ORIGINAL RESEARCH

In Type 2 Diabetes, A Study Examined the Correlation Between Serum Ferritin and Hba1c

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ABSTRACT

Background: Diabetes mellitus type 2 (DMT2) is one of the most prevalent endocrine illnesses, affecting about 135 million individuals globally. The disease's genesis is unknown, but subclinical hemochromatosis has recently been identified as one of the possible causes of DM. The purpose of this study was to look at the association between serum ferritin as a measure of iron excess and diabetes and HbA1c.

Methods: This 12-month study was carried out in the Medicine department of Katihar Medical College Hospital in Bihar, India. 46 patients with T2DM were used as cases in this case control study. The control group consisted of 46 healthy individuals who were age, gender, BMI, and haemoglobin percent matched to the case group. Blood samples were tested for ferritin, haemoglobin, HbA1c, and fasting plasma sugar. Anaemia and any other ailment or medicine that could alter ferritin levels were exclusion criteria.

Result: The Pearson correlation coefficient test, Student's t-test, Chi-square test, and Odds ratio were used to assess the results statistically. Diabetics had considerably higher mean serum ferritin levels than the control group (197.97± 75.99 gm/L vs. 64.24± 27.83 gm/L, p<0.001). In diabetic patients, there was a substantial positive connection between HbA1c and serum ferritin (p<0.001). In this investigation, an OR of 11.64 was also discovered.

Conclusion: Serum ferritin levels are associated with T2DM patients. This could be a significant and independent predictor of the development of diabetes mellitus.

Key Words: Diabetes mellitus, ferritin, HbA1c, relationship, T2DM

INTRODUCTION

Diabetes mellitus (DM) is a collection of metabolic illnesses that share the hyperglycemia phenotype. It is the result of a complicated interaction between genetics and environmental variables. Type 2 diabetes is a very variable disease with no one cause that may explain the transition from normal glucose tolerance to diabetes [1, 2]. Insulin resistance and decreased insulin secretion are the primary molecular problems in type 2 diabetes, which are caused by a combination of environmental and hereditary factors. It is a significant public health issue in both developing and industrialised countries [3, 4, 5]. Along with cardio-vascular disease, cancer, and chronic respiratory disorders, it is one of the four primary noncommunicable diseases.Many people die as a result of diabetes complications. Adult blindness, heart attacks, renal failure, amputation, and strokes are all caused by it.

Glycation, the covalent binding of glucose to haemoglobin, results in the formation of a small haemoglobin derivative known as glycated haemoglobin (HbA1c). In determining glycemic

status, the proportion of HbA1c indicates the integrated glucose levels during the previous 6 to 8 weeks [6]. HbA1c is now utilised globally as a marker of long-term glycemic control as well as a therapeutic target in the mitigation and postponement of the progression of hyperglycemic consequences.

Increased bodily iron levels have lately been linked to the development of type 2 diabetes, insulin resistance syndrome and glucose intolerance [7,8]. Some studies have indicated that hyperglycemia is difficult to control in patients with iron excess [7,9]. Normally, ferritin levels in human plasma are low in relation to overall iron storage in the body. As a result, plasma ferritin levels are thought to represent a measure of bodily iron reserves. Ferritin is one of the essential proteins involved in the regulation of iron homeostasis [10].

The mechanism underlying the link between serum ferritin and type 2 diabetes is unknown, however iron deposition in the liver may produce insulin resistance by interfering with insulin's capacity to decrease hepatic glucose synthesis [8,9]. Iron oxidises on its own to create iron-oxygen complexes. These free radicals have the ability to alter membrane characteristics and cause tissue damage [11,12]. Through a disruption in glucose metabolism, oxidative stress can also cause hyperglycemia [13]. The purpose of this study was to discover a link between serum ferritin and diabetes, as well as HbA1c as a blood glucose control marker in diabetic patients.

MATERIALS AND METHODS

This case-control study was carried out in Bihar on diabetic patients sent to the outpatient department of Katihar Medical College Hospital, as well as a normal control group. Patients with chronic kidney illness, chronic liver disease, corticosteroid medication, and other conditions linked with altered serum ferritin levels, such as haemochromatosis, bleeding disorders, chronic alcoholics, and anaemia, were excluded from our study. Individuals who have received multiple blood transfusions were also excluded. Our anaemic criteria were based on laboratory testing and a haemoglobin level of less than 13 g/dl in males and 12 gm/dl in females. The cut-off value for CRP as an acute phase protein marker was set at 6 mg/dl.

Individuals in the control group had no history of diabetes mellitus. They had fasting blood sugar levels that were less than 6 mmol/L and haemoglobin levels that were higher than the cut-off number. They had no history of medication usage and were age, gender, and BMI matched to the diabetic group. Each individual completed one standard questionnaire, which covered personal information, drug use, disease history, and a physical examination. Body mass index (BMI) was determined using the weight / (height)2 calculation after weight and height were measured using a standard instrument.After 12 hours of fasting, blood sugar was determined using the glucose oxidase method in the biochemical laboratory of Katihar Medical College Hospital. HbA1c was measured using a modified HPLC approach, while ferritin was measured using a DRG Ferritin ELISA kit in the BSMMU laboratory. The results were analysed using SPSS software, and the t-test was used for quantitative variables, the Chi-square test for qualitative variables, and Pearson's regression for variable correlation. The risk factor was also determined using the Odds Ratio.

RESULTS

The diabetes patients had a mean age of 54.91 (± 6.46) years, while the controls had a mean age of 53.19 (± 7.31) years. Males made up 56.5 percent of the cases, while females made up 43.5 percent. In the control group, however, 58.7 percent were male and 43.1 percent were female. Cases had a mean BMI of 27.95 (± 2.21) kg/m^2 while controls had a mean BMI of 27.19 (± 2.98) kg/m^2. There were no significant variations in age, gender, or BMI between

the two groups. These demographic characteristics of the study subjects are reflected in Table 1.

