Original Article

Evaluation of Serum Chromium Levels in Non Diabetics and Type-II Diabetic Patients

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Aims & Objectives: To determine serum chromium levels in patients with diabetes mellitus type-II and compare it with normal healthy population.
Study Design: Cross sectional and comparative.
Sample Size: Fifty diagnosed diabetic type II patients compared with fifty non diabetic healthy controls.
Place of Study: Study was conducted at Diabetes Management Centre, Services Hospital Lahore and Diabetic Clinic, Mayo Hospital Lahore over a period of three months i.e. from April to June, 2007.
Methodology: Serum glucose level was estimated by enzymatic photometric method. HbA1C was estimated by atomic absorption spectrophotometer.
Results: The fasting Glucose levels and the serum glycosylated hemoglobin levels were significantly higher in type- II diabetic patients as compared to healthy controls, while serum chromium levels were significantly lower in type-II diabetic patients as compared to normal healthy controls.
Conclusion: The serum chromium levels were statistically low in type-II diabetic patients.
Key Words: Diabetes Mellitus, Serum Chromium, Fasting Blood Glucose Level, Glycosylated Hemoglobin, Non diabetics.

Introduction

Diabetes Mellitus is a chronic disorder of carbohydrate, fat and protein metabolism in which there is defective or deficient insulin secretory response that leads to impaired carbohydrate (glucose) use which is a characteristic feature of diabetes mellitus resulting in hyperglycemias.[1] About 3% of the world population, approximately 100 million people, suffer from diabetes making this one of the most common non communicable diseases. Type 2 diabetes mellitus once considered a rare disease but recently an explosive increase in its incidence has been observed. Insulin resistance and hyperinsulinemia are characteristics of both type 2 diabetes as well as impaired glucose tolerance.[2] In 1994, WHO estimated that over 100 million people have diabetes affecting on an average around 6% of adult population. In 1992 over 11,000 Pakistanis died due to diabetes.[3]

Type 2 diabetes accounts for most of the current and forecasted figures. By 2025 approximately 2.7 million people in Pakistan may have the disease, yet only 0.8 million have been diagnosed. Diabetes tends to increase with age in Pakistan. The highest prevalence is among urban females between age of 45-65 years, with nearly 20% rise.[4] In addition to these alarming absolute rises in number, there is also a worsening trend for the disease to affect younger age group. Scientists for many years have recognized that very small concentrations of certain elements, such as zinc, chromium and iodine, are essential for the metabolic process involved in life. Years ago these elements were identified as "trace" elements because their exact concentrations were unobtainable by the methods then available. Today we define a trace element as one that constitutes less than 0.01 percent of an organism and we are able to measure concentration in parts per million to parts per billion with great accuracy and precision. At least fourteen different trace elements have been identified as probably essential to human health and metabolism. The list includes chromium, cobalt, copper, fluorine, iodine, iron, manganese, molybdenum, nickel, selenium, silicon, tin and zinc.[5]

During the past several decades, considerable attention has been focused on the biological form of chromium, most of the studies being concerned with the site and mode of its action. More recently, the micro nutritional role of chromium in plants, animals and man has been noted in relation to the ever increasing consumption of highly refined and processed food from which chromium has been either eliminated or greatly reduced. Several independent observations indicate that chromium deficiency impairs glucose tolerance. Recent studies have shed light on a potential role of chromium in

maintaining proper carbohydrate and lipid metabolism at a molecular level.[6]

Aims and Objectives

Chromium, in the form of naturally occurring dinicotinic acid-glutathione complex, also known as glucose tolerance factor (GTF) is vital for carbohydrate metabolism as it potentiates the action of insulin.[1,14] Isolated from brewer's yeast, the active components of GTF were subsequently found to contain trivalent chromium, nicotinic acid, glycine, glutamic acid and cysteine.[1] As such it normalizes blood sugar level in subjects with tendencies toward blood sugar fluctuations associated with diabetes.[15]

Both animal and human studies have demonstrated that first phase of marginal chromium deficiency manifests itself by slightly elevated circulating insulin levels in response to glucose loading.

The second phase begins to show signs of metabolic disorders with low chromium intake which include significantly abnormal glucose fluctuation and disturbances in lipid metabolism.

