

Original Research Article

# Prevalence of anemia among type 2 diabetes mellitus patients in correlation with HbA1c levels a prospective study

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## Abstract

**Introduction:** Diabetes mellitus is a group of metabolic disorders characterized by hyperglycemia. This disorder is associated with abnormalities in carbohydrate, fat and protein metabolism. Anemia is a condition in which the hemoglobin concentration in blood is below the expected value, when age, gender, pregnancy and certain environmental factors, such as altitude, are taken into account. There is an increasing number of patients with diabetes who have been found to be anemic without any evidence of any chronic renal disease.

**The aim of the study:** To compare the hemoglobin levels among normal controls and patients with type 2 diabetes, to correlate the levels of hemoglobin with the degree of glycemic control (HbA1c >7 g% vs. HbA1c <7 g%), to detect the unrecognized cases of anemia among type 2 diabetes mellitus patients.

**Materials methods:** The total sample size of the present study is 90 among which, 30 were healthy controls, 30 were better glycemic controlled T2DM patients (HbA1c < 7 g%) and 30 were poorly glycemic controlled T2DM patients (HbA1c >7 g%). Blood samples were collected from all the subjects for the estimation of Hb%, HbA1c, FBS, PPBS, Blood Urea, and Serum Creatinine.

**Results:** There was a significant decrease in the hemoglobin percentage in the diabetic group compared to the healthy controls. Among diabetics, the better glycemic control group had a significantly higher hemoglobin percentage. The Hemoglobin percentage among controls, better glycemic control T2DM patients and Poor glycemic control T2DM patients was  $13.44 \pm 1.38$ ,  $12.27 \pm$

1.75 and  $11.4 \pm 1.81$  respectively. The HbA1c percentage among controls, better glycemic control T2DM patients and Poor glycemic control T2DM patients was  $6.08 \pm 0.23$ ,  $6.64 \pm 0.18$  and  $8.4 \pm 1.21$  respectively. There was no significant difference with respect to age, demographic characteristics and renal profile (Blood Urea and Serum Creatinine) among the groups.

**Conclusion:** To conclude Anemia is a common finding in Diabetic patients compared to the general population. Further good glycemic control in T2DM will lead to a better hemoglobin percentage in T2DM patients. Among the diabetic group, the better glycemic control group had a better hemoglobin percentage which was statistically significant.

## Key words

Type 2 Diabetes Mellitus, HbA1C, Anemia.

## Introduction

Anemia is a common complication and is more prevalent in diabetics than the nondiabetic individuals. Also, Anemia develops earlier and is more severe in patients of Diabetes Mellitus than in patients with renal diseases or any other causes [1]. Presence of Anemia in Diabetes leads to progression of micro and macrovascular complications of diabetes mellitus [2]. Anemia can lead to falsely low HbA1c values, which may result in undertreatment of hyperglycemia, which in turn will further lead to the progression of micro and macrovascular complications of diabetes mellitus [3]. Anemia may be more common in diabetes and develop earlier than in patients with renal impairment from other causes. In spite of the plethora of reports on the presence of anemia in diabetic patients with renal insufficiency, limited study exists on the incidence of anemia in diabetics prior to the evidence of renal impairment [4]. Hence, I have taken up this study to find the incidence of anemia in Type 2 diabetes mellitus patients. Glycosylated Hemoglobin (HbA1c) is an effective tool to know the glycemic control in type 2 diabetes mellitus. HbA1c values give then an accurate estimate of the average plasma glucose levels from past 8 to 12 weeks. Now instead of glycemic control, HbA1c is used to detect diabetes and ADA has set guidelines to diagnose diabetes based on glycosylated hemoglobin values [5]. Glycemic control is considered as the main therapeutic goal for prevention of organ damage and other complications of diabetes. Glycemic control can

be considered as poor and good based on the values of HbA1c. Desirable values of HbA1c to be maintained suggesting a good glycemic control is 7 g%. Values of HbA1c more than 7 g % is considered as a poor glycemic control in type II diabetes mellitus. The present study was conducted to know the prevalence of Anaemia in persons with Type 2 diabetes mellitus. Early detection of Anaemia and its treatment may lead to halt or slow the progression of micro and macrovascular complications of Type II diabetes mellitus [6].

