

Association Between Serum Ferritin Level and Type 2 Diabetes Mellitus: A Cross-Sectional Study

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ABSTRACT

Background: Diabetes Mellitus is one of the most common chronic metabolic disorders affecting millions of people worldwide. Multiple factors appear to be involved in the pathogenesis of Type 2 Diabetes Mellitus (Type 2 DM). One of these factors may be iron overload. Increased serum ferritin concentrations in non-pathologic conditions, reflecting subclinical iron overload, have been reported to be associated with insulin resistance and an increased risk of Type 2 DM. The study aims to evaluate the association of serum ferritin level with type 2 diabetes mellitus patients.

Materials and methods: This cross-sectional comparative study was conducted during the period from June 2022 to May 2023 in the Department of Biochemistry at Chittagong Medical College Hospital. The study consists of 110 study population out of which 55 were type 2 diabetic patients and 55 were non-diabetic subjects included by non-probability purposive sampling. Fasting Blood Sugar (FBS), Postprandial Blood Sugar (PPBS), HbA1c, serum ferritin and Hb% were calculated following standard protocol. Statistical analysis was performed using SPSS v26.0 statistics.

Results: The mean serum ferritin level of the diabetic patients was $146.45 \pm 32.11 \mu\text{g/L}$, significantly higher ($p < 0.001$) than that of the non-diabetic ($104.96 \pm 22.0 \mu\text{g/L}$) group. The mean HbA1c level in the diabetic group was 8.32 ± 1.02 and that in the non-diabetic group was 5.64 ± 0.29 . Serum ferritin levels were positively correlated with HbA1c with $r = 0.59$ and $p\text{-value} < 0.001$. The correlation of ferritin with duration of diabetes also showed a positive correlation with $r = 0.39$ and $p\text{-value} < 0.01$.

Conclusion: The results of this study concluded that there were a strong association and positive correlation between serum ferritin level and poor glycemic status in patients with type 2 diabetes mellitus when compared to non-diabetic individuals. Serum ferritin was also well associated and positively correlated with HbA1c levels.

Key words: Diabetes Mellitus; Ferritin; HbA1c.

Introduction

Type 2 Diabetes Mellitus (Type 2 DM) is a serious public health concern whose prevalence is increasing globally.¹ DM is also becoming pandemic in developing countries like Bangladesh. It affects a substantial proportion of Bangladeshi people. According to

International Diabetic Federation (IDF) in 2021 about 13.1 million adult Bangladeshi population had DM and it also projects that the total number of patients will increase to 22.3 million by 2045.² Therefore, early diagnosis of type 2 diabetes mellitus is important to prevent the serious micro and macro vascular complications. However, the pathogenesis of type 2 diabetes mellitus (DM) is associated with multiple factors including genetic factors, environmental events, obesity, insulin resistance and islet cell destruction.³ Moreover, recent evidence suggests that iron and serum ferritin may have a role in the pathogenesis of type 2 diabetes mellitus.⁴ During the last three decades, the issue of the health effects caused by iron overload has gained considerable visibility.⁵ Studies have shown that iron metabolism indicators (Transferrin, ferritin, transferrin receptor and so on) can directly or indirectly affect the occurrence and development of type 2 diabetes mellitus.⁶ Type 2 diabetes mellitus is generally characterized by impaired insulin secretion, insulin resistance, excessive hepatic glucose production and abnormal fat metabolism. Although the exact

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mechanism of iron-induced diabetes is uncertain, it is likely to be mediated by, insulin deficiency, insulin resistance and hepatic dysfunction.⁷ Ferritin is a complex globular protein that stores iron as a soluble and non-toxic component. However, the mechanism by which ferritin affects blood glucose may involve insulin resistance.⁸ Recent studies into the early recognition of Type 2 DM have identified the presence of a significant relationship between serum ferritin levels and fasting blood glucose (FBG) levels in patients with the disease and these findings have shifted the focus on the inflammatory markers of patients with Type 2 DM.⁹ Sun and colleagues¹⁰ showed a strong positive association between elevated serum ferritin concentration and the risks of type 2 diabetes mellitus, Impaired Fasting Glucose (IFG) and metabolic syndrome in both men and women aged 50 to 70 years. A prospective cohort study conducted in China showed a significant correlation between serum ferritin levels and HbA1c and FBG and epidemiological studies confirmed this correlation.^{11,12} Therefore, chronic elevation of ferritin level in blood can cause significant organ damage, including liver cirrhosis, type 2 DM, cardiomyopathy and heart failure.¹³ In Bangladesh, the number of studies regarding this is very scant. So, this study was performed to determine the possible association between serum ferritin level and type 2 diabetes mellitus in a tertiary hospital setting of Chattogram, Bangladesh.

