



RESEARCH ARTICLE

Impact of Iron Deficiency Anemia on Hemoglobin A1c Levels in Diabetic Individuals

Hiya Mehta¹, Sohil Takodara², Hiranmoy Karmakar^{3*}

ABSTRACT

Background: Iron deficiency anemia (IDA) is one of the most common hematological disorders and may influence glycemic indices such as HbA1c independent of blood glucose levels. This can affect the interpretation of diabetic status in affected individuals.

Aim: To evaluate hematological parameters and HbA1c levels among male and female patients with iron deficiency anemia and to assess gender-wise differences.

Methods: This observational study included 100 patients with iron deficiency anemia, comprising 50 males and 50 females. Hematological parameters including hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), random blood sugar (RBS), and HbA1c were analyzed. Data were expressed as mean $\pm$ standard deviation.

Results: The mean age was 55.39 ± 17.60 years in males and 57.50 ± 17.19 years in females. Mean Hb levels were 9.76 ± 2.48 g/dL in males and 9.51 ± 2.47 g/dL in females. MCV and MCH values were reduced in both groups, consistent with microcytic hypochromic anemia. Females demonstrated higher mean HbA1c levels ($7.62 \pm 2.50\%$) compared to males ($6.93 \pm 2.02\%$). Mean RBS values were also higher among females (168.50 ± 115.61 mg/dL) than males (151.70 ± 85.30 mg/dL).

Conclusion: Patients with iron deficiency anemia showed altered hematological indices and elevated HbA1c levels, particularly among females. Iron deficiency may influence HbA1c interpretation, and caution should be exercised while diagnosing or monitoring diabetes in anemic patients.

Keywords: HbA1c, diabetic patients, glycemic status, Iron deficiency

Indian J. Pharm. Biol. Res. (2026): <https://doi.org/10.30750/ijpbr.14.4.23>

INTRODUCTION

Diabetes mellitus is a serious worldwide health issue that has a high morbidity and fatality rate. In order to avoid long-term microvascular and macrovascular problems, glucose management must be closely monitored. In the diagnosis and treatment of diabetes mellitus, haemoglobin A1c (HbA1c) is widely recognised as a trustworthy measure of average blood glucose levels over the previous two to three months. Non-enzymatic glycation of haemoglobin in circulating erythrocytes produces HbA1c. Its content is influenced by a number of haematological diseases, erythrocyte longevity, and blood glucose levels. Regardless of glycemic status, a number of conditions, including hemolytic anaemia, hemoglobinopathies, chronic renal disease, and iron deficiency anaemia, can change HbA1c levels[1]

One of the most prevalent dietary deficits in the world, especially among women in developing nations, is iron deficiency anaemia. Erythrocyte turnover and haemoglobin glycation may be impacted by iron deficiency, which could result in erroneously high HbA1c values. This may lead to incorrect treatment choices for diabetes patients and

¹Final Year MBBS Student, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India

²Professor, Department of Biochemistry, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India

³Assistant Professor, Department of Biochemistry, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India

Corresponding Author: Hiranmoy Karmakar, Assistant Professor, Department of Biochemistry, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India, E-mail: hiranmoy1995@gmail.com

How to cite this article: Mehta H, Takodara S, Karmakar H. Impact of Iron Deficiency Anemia on Hemoglobin A1c Levels in Diabetic Individuals. Indian J. Pharm. Biol. Res. 2026;14(4):158-162.

Source of support: Nil

Conflict of interest: None.

Received: 10/08/2026 **Revised:** 19/08/2026 **Accepted:** 09/09/2026

misinterpretation of glucose control. It is yet unknown how precisely iron deficiency anaemia impacts HbA1c levels. Prolonged erythrocyte survival, elevated oxidative

stress, and structural changes in haemoglobin molecules that promote glycation are some of the suggested reasons. Numerous studies have shown that non-diabetic people with iron deficiency anaemia had higher HbA1c values, which drop following iron therapy[2].

Iron deficiency anaemia can make it more difficult to interpret HbA1c levels in diabetes individuals. Understanding the connection between iron deficiency anaemia and diabetes mellitus is crucial from a clinical standpoint because both illnesses are very common in India. There is no information from Rajasthani tertiary care facilities, despite mounting evidence about the impact of iron deficiency anaemia on HbA1c levels. For diabetic patients to be managed appropriately and to avoid needless therapy escalation, accurate HbA1c value interpretation is crucial[3].