## Materials and methods

The present study was carried out in a private hospital in Cuddalore district. This study was conducted over a period of 1 year from January 2016 to January 2017. The total sample size of the present study was 90 among which, 30 were healthy controls, 30 were better glycemic controlled T2DM patients (HbA1c < 7 g %) and 30 were poorly glycemic controlled T2DM patients (HbA1c >7 g %). The institutional Ethical committee approval was sought. Written informed consent was obtained from the subjects prior to the study. A detailed history was taken from the subjects followed by a systemic clinical examination. Blood samples were collected from all the subjects for the estimation of Hb%, HbA1c, FBS, PPBS, Blood Urea, and Serum Creatinine. The values obtained after the analysis was tabulated and statistical analysis was done to know the association. Renal Function Tests ( Blood Urea by GLDH Kinetic; Serum Creatinine by Jaffe's Kinetic) Urine Routine by Standard

Microscopy Method. Stool Microscopy by Standard Method. The data collected were analyzed and expressed as Mean  $\pm$  SD. One way Analysis of variance (one way ANOVA), Pearson's correlation test was used in the present study. Statistical software namely SPSS 20 was used for the analysis of the data and Microsoft Word and Excel to generate graphs and tables. Level of Significance:  $P < 0.05$  was considered as significant while analyzing the data.

## Results

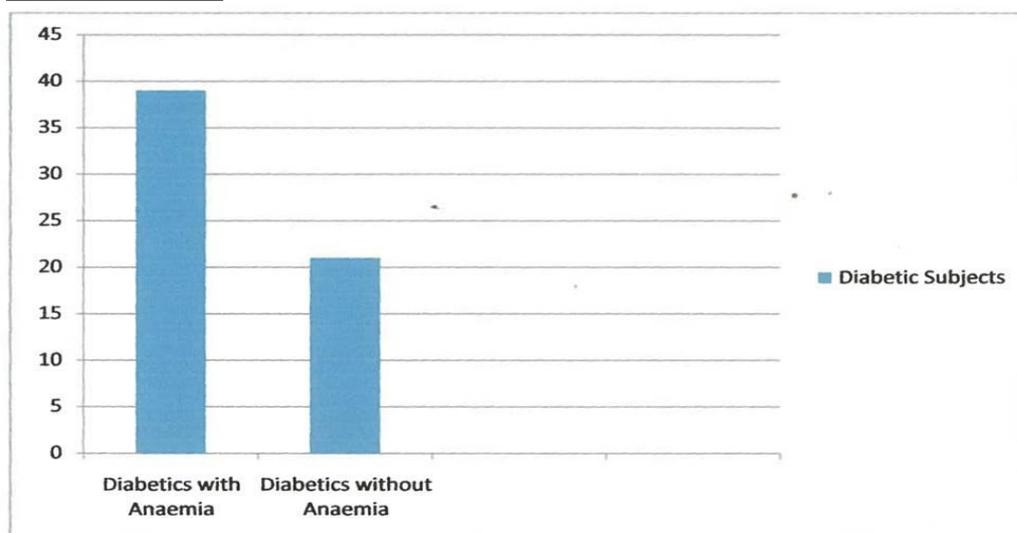
90 Diabetic subjects were divided into three groups based on their glycemic control; Poor glycemic control (HbA1c  $> 7g\%$ ) - Group A,

Better glycemic control diabetic group (HbA1c  $< 7g\%$ ) - Group B and normal controls - Group C. The results were tabulated and analyzed as shown below. Out of the total sample size of 90, 60 were diabetic and 30 were healthy control. Group size comparison was as per **Graph – 1**. No. of undetected anemia subjects in the diabetic group was as per **Graph – 2**. Comparison of levels of urea among the study groups was as per **Graph – 3**. Comparison of level of creatinine among the study group was as per **Graph – 4**. Negative correlation between Hb% and HbA1c% was as per **Graph – 5**. Negative correlation between Hb% and FBS was as per **Graph – 6**.

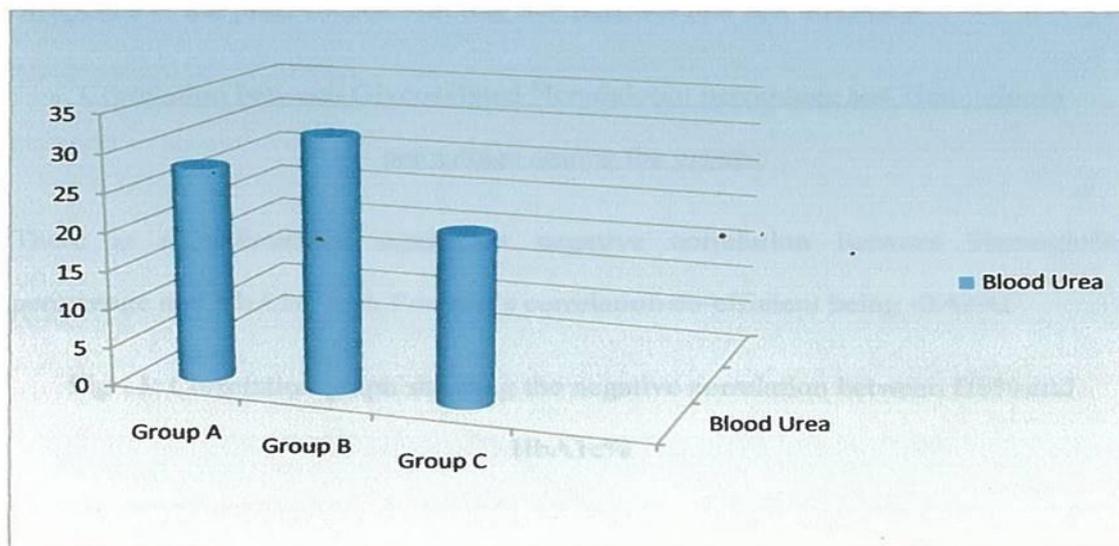
**Graph – 1:** Group Size Comparison.



