

## RESEARCH ARTICLE

### FREQUENCIES OF RHESUS BLOOD GROUP SUBTYPES, AND PROBABLE GENOTYPES IN SUDANESE POPULATION

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**ABSTRACT: Background.** This is a community-based, prospective, and analytical study aimed to determine the frequencies of Rhesus blood group (Rh) alleles, haplotypes, and probable genotypes, and establishing baseline data. **Materials and Methods.** Following informed consent, a total of 1,000 venous blood samples from unrelated individuals were collected. Particle gel immunological diffusion and slide agglutination procedures were used to screen red blood cells for common Rhesus antigens. The frequencies of genes/alleles and haplotypes, as well as the most likely genotypes, were determined. Jaccard's coefficient of similarities was used to calculate similarities between different Sudanese populations. The same coefficient was used to figure out where these people came from. **Results.** The  $\bar{e}$ ,  $\bar{c}$  and the D genes were the commonest alleles detected with frequencies of 98.4%, 93.8% and 90.7% respectively. The C and the E genes were the least frequent with 58.4% and 21.0% frequencies respectively. The Commonest Rh genotype encountered was the  $\bar{cDe}$  (frequency= 44.2%). The  $\bar{CcDe}$  and  $\bar{CcDEe}$  genotypes were detected with lower frequencies of 21.7% and 10.9% respectively, while  $\bar{CcDE}$ ,  $\bar{Cde}$  and  $\bar{CdE}$  genotypes were the least common [frequencies 0.3%), 0.2% and 0.1% respectively]. The most probably common haplotypes complex was  $\bar{cDe}/\bar{cde}$  (frequency= 44.2%) and the least common was  $\bar{CdE}/\bar{cdE}$  (frequency= 0.1%). **Conclusion-** The antigen e was found to be the most frequent in major Sudanese populations, when the frequency of E antigen was the least once. the frequency of c antigen among this study populations exhibited high frequency (99).

**KEYWORDS:** blood groups, Rh phenotype frequencies, Sudan

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## **INTRODUCTION:**

Various cellular and soluble components of whole blood combine with certain antibodies to form red blood group antigens.<sup>[1]</sup> Antibodies and chemicals with known specificities can be used to change the phenotypic of red blood cells. Because of the relevance of blood transfusion in surgery and other hemorrhagic catastrophes<sup>2</sup>, blood types have been the topic of investigation.<sup>[2]</sup> The Rh blood group system was the fourth system to be discovered, yet it is the second most important in blood transfusion medicine. It was first described 60 years ago.<sup>[1]</sup> The Rh blood group system is one of the most polymorphic and immunogenic systems known to man. In the past decade, intense investigation has yielded considerable knowledge of the molecular background of this system. The genes encoding distinct Rh proteins that carry C or c together with either E or e antigens, or the D antigen, have been cloned and the molecular basis of many of the antigens and of the phenotypes have been determined.<sup>[3]</sup> A related protein, the Rh glycoprotein is essential for assembly of the Rh protein complex in the erythrocyte membrane and for expression of Rh antigens. Landsteiner and Wiener found that sera from rabbits (and later guinea pigs) immunized with RBCs from *Macaca mulatta* (*Macacus rhesus* in the original paper) agglutinated 85% of human RBC samples. Initially, it was thought that the animal and human antibodies identified a common factor, Rh, on the surface of rhesus and human RBCs.<sup>[4]</sup> Therefore, the original terms (Rh factor and anti-Rh) coined by Landsteiner and Wiener, although being misnomers, have continued in common usage. The hetero antibody was renamed anti-LW (after Landsteiner and Wiener), and the human alloantibody was renamed anti-D. The Rh blood group system is the most polymorphic of the human blood groups, consisting of at least 45 independent antigens and, next to ABO, it is the most clinically significant in transfusion medicine. The ability to clone complementary DNA (cDNA) and sequence genes encoding the Rh proteins have led to an

