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CLINICAL CORRELATION BETWEEN IRON STORAGE MARKER AND GLYCEMIC CONTROL IN TYPE 2 DIABETES MELLITUS AT TERTIARY CARE HOSPITAL

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Abstract

Background: Type 2 Diabetes Mellitus (T2DM) is a widespread metabolic disorder characterized by insulin resistance and hyperglycemia. Iron metabolism disturbances, reflected by elevated serum ferritin levels, have been implicated in the pathogenesis and complications of T2DM. This study aimed to evaluate the clinical correlation between iron storage markers and glycemic control in T2DM patients at a tertiary care hospital.

Methods: A cross-sectional observational study was conducted on 100 participants, including 50 diagnosed T2DM patients and 50 age- and gender-matched healthy controls. Parameters measured included glycated hemoglobin (HbA1c) and serum ferritin levels. Statistical analysis was performed to compare groups and assess correlations.

Results: T2DM patients showed significantly higher mean HbA1c (8.2 ± 1.5%) and serum ferritin levels (150.6 ± 45.3 ng/mL) compared to healthy controls (HbA1c: 5.4 ± 0.6%, ferritin: 85.2 ± 30.7 ng/mL; $p < 0.001$ for both). The body mass index (BMI) was also significantly greater in the diabetic group (28.4 ± 4.2 kg/m² vs. 23.9 ± 3.1 kg/m², $p = 0.001$). A moderate positive correlation was observed between serum ferritin and HbA1c levels, indicating a link between iron overload and poor glycemic control.

Conclusion: Elevated serum ferritin levels are significantly associated with poor glycemic control in T2DM patients, suggesting that iron overload may contribute to disease progression. Monitoring serum ferritin alongside HbA1c could improve diabetes management. Further longitudinal studies are warranted to establish ferritin as a predictive biomarker in T2DM.

Keywords: Type 2 Diabetes Mellitus, Glycemic Control, HbA1c, Serum Ferritin, Iron Overload, Body Mass Index, Cross-Sectional Study, Iron Metabolism, Diabetes Management, Biomarker

Introduction: Type 2 diabetes mellitus (previously referred to as non-insulin-dependent diabetes mellitus) is the most prevalent form of the disease. It is marked by elevated blood glucose levels, resistance to insulin, and a relative lack of insulin production.[1] The explosive increase of diabetic

population worldwide is a major public health concern both in developing and developed countries. The most common form of diabetes in the world is type 2 diabetes mellitus, affecting 85-90% of all people with diabetes.[2]

The complication of diabetes is preventable in case of early diagnosis and management. Measurement of glycated proteins primarily HbA1c (glycated hemoglobin) is effective in monitoring long-term glucose control in people with diabetes mellitus.[3]

The pathogenesis of type 2 diabetes mellitus is not fully understood as multiple factors appear to be involved. One of these factors may be an excessive absorption and storage of dietary iron.[4]

The most common cause of this is under nutrition particularly amidst females. 50% of anaemia is attributed to iron deficiency, worldwide. The iron status in our body is precisely and accurately predicted by the ferritin levels (iron storage form).[5]

Diabetic patients have various microvascular (like neuropathy, nephropathy, and retinopathy), macrovascular (like atherosclerosis) and miscellaneous (like diabetic cardiomyopathy) complications.[6]

The various complications are produced by reactive oxygen species leads to oxidative damage which is generated by free radicals like free Iron is one of the most important micronutrients for good health and disturbed iron metabolism leads to lipid-protein oxidation and also damages RBC membrane.[7]

Material and Methods: Study was conducted in the of department of Biochemistry in collaboration with department of General Medicine during a period from March 2024- February 2025 at Krishna Mohan Medical College & Hospital, Mathura.

Study design: cross-sectional observational study

Sample size: The study was carried out on a total of 100 participants, comprising 50 individuals with a confirmed diagnosis of Type 2 Diabetes Mellitus and 50 age- and gender-matched healthy controls.

Inclusion criteria:

- Patients aged 30 to 70 years.
- Diagnosed T2DM patients having fasting blood glucose ≥ 126mg/dl or HbA1c ≥ 6.5%.
- Diagnosed cases of Type 2 Diabetes Mellitus
- Patients undergoing regular follow-up at the tertiary care hospital.
- Patients who provide written informed consent.

