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## Evaluation of Serum Ferritin in Type-2 Diabetes Mellitus Sudanese Patients

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### Abstract:

**Background:** Type 2 diabetes mellitus (DM2) is an important health problem worldwide affecting about 8 percent of the population. Diabetes Mellitus is one of the most common chronic diseases in Sudan. These patients have many changes in their blood, and many factors affect the glucose tolerance that is mediated by insulin, one of these changes is S.ferritin level, a marker of iron storage. Increased serum ferritin, reflecting body iron overload, is often associated with insulin resistance. The role of iron in the pathogenesis of diabetes is suggested by an increased incidence of type2 diabetes mellitus in diverse causes of iron overload, and reversal or improvement in glycemic control with a reduction in iron load achieved using either phlebotomy or iron-chelating therapy.

**Aim:** To evaluate serum ferritin level in type-2 Diabetes Mellitus Sudanese Patients.

**Materials and Method:** A case-control study was done in 45diabetic patients and 45normal healthy individuals as a control group, including measurement of serum ferritin by an electrochemiluminescence immunoassay (ECLIA) method full automated chemical analyzer. COBAS e411 machine used Roche HITACHI Kit and quantification of HbA1c level by i-chroma instrument.

**Results:** The study showed that serum ferritin levels were significantly increased in diagnosed cases of type 2 diabetes mellitus in comparison with the age and gender-matched healthy individuals (P. value= 0.008). There was an insignificant correlation between serum ferritin and HbA1c(P. value=0.431).

**Conclusion:** Therefore, the findings of the present study indicate that serum ferritin was increased in diabetes and this increase may contribute to the pathogenesis of this disease as well as to the development of complications. Thus, routine screening for serum ferritin concentration in pre-diabetes and diabetic patients should be done to assess the body's iron stores.

**Key Words:** Diabetes Mellitus, Ferritin, Glycosylated hemoglobinA1c.

**Introduction:**

Type 2 diabetes mellitus (DM2) is an important health problem worldwide affecting about 8 percent of the population. (Hughes et al., 2004). The prevalence of the disease continued to rise over the recent decades. (McKinlay et al., 2000),(Wild S et al., 2000),(Freid et al., 2003),(Yang et al., 2010),(Fox et al., 1970s-1990s). The probable role of inflammatory factors and cytokines in producing DM was described by Pickup JC in 1998. (Pickup et al., 1998). Similar results also were found in other studies which showed that acute phase reactants may be useful for predicting DM;(Thorand et al., 1984-1998),(Festa et al., 2001),(Freeman et al., 2002),(Hu FB et al., 2004), however, these findings were not found in some other studies. (Krakoff et al., 2003).

Acute phase reactants are proteins that respond to acute stress such as infection, trauma, surgery, and tissue necrosis. Some of these agents are alpha-acid glycoprotein, haptoglobin, fibrinogen, C-reactive protein (CRP), and ferritin. (Gauldie et al., 1987),(Moshage et al., 1987),(Kushner et al., 1982). CRP is produced by liver cells and could activate the complement system and T and B lymphocytes. Erythrocyte Sediment Rate (ESR), as an acute-phase reactant, is less important than CRP for the evaluation of inflammation. (Festa et al., 2001),(Hoffmann et al., 1999). Ferritin is a complex globular protein that stores iron as a soluble and non-toxic component. In oxidative stress, Fe<sup>2+</sup> enters cells and then changes to Fe<sup>3+</sup>, linked to ferritin, and then protects cells from oxidative stress. (Theil et al., 1987). Increasing the concentration of iron and ferritin in cells could cause resistance to insulin and dysfunction of  $\beta$  cells of the pancreas. Hyperinsulinemia due to insulin resistance may be responsible for increasing serum ferritin. It has been suggested that disturbance of iron metabolism could cause insulin resistance, hyperinsulinemia, dyslipidemia, HTN, and central obesity. (Jehn et al., 2004),(Ashourpour et al., 2010).

S.ferritin is an acute phase reactant and is a marker of the iron stored in the body. (Koorts et al., 2011).

Increased ferritin may induce diabetes through a variety of mechanisms including oxidative damage to pancreatic beta cells, impairment of hepatic insulin extraction by the liver, and interference with insulin's ability to suppress hepatic glucose production. (Sumesh et al., 2013).

Raised S.ferritin may be related to the occurrence of long-term complications of diabetes, both microvascular and macrovascular. (Kim et al., 2000),(Eshed et al., 2001).

