

# CHROMIUM STATUS IN DIABETES MELLITUS

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**Abstract** — Fasting serum chromium, total cholesterol, HDL-cholesterol, LDL-cholesterol, triacylglycerol and blood sugar were determined in fifty two diabetic patients with no other organic diseases and compared with those obtained from a control group including forty two healthy volunteers matched for age, sex and body mass index (BMI). Fasting serum chromium and HDL-cholesterol were significantly lower in patients than in controls ( $p < 0.0001$  and  $p < 0.001$  respectively), but the mean triacylglycerol concentration was significantly higher in patients than in controls ( $p < 0.002$ ). Mean total cholesterol and LDL-cholesterol values were not significantly different in the two groups. Mean intake of energy, proteins, fats and chromium, estimated by the 24 hr dietary recall method were not significantly different in the two groups. We demonstrated that despite an adequate intake of chromium, the fasting serum chromium was lower in diabetic patients than in control subjects. Chromium deficiency in diabetic patients may act as a contributing factor in aggravating the disease's complications. *Acta Medica Iranica* 34 (1 & 2): 26 - 28; 1996.

**Key words:** chromium, triacylglycerol, diabetes mellitus.

Cr, triacylglycerol, HDL- and LDL-cholesterol in patients with diabetes mellitus. We also studied the intake of Cr in our patients and controls and compared the results obtained with Recommended Dietary Allowances (RDA).

## MATERIALS AND METHODS

52 patients (30 men, 22 women) consulting Tehran Endocrinology and Metabolism Institute, with no other organic diseases, especially disorders of thyroid and kidney were chosen and compared with a control group including 42 healthy volunteers (23 men, 19 women) matched for age (43.9-15.9 and 41.8-13.4 years respectively), sex and BMI (23.8-3.1 and 24.3-3.3 kg/m<sup>2</sup>, respectively). A fasting blood sample was taken from each person. In the sample, serum Cr was measured with furnace atomic absorption spectrophotometry, triacylglycerol and total cholesterol by enzymatic methods (using lipase-glycerokinases and esterase-oxidase, respectively). HDL-cholesterol by a precipitation method, LDL-cholesterol with an indirect method (8) and glucose with a condensation method (9). To determine the food intake, the 24 hr dietary recall method was used and the amount of energy, carbohydrates, proteins, fats and Cr were calculated using a computer, (N3 program). Differences between groups were compared statistically with Student's t-test and using linear regression analysis. Correlation coefficients (r) were calculated to test dependence of fasting serum Cr with triacylglycerol, HDL- and LDL-cholesterol, fasting blood sugar and intake of Cr.

## INTRODUCTION

Chromium (Cr) is an essential trace element for human that is involved in carbohydrate and lipid metabolism. Deficiency of this trace metal has been implicated as a cause of diabetes mellitus. Human sustained on total parenteral nutrition with inadequate Cr have developed a Cr-responsive diabetes (1). Certain data also suggested that impaired utilization of Cr may be a possible etiology for gestational diabetes mellitus (2). Cr supplementation significantly decreased blood glucose concentration within 24 hr (3). Cr, as a constituent of glucose tolerance factor (GTF) can play a role as a cofactor for insulin, facilitating its binding with its receptors and amplifying all known effect of insulin (4,5) since adequate amounts of Cr can improve glucose tolerance in the majority of people with elevated blood glucose concentrations as long as they still secrete insulin (6). Jeejeeboy et al (1) confirmed the efficiency of Cr by treating an insulin resistant diabetic with patient Cr supplementation only. More recently, Cr supplementation has been reported to improve glucose tolerance, and circulating insulin and glucagon in hyperglycemic patients (7) and to reduce hyperlipidemia. The purpose of this study was to determine serum concentration of Cr and possible relationship between

## RESULTS

Concentration of serum Cr, total cholesterol, HDL- and LDL-cholesterol, triacylglycerol and glucose in patients and controls are shown in Table 1.

Mean intake of energy, proteins, fats and Cr were not significantly different in the two groups (Table 2).

**Table 1.** Serum chromium, total cholesterol, HDL- and LDL-cholesterol triacylglycerol and glucose in diabetic patients and control subjects.

