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Prevalence of Phenotypes and Genes of ABO and Rhesus (Rh) Blood Groups in Faisalabad, Pakistan

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Abstract: The frequencies of ABO and Rhesus (D) blood groups and influence of gender were determined on prevalence of these blood groups. Blood group B was found to be the most frequent (38.004%). The frequency of blood group O was 28.755%, for group A 23.260% and for group AB 9.981%. In Rhesus blood grouping system the frequency of Rhesus (D) positive was 89.094%. Gene frequencies with respect to ABO and Rhesus (D) negative were different as for only ABO and ABO along with Rhesus (D) positive. The trend can be shown with a general formula $O > B > A > AB$. Group A positive (24.299%, 6.542% respectively) and negative (21.777%, 4.000% respectively) was more frequent in females as compared to males. In contrast group AB was more prevalent in males (12.444%) as compared to females (9.345%). There was a real preponderance of the blood group B over the blood groups O, A and AB as well as Rh (D) positive over Rh (D) negative. Predominance of blood group A in women was also reported. Group A along with Rhesus (D) negative group was more frequent than group B along with Rhesus (D) negative.

Key words: Blood groups, ABO, rhesus genes, ABO genes, gender influence, phenotype

Introduction

Blood groups have been the subject of research because of the importance of blood transfusion in surgery and the disastrous consequences of transferring blood of the wrong type (Brown *et al.*, 1992). Forensic application of blood group studies is of great value in detection of crime. Determination of paternity is another feature in forensic medicine after studying the blood group serology (Jolly, 2000).

The first human blood group to be discovered was ABO system by Landsteiner (1900). The discovery of ABO blood group system by Karl Landsteiner and his findings of red cell agglutination by serum and recognition of blood groups laid the scientific basis for safe practice of blood transfusion. Even though dozens of blood systems have been identified, the ABO system still remains to be one of the most important systems in transfusion medicine (Yamamoto, 2000). Other important systems are Rhesus (Rh), the MN system is less important in physiological and medical terms, among these, ABO and Rh systems are of major clinical significance.

Blood type is determined by the nature of different proteins present on the surface of red blood cells. Landsteiner, defined four basic groups within ABO system, A, B, AB, and O. The antigens of the ABO system are an integral part of the red cell membrane and of all the cells throughout the body. They are also being found in plasma and other body fluids. These soluble antigens are respectively A, B and H. The H antigen is a precursor to A and B antigens, but is not expressed as a recognizable antigen on red blood cells (Brown *et al.*, 1992).

All human populations share the same blood systems, although they differ in the frequencies of specific types. The distribution patterns of ABO and Rh systems are complex around the world. Some variation may even occur in different areas within one small country (Kolmakova and Kononova, 1999). A significant regional heterogeneity has been reported in the ABO and Rh blood group gene frequencies (Kucinkas *et al.*, 1994). Moreover one population may exhibit a high degree of similarity with a distant population that can be attributed to the common history of these populations (Mukhin, 1994; Susanne *et al.*, 1996).

Studies based on distribution patterns of ABO and Rh systems are very helpful for studying complicated evolutionary history of human and population migration. It is surprising that such studies have pointed out the evolutionary closeness of apes and monkeys to our species, because some of them share a number of blood typing systems with us as well. Another important aspect of such studies is that some diseases have been found to be more

common in some specific blood groups. For example the increased odds of stomach cancer among subjects with blood type A have been reported in epidemiological studies (You *et al.*, 2000). Present study was planned to determine the frequencies of the ABO and Rhesus D blood groups in and around Faisalabad, Pakistan and to assess any difference in prevalence of these blood groups in gender.

Materials and Methods

A total of 1092 persons donating blood and blood recipients attending diagnostic laboratories in different areas of Faisalabad were included in the study and were tested for Rhesus (Rh) (D) and ABO blood groups. The blood samples were collected either by finger prick with sterile lancet or by a sterile syringe. The Rhesus (Rh) and ABO blood groups were tested using TransClone kits for *in vitro* tests. The subjects included were residing in Faisalabad city or in nearby areas of Faisalabad. This data therefore reflects the prevalence of these blood groups in and around Faisalabad. Gender for 332 samples was known. This group was used to find any difference in prevalence of blood groups in gender.

Results

Blood group B was found to be the most frequent and was found in 38.004% subjects. The frequency of blood group O was 28.755% and for Group A was 23.260%. Blood group AB was least prevalent and was found in 9.981% subjects (Table 1). These gene frequencies with respect to ABO can be shown with a general formula $B > O > A > AB$. In Rhesus blood grouping system 89.094% individuals were Rhesus (D) positive.

