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ORIGINAL ARTICLE

Estimation of Zinc Level in Children with Lower Respiratory Tract Infection in Pediatric Hospital in zagazig University

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ABSTRACT

Background: Zinc (Zn) is an essential element in the nutrition of human beings. It is needed in all DNA and RNA syntheses and is required at every step of the cell cycle. Zinc deficiency in children can cause stunted growth and increased incidence of infections. Zinc deficiency has been suggested as a major risk factor for developing pneumonia. The aim of this study was to assess the serum Zn levels in children with lower respiratory tract infe ctions (LRTI) and study the association between low Zn levels and other known risk factors of LRTI.

Methods: A cross-sectional study, which was conducted on ninety patients with acute LRTI. They aged between two months and five years.

The patients were admitted to pediatric department at Zagazig University Hospitals during the period from February 2017 to February 2018. All patients were subjected to general and chest examinations. Also, complete blood picture, serum Zn level measurement and chest X ray were done.

Results: Mean serum Zn level among the studied patients was 200.75 ± 37.44 µg/dl, which is considered normal or even slightly elevated than normal values There was no association between serum Zn levels and any of the other risk factors of LRTI.

Conclusion: There was no significant difference in serum zinc level among different lower respiratory infections and there was no significant difference in serum zinc level and other risk factors of the disease.

Keywords: Serum zinc, Acute lower respiratory tract infection, Pneumonia.

INTRODUCTION

Zinc is an essential nutritional element, with a broad spectrum of biological activities in humans. This element plays an important and vital role in the physical development of digestive and immune systems. Zinc deficiency in children can cause stunted growth and increased incidence of infections **[1].**

Zinc deficiency is common in several developing countries. This is because the commonly consumed main foods have low zinc contents and are rich in phytates which inhibit the absorption and utilization of zinc **[2].**

Acute lower respiratory infection (ALRI), including pneumonia and bronchiolitis, remains the leading cause of childhood hospitalisation and mortality, primarily within developing countries **[3].** The incidence of pneumonia is more than 10-fold higher (0.29 episodes versus 0.03 episodes) and number of childhood related deaths due to pneumonia are around 2000 fold higher in developing than in developed countries. This difference is due to high prevalence of malnutrition and low birth weight (LBW) **[4].**

Apart from infectious agent, child's genetic and immunological status, certain other factors such as malnutrition, LBW, and duration of breast-feeding have been identified as pneumonia risks. Some other inciting factors are smoking habit of parents and household crowding. Many of these risk factors are amenable to corrective measures. Therefore knowledge of these risk factors related to aquiering

ALRI will help in its prevention through effective health education of the community and appropriate initiatives taken by the government, leading to a healthy community and healthy nation as a whole **[5].**

The aim of this study was to assess the serum Zn levels in children with lower respiratory tract infections (LRTI) and study the association between low Zn levels and other known risk factors for LRTI.

METHODS

A cross-sectional study, which was conducted on ninety patients with acute LRTI. The patients were admitted to pediatric department at Zagazig University Hospitals during the period from February 2017 to February 2018.

Inclusion criteria: Children admitted with acute LRTI, aged between two months and five years.

Exclusion criteria: Children less than 2 monthes and more than 5 years, children with clinical diagnosis of reactive airway disease or asthma, children with underlying chronic illnesses, children with inborn errors of metabolism, children on Zn supplementation and children with immunodeficiency disease.

All cases were subjected to history taking regarding name, age, sex, prematurity, birth weight, type of food and smoke exposure, also, clinical examination with vital signs recording.

Detailed chest examination was done with recording of auscultation findings and signs of respiratory distress. All patients were investigated regarding complete blood count (CBC), serum zinc level and chest X ray, as well.

Serum zinc level measurement: Non-fasting blood (5 ml) was collected. 3ml were transferred into an EDTA tube for a full blood count and 2ml were transferred into a lithium heparin tube then centrifuged for Zn determination. All specimens for CBC were analyzed immediately, whereas serum samples for Zn analysis were stored at -70 °C.

Serum Zn level was measured by colometric assay by Zinc assay kits (wako catalog no. 439-14806), purchased from (wako diagnostics, USA) using AU480 (Beckmann Coulter) chemistry analyzer, according to the manufacturer's instructions at wavelength of 560 nm. The normal reference range in children is 63.8-110 µg/dl.

Ethical Clearance: Written informed consent for participation in the study was obtained from the patients' parents. Approval was received from the Pediatrics Department, Zagazig University Hospitals for conducting the study after the approval of the Institutional Review Board (IRB). The work was carried out for human studies in accordance with the World Medical Association's Code of Ethics (Decleration of Helsinki).