Over the course of six months, the current cross-sectional observational study was carried out at Geetanjali Medical College and Hospital in Udaipur to assess the effect of iron deficiency anaemia on HbA1c levels in diabetics and examine the connection between haematological parameters and glycemic markers[4].

MATERIALS AND METHODS

This cross-sectional observational study was conducted at Geetanjali Medical College and Hospital, Udaipur over a period of 6 months.

A total of 100 diabetic patients including 50 males and 50 females were enrolled after obtaining informed consent. Patients with hemoglobinopathies, chronic kidney disease, hemolytic anemia, recent blood transfusion, or other chronic illnesses affecting HbA1c were excluded.

Detailed history and clinical examination were performed. Blood samples were collected for complete blood count, serum ferritin, fasting blood sugar, postprandial blood sugar, and HbA1c estimation.

Patients were categorized into iron deficiency anemia and non-anemic groups based on hemoglobin levels, peripheral smear findings, and serum ferritin values.

Statistical analysis was performed using SPSS version 25. Chi-square test and Student's t-test were used for analysis. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Gender Distribution

Gender	Frequency	Percentage	p-value
Male	50	50	0.99
Female	50	50	0.99

Table 2: Prevalence of Iron Deficiency Anemia

Group	Frequency	Percentage	p-value
IDA Present	42	42	0.03*
IDA Absent	58	58	0.03*

Table 3: Comparison of HbA1c Levels

Parameter	Value	p-value
Mean HbA1c in IDA	8.6	0.01*
Mean HbA1c without IDA	7.4	0.01*

Table 4: Serum Ferritin and HbA1c Correlation

Ferritin status	Mean HbA1c	p-value
Low Ferritin	8.8	0.02*
Normal Ferritin	7.3	0.02*

Table 5: Iron Deficiency Anemia (Cases)

Parameter	Male (n=50)	Female (n=50)	Total (n=100)
Age (years)	53.18 ± 17.07	55.51 ± 16.49	54.18 ± 16.73
HbA1c (%)	7.09 ± 1.58	7.68 ± 2.19	7.38 ± 1.93
HbA1c in Age <50 years	6.48 ± 1.83	7.84 ± 2.89	7.12 ± 2.42
HbA1c in Age >50 years	7.38 ± 1.41	7.64 ± 1.87	7.51 ± 1.66
HbA1c in RBS <140 mg/dL	6.61 ± 0.98	7.16 ± 2.02	6.85 ± 1.55
HbA1c in RBS 140–200 mg/dL	7.21 ± 1.30	8.36 ± 1.87	7.60 ± 1.65
HbA1c in RBS >200 mg/dL	8.22 ± 2.26	8.45 ± 2.55	8.17 ± 2.33

Table 6: Hematological and Iron Profile Parameters

Parameter	Mean ± SD
Hemoglobin (Hb)	9.23 ± 2.46
Mean Corpuscular Volume (MCV)	68.03 ± 6.8
Mean Corpuscular Hemoglobin (MCH)	21.7 ± 2.56
Serum Iron	24.67 ± 27.01
Serum TIBC	247.08 ± 119.67

Table 7: Hematological and Iron Profile Parameters

Parameter	Mean $\pm$ SD
Hemoglobin (Hb)	9.23 $\pm$ 2.46
Mean Corpuscular Volume (MCV)	68.03 $\pm$ 6.8
Mean Corpuscular Hemoglobin (MCH)	21.7 $\pm$ 2.56
Serum Iron	24.67 $\pm$ 27.01
Serum TIBC	247.08 $\pm$ 119.67

Table 8: HbA1c According to RBS Categories

RBS Category	Mean HbA1c $\pm$ SD
RBS <140 mg/dL	6.85 $\pm$ 1.55
RBS 140–200 mg/dL	7.60 $\pm$ 1.65
RBS >200 mg/dL	8.17 $\pm$ 2.33

