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Blood Group, Genotype, Malaria, Blood Pressure and Blood Glucose Screening Among Selected Adults of a Community in Kwara State: Implications to Public Health

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background and Objective: Blood groups and Haemoglobin variants vary widely. The malaria scourge is a major setback in Africa. Due to ageing, adults are prone to non-communicable diseases like hypertension. This research was carried out to determine the ABO, Rhesus blood groups and Haemoglobin variants among young people, and to carry out malaria, blood pressure and blood glucose screening among the elderly in Osi Community, Ekiti Local Government Area, Kwara State.

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Materials and Methods: An empirical research design was done in Osi Community from June 2021 to August 2021. A total of 84 elderly subjects (46 females and 38 males), and 90 young subjects (51 females and 39 males) were selected by purposive sampling. ABO and Rhesus groups were determined using tiles. Haemoglobin variants were determined using alkaline electrophoresis. Malaria screening was done using rapid diagnostic kits. Blood pressure was measured using arm blood pressure monitor. Blood glucose was measured using glucometer.
Results: Elderly males mean age was 66.58±10.97 years compared to 62.07±11.74 years for females (p=0.075). Elderly males blood glucose was 112.71±21.85 mg/dl and 105.09±38.46 mg/dl for females (p=0.281). Systolic blood pressure among elderly males was 147.89±24.45 mmHg and 150.07±22.88 mmHg for females (p=0.676). Diastolic blood pressure among elderly males was 86.61±15.07 mmHg and 86.41±11.12 mmHg for females (p= 0.947). ABO and Rhesus blood group number and percentages among young people were: blood group A 28 (31.1%), B 18 (20.0%), AB 4 (4.4%), O 40 (44.4%), while Rhesus D positive subjects were 87 (96.7%), and Rhesus D negative subjects were 3 (3.3%). Haemoglobin genotype distribution was: AA 66 (73.3%), AS 24 (26.7%), SS 0 (0.0%).
Conclusion: The risk of getting heart-related illnesses increases with age. Knowledge of ABO, Rhesus blood groups and haemoglobin genotype variants is vital in healthcare management, medical diagnosis and genetic counselling.

Keywords: Blood group; haemoglobin; Glucometer; blood glucose; blood pressure; genetic counseling.

1. INTRODUCTION

Hypertension is a major risk factor for cardiovascular and cerebrovascular diseases [1]. Blood pressure is defined as the force of blood pushing against the arterial walls as blood circulates throughout the body. Blood must circulate at an appropriate pressure in order to sustain life. A healthy adult normally has a blood pressure of 120/80 mmHg (millimeters of mercury) or less [1]. Even though blood pressure varies within an individual, those with a pressure of 140/90mmHg or more for a sustained period of time is said to have high blood pressure (Hypertensive) [1]. A person with high systolic pressure and normal diastolic pressure is classified as hypertensive and the same applies for a person with high diastolic pressure and normal systolic pressure [2].

Evaluation of blood glucose is intended to diagnose hypoglycemia, hyperglycemia, or euglycemia.

The ABO and Rhesus blood groups are the most popular blood groups [3], which are classified based on the presence of certain antigens on the surface of erythrocytes. Blood group antigens can either be carbohydrate structures which are present on red blood cell surface glycoproteins or glycolipids [4], or an amino acid sequence of polypeptides or glycoproteins [5]. On the red blood cell (RBC), there are not less than 23 red cell surface proteins which show blood group polymorphism [6]. The A, B and O blood groups were first shown by Karl Landsteiner in 1900 and demonstrated an important step towards development of safer blood transfusions [3]. Alfred von Decastello and Adriano Sturli invented the 4th type of blood group known as AB, in 1902 [7], whereas Landsteiner and Weiner in 1940 discovered the Rhesus (Rh) blood group [7]. Individuals can be classified as blood group A, B, AB and O, based on the reactions produced between their red cell antigens and commercially-prepared antisera, which contain corresponding antibodies. The ABO and Rhesus blood group antigens are particularly important in population genetics studies, in blood transfusion science, and in resolving medicolegal issues like paternity or maternity disputes [8]. The nomenclature “Rh blood group” was derived from the rhesus monkey, in which the Rh antigens were initially discovered in the year 1940. It is the most complex of the human blood group systems with about 52 well-defined antigens, and the D antigen (RhD) is considered the most immunogenic of all Rhesus antigens [6]. An individual can either be classified as either Rhesus D positive or Rhesus D negative, based on the agglutination reaction or no reaction with anti-D antibody or reagent. The Rh group which is complex, is actually described in terms of alleles D and d. other major alleles are C, c, E, e. The ABO and Rh blood groups are considered the most clinically significant because of how they can cause haemolytic disease of the foetus and newborn (HDFN) and also, their ability to

cause blood transfusion reactions during a blood transfusion [8] when an incompatible blood group from a donor is transfused into a recipient.