Materials and methods

This cross-sectional comparative study was done during the period from June 2022 to May 2023 in the Department of Biochemistry at Chittagong Medical College Hospital. 55 type 2 Diabetic patients aged 35-60 years and 55 non-diabetic patients of 35-60 years were included in the study by non-probability purposive sampling method. Patients with anemia of any cause, chronic infections, chronic kidney and liver diseases, transfusion history or iron therapy, glucocorticoid therapy and taking medicines that effects iron level (Tetracycline, ciprofloxacin, hypothyroid and seizures drugs) pregnant and lactating mother, smokers, alcoholics, psychiatric patients and those who were not willing to participate were excluded from the study.

Table I Socio demographic profile of the respondents (n=110)

Gender	Category				Total	
	Type 2 Diabetic	Non-Diabetic				
	n	%	n	%	n	%
Male	42	76.4	36	65.5	78	70.9
Female	13	23.6	19	34.5	32	29.1
Total	55	100.0	55	100.0	110	100.0
Age group						
35-40	04	7.3	18	32.7	22	2.0
41-45	08	14.5	11	20	19	17.2
46-50	10	18.2	7	12.7	17	15.4
51-55	04	7.3	7	12.7	11	1.0
56-60	29	52.7	12	21.8	41	37.2
Total	55	100.0	55	100.0	110	100.0

The above table reveals that majority 78(70.9%) respondents were male. 41(37.2%) of the respondents belonged to age group 56-60 years.

Table II Anthropometric parameter of the respondents (n=110)

Variables	Type 2 Diabetic group n=55	Non-Diabetic group n=55	p value
	Mean±SD	Mean±SD	
Age	52.50±6.53	46.52±8.27	<0.05
BMI	25.05±1.99	23.41±4.26	<0.05

Table II shows mean age and BMI difference between diabetic and non-diabetic groups. Age and BMI of the diabetic and non-diabetic patients reflected significant difference (<0.05).

Table III Comparison of mean of biochemical parameters among respondents (n=110)

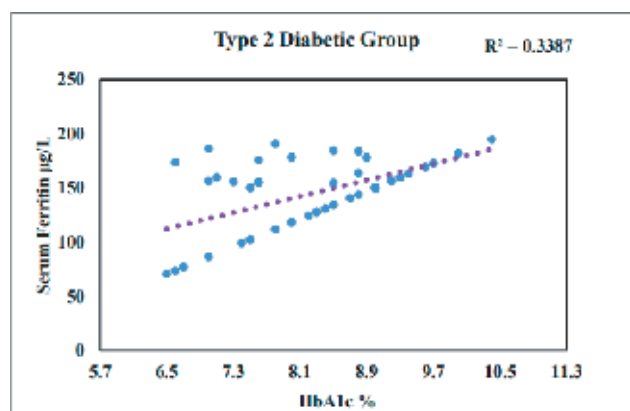
Variables	Diabetic group n=55	Non-Diabetic group n=55	p value
	Mean±SD	Mean±SD	
Fasting Blood Sugar (mmol/L)	8.19 ± 1.45	5.10 ± 0.42	<0.001
2 hours postprandial blood glucose (mmol/L)	14.19 ± 1.79	7.01 ± 0.81	<0.001
HbA1c%	8.32 ± 1.02	5.64 ± 0.29	<0.001
Ferritin (µg/L)	146.45 ± 32.11	104.96 ± 22.0	<0.001
Haemoglobin (gm/dl)	13.75 ± 1.02	14.56 ± 1.14	<0.05

Table III shows the mean FBS, 2PPBS, HbA1c%, Ferritin, and Haemoglobin differences between diabetic and non-diabetic groups. A significant mean FBS, 2HPPBS, HbA1c%, Ferritin, and Haemoglobin difference has been found in the type 2 diabetic group and non-diabetic group.

Table IV Association of serum ferritin level with HbA1c among respondents (n=110)

	Serum ferritin ($\leq 150 \mu\text{g}/\text{L}$)	Serum ferritin ($>150 \mu\text{g}/\text{L}$)	Total	p value
HbA1c (%)				
≤ 6.5	48	08	56	
>6.5	20	34	54	<0.01
Total	68	42	110	

The study shows highly significant association between serum ferritin with HbA1c ($p < 0.01$).

**Figure 1** Scatter diagram of HbA1c% with serum ferritin in type 2 Diabetic Group (n=55)

The above figure shows perfect positive correlation between HbA1c% and serum ferritin.