Final phase manifests itself by a marked insulin resistance to glucose loading, resembling a diabetes like syndrome.[16]

Research has already established that insulin dependent diabetic children exhibit a significantly lower hair chromium concentration compared to control.[17]

Other studies have found that chromium absorption and excretion in diabetics is two to four times greater than in healthy individuals.[18] Also the subjects who died with diabetes had significantly lower hepatic chromium.

The study was designed to determine serum chromium level in patients with type-II diabetes mellitus and to compare it with normal healthy population.

Material and Methods

Study Design

This was a prospective, cross sectional and comparative study conducted on patients with type II diabetes and compared with normal healthy individuals.

Sample Size

A sample of 100 subjects was selected; 50 were diagnosed patients of type II diabetes and 50 were normal non-diabetic healthy individuals.

Place of Study

The study was conducted at Diabetes Management Centre, Services Hospital Lahore and Diabetic Clinic, Mayo Hospital Lahore and normal healthy individuals were selected from the staff members and post graduate students of Post Graduate Medical Institute, Lahore.

Duration of Study

Three months i.e., from April to June 2007.

Inclusion Criteria

Diagnosed patients of type II diabetes between age of 40-50 years of either sex.

Exclusion Criteria

The patients suffering from:

- Endocrinological disorders
- Hepatic disease
- Renal disease
- Significant alcoholism &/or other drug abuse
- In case of female subjects – pregnancy or using oral contraceptive pills

Control Group

50 normal healthy, randomly selected individuals, between age of 40-50 years.

Method of Data Collection

The subjects were selected after taking written consent and detailed history and examination according to:

1. Questionnaire performa
2. Consent form
3. Both patients and controls were requested to come with 10-12 hours fast for fasting blood glucose level and 2HABF (two hours after breakfast) samples were collected for blood glucose level, glycosylated hemoglobin and chromium level.

1.5 ml of blood was taken from anticubital veins for fasting glucose level and then 7ml of blood for 2HABF, 3ml blood being placed in EDTA tube for HbA1C estimation. The remaining 4ml in another test tube for blood glucose level and chromium estimation was allowed to clot and then centrifuged at 2000 RPM for 3 minutes and plasma was separated into tube and stored at -20°C for later analysis at Biochemistry Lab.

Data Analysis

Initially simple frequency distributions of variables were drawn. All means values were expressed as mean

± standard derivation (SD) and were compared by SPSS. A p value of less than 0.05 was considered statistically significant.

Estimation Of Serum Chromium Level

Serum Chromium levels were estimated by atomic absorption spectrophotometer. One volume of serum was added to a volume of 1% nitric acid diluted in de-ionized water and final volume was made up to 10 ml for each sample. Then the diluted samples were treated with heat by placing them within the oven up to 80°C for 20 minutes.

Results

The recent study comprised of two groups of adults of either sex. The two groups were adult type II diabetics and non diabetic healthy control, 50 each. **Table I** shows the descriptive data of both groups in the study. In the diabetic group all were married 40% males and 60% females.

In terms of occupation 16% were civil servants, 10% businessmen, 12% farmers, 4% unemployed and 56% were house wives.

10% used public transport, 4% had drivers, 20% used to drive their transport themselves, 6% used other means of transportation and 60% did not use any transport in routine.

64% were non smokers and 36% were smokers.

In terms of use of hypoglycemic agents by diabetics 24% used biguanides, 70% sulphonylureas, and 6% insulin along with oral hypoglycemic agents.

In the non diabetic group 10% were single and 90% were married, 50% males and 50% females.

In terms of occupation, 30% were civil servants, 16% were businessmen, 8% were farmers and 46% were house wives.

14% were using public transport for their daily activity, 8% used chauffeur driven transport, 30% self driven, 2% used other means of transportation and 46% did not use any transport for their routine activities.

76% were non smokers and 24% were smokers.

Table 2 describes the age, height, weight and BMI of two groups. The mean age for diabetics was 43.26 ± 2.912 years and for non diabetic healthy control it was 43.36 ± 3.306 years. The p value was > 0.05 showing no significant difference.

The mean height for diabetic group was 155.820 ± 11.272 cm and for non diabetics it was 159.73±10.102 (p >0.05). The mean weight for diabetics was 71.12 ±8.665 kg and for non diabetic healthy control it was 72.10 ±13.452 kg (p < 0.05).

Body mass index (BMI) for the diabetics was 29.59 ±4.702 and for the non diabetics it was 27.671 ± 0.257 (p >0.05).

