



EVALUATION OF SERUM LEVELS OF ZINC AND COPPER IN SUDANESE PATIENTS WITH PULMONARY TUBERCULOSIS

Mihad Elsadig Hussein*¹ and Salma Ali Albashir²

Department of Chemical Pathology, Faculty of Medical Laboratory Sciences, University of Khartoum-Sudan.

*Corresponding Author: Mihad Elsadig Hussein

Department of Chemical Pathology, Faculty of Medical Laboratory Sciences, University of Khartoum-Sudan.

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ABSTRACT

Background: Deficiencies in essential trace elements are associated with impaired immunity in tuberculosis infection. However, the trace element concentrations in the serum of Sudanese patients with tuberculosis have not yet been investigated. **Objective:** This study aimed to compare the serum trace element concentrations of Sudanese adult patients with tuberculosis with normal controls and to assess the impact of serum trace element concentration on clinical outcome of tuberculosis patients. **Methodology:** The serum concentrations of zinc and copper in 50 consecutively recruited patients with newly diagnosed pulmonary tuberculosis and 40 controls were analyzed by flame atomic absorption spectrometry. **Result:** Serum zinc and copper concentrations were significantly lower in patients with pulmonary tuberculosis compared with controls ($p=0.00$, $p=0.00$) respectively. **Conclusions:** The results of this study indicate that TB patients have significant decrease in copper and zinc level.

KEYWORDS: tuberculosis, trace elements, flame atomic absorption spectrometry, Sudan.

INTRODUCTION

Pulmonary Tuberculosis (TB) is caused by the bacteria *Mycobacterium tuberculosis*. One can get TB by breathing in air droplets from a cough or sneeze of an infected person. This disease is known as an ancient disease of our planet and still is one of the most serious health problems in the world^[1] Tuberculosis and malnutrition are linked in a complex relationship. Specifically, tuberculosis infection may cause malnutrition through increased metabolic demands and decreased nutrient intake, while nutritional deficiencies may worsen the disease or delay recovery by inhibiting important immune functions.^[2] Micronutrient environments are key contributors to immune function and cytokine kinetics. Thus, such environments have been increasingly suggested to play an essential role in the individual response to infectious diseases.^[3]

Zinc is a component of more than 200 different enzyme system functions that included in most events such as immunity and cell division.^[4] Zinc is a cofactor for the Antioxidant enzyme Superoxide Dismutase (SOD) and also involved in carbohydrate and protein metabolism.^[5] Zinc deficiency affects host defense in a variety of ways. It results in decreased phagocytes and leads to a reduced numbers of circulating T-cells, therefore reduced tuberculin reactivity, at least in animals.^[6]

Copper is an essential trace element involved in the metabolism of several key enzymes including

cytochrome oxidase of the mitochondrial electron transport and cytosolic superoxide dismutase.^[7] Moreover, 60% of Copper in the blood is tightly bounded to a Copper-Zinc dependent enzyme known as superoxide dismutase (Cu/Zn/SOD) which is a powerful anti-oxidant.^[8]

Altered profiles of trace elements have been reported in different populations of patients with tuberculosis.^[9,10,11] Trace element concentrations in serum depend not only on external factors, including micronutrient status, but also on many internal factors; profiles are believed to be influenced by the host physiology, pathogen physiology and host die.^[12] However, the availability of these trace elements for digestion, absorption, and utilization, in addition to their clinical impacts on patient outcomes, are still under investigation.^[9,10,11] Moreover, no study has yet obtained a reliable estimate of the trace element concentrations in the serum of sudanese patients with tuberculosis.

MATERIALS AND METHODS

A case-control study was conducted involving 90 subjects with different ages and genders 40 healthy control and 50 patients with newly diagnosed pulmonary tuberculosis. All individuals gave a written consent that they accepted the terms and conditions of the entire experiment. They were interviewed with structured questionnaire requesting information related to various criteria. Conventional laboratory methods for the

diagnosis of *Mycobacterium tuberculosis* were performed on all patients using Ziehl-Neelsen staining method for Acid-fast Microscopy (AFM).^[13] and culture for growth of the organism on Lowenstein-Jensen (LJ) medium.^[14] All studied cases were also tested for radiographic abnormalities.

RESLUTS

Table 1: Comparison of serum copper and zinc concentrations in patients with pulmonary tuberculosis and control

	Control (n=40)	Patient (n=50)	P value
Copper	0.808±0.209	0.170±0.062	0
Zinc	0.54655±0.1027	0.16586±0.052	0

Table 2: Serum copper and zinc concentration for gender of patients

	Male	Female	P value
Copper	0.166±0.05	0.1176±0.07	0.084
Zinc	0.171±0.05	0.141±0.05	0.09

Table 3: Serum copper and zinc concentration for age of patients

	<36	36-70	P value
Copper	0.173	0.163	0.97
Zinc	0.168	0.168	1.2

DISCUSSION

Concentration of serum Zn, Cu in patients with pulmonary tuberculosis were compared with healthy control. Levels of serum Zn ($p < 0.05$) and Cu ($p < 0.05$) in TB patients were significantly decreased when compared with control group (Table 1). For better evaluation, the patients have been divided into two groups on the basis of age (higher and lower than 36 years) and gender, each parameter was studied separately upon this basis. Males and females were showing no significant difference in copper and zinc with ($p = 0.084$, $p = 0.09$) respectively (Table 2). Also two ages groups of tuberculosis patients were showing no significant difference in both serum Cu and Zn levels with ($p = 0.97$, $p = 1.2$) respectively (Table 3).

The results of this study confirmed the findings of the study conducted in India.^[15,16] Researchers mainly believe that decreasing the levels of serum Zn in patients is because of the redistribution of Zinc in their liver. Metallothionein (MT) binds 7 g atoms of Zn per mole and serves to draw Zn away from free-circulating pools which are induced by IL-1 *in vivo*.^[17] Another reason for decreasing serum Zn levels in TB patients was described in.^[18] They explained that MTB used Zinc for its growth and reproduction. The protective role of this metalloenzyme is known in many bacteria such as *Shigella* and *Salmonella*.^[19]

In this study we found significant decrease in copper concentration which disagree with those studies who show increasing in serum Cu level and mentioned that the reason of increase serum Cu is associated with an increase in the synthesis of the Copper binding protein, ceruloplasmin^[20] the level of serum Copper also

Analysis of Copper and Zinc were measured by using flame atomic absorption spectrometry.

The SPSS software package (Windows version 16.00) was used for all statistical analyses. All values are shown as standard deviation (SD). Statistical analyses were performed by paired t-test. The p-value of less than 5% was considered significant.

increases in other infectious disease such as Pneumonia, Cancer^[21] and Leishmaniasis.^[22]

^[23] claimed that lowering of Zn plasma has been considered to be more sensitive index of tuberculosis infection than raising the levels of plasma Copper. Low plasma Zn levels with normal plasma Cu may mean that infection is in early stages.^[24]

CONCLUSION

This study shows that the serum concentration of trace elements in patients with TB was altered. The low concentrations of zinc, and copper could result from preceding deficiencies that enhanced susceptibility to infection, and/or from their high demands in overt TB. Further studies are required to establish the role of these low concentrations in host defense against TB, so that appropriate and beneficial strategies for micronutrient supplementation can be planned. In addition, the changes in serum trace elements during anti-TB chemotherapy might be used as valuable parameter in assessing response to therapy.

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