


Research Article

# ABO, Rhesus Blood Groups and Transfusion-transmitted Infections among Blood Donors in Gabon

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## Abstract

**Background:** Few studies focused on the study of blood groups in Gabon. This study aimed to determine the phenotypic frequency of ABO and Rhesus antigens in blood donors of Libreville and to assess the association between ABO blood groups and transfusion-transmitted infections.

**Materials and Methods:** The study of ABO and Rhesus blood groups concerned 4,744 blood donors. ABO and Rhesus phenotyping were obtained using monoclonal monospecific antisera: anti-A, anti-B, anti-AB, anti-D, anti-E, anti-C, anti-c, and anti-e with an automate (QWALYS<sup>®</sup> 3, DIAGAST, France) or a card gel (ID Card, BIO-RAD) according to manufacturer's instructions.

**Results:** The phenotypic frequency of blood group antigens A, B, AB and O were respectively 21.0%; 17.6%; 2.6% and 58.9%. Those of Rhesus antigens D, d, C, c, E and e were 97.7%; 2.3%; 15.9%; 99.9%; 17.6%; 99.3%, respectively. The prevalence of ABO and Rh antigens in Gabonese donors reported here are significantly different from those of neighboring countries. No association was found between the prevalence of HIV, HCV and syphilis and ABO blood groups. Instead, HBV seroprevalence was twice as high among non-O blood groups donors compared with blood group O donors [OR = 2 (CI 1.26 to 3.2), p = 0.003].

**Conclusions:** This study provides new data on phenotypic frequency of ABO and Rh blood groups in a representative sample of the Gabonese blood donor population. It suggests a significant association between ABO blood group and HBV infection.

**Keywords:** ABO, Rhesus, blood donors, HBV, Gabon

## 1. INTRODUCTION

Blood transfusion remains a therapy carrying specific risks not only because of the possible blood incompatibility between the donor and the recipient; but also because

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of the potential transmission of blood borne pathogens. One of the ways to limit the post-transfusion adverse events is to phenotype blood donors for the main red cell blood group systems and to simultaneously detect the transfusion-transmitted infections (TTIs).

According to the WHO, in 39 countries blood donations are still not routinely tested for TTIs including HIV, HBV, HCV and syphilis; 47% of blood bags in low-income countries are examined in laboratories without quality assurance [1]. It is estimated that 1.6 million blood units/year are deferred and destroyed due to the presence of TTI's markers [1].

The understanding of blood group systems has evolved to include not only blood transfusion compatibility but also the relationship between some infectious diseases and the antigens in erythrocytes [2]. Several studies have shown an association between specific blood group antigens and the risk of pancreatic cancer [3-5]. Associations between the ABO system and various diseases including malaria infection, cerebral thrombosis and ovarian cancer have also been found [6-8].

In Gabon, few studies have been devoted to blood groups. This relative lack of information has led to undertaking this study. This investigation aimed to determine the phenotypic frequencies of the ABO and Rhesus D, C, c, E, e antigens in the Gabonese population and to study the association between transfusion-transmitted infections and the ABO blood groups.

## 2. MATERIALS AND METHODS

### 2.1. Blood donors

A retrospective analysis of blood donors' data from January to May 2015 in the national blood transfusion center (CNTS) in Libreville, Gabon was conducted. Volunteer and family/replacement donors were all apparently healthy subjects, selected after responding to a questionnaire including a medical history. They were aged 17-65 years weighing over 50 kg and eligible for blood donation. Socio-demographic characteristics were recorded, and venous blood was collected in blood collection bags following standard procedures.

### 2.2. Determination of ABO and Rh phenotyping

ABO and Rhesus phenotyping were obtained using monoclonal monospecific antisera: anti-A, anti-B, anti-AB, anti-D, anti-E, anti-C, anti-c, and anti-e with an automate

(QWALYS® 3, DIAGAST, France) or a card gel (ID Card, BIO-RAD) according to manufacturer's instructions. Positive and negative control red cells were used and the Beth-Vincent and Simonin-Michon's tests were performed as controls.

### 2.3. Serological analysis

Antibodies to HCV and HIV types 1 and 2 were detected using Monolisa HCV Ag-Ab ULTRA version 2 and Genscreen HIV-1/2 version 2 (BIO-RAD, Marnes-la-coquette, France). Hepatitis B surface antigen (HBsAg) and antibodies to *Treponema pallidum* were screened with Monolisa HBsAg ULTRA and *Treponema pallidum* haemagglutination test (BIO-RAD, Marnes-la-coquette, France) following the manufacturer's instructions.

### 2.4. Statistical analysis

Data analysis was done by using the Statistical Package for the Social Sciences (SPSS version 20.0) and EPI-Info version 6.04dfr (CDC, Atlanta, USA). The results were considered significant for  $P < 0.05$ .