Table 3 shows the blood pressure in diabetics and non diabetic healthy control. The mean systolic blood pressure in diabetic subjects was 126.48±12.601 mmHg, while the mean systolic blood-pressure in non diabetic subjects was 125.32±12.891 mmHg (p > 0.05) .

Table 4 describes the mean fasting blood glucose level, the serum glycosylated hemoglobin and serum chromium in diabetics and non diabetics healthy

Table-1: Descriptive Data for Diabetics and Non Diabetic Controls

Data	Diabetics n (%)	Non diabetics n (%)
Marital Status		
Single	00	5(10%)
Married	50(100%)	45(90%)
Gender Distribution		
Male	20(40%)	25(50%)
Female	30(60%	26(50%)
Occupation		
Civil Servant	8(16%)	15(30%)
Businessman	5(10%)	8(16%)
Farmer	6(12%)	4(8%)
Unemployed	2(4%)	00
House Wife	29(58%	23(46%)
Physical Activity		
Public Transport	5(10%)	7(14%)
Chauffeur Driven	2(4%)	4(8%)
Self Driven	10(20%)	15(30%)
Other transport	3 (6%)	1(2%)
No transport	30(60%	23(46%)
Smoking Habit		
Non Smoker	32(64%)	38(76%)
Smoker	18(36%)	12(24%)
Medication		
Biguanides	12(24%)	No
Sulphonylureas	35(70%)	No
Insulin + Drugs	3(6%	No

Table-2: Descriptive data of age, height, weight and BMI of diabetics and non diabetics.

Variables	Diabetics (n=50)		Non-Diabetics (n=50)		p Value
	Mean	SD	Mean	SD	
Age (years)	43.26	2.912	43.36	3.306	0.245
Height (cm)	155.26	11.272	159.73	10.102	0.677
Weight (Kg)	71.12	8.665	72.10	13.252	0.001
BMI	29.29	4.702	27.671	6.241	0.257

Table-3: Descriptive data of Blood Pressure in Diabetics and Non Diabetics

	Diabetics n=50		Non Diabetics n=50		p value
Blood Pressure mm Hg	Mean	SD	Mean	SD	
Systolic	126.48	12.601	125.32	12.891	0.761
Diastolic	87.38	11.071	83.40	11.132	0.358

Table-4: Descriptive data of Fasting Blood Glucose Level, Glycosylated Hemoglobin and Chromium Level in Diabetics and Non Diabetics

	Diabetics n=50		Non Diabetics n=50	
	Mean	SD	Mean	SD
Fasting Glucose mg/dl	151.38	37.970	88.320	9.707
HbA1C gm	7.470	1.183	5.664	0.054
Serum Chromium ug/L	2.496	0.063	2.612	0.054

Table-5: Comparison between diabetics and non diabetics in various parameters.

Parameters	t Test of Equality of Mean						
	t	df	Sign.2tailed	Mean difference	Std. error difference	95% confidence interval Lower	Upper
Fasting Blood Glucose mg/dl	11.378	98	0.000	53.06	5.543	52.061	74.059
Glycosylated hemoglobin gm	9.126	98	0.000	1.806	0.197	1.413	2.199
Serum Chromium Level ug/L	-9.737	98	0.000	-0.115	0.0118	-0.138	-0.091

Fig 1: Mean serum chromium level in diabetic and normal healthy control

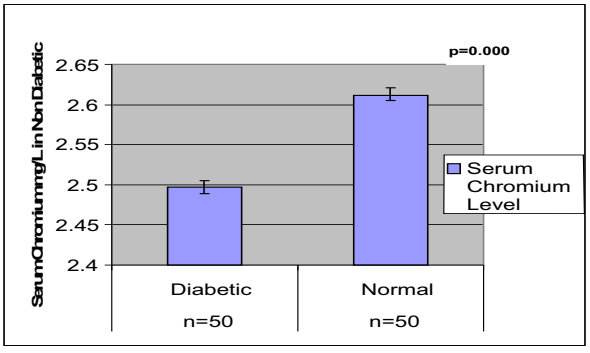
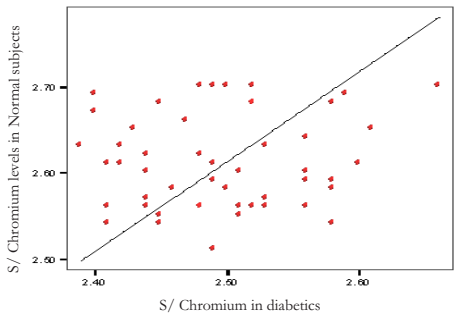


