

ABO Blood Group and RhD Phenotypes in Bahrain: Results of Screening School Children and Blood Donors.

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Background: Frequencies of ABO blood groups and Rh types show geographic variations.

Objective: To estimate frequencies of ABO groups and Rh types in Bahraini subjects.

Setting and Subjects: Frequencies of ABO blood groups and Rh types along with the respective gene frequencies were estimated in two study groups: (1) 5675 Bahraini school students in age group 16-20years and (2) 7362 adult Bahraini blood donors.

Results: Frequencies of ABO groups in both study groups showed Group O>Group B>Group A>Group AB. Both study groups also showed >90% frequency of the RhD phenotype.

Conclusion: The frequencies of ABO and Rh phenotypes in Bahrain are similar to those reported from most areas in the Arabian Gulf region. These frequencies appear to be intermediate between Europe and south/south-east Asia.

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Studies of blood group antigens can be used to characterise populations which is one aspect of their use as genetic markers. Among the different blood group systems, the ABO system is

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the most widely studied for obvious reasons. An approximate estimate of ABO gene frequencies resulting from a compilation of various studies world wide, is 0.63 for group O, 0.215 for A and 0.162 for B¹.

Geographic differences between frequencies of different blood groups may be striking. Gene frequency for group O may be higher than 0.9 (ie.90%) among Central and South American Indians^{1,2}. On the other hand the B gene which is almost totally absent in these populations and in Australian aborigines with similarly very low frequencies in Egypt and West Africa, has a relatively high frequency in Central Asia and North India^{1,2}. A recent study from India confirms this³.

The present study was part of a survey conducted among Bahraini school children. The results have been compared with hospital blood bank samples.

METHODS

The National Project for Prevention of Hereditary Blood Diseases in Bahrain was a collaborative project between the Ministry of Health, Ministry of Education, Rotary Club of Manama, and Bahrain Hereditary Anemia Society. All students in the 11th grade who belonged to the age group 16-20 years were screened for thalassaemia, haemoglobinopathies and G6PD deficiency in addition to ABO blood groups and RhD typing. This included all Bahraini students in the government and private schools.

A total of 7000 students in 38 schools were screened. Permission for screening was obtained from parents, and the response rate of the parents to allow their children to have the test was 81%. Therefore, the number of students screened was 5685.

Blood groups and RhD types of 7362 healthy Bahraini blood donors who reported to the blood bank of Salmaniya Medical Complex were also analysed. Blood groups and RhD types were determined by the slide and tube methods. Commercially available antisera were used. ABO allele frequencies were estimated according to a published method which yields results that are close to maximum likelihood estimates⁴. Preliminary estimates were calculated as: $p = 1 - \sqrt{B+O}$, $q = 1 - \sqrt{A+O}$, $r = \sqrt{O}$ (p , q , r denote allele frequencies and A, B, O denote observed frequencies of blood groups A, B and O). A correction factor (θ) was calculated according to $\theta = 1 - p - q - r$. The final estimate of allele frequencies was then calculated as follows: $p^1 = p(1 + \theta/2)$; $q^1 = q(1 + \theta/2)$; $r^1 = (r + \theta/2) (1 + \theta/2)$ [where p^1 , q^1 , and r^1 denote corrected allele frequencies].

RhD allele frequencies were calculated according to the Hardy-Weinberg equation 4.

RESULTS

Table1 shows comparison of blood groups and RhD distribution in Bahraini students and blood donors. Blood group O was the most common in both study groups comprising 49.6% and 53.4% respectively. Blood group O, RhD (+), and AB, RhD(-) were the most frequent (47.01%), and least frequent (0.25%) phenotypes respectively when both groups were analysed (Fig 1 & 2).

Figure 1. Blood group distribution 1999

Figure 2. Blood group and RH distribution (%) 1999

Table 1. Comparison of blood group and Rh distribution in Bahraini blood donors and school students

Blood Group	Rh	Students*		Total group %	Blood donors		Total group %
		No	%		No	%	
O	+	2668	47.01	2815 (49.6)	3652	49.61	3931 (53.4)
	-	147	2.59		279	3.79	
B	+	1311	23.10	1382 (24.35)	1637	22.23	1803 (24.49)
	-	71	1.39		64	0.87	
AB	+	245	4.32	259 (4.57)	234	3.18	253 (3.44)
	-	14	0.25		19	0.26	

* Total No. of students tested = 5675 Total No. of blood donors tested = 7362

Table 2 shows comparison of RhD phenotypes in students and blood donors. The Rh D (+) phenotype comprised 92.82%.

