ABO blood groups and gestational diabetes among pregnant women attending University of Ilorin Teaching Hospital, Kwara State, Nigeria

Abstract

Introduction: The ABO blood group system is defined based on the presence of blood group antigens present on the cell membrane of erythrocytes. The blood group system is associated with some disease conditions and some epidemiological studies have demonstrated the linkage among the "ABO" blood group and the risk of diabetes mellitus (DM). This study aimed to find out the possible linkage between "ABO" and "Rhesus" blood groups with gestational induced Diabetes Mellitus (DM).

Methods: The study was carried out among the pregnant women attending antenatal clinic in University of Ilorin Teaching Hospital. A total of 200 serially recruited pregnant women were screened for DM using fasting blood sugar (FBS), thereafter, the ABO and Rhesus group of the participants were determined using standard slide agglutination test. Data obtained were analyzed to determine any association between Gestational Diabetes Mellitus (GDM) and different ABO and Rhesus blood groups. The outcome was expressed as percent and absolute number of frequency. **Results:** Highest prevalence of gestational Diabetes Mellitus (GDM) was observed among the individuals with O +ve blood group, followed by A +ve blood group. Both AB -ve and B-ve blood groups were not associated with incidence of GDM in this study. For the Rhesus blood group system, Rhesus positive had the highest percentage (94%) of GDM incidence.

Conclusion: Blood group might be a risk factor and it can be helpful for the evaluation of the disease, a study to investigate causal effect is advisable.

Keywords: *gestational, blood group, diabetes mellitus, Rhesus, disease.*

INTRODUCTION

Gestational diabetes (GDM) is described as glucose intolerance that is initially recognized during pregnancy.[1] Gestational diabetes is the progression of diabetes during pregnancy and returns to normal glucose tolerance after childbirth. Virtually all new cases of diabetes during pregnancy are transient forms of type II diabetes. A small percentage of recent diabetes cases have been found to persist after pregnancy. Most of them are type II diabetes. In rare cases, type I diabetes can occur accidentally during pregnancy.[2] Risk factors for developing GDM during pregnancy are obesity, previous history of GDM, family history, tribe, and hypertension.[3] GDM is associated with primary cesarean section, fetal overgrowth (gestational dystocia or giant infants), shoulder dystocia or birth injury, neonatal hypoglycemia, hospitalization, etc. It is also associated

with an increased risk of adverse outcomes. To the neonatal intensive care unit.[4] GDM may lead to increased morbidity, mortality and complications during pregnancy, intrauterine foetal death (IUFD), trauma during childbirth, and metabolic irregularities like hypoglycemia, hyperbilirubinemia, and erythrocytosis. Early detection and treatment of GDM improves and reduces both maternal and fetal complications.[5]

Pregnancy is considered a diabetogenic condition characterized by over-release of insulin associated with decreased insulin sensitivity at the cellular level.[6] Hormones such as oestrogen, progesterone, cortisol, human placental lactogen, and growth hormone are anti-insulin-producing. These hormones increase during the second trimester, causing impaired glucose tolerance in some women and predisposing them to gestational diabetes.[6] GDM has been reported to affect 1.4% to 12.3% of pregnancies,[7] and its prevalence is due to the increasing incidence of type 2 diabetes worldwide. [8,9] Gestational diabetes (GDM) affects up to 5% of all pregnancies in the UK (Diabetes UK, 2018) and affects 1% to 25% of pregnancies worldwide [10] and its outbreak. The rate is increasing. [11]

The term "blood group" refers to the entire blood group, including the red blood cell (RBC) antigens, whose specificity is due to alleles or several genes that may be very closely related on the same chromosome.[12] The ABO blood group plays an important role in the physiology of the human body. So far, a link between blood groups and 70 diseases has been identified, and these include gastric ulcer, duodenal ulcer, heart attack, arteriosclerosis, gastric cancer, and bladder cancer.[13] Blood group distribution patterns vary by race and geographic region around the world. [14] The ABO blood group is described as a carbohydrate fragment that binds to a protein called the H substance, and presents it on the surface of red blood cells. In addition to its roles in immunohaematology, there are numerous studies, which show that the ABO blood types also have a significant role in different human diseases such as cardiovascular, infectious and neoplastic disorders. [13] The prevalence of gestational diabetes mellitus (GDM) is increasing, with about 16% of all live births being affected by hyperglycemia. [15] Many cases of Type 2 Diabetes Mellitus (T2DM) and GDM could be prevented with lifestyle changes, including maintaining a healthy body weight, consuming a healthy diet and staying physically active. [16] Therefore, there is an increasing need to implement effective preventive policies and to promote a healthy lifestyle.

