

Evaluation of Anemia with Age and Duration of Diabetes in Type 2 Diabetes Mellitus - A Study in A Tertiary Care Hospital of Eastern India

Dr. Sudhangshu Majumder,
NRSMCH, Kolkata
Dr. Hema Malathi Rath,
Assistant Professor, Department of Cardiology, NRSMCH, Kolkata
Dr. Subhashis Chakraborty,
RMO cum Clinical Tutor, Department of Cardiology, NRSMCH, Kolkata. (Corresponding Author)
Dr. Biva Bhakat,
NRSMCH, Kolkata.
Dr. Prantik Bhattacharya,
NRSMCH, Kolkata
Dr. Debarshi Jana,
PhD (Cal), Biostatistics and Epidemiology (IBRI), Consultant Biostatistician and Epidemiologist, Young Scientist (Associate Professor), Department of Science & Technology, Government of India, IPGMER and SSKM Hospital, Kolkata.

(Received: 07	V October 2023Revised: 12 NovemberAccepted: 06 December)
KEYWORDS	ABSTRACT
Anemia, Diabetes	Introduction: Diabetes mellitus, one of the most common non-communicable diseases with
mellitus,	substantial morbidity and effects, has become a major global health concern. Persistent
Haemoglobin and	hyperglycemia can be caused by a variety of hereditary and environmental factors, and over time, it
HbA1C.	can seriously harm the heart, blood vessels, eyes, kidneys, nerves, and cardiac muscle. These causes
	are the origin of diabetes mellitus. Insulin resistance (IR) and relative insulin insufficiency (IR) are
	common in people with type 2 diabetes.
	Aims: Learn about the many forms, prevalence, and risk factors of anemia in individuals with type 2
	diabetes. You should also look into the relationship that these individuals' anemia and risk factors
	have.
	Materials and methods: This cross-sectional analytical study was carried out in a medical facility.
	From July 2022 to June 2023, the research was conducted for a year at the N.R.S. Medical College in
	Kolkata. 240 patients were involved in this investigation.
	Result: More than two thirds (67.1%) of the subjects had an HbA1C% control status. The FBG and
	PPBG values showed that 65.4% and 47.1% of the individuals, respectively, had reached control
	status. It was found that the control status was subpar for the PPBG levels.
	Conclusion: Even among individuals with appropriate eGFR readings, which indicate normal renal
	function, one in five T2DM patients had anemia A small percentage of the participants had some
	degree of anemia. In terms of morphology, the most prevalent type was the normocytic
	normochromic anemia.

INTRODUCTION

Diabetes mellitus, one of the most common noncommunicable diseases with substantial morbidity and effects, has become a major global health concern. Persistent hyperglycemia can be caused by a variety of hereditary and environmental factors, and over time, it can seriously harm the heart, blood vessels, eyes, kidneys, nerves, and cardiac muscle. Diabetes mellitus is the result of these factors. Individuals with type 2 www.jchr.org

JCHR (2023) 13(6), 3175-3181 | ISSN:2251-6727



diabetes have both familial and (as opposed to absolute) insulin insufficiency and insulin resistance (IR).

The global diabetes epidemic is one of the biggest problems that humanity is currently confronting in the twenty-first century. In recent decades, diabetes mellitus has grown to be a major global public health concern. [1] Research from a range of contexts suggests that diabetes is rising in prevalence. [2] Of the 422 million people with diabetes worldwide, most live in low- and middle-income countries, and the disease is directly linked to 1.6 million deaths per year. By 2035, it's predicted to reach 592 million. According to data from the World Health Organization, diabetes was the sixth most common cause of death in 2016. Diabetes-related early mortality increased by 5% between 2000 and 2016.[3]

According to estimates from the World Health Organization (WHO), diabetes patients are more prevalent in India worldwide. It is projected that 88 million individuals in South East Asia have diabetes today, and by 2045, that figure would have increased to 153 million. [4] In India, diabetes mellitus affects 8.9% of individuals between the ages of 20 and 79. By 2040, the number of affected individuals is expected to rise to 123.5 million. [5] the rise is attributed to the quick changes in epidemiology, which were followed by urbanization and socioeconomic growth.

