



ORIGINAL RESEARCH PAPER

Diabetology

THE RELIABILITY OF HEMOGLOBIN A1C IN PREDICTION OF GESTATIONAL DIABETES MELLITUS IN BENGHAZI

KEY WORDS:

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ABSTRACT

Gestational diabetes mellitus (GDM) is a condition that, if left undiagnosed, can have adverse effects not only on the mother but also on the fetus, many studies have recognized the role of HbA1c in the diagnosis of gestational diabetes mellitus and these studies yield different results. This study aims to investigate whether Glycated hemoglobin (HbA1c) level helps to differentiate between pregestational diabetes and GDM. **Methodology:** The study was done in 450 women divided into 5 groups including non-diabetic non-pregnant, non-diabetic pregnant, none-pregnant with type 2 diabetes, preexisting diabetic pregnant (type 2 diabetes) and pregnant with GDM. The parameters were FBS, HbA1c, Hemoglobin, body mass index, blood group and gestational age. The fasting blood sugar and HbA1c measured at first and third trimester. **Results:** Our results showed that first measurement of HbA1c was significantly different across the five groups ($P = 0.001$) as well as across the diabetic groups ($P < 0.001$). The readings of HbA1c% in late pregnancy was significantly different across the pregnant groups ($P < 0.001$), but not between GDM and diabetic pregnant groups ($p = 0.91$). **Conclusion:** HbA1c in first trimester can differentiate between GDM and pregestational diabetes mellitus, but cannot differentiate between GDM and pregestational diabetes in late pregnancy.

INTRODUCTION

Diabetes Mellitus (DM) is a global health problem, although its prevalence varies widely among different populations and its rate has generally increased worldwide, the number of people with diabetes rose from 108 million in 1980 to 422 million in 2014, in 2019 is estimated by 463 rising to 578 million by 2030 and 700 million by 2045, the prevalence is higher in urban than rural areas (International Diabetes Federation IDf) (IDF 2021).

In The Middle Eastern and North African region (MENA) in 2021 there is 20-79 million adult are living with DM which will be raised in to 95 million by 2030 and 136 million by 2045, MENA region has the second highest rate of increase in DM globally. The Arab world has a high prevalence of Type 2 DM (T2DM) (IDF 2021).

According to World Health Organization (WHO) there were 88.000 diabetics in Libya in the year of 2000. This number is expected to raise in 2030 to 245,000. The prevalence of DM in Libya is 3.8% in over 20 years (Bakoush O & Elgyzyri T 2006), it expected to reaches 23.7% in the report by the center of disease control (Tamer et al. 2009).

In Benghazi, screening of randomly selected group of 868 subjects revealed that about 23% above age of 20 years were glucose intolerance, tow-third had diabetes and the rest had impaired glucose tolerance (Kadiki OA et. al 2001).

There is two types of diabetes mellitus type 1 or insulin dependent diabetes mellitus caused by absolute insulin deficiency and type 2 diabetes mellitus or non-insulin dependent DM, due to the combination of both the resistance to insulin action and inadequate compensatory secretory response (WHO 2019).

Another type of DM is diabetes in pregnancy which could be prior to pregnancy (pre-existing DM) or during pregnancy (gestational diabetes mellitus GDM), GDM is defined as

hyperglycemia in second or third trimester of pregnancy (ADA 2020), it is possible to be treated by insulin or healthy diet, after the labor patient with GDM has an increased risk to develop type 2 DM and recurrence of GDM, so risky pregnant such as (marked obesity, bad obstetric history, family history and old age pregnant) should be early scerned in 24-28 weeks of gestation (ADA 2021).

The prevalence of DM in pregnancy about 15.5% in, which is 12.8% is due to gestational diabetes mellitus and 2.7% due to pre-gestational diabetes (IDF 2019).

According to the ADA the global prevalence of GDM is difficult to be estimated as the rates differ between studies due to different risk factors in the population such as maternal age, body mass index and ethnicity among women but they estimated that the prevalence was about 7% in 2021 globally, in the middle east and north Africa (MENA region) the prevalence of DM in pregnancy was 14% (ADA 2021)

During pregnancy, HbA1c determination is routinely used in women with preexisting Type 1 or Type 2 diabetes (T1D, T2D), but the use of HbA1c for GDM diagnosis is still controversial (Figueiredo M 2015).

Aim of the Study

The study aims to investigate whether HbA1c level helps to differentiate between pregestational diabetes and GDM.

Methodology

Cohort study conducted by direct personal interview and from medical records of obstetric and gynecology department in Benghazi medical center, Benghazi diabetic clinic and Ellethy clinic. The study started in May 2019 and finished in May 2020.

