

# Comparison of Serum Zinc Levels Between Healthy and Malnourished Children

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## ABSTRACT

**Objective:** To compare serum zinc levels of healthy and malnourished children. **Study Design:** Prospective study. **Place & Duration of study:**

 Department of Pediatrics and Dermatology Allied/DHQ Hospital Punjab Medical College Faisalabad between July 2006 to September 2006.

**Patients & Method** Serum zinc levels of 150 children between the ages of 2 months to 14 years of either sex were studied, out of which 75 hospitalized children were suffering from malnutrition while 75 healthy children were taken as control from the outdoor. Both groups were further divided into three age groups 2 months to 4 years, 5-10 years and 11-14 years. Verbal consent was taken from all the parents. All the details of children were enrolled on a specific proforma designed for the study. No ethical issue was involved. Malnourished children were classified and sub-grouped according to modified Gomez classification. Serum zinc levels were measured at HiTech Laboratory, Agriculture University, Faisalabad by Atomic

Absorption Spectrophotometry, the most widely used and reliable method. **Results :** The mean serum zinc level of 75 healthy children was found to be 99.97  $\mu\text{g/dl}$  (Standard Error   $\pm 10.2$ ) while mean serum zinc level of 75 malnourished children was 51.2  $\mu\text{g/dl}$  ( $\pm 1.14$ ). The children suffering from 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> degree malnutrition were 22, 27 & 26 in number with a mean level of 56.36  $\mu\text{g/dl}$  ( $\pm 2.26$ ), 51.56  $\mu\text{g/dl}$  ( $\pm 1.89$ ) and 46.46  $\mu\text{g/dl}$  ( $\pm 1.36$ ) respectively. Statistical analysis of data was done by calculating P-value with analysis of variance of serum zinc level for degree of malnutrition, age and sex. It showed that serum zinc level of malnourished children is significantly low ( P-value = 0.001). **Conclusion:** There is a significant difference of serum zinc levels between healthy and malnourished children especially in children with diarrhea and respiratory tract infection. This signifies a proper replacement of zinc as part of management of malnutrition and also during disease process. **Key Words :** Zinc, Malnutrition, Diarrhea, Respiratory and cutaneous infection

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## INTRODUCTION

Over the last few years, micronutrient deficiency has gained importance as a public health problem along with proteins, carbohydrates and fats. Zinc has been known to be an essential element since its discovery by Raulin in 1869.<sup>1</sup> To date more than 200 zinc dependent enzymes have been identified in biochemical pathways. Because of zinc's central role in cellular growth and differentiation, the effects of its deficiency are especially pronounced in tissues and organs with rapid turnover (e.g., the immune system), and during periods of rapid growth.

 Meats and many plant sources like lentils & grains such as

wholemeal meat, maize & polished rice provide a high zinc concentration but the release and absorption of zinc is limited by the abundant phosphorus compound, phytate, which binds zinc.<sup>2</sup> The zinc availability from human milk is far greater than from cow's milk, soy milk and combined formulas.<sup>3</sup>

The normal serum zinc levels of healthy children is 60-100  $\mu\text{g/dl}$ . Zinc deficiency may be due to malnutrition, vegetarianism, chronic diarrhea, nutrient interactions with certain drugs.<sup>4,5,6</sup> Zinc deficiency also occurs due to acrodermatitis enteropathica, gastric surgery or intestinal resections,

inflammatory bowel disease, exocrine pancreatic insufficiency, biliary obstruction, burns, surgery, protein losing enteropathies, renal failure, chronic blood loss and hemodialysis, chelating agents, exfoliative dermatoses, neoplastic diseases and resolving anemia. Various drugs like captopril, proton pump inhibitors, thiazide diuretics, tetracyclines, penicillamine, sodium valproate, caffeine and oral contraceptives inhibit zinc absorption.<sup>4,5,6</sup> Certain nutrients like calcium, soy, manganese, copper and iron also have same effect.<sup>7,8</sup> The deficiency is more common in regions with high consumption of rice and unleavened bread as dietary fibers and phytates inhibit zinc absorption (only 20% of the dietary zinc is absorbed).<sup>9,10</sup>

In humans, inadequate zinc is associated with an increased risk of pregnancy complications, including LBW, IUGR, prolonged labor, abnormal deliveries, vaginal bleeding and a variety of intrauterine malformations.<sup>11,12,13</sup>

Acrodermatitis enteropathica. is classic example of zinc deficiency in children. Other features include anorexia, failure to thrive, tremor, jitteriness, nail dystrophy, Beau's lines, alopecia, frequent loose stools & increased susceptibility to infection due to impaired immune function.

Purpose of this study is to compare serum zinc level between healthy and malnourished children and to look for the magnitude of problem in the drained area of Allied Hospital, Faisalabad and to establish recommendations for prevention of zinc deficiency.

## **PATIENTS AND METHODS**

Serum zinc level of 150 children randomly selected without any sex bias were studied, out of them 75 were hospitalized children suffering from malnutrition while 75 children were taken as control from outdoor. A proforma was designed to get the details of the enrolled patients. The parents were explained about the procedure and consent was taken. Two ml of blood was taken after aseptic measure from antecubital vein. Serum was separated and kept in refrigerator before sending to the Laboratory. Serum zinc level were measured at HiTech Laboratory, Agriculture University, Faisalabad by Atomic Absorption Spectrophotometry which is most widely used and reliable method. Cases classified according to modified Gomez classification with age 2 months to

14 years. They were further sub divided into 03 groups 02 months 04 years, 5 to 10 years, 11 to 14 years.