Table 1: Demographic characteristics

Demographic variables	Group		p value
	Case (Type 2 diabetic)	Control (Non diabetic)	
Age	54.89 ±6.44	53.17 ± 7.30	0.235
BMI	27.94 ± 2.20	27.20 ± 3.01	0.149
Female	19(41.4%)	20(43.4%)	0.832
Male	27 (58.6%)	26 (56.5%)	

Table 2 compares the case and control groups in terms of haemoglobin concentration, fasting plasma glucose (FPG), HbA1c, and serum ferritin.

Table 2: Comparison between the study groups regarding Biochemical parameters

Biochemical parameters	Case	Control	p value
Hb	13.06 ±1.28	13.41 ±0.99	0.725
S. Ferritin	197.98 ±76.01	64.25 ±27.84	0.001
FPG	7.89 ±1.56	5.10 ±0.64	0.001
HbA1c	8.52 ±2.30	5.43 ±0.49	0.001

Table 3 shows the relationship between serum ferritin and HbA1c levels in subjects with high levels (> 6.1 percent) and persons with normal levels (< 6 percent). Serum ferritin levels were shut off at 150 gm/L. The majority of study subjects with normal HbA1c levels (percent) had lower Ferritin levels and vice versa.

Table 3: Association of serum ferritin level with HbA1c

HbA1c	Serum ferritin Serum ferritin		p value
	≤150µgm/L	≥ 150µgm/L	
≥6.1	10	30	≤ 0.001
≤6	47	5	

There was a positive and substantial association between HbA1c and serum ferritinin in diabetic participants. The control group, on the other hand, was positively connected in terms of serum ferritin and HbA1c, but the correlation was not significant statistically. Serum ferritin as a potential cause for t2dm is measured. In this study, an OR of 11.64 was found, indicating that persons with higher serum ferritin levels are 11.64 times more likely to develop type 2 diabetes than those with lower serum ferritin levels.

DISCUSSION

Diabetes mellitus type 2 is a worldwide issue that can lead to a variety of life-threatening complications. The main causes of type 2 diabetes are impaired insulin production and insulin resistance. Increased serum iron stores, as measured by serum ferritin, are now assumed to have a role in the development of the disease [8].Cases in this study were diabetes patients. As a result, their fasting plasma glucose levels were greater than the controls. HbA1c levels differed significantly between patients and controls (p <0.001). Similar findings were made in two more investigations conducted in India and China [14,15].

The diabetes patients' mean serum ferritin level was considerably higher (<0.001) than the controls. These finding is consistent with Raghavani's previous research [16]. We also discovered a significant (p <0.001) relationship between serum ferritin and HbA1c. Those with greater ferritin levels (both cases and controls) also had high HbA1c levels. As a result, higher serum ferritin levels were linked to higher HbA1c levels. This finding is consistent with a study conducted in India by Prashant et al. [17]. Another study indicated that greater

body iron stores were possibly related with the occurrence of glucose intolerance, type 2 diabetes, and gestational diabetes in the general population [18].

In diabetic individuals, serum ferritin levels were likewise found to be positively and significantly linked with HbA1c (p=0.001). Raghavani [16] colleagues found a substantial link between ferritin and FPG and a moderate correlation between ferritin and HbA1c in their investigation [16]. A study in India discovered a substantial relationship between iron and HbA1c [18].

According to the preceding discussion, ferritin may play a function in the aetiology of type 2 diabetes. The mechanism behind the link between serum ferritin and type 2 diabetes is unknown. However, iron accumulation in the liver may prevent insulin from acting on the liver (Mozulski et al. & Fernandez Real et al.) [11, 19]. Iron overload appears to have an effect on skeletal muscle. Because of muscle injury, deposited iron reduces glucose absorption. Increased iron buildup in the pancreas reduces insulin production and secretion (Fernandez Real et al. [11]). Aside from insulin resistance, iron may have a role in diabetes via oxidative stress.Diabetes may be caused by pancreatic β-cells that are more susceptible to oxidative damage. However, Sharifiet al. discovered no association between serum ferritin and HbA1c in an Iranian investigation [20]. Another study conducted in India found no significant relationship between serum ferritin and HbA1c [14].

There was a positive association between serum ferritin and HbA1c (p=0.06) in non-diabetic controls as well, but it was not statistically significant. A similar conclusion was discovered in another study conducted in India by Sumesh Raj et al [21]. Serum ferritin was also found to be a major risk factor (OR= 11.64) for type 2 diabetes in our study. Chang et al. [22] found that persons with moderately high serum ferritin levels were 1.3 times (95 percent CI) more likely to develop hyperglycemia in large population-based research in Taiwan. They also discovered that among people with extremely high serum ferritin levels, the risk increased to 2.16 times (95 percent CI) [22]. Scholl [23] conducted a study on women and discovered that high ferritin levels (170ng/ml) in women increase the chance of acquiring type 2 diabetes.This augmentation occurred three times in ten years. As a result of this investigation, serum ferritin is positively linked with HbA1c in diabetic people and may be a risk factor for type 2 type-2 diabetes. Our conclusions can be well explained by the findings of previous investigations.

CONCLUSION

The current study's findings confirmed that there is a considerable rise in serum ferritin in diabetes mellitus as compared to the control group. A positive relationship between HbA1c and serum ferritin has also been discovered. In diabetes mellitus, hyper ferritinemia may be one of the causes of reduced insulin production and the development of insulin resistance.

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