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Research Article

The Prevalence of Kidd, Lewis, ABO and RhD blood group systems in diabetic patients attending RSUTH

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Abstract:

Aim: This study is aimed at determining the prevalence of Kidd, Lewis, ABO and RhD blood group systems in diabetic patients attending RSUTH.

Method: This cross-sectional study was conducted at Rivers State University Teaching Hospital (RSUTH), and 75 diabetic subjects (30-98 years) was recruited for this study, 5mls of blood was collected using standard venipuncture technique from each subject. Blood grouping were determined manually The presence of ABO, Rh D, Lewis, and Kidd blood group system was examined using Anti-ABO, anti-D, anti-Lea and Leb, anti-Jka and Jkb monoclonal antibody, respectively (Lorne Laboratories). Data generated were analyzed by simple percentage calculation.

Result: In this study the distribution pattern of ABO blood group among subjects with diabetes mellitus was in the other of O>A>B>AB (45.3%, 30.7%, 21.3% and 2.7% correspondingly), for Rh blood group system is Rh+> Rh- (95.3% and 4.7%). Also in this study, no subjects was tested Jka+ and Jkb+, the distribution pattern among diabetic groups the distribution of Kidd blood group antigens is Jka+>Jkb+> Jkb- >Jka-is (100%, 94.7%, 5.3%, 0.00) respectively. Distribution of Lewis antigens in this study showed the following sequence for diabetes subjects is Leb+>Lea+>Lea->Leb- (81.3%, 60.0%, 40.0%, 18.7%).

Conclusion: Lea and Leb in this population was observed frequently than those in other population previously reported.We therefore recommend that routine typing of Lewis blood group system should be done.

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1. Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia and glucose intolerance, resulting from impaired insulin secretion, insulin resistance, or both (1). DM is primarily classified into two main types: insulin-dependent diabetes mellitus (type 1), which is marked by absolute insulin deficiency, and non-insulin-dependent diabetes mellitus (type 2), which is characterized by insulin resistance or impaired insulin secretion. The disorder arises from complex interactions involving peripheral insulin sensitivity, pancreatic β-cell dysfunction, and other metabolic abnormalities (2). Major risk factors include age, genetic predisposition, obesity, sedentary lifestyle, smoking, and environmental influences (3). The prevalence of DM has risen severely worldwide, disproportionately affecting low- and middle-income countries. According to the World Health Organization

(WHO), DM caused 1.5 million deaths in 2019, with 48% of these deaths occurring before the age of 70 years (4). The International Diabetes Federation (IDF) estimated that 537 million adults were living with DM in 2021, and this number is projected to rise to 643 million by 2030 and 783 million by 2045. In Africa, the number of people with DM increased from 4 million in 1980 to 25 million in 2014, with unhealthy diets and the adoption of western lifestyles cited as key contributing factors. Nigeria bears the highest DM burden in Africa, accounting for over 80% of morbidity and mortality from the disease. A study by conducted by Uloko and colleagues highlighted regional variations in DM prevalence across Nigeria's 3.0% in the northwest to 9.8% in the south-south zone (5).

Blood group systems, ABO, Kidd, RhD and Lewis systems, have emerged as potential factors influencing susceptibility to DM. Blood groups are determined by specific antigens on red blood cells (RBCs), which are governed by genetic loci. These antigens, composed of proteins, glycoproteins, or glycolipids, play crucial roles in immunity and disease susceptibility (6). The association between blood group phenotypes and DM is hypothesized to involve shared molecular and genetic mechanisms (7).

The Lewis blood group system, discovered in 1946, consists of antigens (e.g Lea and Leb) synthesized on chromosome 19 at the FUT3 locus (8). The presence of Lewis antigens correlates with genes involved in glucose metabolism, including insulin receptor and glycogen synthase genes, potentially linking the Lewis system to DM risk. The Kidd blood group system, discovered in 1951, includes antigens Jka, Jkb, and Jk3 located on chromosome 18. The Kidd antigen locus may be genetically linked to diabetes susceptibility (9).The RhD blood-group system consists of 49 antigens, with the D antigen being most significant. RhD-negative phenotypes are less common among Africans (3-5%) compared to Caucasians (15%) (10). Several studies suggest an association between RhD phenotypes and DM susceptibility (11).