By the age of 42.5, type 2 diabetes typically starts to manifest. In India, diabetes takes approximately a million lives annually. The American Diabetes Association projected that by 2030, India would see the biggest increase in the country's diabetic diagnosis rate. [6]

Common symptoms of diabetes mellitus include weight loss, thirst, polyuria, and blurred eyesight. In its most severe forms, ketoacidosis, also known as a non-ketotic hyperosmolar condition, can produce stupor, coma, and, in the event that treatment is not received, can even be fatal. The presence of hyperglycemia severe enough to produce pathological and functional problems might go undiagnosed for a long time since symptoms are often nonexistent or very modest.

MATERIALS AND METHODS

Study design

A cross-sectional analytical study was carried out in a hospital setting with patients diagnosed with type 2

diabetes mellitus at the NRSMCH, Kolkata's Department of General Medicine and Cardiology.

Study duration

The study was conducted for a period of one year from July 2022 to June 2023

Study population

Every patient who was diagnosed with type 2 diabetes mellitus and who was admitted to the medicine and cardiology wards during the study period, as well as all outpatient clinics in medicine.

Inclusion criteria

The study will involve patients with type 2 diabetes mellitus who are 30 years of age or older and who are admitted to the medicine and cardiology wards as well as outpatient clinics in medicine.

Exclusion criteria Patients (with/who)

- 1. type 1 diabetes
- 2. known hematological disorders
- 3. known CKD with causes other than diabetes mellitus
- 4. comorbidity like congestive cardiac failure and chronic liver disease
- 5. malignancy
- 6. acute illness/ critically ill
- 7. have undergone major surgeries / blood loss and undergone blood transfusion
- 8. pregnant
- 9. iron deficiency anemia/ treatment for anaemia
- 10. on ACE inhibitors

<u>RESULT</u>

Diabetes was present for an average of 5.8 (3.0) years, between one (1) year and a maximum of eighteen (18) years. The average time span was 6 (3–8) years.

More than two thirds (67.1%) of the subjects had an HbA1C% control status. The FBG and PPBG values showed that 65.4% and 47.1% of the individuals, respectively, had reached control status. It was found that the control status was subpar for the PPBG levels.

The median creatinine level was 0.9 (0.3) mg/dl, ranging from 0.4 mg/dl to 1.9 mg/dl. Eight patients had a creatinine clearance of less than thirty. In nine (9) patients, proteinuria was 2 or higher.

11.3% of type 2 diabetes mellitus patients had retinal disease. In the study's participants, non-proliferative

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 3175-3181 | ISSN:2251-6727



diabetic retinopathy affected 8.0% while proliferative diabetic retinopathy affected 3.3%.

When compared to patients solely receiving oral hypoglycemic medications, patients receiving insulin therapy alone had lower mean hemoglobin levels than patients receiving both insulin and oral hypoglycemic medications, and this difference was determined to be statistically significant. The significance was present between each category on post-hoc analysis with Bonferroni adjustment.

Of the subjects, 28.1% had hypertension. Of the patients with type 2 diabetes, 9.2%, 5.8%, and 4.2% reported having peripheral arterial disease, coronary artery disease, and cerebro-vascular accidents, respectively.

	Frequency (n)	Percentage	
Duration of diabetes mellitus (years)			
Mean [SD]	5.8 (2.8)		
Median [IQR]	6 (3-8)		
Type of treatment			
Oral hypoglycaemic drugs	170	70.8	
Oral hypoglycaemic drugs + Insulin	61	25.4	
Insulin	9	3.8	

Table 1: Clinical profile of the participants

Table 2: Distribution	of participants by control status.	
------------------------------	------------------------------------	--

Control status	Frequency (n)	Percentage	
HbA1C			
Under control (HbA ₁ C \leq 7.0%)	161	67.1	
Not under control (HbA ₁ C>7.0%)	79	32.9	
Fasting blood glucose (mg/dl) n (%)			
Under control (80-130)	157	65.4	
Not under control (>130)	83	34.6	
Post prandial blood glucose (mg/dl) n (%)			
Under control (<180)	113	47.1	
Not under control (180 and above)	127	52.9	

Table 3: Distribution of participants by their renal function

	Frequency (n)	Percentage	
Creatinine level (mg/dl)			
Mean [SD]	0.9 (0.3)		
Creatinine clearance (Cockcroft-Gault formula)			
≤ 30	8	3.3	
31-60	50	20.8	
61-90	107	44.6	
>90	75	31.3	
Proteinuria			
Trace	155	64.6	
1+	76	31.7	
2+ or more	9	3.8	

