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# Original Research

## To compare the Serum Zinc Levels in Asthmatic and Non-Asthmatic Children

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***ABSTRACT:***
**Aim:** To compare the Serum Zinc Levels in Asthmatic and Non-Asthmatic Children. **Methods**: This study was a case and control study, which was conducted on 80 asthmatic children denoted as cases and 80 non-asthmatic children denoted as controls who attended the Department of Pediatricsaged between 5 and 15 years and the diagnosis of asthma was based on a physician's diagnosis according to the American Thoracic Society guidelines in accordance with guidelines of the Global Initiative for asthma and the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire were included in the study. **Results**: Severity of asthma was based on ISAAC questionnaire. Amongst the cases, 19 had intermittent asthma, 15 of them had mild asthma, 17 of them had moderate asthma and 29 of them had severe asthma (Table2). Hypozincemia was defined as serum Zn level below 60.0 ng/dL. As an assessment of zinc deficiency in studied subjects, we analysed the case and control groups in terms of overall state of being deficient or having sufficient serum zinc levels which was further evaluated within case groups. In a total of 160 patients 55 of them were deficient in serum zinc levels with mean serum zinc level of 53.65ng/ dL, while as 105 of them had sufficient serum zinc level with mean value of 82.55ng/dL. Investigating the serum zinc levels in case and control patients, which was further evaluated within case groups, we found that mean serum zinc levels in cases was 59.04ng/dL while in controls it was 89.88ng/dL (taking 60ng/dL as the lowest normal range), which reflected a significant decrease in serum zinc levels in cases as compared to controls. **Conclusion:** We concluded that the Serum zinc levels were considerably lower in children with asthma than in healthy children.

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### INTRODUCTION

Asthma is the most common chronic disease in childhood, and the prevalence has increased considerably in recent decades.[1,2] According to international guidelines, the ultimate goal of asthma management is to control the disease in terms of symptoms, pulmonary function, preventing asthma exacerbations and avoiding adverse effects from asthma medications. The main controller medications are inhaled corticosteroids that switch off the inflammation of asthmatic airways.[3,4]

Zinc (Zn) is a trace mineral involved in many functions in the body.[5] Zn, an essential dietary metal, plays special roles in the conducting airways and contributes partly to the structure and function of many biological enzymes. It also regulates ion transporters relevant to pulmonary diseases.[6-9] Zn is known to exhibit powerful antioxidant activity in the lungs and several body organs.[6-9] Reactive oxygen species (ROS) have a role in initiating inflammation in asthmatic airways. Excessive ROS production in asthma leads to an oxidant-antioxidant imbalance in airways.[10] It is possible that Zn deficiency can disturb the equilibrium between type 1 and type 2 T helpers,[11] which leads to increased inflammation and eosinophilia. This is the same mechanism detected in allergic airway hypersensitivity.[12]

Chronic asthmatics take prophylactic inhaled steroids daily, which may have an important contributing effect on serum Zn status. Such a study has not been reported in the literature, but there are some studies that demonstrated a relationship between oral steroids

and Zn levels in normal humans, asthmatic patients, burn patients, and patients with rheumatoid arthritis.[13-15]

We conducted this study to study the difference in serum zinc levels in asthmatic and non-asthmatic children in order to assess possible association between zinc deficiency and asthma risk

## MATERIAL AND METHODS

This study was a case and control study, which was conducted on 80 asthmatic children denoted as cases and 80 non-asthmatic children denoted as controls who attended the Department ofPediatrics.

## INCLUSION CRITERIA

- Age between 5 and 15 years
- The diagnosis of asthma was based on a physician's diagnosis according to the American Thoracic Society guidelines in accordance with guidelines of the Global Initiative for asthma and the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire

## EXCLUSION CRITERIA

- Malnourished asthmatic patients.
- Patients with chronic illness like chronic kidney disease, chronic liver disease, metabolic diseases, etc.
- Patients on zinc supplements in preceeding 3 months. Patients were classified as intermittent asthma, mild persistent asthma, moderate persistent asthma & severe persistent asthma as per the GINA guidelines.

