

Zinc Status In Children With Bronchial Asthma

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ABSTRACT:

BACKGROUND:

Bronchial asthma is a chronic inflammatory disease of the respiratory tract. The rise in asthma and allergic disease among children is a matter of worldwide concern. Many authors have argued that the changes in diet may have been an important determinant of increased susceptibility to asthma. Free radicals have been proposed to be responsible for the pathogenesis of many diseases because of their harmful effects on the cells and tissues. The enzymes responsible for antioxidant defense have trace elements like zinc.

OBJECTIVE:

To evaluate the relation between bronchial asthma and zinc serum level, and the relation between serum zinc level and the duration and severity of asthma.

PATIENTS AND METHODS:

A Case control study was conducted at Raparin pediatric teaching hospital in Erbil city. Fifty children from ages 1 to 12 years of both sexes who were known cases of asthma and had visited Raparin teaching hospital were enrolled in this study, another sample of 50 healthy children matched for age and gender, without history of chronic disease were taken as a control group. The zinc concentrations in serum were measured in both cases and controls.

RESULTS:

This study shows that there were significant difference in the values of serum zinc between asthmatic and control group ($p < 0,01$ and $p < 0,01$ respectively). The mean concentrations of zinc are lower in asthmatic children ($70.02 \mu\text{g/dl}$) in comparison to controls ($84.04 \mu\text{g/dl}$).

CONCLUSION:

Children with bronchial asthma have a great risk of zinc deficiency, and serum zinc level has significant relation to the severity of asthma and the use of steroid.

KEYWORDS: asthma, serum zinc.

INTRODUCTION:

Asthma is the most common chronic respiratory disorder in childhood. It may be defined as a chronic inflammatory condition of the lung airways characterized by episodic reversible airway obstruction, increased bronchial reactivity, and airway inflammation.^(1,2,3) Asthma results from complex interactions among inflammatory cells, their mediators, airway epithelium and smooth muscle, and the nervous system in genetically susceptible individuals.⁽⁴⁾ Observational studies have shown that diets low in antioxidants, such as vitamin C and vitamin A, magnesium, selenium, and omega-3 polyunsaturated fats (fish oil), or high in sodium and omega-6 polyunsaturates are associated with an increased risk of asthma.⁽⁵⁾ Zinc is an essential trace element necessary for normal human

functioning. It serves as an enzyme cofactor and protects cell membranes from lysis caused by complement activation and toxin release^(6,7) It was proposed that adequate dietary intake and Zn supplementation may decrease the severity of asthmatic attacks.⁽⁸⁾ the proposed several intrinsic factors may contribute to a low Zn status in asthmatics are, (1) like other inflammatory diseases, a redistribution in plasma Zn to the liver can occur during excessive stress. This has been attributed to the release of leucocyte endogenous mediator from activated phagocytes, which then stimulates movement of Zn from plasma to hepatocytes in allergic reactions.⁽⁹⁾ (2) The immune system is extremely dependent on the availability of Zn for maintaining its homeostasis. Inflammatory diseases can cause an increase in the demand for Zn as:

(i) Zn is essential for producing the thymic hormone thymulin necessary for regulating T-cell development and activation; and

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(ii) Zn is crucial for the activation of natural killer cells, phagocytic cells and for granulocytes, such as mast cells and eosinophils. As a result, greater demand for Zn by the immune system could be a contributing factor to the Zn deficiency noted in inflammatory diseases. Zinc deficiency itself is detrimental for inflammation as it results in dramatic increases in the number, size and activation state of mast cells.⁽¹⁰⁾ There have been numerous reviews focusing on the importance of vitamin C, vitamin E and selenium for respiratory diseases such as asthma, but limited studies are available on the role of dietary zinc (Zn). This paper will attempt to review the current state of knowledge, while also proposing the possible importance of Zn in the context of the respiratory system.

AIM OF THE STUDY:

- 1) To study the difference in serum zinc level in asthmatic children compared to the control.
- 2) To study the relation between serum zinc level and the duration and severity of asthma.
- 3) To study the relation between serum zinc level and steroid medications used by asthmatic children.

