

Research article

Study of Glycated Hemoglobin (Hba1C) Levels in Iraqi Pregnant Women with Non-Diabetic Iron Deficiency Anemia

Ali Ibrahim Mohammed AL-Samawi^{1*}, Hassnien S. Al-Hashemi²

ABSTRACT

The objective of the present study was to determine whether the Glycosylated hemoglobin (HbA1c) levels were increased in some non-diabetic pathological states especially Iron deficiency anemia. This study conducted on 52 non diabetic pregnant women sorrow from iron deficiency anemia and 30 non diabetic healthy pregnant women were enrolled to serve as a control group. The patient's data released from National Hematology Center, Baghdad, Iraq for about five months and the required tests were examined under medical expert in this field in order to ensure the accuracy for the demanding tests. The ages of patients were ranged from 20 to 45 years old. Our results showed a significant difference ($P < 0.005$) in case of Hba1C levels between iron deficiency anemia group and control group. Same results was found in all blood and biochemical tests which included in this study (serum ferritin, serum iron, serum total iron binding capacity, Hemoglobin level and Red blood cell count).

Keywords: Glycated hemoglobin, Non-diabetic, Pregnant.

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INTRODUCTION

Anemia is a worldwide public health problem affecting all countries including both developed and undeveloped countries with major impacts for human health as well as social and economic development. It occurs at all stages of the life cycle, but is more predominant in pregnant women and also in young children. Iron deficiency anemia (IDA) in 2002 was considered to be one of the most important funding factors to global disease problem [1]. World Health Organization (WHO) estimated that 2.1 billion people globally have iron deficiency anemia which is approximately 30% of the world population at the time [2, 3]. Furthermore, according to WHO report [4] the global prevalence of anemia among pregnant women is 55.9%

The prevalence of iron deficiency is higher in low and high income countries. Adolescents, children and women are the most susceptible. In these countries, diabetes is also a rapidly increasing issue [5]. Glycated hemoglobin (HbA1C) is produced by a ketamine reaction between glucose and the N-terminal valine of both β -chains of the hemoglobin molecule. The hemoglobin A1C consider as the major form of glycated hemoglobin [6]. HbA1c levels are not affected by blood glucose levels alone. Any condition that shortens the life span of erythrocytes is likely to decrease HbA1c level. They are acute or chronic blood loss, sickle cell anemia, thalassemia, hemolytic anemia, aplastic anemia, splenectomy, pregnancy,



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chronic kidney diseases, vitamin-B12 and folate deficiency anemia [7, 8].

Some studies showed that HbA1c levels were higher in patients with iron deficiency anemia. The results of these studies are conflicting, and the exact mechanism underlying the effects of iron deficiency anemia on HbA1c levels is not yet known [1,9].

The non-enzymatic glycation of proteins has pronounced effects on the structure and the function of proteins. The two known factors which can modulate the glycation of proteins are the prevailing concentration of glucose and the half-life of the protein [10].

The aim of this study is to confirm the relation between iron deficiency anemia and hemoglobin A1c levels during pregnancy.

MATERIALS and METHODS

This study conducted on 52 non diabetic pregnant women suffering from iron deficiency anemia and 30 non diabetic healthy pregnant women were enrolled to serve as a control group. The patient's data released from National Hematology Center, Baghdad, Iraq for about five months and the required tests were examined under medical expert in this field in order to ensure the accuracy for the demanding tests. The ages for the patients ranged from 20 to 45 years old. Results are expressed as mean ± standard error .data were analyzed by one way analysis variance (ANOVA) following by fishers test for multiple comparison. Using stat view version 5.0 differences analysis was performed by analysis of covariance (ANOVA) also using stat view version 5.0.

The medical history of all patients was taken by specialist doctors were done to ensure the correct diagnosis was made. Levels of hemoglobin, mean corpuscular hemoglobin (MCH), hematocrit, mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), were measured by an automated counter (Convergys X5, Germany), and the serum ferritin and serum total iron binding capacity (TIBC) testes were measured using elisa technology (Linear company, Spain) and (Boditech, Korea).

The anemic patients were selected, based first on their hemoglobin levels were less than 11g/dl, and then complete the rest of the hematological tests.

