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The Correlation between Serum Ferritin and Fasting Blood Sugar in Iraqi Women with Gestational Diabetes

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Abstract

Background: Globally, diabetes mellitus is a major metabolic health problem that affects significant number of population. Diabetes can be classified into type 1, type 2, secondary forms and gestational diabetes mellitus (GDM); by far GDM is responsible for about 90% of diabetes in pregnant women. Worldwide, the prevalence of GDM is in the range of 1%-14%. A lot of published articles raised the issue that women who developed GDM are at high risk of developing type 2 diabetes later on during life.

Objective: to study the association between serum ferritin level and fasting blood sugar concentration in pregnant women.

Patients and methods: The present case control study included 49 pregnant ladies who were attending regularly prenatal obstetric clinic in Child and Maternity Teaching Hospital in Al-Dwiniyah province in Iraq. The study started on June 2016 and extended through July 2017. Data collected included age of women, gestational age, fasting blood sugar, body mass index and serum ferritin level.

Results: There was significant positive correlation between serum ferritine ($P<0.001$) and fasting blood sugar and the highest serum ferritin level was seen in diabetic women. Mean serum ferritin of women with GDM was significantly higher than that of prediabetic and healthy control women ($P<0.00$). a positive correlation was found between body mass index and fasting blood sugar when bivariate correlation was carried out ($P<0.001$); however, univariate linear regression showed that the effect of BMI was insignificant.

Conclusion: high serum ferritin is a significant predictor of developing gestational diabetes mellitus by pregnant ladies.

Key words: Gestational diabetes, serum ferritin, fasting blood sugar

INTRODUCTION

Globally, diabetes mellitus is a major metabolic health problem that affects significant number of population. (1) Diabetes can be classified into type 1, type 2, secondary forms and gestational diabetes mellitus (GDM); by far GDM is responsible for about 90% of diabetes in pregnant women. (2, 3) Worldwide, the prevalence of GDM is in the range of 1%-14%. (4)A lot of published articles raised the issue that women who developed GDM are at high risk of developing type 2 diabetes later on during life. (5) The development of GDM is associated with increased risk of significant maternal and fetal complications and for that reason it is of prime importance to diagnose the disease as early as possible with targets of strict control to get rid of these imminent adverse outcomes. (6, 7) the risk factors for development of GDM are not well characterized and extensive investigation have been done; however there is still a lot of information that need to be elucidated about how to develop and how to avoid GDM. Potential risk factors include older age, obesity, family history, hypertension and increased serum ferritin level. (8) Some authors suggested a positive correlation between high serum ferritin and high blood sugar in pregnant women (9, 10). Other studies generalized the idea that high iron storage is associated with impaired glucose metabolism in type 2 diabetes besides being blamed in the pathogenesis of GDM. (11-13)some evidence existed that iron deficiency is associated with enhanced insulin sensitivity. (14, 15)on the other hand it has been recorded that high serum frritin is associated with increased insulin resistance (16-18). Despite these findings, a lot of controversy existed in published literatures that justified the conductance of the current study; in this regard several cross sectional studied denied the existence of a correlation between serum ferritin level and fasting blood sugar (19). So the aim of the present study was to investigate the relation between fasting blood sugar concentration and serum ferritin concentration in a sample of pregnant ladies.

PATIENTS AND METHODS

The present case control study included 49 pregnant ladies who were attending regularly prenatal obstetric clinic in Child and Maternity Teaching Hospital in Al-Diwaniyah province in Iraq. The study started on June 2016 and extended through July 2017. Verbal consent was taken from all women participating in the present study and the study was approved ethically by the ethical approval committee in Al-Diwaniyah Health Directorate. During this period body mass index was assessed in early first trimester for all women participating in the current study. Women were followed up till the third trimester and a fasting blood sample was taken from each woman at mid third trimester and sent for lab in order to measure both fasting blood sugar and serum ferritin.

Data collected included age of women, gestational age, fasting blood sugar, body mass index and serum ferritin level and these data were administered into a Microsoft Office Excel sheet. Data analysis was carried out using SPSS version 23. Nominal variables were expressed as number and percentage whereas numeric variables were expressed as mean, standard deviation and range. Pearson correlation coefficient was used to evaluate bivariate correlation whereas univariate linear regression analysis was conducted to eliminate bias caused by

covariates.Kruskall Wallis test was carried out to study mean serum ferritin rank differences among various groups that were classified according to mean fasting blood sugar. The level of significance was considered at $P \leq 0.05$.

