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COMPARISON OF SERUM CHROMIUM LEVEL IN DIABETIC AND NON-DIABETIC POPULATION BY ATOMIC ABSORPTION SPECTROPHOTOMETER

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ABSTRACT

Chromium is an essential micronutrient which is required for normal insulin effect regulation of blood sugar level. Serum chromium status of patients of type 1 and type 2 diabetes was compared with non-diabetic subjects. Blood samples were collected and serum glucose level of both groups was determined with the help of Flame Atomic Absorption Spectrophotometer. The findings of this study showed significant difference between mean of serum chromium concentration of type 1 diabetic patients (4.26 mcg/l) compared with control group (7.017 mcg/l) and type 2 diabetic patients (4.33 mcg/l) compared with their control group (7.02 mcg/l). It was revealed that there was significant correlation between the serum glucose and serum chromium level. The negative correlation shows that as the concentration of serum glucose increases, the concentration of chromium decreases. There was no significant difference between chromium level of type 1 and type 2 diabetic individual.

KEYWORDS: Diabetes; Chromium; Insulin; Glucose tolerance factor.

INTRODUCTION

Chromium is an essential micronutrient that is required for normal carbohydrate and fat metabolism.[1] Chromium deficiency is associated with hyperglycemia, hyper-insulin/insulin resistance, insulin dependent diabetes mellitus (type 1), adult onset diabetes (insulin independent ,type 2), gestational diabetes, corticosteroid induced diabetes.[2] In body when

sufficient level of chromium is present, much lower amount of insulin is required.[3] Chromium functions by increasing the activity of insulin, thus reducing the amount of insulin required to control blood-sugar levels, it is called insulin potentiator,[4] Chromium deficiency is relatively common in type 2 diabetes and may impair the functions of GTF (glucose tolerance factor), causing the uptake of glucose into cells to become less efficient. It also plays a major role in gestational diabetes. High insulin level also seem to increase chromium excretion,[3] because chromium act as a cofactor in insulin response so as the insulin level increases urinary excretion of chromium also increases and diabetic individual have more rate of chromium excretion compared to normal individual.[5] Chromium deficiency is also related to glycated haemoglobin as the chromium inhibits the glycation process.[6] Chromium also plays a role in fat metabolism. Chromium supplementation altered the body fat composition to increase non- fat body mass. In the present work, an attempt has been made to determine the serum chromium level in patients of diabetes (both type 1 and type 2) compared to healthy volunteers.

MATERIAL AND METHOD

1- STUDY DESIGN

Samples had been collected from the indoor and outdoor patient of S.V.B.P Hospital, Meerut. Serum samples had been collected from the diabetic and non-diabetic individuals. Individuals had been checked by physician and had been choosen by following diagnostic criteria1 -symptoms of diabetes plus random blood glucose concentration ≥ 11.111 mmol/l. -fasting blood glucose ≥7 mmol/l. Fasting is defined as no calories intake for at least 8 hour. -two hours blood glucose ≥ 11.111 mmol/l during an oral glucose tolerance test. -patients of juvenile and adult onset diabetes. -individuals with fasting blood glucose by ≤7 mmol/l and post prandial blood glucose ≤11.111 mmol/l had been choosen as a healthy volunteers. -individuals of either men or women who matches the above criteria has been randomly selected (N=40), -healthy volunteers (N=65) of either sex has been randomly selected without history of diabetes according to above criteria. This group is performed as a control group and compared with diabetic individuals. Study has been conducted in S.V.B.P Hospital, Meerut and Chemistry Department, C.C.S University, Meerut.