Statistical Analysis: All statistical analysis was conducted using medcalc 17.9 and IBM SPSS Statistics, version 22.0 (IBM; Armonk, New York, United States). Continuous variables were presented as the mean±SD if normally distributed or median(range) if not normally distributed. Normality was checked by Shapiro-Wilk test. Categorical variables were presented by the count and percentage.

Mann Whitney U test was used to compare two groups of non-normally distributed data. Spearman's rank correlation coefficient was calculated to assess relationship between serum level of zinc and selected study parameters, [+] sign indicate direct correlation & [-] sign indicate inverse correlation, also values near to 1 indicate strong correlation & values near 0 indicate weak correlation.

Probability (P-value) < 0.05 was considered significant.

RESULTS

This study included 90 patients, 48 of them were males with percentage of 53% and 42 females with percentage of 47%. The ages of patients ranged from 2 to 60 months with median of 24 months, as shown in table 1.

The most common radiological finding among the patients was right sided consolidation (27.78%) followed by pneumonic patches (21.11%) and bilateral hyperinflation (16.67%), as shown in table 2.

The hematological findings and serum Zn levels of the studied patients are shown in table 3. The results revealed that mean total leucocytic count was $9.503\pm3.42\times10^3$ and hemoglobin 10.2±1.1 gm/dl, indicating presence of anemia. However, platelets count was not significantly different from the normal values. All patients had a mean±SD value 200.8± 37.4 above that of the normal level (63.8-110 µg/dl).

As regard the final diagnosis of the patients, the most common is lobar pneumonia (38.9%) followed by bronchopneumonia (23.3%). There was no significant difference in serum Zn level among different respiratory diagnosis, as shown in table 4.

There was no significant difference in serum Zn level between males and females, as shown in table 5.

There was no association between serum Zn levels and any of the other risk factors of acute LRTI, as shown in table 6.

Table (1): Demographic, History taking and clinical data of the studied patients.

Parameters	Cases (N=90)	
Age (months)		
Median (Range)	24 (2-60)	
	N	%
Sex		
Male	48	53
Female	42	47
Birth weight		
Normal	70	77.8
Low	20	22.2
Feeding history		
Breast	66	73.3
Artificial	24	26.3
Nutritional history		
Good	60	66.7
Bad	30	33.3
Fever		
Yes	59	65.6
No	31	34.4
Breathlessness		
Yes	80	88.9
No	10	11.1
Wheezes		
Yes	35	38.9
No	55	61.1
Refusal of feeding		
Yes	39	43.3
No	51	56.7

Table (2): Radiological findings of the studied patients.

	Cases (N=90)	
	N	**(%)**
Normal	6	6.7
Bilateral hyperinflation	15	16.7
Pleural effusion	6	6.7
Consolidation		
left side consolidation	8	8.9
Right side consolidation	25	27.8
Bilateral consolidation	10	11.1
Pneumonic patches	19	21.1
Pulmonary infiltrate	1	1.1

Table (3): Laboratory findings of the studied patients.

	Cases (N=90)
	Mean ± SD
CBC	
TLC ($\times 10^3$)	9.5 ± 3.42
Hemoglobin (gm/dl)	10.2 ± 1.1
MCV	75.3 ± 6.9
MCH	26.1 ± 3.7
Platelets count ($\times 10^3$)	341.1 ± 147
Zinc level (µg/dl) [Normal: 63.8-110 µg/dl]	200.8 ± 37.4

Table (4): Final diagnosis of the patients and Zinc level distribution.

	Cases (N=90)		Serum Zinc level
	N	(%)	Mean ± SD
Lobar pneumonia	35	38.9	196.2 ± 45.1
Bronchopneumonia	21	23.3	197.8 ± 40.2
Bronchiolitis	15	16.7	200.1 ± 31.3
Interstitial pneumonia	10	11.1	218.7 ± 6
Pneumonia effusion	6	6.7	185.7 ± 56.1
Aspiration pneumonia	2	2.2	220.5 ± 4.0
Test			0.83
P-value			0.551

Table (5): Zinc level distribution according to sex of the studied patients.

	Serum zinc level (µg/dl)	Test*	P-value
	Mean ± SD		
Sex			
Male (N=28)	202.9 ± 38.2	2354	0.17
Female (N=42)	198.3 ± 36.8		

***Mann-Whitney test**

Table (6): Association between zinc levels and related risk factors.