With respect to both ABO and Rhesus systems prevalence of group B along with Rhesus (D) positive (B+ve) was 34.432%, group O along with Rhesus (D) positive (O+ve) 24.664%, group A along with Rhesus (D) positive (A+ve) 20.604% and group AB along with Rhesus (D) positive (AB+ve) 9.524% (Fig. 1). These gene frequencies with respect to ABO and Rhesus (D) positive were similar as for only ABO and can be shown with a general formula $B > O > A > AB$. Prevalence of group O along with Rhesus (D) negative (O-ve) was the highest and was 4.171%. Then after prevalence of group B along with Rhesus (D) negative (B-ve) was 3.571%, group A along with Rhesus (D) negative (A-ve) 2.656% and group AB along with Rhesus (D) negative (AB-ve) 0.458%.

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Table 1: Prevalence of ABO and Rhesus (Rh) blood groups in and around Faisalabad.

Rh group	ABO group				
	A	B	O	AB	
Rh Positive					
No.	225.000	376.000	269.000	104.000	974.000
percentage	20.604	34.432	24.664	9.524	89.094
Rh Negative					
No.	29.000	39.000	45.000	5.000	118.000
percentage	2.656	3.571	4.171	0.458	10.806
Total for ABO	254.000	415.000	314.000	109.000	1092.000
%ABO	23.260	38.004	28.755	9.981	

Table 2: Sex specific prevalence of ABO and Rhesus (Rh) blood groups in and around Faisalabad

Rh group	ABO group			
	A	B	O	AB
Rh Positive				
Male (%)	49(21.777)	66(29.333)	52(23.111)	28(12.444)
Female (%)	26(24.299)	32(29.906)	26(24.299)	10(9.345)
Rh Negative				
Male (%)	9(4.000)	8(3.555)	13(5.777)	0.00
Female (%)	7(6.542)	2(1.869)	4(3.738)	0.00
Total				
Males	25.777%	32.888%	28.888%	12.444%
Females	30.841%	31.775%	28.037%	9.345%

Figures in parenthesis indicate percentage (Total males = 225, Total Females = 107 these numbers were used for percentage calculation)

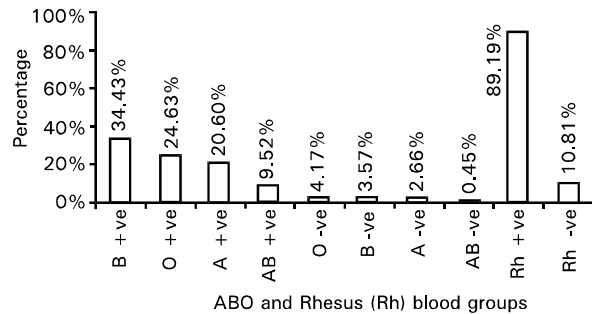


Fig. 1: Prevalence of Rh and ABO blood groups in Faisalabad district of Pakistan

These gene frequencies with respect to ABO and Rhesus (D) negative were different as for only ABO and ABO along with Rhesus (D) positive systems. These gene frequencies with respect to ABO and Rhesus (D) negative can be shown with a general formula $O > B > A > AB$. This means group B was more frequent than group A when it was inherited along with Rhesus (D) positive and group A was more frequent than group B when it was inherited along with Rhesus (D) negative group. Gender for 332 samples was known. This group was used to find sex specific prevalence of ABO and Rhesus (Rh) blood groups (Table 2). Out of 225 males 86.665% were Rhesus (D) positive and out of 107 Females 87.849% were Rhesus (D) positive. This shows equal sex specific prevalence for Rhesus (D) positive group. Similarly, out of 225 males 13.327% were Rhesus (D) negative and out of 107 females 12.149% were Rhesus (D) negative. This again shows equal sex specific prevalence for Rhesus (D) negative group. For ABO system group A was more prevalent in females (30.841%) as compared to males (25.777%) while group B (male 32.888% and female 31.775%) and group O (male 28.888% and female 28.037%) were equally prevalent in both sexes. Group AB was more prevalent in males (12.444%) as compared to females

(9.345%). Sex specific gene frequencies for group O positive (male 23.111% and female 24.229%) and for group B positive (male 29.333 and female 29.906%) were same for both sexes. Group A positive and negative was more frequent in females (24.299, 6.542% respectively) as compared to males (21.777, 4.000% respectively).

In contrast with this AB positive was more frequent in males as compared to females.

Discussion

Gene frequencies with respect to ABO system for present study can be shown with a general formula $B > O > A > AB$.