Fig. 2: Correlation graph of serum Chromium in diabetic and normal subjects



controls. The mean fasting blood glucose level in diabetics was 151.38±37.970 mg/dl while the mean fasting blood glucose level in non diabetics was 88.320±9.707 mg/dl. The mean glycosylated hemoglobin levels in non diabetics was 7.470 ± 1.183 gm% and in non diabetics health controls was 5.664 ± 0.0747 gm%. The mean serum-chromium level for the diabetics was 2.496 ± 0.063 µg/L and for non diabetics it was 2.612 ± 0.054 µg/L. **Table 5** shows comparison of the means of fasting blood glucose level in diabetics and non diabetics healthy controls**, t**he p value < 0.05 indicating statistically significant difference of the mean blood glucose level in diabetics and non diabetics at 95% Confidence Interval.

Table 5 also gives the comparison of the mean glycosylated hemoglobin in diabetics and non diabetic healthy controls. The p value was < 0.05 at 95% Confidence Interval indicating statistically significant difference among the two groups.

The mean serum chromium levels of the diabetics and non diabetics healthy controls are compared in **Fig 1**. The p value was < 0.05 at 95% Confidence Interval indicating that there is statistically significant difference of the mean serum chromium level among diabetics and non diabetic groups. **Fig 2** shows correlation graph of serum-chromium between diabetics and non diabetic healthy controls.

Discussion

Diabetes mellitus is the major cause of premature disability and mortality. It is the leading cause of blindness among working age people, end stage renal disease (ESRD) and of non-traumatic limb amputation. It increases the risk of cardiac, cerebral and peripheral vascular disease two to seven folds and is a major factor contributing to neonatal mortality and morbidity.[7] Type 2 diabetes mellitus once considered a rare disease recently has shown an explosive increase in its incidence (Jaleel A et al).[2] About 16 million Americans have type 2 diabetes and at least an equal number have impaired glucose tolerance.[8] In 1994 WHO estimated that over 100 million people have diabetes affecting an average around 6% of adult population. In 1992 over 11,000 Pakistanis died due to diabetes.[3] By 2025 approximately 2.7 million people in Pakistan will have the disease, yet only 0.8 million have been diagnosed. Diabetes tends to increase with age in Pakistan. The highest prevalence is among urban females 45-65 years of age with nearly 20% rise.[4] According to WHO, At least 171 million people worldwide have diabetes, this figure is likely to be more than double by 2030. The top ten countries in number of sufferers are India, China, USA, Indonesia, Japan, Pakistan, Russia, Brazil, Italy and Bangladesh. Overall health care cost related to diabetes ranges from 2.5% to 15% of annual health care budget, depending on local diabetes prevalence and the sophistication of the treatment available. Nutritional management, along with exercise are central to the management of the diabetic patients. The nutritional emphasis of traditional medical management of diabetes has revolved around micro nutrient intake. In fact, a quick glance at recent medical and nutritional texts on the subject show that a diabetic has the same micro nutrient needs as a non-diabetic. The opinion lives on, despite the strong evidence that diabetics have an abnormal metabolism pertaining to several micro nutrients. In reviewing clinical studies published on this topic over the last few years, it becomes apparent that several minerals are of great importance and have potential impact on the typical diabetic individual. The minerals found to be subjects of interest in the diabetics most commonly are: Magnesium, Zinc, Chromium and Manganese. Alteration in the status of trace elements has been reported in a number of disease states, trauma and infections. Diseases of the liver and kidney have been known to cause derangements in the hemostatic regulation of trace elements affecting tissue distribution and excretion.[9] Excessive accumulation or depletion of trace elements may have significant clinical implications including increased risk for cancer, cardiovascular disease, immune deficiency, anemia, renal function impairment and bone disease.[10] The actual status of these elements in diabetes and other ailments is still uncertain. A number of signs and symptoms of diabetes are shared in common with chromium deficiency. These include impaired glucose tolerance, fasting hyperglycemias, glycosuria, hypoglycemias, elevated inculcating insulin receptor number and peripheral neuropathy.[11]

