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There is no competing interest.

Assessment of the Serum Chromium Level in Patients with Type 2 Diabetes Mellitus

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Abstract

Chromium is an essential micronutrient which is required for normal insulin effect and regulation of blood sugar level. Serum chromium status of patients with type 2 diabetes was compared with control non-diabetic subjects. Blood samples were collected and serum glucose level of both groups was determined. The serum chromium concentration of samples was measured by flame-less atomic absorption spectrophotometer. The results showed significant differences between mean of serum chromium concentration of diabetic patients (4.58µ/l) compared with control group (7.92µ/l). We found no significant differences between chromium level of women and men either among the diabetics or non-diabetic control groups. The finding of this study confirmed the idea that chromium is an essential microelement in diabetes.

Introduction

Diabetes mellitus is an impaired ability of body to regulate the utilization of blood glucose, as a result of failure of normal control by insulin. There are two main types of diabetes mellitus. Type 1 diabetes (insulin–dependent diabetes mellitus IDDM) is the failure in insulin secretion as a result of damage to the b-cells of pancreatic islets caused by viral infection or autoimmune disease [1,2]. Type 2 diabetes (non-insulin-dependent diabetes mellitus NIDDM) is impaired responsiveness to insulin, as a result of decrease formation or diminished sensitivity of insulin receptors in target cells.. Diabetes mellitus is a highly complex disorder, and the simple concept that its pathogenesis is solely due to insulin deficiency, is no longer tenable [3].

Chromium deficiency is relatively common in patients with type 2 diabetes. The significance of Chromium as a trace nutrient is well documented and its function in the control of glucose and lipid metabolism has been claimed [3]. Studies have shown that chromium can facilitate or potentiate the action of insulin [4-7].

This study was performed to determine the serum chromium status of Iranian individuals with type 2 diabetes compared to healthy volunteers.

Materials and Methods

The project was approved by ethical committee of Jundishapur University of Medical Sciences. The schedule was explained for the men and women who participate in the study and written consent was taken from each of them.Diabetic patients group (n=25) were selected from admitted patients in internal ward of Sevome khordad Hospital in Khoramshahr, Khuzestan province, Iran. They were checked by a physician and were chosen by the following diagnostic criteria:

1- Symptoms of diabetes plus casual blood glucose concentration ≥200 mg/dl. Casual is defined as any time of day without regard to time since the last meal. The classic symptoms of diabetes were: polyuria, polydipsia and unexplained weight loss.

2- Fasting blood glucose ≥126 mg/dl. Fasting is defined as no calories intake for at least 8 hr.

3- Two hours blood glucose ≥200 mg/dl during an oral glucose tolerance test.

4- Higher than 40 years of age for both sexes.

5- Use of oral anti-diabetic drugs and specific dietary regimen.

Patients whom met the above criteria, individuals of either men (n=12) or women (n=13) were randomly selected. Healthy volunteers of either men (n=11) or women (n=14) without history of diabetes according to the above criteria, matched by age and sex from hospital staff were randomly selected as control group.

Chromium analysis:

For the determination of serum glucose and chromium level, at least 2 blood samples were taken from each patient within one week interval in early morning. 5ml blood of each individual was collected from arm vein by a disposable syringe. Blood was quickly placed into a test tube and left for twenty minutes at 37°C. After removing the coagulum the specimens were centrifuged at 3000rpm for 20 minutes and then serum sample were separated. Serum glucose level was determined using O-toluidine method [8]. For chromium determination serum samples was diluted at ratio 1 to 4 in 0.1 % (v/v) triton-x 100 + 0.01 mol/l nitric acid and was prepared for atomic absorption spectrometric analysis. All laboratory-glass wares were immersed in diluted aqueous alkaline phosphate free detergent solution for 48 hours. They were then

rinsed with copious quantities of tap water, followed by soaking in the nitric acid for 3 days at room temperature, once again rinsed with deionized water. Extreme care was exercised to avoid metal contamination during sampling, handling, and analysis of the different specimens.