Hemoglobin A1c testes were measured using Clover A1c self (Euromidx, Korea), the HbA1c test was made for each patient five times during the period of the study (once per month).

RESULTS

Results of current study ensures that there is a significant difference ($P < 0.005$) in serum ferritin levels between pregnant patients suffering from iron deficiency anemia and control (healthy) group (Table 1 and Fig. 1).

Table 1. Level of S. ferritin in pregnant patients suffering from iron deficiency anemia and healthy control group.

| | Patients mean | Control mean | T test | P value |
|----------------|---------------|--------------|--------|---------|
| Serum ferritin | 10.09 µg/l | 100.72 µg/l | -10.14 | < 0.005 |

Table 2 and Fig 2 showed that there was a significant difference ($P < 0.005$) between non diabetic pregnant women

suffering from iron deficiency anemia group and control group in serum Iron levels.

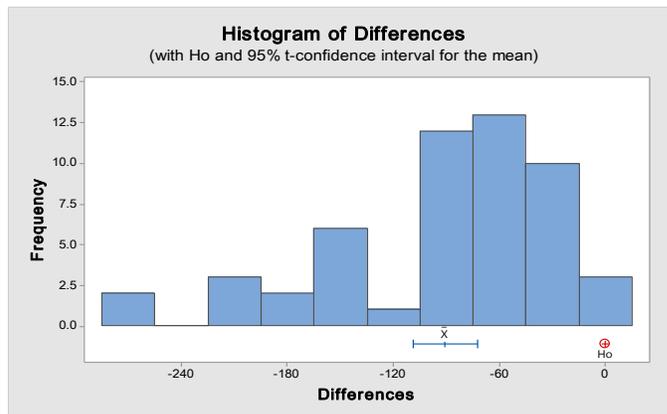


Fig 1. Histogram of difference between S. ferritin levels in pregnant patients suffering from iron deficiency anemia and control group.

suffering from iron deficiency anemia group and control group in serum Iron levels. The statistical analysis for serum total iron binding capacity (TIBC) showed a significant difference ($P < 0.005$) between level of TIBC in sera of patients and control group (Table 3, Fig 3).

Table 2. Levels of S. Iron in pregnant patients suffering from iron deficiency anemia group and control group.

| | Patients mean | Control mean | T test | P value |
|------------|---------------|--------------|--------|---------|
| Serum Iron | 15.32 µg/dL | 70.38 µg/dL | -21.79 | < 0.005 |

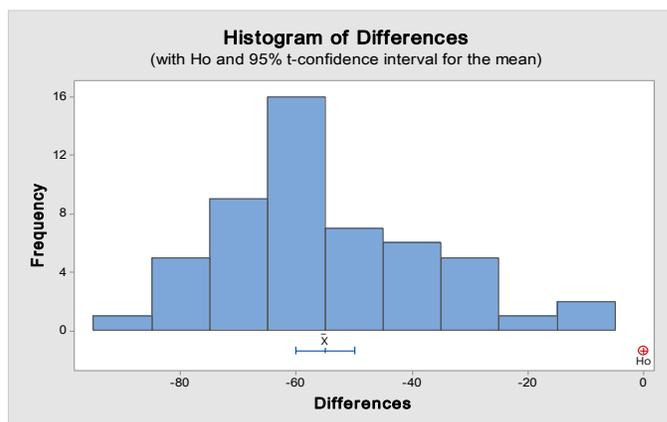


Fig 2. Histogram of level of S. Iron levels in pregnant patients suffering from iron deficiency anemia and control group.

Furthermore, The comparison between level of Hb1c levels in non diabetic pregnant patients suffering from iron deficiency

Table 3. Level of serum total iron binding capacity (TIBC) in pregnant patients suffering from iron deficiency anemia and control group.

| | Patients (mean) | Control (mean) | T test | P value |
|------------|-----------------|----------------|--------|-----------|
| Serum TIBC | 106.88 µg/dL | 268.12 µg/dL | -19.07 | P < 0.005 |

anemia and healthy control group showed significant difference ($P < 0.005$) (Table 4, Fig 4). The results that presented in table 5 and fig 5 showed that there was a significant difference ($P < 0.005$) in the hemoglobin levels between patients and healthy control group. The results of RBC levels showed in table 6 and fig 6. They showed that there was a significant difference ($P < 0.005$) between the number of RBCs in blood of non diabetic pregnant women suffering from iron deficiency anemia group and healthy control group.