Table 2. Comparison of Rh phenotypes in Bahraini blood donors and school students

RH	No. of students	%	No. of blood donors	%
RhD (+)	5364	94.52	6834	92.82
RhD (-)	311	5.48	528	7.18

Table 3 shows comparison of expected allele frequencies of A, B and O blood groups among students and donors. The most frequent, blood group O, had a frequency of 0.73.

Table 3. Comparison of expected gene frequencies of A, B and O blood groups in Bahraini blood donors and school students

Gene	School students	Blood donors
p*	0.141	0.118
q	0.157	0.152
r	0.704	0.73

**p,q,r denotes gene frequencies of A,B and O respectively*

Table 4 shows comparison of expected gene frequencies of RhD in students and donors. Expected frequency of D was 0.77 in students while it was 0.73 among blood donors.

Table 4. Comparison of expected gene frequencies of Rh in Bahraini blood donors and school students

Rh gene	School students %	Blood donors %
D*	77	73
D	23	27

**D and d denotes gene frequencies of Rh positive and negative phenotypes*

DISCUSSION

The ABH antigens are ubiquitously expressed in humans and are present primarily as glycoproteins and partly as glycolipids. The ABO locus is found on the long arm of chromosome 9 (9q34.1-q34.2), and is linked to the AK₁ (adenylate kinase) locus and the NP (nail patella syndrome) locus^{5,6}. The locus for RhD is on chromosome 1⁶.

The two survey groups in this report differed in age: juvenile school children versus adults. Despite this difference, the ABO group and RhD frequencies were not significantly different between the two groups. A previous study in Bahrain that analysed blood bank samples only, reported similar figures⁷.

Phenotype frequencies of these antigens vary among different racial groups. Group O is the mark of a very ancient isolate¹. As mentioned previously, Group O is strikingly common (>0.9) in South American indigenous populations while group B is uncommon in these areas (<0.1). Approximate ABO blood group frequencies in North American Caucasians are: group O, 45%; group A, 40%; group B, 11% and group AB, 4%⁵. Similarly, in Britain, phenotype frequencies are: O, 46.8%; A, 41.7%; B, 8.6% and AB, 3% (gene frequencies are 0.683, 0.257, and 0.06 for O, A and B respectively)⁸. Generally, gene frequency of group A over much of Europe varies between 0.2 – 0.35 where as group B is less common than group A. From Europe to Asia, The frequency of B rises from a low of <0.1 in much of western Europe, to a range of 0.1 – 0.2 in East Europe to a high of 0.49 in Malaya. Group B is commoner than group A in some Asian countries such as India, Malaysia and Korea² and usually has a gene frequency between 0.2 to 0.4 in these regions.

Calculated gene frequencies from countries around the Arabian Gulf (Saudi Arabia, Yemen, Kuwait and Iran) show that frequency of group O gene varies between 0.6 to 0.75. Gene frequencies for groups A and B show minor differences and are generally between 0.12 to 0.17. The reported data from Bahrain, past and present, fall within these ranges. Slightly different figures have been reported from the Abadan area of Iran with a higher frequency of Group B (0.235) and a lower frequency of group O (0.601). Therefore the frequencies of groups A and B in Bahrain and in neighbouring countries of the Arabian Gulf appear to be intermediate between Europe and South/South-East Asia.

There are wide variations in the frequencies of the Rh gene complexes. The highest frequencies are seen in South America (Peru). High frequencies of RhD, >0.9, are also seen in North India and has been observed in some areas in Nigeria. High values are also seen in most parts of Africa². West Europe shows a relatively low frequency of RhD, ie., <0.7, with few exceptions. RhD gene frequency is remarkably low in parts of Italy and France (<0.5%)².

CONCLUSION

Blood group O RhD (+) was the most common and blood group AB RhD(-) was the least common among Bahrainis. Survey of blood groups and RhD types in school children and adults showed similar frequencies. The ABO group allele frequencies in the Bahraini population appears to be intermediate between eastern (Asian) and western (Caucasian) data.

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