

## Serum chromium and selenium levels in type 2 diabetes mellitus

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### Abstract

**Background:** Emerging evidence suggests that several trace elements such as serum chromium (Cr) and selenium (Se) levels are altered in type 2 DM and its deficiencies are associated with the development of diabetes related complications. **Objective:** To assess the serum Cr and Se levels in patients of 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 patients with age ranging from 40 to 55 years were study group and fifty ages, 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 Cr and Se levels were estimated by flame atomic absorption spectrophotometry. For statistical analysis unpaired Student's 't' test and Chi square test were performed. **Results:** In this study, serum Cr and Se levels were significantly ( $P < 0.001$ ) lower in patients than that of control group. In addition 20% patients had low Cr and 16% had Se deficiencies. Moreover, 6% of control had low Cr and 4% had low Se. **Conclusion:** From this study, it is concluded that serum Cr and Se deficiencies are associated with type 2 diabetes mellitus.

**Key words:** Serum chromium, serum selenium, type 2 diabetes mellitus.

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### Introduction

**D** Diabetes mellitus (DM) is a metabolic disease in which there is hyperglycemia, either because the body does not produce enough insulin, or the cells do not respond to the insulin that is produced. This hyperglycemia produces the symptoms of polyuria, polydipsia and polyphagia<sup>1</sup>. According to American Diabetes Association (ADA), diagnostic criteria of diabetes mellitus are fasting blood glucose level (FBG) of  $\geq 7.0$  mmol/l, 2 hour after glucose of  $\geq 11.1$  mmol/l and glycosylated hemoglobin (HbA<sub>1c</sub>) of  $\geq 6.5\%$ <sup>2</sup>.

Recent estimates suggest that the prevalence of diabetes is rising globally, particularly in

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developing countries<sup>3</sup>. In the year 2013, about 5.1 million diabetic people in Bangladesh and the number will rise to 16.8 million by the year 2035<sup>4</sup>. Patients with DM have increased risk for the development of specific complications like atherosclerosis, hypertension and coronary heart disease<sup>5</sup>.

Chromium (Cr) is an essential trace element which is required for the normal action of insulin and regulation of blood glucose level<sup>6</sup>. Chromium increases numbers of cell membrane insulin receptor and leads to increased insulin sensitivity, glucose utilization and beta cell sensitivity<sup>7</sup>. Chromium is powerful antioxidants and its deficiency increases oxidative stress in diabetic patients that could lead to atherosclerosis<sup>8</sup>.

Selenium (Se) is a trace element which is involved in the complex system of defense against oxidative stress through selenium dependent glutathione peroxidases and other selenoprotein<sup>9</sup>. Selenium acts as a cofactor with glutathione peroxidase, an active antioxidant enzyme that reduces formation of free radicals and peroxides of lipoproteins<sup>10</sup>. Lower serum Se levels are seen in diabetics together with increased oxidative stress. In type 2 diabetics with lower serum Se level increases the risk of hypertension and coronary heart disease<sup>11</sup>.

It is obvious that lower serum chromium and selenium 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 chromium and selenium 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 FBG level  $\geq 7.0$  mmol/l and HbA<sub>1c</sub>  $\geq 6.5\%$  were selected from the Out Patient Department (OPD) 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<sub>1c</sub>, FSG levels were estimated in the laboratory of the Department of Biochemistry, BIRDEM General Hospital, Dhaka. Serum chromium and selenium levels were estimated in the laboratory of the Department of Soil, Water and Environment, University of Dhaka, Dhaka. Statistical analysis were done by unpaired Student's 't' test and 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 chromium and selenium levels were significantly ( $p < 0.001$ ) lower in patients with diabetes mellitus (Table II). In addition low serum chromium was found in 20% of diabetic patients and 6% of nondiabetic subjects. Again low serum selenium was in 16% diabetic and 4% control. The differences of low serum chromium and selenium between diabetic and nondiabetic subjects were significant (Table III).

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

Variables	Control (n=50)	Diabetics (n=50)
Age (years)	47.58 $\pm$ 3.59	48.00 $\pm$ 3.49
Male	26 (52%)	28 (56%)
Female	24 (48%)	22 (44%)
Height (cm)	159.54 $\pm$ 5.20	158.32 $\pm$ 8.17
Weight (kg)	64.62 $\pm$ 5.51	64.54 $\pm$ 8.21
BMI (kg/m <sup>2</sup> )	25.44 $\pm$ 2.06	25.80 $\pm$ 3.06
SBP (mmHg)	121.70 $\pm$ 5.31	123.40 $\pm$ 7.45
DBP (mmHg)	76.30 $\pm$ 5.70	79.70 $\pm$ 5.19

Sex distribution has been shown in number and percentage. All other results are expressed as mean $\pm$ SD. Figures in parentheses indicate ranges. Unpaired Student's 't' test was performed for comparison between groups. n = Number of subjects. BMI = Body mass index. SBP = Systolic blood pressure. DBP = Diastolic blood pressure.

**Table II:** Serum chromium and selenium levels in both groups (n=100)

Variables	Control (n=50)	Diabetics (n=50)
Serum chromium (µg/L)	0.17±0.05	0.13±0.06***
Serum selenium (µg/L)	94.22±16.67	78.72±21.85***

Data are expressed as mean±SD. Unpaired Student's 't' test was performed for comparison between groups. \*\*\*p<0.001.

**Table III:** Frequency distribution of low serum chromium and selenium levels in both groups (n=100)

Variables	Control (n=50) no. (%)	Diabetics (n=50) no. (%)
Low Serum chromium	3 (6)	10 (20) ***
Low Serum selenium	2 (4)	8 (16) ***

Data was analyzed by Chi square test. \*\*\*p<0.001. Cut point for Cr≤0.04 µg/L<sup>25</sup> and Se≤70 µg/L<sup>25</sup>.

### Discussion

In the present study, mean serum chromium and selenium levels were lower in type 2 diabetic patients than that of healthy subjects. These results are similar to others<sup>12-18</sup>. But some study did not find difference in serum chromium and selenium levels in between type 2 diabetic subjects and healthy control<sup>19, 20</sup>.

In addition, significant numbers of diabetic patients are found with low serum chromium and selenium levels. Literature review suggested that hyperglycemia is the diagnostic hallmark finding in type 2 diabetes mellitus. This prolonged hyperglycemia increases the osmotic pressure of kidney tubules that inhibits the reabsorption of water by the kidney, resulting polyuria. Due to

this polyuria increased excretion of chromium and selenium occur in type 2 diabetic patients<sup>21-24</sup>. As a result lower serum chromium and selenium levels increase the risk of diabetic complications like atherosclerosis, hypertension and coronary heart disease in type 2 diabetes mellitus.

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

### Conclusion

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

**Conflict of Interest** None

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