Despite evidence linking blood groups like ABO, Lewis, Kidd, and RhD to DM, the mechanisms remain poorly understood. This study is aimed at determining the prevalence of Kidd, Lewis, ABO and RhD blood group systems in diabetic patients attending RSUTH. Investigating the prevalence of these blood groups among diabetic patients could provide insights into their role in disease susceptibility and management and there is dearth of published research information on the occurrence and percentage distribution of these blood group system in diabetic population in this region as the frequency of blood group antigens varies across populations.

2. Materials and Methods

2.1 Study Design

This is a cross-sectional study carried out among diabetic patients attending Rivers State University Teaching Hospital

2.2 Study Area

Rivers State, located in the Niger Delta region of Nigeria's south-south geopolitical zone, was established in 1967 and comprises 23 Local Government Areas. Its capital, Port Harcourt, is a hub for Nigeria's crude oil industry. The state is the 26th largest by area, with numerous rivers, including the Bonny River, flowing through it (12).

The study was conducted at Rivers State University Teaching Hospital (RSUTH), formerly known as Braithwaite Memorial Specialist Hospital (BMSH).

2.3 Study Population

A total of 75 subjects were recruited for this study, 75 diabetic subjects 32 males and 43 females between the ages of 30-98years for both groups.

2.4 Collection of Blood Samples, Storage and Transportation

After pre-test counselling and explanations, venous blood was drawn from the antecubitalfossa of the subjects with the use of vacutainer (13). Three (3.0) ml of venous

blood was collected into a glass vacutainer sample bottle that contains 0.5 mL of 1.2 mg/mL dipotassium ethylene diamine tetraacetic acid. It was well mixed for the serological identification of Le^a and Le^b blood groups. Blood samples were analyzed within 24 hours of collection. When testing is delayed, red cells would be separated from the plasma, washed and stored properly at 2–8°C (25).

2.5 Methodology

2.5.1 Determination of ABO Blood Groups Using Anti-A, Anti-B, Anti-AB IgD/IgM Blend Reagents, Atlas Medicals, Cambridge-UK, Lot No[s]23112903;23111905;22112023; Expiry Dates: 2025/11/01; 2025/10/11; 2024/11/17.

Standard tube techniques described by Brecher (14) were followed:

5% red blood cell suspension prepared in saline was added to test tubes labeled 1, 2, and 3.

Reagents were added accordingly, mixed, centrifuged for 30 seconds at 1000 g, and examined for agglutination.

Agglutination indicated a positive result, while a smooth cell suspension confirmed a negative result (15, 30).

2.5.2 Determination of Rhesus D Blood Group Using Anti-D IgD/IgM Blend Reagents, Atlas Medicals, Cambridge-UK, Lot No 23031505; Expiry Dates: 2024/11/17

A drop of anti-D reagent and 5% RBC suspension was mixed and centrifuged at 1000 g for 30 seconds.

Agglutination indicated a positive Rhesus D result, while a smooth suspension confirmed negativity microscopically with bovine albumin and anti-human globulin.

2.5.3 Determination of Lewis-a and b Blood Group Using Anti-Lea and Leb Monoclonal, Lorne Laboratories Ltd, UK. Lot No: 63216-A1; 63199-A1 Expiry Date: 2024/11/09

Method: Standard tube technique.

Standard tube technique was used to phenotype red cellsas described by Lorne Laboratories. Three percent (3%) red cell suspension was prepared using isotonic saline. One volume of Lorne Anti-Le^a reagent was added to one volume of the prepared 3% red cell suspension and properly mixed and incubated for 15 minutes at room temperature before it was centrifuged for 20 seconds at 1000 g. The red cell button was gently re-suspended and read macroscopically for the presence of agglutination. Presence of agglutination is indicative of a positive result while on the contrary, a negative result is indicative of absence of agglutination (14).