Journal of Chemical Health Risks

www.jchr.org JCHR (2023) 13(6), 3175-3181 | ISSN:2251-6727



Table 4. Distribution of participants by type of anaenna			
Type of anaemia	Frequency	Percentage	
Microcytic hypochromic	40	56.3	
Normocytic normochromic	169	43.7	

Table 4. Distribution of participants by type of anaemia

Table 5. A secolation	of 4 of	4	He am a slahin land
Table 5: Association	or type or	treatment with	naemogiobin ievei

Type of treatment	Haemoglobin level		p value*
	Mean (g %)	SD (g %)	
Oral hypoglycaemic drugs	13.4	1.4	
Oral hypoglycaemic drugs + Insulin	12.3	1.7	<0.001
Insulin	10.9	1.1	

Table 6. Macrovascular complications among the study participants (N=240)

Macrovascular complication	Frequency	Percentage		
Hypertension				
Yes	65	27.1		
No	175	72.9		
Coronary artery disease				
Yes	22	9.2		
No	218	90.8		
Cerebral-vascular accidents				
Yes	14	5.8		
No	226	94.2		
Peripheral arterial disease				
Yes	10	4.2		
No	230	95.8		

DISCUSSION

Diabetes mellitus (DM) is a metabolic disease that affects people worldwide. While anemia is unavoidable in all individuals, it is more common in those with diabetes mellitus who also have renal insufficiency. Anemia is associated with the emergence of complications and significantly lowers the quality of life for people with diabetes. Nevertheless, the hemoglobin reading is frequently ignored until the problem becomes apparent. It was therefore necessary for this study to investigate the facts in order to improve our understanding and, eventually, our ability to manage diabetes-related issues.

Two thirds of the participants in our study were in the age range of 41 to 60 years old, with a mean age of 57.1 (6.6) years. Our investigation's results are in line with many other research that have been conducted elsewhere.[7, 8, 9, 10] This finding raises the possibility

of issues because it implies that the individuals may have experienced the condition much earlier in life or that the diagnosis may have been delayed. One could argue that, as a result, it was imperative that the study be conducted with the primary objective of preventing the problems at an earlier stage.

With a M:F of 0.58:1, nearly two thirds (63.3%) of the participants were female, which is a slight departure from the research that is currently available, It principally suggests that the illness is either equally prevalent in men and women or noticeably more prevalent in men. [7, 11]. The reason behind the aforementioned observation remains unknown.

According to our study, of the participants, there were 36.3% who were overweight and 27.0% who were obese. Unlike prior research that found a higher frequency of anemia among adults with higher BMIs, our study found no association between anemia and



BMI status. [12, 13] The commonly recognized view states that anemia in people with diabetes is linked to obesity, a high body mass index (BMI), and a large waist circumference. An inflammatory condition that is conducive to the formation of insulin resistance is linked to obesity or the buildup of circulating fatty acids. Particularly in adipocytes and muscle cells, where insulin mediates glucose absorption, insulin resistance lowers glucose tolerance. Blood glucose levels rise as a result, leading to a hyperglycemic state. The adipose tissue of obese people has higher inflammatory activity, which promotes the production of hepcidin. Hepcidin lowers blood iron levels by reducing the availability of iron and is increased during infection and inflammation in anemia caused by chronic illnesses. Researchers have shown time and time again that higher iron reserves are associated with diabetes and insulin resistance. The observed outcome of our inquiry could potentially be attributed to the enhanced control status within the research population.

Individuals with hypertension and coronary artery disease had significantly higher rates of anemia (p 0.001). This association is alarming because diabetes raises the risk of cardiovascular problems such atherosclerosis, heart failure, stroke, and tissue inflammation in addition to hypertension.[14]

Diabetes was present on average for 5.8 (3.0) years, with a minimum of one (1) year and a maximum of eighteen (18) yearsMore over two thirds (67.1%) of the participants had a control status for HbA1C. The FBG and PPBG values showed that 65.4% and 47.1% of the individuals, respectively, had reached control status. It was found that the PPBS levels had a low control status. Several other examinations revealed relatively low control status in compared to our study. [15] It's possible that increased medication adherence led to the finding or that it happened by accident. The research cohort's mean duration of diabetes was 5.8 years, which could be one reason, which is a shorter time than previous studies.38, 56, 91 Given that the patients in our study were chosen through purposive sampling, selection bias may have been the root of this.