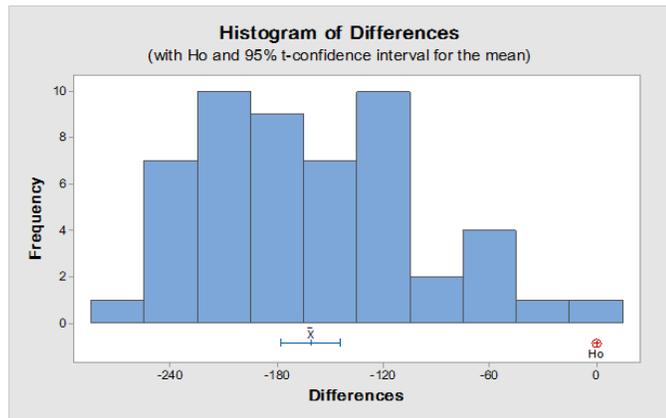


Fig 3. Histogram of serum total iron binding capacity (TIBC) levels in pregnant patients suffering from iron deficiency anemia and control group.

DISCUSSION

Iron deficiency presently is the most common nutritional disorder in pregnant women in developing and industrialized countries [11]. In this study, we found that the ferritin levels is drops significantly in pregnant women with iron deficiency anemia, which make a huge difference in its levels when we

Table 4. Level of HbA1c in pregnant patients group and healthy control group.

| | Patients mean | Control mean | T test | P value |
|-------|---------------|--------------|--------|---------|
| HbA1c | 7.887 | 5.175 | 20.05 | < 0.005 |
| | µg/dL | µg/dL | | |

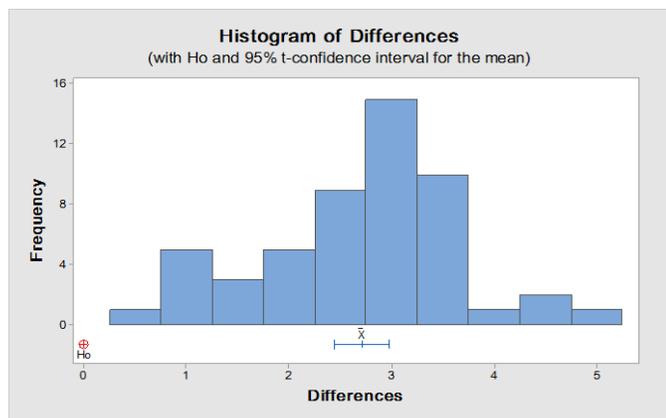


Fig 4. Histogram of level of HbA1c in pregnant patients and healthy control group.

compare it with health pregnant women. Similarly Morasso *et al.* (2002) found that the same results about iron deficiency percentage in pregnant women in Latin America [12]. Another study of Provan (1999) supported our results about the difference in serum iron levels, Provan showed that iron deficiency anemia is causing a defect in hemoglobin synthesis, which primarily affecting in red blood cells that are abnormally small (microcytic) and contain a decreased amount of hemoglobin (hypochromic) [13].

Table 5. Level of Hb in blood of pregnant patients suffering from iron deficiency anemia and healthy control group.

| | Patients mean | Control mean | T test | P value |
|----|---------------|--------------|--------|---------|
| Hb | 9.201 | 13.123 | -17.45 | 0.005 |

The present study agreed with the conclusion of a study carried out in south India by Mahfouz, *et al.* (1994), the prevalence of iron deficiency anemia (Hb less than 11g/dl and serum ferritin less than 12 ug/l) was found to highest among pregnant women in their second trimester [14].