## 3. RESULTS

### 3.1. ABO and Rh phenotypic frequencies

From a total of 4,744 blood donors, 59.7% were in the age group of 21-30 years with a mean age of  $29.9 \pm 7.0$  (range 17-61 years). Of these, 83.1% donors were male and 16.9% donors were female.

Among blood donors the overall prevalence of blood groups O, A, B and AB were 58.9%; 21.0%; 17.6% and 2.6%, respectively (Table 1). The majority of blood donors from O blood group were male (48.8%). AB blood group was the least represented among blood donors (2.2% of male and 0.4% of female) (Table 1).

In the Rhesus blood group, 5 antigens were tested: D (RH1), C (RH2), E (RH3), c (RH4) and e (RH5). The absence of the D antigen was denoted d (Rhesus negative). The frequencies of Rhesus antigens D, d, C, E, c and e were respectively 97.7%; 2.3%; 15.9%; 17.6%; 99.9% and 99.3% (Table 2). The majority of Rhesus negative individuals was male (2.0%) and from O blood group (1.4%). Only 0.3% of female was Rhesus negative and 0.1% of blood donors were both AB blood group and Rhesus negative (Table 2).

	Blood Groups			
	O	A	B	AB
	N (%)	N (%)	N (%)	N (%)
<b>Sex</b>				
Male	2,314 (48.8)	832 (17.5)	692 (14.6)	105 (2.2)
Female	478 (10.1)	162 (3.4)	144 (3.0)	17 (0.4)
<b>Age groups (years)</b>				
≤ 20	88 (1.9)	29 (0.6)	29 (0.6)	5 (0.1)
21-30	1,658 (35.0)	597 (12.6)	507 (10.7)	71 (1.5)
31-40	775 (16.3)	276 (5.8)	221 (4.7)	38 (0.8)
> 40	271 (5.7)	92 (1.9)	79 (1.7)	8 (0.2)
Total	2,792 (58.9)	994 (21.0)	836 (17.6)	122 (2.6)

TABLE 1: Frequency of ABO blood groups in blood donors according to sex and age groups.

The major Rh phenotypes observed among blood donors were respectively Dccee (66.5%), DccEe (15.3%) and DCcee (13.5%). The minor phenotypes obtained were DCcEe (1.5%), ddccee (1.5%), dCcee (0.8%), DccEE (0.7%), DCCee (0.1%) and DCCEe (0.02%).

### 3.2. Association between blood groups and transfusion-transmitted infections

Among blood donors 233/4,744 (4.9%) were infected with at least one pathogen. The overall seroprevalence of antibodies to HIV, HCV and syphilis was 1.1%; 0.5% and 1.6%; HBsAg prevalence was 1.7%. The seroprevalence of HIV, HBV, HCV and syphilis markers was compared between blood donors of blood group O and non-O as shown in Table 3.

HIV, HCV and syphilis markers seroprevalence was similar in blood donors of group O compared to non-O blood groups (Table 3). However, the prevalence of HBsAg was twice higher among non-O blood groups donors compared to donors of O blood group [OR= 2; 95%CI: 1.3, 3.2;  $p = 0.003$ ].

	Sex		Blood groups			
	Male	Female	O	A	B	AB
<b>Rh antigen:</b>	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
D	3,846 (81.1%)	787 (16.6%)	2726 (57.5%)	972 (20.5%)	818 (17.2%)	117 (2.5%)
d	97 (2.0%)	14 (0.3%)	66 (1.4%)	22 (0.5%)	18 (0.4%)	5 (0.1%)
C	617 (13.0%)	138 (2.9%)	442 (9.3%)	165 (3.5%)	126 (2.7%)	22 (0.5%)
c	3,938 (83.0%)	800 (16.9%)	2787 (58.8%)	994 (21.0%)	835 (17.6%)	122 (2.6%)
E	694 (14.6%)	143 (3.0%)	491 (10.4%)	175 (3.7%)	142 (3.0%)	29 (0.6%)
e	3,915 (82.5%)	795 (16.8%)	2770 (58.4%)	991 (20.9%)	828 (17.5%)	121 (2.6%)

TABLE 2: Distribution of rhesus antigens according to sex and blood groups.

Blood groups	N	HIV positive N (%)	OR (IC 95%)	P-values
O	2,792	29 (1.0)	-	0.635
Non O	1,952	24 (1.2)	1.2 (0.7-2.1)	
		HBV positive N (%)		
O	2,792	34 (1.2)	-	<b>0.003</b>
Non O	1,952	47 (2.4)	2 (1.3-3.2)	
		HCV positive N (%)		
O	2,792	10 (0.4)	-	0.288
Non O	1,952	12 (0.6)	1.7 (0.7-4.3)	
		Syphilis positive N (%)		
O	2,792	44 (1.6)	-	0.848
Non O	1,952	33 (1.7%)	1.1 (0.7-1.7)	

OR= Odds ratio ; CI = confidence interval. In bold significant p-value

TABLE 3: Prevalence of HIV, HBV, HCV and syphilis according to ABO blood groups.