Previously in a survey conducted in Punjab the frequency of blood group A was 21.20, B, 36.16, AB, 9.05 and O, 34.14% (Afzal *et al.*, 1977). Distribution of blood groups in present study is therefore in agreement with those frequencies previously reported in Punjab.

Distribution of the ABO blood groups and of the Rh factor (D) investigated in different native ethnic groups (Kafirs, Kalash, Chitrali) in the Hindu Kush region of Afghanistan and Pakistan has revealed that all studied groups were characterized by a relatively high frequency of blood group gene A and extremely low frequencies of B and O (Bernhard, 1980). This distribution differs appreciably from gene frequencies in present study and the rest of the Indian subcontinent as well as that of the adjacent central Asiatic areas. These populations exhibited a high degree of dissimilarity with distant Punjabi population in Pakistan that can be attributed to the uncommon history of these populations.

There may be correlation between the incidence of this or that ABO blood group and geographic position of a region. For this reason we compare our own results with the data of other investigators concerning other Asian populations. Blood group A is the most prevalent in Russian Federation (Tomilin and Gurtovaia, 1999). Previously Mukhin (1994) has detected the irregular genetic-population structure of residents of the Donetsk Province Russia with respect to the ABO and Rh systems with a general formula $A > O > B > AB$, the only exception being Slavyansk where it was $O > A > B > AB$ (Mukhin, 1994). Therefore gene frequencies with respect to ABO system in present study differed greatly from the Russian populations.

Distribution of ABO and Rh (D) blood groups among four endogamous groups of Andhra Pradesh India showed a general trend of O greater than B greater than group A (Reddi *et al.*, 1980). Similarly in a Blood group distribution study in Nairobi, blood group O was found to be the most frequent: 49% in indigenous African donors, 45% in the general donor population and 34% among Asian donors. The frequency of blood group B was 33%, group A 26%, group AB 7% in the Asian donors (Mwangi, 1999). This difference with present study may be due to different geographical locations.

In a study of the distribution of ABO and Rh(D) blood groups amongst Lodha tribe in Midnapore district of West Bengal it was observed that incidence of group A was maximum and incidence of group AB was minimum; 99.5% of the subjects were 'Rh' positive (Datta *et al.*, 1997).

For Rhesus blood grouping system in present study 89.094%

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individuals was Rhesus (D) positive. In a blood group distribution study in Nairobi 90% of the Asian donors were Rhesus D positive (Mwangi, 1999). Our studies are in agreement with these findings. Previously in a survey conducted in Punjab only 2.76% cases were found to be Rh negative (Afzal *et al.*, 1977). Region under study therefore shows a relatively high frequency of Rhesus (D) genes as compared to other parts of Punjab. This shows that there might be difference in gene frequency of Rh system even in a small region within a small country.

In a study in Andhra Pradesh India, all individuals examined among the Vadagalai Ayangar Brahmins were Rh (D)-positive while other populations showed a low frequency of D allele (Reddi *et al.*, 1980). This similarity in frequency of Rhesus (D) genes in India and Pakistan can be attributed to the common history of these populations.

Gene frequencies for ABO along with Rhesus (D) positive were similar as for only ABO and can be shown with a general formula $B+ve > O+ve > A+ve > AB+ve$. Gene frequencies for ABO along with Rhesus (D) negative were different as for only ABO and ABO along with Rhesus (D) positive systems. These gene frequencies with respect to ABO along with Rhesus (D) negative can be shown with a general formula $O-ve > B-ve > A-ve > AB-ve$. This means that group B was more frequent than group A when it was inherited along with Rhesus (D) positive and group A was more frequent than group B when it was inherited along with Rhesus (D) negative group.

Previously, the predominance of blood group A in women has been reported in Russian Federation (Tomilin and Gurtovaia, 1999). Similarly in present study group A was more prevalent in females as compared to males while group B and group O were equally prevalent in both sexes. Group AB was more prevalent in males (12.444%) as compared to females (9.345%).

For Rhesus system their was equal prevalence in males and females for both Rhesus (D) negative and positive groups. Sex specific gene frequencies for group O positive and negative and for group B positive and negative were same for both sexes. Group A positive and negative was more frequent in females (24.299, 6.542% respectively) as compared to males (21.777, 4.000% respectively). In contrast with this AB positive was more frequent in males as compared to females.

There was a real preponderance of the blood group B over the blood groups O, A and especially AB as well as Rh (D) positive over Rh (D) negative. Predominance of blood group A in women was also reported. Group B was more frequent than group A when it was inherited along with Rhesus (D) positive and group A was more frequent than group B when it was inherited along with Rhesus (D) negative group.

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