Trace elements are uniquely required for growth and maintenance of life and health. Lack or an inadequate supply of such nutrients produces a functional impairment or can result in disease. The clinical significance and evaluation of trace elements such as chromium in regard to different diseases including diabetes mellitus remain conflicting as well as controversial and many questions still remain unanswered. The present cross sectional study was conducted between two groups that is diabetics and non diabetic healthy controls. Specimens were

collected for fasting blood glucose, Glycosylated hemoglobin, serum chromium and other parameters like BMI were analyzed. Fasting blood glucose level and glycosylated hemoglobin were significantly higher in diabetics as compared to healthy controls. According to Giampietro[12] and Anetor et al[13]. It has been established that diabetics have higher levels of fasting plasma glucose and glycosylated hemoglobin. There was no significant difference between body mass index of the two groups which was against the finding of Giampietro et al[12] and Anetor et al.[13] According to Wokama et al,[14] the higher levels of fasting plasma glucose seen in diabetics are a result of insulin deficiency or insulin resistance associated with diabetes mellitus. The serum chromium levels in diabetic group were significantly lower as compared to healthy controls which confirmed the finding of Nouramonamadi et al,[15] who also reported lower level of serum chromium in diabetics. Significantly low serum chromium was also reported by Ding et al[16] in elderly diabetics. Reduced chromium levels are also reported in patients with diabetes type 2 by Davis et al[17]. Elmekcioglu et al[18] also reported significantly lower chromium levels in the plasma of type 1 diabetic individuals compared with non diabetic healthy control subjects. Morris et al reported the finding that mean levels of plasma chromium were approximately 33% lower in 93 non insulin dependent diabetes mellitus (NIDDM) patients compared to a group of healthy control subjects. Even though the data presented in this study is consistent in some aspects with previous findings of other researchers, the authors feel that additional and more reliable quantitative data must be collected and evaluated. Larger number of specimens should be obtained in order to fully elucidate the relationship between the chromium and diabetes mellitus.

Conclusion

Serum chromium levels were significantly lower in patients with diabetes type-II as compared to normal health controls.

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Medical News

Half-Dose Flu Shots Work Best in Women

That was a big question as recently as 2004, when a sudden U.S. shortage of flu vaccine kept healthy adults from getting their flu shots.

One solution considered in 2004 was to give healthy adults a half dose of vaccine. An earlier study with the 2001/2002 flu vaccine suggested it might work.

As it turned out, the half-dose strategy wasn't used in the 2004/2005 flu season. But it did happen as part of an experiment to see how well a half dose would work. Because healthy adults were asked to hold off getting their flu shots, it became ethical to give volunteers a half dose to see what happened.

Renata J.M. Engler, MD, of Walter Reed Army Medical Center and colleagues enrolled 1,114 volunteers. Half got the full-dose flu shot, and half got a half dose. Neither the researchers nor the volunteers knew at the time who got which shot.

There are three flu types in the flu vaccine. For people aged 18-49, overall antibody responses to half-dose vaccine were no worse than overall antibody responses to full-dose vaccine.

Interestingly, 18- to 49-year-old women had better antibody responses than did men for all three components of the flu vaccine.

For study participants aged 50-64, half-dose flu vaccine was as good as full-dose vaccine for two of the three flu types (H3N2 and B) and not as good for one type (H1N1).

Engler and colleagues conclude that if there's another flu shortage, it might be a good idea to give half-dose vaccines to young adult women, and perhaps to young adult men, but not to older men and women.

Did the half-dose vaccine actually keep anyone from getting the flu? That's not known. People who got the half-dose vaccine didn't get any more influenza-like illnesses than those getting the full dose -- but the study ended before the 2004-2005 flu season was fully under way.

An editorial accompanying the study, Ann R. Falsey, MD, of the University of Rochester, N.Y., ponders whether the half-dose strategy really stretches thin supplies -- or whether it wastes precious vaccine.

"If more [flu] antibodies are better, how much is 'good enough' in a time of critical vaccine shortage?" Falsey asks.

She notes that flu vaccine is still made the old-fashioned way -- in a laborious process involving hens' eggs. A breakdown in this process is what led to the 2004 flu vaccine shortage. And there's no guarantee such breakdowns won't happen in the future.

Meanwhile, improved cell-culture techniques promise to deliver flu vaccines that are faster to make and better matched for circulating flu strains than the old hens' eggs technology.

"Perhaps the real message of this study is that better methods of influenza vaccine production that are less prone to problems are clearly needed," Falsey suggests. "The time has come to relegate the use of eggs back to the kitchen where they belong."

The Engler study, and the Falsey editorial, appear in