2- CHROMIUM ANALYSIS

Blood samples were obtained in such a way to minimize contamination. 5 ml blood sample is taken from the arm vein of patient by disposable syringe. Before collection, the vein has sterilized and always a new sterilized syringe was used. Sample is placed in vacutainer tube

and left for 20 minutes at 37 °C. After removing the coagulum, the specimens were centrifuged at 3000 rpm for 20 min and serum is separated. Serum glucose level was measured by glucose oxidase method.[29] For chromium determination serum samples was diluted at the ratio of 1:1 1% HNO_3 and was prepared for flame atomic absorption spectrophotometer. All Chemical reagents were used of analytical grade. The chromium stock solution was prepared (1000 mcg/l) from chromium tri oxide reagent. Chromium standards solutions (1, 2,3,4,5 mcg/l) were freshly prepared by serial dilution of the stock solution by deionized water. The light source was chromium cathode lamp (wavelength 357.9 nm). After obtaining calibration curve, diluted serum samples were placed in the flame atomizer manually and the chromium concentration was measured three times. Statistical analysis was performed using the statistical software SPSS. The comparison of serum chromium level between diabetic and non-diabetic individual had been calculated by Student‘s t-Test and the correlation between serum chromium and serum glucose level was measured by Pearson‘s correlation coefficient.

RESULTS

Results of this study indicate that the serum chromium level of diabetic patients is lower than the control individuals ($p < .001$). type 1 diabetic patients shows serum chromium level 4.265 mcg/l which is significantly lower than their control group (7.01736 mcg/l) shown in table 1 while type 2 diabetic patients shows the serum chromium level (4.3311 mcg/l) which is significantly lower than their control group (7.0210 mcg/l) as shown in table 2. The comparison of serum chromium level type 1 and type 2 diabetic group does not significant difference ($p= .8$) shown in table 3. Comparison between the chromium level in control and diabetic individual including both type 1 and type 2 also shows significant difference which has been shown in table 4. In the present study serum glucose level and serum chromium level in type 1 (diabetic and control individual) and type 2 (diabetic and control individual) shows significant co relation ($p <.001$) represented in table 5, 6 and figure 1, 2. Sugar and chromium level in control and diabetes group including both type 1 and type 2 also shows significant correlation shown in table 7 and figure 3. Negative co relation shows that as the level of serum glucose increases, serum chromium level decreases.

Table 1: Type 1 Chromium level(mcg/l) at the 5% Level of significance (Group of Control and Diabetic)

Group Statistics						
	Groups	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**P value**
Chromium level(mcg/l)	Control	35	7.017360	.3626529	.0612995	< .001
	Diabetic	20	4.265860	.9280832	.2075257	

Table 1: shows the comparison of chromium level of type1 control and diabetic individuals. In the above result, it is revealed that the p-value is less than 0.05, this implies that the hypothesis that there is no significant difference is reject. In other words, it can be informed that there is significant difference in chromium level between control and diabetic patient.

Table 2: Type 2 Chromium level (mcg/l) at the 5% Level of significance (Group of Control and Diabetic)

Group Statistics						
	Groups	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**P value**
Chromium level(mcg/l)	Control	30	7.0210530	.3848892	.0702708	<.001
	Diabetic	20	4.3311700	1.0293428	.2301680	

Table 2: shows the comparison of chromium level of type 2 control and diabetic individuals. In the above result, it is revealed that the p-value is less than 0.05, this implies that the hypothesis that there is no significant difference is reject. In other words, it can be informed that there is significant difference in chromium level between control and diabetic patient.

Table 3: Type I Type 2 Chromium level (mcg/l) at the 5% Level of significance (Group of Diabetic)

Group Statistics						
	Type	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**P value**
Chromium level(mcg/l)	Type 1	20	4.265860	.9280832	.2075257	.8
	Type 2	20	4.331170	1.0293428	.2301680	

Table 3: shows the comparison of serum, chromium level of type 1 and type 2 diabetic individuals. In the above result, it is revealed that the p-value is greater than 0.05, this implies that the hypothesis that there is no significant difference is accepted. In other words, it can be

informed that there is not significant difference in chromium level between control and diabetic patient.