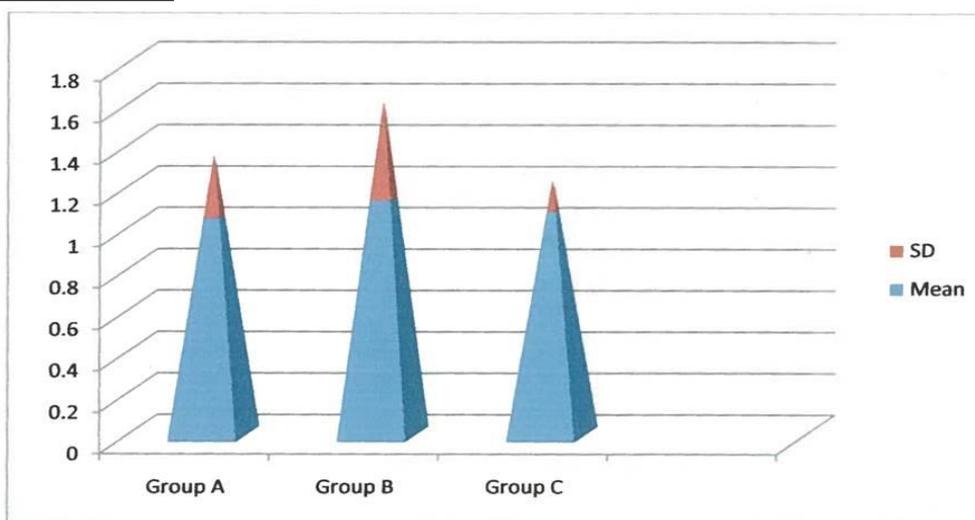
**Graph – 2:** No of Undetected Anaemia subjects in the Diabetic group



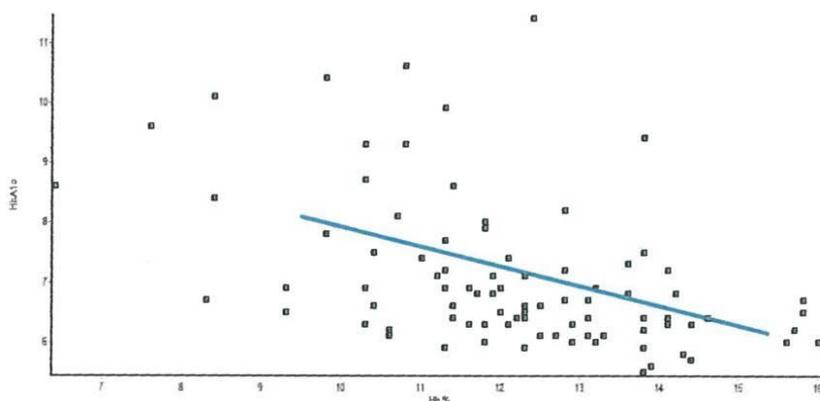
**Graph – 3:** Chart comparing the levels of Blood Urea among the study groups



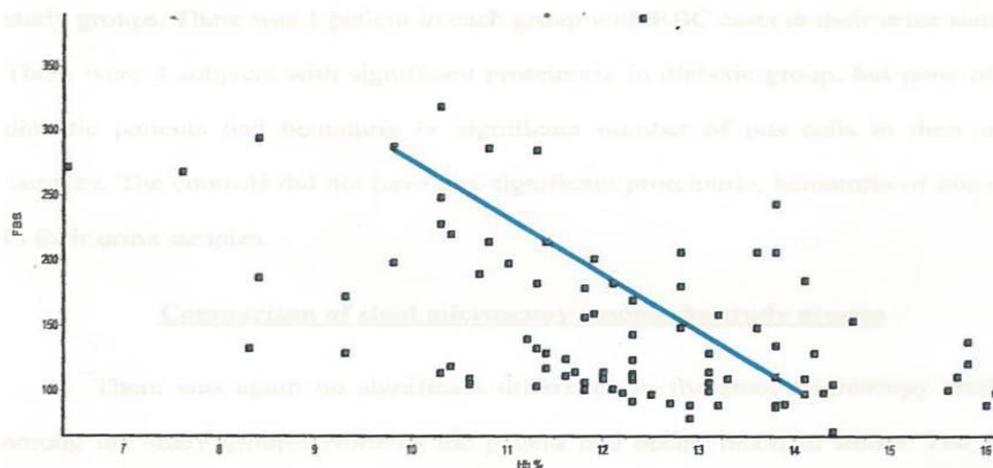
**Graph – 4:** Chart comparing the levels of Serum Creatinine among the study groups