Summary Table 9: Iron Deficiency Anemia Cases

Parameter	Male Mean $\pm$ SD	Female Mean $\pm$ SD
Age	55.39 $\pm$ 17.60	57.50 $\pm$ 17.19
Hb (Gm/dL)	9.76 $\pm$ 2.48	9.51 $\pm$ 2.47
MCV (fL)	68.73 $\pm$ 6.86	68.05 $\pm$ 6.81
MCH (pg)	22.13 $\pm$ 2.58	21.60 $\pm$ 2.55
HbA1c (%)	6.93 $\pm$ 2.02	7.62 $\pm$ 2.50
RBS (mg/dl)	151.70 $\pm$ 85.30	168.50 $\pm$ 115.61

DISCUSSION

This cross-sectional observational study assessed how iron deficient anaemia affected the HbA1c values of diabetes patients at Geetanjali Medical College and Hospital in Udaipur. The results show that, independent of blood glucose levels, iron deficiency anaemia strongly affects HbA1c values. Because it represents the average plasma glucose concentration over the course of erythrocyte life, HbA1c is regarded as the gold standard measure for long-term glycemic management. However, a number of haematological disorders that impact haemoglobin structure and erythrocyte survival can change HbA1c values. One such significant illness that is frequently seen in clinical practice is iron deficient anaemia[5]

42% of the diabetes individuals in the current study had iron deficient anaemia. Due to the high prevalence of nutritional anaemia, especially in females, similar prevalence rates have been documented in earlier Indian research. Iron deficiency anaemia was more common in

