

Serum zinc and manganese levels in subjects with type 2 diabetes mellitus

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Abstract

Background: Serum level of several trace elements such as zinc (Zn) and manganese (Mn) levels are altered in type 2 DM and its deficiencies are associated with the development of microvascular and macrovascular complications. **Objective:** To assess the serum zinc (Zn) and manganese (Mn) levels in subjects with type 2 diabetes mellitus. **Methods:** This cross sectional study was conducted in the Department of Physiology, Dhaka Medical College, Dhaka from July 2014 to June 2015. Fifty type 2 diabetic subjects with age ranging from 40 to 55 years of both sexes were study group and 50 age, sex and BMI matched healthy subjects were control group. Patients were selected from Bangladesh Institute of Research for Diabetic Endocrine and Metabolic Disorders (BIRDEM) General Hospital, Dhaka. Serum Zn and Mn levels were estimated by flame atomic absorption spectrophotometry. For statistical analysis, unpaired Student's 't' test and chi square test was performed. **Results:** In this study, mean serum zinc and manganese levels were significantly ($P < 0.001$) lower in the study group than that of control group. In addition, hypozincemia in 36% and hypomanganesemia in 18% of diabetic patients were observed and which was significantly ($p < 0.001$) higher than those of control. **Conclusion:** From this study, it may be concluded that serum zinc and manganese deficiencies may develop as diabetes related complications.

Key words: Serum zinc, serum manganese, type 2 diabetes mellitus.

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Introduction

Diabetes mellitus (DM) is a metabolic disorder of carbohydrate, lipid and protein metabolism. It is characterized by hyperglycemia due to defects of insulin secretion or of insulin action, or both¹. Diagnostic criteria of diabetes mellitus are fasting blood glucose level of ≥ 7.0 mmol/l, after 2 hour value of ≥ 11.1 mmol/l in 75 g oral glucose tolerance test and HbA_{1C} of $\geq 6.5\%$ ².

Diabetes mellitus is a major global health problem. Prevalence of diabetes in Bangladesh was 5.1 million in the year 2013³. In developing

countries, most of people suffering from diabetes are aged between 40 to 60 years and this number is increasing day by day⁴. Chronic hyperglycemia produces macrovascular complications like coronary artery disease, peripheral arterial disease, stroke and microvascular complications like retinopathy, nephropathy, neuropathy⁵.

Zinc (Zn) is required for synthesis, storage and secretion of insulin⁶. Diabetes and poor glycaemic control alters the metabolism of Zn by increasing urinary excretion and lowering serum Zn levels⁷. In type 2 diabetic patients, insufficient dietary Zn intake increases the risk

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of coronary heart disease, hypertension, retinopathy, thrombosis^{8, 9}.

Manganese (Mn) acts as a cofactor with antioxidant enzyme like superoxide dismutase which helps to remove free radicals¹⁰. Diabetes causes increase urinary excretion and lower serum level of Mn¹¹. Manganese deficiency increases oxidative stress in diabetic patients causing development of diabetic complications¹². Diabetics with lower serum level of Mn were less protected from oxidation of low density lipoprotein (LDL) cholesterol. This oxidation of LDL contributes to the development of intra-arterial plaque that can lead to heart attack and stroke¹³.

It is obvious that lower serum zinc and manganese levels increase the risk of diabetic complications in type 2 diabetes mellitus. This study aimed to create further awareness among the physicians and type 2 diabetic patients in Bangladesh regarding the diabetic complications that may occur due to zinc and manganese deficiencies.

Methods

This cross sectional study was done in the Department of Physiology, Dhaka Medical College, Dhaka from July 2014 to June 2015. Protocol of this study was approved by Ethical review committee of Dhaka Medical College and Diabetic Association of Bangladesh. For this study 50 subjects (28 male and 22 female), age (40-55 years), type 2 diabetic patients with fasting blood glucose FBG level < 7.0 mmol/l and HbA_{1c} e⁷ 6.5% were selected from out patient department of BIRDEM General Hospital, Dhaka and 50 age, BMI matched healthy subjects (26 male and 24 female) were control. After selection of the subjects, the nature, purpose and benefit of the study were explained to each subject in details and informed written consent was taken. Before taking blood, detailed family and medical history were taken. Anthropometric measurement of the subjects was done and blood pressure was measured. All the information was recorded in a data schedule. With aseptic precaution, 20 ml of venous blood was collected from ante-cubital vein by a disposable plastic syringe from each subject for estimation of biochemical tests. HbA_{1c}, fasting