Table 4: Type I Type 2 Chromium level (mcg/l) at the 5% Level of significance (Group of control and Diabetic)

Group Statistics						
	Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**p value**
Chromium level(mcg/l)	Control	65	7.019065E0	.3701320	.0459092	< .001
	Diabetic	40	4.279135E0	1.0257896	.1621916	

Table 4: shows the comparison of serum chromium level of type 1 and type 2 control and type 1 and type 2 diabetic individuals. In the above result, it is revealed that the p-value is less than 0.05, this implies that the hypothesis that there is no significant difference is reject. In other words, it can be informed that there is significant difference in chromium level between control and diabetic patient.

Table 5: Correlation between serum glucose and serum chromium level in control and Diabetics Type 1

Correlations				
		Sugar level (mg/dl)	**Chromium level(mcg/l)**	**P value**
Sugar level (mg/dl)	Pearson Correlation	1	-.815**	
	Sig. (2-tailed)		.000	< .001
	N	55	55	
Chromium level(mcg/l)	Pearson Correlation	-.815**	1	
	Sig. (2-tailed)	.000		
	N	55	55	

Table 5**:** shows the correlation of serum glucose and serum chromium level in type 1 control and diabetic individuals. Correlation is significant at the 0.01 level (2- tailed). Negative correlation shows that as the serum glucose level increases, serum chromium level decreases.

Table 6: Correlation between serum glucose and serum chromium level in control and Diabetics Type 2 Correlation

		Sugar level (mg/dl)	Chromium level(mcg/l)	P value
Sugar level (mg/dl)	Pearson Correlation	1	-.825**	
	Sig. (2-tailed)		.000	<.001
	N	50	50	
Chromium level(mcg/l)	Pearson Correlation	-.825**	1	
	Sig. (2-tailed)	.000		
	N	50	50	

Table 6: shows the correlation of serum glucose and serum chromium level in type 2 control and diabetic individuals. Correlation is significant at the 0.01 level (2- tailed). Negative correlation shows that as the serum glucose level increases, serum chromium level decreases.

Table 7: Correlation between sugar and chromium level in control and diabetics type 1 and type 2:

Correlations				
		Sugar level(mg/dl)	**Chromium level(mcg/l)**	**p value**
Sugar level (mg/dl)	Pearson Correlation	1	-.810**	
	Sig. (2-tailed)		.000	< .001
	Sum of Squares and Cross-products	1023763.746	-12587.523	
	Covariance	9843.882	-121.034	
	N	105	105	
Chromium level (mcg/l)	Pearson Correlation	-.810**	1	
	Sig. (2-tailed)	.000		
	Sum of Squares and Cross-products	-12587.523	235.698	
	Covariance	-121.034	2.266	
	N	105	105	

Table 7: shows the correlation of serum glucose and serum chromium level in type 2 control and diabetic individuals. Correlation is significant at the 0.01 level (2- tailed). Negative correlation shows that as the serum glucose level increases, serum chromium level decreases.