understanding of the molecular bases associated with some of the Rh antigens.<sup>[4]</sup> The clinical importance of the Rh blood group system stems from the fact that the antigen D of the system is highly immunogenic. If a unit of D-positive blood is transfused to a D-negative recipient, anti-D antibodies are formed in 90% of cases. Moreover, if a D-negative women becomes pregnant with a D-positive (ABO compatible) infant, the passage of red cells across the placenta from fetus to mother induces primary immunization to D in about one in six cases, unless the mother receives anti-D IgG. In a subsequent pregnancy with a D-positive infant, secondary immunization may be induced leading to hemolytic disease in the infant.<sup>[5]</sup>

## **MATERIALS AND METHODS:**

This is descriptive, prospective analytical study conducted in different parts of Sudan during the period over two years, to determine the Rh phenotypes frequencies and gene complexes among the major Sudanese populations. Following written informed consent 1000 unrelated volunteers will be bled. By using venous blood collection technique 2.5 ml of venous blood is collected in EDTA container from each member of study group.

By employing gels premixed with reagents, specific volumes and a no-wash antiglobulin test that eliminates re suspension of red cell buttons, the gel test reduces the variation inherent in conversional techniques.

The DiaMed-ID Micro Typing System utilises a sephadex gel to capture agglutinates in a semi-solid medium. This enhances visualization of agglutination as compared to the traditional tube techniques. In the latter, the agglutinate, particularly in weak reactions, mixes with the free cells at the bottom of the tube, making visualization difficult.<sup>6</sup>

## **Ethical approval**

This study received ethical approval from the Sudanese state of Khartoum's Directorate of Health

Affairs. Each participant received an information leaflet and a consent form prior to participating. All participants were informed that their participation was entirely voluntary and that they might refuse to answer any questions if they so desired. They were able to interrupt and leave the interview whenever they wanted, with no repercussions. All participants' consent forms, according to this study, included the distribution of anonymized responses.

**RESULTS:**

The antigen e was found to be the most frequent in major Sudanese tribes (98.4%) followed by c (93.8%), D (90.7%), C (58.4%), and E (21.0%) respectively.

The distribution of antigen e among major Sudanese populations has revealed that high similarity between different Sudanese tribes. The prevalence of C antigen in these populations in **Table 1.** revealed that high heterogeneity between different populations of Sudan. 36

About the frequency of c antigen among this study populations exhibited high frequency (99%). Also, with respect to the distribution of D antigen in this study in **Table 1.** it was observed that high similarity between different major population of Sudan. The frequency of E antigen among Sudanese populations in **Table 1.** was showed that the E antigen is least frequent of all common Rhesus antigens **Table 1.** Common phenotypes in order of frequency among Sudanese populations in **Table 2.** was exhibited that the most frequent phenotype is cDe (44.2%) and the least frequent phenotypes are CE (0.1%) and CcE (0.1%). Common gene complex frequency among Sudanese populations in **Table 3.** was showed the most common gene complex is cde , the second one is cDe (22.1%) and the least common is Cde (0.1%). Common genotype in order of frequency in **Table 4.** was revealed that the cDe/cde (R0r) (44.2%) is the most frequent genotype and Cde/cdE (ryr//) (0.1%) is the lowest frequent genotype. In all this study

populations in **Tables 5.** the cDe/cde is the most frequent genotype

**Table 1. Common Rh antigens in order of frequency among Sudanese populations:**

Antigen	frequency (Percentage)
E	98.4
C	93.8
D	90.7
C	58.4
E	21.0

**Table 2. Common phenotypes in order of frequency among Sudanese populations:**

Phenotypes	Frequency (percentage)
cDe	44.2
CcDe	21.7
CcDEe	10.9
cDEe	6.8
Ce	5.7
CDe	5.6
Cce	1.5
CcEe	0.9
cDE	0.8
cEe	0.6
CDEe	0.3
CDE	0.3
CcDE	0.3
Ce	0.2
CE	0.1
CcE	0.1

