VOLUME - 14, ISSUE - 02, FEBRUARY - 2025 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

General Medicine

EFFECT OF IRON DEFICIENCY ANEMIA ON GLYCATED HEMOGLOBIN IN NON-DIABETIC INDIVIDUALS

Roohi Nanda* Senior Resident, Department Of General Medicine, MGMCRI, Puducherry
*Corresponding Author

Tumbanatham A Professor, Department Of General Medicine, MGMCRI, Puducherry

ABSTRACT

Introduction: Iron deficiency anaemia is a globally prevalent disease, majorly affecting children and women of childbearing age. American Diabetes Association has now accepted HbA1c as the diagnostic tool for detecting diabetes. HbA1c is found to be elevated in several conditions, including iron deficiency anemia. Hence, finding the correlation between glycated hemoglobin and iron deficiency anemia is important. The study aimed to investigate the effect of iron deficiency anaemia on glycated haemoglobin levels in non-diabetic individuals. **Methods:** This prospective observational study was conducted among 93 non-diabetic subjects with iron deficiency anaemia. All subjects who attended the Outpatient (OPD) and in-patient department (IPD) at Mahatma Gandhi Medical College and Research Institute, Pondicherry, were included in the study. Iron supplementation was administered for three months in those with elevated HbA1c levels and iron deficiency anemia. The correlation between HbA1c and iron studies was observed after three months. **Results:** Among 93 patients, the majority of the patients (60) belonged to >60 years of age (47.31%). Forty-eight patients were male (51.61%), and 45 were female (48.39%). The clinical profile gathered from this geographical territory implied an increase in glycated haemoglobin was observed in non-diabetic, iron deficiency individuals. On administering iron supplementation for three months, it was observed that there was a significant reduction in HbA1c levels with an increase in serum ferritin and haemoglobin levels. **Conclusion:** Patients with elevated levels of HbA1c and co-existing iron deficiency anemia should not be diagnosed as diabetes, unless the anemia has been corrected.

KEYWORDS : Iron deficiency, Anaemia, Glycated haemoglobin, HbA1c, Serum ferritin

INTRODUCTION

Iron is a vital micronutrient in the human body, as it is required for various metabolic processes. Iron deficiency can affect mental and physical growth, decreasing learning capacity and work productivity. Iron deficiency anemia is hypochromic, and microcytic red blood cells are produced due to an inability to synthesize haemoglobin.[1] World Health Organization defines anaemia as a condition in which either the oxygen-carrying capacity or the number of RBCs is insufficient to meet physiological requirements. It varies according to age, gender as well as lifestyle factors such as smoking and pregnancy state.[2] IDA is considered one of the most common public health problems affecting people of all ages, including infants, adolescents, women in their reproductive years, and older people.[3,4] Prevalence of anaemia among non-pregnant women and pregnant women in Tamil Nadu was 55.4 percent and 44.4 percent, respectively, according to the National Family Health Survey-4 (NFHS-4) results.[5]

HbA1c, also known as glycated haemoglobin, is formed by non-reversible, non-enzymatic, and slow catalysis of the globin chain in the mature haemoglobin, forming amorphous haemoglobin.[6] The test is considered a gold standard test for the diabetic population as it tests the glycemic control in the past three months, which equates to the life cycle of the red blood cells.[7]

Several factors, including structural hemoglobinopathies, uremia, thalassemia, and any change in the quaternary structure of haemoglobin, can affect HbA1c levels, including diabetes.[7,8] IDA can increase red blood cell turnover, increasing haemoglobin glycation and higher HbA1c values.[7] Iron levels are inversely related to HbA1c glycation, with lower iron levels resulting in falsely elevated HbA1c levels in diabetic and non-diabetic populations.[6,7] However, previous epidemiologic studies have not determined the exact mechanism by which the IDA-associated depletion of Hb is associated with the elevation of HbA1c levels.

India has the highest prevalence of iron deficiency anaemia. Worldwide, researchers from El-Agouza L et al. discovered that patients with iron deficiency anaemia had higher haemoglobin A1c levels, which decreased significantly after receiving iron treatment.[9] Sinha and colleagues demonstrated that treatment of iron deficiency anaemia resulted in increased HbA1c levels and absolute HbA1c levels.[10] We were motivated to investigate the effect of iron deficiency anaemia on glycated haemoglobin levels in non-diabetic individuals in India because the findings of all previous studies were inconclusive.

MATERIALS AND METHODS

The prospective observational study was conducted at the OPD, and IPD of MGMCRI, from Jan 2020 to July 2021.