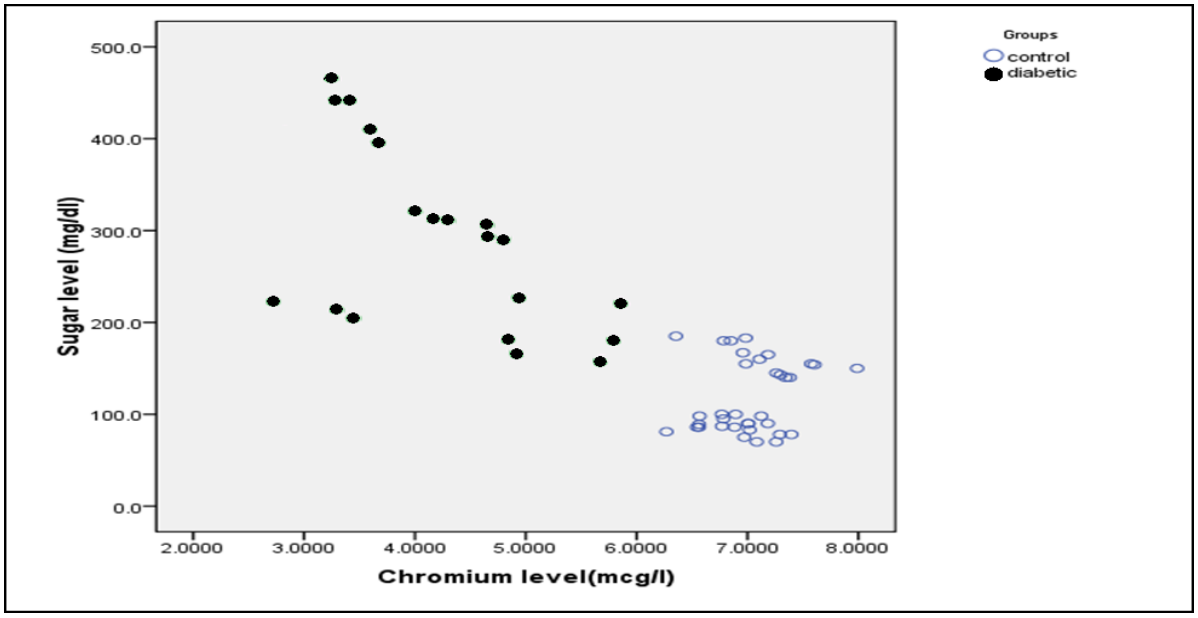

Figure 1: Scattered diagram showing correlation between serum chromium level and serum glucose level in Control and Diabetics with type 1.

Figure 1: represents the correlation between sugar and chromium in type1 control and diabetic individual. Diagram represents that as the level of sugar increases, chromium level decreases.

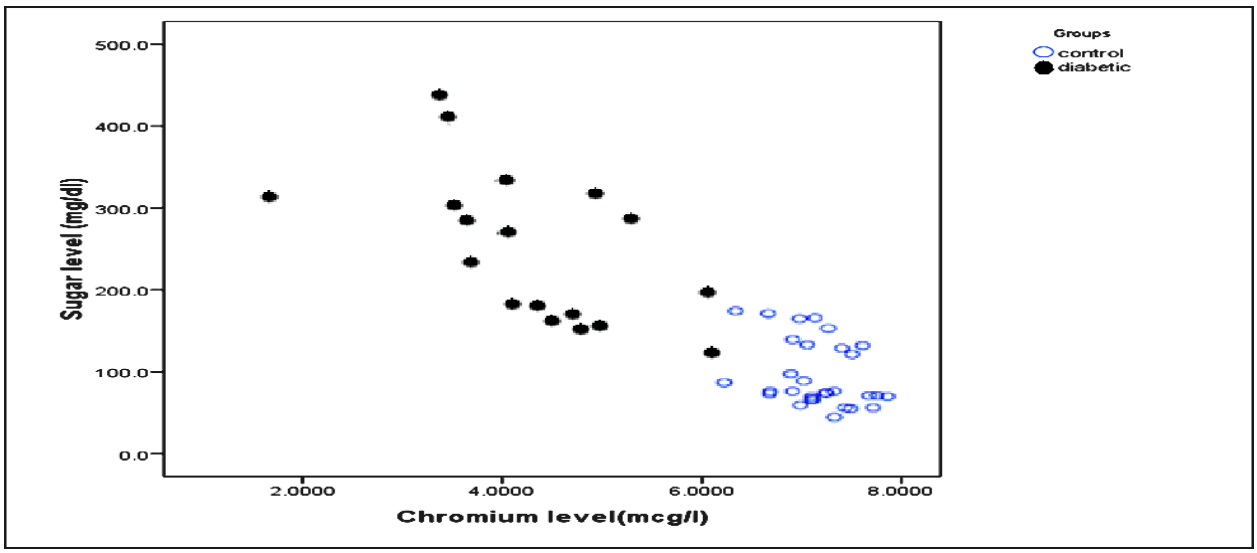

Figure 2: Scattered diagram showing correlation between serum chromium level and serum glucose level in Control and Diabetics type 2.