Of patients with type 2 diabetes, 11.3% had retinal disease. 3.3% of research participants had proliferative diabetic retinopathy, while 8.0% had non-proliferative diabetic retinopathy. Dyslipidemia was identified in 30.4% of the type 2 diabetic patients.

Type-2 diabetes mellitus patients had an anaemia prevalence of 29.6% (95% CI: 23.9%-35.9%). Several research that have been carried out in various nations provide evidence in favor of this. However, two research projects carried out in wealthier nations [11] was found that individuals with type 2 diabetes had a lower incidence of anemia. These variations could stem from disparities in the level of development of the country, which influences aspects including the length of DM, ethnicity, age of research participants, geographic elevation above sea level, and the standard of health care delivery. Our investigation yielded unexpectedly lower results than several other studies carried out in India, which reported anemia prevalence ranging from 38.0% to 74.0%. [9, 16] this is important because the results imply that selection bias may have contributed to a lower mean duration of diabetes mellitus in our population, which could explain the lower prevalence.

Individuals with mild-to-moderate anemia, also referred to as anemia of inflammation or infection, may have long-term medical issues including diabetes. According to the research published in Anemia of Chronic Disease, people with diabetes who also have anemia exhibit higher levels of proinflammatory cytokines than people who simply have diabetes. The correlation between IL-6 synthesis and antierythropoietic activity was confirmed by the anemic patient's elevated B cell activity and IL-6 synthesis. Ferritin increases were connected with the chronic inflammatory process associated with diabetes, despite the low iron concentrations in the anemic and diabetic individuals. This was demonstrated by the elevated levels of C-reactive protein and ferritin ultrasensitive.

Of the anemic patients, 56.3% of the participants had microcytic hypochromic anemia, whereas 43.7% of the participants had normocytic normochromic anemia. This conduct is referred to be ACD behavior. The red blood cell survival rate in ACD is lowered from 120 to 80 days, indicating a mild to severe anemia. The hyperactive state of the mononuclear phagocyte system, which is triggered by an inflammatory, infectious, or malignant process and results in the early clearance of circulating red blood cells, is suggested to be the etiology of this illness. Abnormally low erythropoietin secretion, a decreased bone marrow response to erythropoietin, and decreased erythropoiesis due to a



reduction in iron availability to the bone marrow are the main causes of the observed poor bone marrow response. This theory could be the reason for the phenomenon that produced the same results in other studies. [73]

The duration of diabetes, age, Hemoglobin level and therapy type had a statistically significant negative connection (p 0.001). The hemoglobin levels of research participants were shown to be significantly correlated negatively with both FBG and PPBG. Hemoglobin levels, however, did not correlate with HbA1C. There was a strong correlation found between the patients' anemic state and their creatinine clearance and proteinuria. However, there was no significant correlation (p>0.05) found between the occurrence of anemia and either peripheral artery disease or cerebral vascular accidents.

One of the study's main advantages is that the results may be extended to comparable contexts because it was carried out on a randomly chosen population sample. As with many other cross-sectional research, one of the limitations of our study may be the difficulty to establish a cause-and-effect relationship. Furthermore, there's a chance that selection bias had a part in the greater control status of our research sample, but this is uncertain because it's always possible that higher compliance led to the better control status.

CONCLUSION

With a M:F ratio of 0.58:1, The mean age of the 240 patients was 57.1 (6.6) years, with about two thirds of them being female. The average duration of diabetes was 5.8 (3.0) years. Sixty-one percent (67.1%) of the participants had a control status for HbA1C. The FBG and PPBG values showed that 65.4% and 47.1% of the individuals, respectively, had reached control status. Type-2 diabetes mellitus patients had an anaemia prevalence of 29.6% (95% CI: 23.9%-35.9%). Of the anemic subjects in the study, 56.3% had microcytic hypochromic anemia. 11.3% of people with diabetes had diabetic retinopathy, of which 8.0% had nonproliferative diabetic retinopathy. Thirty.4% of the patients had dyslipidemia, and 28.1% had hypertension. 9.2%, 5.8%, and 4.2% of patients with type-2 diabetes reported having coronary artery disease, strokes, or peripheral arterial disease, respectively. Age, the duration of diabetes, the kind of treatment, and

hemoglobin level all showed statistically significant negative correlations (p 0.001). The hemoglobin levels of research participants were shown to be significantly correlated negatively with both FBG and PPBG. There was a strong correlation found between the patients' anemic state and their creatinine clearance and proteinuria. Anemia was more common in patients with diabetic retinopathy, hypertension, and coronary artery disease (p 0.05Consequently, diabetics should have routine anemia screenings even if there is no renal involvement since anemia may increase the risk of cardiovascular disease. It also calls for a substantial multicenter study with a long-term follow-up. When a person is diagnosed with diabetes, they should be informed about the risk of anemia as well as other implications of the disease.

