

Blood group phenotype distribution in Saudi Arabs

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Summary

The distribution of eight blood phenotypes (ABO, Rh, MNSs Lutheran, Kell, Duffy, Kidd and Lewis) was determined in Saudi Arabs and compared with corresponding published information for Caucasians and Negroes of United States of America. Saudi Arabs manifest ABO phenotype distribution similar to Negroes; rhesus phenotypes similar to Caucasians but an MNSs pattern largely distinct. Heterozygous Kell phenotype, Kk, was much more frequent in Saudi Arabs than in either Caucasians, or Negroes. The Kidd system null allele, JK^{a-b} was not seen in the studied group. However, increased frequencies of null alleles of the Duff (Fy^{a-b}) and Lewis (Le^{a-b}) systems were observed in Saudi Arabs.

Keywords: Blood groups, phenotypes, Saudi Arabs.

Résumé

La distribution de huit groupes sanguins a phenotype (ABO, Rh, MNS, Luthran, Kell, Duffy, Kidd et Lewis) avait été déterminée chez les Saoudiens et comparée aux informations publiées des Caucasiens et Nègres des Etats-Unis d'Amérique. Les Saoudiens ont présenté les phenotypes ABO similaire a ceux des negres. Leurs facteur Rhesus étaient similaire a ceux des Caucasiens mais avec un MNSs très différent. Le phenotype heterozygote de Kell, Kk était plus fréquent chez les saoudiens que chez les Caucasiens ou Nègres. Le Systeme allele nul de Kidd, KJK^{a-b} n'était pas observé dans le groupe étudié, mais une augmentation de fréquence du système de null allele de Duffy, (Fy^{a-b}) et de Lewis (Le^{a-b}) avait été observée chez les Saoudiens.

Introduction

The distribution of blood group phenotypes has been known to show interesting variations among and at times within racial groups [1,2]. These variations have been attributed to various factors which include genetic and environmental selective pressures. Knowledge of the frequency of blood group phenotypes in a given population is of anthropological, forensic, as well as clinical values.

Since the discovery of human blood groups by Karl Landsteiner in 1900, several investigators have documented the distribution of blood groups in many racial and ethnic groups [3,4]. Particularly notable are studies on Caucasians and Negroes which have identified certain blood group phenotypes as virtually distinguishing these two races [5].

The Kingdom of Saudi Arabia (KSA) is a prominent country in the Middle East. It is bordered on the West by the Red Sea; by Jordan, Iraq and Kuwait on the North; by the Persian Gulf, Qatar, United Arab Emirates and Oman on the East and Yemen and Oman on the South. For many thousand years the KSA has been inhabited by

Arabs that originated from two major tribes namely Adnanian and Gahtanian [6].

The main subtribes of the Adnani tribe are the Gorashi that live in the Western Region of the KSA between Makkah, Medinah and Taif; Thogaif in the Taif area; Sobaic in Najd and South of Taif, Mutairi in the Central and Eastern regions of the Peninsula and Otaybi that live in the area extending east of the Taif to the Washm and Gaseem region [6]. The subtribes of the other main tribe, Gahtan, include Belawis that live in the Northern West part of KSA; Jehanis which live along the Western coast of KSA in Wajh and Yanbu area; Harbis that live in Higaz region; Harthi in Taif area; Bogami in the West of Taif; Shahrani, Ghamdi, Zahrani, Malki and Asiri all live in the Southern part of KSA [6].

A computer-based search indicates that the distribution of blood group phenotypes in Saudi Arabs has hardly been studied. The aim of this study is to provide this information, and to compare blood groups phenotype distribution patterns of Saudi Arabs with those published for Caucasians and Negroes.

Materials and methods

Of approximately ten thousand Saudi Arab blood donors and antenatal patients attending King Khalid National Guard Hospital (KKNHG), Jeddah, KSA, during 1990-1994, 3924 were randomly selected for this study. KKNHG is a general hospital serving the National Guard Soldiers and their dependants in addition to the general Saudi population. Arab status of each subject was thoroughly ascertained prior to inclusion by an experienced Saudi interviewer. Reference was also made to the characteristic tribal/subtribal names as stated in subjects' national identity cards. Blood donors were all consented before bleeding in accordance with the guidelines of the American Association of Blood Banks.