blood glucose (FBF) levels were estimated in the laboratory of the Department of Biochemistry, BIRDEM General Hospital, Dhaka. Serum zinc and manganese levels were estimated in the laboratory of the Department of Chemistry, Atomic Energy Centre, Dhaka. Statistical analysis were done by unpaired Student's 't' test & chi square test. P value < 0.05 was accepted as level of significance. Statistical analyses were performed by using a computer based statistical program SPSS Version 20.

Results

General characteristics are presented in table I. In this study mean serum zinc and manganese levels were significantly ($p < 0.001$) lower in patients with type 2 diabetes mellitus (Table II). In addition, hypozincemia was found in 36% of diabetic patients & 10% of nondiabetic subjects. Again hypomanganeemia was found in 18% diabetic & 4% of nondiabetics. The differences of hypozincemia & hypomanganeemia between diabetic & nondiabetic subjects were highly significant ($p < 0.001$) (Table III).

Table I: General characteristics of the subjects in both groups (n=100)

Parameters	Control (n=50)	Diabetic patients (n=50)
Age (years)	47.58±3.59	48.00±3.49
Sex		
Male	26 (52.0)	28 (56.0)
Female	24 (48.0)	22 (44.0)
Height (cm)	59.54±5.20	158.32±8.17
Weight (kg)	64.62±5.51	64.54±8.21
Body mass index (kg/m ²)	25.44±2.06	25.80±3.06
Systolic blood pressure (mmHg)	121.70±5.31	123.40±7.45
Diastolic blood pressure (mmHg)	76.30±5.70	79.70±5.19

Sex distribution has been shown in number and percentage. All other results are expressed as mean±SD. Unpaired Student's 't' test was performed to compare between groups. n = Number of subjects.

Table II: Serum Zinc and Manganese levels of the subjects in both groups (n=100)

Parameters	Control (n=50)	Diabetic patients (n=50)
Serum zinc ($\mu\text{g/dl}$)	89.91 \pm 17.48	71.77 \pm 19.95***
Serum manganese (ng/ml)	12.95 \pm 2.76 (8.07 18.89)	10.45 \pm 2.77*** (6.63 16.40)

Data are expressed as mean \pm SD. Unpaired Student's 't' test was performed to compare between groups. ***p<0.001.

Table III: Frequency distribution of hypozincemia and hypomanganasemia in both groups (n=100)

Parameters	Control (n=50) no. (%)	Diabetic patients (n=50) no. (%)
Hypozincemia	5 (10)	18 (36) ***
Hypomanganesemia	2 (4)	9 (18) ***

Data was analyzed by Chi square test. ***p<0.001. Cut point for Zn <72 $\mu\text{g/dl}$ & Mn <4.7 ng/ml^{26,27}.

Discussion

In the present study, mean serum zinc level was significantly lower in type 2 diabetic patients than that of adult healthy subjects. This finding is in agreement with others^{1, 12, 14-16} But some investigators found higher Zn levels in type 2 diabetic subjects¹⁷.

Again, in the present study, serum manganese level was found lower in type 2 diabetic patients than that of healthy adult subjects. Similar finding was also made by other research workers^{13, 18, 19}. On the contrary, some researchers observed no significant difference in serum manganese level between type 2 diabetic subjects and adult healthy subjects^{20, 21}.

In this study, significant numbers of diabetic patients are found with hypozincemia and hypomanganesemia. From this study the pathogenesis of low zinc and manganese level in diabetic is not clear. But literature review suggested that prolonged hyperglycemia in

uncontrolled diabetes causes polyuria due to osmotic diuresis. This cause increased excretion of minerals including zinc and manganese^{22, 23, 24, 25}. As a result without adequate dietary replacement of these two minerals, deficiency of Zn and Mn may develop in diabetics.

In the present study the poor zinc and manganese levels in the diabetic subjects may be related to the increased urinary excretion and without dietary replacement of these two minerals.

Conclusion

From the results of the study, it may be concluded that zinc and manganese deficiencies may develop as diabetes related complications in type 2 diabetic patients.

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Conflict of Interest None

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