Ethnicity and/or lower socioeconomic status are important considerations in individuals affected by diabetes. For example, people with the lowest socio-economic class are 25 times more likely to develop diabetes, and blacks and ethnic minorities are up to 6 times more likely to develop diabetes than the general population. [17] This may be due in part to lifestyle factors. This has even more serious consequences for underprivileged and vulnerable communities. [18] But from a precautionary point of view, it is even more difficult to achieve. [18] A possible mechanism for the association between blood group and disease is the effect of some genetic mutations at the ABO locus on abnormalities in some biological substances, including inflammatory cytokines, adhesion molecules and thrombus-forming factors. [19] Blood group effects on pregnancy outcomes have also been reported, but with contradictory results. [19] Some authors have found that women with blood group A or AB are at increased risk of pre-eclampsia, [20] though another study found that the percentage of blood group O was high among women who had GDM. [21] Some have found that there is no association between maternal blood type and pregnancy outcomes, such as pre-eclampsia, postpartum bleeding, intrauterine growth retardation, gestational age (GA), and stillbirth. [21] Therefore, in this study, we sought to find out if there was a positive relationship between gestational diabetes and the ABO blood group.

MATERIALS AND METHODS

The study was conducted at the Department of Medical Laboratory Science (Haematology and Chemical Pathology Units), University of Ilorin Teaching Hospital, Ilorin, Kwara State. It was a prospective case-control study comprising 200 women, made up of 49 sexually active pregnant women suffering from Gestational Diabetes Mellitus (GDM) and 151 sexually active pregnant women without GDM attending clinic at the University of Ilorin Teaching Hospital. Subjects who were aged between 20 and 45 years and who had been diagnosed with GDM and who were in different trimesters of their pregnancy were included in the study, while subjects who were outside the age range and who were suffering from secondary Diabetes Mellitus like drug-induced Diabetes Mellitus, were excluded from the study.

A semi-structured questionnaire was used to collect data from the 200 patients recruited for the study. The data obtained included socio-demographic characteristics, duration of pregnancy, duration of gestational Diabetes Mellitus, weight, height, body mass index (BMI), ABO blood group, Rhesus blood group and other relevant information. Data from collected blood samples were collated and analyzed statistically. The research instrument included data from

questionnaire, laboratory analyses involving ABO blood grouping with their respective Rhesus factor and Oral Glucose Tolerance Test. Four (4) ml venous whole blood sample was collected from the most prominent alcohol-swabbed medial cubital vein using a hypodermic syringe and immediately two (2) ml each was dispensed into EDTA bottle for ABO blood group determination, and the remaining 2 ml was dispensed into a sodium fluoride-oxalate bottle for the Oral Glucose Tolerance Test (OGTT). Both bottles were mixed by inversion to ensure even mixing and to prevent clotting. The blood samples were subsequently taken to the main laboratory for further processing and analyses.

LABORATORY PROCEDURES

ABO and Rhesus typing was done using the tile method. [22] The gestational Oral Glucose tolerance test was carried out according to the method of Pagana. [23]

The data obtained were recorded using Epi Info software and analyzed with SPSS Version 20 statistical software. The analyses included the following descriptive statistics: Mean, Standard deviation, and Percentage. To compare the proportion of GDM across the age groups, weight, gestational age and family history of diabetes mellitus, Chi-square test was employed.

RESULTS

The basic characteristics of enrolled participants are presented in Table 1. A total of 200 pregnant women recruited for the study comprised 49 women with Gestational Diabetes Mellitus (GDM) and 151 women without GDM. The mean age for the participants was approximately 36 years, and most subjects were aged between 20 and 45 years.

The maternal age, antenatal registration, prophylaxis drug use, blood group, and genotype of the participants, together with parity and gestational age were determined using standard questionnaire.