	Cases (N=90)	
	r*	P-value
Smoke exposure	-0.024	0.82
Overcrowding	0.005	0.96
Feeding history	0.005	0.96
Nutritional history	-0.182	0.086

R* Spearman's rank correlation coefficient

DISCUSSION

Zinc is an essential mineral that is involved in numerous aspects of cellular metabolism. It is required for the catalytic activity of approximately 100 enzymes and it plays a role in immune function, protein synthesis, wound healing, DNA synthesis, and cell division **[6].** It is required for maintaining intestinal cells, bone growth and immune function. It is second to iron as the most abundant trace element in the body. Zinc deficient children are at increased risk of restricted growth and developing diarrheal diseases and respiratory tract infections **[7].**

It has been known that zinc affects immunomodulators, immunoregulators and epithelium of the respiratory tract, protects children from infections and improves T-lymphocytes. Furthermore, zinc is an important antioxidant and zinc received by diet is extremely essential in the healthy functioning of the body **[8].**

Zinc is thought to decrease susceptibility to acute lower respiratory tract infection [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. ALRTI are the leading cause of mortality and a common cause of morbidity in children below five years of age. Most of these deaths are caused by pneumonia and bronchiolitis. Pneumonia kills more children each year than AIDS, malaria or measles combined with more than 2 million deaths per year **[9].**

Numerous studies investigated the effects of Zn on many infections such as diarrhea and common cold and positive results have been obtained. However, few numbers of studies have been conducted in various countries, which may reveal the relationship between pneumonia and zinc as shown by **Lassi et al., [10]** study.

In addition, this study showed that there were abnormal radiological findings in most of the cases with right side consolidation presented in 27.78% of cases followed by pneumonic patches (21.11%) and bilateral hyperinflation (16.67%).

The hematological data of patients in the present study revealed that some cases experienced anemia. The findings are in agreement with **Mourad et al., [11]** who studied the hemoglobin level as a risk factor for lower respiratory tract infections as they found that mean hemoglobin level was 9.9 ± 0.6 gm/dl with presented anemia in 32% of hospitalized cases.

Regarding platelets count, the current results are in line with **Karadag-Oncel et al., [12]** who studied the CBC values in community acquired pneumonia and showed that platelets count was not significantly different between cases and healthy controls.

In the present study, the mean serum Zn level among the studied patients was 200.75 ± 37.44 µg/dl ranged from 57.1 to 231.5 µg/dl. These values were normal or even slightly elevated than normal values [63.8-110 µg/dl], which was against to the **Hussain et al., [13]** who found low serum level of zinc in severe pneumonia cases.

The most common diagnosis was lobar pneumonia followed by bronchopneumonia and bronchiolitis. Serum Zn levels were analyzed among the different clinical diagnosis but there was no clinical difference between all types of clinical diagnosis.

There was no significant difference on level of zinc between males and females. This was agreed by **Hussain et al., [13]** study who also showed no significant difference in serum zinc level as per sex. About 44.4% of the LRTI patients in the current study were exposed to passive smoking with no significant difference in serum Zn levels among smoking exposed and non-exposed. Also, there was no association between serum Zn level and exposure to smoking. This was in line with **Jackson et al., [14]** study which observed an inconsistent association between the presence of smokers in the house and severe LRTI. Also, as according to **Galan et al., [15],** smoking had no significant influence on serum Zn level.

This study showed that 73.33% of patients had received breast feeding compared to 26.67% received artificial feeding with no significant difference in serum levels according to type of feeding. Also, as regard the nutritional history, 66.7% of cases had good nutritional history compared to 33.3% with bad history with no significant difference between both groups with or without good nutritional history.

This was against **Hussain et al., [13]** who found that there was there was significant decrease in serum zinc level among artificially fed infants than breast-fed. Also, there was significant decrease in serum zinc with bad nutritional history. However, in line with the present results, **Van Biervliet et al., [16]** reported that the type of infant feeding either breast-feeding, adapted, hypoallergenic and soy, does not influence the serum Zn concentrations.

CONCLUSIONS

The findings of the current study showed that there was no significant difference in serum zinc level among different lower respiratory infections and there was no significant difference in serum zinc level and other risk factors of the disease.

Limitations of study: The conclusions of this study were limited by the sample size, unavailability of the base-line serum Zn level of the studied patients and absence of full data about the nutritional history of the patients, which depended only on the mothers recall rather than documentation.

RECOMMENDATION

Further studies are needed to assess the association between Zn level and acute lower respiratory infections using large sample size and for longer periods.

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