The study was reviewed by us for submission to the SBV Institutional Ethics Committee and certified that this protocol represents an accurate and complete description of the proposed research.

Sample Size: 93.

Inclusion Criteria: Men and women >18 years of age, non-diabetic patients, non-pregnant women, iron-deficient patients, and patients presented to the casualty, OPD, and ward of MGMCRI were included.

Exclusion Criteria: Diabetic individuals, pregnant women, lactating women, individuals with Hb<7 g/dl, known complaints of bleeding disorder, hypothyrodisim were excluded.

All patients who fell into the inclusion criteria were administered tablet ferrous sulfate 200 mg OD daily for three months. After three months, the HbA1c, hemoglobin, and serum ferritin levels were measured again, and a statistical correlation was observed.

Statistical Analysis

Results

Table 1: Distribution Of Patients According To Their Age In Years

Age group (yrs)	No of patients	Percentage
≤30 yrs	6	6.45
31-40 yrs	4	4.30
41-50 yrs	17	18.28

51-60 yrs	22	23.66
>60 yrs	44	47.31
Total	93	100
Mean ± SD	57.69 ± 13.28 (25-87 yrs)	

Among 93 patients, the majority of the patients belonged to >60 years of age 60 (47.31%). Forty-eight patients were male (51.61%), and 45 were female (48.39%) (Table 1).

Table 2: Correlation of Hemoglobin (Baseline) with HbA1c (Baseline)

Parameters	Mean	Standard Deviation	Correlation
Hb%	9.40	1.10	-0.597
HbA1c	8.76	1.82	p=0.0001. S

The correlation between HbA1c (baseline) and hemoglobin (baseline) was found to be statistically significant (p=0.0001), which means that HbA1c is elevated when the hemoglobin levels are low (table2).

Table 3: Correlation of Hemoglobin (after 3 months) with HbA1c (after 3 months)

Parameters	Mean	Standard Deviation	n	Correlation
Hb%	11.44	1.02	89	-0.313
HbA1c	5.96	0.72	89	p=0.0001, S

This Represents the correlation between the haemoglobin levels and HbA1c after three months of iron supplementation. The correlation is statistically highly significant (p<=0.0001) and suggestive of a reduction in HbA1c levels with an increase in hemoglobin levels after administering iron supplements (table 3)

Table 4: Correlation Between Serum Ferritin Vs HbA1c At Baseline

	Mean	Std. Deviation	N	Correlation "r"	p-value
Serum Ferritin	7.82	2.46	93	-0.067	0.52, NS
HbA1c	8.76	1.82	93		

The Pearson's Correlation Coefficient between serum ferritin baseline and HbA1c baseline is shown in Table 4. The correlation is insignificant between Serum Ferritin Vs HbA1c at baseline.

Table 5: Correlation Between Serum Ferritin Vs HbA1c at Three Months

	Mean	Std. Deviation	N	Correlation, r	p-value
Serum Ferritin	43.48	16.87	89	-0.690	0.0001, S
HbA1c	5.96	0.72	89		

This represents the correlation between serum ferritin and HbA1c three months after iron supplementation. The Pearson's Correlation Coefficient is significant (p=0.0001), suggesting a reduction in HbA1c levels with increased serum ferritin levels after administering iron supplements (table 5).

DISCUSSION

Iron deficiency anaemia is a critical major health problem in developing and developed countries. It attributes to a considerable part of morbidity and mortality in all age groups especially in children and women of childbearing age group.[1] HbA1c has now been approved by the American Diabetes Association for diagnosis of diabetes. [11] Hence we need to know that HbA1c can be affected by various other factors, where it can show a false elevation.[12]

Several studies have been done to determine the correlation between HbA1c and iron deficiency anemia. Janice et al.[13] studied iron deficiency anaemia over glycated haemoglobin in non-diabetic women. The study found a positive correlation of HbA1c with ferritin and hemoglobin and inversely correlated with iron deficiency anemia. Similarly, Bansal et al.[14] reported the effect of iron deficiency anemia on HbA1c in non-diabetics. They found that the mean HbA1c level is higher in iron-deficient anemic non-diabetic patients than non-anaemic non-diabetic patients.

In another recent study, reported by Alzahrani et al.[15], the effect of different types of anaemia on HbA1c levels in non-diabetic patients is demonstrated. They found a significant increase in HbA1c levels in iron deficiency anaemia and sickle cell disease in non-diabetic patients. They further showed that the treatment of iron deficiency anaemia significantly decreased the HbA1c level to normal. A review on the influence of iron deficiency anaemia on HbA1c reported by Naqash et al.[16] detailed the factors affecting HbA1c in IDA patients.