Malaria remains the most endemic parasitic disease which has ravaged humanity, and Africa happens to be one of the most affected continents. The disease is caused by a haemoparasite known as *Plasmodium*, which is a member of the Plasmodium genus. It is transmitted through the bite of a female Anopheles mosquito which is infected with the parasite. There are five species of *Plasmodium* which cause malaria in man. They include: *P. vivax*, *P. ovale*, *P. malariae*, *P. knowlesi* and *P. falciparum* [9].

Malaria is a major public health challenge in 97 countries and territories in the tropics and subtropics [10]. According to the WHO annual malaria report [9], Nigeria suffers the world's greatest malaria burden, with approximately 51 million cases and 207,000 deaths reported annually (approximately 27 % of the total malaria burden in Africa), while 97 % of the total population (approximately 173 million) is at risk of infection.

Sickle Cell Disease (SCD) is the most common single gene disorder with a large prevalence in sub-Saharan Africa, the Mediterrenean, and the Middle East because of the concept of heterozygous advantage in which the sickle cell trait provides protection against malaria in the individual, who possesses the defective gene [11]. It has a high prevalence in malaria-endemic regions [12]. SCD is an inherited qualitative haemoglobinopathy, which is caused by the substitution of a single amino acid at the sixth residue of the beta (*β*)-globin subunit resulting in the production of the characteristic haemoglobin S (HbS) [13]. Under conditions of deoxygenation (that is, when the Haemoglobin molecule is not bound to oxygen), the four tetramers of haemoglobin, which include the two-mutant sickle *β*-globin subunits (HbS), can polymerize, and this can cause the RBC to take up a crescent or sickle cell shape. These sickle-shaped RBCs are rigid and non-functional, and are also responsible for acute and chronic clinical manifestations of SCD.

This study was aimed at carrying out the ABO blood group and Haemoglobin genotype among young people with malaria screening, blood pressure and blood glucose levels among adults in Osi community, Ekiti Local Government Area of Kwara State.

2. MATERIALS AND METHODS

The PI visited Osi Community on the 22nd of June 2021 on a familiarization visit, in the company of the designated representative of the CCD. An introductory letter from the CCD was presented to the Traditional Ruler, His Royal Highness, the Olosi of Osi Community by the PI who also explained the purpose of the visit. The Traditional Ruler of Osi Community encouraged the team to visit the Community anytime they so desired for execution of the study. The day for the subsequent visit to the Community was initially fixed for Thursday 8th July 2021, but subsequently rescheduled to Saturday 10th July 2021.

Thereafter, blood samples of consenting youths were collected into EDTA anticoagulated sample containers, where they were to be subsequently subjected to ABO grouping and Haemoglobin genotype screening.

The ABO blood group and Haemoglobin genotype tests of ninety (90) youths were subsequently analyzed from Sunday 11th July 2021 to Wednesday 14th July 2021. The youths were of different blood groups while 66 youths (73%) were of Haemoglobin genotype AA, and 24 youths (27%) were of Haemoglobin genotype AS. The blood samples used for the study were adequately disposed of after analysis, in line with standard laboratory protocols.

3. RESULTS

Table 1 shows that out of 84 adult and elderly participants, 4 (4.8%) were aged between 36 and 45 years, 11 (13.1%) were aged between 46-55 years; 31 (36.9%) were aged between 56-65 years; 22 (26.2%) were aged between 66-75 years, while 16 (19.0%) were aged between 76 and 85 years. Also, 46 (55%) of the participants were females, while 38 (45%) of the participants were males. In the same vein, 8 (9.5%) of the participants had normal BP, 12 (14.3%) had elevated BP, 24 (28.6%) had stage 1 HT, 35 (41.7%) had stage 2 HT, while 5 (6.0%) had hypertensive crisis. For their glycemic state, 1 subject (1.2%) had hyperglycemia (elevated sugar level), while 83 (98.8%) had euglycemia (normal sugar level). For their malaria statuses, 2 subjects (2.4%) tested positive to Plasmodium falciparum, while 82 (97.6%) tested negative.