In control only healthy children were taken with weight above 80% and having no acute or chronic problem at the time of collection of samples.

Following cases are excluded from study:

Children suffering from some inherited disorder of zinc deficiency like acrodermatitis enteropathica:

Children above 14 years.

Children with weight above 80% of normal were not taken as malnourished.

Children with normal weight but having some acute or chronic disease were not selected as control.

## **RESULTS**

In this study 75 healthy and 75 malnourished children were selected. They were divided into three age groups 0-4 years, 4-10 years and 11-14 years. Malnourished children belonged to all the degrees of malnutrition according to modified Gomez Classification without any sex bias. The mean serum zinc level of 75 healthy children was found to be 99.97  $\mu\text{g/dl}$  (Standard Error  $\pm 10.2$ ) while mean serum zinc level of 75 malnourished children was 51.2  $\mu\text{g/dl}$  ( $\pm 1.14$ ). The children suffering from 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> degree malnutrition were 22, 27 & 26 in number with a mean level of 56.36  $\mu\text{g/dl}$  ( $\pm 2.26$ ), 51.56  $\mu\text{g/dl}$  ( $\pm 1.89$ ) and 46.46  $\mu\text{g/dl}$  ( $\pm 1.36$ ) respectively as shown in the figure.

\* Nutritional Status (Healthy Children 1, 1<sup>st</sup> degree malnutrition 2, 2<sup>nd</sup> degree malnutrition 3, 3<sup>rd</sup> degree malnutrition 4)

Statistical analysis of data was done by calculating P-value with analysis of variance of serum zinc level for degree of malnutrition, age and sex. It showed that serum zinc level of malnourished children is significantly low (P value = 0.001).

## **DISCUSSION**

In this study, mean serum zinc level of 75 healthy children is found to be 99.97 $\mu\text{g/dl}$  ( $\pm 10.2$ ). Tahir Masood et al reported mean serum zinc level of healthy children 72.72  $\mu\text{g/dl}$  ( $\pm 8.21$ ).<sup>14</sup> In one study serum zinc level of 420 healthy children was on an average of 92  $\mu\text{g/dl}$  ( $\pm 30$ ) was found.<sup>15</sup> Kholey et al reported mean serum zinc level of 230 healthy children from 2-12 year of age to be 88  $\pm 11$   $\mu\text{g/dl}$ .<sup>16</sup> Nakamura et al showed mean serum zinc level of

healthy children to be  $78 \pm 6 \mu\text{g/dl}$  ranging from 65-130 $\mu\text{g/dl}$ .<sup>17</sup> These studies favour the observation made in this study.<sup>18,19</sup>

Some studies detected that there is a high prevalence of zinc deficiency in communities with high prevalence of other micronutrient deficiencies.

The low plasma zinc level in a study among children with active pulmonary TB are similar the findings of our study. Ray et al. conducted a similar study in 1998 in India.<sup>20</sup> They showed low zinc levels in children with different type of including Pulmonary TB including Pulmonary TB. It is well known that malnutrition is a predisposing factor to low zinc levels, which results in reduction of thymulin activity, proliferation response of lymphocytes in the present of mitogens and neutrophil chemotaxis.

<sup>21</sup> It also causes a significant reduction in the number of CD4 helper cells. On the other hand, TB is very closely, linked to the cell mediated immune response of the host, and alterations in lymphocyte and macrophage functions contribute to the natural course of the diseases.<sup>22</sup>

The observations seen in this study is strengthened by a local study at Lahore which showed significantly low serum zinc levels in malnourished children, p value  $<0.001$ .<sup>14</sup> Malnourished children are found to have low serum zinc level all over the world including South America<sup>23</sup>, Egypt<sup>24</sup>, Turkey<sup>25</sup>, India<sup>26</sup>, Nigeria<sup>27</sup>, Jamaica<sup>28</sup>, Pakistan<sup>29</sup> & Bangladesh<sup>30</sup>. The serum levels of 4 micronutrients, namely calcium, magnesium, zinc and copper and albumin were assessed on 60 under-fives with varying grades of malnutrition before and after rehabilitation and were compared with appropriate controls. After rehabilitation and follow up for 3 months it showed that dietary supplementation alone appears to be inadequate to replenish the already depleted stores in children with protein energy malnutrition. They may need micronutrient supplementation especially trace elements<sup>31</sup>.

Zinc supplementation can be used for growth enhancement<sup>32</sup> & improvement of immune function in deficient children<sup>33</sup>. Zinc supplementation helps in reducing incidence of diarrhea, common cold and pneumonia<sup>34</sup> & it also improves wound healing. These observations indirectly support the

observations made in this study because zinc deficient children suffer from these problems. 

## CONCLUSION

This study indicates a significant difference of serum zinc level between healthy and malnourished children especially in children with diarrhea and RTI. So it is suggested that adequate zinc supplementation should be provided during rehabilitation from malnourished state to compensate for zinc deficiency. It improves immunity, preventing diarrhea and RTI & helps in adequate growth. We should also promote zinc containing diets to improve zinc status of community in general. 

In our country further studies should be done including follow up after zinc supplementation.

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