All chemical reagents were of analytical grade purchased from Merck and Sigma agents, in Iran. The chromium stock solution (1000 mg/l Cr) was prepared from titrisol concentrates. Chromium standard solutions for preparing the calibration curve (2, 5, 10, 15 mg/l Cr) were freshly prepared by serial dilution of the stock solution with 0.01 mol/l nitric acid.

A graphite furnace atomizer (Shimadzu GFA-AA) was set on an atomic absorption spectrometer (Shimadzu 670G). Samples were introduced by auto sampler (Shimadzu model ASC 60G). The light source was a 5mA Chromium hollow cathode lamp, wavelength of 357.9nm and 0.5nm spectral slit width was used to check the samples

After obtaining calibration curve, 10µl aliquots of diluted serum sample (or aqueous Cr standards) were injected into graphite tube, the absorbance was recorded and the chromium concentration was determined.

Statistical analyses were performed using Student's t-test. The differences were considered significant when P

Results

Results of this study indicates that fasting blood sugar of diabetic patients (men and women) are significantly higher (p

Discussion

Diabetes is a complex problem which has brought about great attention for research and investigation. The etiology of diabetes is not completely understood, numerous factors are associated with its development. Its pathophysiology, primarily reflects an absolute or relative insulin deficiency. Although discovery of insulin could provide an effective cure for diabetes, the factors that bring about that genetic susceptibility appear to be an important factor for the chance of developing diabetes [9,10]. Many patients with type 2 diabetes have excess insulin secretion and may suffer from obesity [11]. In addition to hyperinsulinemia and obesity they may have hypertension, dyslipidemia, and impaired fibrinolysis, a collection of conditions called syndrome X [12]. Patients with syndrome X are more likely to experience cardiovascular diseases and develop long-term complications of diabetes. Hyperinsulinemia and insulin resistance may be correlated with a decrease in insulin receptors, reduced insulin binding, or post-insulin- receptor signaling defects. Insulin resistance is thought to be the initial cause in people with type 2 diabetes. Patients with type 2 diabetes and insulin resistance demonstrate a diminished sensitivity of target tissue (primarily the liver and skeletal muscle) to the action of insulin and a relative deficiency of endogenous insulin secretion [13,14]. Impaired insulin secretion and increased glucagons contribute to continued hepatic glucose output resulting in elevated fasting glucose levels [15]. Some patients may have elevated blood glucose because of excessive glucagon or abnormal and excessive hepatic glucose production. Others may have a defect in somatostatin, an excess of growth hormone, cortisol, epinephrine, or other hormone that affects blood glucose regulation [16-18]. Cushing's syndrome, pheochromocytoma, aldosteronism, hyperthyroidism, pancreatitis, cirrhosis, pregnancy, emotional stress, and myocardial infarctions are other factors that may cause an increased in blood glucose. It appears that the etiology is probably multifactorial.

It has been shown that trace elements may regulate hormone secretion and its function[19]. Among trace elements, chromium deficiency was first identified as a cause of impaired glucose tolerance in 1959 [20]. Chromium as part of a compound known 'glucose tolerance factor' (GTF) is needed for appropriate glucose use, Lipid metabolism, and insulin receptor sensitivity [21]. One study has been reported that administration of 500mg chromium two times per day for 2 months resulted in a significant improvement of glycosylated hemoglobin (HbAlc) values, and indication of how well glucose is metabolized [6]. Recently, it has been reported that chromium may reduce triglycerides in patients with type 2 diabetes [7]. While some studies have demonstrated that chromium has positive effect on serum glucose levels [5], other studies have not shown any beneficial effects when used in patients with type 2 diabetes [22,23]. On the other hand, it is not clear whether differences in trace element status are a consequence of diabetes or, alternatively, whether they contribute to the disease. This study was carried out to verify the serum chromium status of patient with type 2 diabetes. The results of this study showed significant differences between mean serum chromium concentrations of diabetic patients (4.58 mg/l) compared with control group (7.92 mg/l). Our result indicates a similar profile with other study performed elsewhere [20, 21]. According to our results it seems that serum chromium

