

Zinc acts as a direct anti-viral activity and a demonstrable effect on immune-mediated production of interferon. Also, zinc prevents pathogens from gaining entry into cells and hinders their intra-cellular multiplication<sup>(10)</sup>.

The present study was carried out on eighty Egyptian children aged four months to five years who presented with acute lower respiratory infection diagnose according to The World Health Organization definition as (Case group). Who were recruited from Children's department at Saied Galal Hospital, Al-Azhar University, from January 2018 to March 2018. And twenty healthy age and sex matched with the patient's group taken from pediatric surgical clinic. (Control group).

Children with diarrhea, allergic diseases, asthma, children with chronic diseases, children who had severe form of malnutrition and children with history of zinc supplementation prior to admission for current illness were excluded.

This case control study aimed to assess the Serum Zinc status in children suffering from acute lower respiratory infection and to evaluate the relationship between Serum zinc status and severity of acute lower respiratory infection.

This study reported that the mean age was (22±17 months). The incidence of LRTIs is high in young age due to defect in the complex system of defense mechanisms which normally protect the lungs from a hostile microbiological environment. These include physical defenses such as cough and mucociliary clearance, circulating and resident cellular defenses, and a range of humoral or secretory mechanisms. And due to limited access to zinc-rich foods (animal products, oysters and shellfish) and the abundance of zinc inhibitors such as phytate. As is seen in many underdeveloped countries<sup>(11)</sup>.

This result was higher than results found in studies undertaken in Uganda Nepal<sup>(9,12,13)</sup>. They reported that the mean age of their children was (17.9±12.2, 7.8±6.0 and 6.2±4.28 months); respectively.

The differences between our results and other investigators could be attributed to the differences in number of cases in various studies, association of other epidemiological factors affecting zinc and differences on the cut-off value of zinc deficiency.

## CONCLUSION

Serum zinc levels were found to be lower in risk factors of LRTI like poor nutritional status, anemia, vitamin A deficiency, low birth weight and formula fed patients.

It is advised that zinc supplementation is required in LRTI patients especially those with the above mentioned risk factors.

Although the present findings are promising and few recent studies have shown reduction of incidence of ALRTI with zinc supplementation, but there is currently no standard guidelines to use Zinc in all malnourished

children to prevent respiratory tract infection and additional studies are needed to further investigate whether Zinc should be given to all malnourished children as standard of care and any other micronutrients also along with zinc to boost immunity.

## RECOMMENDATION

Follow up studies should be considered in order to determine the level of zinc in children with recurrent respiratory infections, thereby prophylactic administration of zinc could be useful in avoidance of such acute infections or at least guard against recurrent attacks.

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