Exclusion criteria:

- Patients diagnosed with Type 1 Diabetes Mellitus or Gestational Diabetes Mellitus**.**
- Patients with known hematological disorders**,** including anemia**,** thalassemia**,** hemochromatosis**,** or any other iron metabolism disorder**.**
- Individuals with chronic kidney disease or chronic liver disease**.**
- Patients with a history of malignancy or currently undergoing cancer treatment.
- Individuals who have received a blood transfusion within the past 3 months**.**
- Pregnant or lactating women.
- Patients unwilling or unable to provide informed consent**.**

Result:

Table 1: table represents gender distribution of the patients

Gender	T2DM Patients (n = 50)	Healthy Controls (n = 50)	Total
Male	28	26	54
Female	22	24	46
Total	50	50	100

There was no statistically significant difference in gender distribution between T2DM patients and healthy controls (p = 0.688), indicating that both groups were well matched in terms of gender. The T2DM group included 28 males (56%) and 22 females (44%), while the healthy control group had 26 males (52%) and 24 females (48%). This gender matching helps minimize potential gender-related bias in the analysis.

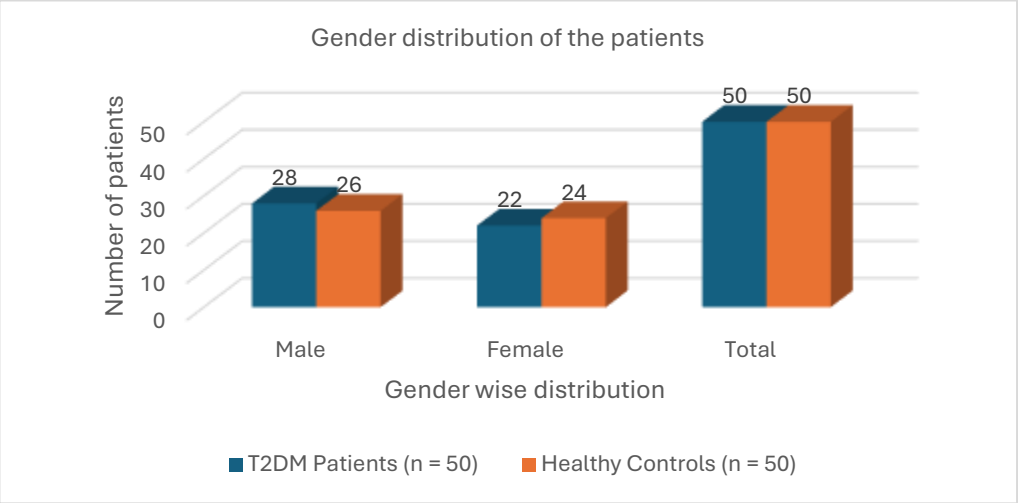

Figure 1: diagrammatical gender distribution of the patients

Table 2: Table represent age distribution of the patients

Age Group (years)	T2DM Patients (n = 50)	Healthy Controls (n = 50)	Total (n = 100)	P value
30–39	6	8	14	0.842
40–49	12	15	27	0.632
50–59	18	16	34	0.832
60–69	10	8	18	0.798
70 and above	4	3	7	0.871
Total	50	50	100	

The table distribution of participants across different age groups showed no statistically significant differences between T2DM patients and healthy controls. The p-values for each age category—ranging from 0.632 to 0.871—indicate that age was well matched between the two groups. This confirms that age is unlikely to be a confounding factor in the comparison of other clinical parameters between the groups.