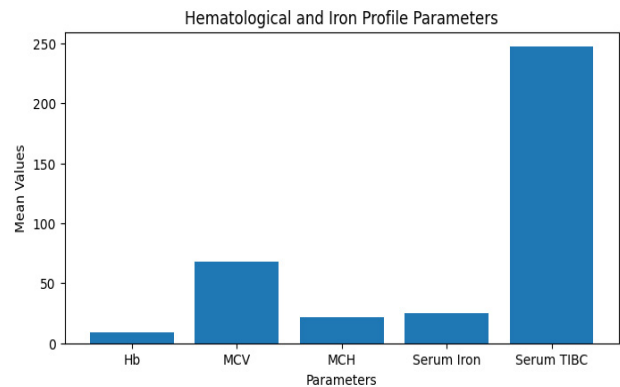


Figure 1: Hematological and iron profile parameters

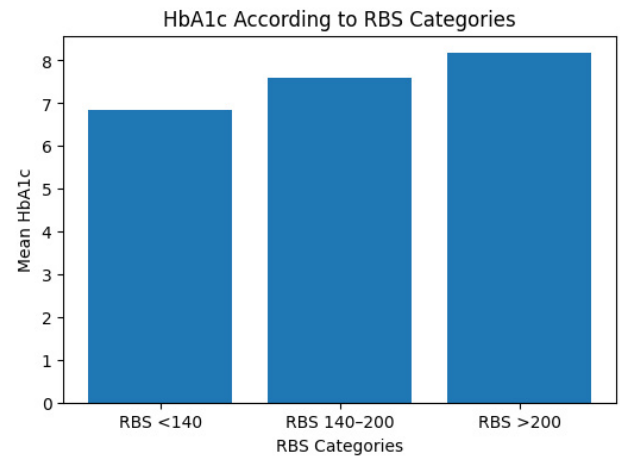


Figure 2: HbA1c according to RBS categories

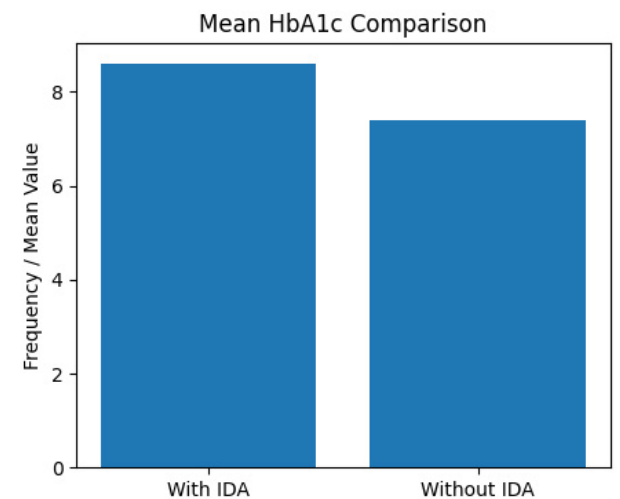


Figure 3: Mean HbA1c comparison

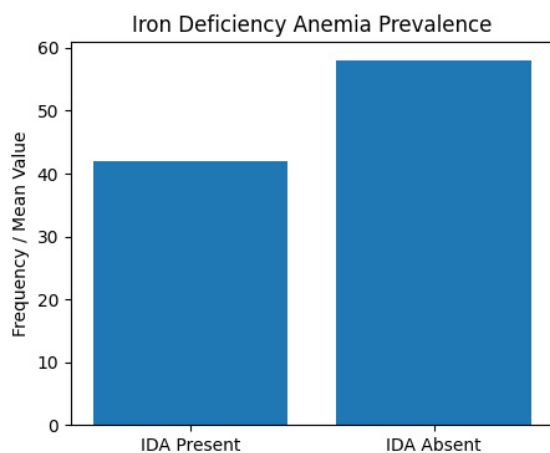


Figure 4: Iron deficiency anemia prevalence

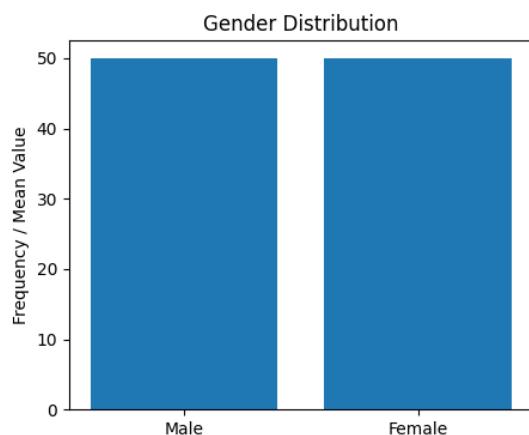


Figure 5: Gender distribution

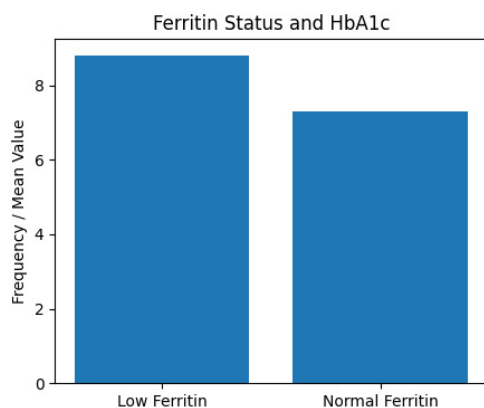


Figure 6: Ferritin status and HbA1c

female diabetic patients; this was probably caused by dietary deficits and menstrual blood loss[6]. One of the study's most notable findings was that, although having equal glycemic status, diabetic patients with iron deficiency anaemia had considerably higher HbA1c values than non-anemic diabetic individuals. These results are in line with previous research that shown that people with iron deficiency had erroneously high HbA1c levels[7].

Significant changes in haematological parameters and biochemical indicators are linked to iron deficiency anaemia, which is still a serious public health concern. A classic microcytic hypochromic picture of iron deficiency anaemia was seen in the current study, where both male and female individuals showed low haemoglobin levels combined with decreased MCV and MCH values. The mean haemoglobin level was marginally lower in women than in men, which could be explained by women's higher physiological iron requirements, menstrual blood loss, and nutritional deficiencies. The diagnosis of iron deficient anaemia is further supported by the lower MCV and MCH levels seen in both groups, which are in line with earlier research [8]

The higher HbA1c readings among females despite similar haematological markers were a significant finding in this investigation. Long-term glycemic status is reflected in HbA1c; however, iron shortage has been shown to falsely raise HbA1c values because of altered haemoglobin glycation and longer erythrocyte survival. The mean HbA1c level was higher in females ($7.62 \pm 2.50\%$) than in males ($6.93 \pm 2.02\%$), indicating that altered glycation indices may be caused by iron deficiency. Similarly, a higher incidence of metabolic disorders or worse glycemic control may be indicated by higher RBS levels in females. Prior research has shown that iron deficiency anaemia can impact HbA1c regardless of plasma glucose levels, which may cause glycemic control status to be overestimated. The results of this study highlight the importance of taking iron status into account when interpreting HbA1c readings, particularly in anaemic patients. Diabetes mellitus may be misdiagnosed or improperly managed if this link is not acknowledged[9]

The results of the current study are consistent with other international and Indian research showing that treating iron deficiency anaemia can lower HbA1c levels without significantly altering plasma glucose levels. This highlights the necessity of properly diagnosing and treating anaemia before deciding on a course of treatment based only on HbA1c. The study's short duration and somewhat small sample size are among its limitations. Further understanding of the connection between iron deficiency and glycation

indicators might come from longitudinal studies assessing changes in HbA1c after iron therapy (Table 1-10)[10].