RESULTS

The present study included 49 pregnant ladies with a mean age of 30.02 ±6.37 years and the age range was from 20-40 years. Mean body mass index of the entire sample was 27.06 ±5.31 kg/m^2 and it ranged from 20-39 kg/m^2. According to body mass index, 21(42.7%) women were normal, 11(22.5%) women were overweight and 17 (34.7%) women were obese. Mean fasting blood sugar of all women enrolled in the present study was 118.90 ±19.10 and it ranged from 90-165 mg/dl. According to fasting blood sugar women were grouped into three categories: normal, prediabetic and diabetic. The sample included 6 (12.2%) normal, 31 (63.3%) prediabetic and 12 (24.5%) diabetic women. Mean serum ferritin was 93.38±37.91 mg/dl and it ranged from 20-175 mg/dl, as shown in table 1.

To study the correlation between serum ferritin and fasting blood sugar, bivariate correlation was evaluated and showed highly significant positive correlation (r=0.680; P<0.001); however R^2 value was 0.462, indicating that this correlation can predict only 46.2 % of cases, as shown in figure 1. Moreover mean serum ferritin concentrations in normal, prediabetic and obese women were as following: 64.33 ±30.09 mg/dl, 82.42 ±31.42 mg/dl and 136.25 ±19.12 mg/dl, respectively and the difference was highly significant (P<0.001), as shown in figure 2.

Due to the presence of 34.7% obese women and 22.5% overweight women, a correlation was made between body mass index and fasting blood sugar and between body mass index and serum ferritin and both of these correlations were highly significant (P<0.01), as shown in figures 3 and 4. For that reason, uni-variate linear regression analysis was performed and it showed that the correlation between fasting blood sugar and body mass index was insignificant (P=0.124) and that the correlation between fasting blood sugar and serum ferritin was highly significant (P<0.001) and the adjusted R-squared was 0.483, as shown in table 2.

Table 1: General characteristics of the study sample

Characteristic		Value
Number of cases		49
Age (years)	Mean± SD	30.02 ±6.37
	Range (min-max)	20 (20-40)
BMI (kg/m2)	Mean± SD	27.06 ±5.31
	Range (min-max)	19 (20-39)
Normal	Number (%)	21 (42.7)
Overweight	Number (%)	11 (22.5)
Obese	Number (%)	17 (34.7)
FBS (mg/dl)	Mean± SD	118.90 ±19.10
	Range (min-max)	75 (90-165)
Normal	Number (%)	6 (12.2)
Prediabetic	Number (%)	31 (63.3)
Diabetic	Number (%)	12 (24.5)
Serum ferritin (mg/dl)	Mean± SD	93.38±37.91
	Range (min-max)	155 (20-175)