Ten mls of blood was collected from each subject into plain tubes. Blood group determination was done within 8 hours of sample collection in batches by experienced blood bank technologists. ABO phenotype was determined on all subjects by the forward and reverse groups using monoclonal anti-sera (anti-A, anti-B, anti-A, B) and standard red cells (A1, B and O) obtained from Ortho-Diagnostics, NJ, USA. Adequate controls were included with each batch. The Rhesus (D) grouping was done on all subjects. However, phenotyping for C.c.E. and e antigens was done on 203 randomly selected subjects from the main study group using specific anti-sera obtained from Ortho-Diagnostics according to the manufacturer's instructions. Subjects were randomly selected from the main group for determination of Kell, Duffy, Kidd, Lutheran, MNSs and Lewis blood group phenotypes. Specific antisera (anti-K, k, M, N, S, s, Le^a, Fy^a, Fyb, Jk^a, Jk^b, Lu^a, and Lu^b) obtained from Ortho-Diagnostics, Behringwerke (Marburg, Germany), DiaMed AG (Cressler sur Morat Switzerland), Dominion Biologicals (N.S. Canada), were used according to the manufacturers instructions. One hundred subjects were typed for the MNSs antigens, 116 for the Kell, 161 for the Kidd, 91 for the Duffy, 256 for the Lewis, and 192 for the Lutheran antigens.

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Results

The percentage frequency distributions of the different blood group phenotypes in Saudi Arabs are shown and compared with those published for Negroes and Caucasians in Tables 1, 2, 3, and 4.

Table 1: Percentage frequencies of ABO blood group phenotypes in Saudi Arabs compared with Caucasian and Negro distributions

ABO phenotype	Saudi Arabs	Caucasians ¹⁵	Negroes ¹⁶
A	27	44.7	27
B	15.9	8.59	19
O	53.9	43.45	49
AB	3.5	3.26	4

Table 2: Percentage frequency distribution of Rhesus blood group phenotypes in Saudi Arabs compared with Caucasians, and negro distribution.

Rhesus Phenotype	Saudi Arabs	Caucasian ¹⁶	Negroes ¹⁶
CcDEe	14.8	14	4
CcDee	28.1	32	26
ccDEe	10.3	13	16
CCDec	20.7	16	3
ccDEE	4.4	3	1
ccDee	10.8	1.5	42
ccdee	10.3	15	7
Ccddee	0.49	0.4	1
ccddEe	Rare	0.2	Rare

Discussion

As evident from Table I, Saudi Arabs share similar A and B phenotype distributions with Negroes but differ from Caucasians who manifest at least 1.6 times more group A, and about half the distribution of group B phenotypes seen in Arabs. In Saudi Arabs. Group O phenotype frequency is 1.2 times that reported in the Caucasians, but is closely similar to the Negroes figures (53.9% 49%). It is therefore inferred that Saudi Arabs share a closer ABO phenotype distribution pattern with Negroes than with Caucasians.

The frequency of rhesus-D antigen in the Saudi Arabs, Caucasians, and Negroes when computed from Table II are 89.2%, 84.4%, respectively. While the CcDee phenotype is the most common rhesus phenotype in Saudi Arabs as well as in Caucasians, the ccDee phenotype is the most frequent in Negroes being at least three times more than that found in Saudi Arabs or Caucasians. The distributions of the CcDee and ccDEe are however comparable in the three racial groups. Conversely, each of the phenotypes, CcDEe, CCDec, ccDEE and ceddee is at least 1.5 to 6 times more frequent in Saudi Arabs or Caucasians than in Negroes. These frequency distribution patterns tend to indicate a closer rhesus phenotype distribution pattern in Saudi Arabs and Caucasians as compared to that reported for the Negroes. This information may be of clinical relevance with regard to suggesting potential relative frequencies of occurrence of rhesus iso-immunisation associated with pregnancy or transfusion in the three racial populations.

Table 3: Percentage frequencies of MNSs, Kell and Kidd blood group phenotypes in Saudi Arabs compared with Caucasian, and Negro distribution.