2.5.4 Determination of Jka and Jkb Blood Group Using Anti-Jka and Anti-Jkb Monoclonal, Lorne Laboratories Ltd, UK. Lot No: 77612-A3; 77612-A3 Expiry Date: 2024/03/28

Method: Standard tube technique. Standard tube technique was used for phenotyping of red cells as described by Lorne Laboratories[RBCs were washed thrice using phosphate-buffered saline, and a 3% suspension was prepared.

Equal volumes of the suspension and anti-Jka/anti-Jkb reagent were mixed, incubated at 37°C for 15 minutes, washed, and centrifuged for 20 seconds at 1000 rpm.

Agglutination was assessed macroscopically and microscopically, with antihuman globulin added after the wash step to confirm results.

2.5.5 Statistical Analysis

Data collected was statistically analyzed by simple percentage calculation.

3. Results

3.1 Demographic Details of Studied Participants and the Frequency Occurrence and Percentage Distribution of Blood Groups

Table 3.1 provides a comprehensive overview of various demographic factors of the 75 participant and their prevalence among diabetes. Table 3.1: Demographic Characteristics of Study Population

This table provides details about the demographic distribution of the study population across various categories, highlighting the frequency and percentage prevalence of diabetes for each subgroup.The distribution indicates that the majority of diabetes cases occur in the 57–70 years age group (36%), followed by 43–56 years (26.7%).The prevalence significantly declines in individuals aged 85–98 years (1.3%). Diabetes is more common among females (57.3%) than males (42.7%).

Marital Status: The married group has the highest prevalence of diabetes (66.7%), followed by widows (21.3%) and widowers (5.3%). Those who are single or separated have the lowest percentages.

Education: The prevalence of diabetes is highest among individuals with tertiary education (56%), followed by secondary education (30.7%).Individuals with no formal education (5.3%) and primary education (8%) represent a smaller proportion.

State of Origin: Most diabetes cases are from Rivers State (58.7%), followed by Imo State (14.7%). States like Anambra and Bayelsa have the least cases (1.3% each).

Occupation: Diabetes is most common among the self-employed group (44%), followed by the employed (30.7%).Students have no reported cases (0%).

Table 3.1: Demographic Characteristics of Study Population

Variables	Frequency of Diabetes (N)	Prevalence of Diabetes (%)
Age Group		
29-42	12	16
43-56	20	26.7
57-70	27	36
71-84	15	20
85-98	1	1.3
Gender		
Female	43	57.3
Male	32	42.7
Marital Status		
Single	2	2.7

Married	50	66.7
Widower	4	5.3
Widow	16	21.3
Separated	3	4.0
Education		
No formal	4	5.3
Primary	6	8
Secondary	23	30.7
Tertiaries	42	56.0
State of Origin		
Rivers	44	58.7
Abia	8	10.7
AkwaIbom	5	6.7
Delta	5	6.7
Imo	11	14.7
Anambra	1	1.3
Bayelsa	1	1.3
Occupation		
Unemployed	5	6.7
Employed	23	30.7
Self Employed	33	44.0
Retired	14	18.7
Student	0	0.0
Total	75(100)	100

Table 3.2: Frequency Occurrence and Percentage Distribution of Blood Groups in the Study Population

This table focuses on the distribution of blood group systems among individuals with diabetes.

ABO Blood Group SystemBlood group O is the most prevalent among the diabetic population (45.3%), followed by group A (30.7%), B (21.3%), and AB (2.7%).

Rh D Blood Group System: The Rh-positive group dominates the population (96%), while Rh-negative accounts for only 4%.

Lewis Blood Group System: The Le^{a+} group (60%) is more prevalent than Le^{a-} antigens (40%), similarly, Le^{b-} individuals (81.3%) vastly outnumber Le^{b-} antigens (18.7%).

Kidd Blood Group System: No individuals were Jk^{a+}, with the entire population being Jk^{a-} (75 cases, 100%). For the Jkb antigen, only 4 cases (5.3%) were Jk^{b+}, while most individuals are Jk^{b-} (71 cases, 94.7%).