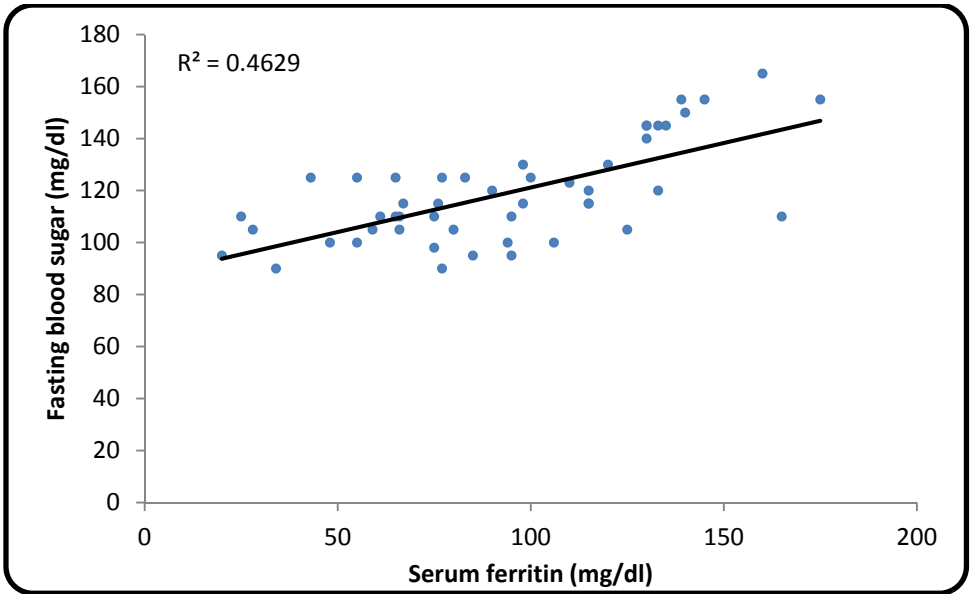

Figure 1: Bivariate correlation between fasting blood sugar and serum ferritin

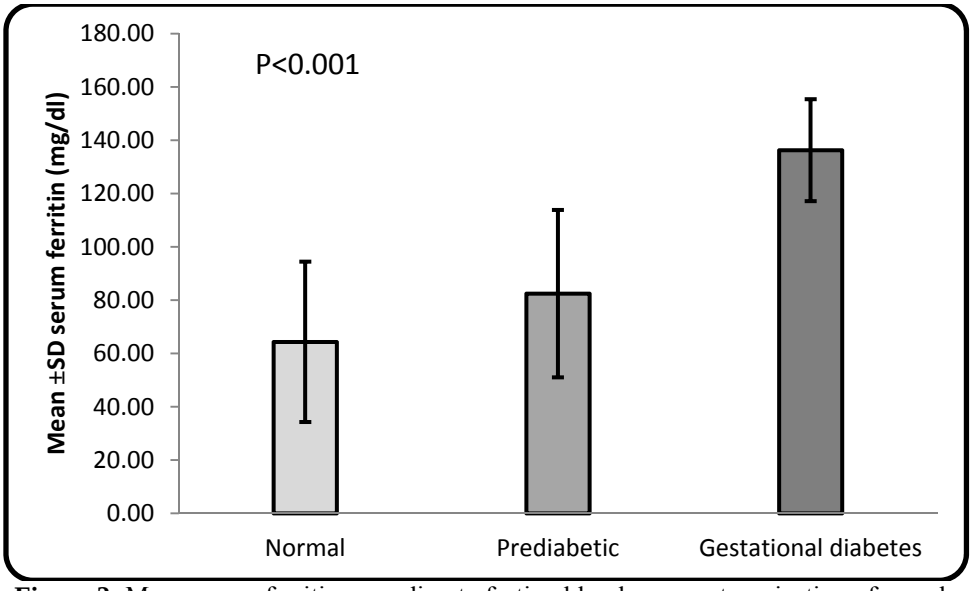

Figure 2: Mean serum ferritin according to fasting blood sugar categorization of sample