Figure 2: represents the correlation between sugar and chromium in type 2 control and diabetic individuals. Diagram represents that as the level of sugar increases, chromium level decreases.

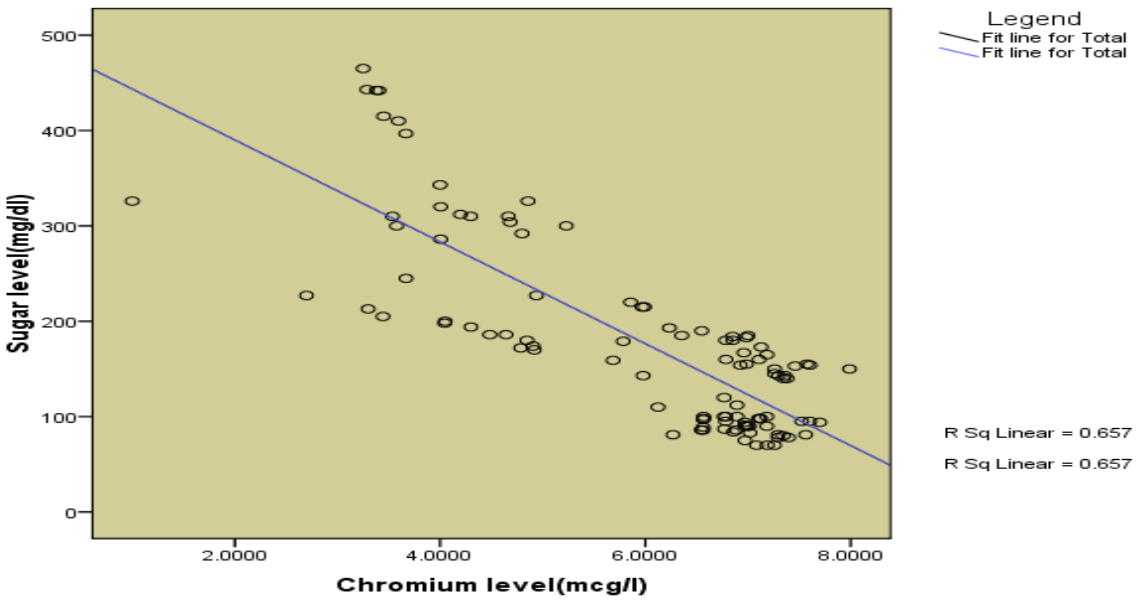

Figure 3: Scattered diagram showing correlation between sugar and chromium level in control and diabetics

Figure 3: represents the correlation between sugar and chromium in type1 and type 2 control and diabetic individual. Trend line represents that as the level of sugar increases, chromium level decreases.

DISCUSSION

Diabetes is a complex problem which has brought about great attention for research and investigation. 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.[11,12] The etiology of diabetes is not completely understood, numerous factors are associated with its development. Onset of type 1 diabetes is generally sudden and mostly occurs in children. type 1 diabetics are generally thin and normal.[13,14] In type 1 diabetes beta cell of islets of langerhans are lost by the T cell mediated auto immune attack. There is no known preventive measured against type 1. In type 1 diabetes the sensitivity and responsiveness of insulin receptor is normal especially in the early stages. Type 1 diabetes can effect children or adults but was traditionally termed ―juvenile‖ because a majority of these diabetic cases were in children.[15] There are many reasons for type 1 diabetes to be accompanied by irregular and unpredictable hyperglycemias frequently with ketosis and sometimes serious hypoglycemias, including an impaired counter regulatory response to hypoglycemia, occult infection, gastroparesis (which leads to erratic absorption of dietary carbohydrates), and endocrinopathies (e.g., Addison's disease). These phenomena