**Graph – 5:** Correlation graph showing the negative correlation between Hb% and HbA1c%



**Graph – 6:** Correlation graph showing the negative correlation between Hb% and FBS



## Discussion

Often, chronic diseases, such as DM, are accompanied by mild-to-moderate anemia, often called anemia of inflammation or infection or anemia of chronic disease [7]. The results found by the authors demonstrate that diabetic patients with anemia exhibit increased expression of proinflammatory cytokines as compared to diabetic patients only. In an anemic patient increase in IL-6 production, as well as B cell activity, was confirmed which reinforces the association between IL-6 and antierythropoietic action [8]. Moreover, the diabetic and anemic patients had high levels of C-reactive protein and ferritin ultra sensible; however, these diabetic and anemic patients had low iron contents, showing that ferritin increases were associated with chronic inflammatory process present in diabetes [9]. It was observed in the present study that there are decreased values of hemoglobin, hematocrit, and red blood cells in anemic patients, which can be associated with a normocytic normochromic anemia, characteristic of an anemia of chronic disease (ACD) [10]. ACD is a light-to-moderate anemia shortening the survival of red blood cells (about 80 days instead of 120 days normal) [11]. This phenomenon is attributed to hyperactivity state mononuclear phagocyte system, triggered by the

infectious, inflammatory, or neoplastic process, leading to the early removal of circulating red blood cells [12]. Inadequate bone marrow response observed is due basically to inappropriately low Secretion of Erythropoietin (EPO), decreased bone marrow response to EPO, and decreased erythropoiesis consequent to lower supply of iron to the bone marrow. In the present study, the age groups of all the three groups i.e. Controls, Poor glycemic control T2DM and good control T2DM patients were  $48.33 \pm 11.08$ ,  $55.13 \pm 12.49$  and  $58.3 \pm 7.93$  respectively [13]. The mean age among the groups was comparable and there was no significant difference in the mean age of all the 3 groups [14]. The present study was done to compare the hemoglobin levels among normal controls and Type 2 diabetes mellitus patients. I also wanted to compare the hemoglobin levels among diabetics based on their glycemic control and to find the undetected cases of anemia among the diabetics. In my study Blood, urea and serum creatinine values were compared among the groups to know any variation in the renal profile [15]. There was no significant difference in either the Blood urea or serum creatinine levels among the groups [16]. The renal profile was similar and comparable among the 3 groups showing that the renal pathology did not influence on the Haemoglobin levels in the present study. On the

basis of my results, the hemoglobin levels were least in the Group A (Poor glycemic control T2DM patients) and highest in Group C (normal controls) [17]. The mean hemoglobin concentrations were higher in the control group compared to that of diabetic subjects and further among diabetic subjects the better glycemic control had a better hemoglobin percentage [18]. The above result shows that Anemia is more common in the diabetic subjects than that of the normal controls. Further glycemic control plays an important role in maintaining better hemoglobin levels in T2DM patients. Lower the HbA1c levels, higher the Hemoglobin percentage. Further HbA1c and Fasting blood sugar showed a negative correlation with the hemoglobin levels, stating that they act as important predictors of Hb level in T2DM patients. There were 39 subjects in the diabetic group with undetected anemia [19]. This comes to a significant 65% of subjects with undetected anemia in the diabetic group. Among the 39 subjects, 24 were male and 15 were female with their hemoglobin levels below 12 g% and 13 g% for females and males respectively [20]. To conclude Anaemia is a common finding in Diabetic patients compared to the general population. Further good glycemic control in T2DM will lead to a better hemoglobin percentage in T2DM patients. Among the diabetic group, the better glycemic control group had a better hemoglobin percentage which was statistically significant.

## Conclusion

Anemia is a common finding in Type 2 Diabetes Mellitus patients when compared with the general population. Further good glycemic control in diabetes mellitus is associated with better hemoglobin levels and a lesser incidence of anemia. Hence in diabetic patients, it would be desirable to evaluate the hemoglobin levels often, even when the renal parameters are within the normal limits for a better quality of life.

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