Table 1. Socio-demographic characteristics of the elderly subjects

Characteristic	Number observed	Percentage (%)
Age (Years)		
36-45	4	4.8
46-55	11	13.1
56-65	31	36.9
66-75	22	26.2
76-85	16	19.0
Gender		
Female	46	55
Male	38	45
Blood pressure		
Normal BP	8	9.5
Elevated BP	12	14.3
Stage 1 HT	24	28.6
Stage 2 HT	35	41.7
Hypertensive crisis	5	6.0
Glycemic state		
Hyperglycemia	1	1.2
Euglycemia	83	98.8
Malaria		
Positive	2	2.4
Negative	82	97.6

The numbers are values and percentages with respect to the total number of participants

Table 2 depicts the mean levels of the age, blood glucose levels, Systolic blood Pressure and Diastolic blood pressure between the male and female participants.

The mean of the age was higher in the male subjects (66.58±10.97) compared to the female subjects (62.07±11.74) (p = 0.075).

Also, the mean blood glucose level (mg/dl) was higher in the male subjects (112.71±21.85) compared to the females (105.09±38.46) (p = 0.281).

In the same vein, the Diastolic blood pressure (mmHg) was slightly higher among the male subjects (86.61±15.07) compared to the female subjects (86.41±11.12) (p = 0.947).

Conversely, the Systolic blood pressure (mmHg) was higher among the female subjects (150.07±22.88) when compared with that of the male subjects (147.89±24.45) (p = 0.676).

Table 3 shows the mean levels of the blood glucose levels according to the ages and blood pressures of the subjects

Subjects aged between 36-45 years were 4 in number (4.8%) and had a mean blood glucose level of 96.25±12.69. Subjects aged between 46-55 years were 11 in number (13.1%) and had a mean blood glucose level of 97.64±9.93. Subjects aged between 55-65 years were 31 in number (36.9%) and had a mean blood glucose level of 108.19±24.59. Subjects aged between 66-75 years were 22 in number (26.2%) and had a mean blood glucose level of 118.86±51.47. While subjects aged between 76-85 years were 16 in number (19.0%) and had a mean blood glucose level of 105.56±19.65.

Table 2. The mean levels of the age, blood glucose levels, Systolic blood Pressure and Diastolic blood pressure between the male and female participants

Characteristic	Male	Female	P value
Age	66.58±10.97	62.07±11.74	0.075
Blood Glucose (mg/dl)	112.71±21.85	105.09±38.46	0.281
BP Systolic (mmHg)	147.89±24.45	150.07±22.88	0.676
BP Diastolic (mmHg)	86.61±15.07	86.41±11.12	0.947

**P is significant at <0.05 N = 84*

With respect to blood pressure, 8 subjects (9.5%) had normal blood pressure and a mean blood glucose of 106.75±26.80. A total of 12 subjects (14.3%) had elevated blood pressure and a mean blood glucose of 104.67±18.33. There were 24 subjects (28.6%) with Stage 1 Hypertension and a mean blood glucose of 105.67±18.38. There were 35 subjects (41.7%) with Stage 2 Hypertension and a mean blood glucose level of 112.86±44.10. Finally, there were 5 subjects (6.0%) with Hypertensive crisis and a mean blood glucose of 104.20±20.47.

Table 4 shows the sociodemographic characteristics of the young subjects.

Out of 90 young people who participated in the study, 15 (16.7%) were aged between 1-10 years, while 54 (60.0%) were aged between 11-20 years. Also, 16 (17.8%) were aged between 21-30 years, while 4 (4.4%) were aged between 31-40 years. Lastly, 1 (1.1%) was aged between 41-50 years.

For the gender distribution, 39 (43.3%) of the subjects were males, while 51 (56.7%) were females. In terms of religious denomination, 35 (38.9%) of the participants were Muslims, while 55 (61.1%) were Christians. For distribution by ethnicity, 86 (95.6%) of the participants were Yoruba, 1 (1.1%) was Idoma, 2 (2.2%) were Bassa, while 1 participant (1.1%) was Igala.

For occupation, 73 (81.1%) of the young participants were students, 9 (10.0%) were teachers, 2 (2.2%) were tailors, 3 (3.3%) of the participants were entrepreneurs, 2 (2.2%) were farmers, while 1 (1.1%) was a driver.

Table 5 shows the ABO blood group, Rhesus blood group and Haemoglobin genotype distribution of the young participants.

Out of the 90 subjects, 28 (31.1%) were of blood group A, 18 (20.0%) were of blood group B; 4 (4.4%) were of blood group AB, while 40 (44.4%) were of blood group O. While for the Rhesus blood group distribution, 87 of the participants (96.7%) were Rhesus D Positive, while 3 (3.3%) were Rhesus D Negative.