are believed to occur no more frequently than in 1% to 2% of persons with type 1 diabetes. Type 1 diabetes is partly inherited, and then triggered by certain infections, with some evidence pointing at Coxsackie B4 virus. A genetic element in individual susceptibility to some of these triggers has been traced to particular HLA genotypes (i.e., the genetic "self" identifiers relied upon by the immune system). However, even in those who have inherited the susceptibility, type 1 DM seems to require an environmental trigger. The onset of type 1 diabetes is unrelated to lifestyle. Patients with type 2 diabetes have excess insulin secretion and may suffer from obesity.[16] In addition to hyperinsulinemia and obesity they may have hypertension, dyslipidemia, and impaired fibrinolysis, a collection of conditions called syndrome X.[19] 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-insulin1 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.[18,19] Impaired insulin secretion and increased glucagons contribute to continued hepatic glucose output resulting in elevated fasting glucose levels.[20] 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.[21-23] 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.[24] Among trace elements, chromium deficiency was first identified as a cause of impaired glucose tolerance in 1959 .[25] Chromium as part of a compound known glucose tolerance factor (GTF) is needed for appropriate glucose use, Lipid metabolism, and insulin receptor sensitivity.[26] One study has been reported that administration of 500 mcg 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. Recently, it has been reported that chromium may reduce triglycerides in patients with type 2 diabetes. While some studies have -4 demonstrated that chromium has positive effect on serum glucose levels, other studies have not shown any beneficial effects when used in patients with type 2 diabetes.[27, 28] 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. Chromium status in Indian subjects in type 2 diabetes mellitus and effect of chromium supplementation on diabetes was studied by Debjani Ghosh et al. They found a significant difference in the serum chromium level in Indians (36.5-50.9 nmol/L) to foreigners (2.3-40.3 nmol/L). They also found improvement of chromium supplementation on diabetic people [6]. In another study the effect of chromium supplementation on elderly diabetic patient was evaluated by Rabinovitz H et al. They found beneficial effect of chromium supplementation on glycemic persons,[7] Supplemented chromium has been shown to have beneficial effects on people with varying degree of glucose intolerance ranging from mild glucose intolerance to overt type 2 diabetes mellitus.[1] Within a decade chromium has been shown to play a role in glucose intolerance, Type 2 diabetes mellitus, and gestational diabetes. A work had been done on the assessment of serum chromium level in patients with type 2 diabetes mellitus .They found the significant difference between the chromium level of diabetic and non-diabetic people. They did not get any significant difference in the serum chromium level in men and women. The finding of this study gives the idea about the relation between chromium and diabetes,[8] It had been reported that the chromium supplementation especially CrP in patient with type 2, gestational or steroid induced diabetes can improve both glucose and insulin metabolism.[9] A study had been conducted on the women of Indian gestational diabetic subject and found significant difference. This study was carried out to verify the serum chromium status of patient with type 1 and type 2 diabetes. The result of this study shows the significant difference between the serum chromium level in diabetics and non-diabetics. Results of this study show the significant co relation between the serum chromium level and serum glucose level. This study support the idea that chromium may be recommended as a supplement to improve serum glucose levels in diabetic individuals.