## 4. DISCUSSION

This study aimed to determine the prevalence of ABO and Rhesus blood groups among blood donors and their association with TTIs. This study shows the distribution of ABO and Rhesus phenotypes in a relatively large population of Gabonese blood donors. The phenotypic frequency of blood groups A, B, AB, O and D were respectively 21.0%,

Continents/countries	Frequencies of ABO and RhD (%)					References
	O	A	B	AB	D	
Present study (N= 4,744)	58.9	21.0	17.6	2.6	97.7	
<b>Africa</b>						
Congo (N= 5,400)	52.3	23.1	21.1	3.5		Ref. [13]
Cameroon (N= 14,546)	48.6	25.1	21.9	4.5	96.3	Ref. [14]
Burkina Faso (N= 37,210)	43.4	22.7	28.2	5.8	86.2	Ref. [15]
Morocco (N= 344,954)	46.1	33.9	15.7	4.3		Ref. [16]
<b>Europe</b>						
France	43.0	45.0	9.0	3.0	85.0	Ref. [17]
<b>Asia</b>						
India (N = 12,701)	28.7	28.7	32.1	10.5	94.5	Ref. [8]
Japon	29.9	39.8	19.9	9.9	-	Ref. [19]
USA	46.6	37.1	12.2	4.1	85.4	Ref. [20]

TABLE 4: Comparison of ABO frequency in Gabonese blood donors and in previous studies.

17.6%, 2.6%, 58.9 and 97.7% (Tables 1 and 2). Group O and Rh positive blood groups were predominant in contrast with AB and Rh negative groups. The AB blood group was relatively rare, (0.4% in women and 2.2% in men). There were very few Rh negative women (0.3%) limiting the risk of maternal-fetal incompatibility and its prevention during pregnancy. The major Rhesus phenotypes observed were Dccee (66.5%), DccEe (15.3%), DCcee (13.5%). Indeed, Dccee Rhesus phenotype has been previously described as more prevalent in black populations<sup>9</sup>. The frequency of Dccee phenotype found in our study is comparable to that reported in Mali<sup>10</sup>. However, it is lower than the 73.6% reported in southern Nigeria [11].

The prevalence of the ABO blood groups were compared with those obtained in a previous study in Gabon, which reported the following phenotypic frequencies: 20% for A, 17.3% for B, 4.1% for AB and 58.6% for group O [12]. These results are similar to ours presented here.

However, AB blood group prevalence was higher in the study by Languillat et al [12], although the difference observed was not statistically significant ( $X^2 = 2.4$ ,  $p = 0.122$ ).

Frequencies of the ABO and Rh blood groups obtained from blood donors were compared to neighboring donor populations of Central Africa (Congo and Cameroon), West Africa (Burkina Faso), North Africa (Morocco) and the world (Table 4). The prevalence of ABO phenotypes in Gabon was significantly different from those observed in other African countries such as Congo, Cameroon, Burkina Faso, and Morocco [13–16]. In fact, the frequency of the O blood group was higher than that observed in these African countries while the prevalence of blood groups A and B was lower. Unsurprisingly, the ABO phenotypic prevalences in this study were very different from those observed in

Asia, including India and Japan; in Europe and the USA [17–20]. This could be explained by the genetic distance between the predominantly Gabonese black population and population of Caucasian and Asian descent. The high prevalence of group O in sub-Saharan Africa has been in part attributed to selection related to malaria being less severe clinically in carriers of O blood group [21–23].

This study also evaluated the association between ABO blood groups and blood-borne infections such as HIV, HBV, HCV and syphilis. The prevalence of seroreactive HIV, HBV, HCV and syphilis markers was 1.1%, 1.7%, 0.5% and 1.6%, respectively. These seroprevalences were lower than seroreactivities reported in a previous study [24]. No confirmation was performed so that the prevalence of antibodies to HIV, HCV and syphilis was likely considerably overestimated. The difference between the two sample sizes, the selection of Gabonese donors only in the present study and the evolution of these infections' epidemiology could partly explain these differences.

No significant association between HIV, HCV, syphilis and ABO blood groups was found among blood donors. However, the risk of HBV infection appeared twice higher among non-O donors compared to O blood group donors. This result would need to be supported by detection of HBV DNA with a sensitive assay. It is however in agreement with previous studies [25, 26]. A recent study showed a higher risk of hepatocellular carcinoma associated with hepatitis B in non-O blood group compared to O blood group patients [27].

## 5. CONCLUSION

This study reports the prevalence of the ABO and RhD blood groups in a representative sample of the Gabonese blood donor population. It also suggests the association between the ABO blood group and chronic HBV infection.

## 6. DECLARATIONS

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**Ethics approval:** This study was approved by the CNTS Ethics Committee.

**Competing interests:** the authors declare no conflict of interest.

**Availability of data and material:** Data and material could be available on demand.

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