level of Iranian healthy individuals are higher than the value reported by Burtis and Ashwood [21]. Such difference may be due to race, life style, geographical influence and even analytical methods [24]. According to the results of this study there were not significant differences between mean serum chromium concentration of the adult women compared with the adult men of diabetic patients and also those of control group. This indicates that serum chromium concentration is not sex related factor. Few definitive studies of human chromium deficiency have been carried out, mainly because of analytical difficulties in determining ultra trace levels of chromium in tissue. This human study support the idea that chromium may be recommended as a supplement to improve serum glucose levels in diabetic patients.

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Illustrations

Illustration 1

Fig 1: Serum glucose level (mg/dl) in control and NIDDM male groups. Data are shown as mean±SEM. Significant difference between control and NIDDM group indicated as **p<0.01

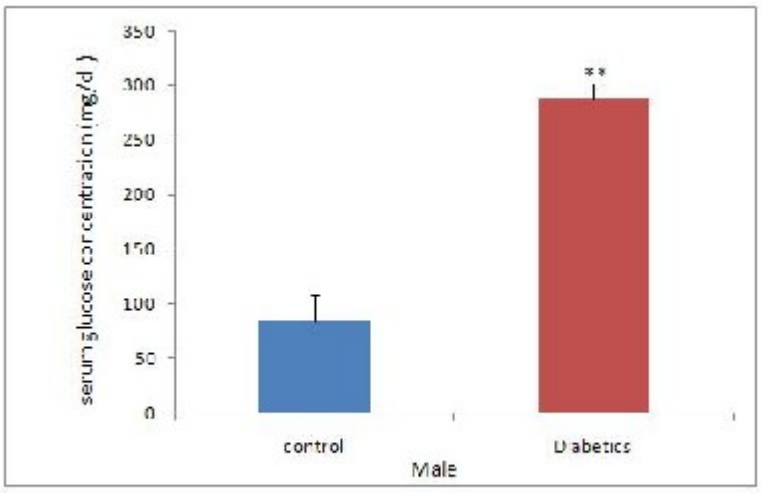


Illustration 2

Fig 2: Serum glucose level (mg/dl) in control and NIDDM female groups. Data are shown as mean±SEM. Significant difference between control and NIDDM group indicated as **p<0.01

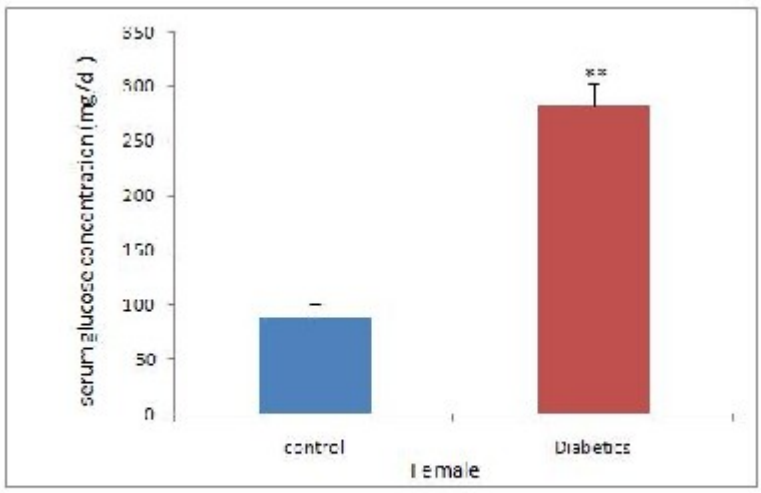


Illustration 3

Fig 3: Serum chromium level (mg/l) in control and diabetic groups. Data are shown as mean±SEM. Value significantly different from control, is indicated as **(P<0.01)