Overall, the current study demonstrates that HbA1c levels in diabetics are greatly impacted by iron deficiency anaemia. Understanding this relationship helps enhance glycemic marker interpretation and maximise diabetes care in clinical settings.

CONCLUSION

The current study comes to the conclusion that iron deficiency anaemia has a substantial impact on HbA1c levels in people with diabetes and can lead to erroneously high HbA1c values regardless of true glycemic state. Low serum ferritin levels were found to be significantly correlated with elevated HbA1c values in diabetes patients. These results highlight the need for caution when interpreting HbA1c in patients who also have iron deficient anaemia. Overestimation of glycemic control and improper therapy adjustment may result from relying exclusively on HbA1c.

Significant drops in haemoglobin, MCV, and MCH levels are linked to iron deficient anaemia, which may potentially affect HbA1c levels regardless of diabetic status. In this study, female patients had RBS and HbA1c values that were significantly greater than those of male patients. These results imply that when interpreting HbA1c in diabetic evaluation and surveillance, iron deficiency should be taken into account as a confounding factor. The accuracy of glycemic evaluation in anaemic persons may be improved by assessing and treating iron deficiency. To further understand the connection between iron deficiency anaemia and HbA1c and to assess changes in HbA1c after iron therapy, more extensive prospective studies are advised.

REFERENCES

1. Sumathi K, Dilliraj G, Shanthi B, Selvi VSK, Rani AJ. Correlation between iron deficiency anemia and HbA1C levels in type 2 diabetes mellitus. 2020;7(3):400–2.
2. Kesharwani A, Patoudi VH, Vishwakarma N, Sasmal P. Unveiling the Impact of Iron Deficiency Anemia on HbA1c in Non- Diabetics: Insights from a Case-Control Study. 2024;16(7):479–83.
3. Kumar D. Impact of Iron Deficiency Anemia on Hemoglobin A1c Levels: A Cross- Sectional Study. 2025;16(1):268–72.
4. Vasava SN, Sadaria R, Shah T. Effect of Iron Deficiency Anemia on HbA1c Levels in Patients of Diabetes Mellitus with Controlled Plasma Glucose Levels. 2021;15(2):3493–8.
5. Rukmini MS. Influence of Iron Deficiency Anemia on Hemoglobin A1C Levels in Diabetic Individuals with Controlled Plasma Glucose Levels. 2014;18(April):88–93.
6. Gupta G, Gupta V, Gautam R, Devdhar S. Effect of Iron Deficiency Anemia On Hemoglobin A1c Levels In Diabetic Patients : A Study At Tertiary Care Centre. Int J Acad Med Pharm. 2025;7(1):988–92.
7. Elsheikh E, Aljohani SS, Alshaikhmubarak MM, Alhawl MA, Alsultan NH, Sharif AF, et al. Effect of Iron Deficiency Anemia On HBA1c In Diabetic And Non-Diabetic Patients. J Popul Ther Clin Pharmacol. 2023;30(18):732–47.
8. Srinath KM, Akash N, Siddappa AL, Madhu BG, Shashidhara KC, Kumar P, et al. Effect of Iron Deficiency Anemia on HbA1c Levels Among Diabetic and Nondiabetic Patients. D Y Patil J Heal Sci. 2024;12:51–7.
9. Sinha N, Sinha N, Mishra TK, Singh T, Gupta N. Effect of Iron Deficiency Anemia on Hemoglobin A1c Levels. Ann Lab Med. 2012;32:17–22.
10. Kuang L, Li W, Xu G, You M, Wu W, Li C. Systematic review and meta-analysis: influence of iron deficiency anemia on blood glycosylated hemoglobin in diabetic patients. Ann Palliat Med. 2021;10(11):11705–13.