Table 1: Sociodemographic characteristics of the Participants

Characteristic		Number observed	Percentage (%)
Age (years)	18 – 29	96	48

	30 – 39	104	52
BMI (Kg/m2)	< 24.9	76	38
	≤25.0	124	62
Tribe	Yoruba	156	78
	Nupe	23	11.5
	Igbo	21	10.5
Gravidity	Primigravida	46	23
	Secundgravida	51	25.5
	Multigravida	103	51.5
Gestational age (week)	1st trimester	61	30.5
	2nd trimester	63	31.5
	3rd trimester	76	38
ABO (Rhesus)	A+ve	26	13
	B+ve	28	14
	AB+ve	32	16
	O+ve	92	46
	A-ve	6	3
	B-ve	6	3
	AB-ve	2	1
	O-ve	8	4
Glycemic state	Hyperglycemia	49	24.5
	Euglycemia	151	75.5

The number are value and percentage with respect to the total number of participants

Table 2 displayed the prevalence of gestational-induced DM with respect to ABO/Rhesus blood group system. As shown on the table, O+ve had the highest incidence of GDM, while AB-ve and B-ve did not reveal any association with GDM. Both A+ve and B+ve had a moderate prevalence of GDM. The percentage of GDM in relation to ABO and Rhesus was computed and displayed on the table.

Table 2: Prevalence of GDM with respect to ABO (Rhesus) blood group.

ABO (Rhesus) group	Number observed	Prevalence (%)	Percentage (%)
A+ve	9	4.5	18.4
B+ve	6	3	12.2
AB+ve	2	1	4.1
O+ve	29	14.5	59.2
A-ve	1	0.5	2.0
B-ve	Nil	NA	-
AB-ve	Nil	NA	-
O-ve	2	1	4.1

The number are value, over all prevalence and percentage of those with GDM

Table 3 shows the comparison of Fasting Blood Sugar (FBS) value between GDM and non-GDM participants with respect to different ABO/Rhesus blood groups. As shown on the table,

groups A+ve, B+ve, AB+ve and O+ve of subjects with GDM had significantly higher FBS values than non-GDM subjects, while A-ve, B-ve, AB-ve and O-ve showed no association with respect to FBS between GDM and non-GDM. did not reveal any association with GDM.

Table 3: Comparison of FBS value between GDM and non GDM participants with respect to different ABO/Rhesus blood groups.

ABO/Rhesus blood group	GDM	Non-GDM	P value
N	49	151	0.003*
A+ve	8.96 ± 1.21	3.98 ± 1.86	0.000*
B+ve	8.80 ± 1.42	4.02 ± 0.96	0.000*
AB+ve	8.00 ± 0.56	3.99 ± 1.23	0.000*
O+ve	7.96 ± 0.96	4.38 ± 1.09	0.000*
A-ve	7.40 ± 0.00	0.00	NA
B-ve	8.40 ± 0.00	0.00	NA
AB-ve	0.000	0.00	NA
O-ve	0.000	0.00	NA

The values are mean ± SD, p-value were determined by Student's t test as appropriate.
*p < 0.05 was considered significantly different.
NA= not applicable, and **FBS**= Fasting blood sugar.

Table 4 shows the comparison of Fasting Blood Sugar (FBS) value between GDM and non-GDM participants. As shown on the table, subjects with GDM had significantly higher FBS values (8.9±2.34) than non-GDM subjects (4.7±1.09) (p=0.000).

Table 4: Comparison of FBS result between GDM and none-GDM participants

Parameter	Non-GDM	GDM	P value
FBS (mmol/L)	4.7±1.09	8.9±2.34	0.000*

The values are mean ± SD, p-value were determined by Student's t test as appropriate.
*p < 0.05 was considered significantly different.

Figure 1 shows the percentage distribution of the incidence of GDM in relation to Rhesus blood group. The pie chart shows that the 94% of the GDM were Rhesus D positive, while 6% were Rhesus D negative.