	Controls (n=42)		Patients (n=52)		P
	mean	SD	mean	SD	
Chromium ( $\mu$ g/l)	0.15	0.01	0.113	0.01	<0.0001
Total cholesterol (mg/dl)	166.30	23.80	161.30	21.80	NS
HDL-cholesterol (mg/dl)	38.10	11.90	30.30	10.00	<0.001
LDL-cholesterol (mg/dl)	103.80	24.80	99.60	24.20	NS
Triacylglycerol (mg/dl)	120.70	60.80	155.80	77.70	<0.002
Fast blood sugar (mg/dl)	81.6	8.2	188.2	81.3	<0.01

**Table 2.** Mean intake of energy, carbohydrates, proteins, fats and chromium in diabetic patients and control subjects.

	Controls (n=42)		Patients (n=52)		P
	mean	SD	mean	SD	
Energy (Kcal)	2194	817.7	1868.2	807.2	NS
Carbohydrates (g)	302.3	125.8	245.3	105.3	<0.02
Proteins (g)	76.6	36.7	79.6	39.9	NS
Fats (g)	75.7	35.8	63.2	38.2	NS
Chromium (g)	209.2	92.2	197.2	87.5	NS

No correlation was found between concentration of Cr and cholesterol, Cr and HDL-cholesterol, Cr and LDL-cholesterol, Cr and triacylglycerol and between Cr concentration and intake of Cr.

## DISCUSSION

It is well known that insufficient dietary Cr intake by free living individuals leads to impaired glucose and lipid metabolisms, elevated circulating insulin and decreased insulin receptor number (10). In this study, Cr intakes in the two groups were not significantly different. The mean daily intake of Cr for patients was of 197.2-87.5  $\mu$ g and for controls of 209.2-92.2  $\mu$ g which are safe and adequate Cr intakes according to the recommendations of the National Academy of Sciences (50-200  $\mu$ g/day) (11). The Iranian diet is richer in Cr than the standard North American diet which was estimated to contain less than 50  $\mu$ g/day (12). Serum concentration of Cr in our patients was significantly lower than in control subjects. These data demonstrate that despite an adequate intake of Cr, the fasting serum Cr was lower in diabetic patients than in control subjects. Previously, Morris and coworkers (13,14) reported that Cr concentration in randomly chosen plasma is lower in diabetic than in control subjects. Hambidge et al (15) reported that hair Cr concentrations of diabetic, insulin requiring children were significantly lower than those of normal subjects. Diabetes mellitus with depletion of Cr store in response to increased blood glucose eventually lead to a decrease in serum Cr and cause Cr deficiency in diabetic subjects (16). Cr deficiency has been also associated with lipid abnormalities.

In fact, Cr may have a role in maintaining serum lipid perhaps because of its effect on normal glucose tolerance and normal insulin sensitivity (17). Moreover many studies strongly suggest a link between Cr deficiency and arteriosclerotic heart disease (18,19). Riales and Albrink (20) reported that Cr supplementation after 12 weeks leads to increase HDL-cholesterol from 35 to 39 mg/dl. Since atherosclerosis is common in patients with diabetes mellitus and is one of the primary cause of death in these patients and since HDL-cholesterol is a protective factor against arteriosclerotic heart disease (21), a supplementation with Cr may have a protective effect.

Several studies have reported a beneficial effect of Cr on serum lipids. Lee and Reasner (22) were the first to report a significant reduction in serum triacylglycerol in a group of non insulin dependent diabetes mellitus patients treated with Cr. The average reduction in triacylglycerol concentration was of 17.4%. But no differences were noted in LDL- and HDL-cholesterol concentrations by these authors. Mean serum triacylglycerol in our patients were significantly higher than in controls. Insulin is an activator of the lipoprotein lipase which is responsible of hydrolysis of triacylglycerol to fatty acids and glycerol and is required for the entry of fatty acids into adipose tissue.

Therefore, lack or absence of insulin leads to inhibition of lipoprotein lipase. Moreover, HDL-cholesterol in our patients was significantly lower than in controls. It was reported that composition of HDL may be altered by triacylglycerol enrichment. The Lower HDL-cholesterol concentration observed in our patients may also be attributed to their Cr deficiency since an increase in HDL-cholesterol concentrations was reported by Riales and Albrink (20) after Cr treatment in 23 healthy volunteers. In the present study serum triacylglycerol concentration was significantly more elevated in patients than in controls. This may also contribute to reduction of HDL-cholesterol in serum.

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