

Research Article**Study of serum levels of Zinc and Magnesium in Type 2 Diabetic subjects****Abdul Malek¹, AbdurRazzak Mia², ShyamSundar Shaha³, Abul Kalam Azad^{4*}**^{1,3}Department of Biochemistry, Gonoshahstha Samaj Vittik Medical College, Dhaka, Bangladesh.²Department of Biochemistry, Mymensingh Medical College, Mymensingh, Bangladesh.⁴Department of Basic Medical Sciences, Faculty of Pharmacy, International Islamic University Malaysia, Malaysia.

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Abstract

Objectives: Aim of this study was to investigate and evaluate the Zinc and Magnesium levels of serum among the Type 2 diabetes patients who have admitted in Mymensingh Medical College, Bangladesh. **Materials and methods:** The study was designed to evaluate the serum Zn, Mg, Cu, Fe and Ca status in type 2 diabetes mellitus patients. The subjects were selected on the basis of inclusion and exclusion criteria by purposive (non-random) method. This study included 60 type 2 diabetic subjects as case. **Results:** The results were compared with 60 apparently healthy non-diabetic subjects as control. Serum Zn, Mg, Cu, Fe and Ca levels were analyzed. All statistical analysis was done by using SPSS windows package. The values were expressed as Mean \pm SD. Statistical significance of difference between two groups were evaluated by using student's unpaired t-test. Serum zinc and magnesium were estimated by Atomic absorption spectrophotometry. The serum zinc and magnesium levels were (85.28 \pm 28.68 μ gm/dl) and (1.35 \pm 0.40 mg/dl) respectively in group I and (115.68 \pm 46.99 μ gm/dl) and (2.03 \pm 0.36 mg/dl) respectively in group II. The levels were significantly decreased in group I. **Conclusion:** outcome of this study showed that type 2 diabetes mellitus can result in changes in zinc and magnesium levels and supplementation of both zinc and magnesium may be considered in those cases.

Keywords: Zinc, magnesium, Type 2 Diabetes Mellitus**Introduction**

Diabetes mellitus is a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both. The effects of diabetes mellitus include long-term damage, dysfunction and failure of various organs. Diabetes can lead to heart disease, nerve damage, and kidney disease and vision loss (Chiasson, 2007). Diabetes mellitus is one of the greatest medical problems threatening the world. With the worldwide explosion in its

prevalence, type 2 DM has turned into a global epidemic (Sarah et al. 2004). According to recent estimates the prevalence of diabetes mellitus is 4% worldwide and that indicates 143 million persons are affected which will increase to 300 million by the year 2025 (Islam and Azad, 2014).

According to Sarah et al. the existing prevalence of diabetes mellitus is expected to rise up to 4.4% by 2030 (Arquilla et al., 1978). Micronutrients play crucial roles in human nutrition, including the prevention and treatment of various diseases and conditions, as well as the optimization of physical and mental functioning. Understanding micronutrients is critical for anyone seeking to maintain or improve his or her health. Vitamins and minerals are the two types of micronutrients. While only needed in small amounts, they play important roles in human development and well-being, including the regulation of metabolism, heartbeat, cellular pH, and bone density. Lack of

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micronutrients can lead to increased risk for various diseases in adulthood. Without proper consumption of micronutrients, humans can suffer from diseases such as Diabetes, Rickets (lack of vitamin D), Scurvy (lack of vitamin C), and Osteoporosis (lack of calcium) (John, 2008).

Zinc a trace element, is a component of many enzymes. The function of zinc in the body metabolism is based on its enzymatic affinity, way of a zinc enzyme complex or zinc metalloenzyme (Marjani, 2006). It plays an important role in the maintenance of several tissue functions, including the synthesis, storage and release of insulin. Zinc has been found to enhance the effectiveness of insulin in vitro, and it has been postulated that zinc deficiency may aggravate the insulin resistance in non-insulin dependent diabetes mellitus (Zargar et al., 1998). In most mammals, insulin is stored as zinc crystals and is likely to secrete in zinc form. Zinc has an important role in modulating the immune system and its dysfunction in diabetes mellitus may be related in part to the status of zinc (Mocchegianai et al., 1989).

Magnesium is important in maintaining the electrical potential in nerve and muscle membranes and is also involved in glucose homeostasis. It is a cofactor in various enzymatic pathways involved in glucose oxidation (Zargar et al., 1998). Mooradian and Morley in 1987 reported that magnesium imbalance has been implicated in diabetes mellitus both as a cause and a consequence. Magnesium is an important element for health and disease. Magnesium, the second most abundant intracellular cation, has been identified as a cofactor in over 300 enzymatic reactions, involving energy metabolism and protein and nucleic acid synthesis. Magnesium may participate in the pathogenesis of diabetic complications and may contribute to the increased risk of sudden death associated with diabetes. Magnesium (Mg) acts as a critical cofactor involved in the carbohydrate, lipid, and protein metabolism. In all, Mg^{2+} activates over 300 cellular enzymes and is important for the synthesis of proton and electron transporters in the energy cycle of the cell. Mg is also an integral part of the structure of cellular and sub cellular membranes where its major function is providing membrane stability (Franz et al., 2009).

In this study, estimation of serum zinc and magnesium in type 2 diabetic patients and comparison of it with that of the apparently healthy non diabetic subjects has been made.