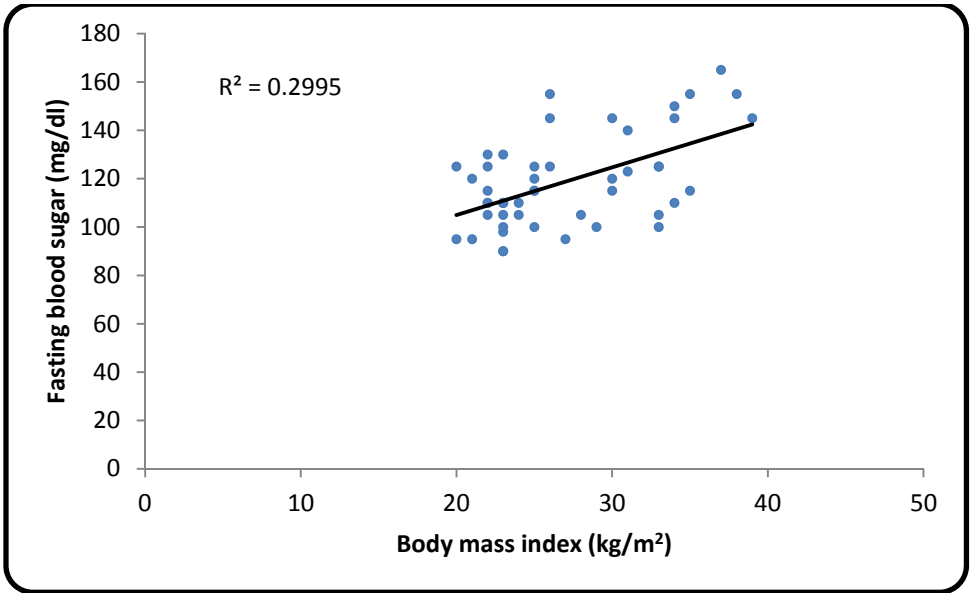

Figure 3: Bivariate correlation between fasting blood sugar and body mass index

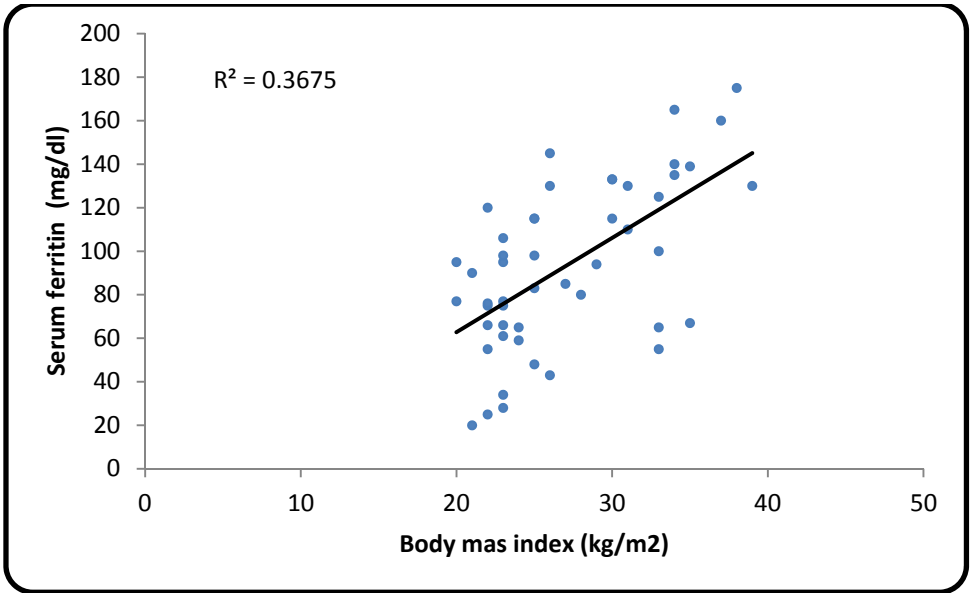

Figure 4: Bivariate correlation serum ferritin and body mass index

Table 2: Results of uni-variate linear regression analysis

Source	Type III Sum of Squares	df	Mean Square	F	P-value
Corrected Model	8607.264	3	2869.088	14.505	<0.001
Intercept	4215.582	1	4215.582	21.312	<0.001
Age	0.025	1	0.025	0.000	0.991
BMI	486.761	1	486.761	2.461	0.124
Serum ferritin	3335.883	1	3335.883	16.865	<0.001
Error	8901.226	45	197.805		
Total	710208	49			
Corrected Total	17508.49	48			

DISCUSSION

The present study showed highly significant correlation between fasting blood sugar and serum ferritin in pregnant ladies and that the highest serum ferritin was seen in diabetic women. In addition, the study showed that the high fasting blood sugar was not merely due to high body mass index and that serum ferritin was a significant independent variable to predict and explain the high blood sugar in those diabetic women. The results of the present study agrees with Sharifi et al., in 2010 who stated that women with gestational diabetes mellitus (GDM) had a higher concentration of serum ferritin (112 ± 28.4 pmol/L in GDM versus 65 ± 16.9 pmol/L in controls, $P< 0.001$). A positive correlation was found between serum ferritin level and mid-pregnancy fasting plasma glucose and HbAlc levels. (20) In addition Soheilykhah et al., in 2017 carried out a study on 1,384 pregnant women and found that women who developed GDM had a higher concentration of serum ferritin than women who did not develop GDM, and this result is in accordance with the findings of the present study. (21) Moreover, Chen et al., in 2006 performed a study that included 1,456 pregnant women and concluded that women who developed GDM had a higher concentration of serum ferritin than women who did not develop GDM ($P < 0.001$). and that elevated serum ferritin level was significantly and positively correlated with BMI. (22) Again these findings are similar to the findings of the presents study.

In another case control study, Amiri et al., in 2013 found that high serum ferritin level increased the risk of gestational diabetes to 2.4-fold which is in agreement with the finding of the current study (23). Administration of iron supplements along with vitamin C in women with sufficient levels of iron stores contributes to free radical overproduction, lipid membrane damage, delayed growth and increased carcinogenesis.(24) In addition, increased iron administration affects insulin secretion and increases lipid oxidation and leads to decrement in muscle glucose uptake and consumption and increment in gluconeogenesis in liver, resulting in enhanced sensitivity to insulin and predisposition to GDM.(25) In some studies, iron level augmentation has been identified as a harmful factor for the body through oxidative stress and free radicals.(26, 27) Excess iron and oxidative stress play a role in the pathogenesis and increased risk of type II diabetes and other associated disorders. Recently, it has been clear that iron influences glucose metabolism even in the absence of excess iron. The surveys have displayed that body iron stores are involved in impaired glucose tolerance and gestational diabetes, because iron compounds can affect insulin synthesis and secretion, increased lipid oxidation and subsequent reduction in glucose transport into the muscle and elevation in gluconeogenesis, and as a result, eventuate in insulin resistance in tissues.(28) Iron has a role in diabetes development via three mechanisms: (1) decreased insulin production, (2) increased resistance to insulin and (3) causing liver dysfunction.(29).

CONCLUSION:

High serum ferritin is a significant predictor of developing gestational diabetes mellitus by pregnant ladies. Referring to the above information it appeared that routine administration of iron supplementation to pregnant ladies should be questioned.

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