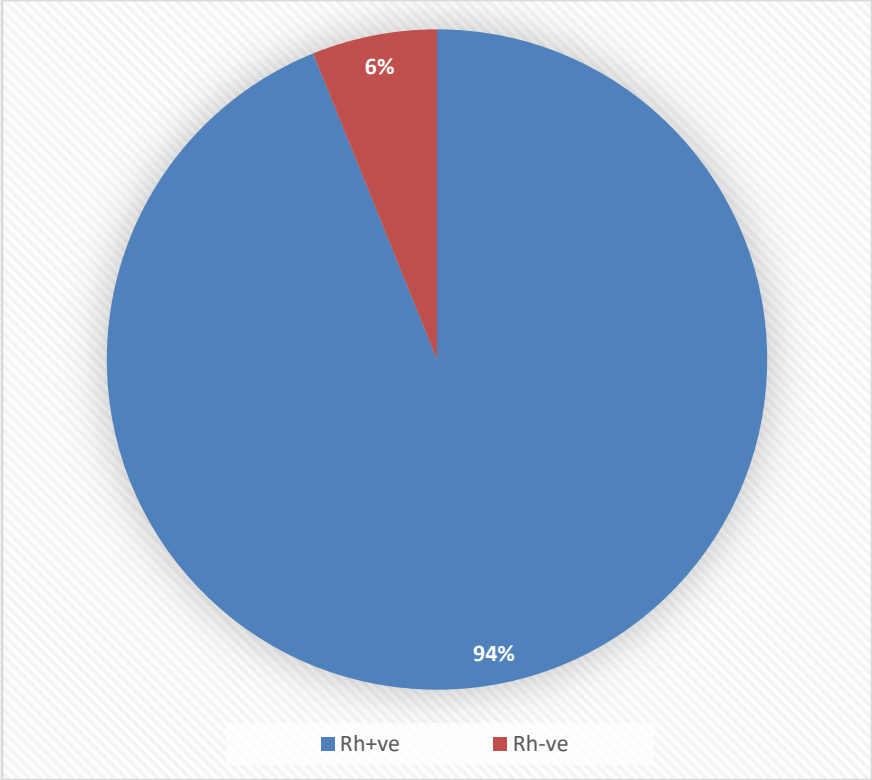

Figure 1: Percentage distribution of incidence of GDM in relation to Rhesus blood group

Figure 2 shows the distribution of incidence of GDM in respect to gestational age and gravidity of the participants. From the displayed data, subjects who were multigravida had the highest incidence of GDM in the 2nd trimester of their pregnancy, and the lowest incidence of GDM in the 3rd trimester. Subjects who were primigravida had the highest incidence of GDM in the 3rd trimester and the lowest incidence in the 1st trimester, while subjects who were secundagravida had the highest incidence of GDM in the 1st trimester and the lowest incidence in the 2nd trimester.

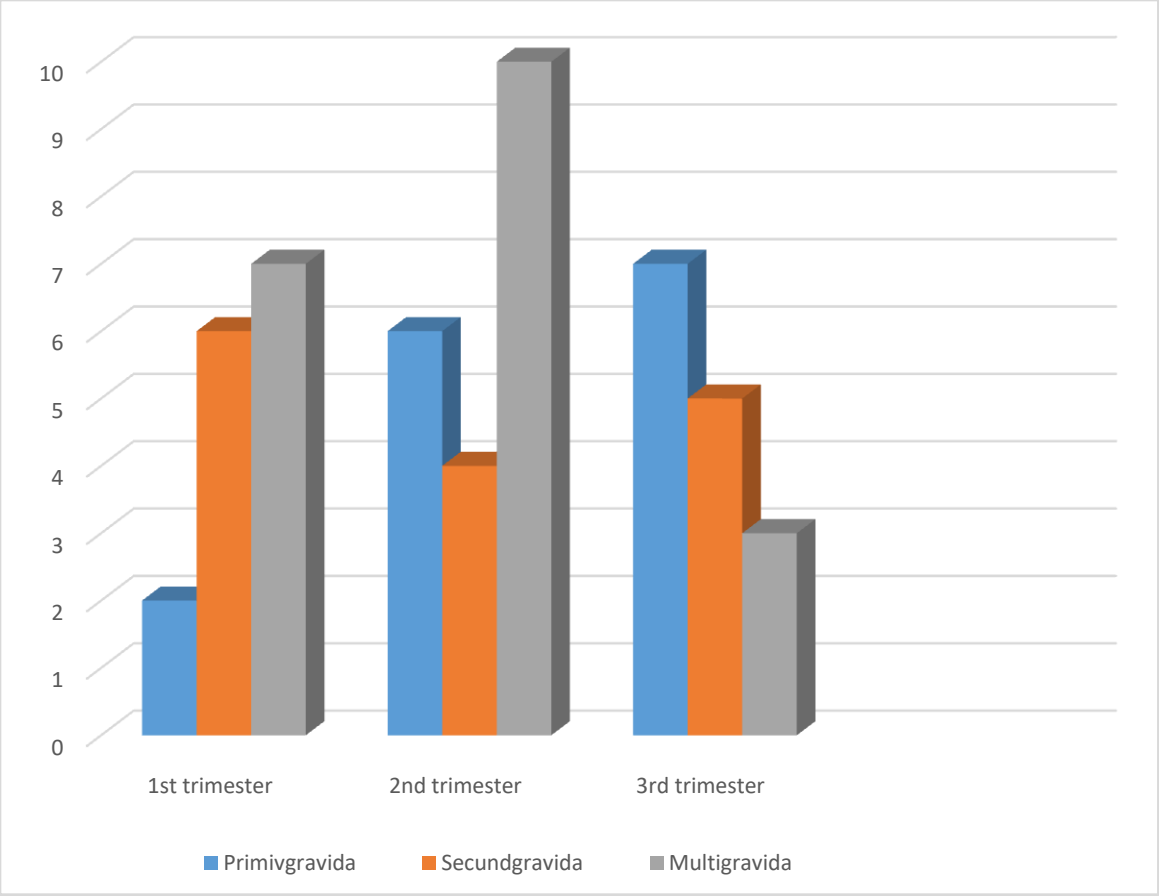

Figure 2: Distribution of incidence of GDM in respect to gestational age and gravidity of the participants