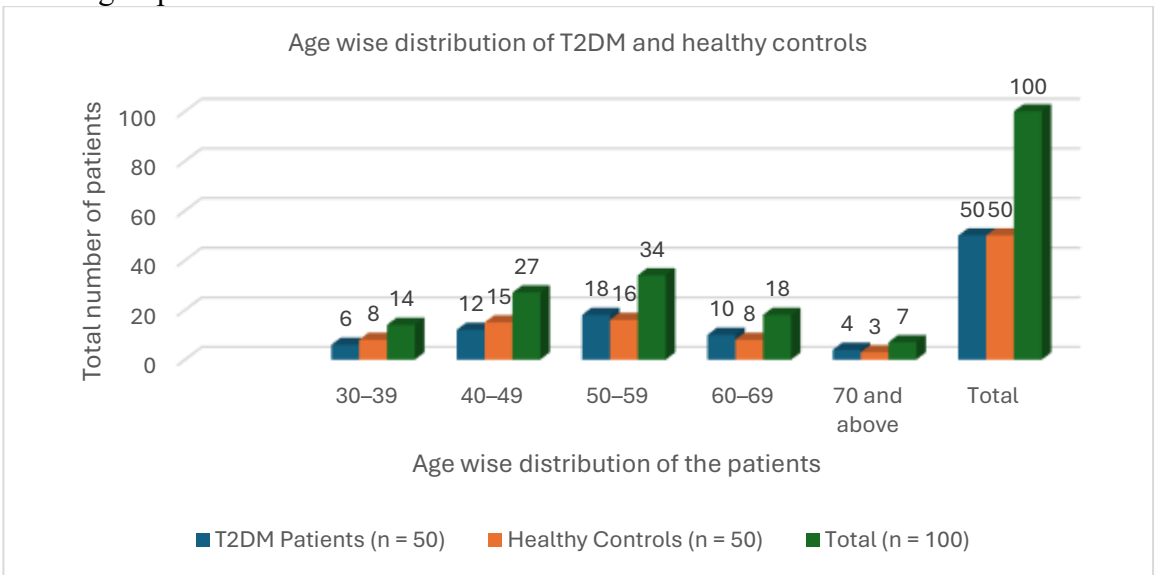

Figure 2: diagrammatic represents age wise distribution of T2DM and healthy controls

Table 3: table represents Comparison of BMI Between T2DM Patients and Healthy Controls.

Group	Number of Subjects (n)	BMI (kg/m²) Mean SD	p-value
T2DM Patients	50	28.4 ± 4.2	0.001**
Healthy Controls	50	23.9 ± 3.1	

The mean Body Mass Index (BMI) among T2DM patients was 28.4±4.2 kg/m², which is significantly higher than the BMI of healthy control subjects, who had a mean BMI of 23.9±3.1 kg/m². The p-value of 0.001 indicates a statistically significant difference between the two groups ($p < 0.01$). This suggests that individuals with Type 2 Diabetes Mellitus are more likely to have a higher BMI compared to non-diabetic individuals, reinforcing the association between increased body weight and the risk of developing Type 2 Diabetes.

Table 4: Comparison of HbA1c and Serum Ferritin Levels Between T2DM Patients and Healthy Controls.

Parameter	T2DM Patients (n = 50)	Healthy Controls (n = 50)	p-value
HbA1c (%)	8.2 ± 1.5	5.4 ± 0.6	< 0.001**
Serum Ferritin (ng/mL)	150.6 ± 45.3	85.2 ± 30.7	< 0.001**

The mean HbA1c level in T2DM patients was 8.2 ± 1.5%, significantly higher than in healthy controls (5.4 ± 0.6%, $p < 0.001$). Similarly, the mean serum ferritin concentration was significantly elevated in the diabetic group (150.6 ± 45.3 ng/mL) compared to controls (85.2 ± 30.7 ng/mL, $p < 0.001$).

Discussion: T2DM patients showed significantly higher HbA1c and serum ferritin levels than healthy controls, indicating a possible link between iron storage and poor glycemic control. A moderate positive correlation between ferritin and HbA1c supports iron's role in diabetes pathogenesis. Elevated BMI in diabetics further suggests a connection between obesity, iron metabolism, and glucose imbalance.

Conclusion: This study demonstrates a significant association between elevated serum ferritin levels and poor glycemic control in patients with Type 2 Diabetes Mellitus. The positive correlation between ferritin and HbA1c suggests that increased iron storage may contribute to the progression of diabetes. Monitoring ferritin levels, alongside traditional glycemic markers, may offer additional insight into disease management. Further longitudinal studies are needed to explore ferritin's potential as a predictive biomarker for glycemic control.[7]

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