Blood Group Phenotype	Saudi Arabs	Caucasian ¹⁶	Negroes ¹⁷
MNSs System			
M	55	28	26
MN	41	50	44
N	4	22	30
S	22	11	3
Ss	43	44	28
s	35	45	69
Kell System			
K	0.9	0.2	0.13
Kk	19	8.8	3.5
k	80	91	96.5
Kidd System:			
Jka+b-	50	27.5	57
Jka+b+	8	49.5	34
Jka-b+	42	23.1	9

Table 4: Percentage frequencies of Duffy, Lewis, and Lutheran blood group [phenotypes in Saudi Arabs compared with Caucasian, and Negro distribution.

Blood group Phenotype	Saudi Arabs	Caucasian ¹⁶	Negroes ¹⁶
Duffy System			
Fya ^{-b-}	25	17	9
Fy ^{a+b+}	11	49	1.0
Fy ^{a+b-}	29	34	22
Fy ^{a-b-}	35	Very rare	68
Lewis System			
Le ^{a+b-}	27	22	23
Lea-b+	56	72	55
Le ^{a-b-}	17	6	22
Lutheran System			
Lu ^{a+b-}	1.9	0.15	0.1
Lu ^{a+b+}	16	7.5	5.2
Lu ^{a-b-}	81	92.35	94.7
Lu ^{a-b+}	0.5	Very rare	Rare

Saudi Arabs manifest the highest frequency of the M (at least twice more) and least of N (at least 3 times less) of the racial groups compared, Table 3. However, the MN phenotype occurs at relatively similar frequencies in all the groups. The S phenotype on the other hand, is at least twice more in Saudi Arabs than in either of the other groups. Only in respect of the Ss phenotypes is similarity apparent for Saudi Arabs and Caucasians. It appears therefore, that the Saudi Arabs manifest MNSs phenotypes frequencies that is distinct from those of Caucasians or Negroes. The implications of this observation are not immediately clear but are obviously of interest because the MNSs system phenotype is known to be of considerable genetic and anthropological importance since they show less local variations than the ABO blood group phenotype [7]. Further, there are established associations between some MNSs phenotypes and disease. Some examples include malaria hepatosplenomegaly and the N phenotype [7] M-sialoglycoprotein and *P falciparum* infectivity of red blood cells

on the one hand and nephritogenic *E. Coli* infectivity on the other [8,9] and Ss phenotype and parotid gland enlargement [7].

The K phenotype is not frequently encountered in any of the three racial populations compared, Table 3. The reverse is however the case for the k phenotype. The Kk phenotype on the other hand is at least twice as frequent in Saudi Arabs than that reported in Caucasians and Negroes. The Jk^{a-b} phenotype of the Kidd system which has been reported to be exceedingly rare in Caucasians and Negroes [10] also appears to be very rare in Saudi Arabs since no such phenotype was detected in the present study, Table 3. Jk^{a-b} is however very frequent in Saudi Arabs (42%) compared with Caucasians (23%) and Negroes (9%).

Table 4 depicts phenotype distributions of the Duffy, Lewis, and Lutheran system. Saudi Arabs when compared with Caucasians manifest a high occurrence of null alleles of these blood group systems, almost similar to the pattern seen in Negroes. The Fy^{a-b} phenotype has been associated with resistance to *P. vivax* malaria in West Africans [11]. In Saudi Arabs, Geli and King [12] demonstrated an association between sickle-cell trait and Duffy null phenotype. Because malaria does occur in Saudi Arabia [13], the high frequency of Fy^{a-b} phenotype seen in Saudi Arabs may be a consequence of natural selection forces imposed by malaria. The frequency of Le^{a-b} phenotype in Saudi Arabs is 2.8 times that observed in Caucasians, but similar to Negro frequency. The null allele of the Lutheran phenotype, Lu (a-b-) is reported to be very rare in Caucasian and Negroes 14 while Saudi Arabs manifest a frequency of 0.5% for this phenotype, suggesting that the phenotypes is not uncommon in this population.

In conclusion, of the eight blood group systems examined in Saudi Arabs in the present study, three (ABO, Lewis and Duffy System) exhibit phenotype distribution patterns essentially similar to patterns reported by previous studies for Negroes. Conversely, similarity is shared with figures published for Caucasians only in respect of some rhesus phenotypes notably CeDEe, CeDee, CCDee, eeEe Ccddee. For the Kell, Kidd, and Lutheran systems, Saudi Arabs appear to exhibit phenotypes distribution pattern which neither conform to Negroes nor Caucasian published figures.

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