Patients with the following conditions which are known to interfere with or lead to the misinterpretation of HbA1c results were excluded from participation like anemia, chronic renal

disease, used of medications that affect carbohydrate metabolism such as glucocorticoids, patients who had diseases related to metabolism of carbohydrates such as liver disease, previous uses of oral contraceptive.

Subjects: The study was conducted on reproductive female groups between ages of 20 to 40 years, this cohort study contained 450 women, they are divided into 5 groups. The first group (control group 1): randomly taken, consisted of 100 female non-diabetic non-pregnant. The second group (control group 2): consisted of 100 female non-diabetic pregnant. The third group (experimental group 1): consisted of 100 female none-pregnant with type 2 diabetes. The fourth group (experimental group 2): consists of 50 preexisting diabetic pregnant (type 2 diabetes). The fifth group (experimental group 3): consists of 100 female with GDM.

The history was obtained by questionnaire and the parameters are FBS, HbA1c, Hb, BMI, blood group, gestational age. The FBS and HbA1c measured at first and third trimester. The reading of FBS and HbA1c was taken from patient's file who were diagnosed as GDM.

Estimation of HbA1c

HbA1c was estimated by immunochemical assay, the levels of HbA1c were measured according to National Glycohemoglobin Standardization Program (NGSP) guidelines and standardized to Diabetes Control Complication Trial (DCCT).

According to ADA the normal level of HbA1c for adults below 5.7%. Levels between 5.7% and 6.4% may indicate prediabetes, while those with more than 6.5% will be diagnosed as diabetics.

Estimation of FBS

For patients in our study FBS was estimated by immunochemical assay, normal range of lab is (70-110mg\dl). Range for pregnant: ADA recommends the target for pregnant women is from 70 to ≤ 95 mg\dl

The Measurement Done By

HbA1c (G8), FBS (integra), CBC (Sysmex).

Ethical Consideration

An official consent from the administration of Benghazi medical center and Benghazi diabetic clinic unit was taken, verbal consent was taken from patients before the personal interview and filling of the questionnaire.

RESULTS

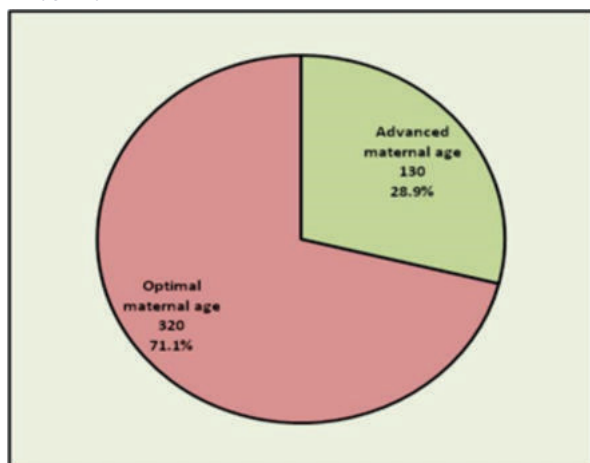


Figure 1: Distribution Of The Study Population According To Advanced Maternal Age

The percentage of advanced maternal age (>35 years) was 28.9%, the rest is non-advanced age (21-35 years) was 71.1%

Fasting Blood Glucose (FBG)

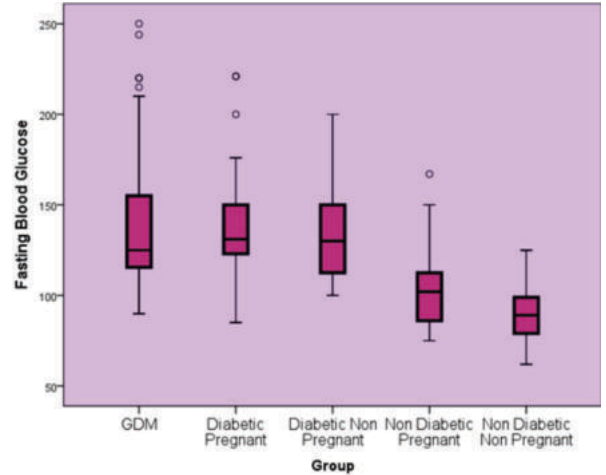


Figure 2 : FBS Parameters Across The Five Groups Of The Study

Box plot for distribution of numeric data values compare with multiple groups for FBS levels. The groups were not homogeneous in the levels of FBS. In the group of GDM the median was 125 mg\dl, the range from 90-250 mg\dl. In the group of diabetic pregnant the median was 131 mg\dl, the range from 85-221 mg\dl. In the group of diabetic non-pregnant the median was 130 mg\dl, the range from 100-200 mg\dl. In the group of non-diabetic pregnant the median was 101 mg\dl, the range from 75-167 mg\dl. In non-diabetic non-pregnant the median was 89 mg\dl, the range from 62-125 mg\dl.