PATIENTS AND METHODS:

The A prospective case control study was performed in Raparin teaching hospital in Erbil city, Kurdistan region, Iraq. The study was conducted in period of six months from the beginning of February 2010 to the end of July 2010. Fifty children from ages 1 to 12 years of both sexes who were known cases of asthma and had visited Raparin teaching hospital during the study period were enrolled in this study. The following criteria were selected in the study: Age between 1-12 years. More than one attack of airway obstruction which was reversible. Another sample of 50 healthy children matched for age and gender, without history of chronic disease coming with their parents who bring another ill child to Raparin teaching hospital during the study period were taken as a control group. Information was collected from the patients and their parents via face to face interview and included: name, age, gender, and age at the first presentation of asthma, duration of asthma, daytime and night symptoms, frequency of admission per year, family history, types of drug used. According to the frequency of daytime and nocturnal symptoms, patients were put in three groups:⁽¹⁾

Group 1: Mild asthma

- Mild intermittent : A- Daytime symptoms 2 or less per week
B- Nocturnal symptoms 2 or less per month

- Mild persistent : A- Daytime symptoms more than 2 per week but not daily.

B- Nocturnal symptoms more than 2 per month.

Group 2: Moderate asthma:

- Daily symptoms
- Nocturnal symptoms more than once per week.

Group 3: Severe asthma:

- Continual daytime symptoms
- Frequent nocturnal symptoms

For each patient weight and length or height, were measured. The same parameters were measured for the children in the control group. Weight was measured by precision dial scale (seca optima). Participants were weighed in light clothing as far as possible and without shoes. The scales were calibrated before use. Height was measured by using the (Centre of Disease Control) CDC measuring board. Individuals were measured barefoot and standing erect, with feet together and head against the measuring rod, looking straight ahead, with arms hanging loosely at the sides and palms facing thighs. Blood samples were taken. Serum of peripheral venous blood samples was determined from the patients and control group. The zinc concentrations in serum were measured by means of spectrophotometer (CE 2021), LTA reagents were used (LTA s. r. 1 via Milano 15/F). The serum and reagents were mixed and read at wavelength 578 nm. Data were entered into statistical package for social science (SPSS) program for windows version 18 to generate the general characteristics of the study. Quantitative variables were summarized by finding mean \pm SD.

RESULTS:

The study showed that 30 of asthmatic patients (60%) were between 1-4 years and 11 of them (22%) between 5-8 years old, while 9 (18%) were between 9-12 years old. Also the study showed that 27 of asthmatic patients (54%) were males and 23 of them (46%) were females (i.e. male/female ratio 1.17/1), as shown in table (1).

A corresponding number of the same age groups and sex were selected as a control group. Mean serum zinc values of asthmatics and controls together with p values are given in Table 2. There were significant difference in the values of serum zinc between asthmatic and control group ($p < 0.01$). The mean concentrations of zinc are lower in asthmatic children (70.02 $\mu\text{g}/\text{dl}$) in comparison to controls (84.04 $\mu\text{g}/\text{dl}$). There were differences in serum zinc levels between mild asthma (72.9 $\mu\text{g}/\text{dl}$), moderate asthma (68.3 $\mu\text{g}/\text{dl}$) and severe asthma (66.2 $\mu\text{g}/\text{dl}$), which were lower

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in severe asthmatic children in comparison to mild and moderate asthmatic as shown in Table 3. Children with duration of 5 years & more have lower mean serum zinc level (64.8µg/dl) than those with duration of one and two years (72.05µg/dl and 70.7µg/dl respectively), as shown in Table 4. Thirty eight (38%) of asthmatic children were used steroid and sixty two (62%) were not used steroid, mean serum zinc level were significantly lower in those used

steroid (66.7µg/dl) than those not used it (72.0µg/dl), as shown in Table 5.

Growth parameters of asthmatic children had a relationship with serum zinc level, those with weight and height (length) below 50thcentile tend to have lower serum zinc level (67.10µg/dl and 68.00µg/dl respectively) than those with weight and height (length) ≥ 50thcentile (74.04µg/dl and 72.59µg/dl respectively), as shown in Table 6.

Table 1: The distribution of age and sex for both patients and controls.

Age group(years)	No. of patients		%	No. of controls		%
1-4	30	Male: 14 Female:16	60	30	Male: 14 Female:16	60
5-8	11	Male: 7 Female: 4	22	11	Male: 7 Female: 4	22
9-12	9	Male: 6 Female: 3	18	9	Male: 6 Female: 3	18
Total	50		100	50		100

Table 2: Serum zinc levels in asthmatic and control.

Groups	No,	Mean	Std. Deviation	P value
Zinc level	Asthmatic children	50	70.02µg/dl	± 7.78
	Control	50	84.04µg/dl	± 10.08
				P<0.01

Table 3: Correlation between serum zinc level and severity of asthma.

Asthma Severity	No.	Serum zinc level		p
		Mean µg/dl	Std. Deviation µg/dl	
mild	22	72.90	±9.14	0.01
Moderate	20	68.35	±5.59	
Severe	8	66.25	±6.13	
Total	50	70.02	±7.78	

Table 4: Correlation between serum zinc level and duration of asthma.