REFERENCES

- de Lusignan S, Sismanidis C, Carey IM, DeWilde S, Richards N, Cook DG. Trends in the prevalence and management of diagnosed type 2 diabetes 1994–2001 in England and Wales. BMC family practice. 2005 Dec;6(1):1-8.
- Ramachandran A, Snehalatha C, Dharmaraj D, Viswanathan M. Prevalence of glucose intolerance in Asian Indians: urban-rural difference and significance of upper body adiposity. Diabetes care. 1992 Oct 1;15(10):1348-55.
- Sciberras J, Camilleri LM, Cuschieri S. The burden of type 2 diabetes pre-and during the COVID-19 pandemic–a review. Journal of Diabetes & Metabolic Disorders. 2020 Dec;19:1357-65.
- 4. Deepa M, Pradeepa R, Rema M, Anjana RM, Deepa R, Shanthirani S, Mohan V. The Chennai Urban Rural Epidemiology Study (CURES)--study design and methodology (urban component)(CURES-I). The journal of the association of physicians of India. 2003 Sep 1;51:863-70.
- 5. Moorthy A, Gaikwad R, Krishna S, Hegde R, Tripathi KK, Kale PG, Rao PS, Haldipur D, Bonanthaya K. SARS-CoV-2, uncontrolled diabetes and corticosteroids—an unholy trinity in invasive fungal infections of the maxillofacial region? A retrospective, multi-centric analysis.



Journal of maxillofacial and oral surgery. 2021 Sep;20:418-25.

- 6. Bansal AG, Oudsema R, Masseaux JA, Rosenberg HK. US of pediatric superficial masses of the head and neck. Radiographics. 2018 Jul;38(4):1239-63.
- Barbieri J, Fontela PC, Winkelmann ER, Zimmermann CE, Sandri YP, Mallet EK, Frizzo MN. Anemia in patients with type 2 diabetes mellitus. Anemia. 2015 Oct;2015.
- 8. Shaheen ES. Prevalence of anemia in patients with type 2 diabetes. Journal of Medicine in Scientific Research. 2019 Apr 1;2(2):114.
- Panda AK, Ambade RA. Prevalence of anemia and its correlation with HBA1c of patients in type-II diabetes mellitus: a pilot study. National Journal of Physiology, Pharmacy and Pharmacology. 2018 Oct 1;8(9):1409-13.
- Periasamy S, Xavier AA, Gowtham R. Incidence of anemia in type 2 diabetic mellitus and its prognostic index. Int J Med Res Rev. 2016;4(7):1239-42.
- 11. Thomas MC, Tsalamandris C, MacIsaac RJ, Jerums G. The epidemiology of hemoglobin levels in patients with type 2 diabetes. American journal of kidney diseases. 2006 Oct 1;48(4):537-45.
- Winkler AS, Marsden J, Chaudhuri KR, Hambley H, Watkins PJ. Erythropoietin depletion and anaemia in diabetes mellitus. Diabetic medicine. 1999 Oct;16(10):813-9..
- Baisakhiya S, Garg P, Singh S. Anemia in patients with type II diabetes mellitus with and without diabetic retinopathy. Int J Med Sci Public Health. 2017 Feb 1;6(2):303-6.
- Francisco PM, Belon AP, Barros MB, Carandina L, Alves MC, Goldbaum M, Cesar CL. Selfreported diabetes in the elderly: prevalence, associated factors, and control practices. Cadernos de saude publica. 2010;26:175-84.
- 15. Cheekurthy AJ. Prevalence of anaemia and abnormality in absolute blood count in type 2 diabetes mellitus patients. EC Diabetes and Metabolic Research. 2019;3(1):06-9.
- Harish Kumar S, Srinivasa SV, Prabhakar K. Haematological profile of diabetes and nondiabetes patients in rural tertiary centre. Int J Adv Med. 2017;4(5):1271-5.

 Little M, Humphries S, Dodd W, Patel K, Dewey C. Socio-demographic patterning of the individual-level double burden of malnutrition in a rural population in South India: a cross-sectional study. BMC Public Health. 2020 Dec;20(1):1-4.