For the Haemoglobin genotype distribution, 66 of the young participants (73.3%) were of genotype AA, while 24 (26.7%) were of genotype AS.

Table 3. The mean levels of the blood glucose levels according to the ages and blood pressures of the subjects

Age	*BG (mg/dl)	BP (Systolic) mmHg	BP (Diastolic)	N	%
36-45 years	96.25±12.69	152.25±17.78	82.75±14.13	4	4.8
46-55 years	97.64±9.93	140.09±19.73	85.00±9.09	11	13.1
56-65 years	108.19±24.59	151.77±23.82	85.94±14.60	31	36.9
66-75 years	118.86±51.47	145.82±24.96	86.18±13.56	22	26.2
76-85 years	105.56±19.65	153.75±24.62	90.00±11.51	16	19.0
BP	***BG (mg/dl)**			**N**	**%**
Normal BP (<120/80 mmHg)	106.75±26.80			8	9.5
Elevated BP (Systolic=120-129 mmHg) (Diastolic= <80 mmHg)	104.67±18.33			12	14.3
Stage 1 HT (Systolic=130-139 mmHg) (Diastolic=80-89 mmHg)	105.67±18.38			24	28.6
Stage 2 HT (Systolic ≥ 140 mmHg) (Diastolic ≥ 90 mmHg)	112.86±44.10			35	41.7
Hypertensive crisis (Systolic= >180 mmHg) (Diastolic >120 mmHg)	104.20±20.47			5	6.0

*Key: *random blood sugar result ≥200mg/dl is indicative of Diabetes (ADA, 2021)*
BG: Blood Glucose
BP: Blood Pressure

Table 4. Sociodemographic characteristics of the young subjects

Characteristic	Number observed	Percentage (%)
Age (Years)		
1-10	15	16.7
11-20	54	60.0
21-30	16	17.8
31-40	4	4.4
41 and above	1	1.1
Gender		
Female	51	56.7
Male	39	43.3
Religion		
Muslim	35	38.9
Christianity	55	61.1
Ethnicity		
Yoruba	86	95.6
Idoma	1	1.1
Bassa	2	2.2
Igala	1	1.1
Occupation		
Students	73	81.1
Teachers	9	10.0
Tailors	2	2.2
Entrepreneurs	3	3.3
Farmers	2	2.2
Drivers	1	1.1

Table 6 shows the correlation of the ABO blood group, Rh blood group, haemoglobin genotype with other parameters among the young subjects.

A non-significant positive relationship was observed between the ABO blood group and the age, sex, religion, ethnicity and occupation of the subjects ($r = 0.071$; $r = 0.021$; $r = 0.117$; $r = 0.154$; $r = 0.096$ and $p = 0.508$; $p = 0.841$; $p = 0.273$; $p = 0.148$; $p = 0.369$).

A significant positive relationship was observed between the Rhesus blood group and the age and ethnicity of the participants ($r = 0.207$; $r = 0.386$ and $p = 0.050$; $p = 0.001$). There was a non-significant positive relationship observed between the Rhesus blood group and the religion of the subjects ($r = 0.021$ and $p = 0.843$). A non-significant negative relationship was observed between the Rhesus blood group and the sex and occupation of the subjects ($r = -0.087$; $r = -0.010$ and $p = 0.413$; $p = 0.922$).

A non-significant positive relationship was observed between the Haemoglobin genotype and the age, sex, religion, ethnicity and occupation of the subjects ($r = 0.187$; $r = 0.020$; $r = 0.069$; $r = 0.107$; $r = 0.017$ and $p = 0.077$; $p = 0.850$; $p = 0.520$; $p = 0.315$; $p = 0.874$).

4. DISCUSSION

This participatory action research aimed to ascertain the ABO blood group and Haemoglobin genotype among young people and also assess malaria status, blood pressure and blood glucose levels among adults in Osi community, Ekiti Local Government Area of Kwara State. This will give insight in the relationship between ABO and Rh blood group with haemoglobin genotype to malaria, blood pressure and blood glucose for public health implications.