The significance of iron in the pathophysiology of diabetes is derived from the ease with which iron is reversibly oxidized and reduced as it plays a critical role in the production of reactive oxygen species.

**Patients and method:**

The study was done in Khartoum-Sudan- Zinam Center for diabetes and endocrinology. A forty-five (45) Sudanese patients with type2 diabetes mellitus were enrolled in this study against another forty-five (45) healthy donors to compare S.ferritin between the two groups.

Information was obtained from patients and control groups before collection. Any patient who has an autoimmune disease, infectious disease, consumption of steroid or immunosuppressive drugs was excluded. Venous blood (3 ml) was collected in a plain tube from each patient. the clotted blood sample was centrifuged, and the sera were transferred to new containers.

Laboratory investigations included measurement of serum ferritin level by COBAS E411 machine.

**Statistical analysis:**

Data were analyzed manually and by using computer software (SPSS) version 25 and the results were presented in graphs.

Statistical values less than 0.05 were considered significant, and above 0.05 were considered insignificant.

**Results:**

A total of 45 type2 of diabetic patient samples were collected in this study (21) were male, (and 24) were female. The mean age of patients was (18-60) years old.

The serum ferritin in type2 diabetic patients (mean male(47.0%)(mean499.4± SD123.8) and 411.3± SD 82.5) and control (186.3± SD 6.65)(P = female(53.0%)(mean 334.2±SD110.5)(P=0.326). 0.008).The serum ferritin in

**Table 1:** shows a comparison between diabetic and normal cases regarding their ferritin levels

Parameters	Group	N	Mean±SD	P-value
Serum ferritin (ng/ml)	Case	45	411.3±82.5	0.008
	Control	45	186.3±6.65	

**Table 2:** shows a comparison of the mean value of serum ferritin related to age among diabetic patients

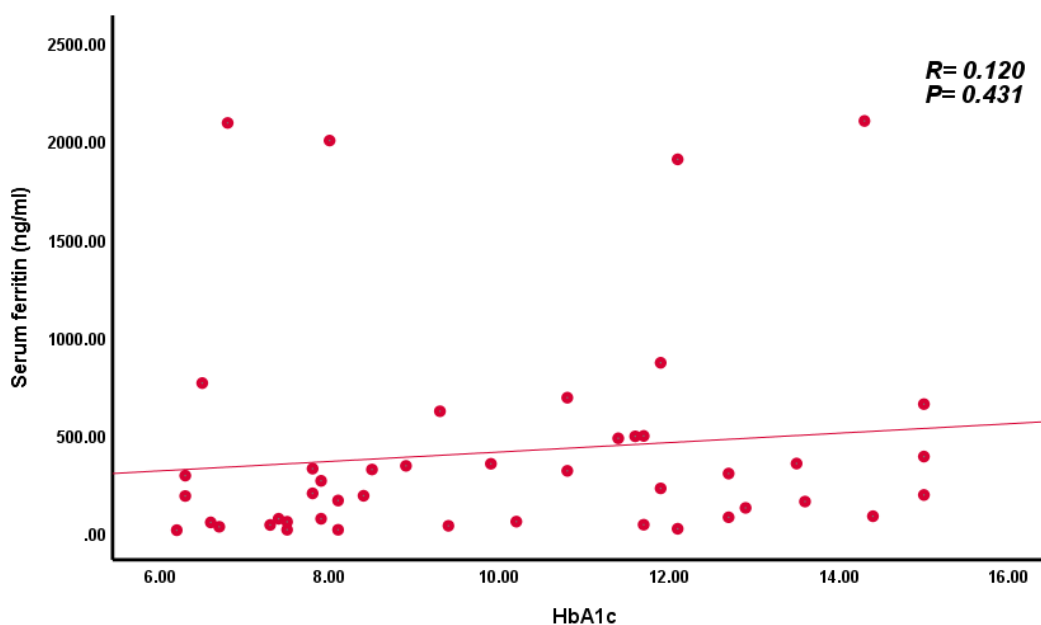
Age	N	Mean±SD	P-value
18-40 Years	3	772.3±160.2	
40-60 Years	27	384.8±98.72	0.023
>60 Years	15	386.8±131.2	

**Table 3:** Showing the duration of diabetes mellitus in years and serum ferritin (ng\ml)

Duration	N	Mean±SD	P-value
<5 Years	11	477.2±181.9	
5-10 Years	17	477.6±178.6	0.124
>10 Years	17	302.3±55.98	