Baseline HbA1c%:

Table 1: HbA1c%; First Measurement (First Trimester) Parameters Across The Five Groups Of The Study

	GDM	Diabetic Pregnant	Diabetic Non Pregnant	Non Diabetic Pregnant	Non Diabetic Non Pregnant
Mean	4.750	5.404	6.939	3.730	3.339
Median	4.900	5.000	6.700	4.000	3.200
SD	.9507	.8997	1.1338	.8409	1.1344
Minimum	2.5	3.7	5.0	1.5	1.5
Maximum	9.0	8.0	10.0	6.0	6.0

KruskalWallis X2 292.686 P=0.001

First measurement of glycated hemoglobin was significantly different across the five groups (P = 0.001) as well as across the diabetic groups (P<0.001). Diabetic non pregnant group had the highest median (6.7% ±SD 1.13%)

Regarding to the pregnant groups, the diabetic pregnant has the highest mean and median, while GDM group had a mean of 4.75% ±SD 0.95%, less than the diabetic pregnant and more than the non-diabetic pregnant.

Second Measurement of HbA1c%

Table 2: HbA1c%; Second Measurement Parameters Across The Pregnant Groups Of The Study

	GDM	Diabetic Pregnant	Non Diabetic Pregnant
Mean	6.424	6.098	4.371
Median	6.000	6.000	4.000
SD	1.8541	1.1237	1.0745
Minimum	4.0	4.0	2.5
Maximum	11.5	9.0	10.6

KruskalWallis X2 101.938, P < 0.001

The reading of HbA1c% in late pregnancy was significantly different across the pregnant groups $P < 0.001$, but not between GDM and diabetic pregnant groups ($p = 0.91$), the lowest is non-diabetic pregnant.

DISCUSSION

Our results suggested that there is a significant difference in FBS, the mean FBS level was significantly higher in women with GDM compared with Non diabetic ($p < 0.001$) but not significance in GDM women compared with pregestational diabetic women ($p = 0.783$) of the other groups, the median is higher in preexisting diabetic women, we found result from other study done in 2019 by Kouhkan A et al that have proved a strong relation between FBS and HbA1c at which there is 17% increase in the risk of developing GDM with each 1 mg/dl increase in FBS level,

Another study done in 2021 by Bojnordi et al demonstrated patients with higher FBS should be considered high risk for GDM, a retrospective study assessed FBS and body mass index (BMI) during the first trimester of pregnancy as potential screening indicators of later gestational diabetes mellitus done by Hao M& Lin L (2017), in which they found high FBS or BMI in the first trimester, especially in combination, may predict later GDM with limited accuracy and specificity in Chinese women.

Also Muke SH et al (2015) in their study in the United Arab Emirates they found a poor correlation of HbA1c with both FBS. So, despite all the current technological advances and standardization, the value of HbA1c as a screening/diagnostic test for GDM still remains poor.

The analysis revealed that, the base line of HbA1c of the five groups in the first trimester there is a significant difference ($P = 0.001$), the mean and median in pregestational diabetes pregnant is more than others, non-diabetic pregnant is the lowest, in GDM pregnant the mean and median more than non-diabetic pregnant so the HbA1c become predictor for GDM,

These findings are in agreement with other study done by Renz P et al in 2015 which found that the HbA1c values in pregnant women without GDM were significantly lower than those found in pregnant women with GDM, they prefer the combination use of OGTT, may be a useful diagnostic tool for GDM. Our results of HbA1c in first trimester agree with study done by Punnose J et al at 2020 in which they found HbA1c in first trimester is an independent GDM predictor in Asian Indian women but lacks sufficient sensitivity or specificity for use as a diagnostic test.

In our study we can differentiate GDM from pre-gestational diabetes by use of HbA1c in first trimester but in the third trimester we cannot depend on HbA1c to differentiate GDM from pre-gestational diabetes, it is predictor in first trimester for pre-gestational diabetes.

According the age, there is no significant change in age of the five groups ($P = 0.346$), in our study the distribution of population according to maternal age was as 28% with advanced age (>35 years) and 71% not advanced age (20-35 years).

CONCLUSION

GDM cannot be predicted by using HbA1c in first trimester and cannot differentiate between GDM and pregestational diabetes mellitus in third trimester. But HbA1c can differentiate between GDM and normal pregnancy in the third trimester. HbA1c must be measured at first and third trimester to be predictor. Most of our cases of GDM are younger in ages than other countries.

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