Materials and methods

This case control study was carried out at the Department of Biochemistry, Mymensingh Medical College and the subjects were collected from the outpatient Department of Endocrinology, Mymensingh Medical College Hospital, Mymensingh during the period of January 2015 to December 2015. A total of 120 subjects were studied. For both case and control group persons having no acute complications, serious

co-morbid diseases and history of renal failure were selected. With all aseptic precautions 6 ml of venous blood will be collected from the study subjects after overnight fasting by a disposable syringe from antecubital vein. The blood will be transferred to a dry screw capped sterile test tube immediately after removal of needle from the syringe with a gentle push to avoid hemolysis. Test tube will be kept in vertical position until clot formation and then will be centrifuged at 3000 rpm for 5 minutes. Clear serum will be taken out by micro pipette in a plain plastic eppendorf tube. Estimation of serum zinc, magnesium, copper, iron and calcium will be done as soon as possible. In case of any delay the sample will be stored at minus 20°C. Serum zinc was estimated by colorimetric method using test kit. Serum magnesium was estimated by colorimetric method using test kit. Serum glucose was estimated by enzymatic method by GOD PAP.

Statistical analysis

All statistical analysis was done by using Statistical Package for social Science (SPSS) using version 20. Results were expressed as mean±SD. Statistical significance of reference between two groups were evaluated by using student's unpaired t test and 95% confidence limit was taken as level of significance.

Results

In this study, a total 120 subjects were enrolled out of which 60 were case and 60 were control. Blood glucose was done in all study subjects. Then serum zinc and magnesium levels were measured in fasting samples of both groups. Serum zinc was expressed in $\mu\text{gm/dl}$ while serum magnesium in mg/dl and blood glucose level in mmol/l . In group I (case) mean±SD fasting blood glucose levels was 9.83 ± 1.33 and two hours after blood glucose load was 15.62 ± 3.76 , while in group II (control) mean±SD fasting blood glucose levels was 4.51 ± 0.48 and two hours after blood glucose load was 6.40 ± 0.50 mmol/L respectively (Table 1).

Table 1. Blood glucose of the study subject

Variables	Case group (Mean±SD)	Control group Mean±SD	t value	P value
Fasting blood glucose (mmol/l)	9.83±1.33	4.51±0.48	29.049	$P<0.001$
2 hours after glucose load (mmol/l)	15.62±3.76	6.40±0.50	18.842	$P<0.001$

In diabetic subjects fasting and two hours after blood glucose load serum glucose levels were significantly higher than control ($P<0.001$). The mean ±SD of serum zinc levels in group I and group II were 85.23 ± 28.68 and 115.68 ± 46.99

$\mu\text{gm/dl}$ respectively (Table 2). There was significantly decreased ($P<0.001$) of zinc in group I compared to that in group II. The mean \pm SD of serum magnesium levels in group I and group II were 1.35 ± 0.4 and 2.03 ± 0.36 mg/dl respectively (Table 2). There was significantly decreased ($P<0.001$) of zinc in group I compared to that in group II.

Table 2. Serum zinc and magnesium levels of the study subjects

Variables	Case group (Mean \pm SD)	Control group (Mean \pm SD)	t value	P value
Zinc (μ gm/dl)	85.28 \pm 28.68	115.68 \pm 46.99	4.278	$P<0.001$
Magnesium (mg/dl)	1.35 \pm 0.40	2.03 \pm 0.36	9.809	$P<0.001$

P Value less than 0.05 taken as level of significance, $P<0.001$ = highly significant, ** = highly significant, SD = Standard Deviation

Discussion

Diabetes mellitus is one of the most common metabolic diseases worldwide, characterized by inappropriately elevated glucose levels in the blood (Belle et al., 2011). The concentration of several trace elements have been reported to be altered in type 2 diabetes mellitus and these elements might have specific roles in the pathogenesis and Progress of this disease (Hussain et al., 2009). This study was focused on the hypothesis that T2DM patients have impaired levels of certain trace elements (zinc and magnesium). Zinc is a component of many enzymes and has many important interrelationships with the endocrine system. It is also essential for normal growth and functions of the thyroid glands, as well as glucose metabolism (Zargar et al., 1998).

In this study, serum zinc levels in type 2 diabetic subjects were found significantly decreased ($P<0.005$) in than that of control group. The findings are consistent with those of AbouSeif, (2004) and Marjani, (2008). The possible reason for decrease in serum zinc concentration in diabetic patients is excessive for urinary excretion of zinc. But studies by Zargar et al. (1998) showed that the levels of zinc in diabetic patients were equal to or higher than that of control groups, which is inconsistent with the findings of the present study. It is now becoming clear that the predominant effect on Zn homeostasis of diabetes is hypozincemia, which may be the result of hyperzincuria or decreased gastrointestinal absorption of Zn, or both (Chausmer, 1998). Magnesium is a cofactor in the glucose transporting mechanism of the cell membrane and various enzymes in carbohydrate oxidation (Laughlin & Thompson, 1996).

In this study, serum magnesium concentration in the type 2 diabetic patients was significantly ($P<0.001$) decreased than that of control group. Similar observations were reported by Paul (2004) and Paolisso et al., (1990). The reasons of decreasing magnesium in type 2 diabetic patients due to increase urinary

losses or impaired absorption of magnesium. The decreased of serum magnesium may also be due to magnesium depletion caused by osmotic diabetes. Analyzing the findings of the present study, it can be concluded that significant decreases of serum zinc and magnesium occur in type 2 diabetic subjects. Although the small numbers of samples resists any definite comment on the normal ranges, it however gives an elementary idea on the serum levels of zinc and magnesium in type 2 diabetes patients. However an intervention for the increase of dietary intake of zinc and magnesium may be beneficial for these patients.

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Conflict of interest

All authors have declared no conflict of interest.

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