**Table 4:** Showing comparison of the mean value of serum ferritin related to gender among diabetic patients

Parameters	Gender	N	Mean±SD	P-value
Serum ferritin (ng/ml)	Male	21	499.4±123.8	0.326
	Female	24	334.2±110.5	



**Figure 1:** Scatter diagram showing no correlation between serum ferritin and Glycated hemoglobin

**Discussion:**

Type 2 diabetes mellitus (DM2) is an important health problem worldwide affecting about 8 percent of the population. (Hughes E et al., 2006) Diabetes Mellitus is one of the most common chronic diseases in Sudan. (Bos M, Agyemang C, 2013). Those patients have many changes in their blood, and many factors affect the glucose tolerance that is mediated by insulin, one of these changes is S.ferritin level, a marker of iron storage. The results of this study showed that serum ferritin in diabetic patients is significantly higher than in non-diabetics, but its level has no correlation with HbA1c in diabetic patients. Ferritin has been known as an index for body iron stores and also as an inflammatory marker.

There are different theories regarding the role of ferritin in diabetes mellitus. Oxidative damage to pancreatic beta cells, impairment of hepatic insulin extraction by the liver, and interference with insulin's ability to suppress hepatic glucose production. Pancreatic inflammation and some referred to it as a marker for insulin resistance.

The present study is reported from Sudan Khartoum state regarding the role of serum ferritin levels and their effect in patients with type2 diabetes mellitus. In this study the correlation between serum ferritin and normal control, but its level does not correlate with HbA1c. Such results have also been reported by F.Sharfi\*and Sh.Sazandeh in Zanjan diabetes clinic, Iran.( F.sharifi et al., 2004).

Sumesh Raj, G.V.Rajanz, in their study reported that S.ferritin level is higher in type2 DM patients than in the control group and serum ferritin had a positive correlation with increasing duration of diabetes. There was a positive correlation between serum ferritin and HbA1c. There was no correlation between serum ferritin and age, or gender. (Raj et al., 2013).

The result in this study differs from the study done by Maheswari et al., serum ferritin was significantly higher and the correlation between serum ferritin and HbA1c was positive. (Maheshwari et al .,2015).

Another study was done by Meghna Borah, Rohini k. Goswami, in Indian populations. The study showed that serum ferritin levels significantly increased in diagnosed cases of type2 DM in comparison with the age and gender-matched healthy individuals. A strong positive correlation between serum ferritin and HbA1c.(Meghna et al .,2016).

The result in this study differs from other results due to varies greatly in different populations, sample sizes, and methods.

In summary, this study revealed that serum ferritin level was increased in type2 diabetic patients. However, further investigations are needed to confirm these results in other larger populations.

**Conclusion:**

A high level of serum ferritin is found in patients with type2 diabetes mellitus, thus, routine screening for serum ferritin concentration in pre-diabetes and diabetic patients must be done to assess the body's iron stores.

**References:**

**Ashourpour M, Djalali M, Djazayeri A, Eshraghian MR, Taghdir M, Saedisomeolia A.** Relationship between serum ferritin and inflammatory biomarkers with insulin resistance in a Persian population with type 2 diabetes and healthy people. *Int J Food Sci Nutr.* 2010;61:316–23.

**Bos M, Agyemang C.** Prevalence and complications of diabetes mellitus in Northern Africa, a systematic review. *BMC Public Health.* 2013;13:387. Published 2013 Apr 25. doi:10.1186/1471-2458-13-387.

**Eshed. Elis A, LishnerM.** plasma ferritin and type-2 diabetes mellitus. *Endocr Res* 2001; 27:91-7.

**F.sharifi,Sh.Sazandeh.** Serum ferritin in type2 diabetes mellitus and its relationship with HbA1c. Department of Endocrinology, school of medicine, Zanjan, Iran 42(2):142-145; 2004.

**Festa A, D'Agostino R, Jr, Williams K, Karter AJ, Mayer-Davis EJ, Tracy RP, et al.** The relation of body fat mass and distribution to markers of chronic

inflammation. *Int J ObesRelatMetabDisord.* 2001;25:1407–15.

**Fox CS, Pencina MJ, Meigs JB, Vasan RS, Levitzky YS, D'Agostino RB., Sr** Trends in the incidence of type 2 diabetes mellitus from the 1970s to the 1990s: The Framingham Heart Study. *Circulation.* 2006;113:2914–8.