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REFERENCES

1. Anderson R A. Chromium, glucose intolerance and diabetes, J Am Coll Nutr, 1998; 17: 548-555.

2. Braley J, Hoggan R.Dangerous Grains: Whey glutin cereal grains may be hazardous to your health., 1992: 36.
3. Reavely Nicola .The New Encyclopedia of vitamins, minerals, supplements and herbs, 1999.
4. Adams Mike. Cromium prevents diabetes by improving insulin sensitivity. www.naturalnews.com/027398_Cromium_diabetes_natural.html
5. Redfern Robert .Miracle Enzyme is Serrepeptose, 2009.
6. Ghosh Debjani et al. The Journel of Nutritional Biochemistry, 2002; 13: 690-697.
7. Rabinavit et al. Effect of Cromium supplementation on blood glucose and lipid level in type 2 diabetes mellitus in elderly patients , Int Vitam Nutr Res, 2004; 74(3): 178-182.
8. Hemmati A A . Assesment of the Serum Cromium level in patient with type 2 Diabetes Mellitus , Webmed Central Medicine, 2011; 2(3): WMC00172.
9. Cefalu T W, Hu B F. Role of Cromium in Health and in Diabetes, Diabetes Care, 2004; 27: 11.
10. Sundararaman PG, Sridhar GR, Sujatha V, Anita V. Serum chromium levels in gestational diabetes mellitus. Indian J Endocr Metab., 2012; 16: 70-3.
11. Atkinson MA, Maclaren NK. The pathogenesis of insulin-dependent diabetes mellitus,New England J.Med., 1994; 331: 1428
12. Skyler JS, Marks JB.Immune intervention in type I diabetes mellitus,Diabetes., 1993; 1: 15.
13. Rother KI.Diabetes treatment—bridging the divide, The New England Journal of Medicine, 2007; 356(15): 1499–501. doi:10.1056/NEJMp078030. PMID 17429082.
14. Diabetes Mellitus (DM): Diabetes Mellitus and Disorders of Carbohydrate Metabolism: Merck Manual Professional;Merck Publishing., 2010; Retrieved 2010-07-30.
15. Dorner M, Pinget M, Brogard JM.Essential labile diabetes (in German), MMW Munch Med Wochenschr., 1977; 119(19): 671–4. PMID 406527.
16. Pederson. O, The impact of obesity on pathogenesis of non-insulin dependent diabetes mellitus: a review of current hypotheses, Diabetes Metabolism., 1989; 5: 495.
17. Raven GM. Banting lecture: Role of insulin resistance in human disease, Diabetes., 1988; 37: 1595.
18. Defronzo RA et al. Pathogenesis of NIDDM A balanced overview,Diabetes Care., 1992; 15: 318.
19. Reaven GM, Pathophsiology of insulin resistance in human disease., 1997; 75: 473.

20. Polonsky KS, et al, Non insulin–dependent diabetes mellitus genetically program made failure of the beta cell to competent for insulin resistance,New England J. Med., 1996; 334: 777.
21. Pfeifer MA et al. Insulin secretion in diabetes mellitus, Am. J. Med., 1981; 70: 579.
22. Baker L., et al. Hyperglycemia and acetonuria simulating diabetes, Am. J. Dis. Children, 1996; 33: 59.
23. Bressler P, Defronzo.R. Drugs and diabetes, Diabetes Rev., 1994; 2: 531.
24. Henkin, R.I. Trace metals in endocrinology, Med. Clin. J. North America., 1976; 60: 776.
25. Schwarz, K. Mertz. WI. Chromium (III) and the glucose tolerance factor,Archives of Biochem. Biophysics., 1959; 85: 292.
26. Burtis CA, Ashwood ER. Tietz textbook of clinical chemistry. fourth ed,WB Saundesrs Co Philadelphia., 2006: 235.
27. Whitney EN. Nutrition for health and health care,Wadsworth, Belmont, USA., 2011: 76.

Tables:

28. Table 1: shows the comparison of chromium level of type1 control and diabetic individuals.
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32. Table 5: shows the correlation of serum glucose and serum chromium level in type 1 control and diabetic individuals.
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34. Figure 1 represents the correlation between sugar and chromium in type1 control and diabetic individuals.
35. Figure 2 represents the correlation between sugar and chromium in type 2 control and diabetic individuals.
36. Figure 3 represents the correlation between sugar and chromium in type1 and type 2 control and diabetic individual.