**Table 3. Common gene complex frequency among Sudanese populations:**

gene	Frequency (percentage)
CDe	21.95
cde	43.15
cDe	22.10
cDE	09.75
Cde	01.50
cdE	00.80
CDE	00.60
CdE	00.15

**Table 4. Common genotypes in order of frequency among Sudanese populations:**

Genotypes	Frequency (percentage)
cDe/cde	44.2
CDe/cde	21.7
CDe/cDE	10.9
cDE/cde	6.8
cde/cde	5.7
CDe/CDe	5.6
Cde/cde	1.5
Cde/cdE	0.9
cDE/cDE	0.8
cdE/cde	0.6

**Table 5. Common genotypes in order of frequency among Sudanese populations:**

Genotypes	Frequency (percentage)
cDe/cde	44.2
CDe/cde	21.7
CDe/cDE	10.9
cDE/cde	6.8
cde/cde	5.7
CDe/CDe	5.6
Cde/cde	1.5
Cde/cdE	0.9
cDE/cDE	0.8
cdE/cde	0.6
CDE/CDe	0.3
CDE/CDE	0.3
CDE/cDE	0.3
Cde/Cde	0.3
CdE/CdE	0.1
CdE/cdE	0.1

**DISCUSSION:**

D antigen positive in these study populations was found to be (90.7%), which is similar to that reported in Afro American frequency which was (90%).<sup>[7]</sup> And differ to that found in Caucasians (85%)<sup>8</sup>, Nigeria populations (95%).<sup>[9]</sup> This finding as such because the Nigerians are parley African and Caucasians are parley Whites, but Sudanese populations are a mixture of Africans and Arabs. The e antigen frequency in these study populations was found to be (98.5%), which is representing the highest incidence of all common Rhesus antigens in Sudanese populations. This frequency is like Nigerians

populations lived in West (98.7%)<sup>[16]</sup> But is differ to Nigerians lived in Eastern part (94.7%).<sup>[10]</sup> In all tribes of this study populations the frequency of e antigen is higher than (95%), in Caucasians is (98%), in Nigerians is higher than (94%).<sup>[9]</sup>

According to this finding we are suggesting that the e antigen is the most frequent antigen in most world populations than the other common Rhesus antigens.

There is a great similarity of the distribution of e antigen between many Sudanese populations. The frequency of c antigen in Sudanese populations is (93.8%) which is differ to Nigerians (100%)<sup>[11]</sup>, and Caucasians (80%).<sup>[12]</sup> The distribution of C antigen among Sudanese populations was found to be (58.4%), which is unlike to Nigerians and Caucasians (2.78% and 70% respectively)<sup>[13]</sup>. In prevalence of C antigen there is no identical percentage between the Sudanese populations. The frequency of E antigen in this study populations is (21.0%), which is differ to the results reported in Caucasians (30%)<sup>[14]</sup> and Nigerians (18.89%).<sup>[15]</sup> The E antigen least frequent in Sudanese population among all other common Rhesus antigen. The most frequently occurring Rhesus phenotypes in Sudanese populations is Dce (47%), which also most frequently existing phenotype in Nigerians (73.61%),<sup>[16]</sup> but is unlike to Caucasians DCce (32.6%).<sup>[17]</sup>

### **CONCLUSIONS:**

The e (Ag) resembled the predominant frequency (95.8%), followed by c and C (Ags) (81.8% and 62.3%, respectively). The lowest Rh (Ag) frequency was 31.4% for E. The e (Ag) was the highest frequency (95.8%) for female donors, followed by c and C (Ags) (81.8% and 60.4%, respectively). For the male subjects, the frequencies of Rh (Ag) C, E, c, and e were 62.5%, 31.9%, 81.7%, and 95.8%, respectively)

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