## METHODOLOGY

Asthma control was assessed using the Asthma Control Test (ACT) that includes five items (activity limitations, shortness of breath, nocturnal symptoms, rescue medication, and overall control in the past 4 weeks). Each item was scored from 1(worst) to 5 (best). The ACT ranged from 5 to 25 (better indicated by higher values). A score of >20 indicates well-controlled asthma, 16–19 partially controlled, and <16 uncontrolled asthma.

We measured the serum Zn level in controls and then compared the levels with those of cases. None of the subjects in either the cases or control group had acute respiratory infection for more than 4 weeks prior to enrollment. For the measurement of serum zinc level, blood samples were collected by vein puncture from ante cubital vein and collected in blood vacutainer system CAT-plain tubes. After 25-30 minutes, the serum was separated and collected in Eppendorf tubes and stored at -20ºC for estimation of serum zinc level. Zinc concentration was measured by means of semi automaticanalyser.

## RESULTS

This study was a prospective case-control study which was conducted over a period of two years with the primary objective of ascertaining serum zinc levels in asthmatic and non-asthmatic patients. We enrolled a total of 160 pediatric patients (80 cases and 80 controls). We further categorized the patients into two age groups; one of them being below 10 years and another one being 10-15 years (Table 1). The median age in the asthma group was ±9.8 while as in the non-asthma group it was ±10.0 years. There was no significant difference regarding the mean ages of the groups ($p > 0.05$). There were 50 males and 30 females in both the case as well as the control groups. Severity of asthma was based on ISAAC questionnaire. Amongst the cases, 19 had intermittent asthma, 15 of them had mild asthma, 17 of them had moderate asthma and 29 of them had severe asthma (Table2). Hypozincemia was defined as serum Zn level below 60.0 ng/dL. As an assessment of zinc deficiency in studied subjects, we analysed the case and control groups in terms of overall state of being deficient or having sufficient serum zinc levels which was further evaluated within case groups. In a total of 160 patients 55 of them were deficient in serum zinc levels with mean serum zinc level of 53.65ng/ dL, while as 105 of them had sufficient serum zinc level with mean value of 82.55ng/dL (Table 3) The difference was statistically significant ($p=0.003$).

Within the case sub- groups, in the intermittent group 11patients were deficient whereas 8 patients had sufficient serum zinc levels, in mild group 10 patients were deficient whereas 5 patients had sufficient serum zinc levels, in moderate group 7 patients were deficient whereas 10 patients had sufficient serum zinc levels, and in severe group 17 patients were deficient whereas 12 patients had sufficient serum zinc levels (Table 4).

Investigating the serum zinc levels in case and control patients, which was further evaluated within case groups, we found that mean serum zinc levels in cases was 59.04ng/dL while in controls it was 89.88ng/dL (taking 60ng/dL as the lowest normal range), which reflected a significant decrease in serum zinc levels in cases as compared to controls ( p.value of 0.0001) (Table 5).

Among the four case groups of asthma severity; mean serum zinc levels in intermittent group was 57.08ng/dL, in mild group it was 56.78ng/dL, in moderate group it was 65.3ng/ dL and in severe group it was 58.0ng/dL (Table 6), the same does not reflect any increased deficient state of serum zinc levels with disease severity ($p>0.05$)

**Table-1: Age wise frequency in asthma subjects.**

| Age in years | Number =80 | Percent |
|---|---|---|
| Below 10 | 50 | 62.5 |
| 10-15 | 30 | 37.5 |
| Mean±SD (Range)=9.42±2.92 (5-15) | | |

**Table-2: Distribution of Asthma patients as per severity.**

| Grade of asthama | Frequency | Percent |
|---|---|---|
| Intermittent | 19 | 23.75 |
| Mild | 15 | 18.75 |
| Moderate | 17 | 21.25 |
| Severe | 29 | 36.25 |
| Total | 80 | 100 |