Table 3.2: Frequency Occurrence and Percentage Distribution of Blood Groups in the Study Population

Blood Groups	FrequencyofDiabetes (N)	Prevalence of Diabetes (%)
A	23	30.7
B	16	21.3
AB	2	2.7
O	34	45.3
Rh^-	3	4.0
Rh^+	72	96.0
Le^{a+}	45	60.0
Le^{a-}	30	40.0
Le^{b+}	61	81.3
Le^{b-}	14	18.7
Jk^{a+}	0	0.00
Jk^{a-}	75	100
Jk^{b+}	4	5.3
Jk^{b-}	71	94.7
Totalforeachbloodgroup	75	100

4. Discussion

Numerous studies have been done to look into the potential relationship between the phenotypes of the blood groups among diabetes mellitus, but the results have proven to be inconsistent and varied from study to study from one country to another country, from one region to another region or even from one city to another city (16).

This study aimed to explore the prevalence of Kidd, Lewis, ABO and RhD blood group systems in diabetic patients attending RSUTH. The prevalence of ABO blood group among diabetes in this study was in the other of O>A>B>AB. This study slightly relates with the research done by Reetu and associate were they had the similar trends of ABO blood group system distribution among diabetes but differs from the study of (17) were they observed increased frequency of blood group AB (19). Also, this study slightly differs to the study of Abdullahi and associates in Lagos were blood group O individuals were the least diabetic and blood group B and A were the most diabetic (31). This study also corresponds with the study conducted by Bener & Yousafzai, in Qatar were blood group B was dominant among diabetics. Various authors have different findings which can be as a result of different geographical regions (18).

Additionally, the percentage distribution of RhD antigen is RhD+> RhD- (95.3% and 4.7%) The study is similar with the of Christian and colleugues (20) and (21), where they reported that RhD is predominate amongst Kalabari ethnic tribe and in the Imo an Eastern state both in Nigeria. This finding also correspond to that of Reid and associates, where they reported a percentage distribution among Blacks to be 92 % (32).

Distribution of Lewis blood group system among diabetes individual is yet to be extensively studied in Rivers State. This study has therefore revealed the presence of Lea and Leb amongst the diabetic and non-diabetic subjects. The trends of Lewis antigens distribution for diabetes subjects is Leb+>Lea+>Lea->Leb-. The findings in this study does not correspond with the findings of Dipta and associates (22) and (23) were the distribution was Lea- > Leb->Le b+ > Lea+> Lea+.

In addition, among diabetic groups the distribution of Kidd blood group antigens is Jka+, ,Jkb+,Jkb- Jka- (0.0%, , 5.3%, 94.7% 100%) respectively. This study slightly disagrees with the study of (24) and (25) they reported 3.3% and 2.1% for Jka antigens. Their slightly elevated percentage might be due to the fact that in their study, freshly collected samples were analysed with potentiating medium which enhance the detection of the antigens as this medium wasn't used in this study. The finding from this current study also differs from the research of Halawani (26); Capriolli (27) and Onodera (28) were none of their study participants had Jka- or Jkb-. The reason for this wide variance may be due to geographical differences. Our findings of very high prevalence of Jka- and Jkb- corresponds with what Hamilton & Janis postulated (29), they concluded that the genetic background of the dominantly inherited Jka- or Jkb- is due to an 84 bp deletion in ZFN850 on chromosome 19.

5. Conclusion

In this study the distribution pattern of ABO blood group among subjects with diabetes mellitus was in the other of O>A>B>AB (45.3%, 30.7%, 21.3% and 2.7% correspondingly), for Rh blood group system is Rh+> Rh- (95.3% and 4.7%). Also in this study, no subjects was tested Jk^{a+} and Jk^{b+}, the distribution pattern among diabetic groups the distribution of Kidd blood group antigens is Jk^{a+}>Jk^{b+}> Jk^{b-} >$Jk^{a-}$is 0.0%, 100%, 5.3%, 94.7% respectively. Distribution of Lewis antigens in this study showed the following sequence for diabetes subjects is Le^{b+}>Le^{a+}>Le^{a-}>Le^{b-}.

CONSENT AND ETHICAL APPROVAL

Informed consent was obtained from apparently healthy subjects prior to enrolment upon approval by the Department of Medical Laboratory Science, Rivers State University, Port Harcourt.

COMPETING INTERESTS

Authors have declared that no competing interests

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