**Freeman DJ, Norrie J, Caslake MJ, Gaw A, Ford I, Lowe GD, et al.** C-reactive protein is an independent predictor of risk for the development of diabetes in the West of Scotland Coronary Prevention Study. *Diabetes.* 2002;51:1596–600.

**Freid VM, Prager K, MacKay AP, Xia H.** Hyattsville, Maryland: National Center for Health Statistics; 2003. Chartbook on Trends in the Health of Americans. Health, United States, 2003.

**Gauldie J, Richards C, Harnish D, Lansdorp P, Baumann H.** Interferon beta 2/B-cell stimulatory factor type 2 shares identity with monocyte-derived hepatocyte-stimulating factor and regulates the major acute phase protein response in liver cells. *ProcNatlAcadSci U S A.* 1987;84:7251–5.

**Hoffmann JA, Kafatos FC, Janeway CA, Ezekowitz RA.** Phylogenetic perspectives in innate immunity. *Science.* 1999;284:1313–8.

**Hu FB, Meigs JB, Li TY, Rifai N, Manson JE.** Inflammatory markers and risk of developing type 2 diabetes in women. *Diabetes.* 2004;53:693–700.

**Hughes E, McCracken M, Roberts H, Mokdad AH, Valluru B, Goodson R, et al.** Surveillance for certain health behaviors among states and selected local areas--behavioral risk factor surveillance system, United States, 2004. *MMWR SurveillSumm.* 2006;55:1–124.

**Jehn M, Clark JM, Guallar E.** Serum ferritin and risk of the metabolic syndrome in U.S. adults. *Diabetes Care.* 2004;27:2422–8.

**Kim NH.** Serum ferritin in healthy subjects and type-2 diabetes mellitus. *Med Korea* 2000; 41:387-92.

**Koorts AM, Viljoen M.** Acute phase proteins: ferritin and ferritin isoforms. University of petoria, South Africa 2011; 154-84.

**Krakoff J, Funahashi T, Stehouwer CD, Schalkwijk CG, Tanaka S, Matsuzawa Y, et al.** Inflammatory markers, adiponectin, and risk of type 2 diabetes in the Pima Indian. *Diabetes Care.* 2003;26:1745–51.

**Kushner I.** The phenomenon of the acute phase response. *Ann N Y Acad Sci.* 1982;389:39–48.

**Maheshwari AV et al.** Correlation between serum ferritin and glycaemic control in patients of type2 diabetes mellitus: *Int J Res medsci.*2015 Sep; 3(9): 2327-2330. Org PISSN 2320-6071 I.e. ISSN2320-6012.

**McKinlay J, Marceau L.** US public health and the 21<sup>st</sup> century: Diabetes mellitus. *Lancet.* 2000;356:757–61.

**Meghna Borah, Rohini k.Goswami.** Evaluation of serum ferritin in type2 diabetes mellitus: a hospital based observational study from Dibrugarh, Assam, India, *IJRMS,* volume4, NO11(2016).

**Moshage HJ, Janssen JA, Franssen JH, Hafkenscheid JC, Yap SH.** Study of the molecular mechanism of decreased liver synthesis of albumin in inflammation. *J Clin Invest.* 1987;79:1635–41.

**Pickup JC, Crook MA.** Is type II diabetes mellitus a disease of the innate immune system? *Diabetologia.* 1998;41:1241–8.

**Raj S.et al .** Correlation between elevated serum ferritin and HbA1c in type2 diabetes mellitus.*Int J Res medsci;* 2013 Feb; 1 (1):12-15. Org PISSN 2320-6071 e1 SSN2320-6012.

**Sumesh Raj, G.V.Rajan.** Correlation between elevated serum ferritin and type-2 Diabetes Mellitus. *Int J Re'smedsci.* 2013 ;( 1):12-5.

**Theil EC.** Ferritin: Structure, gene regulation and cellular function in animals, plants, and microorganisms. *Annu Rev Biochem.* 1987;56:289–315.

**Thorand B, Lowel H, Schneider A, Kolb H, Meisinger C, Frohlich M, et al.** C-reactive protein as a predictor for incident diabetes mellitus among middle-aged men: Results from the MONICA Augsburg cohort study, 1984-1998. *Arch Intern Med.* 2003;163:93–9.

**Wild S, Roglic G, Green A, Sicree R, King H.** Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes Care.* 2004;27:1047–53.

**Yang W, Lu J, Weng J, Jia W, Ji L, Xiao J, et al.** Prevalence of diabetes among men and women in China. *N Engl J Med.* 2010;362:1090–101.