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Serum level of zinc in asthmatic patients: A case–control study

G. Khanbabaee^{a,*}, A. Omidian^b, F. Imanzadeh^c, F. Adibeshgh^c, M. Ashayeripناه^d, N. Rezaei^{e,f}

^a Department of Pediatric Respiratory Diseases, Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran

^b Department of Pediatric Diseases, Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran

^c Department of Pediatric Gastrointestinal Diseases, Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran

^d Department of Microbiology, Faculty of Biological Sciences, Shahid Beheshti University, Tehran, Iran

^e Research Center for Immunodeficiencies, Children's Medical Center, Tehran University of Medical Sciences, Tehran, Iran

^f Molecular Immunology Research Center; and Department of Immunology, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

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Abstract

Background: Hypozincemia could lead to a variety of defects in growth and the immune system, while it seems to be associated with increased rate of asthmatic attacks in children.

Methods: This study was performed to assess the serum zinc level in 100 paediatric asthmatic patients in comparison with a control group.

Results: Mean serum level of zinc in the asthmatic patients was $70.5 \pm 22.6 \mu\text{g/dL}$, which was significantly lower than $80.9 \pm 16.9 \mu\text{g/dL}$ in the control group ($p < 0.001$). Forty-two asthmatic patients (42%) had hypozincemia, while this rate was 12% in healthy children ($p < 0.001$). There was a significant association between the zinc level and severity of asthma ($p < 0.001$). However, no significant association was detected between the serum level of zinc and other factors, including control and treatment of the disease.

Conclusions: As for high rate of hypozincemia in the asthmatic children, evaluation of serum zinc level in asthmatic children could be suggested, while zinc substitution in the diet of those with hypozincemia could be recommended.

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Introduction

Asthma is a common chronic disease with a high rate of mortality and morbidity among children that leads to emergent visits, hospitalisation, and absence from school. It seems that the prevalence of this disease has increased during recent decades, which could be due to genetic

* Corresponding author.

E-mail address: khanbabaee@yahoo.com (G. Khanbabaee).

susceptibilities and/or environmental, economic, and nutritional factors.¹ Lack of antioxidants and zinc deficiency seem to be important factors in this regard.²

It seems that zinc deficiency can disturb the equilibrium between the type 1 and 2 T helpers,³ which causes increased inflammation and eosinophilia, the same mechanism detected in allergic airway hypersensitivity.⁴ Zinc deficiency can lead to a variety of complications, including growth retardation, pubertal delay, delayed wound healing, chronic diarrhoea, and increased susceptibility to infections.⁵

In this study, we aimed to evaluate serum level of zinc in a group of paediatric patients with asthma and compare frequency of hypozincemia between asthmatic children and healthy controls. Our particular interest was to test the hypothesis that a low serum zinc level is a risk factor for asthmatic symptoms in childhood.

Materials and methods

In this case-control study, a total of 100 asthmatic (cases) and 100 healthy (controls) children (55 male and 45 female in each group) were consecutively selected and enrolled into the study. The controls had no history and evidence of asthma and zinc deficiency and were matched to the cases regarding age and sex. In the case group, those with confirmed diagnosis of asthma under no zinc supplementation in drug history were included. The control group consisted of non-allergic volunteers without any particular health problems. They had never had any episode of breathlessness and/or wheezing and had never used asthma medication. The children are from middle-income socioeconomic status families. This study was approved by the Local Ethics Committee of the Hospital. Written informed consents were taken from the parents of all subjects before sampling. Diagnosis of asthma was confirmed using Global Initiative for Asthma (GINA) protocol. According to the GINA documents, asthma could be subdivided into four categories of intermittent, mild persistent, moderate persistent, or severe persistent, available at www.ginasthma.com, based on the levels of symptoms, airflow limitation, and lung function variability.⁶ A clinical diagnosis of asthma is often prompted by symptoms such as episodic breathlessness, wheezing, cough, and chest tightness. Measurements of lung function (spirometry or peak expiratory flow) provide an assessment of the severity of airflow limitation, its reversibility, and its variability, and provide confirmation of the diagnosis of asthma. Making a diagnosis of asthma in children three years and younger may be difficult, because episodic respiratory symptoms, such as wheezing and cough, are also common in children without asthma. Therefore, the diagnosis of asthma in early childhood was based on clinical judgement and an assessment of symptoms and physical findings. The presence of atopy or allergic sensitisation provides additional predictive support, as early allergic sensitisation increases the likelihood that a wheezing child will have asthma. A useful method for confirming the diagnosis of asthma in children five years and younger is a trial of treatment with short-acting bronchodilators and inhaled glucocorticosteroids. After the confirmation of the diagnosis, the patients' data were collected and severity of the disease