Bindayel et al.[17] reported the influence of iron deficiency anaemia on glycated haemoglobin levels in non-diabetic Saudi women. The study demonstrated the significance. They showed a significant association of HbA1c with parameters related to IDA in non-diabetic Saudi women. Jyothsna et al.[18] studied the effect of iron deficiency anaemia on glycated albumin levels in non-diabetic individuals. They showed the use of glycated albumin in diabetes mellitus, along with IDA, needs to be administered with caution to favour appropriate treatment and prevent the risk of hypoglycemia.

The majority of the studies were in favour of the elevation of HbA1c seen with iron deficiency anaemia. Some studies favoured a reduction in HbA1c with iron deficiency anaemia. Few studies suggested that HbA1c level and iron deficiency are not related. Since there were a lot of varying results regarding the correlation between HbA1c levels and iron deficiency anaemia, the final result was elusive, and we were prompted to do this study.

Limitations: The sample size of the study was small

The study should be done at the community level to prove a statistically significant correlation.

CONCLUSION

The study found a significant negative correlation between baseline hemoglobin and HbA1c levels. However, no significant relation was observed between HbA1c and serum iron levels. Therefore, anaemic patients with elevated levels of HbA1c should not be considered as diabetic always and IDA should always be ruled out and treated if it is diagnosed.

Conflict of Interest: None

REFERENCES

1. Abbaspour N, Hurrell R, Kelishadi R. Review on iron and its importance for human health. J Res Med Sci 2014;19:164–74.
2. Provan D. Mechanisms and management of iron deficiency anaemia. Br J Haematol 1999;105 Suppl 1:19–26.
3. Kozuki N, Lee AC, Katz J. Child Health Epidemiology Reference Group. Moderate to severe, but not mild, maternal anaemia is associated with an increased risk of small-for-gestational-age outcomes. J Nutr. 2012;142:358-62.
4. Cappellini MD, Musallam KM, Taher AT. Iron deficiency anaemia revisited. J Intern Med 2020;287:153–70.
5. International Institute for Population Sciences, Macro International. National Family Health Survey-4. Mumbai: IIPS; 2015-16. 2016.
6. Leow MKS. Glycated haemoglobin (HbA1c): Clinical applications of a mathematical concept. Acta Inform Med 2016;24:233–8.
7. Sherwani SI, Khan HA, Ekhzaimy A, Masood A, Sakharkar MK. Significance of HbA1c test in diagnosis and prognosis of diabetic patients. Biomark Insights 2016;11:95–104.
8. Klonoff DC. Hemoglobinopathies and hemoglobin A1c in diabetes mellitus. J Diabetes Sci Technol 2020;14:3–7.
9. El-Agouza I, Abu Shahla A, Sirdah M. The effect of iron deficiency anaemia on the levels of haemoglobin subtypes: possible consequences for clinical diagnosis: Effect of IDA on haemoglobin subtypes. Clin Lab Haematol 2002;24:285–9.
10. Sinha N, Mishra TK, Singh T, Gupta N. Effect of iron deficiency anaemia on haemoglobin A1c levels. Ann Lab Med 2012;32:17–22.
11. Florkowski C. HbA1c as a diagnostic test for diabetes mellitus - reviewing the evidence. Clin Biochem Rev 2013;34:75–83.
12. Ao X, Ganta N, Choe S, Patel P, Turro J, Cheriyath P. Hemoglobin Wayne: A rare variant that can cause falsely elevated haemoglobin A1c. Cureus 2022;14:e26559.
13. Janice D, Prathima MB, Sushith S, Narayanan R, Reshma S, Nair S, et al.

Effect of iron deficiency anaemia over glycated haemoglobin in non-diabetic women. Int J Biochem Mol Biol 2022;13:23–7.
14. Bansal RK, Yadav YR, Kulkarni HS, Sonam, Garg S, Jain P, et al. Effect of Iron Deficiency Anemia on HbA1c in non-diabetics. Jour of Diab and Endo Assoc of Nepal 2020;4:10–6.
15. Alzahrani BA, Salamatullah HK, Alsharm FS, Baljoon JM, Abukhodair AO, Ahmed ME, et al. The effect of different types of anemia on HbA1c levels in non-diabetics. BMC Endocr Disord 2023;23:24.
16. Naqash A, Bader GN. Influence of iron deficiency anaemia on HbA1c: a review. J Clin Diag Res 2018;5:1-3.
17. Bindayel IA. Influence of iron deficiency anaemia on glycated haemoglobin levels in non-diabetic Saudi women. J Int Med Res 2021.