Table V Pearson correlation of different biochemical parameters among respondents (n=110)

Variables	Type 2 Diabetic Group n=55	p value	Non-Diabetic Group n=55	p value
	r		r	
Ferritin vs Fasting Blood Sugar	0.29	<0.05	-0.13	>0.05
Ferritin vs 2 hours postprandial blood sugar	0.32	<0.05	0.10	>0.05
Ferritin vs HbA1c	0.59	<0.001	-0.13	>0.05
Ferritin vs Haemoglobin	0.01	>0.05	-0.21	>0.05
Ferritin vs BMI	0.25	>0.05	-0.08	>0.05
Ferritin vs duration of diabetes	0.39	<0.01	Not applicable	

The above table shows significant correlation of ferritin with FBS, 2HPPBS, HbA1c and duration of diabetes in type 2 diabetic group.

Discussion

This study was conducted among 110 subjects attending in the Chittagong Medical College Hospital, Chattogram. The study population was divided into two groups diabetic and non-diabetic group. Among the 55 diabetic cases, majority of the patients were in the age group >55 years were 29 (52.7%). In the non-diabetic group, (21.8%) 12 people having age group >55 years. Harikrishnan showed similar findings in their study. The mean age for the diabetic group was 52.50 ± 6.53 years and for the nondiabetic group was 46.52 ± 8.27 years ($p < 0.05$). Momeni, A. et al. had found similar results in their study.^{14,15} The mean BMI in diabetic patient group was $25.05 \pm 1.99 \text{ kg}/\text{m}^2$ and for the nondiabetic group was $23.41 \pm 4.26 \text{ kg}/\text{m}^2$ ($p < 0.05$). There was a significant mean BMI difference between the two groups, Momeni, A. et al. found similar results in their study.¹⁵ In the present study, the mean fasting blood sugar was $8.19 \pm 1.45 \text{ mmol}/\text{L}$ in the diabetic group and $5.10 \pm 0.42 \text{ mmol}/\text{L}$ (Table III) in the non-diabetic group. And the PPBS in the diabetic group was $14.19 \pm 1.79 \text{ mmol}/\text{L}$ which was higher than $7.01 \pm 0.81 \text{ mmol}/\text{L}$ in the non-diabetic group. These findings are similar with the study by Harikrishnan.¹⁴ The mean serum ferritin level of the diabetic patient group was $146.45 \pm 32.11 \mu\text{g}/\text{L}$, significantly higher ($p < 0.001$) (Table III) than that of the non-diabetic ($104.96 \pm 22.0 \mu\text{g}/\text{L}$) group. These findings were consistent with the studies conducted by Harikrishnan.¹⁴ The mean HbA1c level in the diabetic group was 8.32 ± 1.02 (Table III) and that in the non-diabetic group was 5.64 ± 0.29 (Table III) this was similar to the study by Zhang.¹⁶ The present study (Table IV) showed the association between serum ferritin among the subjects with HbA1c ($\leq 6.5\%$) and the subjects with high levels ($> 6.5\%$) of HbA1c ($p < 0.01$). Khondker also observed similar type of association in their study.¹⁷ The current study showed in (Table V) that serum ferritin level was positively correlated with HbA1c with r value 0.59 (Figure 1) and p-value < 0.01 . When considering the correlation of ferritin with FBS and PPBS, showed $r = 0.29$, p-value < 0.05 and $r = 0.32$, p-value < 0.05 respectively. These significant observations were consistent with the findings of other studies.¹⁴⁻¹⁷ In summary, in all of the cited studies in this context, there was a significant association between serum ferritin level and type 2 diabetes mellitus. Further studies are required to explain the benefit of close monitoring of such parameters like serum ferritin in patients with type 2 diabetes mellitus.

Limitations

This study was done on a relatively small sample size. The patients were also selected from a single centre. So, this result cannot be generalized for whole country.

Conclusion

The study showed significantly increased level of serum ferritin in Type 2 DM patients compared to non-diabetic group. A positive correlation has also been found between serum ferritin and HbA1c level. Hyperferritinemia may also be responsible for development of insulin resistance in diabetes mellitus. It is therefore suggested that serum ferritin level could be helpful for the assessment of glycemic status of patients with established Type 2 DM.

Recommendation

A prospective multi centered study needs to be conducted for assessing the pathological relation between serum ferritin and type 2 diabetes mellitus. A feasibility study maybe aimed to convey awareness regarding the measurement of serum ferritin in type 2 diabetes mellitus and its complications.

Disclosure

All the authors declared no competing interest.

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