**Table-3: Overall Serum zinc levels in subjects**

| Serum zinc status | Mean | Std. Deviation | N |
|---|---|---|---|
| Deficient | 53.65 | 3.07 | 55 |
| Sufficient | 82.55 | 13.361 | 105 |
| Total | 74.46 | 16.959 | 160 |
| p=0.003 | | | |

**Table-4: Severity of Asthma and serum zinc levels**

| Grade of Asthma | Defficient (n=50) | Sufficient (n=30) | Total |
|---|---|---|---|
| Intermittent | 11 | 8 | 19 |
| Mild | 10 | 5 | 15 |
| Moderate | 7 | 10 | 17 |
| Severe | 17 | 12 | 29 |
| P=0.001 | | | |

**Table-5:** Serum zinc levels in subjects

| Serum Zinc level | Group | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| | Asthmatic | 80 | 59.04 | 6.31 | 1.04 |
| | Non asthmatic | 80 | 89.88 | 11.62 | 1.61 |
| p=0.0001 | | | | | |

**Table-6: Serum zinc level with asthma severity**

| Asthma Severity | Mean | Std. Deviation | N |
|---|---|---|---|
| Intermittent | 57.08 | 4.98 | 19 |
| Mild | 56.78 | 9.03 | 15 |
| Moderate | 63.2 | 6.53 | 17 |
| Severe | 56.0 | 6.78 | 29 |
| Total | 74.46 | 15.95 | 80 |

## DISCUSSION

Zinc deficiency is common in children from developing countries and often it is aggravated by inter current acute and chronic infections. A regular intake of dietary zinc is essential for maintenance of physiological zinc need. Zinc deficiency occurs as a result of either high dietary phytate intake with inadequate intake of zinc-rich animal protein or from increased loss of zinc in infections such as diarrhea. It is claimed that nutritional deficiency of zinc may affect nearly 2 billion people in the developing world. In Bangladesh, prevalence of zinc deficiency is 44.6% in the preschool aged children and 57.7% in slum children.[16]

Further, chronic inflammation events cause a characteristic decline in plasma or serum zinc levels in experimental studies. The explanation of this hypozincemia is the redistribution of plasma zinc in the body. Activation of the phagocytic cells occurs in IgE-mediated allergic reactions, leading to the release of Leukocyte Endogenous Mediator which increases the movement of zinc from plasma to the hepatocytes, decreasing its serum level. It appears that hypozincemia plays a role in producing, or at least exacerbating, the allergic diseases. Zinc deficiency seems to have a role in the pathogenesis of asthma. The results of this study confirm previous observations that there is low serum zinc level in asthmatic children. In this study, a significant

frequency of hypozincemia was detected in the studied subjects and a decreased level of mean serum zinc [59.04ng/dL] was found in cases, which was in agreement with some previous studies. Mao et al[17] suggested a different zinc status between asthmatic and healthy subjects. In the study by Di Toro et al[18], mean hair zinc level was lower in asthmatic and healthy children ($p < 0.05$). Our study didn't showed that severity of asthma can be associated with increased deficiency in serum zinc level which is in concordance with the works of Urushidateet al[19,] who noted a similar onservation in their study in Japanese subjects 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.

## CONCLUSION

We concluded that the Serum zinc levels were considerably lower in children with asthma than in healthy children.