Findings revealed that the male adult subjects had an average mean age and blood glucose level that was greater than their female counterparts, while the females had slightly higher systolic blood pressure than the males. The male subjects had a slightly higher diastolic blood pressure than the females, though these

Table 5. ABO Blood group, Rhesus Blood group and Haemoglobin genotype characteristics of the young participants

Characteristic	Number observed	Percentage (%)
ABO Blood Group		
Blood Group A	28	31.1
Blood Group B	18	20.0
Blood Group AB	4	4.4
Blood Group O	40	44.4
Rhesus Blood Group	**Number observed**	**Percentage (%)**
Rhesus D Positive	87	96.7
Rhesus D Negative	3	3.3
Haemoglobin genotype	**Number observed**	**Percentage (%)**
AA	66	73.3
AS	24	26.7

Table 6. The correlation of the ABO blood group, Rh blood group, haemoglobin genotype with other parameters among the young subjects

Parameters	ABO Blood group		Rhesus Blood group		Haemoglobin genotype	
	r	p-value	r	p-value	r	p-value
Age	0.071	0.508	0.207	0.050*	0.187	0.077
Sex	0.021	0.841	-0.087	0.413	0.020	0.850
Religion	0.117	0.273	0.021	0.843	0.069	0.520
Ethnicity	0.154	0.148	0.386	0.001*	0.107	0.315
Occupation	0.096	0.369	-0.010	0.922	0.017	0.874

**p-value is significant at 0.05 N=90*

differences were not statistically significant. These findings do not agree with that of [14] where men had significantly higher blood pressure than women. We believe that the females in this study had a higher systolic blood pressure because of the numerous pressures associated with domestic family life among women in the rural areas. For instance, some men in this part of Nigeria marry more than one wife and only concern themselves occasionally with providing for the needs of the family, while the women have to suffer from the pressures associated with childbirth, where some develop pre-eclampsia, which leads to high blood pressure and has no cure. In addition, most women in these rural areas engage in daily strenuous farm work and still have to come home cook to for the family. They also have to run around to care for the children when they fall sick, while the men only have to concentrate mostly on procreation. The men had a slightly higher blood glucose level than the females. This could be as a result of the fact that most men in this part of Nigeria participate in different kinds of ceremonies and events in which refreshments are usually bountiful, while the women are mostly engaged in domestic activities as highlighted earlier.

We also found that 22 subjects within the age range of 66 to 75 years had the highest blood sugar level, while 16 subjects within the age range of 76 to 85 years had the highest systolic and diastolic blood pressure. Subjects within these age ranges are highly prone to heart attack due to weakened blood vessel walls and consequently, an increased workload for the heart [15] A total of 35 subjects with stage 2 Hypertension according to the AHA classification had the highest blood glucose level, while normal blood pressure was observed among only 8 subjects. Reduction of the blood pressure could lead to a reduction in major macrovascular and microvascular complications [16].

The predominant blood group among the youths in our study was blood group O, while the least common blood group was blood group AB. These findings are similar to the studies by Oke, T.O et al. [3], [17], [18], and [19]. We also observed that 97% of the young subjects were Rhesus D positive, while 3% were Rhesus D negative. This finding is very similar to the finding of [3] and much similar to a study carried out in Uganda involving 23,504 subjects [20]. However, given the number of participants in our study, our data cannot be considered to be statistically significant. It is important to know the Rhesus status of an individual, because it is a very key component of blood transfusion after the ABO blood group. The Rhesus antigen is clinically important because it is highly immunogenic [21]. Individuals who lack the D antigen will produce antibodies to the antigen (anti-D) if they are transfused with blood containing the antigen. This could result in a blood transfusion reaction, or, in the case of pregnant, Rhesus D negative females married to Rhesus positive males, could lead to Haemolytic Disease of the Newborn (HDN). Moreover [22], opined that when blood groups are 100% inherited genetically, the particular blood groups in a given population that can be passed on to the next generation, can be determined by the environment through the process of natural selection.

The overall distribution and prevalence of the Haemoglobin genotype was 73.3% for AA and 26.7% for AS. We did not record any case of SS genotype, probably because of the small population of our study. However, our findings were similar to that of [18], who used a much larger population. Knowledge of haemoglobin variants and carrier status is very important in making decisions pertaining to human

reproduction, in order to reduce the risk of acquiring conditions like sickle cell disease and other haemoglobinopathies.

We observed a significant positive relationship between the age, ethnicity, and Rhesus blood group of the young subjects. This could be because majority of the participants were youths of Yoruba descent.

5. CONCLUSION

The importance of screening for blood glucose and blood pressure among adults cannot be overemphasized, since aging affects these parameters. Also, due to the endemicity of malaria in Nigeria, it is imperative that adults should be screened regularly in order to know their status regarding the aetiological agent. It is also important that youths, especially those who have attained marriageable age be subjected to ABO, Rhesus, and Haemoglobin genotype screening, in order to help them with the right choice of a suitable and compatible life partner.

ETHICAL APPROVAL

Ethical Clearance for the study was obtained from the Kwara State Ministry of Health on Wednesday 7th July 2021.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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