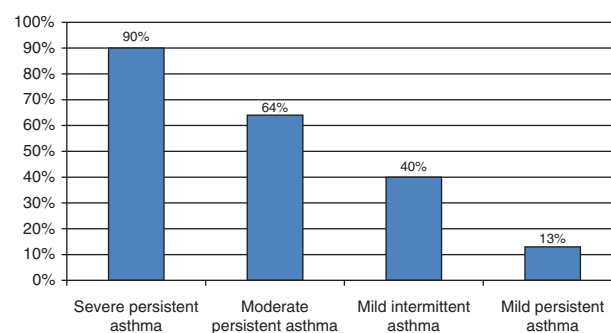


Figure 1 Frequency of hypozincemia in different asthmatic groups based on disease severity.

was determined. Serum zinc concentration was measured by using an assay kit (Randox Kit, Ireland). The data were analysed using SPSS software (version 17). Kolmogorov-Smirnov, Student's *t* test, Chi-square test, and Fisher's exact test were performed to analyse the data. A *p*-value of less than 0.05 was considered to be statistically significant.

Results

Mean age of the asthmatic patients was 65 ± 3 months (range of 3–149 months) in comparison with 64 ± 3.1 months (range of 5–144 months) in the control subjects.

Mean serum level of zinc was 70.5 ± 22.6 $\mu\text{g/dL}$ (range of 31–140 $\mu\text{g/dL}$) in the asthmatic children, which was significantly lower than 80.9 ± 16.9 $\mu\text{g/dL}$ (range of 42–119 $\mu\text{g/dL}$) in the control group ($p < 0.001$). The serum Zn cut-off to classify patients and control group as hypozincemia was 63 $\mu\text{g/dL}$. Indeed in the case group, 42% had hypozincemia, which was significantly higher than 12% in the controls ($p < 0.001$).

Frequency of hypozincemia was assessed in asthmatic patients with different severity which showed that 90% of patients with severe persistent asthma had hypozincemia, whereas this rate was significantly lower than other asthmatic groups (Fig. 1). These results indicated a significant association between the zinc level and severity of asthma ($p < 0.001$; $r = -0.528$), while severity of asthma was increased by deficiency of zinc ($p = 0.001$).

In the asthmatic children whose disease was not under control, 52% had hypozincemia; in those with controlled asthma, this rate was 35%, which did not show any significant difference ($p = 0.1$).

Discussion

Zinc deficiency seems to have a role in the pathogenesis and severity of asthma. The results of this study confirm previous observations that there is low serum zinc level in asthmatic children. In this study, significant frequency of hypozincemia was detected in the asthmatic children, while a significant decreased level of zinc was found in this group of patients, which was in agreement with some previous studies. However, the association between the severity of hypozincemia and severity of asthma has not been evaluated. Vural et al.⁷ suggested a different zinc status between asthmatic and healthy subjects. In the study by Di Toro et al.,⁸ mean

hair zinc level was lower in asthmatic and healthy children ($p < 0.05$). Our study showed that more severity of asthma can be associated with more deficiency in serum zinc level. It should be noted that the changes in zinc status do not necessitate with cause of disease, while it could be as a result of other factors such as chronic disease state.

In a recent study in Japanese adult asthmatic cases, no significant decrease of zinc was detected in the asthmatic patients,⁹ but it should be noted that the mean serum zinc levels in patients and controls were about 100 $\mu\text{g/dL}$, which is considerably higher than the level in Iran. Zinc deficiency seems to be a common condition in Iran, while the study on 23 provinces of the country showed a prevalence of 13.7% in healthy children,¹⁰ which is similar to findings of this study. In addition to the age group of studied cases, such a discrepancy may be due to the difference in the economic and social levels among different countries.

Measurement of zinc level could be recommended in asthmatic children, especially in countries with a higher prevalence of zinc deficiency. Zinc supplementation might be suggested in asthmatic patients with hypozincemia, while such a defect could aggregate to the severity of disease. However, further multi-centre studies with greater sample sizes are needed to warrant the results of this study.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the responsible Clinical Research Ethics Committee and in accordance with those of the World Medical Association and the Helsinki Declaration.

Confidentiality of data. The authors declare that they have followed the protocols of their work centre on the publication of patient data and that all the patients included in the study have received sufficient information and have given their informed consent in writing to participate in that study.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects mentioned in the article. The author for correspondence is in possession of this document.

Conflict of interest

The authors have no conflict of interest to declare.

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