Duration of asthma	No.	Serum zinc level		p
		Mean µg/dl	Std. Deviation µg/dl	
1 year	20	72.05	±7.72	0.69
2 years	11	70.72	±7.11	
3 years	9	68.33	±11.43	
4 years	5	66.20	±7.91	
5 years&more	5	64.80	±6.27	
Total	50	70.02	±7.78	

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Table 5: Correlation between serum zinc level and use of steroid among patients studied.

	No.	%	Serum zinc level		P
			Mean µg/dl	Std. Deviation µg/dl	
used steroid	19	38	66.78	±6.28	0.02
not used	31	62	72.00	±8.03	
Total	50	100	70.02	±7.78	

Table 6: Correlation between weight and height (or length) percentiles of asthmatic children and serum zinc level.

Weight and Height/Length		No.	%	Serum zinc level		P
				Mean µg/dl	Std. Deviation µg/dl	
Cases wt.	≥50 th centile	21	42%	74.04	±9.45	0.01
	<50 th centile	29	58%	67.10	±4.60	
Cases Ht/Length	≥50 th centile	22	44%	72.59	±8.69	0.03
	<50 th centile	28	56%	68.00	±6.44	

DISCUSSION:

The rise in asthma and allergic disease among children is a matter of worldwide concern. Many authors have argued that the changes in diet may have been an important determinant of increased susceptibility to asthma. Free radicals have been proposed to be responsible for the pathogenesis of many diseases because of their harmful effects on the cells and tissues. There are some defense mechanisms to avoid the harmful effects of free radicals. The enzymes responsible for antioxidant defense have trace elements like zinc. Decreased levels of these elements lead to a reduction in antioxidant activity.⁽¹¹⁾

Our study had shown that male was more prone for childhood asthma, 27 (54%) of our patients were males, this result was compatible with other studies like that done by Mahmood 2009⁽¹²⁾ (where the male percent in his study was 70%), Hazim 2005⁽¹³⁾ (where the male percent in his study was 71%), Kalyoncu, Selcuk in 1999⁽¹⁴⁾ (73% males) and Hasan in 1998⁽¹⁵⁾ (62% males).

The greatest number of the study patients (60%, n=30) were in the age group 1-4 years and this was compatible with Mahmood 2009⁽¹²⁾ (1-4 years were 40%), Hazim⁽¹³⁾ (1-5 years were 47%), Hasan⁽¹⁵⁾ (1-4 years 55%), and Khalil.⁽¹⁶⁾

This study revealed that the serum concentration of zinc in asthmatic patients were lower than that in control group. Similarly other studies have reported that the serum level of zinc in bronchial asthma patients tended to be lower, like Vural et

al in Turkey⁽¹⁷⁾, el Kholy et al in Egypt⁽⁹⁾, Nevin et al in Turkey⁽¹¹⁾, and Bahri et al in Turkey⁽¹⁸⁾. However, the relationship between serum zinc and bronchial asthma still remains controversial as some had reported to have no significant differences like Toro et al in Italy⁽¹⁹⁾, or even opposite like SotashiUrushidate et al in Japan.⁽²⁰⁾

In this study the mean serum zinc level was lower in children used steroid than those not used, this is because of increase urinary excretion of zinc reducing serum zinc level by steroid.⁽²¹⁾ This result is in contrast with the finding of Goldey et al who found no correlation between serum zinc level and the use of steroid in asthmatic children.⁽²²⁾

In this study, the mean serum zinc level was lower in children with severe asthma than those with mild and moderate asthma, this may be explained by that in severe asthma the use of steroid is part of treatment. This result is in contrast with the finding of Picado et al who found no evidence that the severity of the asthma has any influence on serum zinc level.⁽²³⁾

Despite that the mean serum zinc level were lower in asthmatic children in comparison to control group, but these differences were not statistically significant among asthmatic children in relation to the duration of the disease, and no further studies have been found concerning the duration of asthma and serum zinc level. The relationship between poor growth and low serum

zinc levels observed among children with bronchial asthma supports the research of Prasad et al⁽²⁴⁾, Ann et al⁽²⁵⁾, and Carol et al⁽²⁶⁾, while in contrast to Maqbol . et al⁽²⁷⁾ who showed surprisingly no correlations between plasma zinc levels and growth. Despite these studies, the significance of these correlations between the severity of asthmatic symptoms and low Zn levels is not yet fully understood. Hence, future studies are required to fully appreciate the importance of varying Zn status and its effect on the clinical symptoms and pathological changes noted in asthma.

CONCLUSION:

Children with bronchial asthma have a great risk of zinc deficiency, and serum zinc level has significant relation to the severity of asthma and the use of steroid.

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