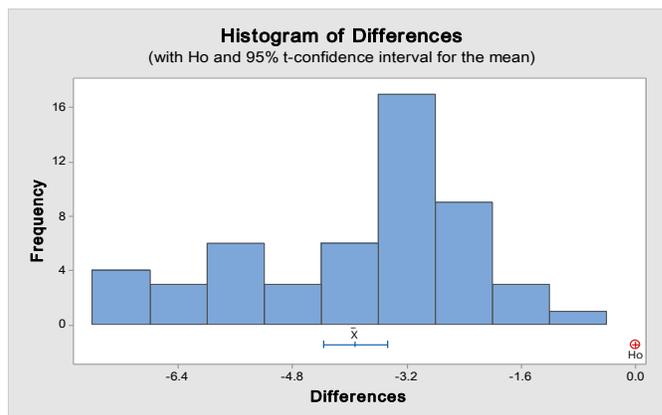


Fig 5. Histogram of Hb levels in pregnant patients suffering from iron deficiency anemia and healthy control group.

Our study showed significantly higher levels of hemoglobin A1c (HbA1c) in iron deficiency anemia patients when compared with the controls.

The mechanisms may lead to increase glycated HbA1 levels were not clear until 1980. Some study proposed that, in iron deficiency anemia, the quaternary structure of the hemoglobin molecule was altered, and glycation of the globin chain arisen more readily in the relative absence of iron [15]. Meanwhile, previous study [15, 16], calculated the absolute amount of HbA1 in each red cell (i.e., the mean corpuscular HbA1) and found that there were no significant differences in HbA1 levels even with the iron treatment. Also they investigated the study done by Sluiter *et al.* (1980) suggested that age of red cell was unlikely to be a significant factor in explaining the changes in HbA1 levels during the iron deficiency anemia treatment [16].

Table 6. Level of RBC in blood of pregnant patients suffering from iron deficiency anemia and control group.

| | Patients mean | Control mean | T test | P value |
|-----|---------------|--------------|--------|---------|
| RBC | 4.4290 | 5.2321 | -7.08 | < 0.005 |

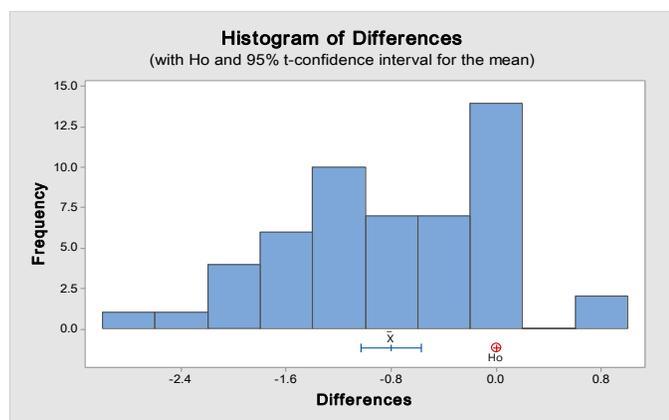


Fig 6. Histogram of RBC levels in blood of pregnant patients suffering from iron deficiency anemia and control group.

In a result of a study done by Rafat *et al.* (2012) observed that a significant correlation between HbA1c and red blood cell and iron metabolic indices which is the same findings of our data results, their study involving non-diabetic pregnant women with and without iron deficiency anemia and an age matched control group, analyzed the effect the metabolism of iron indices on HbA1c and found a significant correlation between HbA1c and red blood cell and iron metabolic indices. The results indicated that HbA1c levels were higher in women with iron deficiency anemia [17]. Furthermore, to analyze the influence of iron-deficiency anemia and noniron- deficiency anemia on HbA1c levels among adults in the United States; Ford *et al.* (2011) revealed that there is a significant positive correlation between hemoglobin concentrations and HbA1c. After adjusting for age, gender, and race, the mean HbA1c was 5.28% in participants with Hb < 100 g/L and 5.72% in participants with Hb > 170 g/L. The adjusted mean concentrations of HbA1c were 5.56% and 5.46% among participants with and without iron deficiency, respectively (P = 0.095). They suggested, in contrast to previous studies, that iron deficiency anemia had little population effect on HbA1c. The difference in concentrations of HbA1c between extremes of concentrations of Hb was 0.2%. It was concluded that people with anemia who are close to the diagnostic threshold should be retested or undergo another diagnostic method [18]. In conclusion, the present study showed that iron deficiency was associated with higher extents of HbA1c, which could cause difficulties in the identification of uncontrolled diabetes mellitus in iron deficient patients. The ferritin and iron status must be measured during the clarification of the HbA1c concentrations in diabetes mellitus.

Conflict of interest

The authors declare that they have no conflict of interests.

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