Discussion

The present study was done to determine the prevalence of ABO and Rhesus blood group system among pregnant women suffering from Gestational Diabetes Mellitus (GDM). Its genetic predisposition has been explained and several studies have established the fact that environmental factors do have an influence in its genetic expression. The study population consisted of pregnant female Nigerians aged 18-45 years, and all the participants were residents of Ilorin, Kwara State, Nigeria.

During pregnancy, there are significant changes in maternal chemistry, which help to reflect the normal physiology of pregnancy. Understanding what causes these changes and the different reference ranges that may be appropriate in pregnancy is important for clinicians who care for pregnant women.

In this prospective study of pregnant women, effort was made to evaluate the incidence of gestational induced DM in relation to ABO/Rhesus blood group. Findings showed that blood

group O+ve had the highest frequency (59.2%) followed by blood group A+ve (18.4%), blood group B+ve (12.2%), with blood group AB+ve and O-ve having the least frequency (4.1%). However, this finding contradicts that of Akinnuga et al, [24] who reported the ABO distribution among the population in Northcentral of Nigeria is as follows; blood group O, followed by A, B, then AB.

Also, in the current study, it was observed that the mean Fasting Blood Sugar (FBS) level was significantly higher in GDM participants compared to the non-GDM control (Table 3). This is in agreement with a study. [25] Sequel to insulin resistance/deficiency in DM, the combination of increased hepatic glucose production and reduced peripheral tissues metabolism leads to elevated plasma glucose levels. [15]

When the FBS was analyzed for different ABO/Rhesus groups, the FBS was significantly higher in blood group O+ve, A+ve and B+ve of subjects with GDM compared to their non-GDM counterparts.

The blood group O has neither antigen A nor B, and individual with O group can either possess or lack the Rhesus "D" antigen. The outcome of this study showed that majority of the pregnant women with GDM were O Rhesus D +ve (Table 2). This could be attributed to the high prevalence of blood group O Rhesus D +ve in the area under study. [26] The high prevalence observe could also be attributable to genetic predisposition of the population studied. [25] In the same vein, blood group A+ve, and B+ve had moderate prevalence (table 2). Both the blood AB+ve and O-ve had the least and equal prevalence among the population studied. In this study also, there was no incidence GDM reported for both AB-ve and B-ve (table 2). The results of this study are contrary to what was reported by Aggarwal *et al*, [27] who found high percentage of blood group AB in diabetics and also a positive association between Rhesus negative blood group and diabetics. The possible explanation of these conflicting results regarding the association between ABO blood groups and DM could be racial and geographical variations playing role in the genetic expression of the disease. [25]

With respect to Rhesus grouping system, blood groups are Rhesus-positive or Rhesus-negative on the basis of presence or absence of Rhesus D antigens on red cell surface. The Rhesus antigens are determined by three pairs of closely linked allelic genes located on chromosome one. Of the two Rhesus groups, this study revealed that Rhesus D positive blood had the higher prevalence of GDM with 94% when compared with Rhesus D negative which had a prevalence

of 6% (Figure 1). This finding is similar to what was reported by James *et al*, [28] who reported 92% prevalence among the ABO Rhesus D positive against 8% in Rhesus D negative individuals. The possible mechanism responsible for high prevalence of GDM among individuals with positive Rhesus blood types is still not well defined. [28]

With respect to gestational age and gravidity, it was observed that highest participants in this study were in there second trimester and they are mostly secundadgravida (Figure 2).

Conclusion

Highest prevalence of gestational diabetes mellitus was noted with O+ve blood group followed by A+ve and least prevalence was noted with blood group AB. Also, 94% of the study population were Rhesus D positive.

Ethical Approval and Consent:

Ethical approval was obtained from the Ethical Review Committee of the Kwara State Ministry of Health, Ilorin, Kwara State, Nigeria. The sample collection method was explained to the patients involved in the study using the information provided in the semi-structured questionnaire. Each patient was requested to sign a written informed consent before being eligible to participate in the study.

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