## REFERENCE


1. *Centers for Disease Control and Prevention: National Center for Health Statistics, National Health Interview Survey Raw Data.* American Lung Association Research; Chicago, IL, USA: 2011. Analysis by the American Lung Association Research and Health Education Division Using SPSS and SUDAAN Software.
2. Gelfand E.W. Pediatric asthma: A different disease. *Proc. Am. Thorac. Soc.* 2009;6:278–282. doi: 10.1513/pats.200808-090RM
3. Reddel H.K., Bateman E.D., Becker A., Boulet L.P., Cruz A.A., Drazen J.M., Haahtela T., Hurd S.S., Inoue H., De Jongste J.C., et al. A summary of the new GINA strategy: A roadmap to asthma control. *Eur. Respir. J.* 2015;46:622–639. doi: 10.1183/13993003.00853-2015
4. Castro-Rodriguez J.A., Rodrigo G.J., Rodriguez-Martinez C.E. Principal findings of systematic reviews for chronic treatment in childhood asthma. *J. Asthma.* 2015;52:407–416. doi: 10.3109/02770903.2014.971968.
5. Prasad A.S. Zinc deficiency in women, infants, and children. *J. Am. Coll. Nutr.* 1996;15:113–120. doi: 10.1080/07315724.1996.10718575.
6. Zalewski P.D. Zinc metabolism in the airway: Basic mechanisms and drug targets. *Curr. Opin. Pharmacol.* 2006;6:237–243. doi: 10.1016/j.coph.2006.01.005.
7. Childers M., Eckel G., Himmel A., Caldwell J. A new model of cystic fibrosis pathology: Lack of transport of glutathione and its thiocyanate conjugates. *Med. Hypotheses.* 2007;68:101–112.
8. Zsembery A., Fortenberry J.A., Liang L., Bebok Z., Tucker T.A., Boyce A.T., Braunstein G.M., Welty E., Bell P.D., Sorscher E.J., et al. Extracellular zinc and ATP restore chloride secretion across cystic fibrosis airway epithelia by triggering calcium entry. *J. Biol. Chem.* 2004;279:10720–10729.
9. Taylor C.G., Bray T.M. Effect of hyperoxia on oxygen free radical defense enzymes in the lung of zinc-deficient rats. *J. Nutr.* 1991;121:460–466.
10. Nadeem A., Masood A., Siddiqui N. Oxidant-antioxidant imbalance in asthma: Scientific evidence, epidemiological data and possible therapeutic options. *Ther. Adv. Respir. Dis.* 2008;2:215–235.
11. Hönscheid A., Rink L., Haase H. T-lymphocytes: A target for stimulatory and inhibitory effects of zinc ions. *Endocr. Metab. Immune Disord. Drug Targets.* 2009;9:132–144.
12. Truong-Tran A.Q., Ruffin R.E., Foster P.S., Koskinen A.M., Coyle P., Philcox J.C., Rofe A.M., Zalewski P.D. Altered zinc homeostasis and caspase-3 activity in murine allergic airway inflammation. *Am. J. Respir. Cell Mol. Biol.* 2002;27:286–296.
13. El-Kholy M.S., Gas Allah M.A., el-Shimi S., el-Baz F., el-Tayeb H., Abdel-Hamid M.S. Zinc and copper status in children with bronchial asthma and atopic dermatitis. *J. Egypt Public Health Assoc.* 1990;65:657–668.
14. Kadrabová J., Mad'aric A., Podivínsky F., Gazdík F., Ginter F. Plasma zinc, copper and copper/zinc ratio in intrinsic asthma. *J. Trace. Elem. Med. Biol.* 1996;10:50–53. doi: 10.1016/S0946-672X(96)80008-3
15. Peretz A., Neve J., Famaey J.P. Effects of chronic and acute corticosteroid therapy on zinc and copper status in rheumatoid arthritis patients. *J. Trace Elem. Electrolytes Health Dis.* 1989;3:103–108.
16. Islam, S.N., Kamal, M.M., Rahmatullah, R., Sadi, S.K.S., Ahsan, M. Serum zinc levels in children with acute respiratory infections: Association with sociodemography and nutritional status. Clinical Nutrition Experimental; 2018;22:11-18.
17. Mao,S., Wu,L., Shi,W. Association between trace elements levels and asthma susceptibility. Respiratory Medicine 2018;;145:110–119.
18. Di Toro R, GaldoCapotorti G, Gialanella G, Miraglia del Giudice M, Moro R, Perrone L. Zinc and copper status of allergic children. ActaPaediatr Scand. 1987;76:612-7.
19. Urushidate S, Matsuzaka M, Okubo N, Iwasaki H, Hasebe T, Tsuya R, et al. Association between concentration of trace elements in serum and bronchial asthma among Japanese general population. J Trace Elem Med Biol. 2010;24:236-4