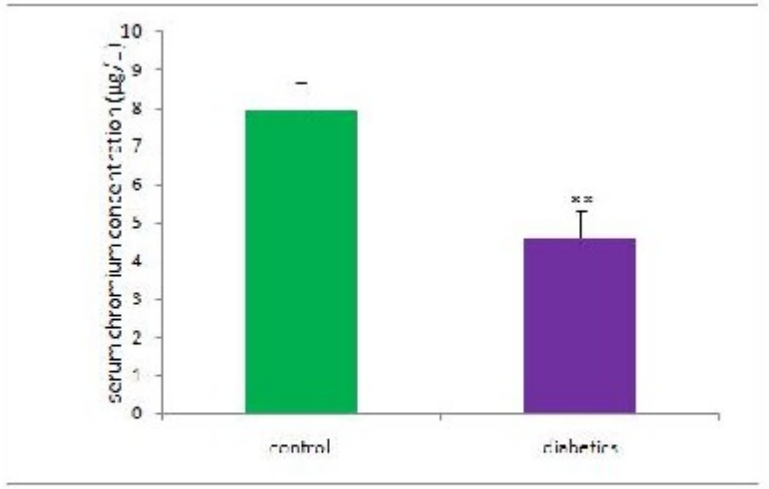


Illustration 4

Fig 4: Serum chromium level(mg/l) in male and female control groups. Data are shown as mean±SEM. There is no significant difference between male and female groups

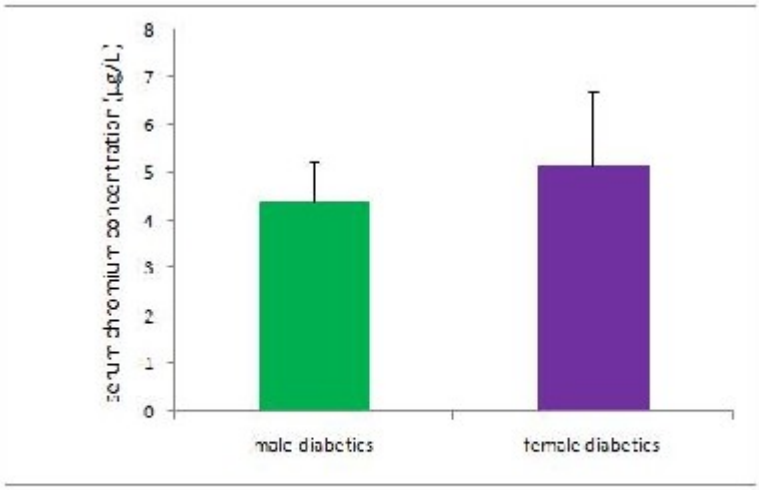
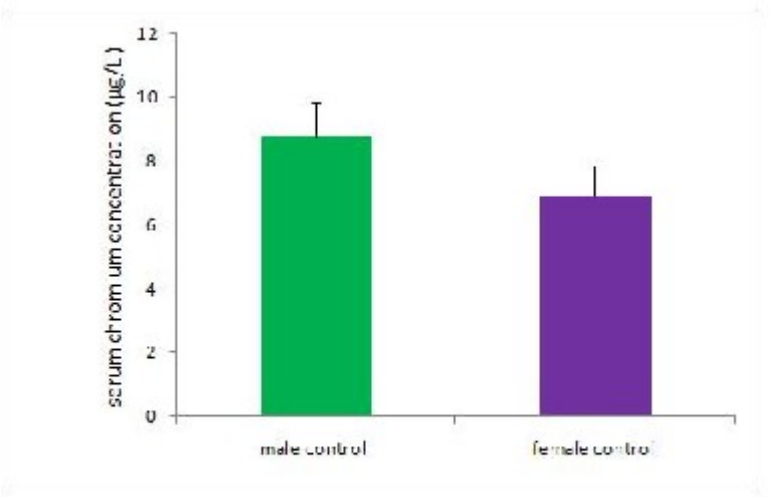


Illustration 5

Fig 5: Serum chromium level (mg/l) in male and female diabetic groups. Data are shown as mean±SEM. There is no significant difference between male and female groups



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