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

Armaj Hameed, Wajahat Hussain, Janbaz Ahmed, Fazli-Rabbi and Javed Anver Qureshi
National Institute for Biotechnology and Genetic Engineering, P.O. Box 577 Jhang Road Faisalabad, Pakistan
National Laboratory, Akbar Chock, Near Allied Hospital Faisalabad, Pakistan

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 (39.004%). 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 (24.295%, 6.542% respectively) and negative (21.777%, 4.000% respectively) was more frequent in males as compared to females. In contrast group A positive 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 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 transfusing 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 Rh (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. Landsteiners, 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 (Kolnhekova and Konovova, 1999). A significant regional heterogeneity has been reported in the ABO and Rh blood group gene frequencies (Kucinski 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 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 1992 persons donating blood and blood recipients attending diagnostic laboratories in different areas of Faisalabad were included in the study and were tested for Rhesus (Rf) (D) and ABO blood groups. The blood samples were collected either by finger prick with sterile lancet or by a sterile syringe. The Rhesus (Rf) and ABO blood groups were tested using TransCure 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 O > B > A > AB. In Rhesus blood grouping system 89.094% individuals were Rh (D) positive. With respect to both ABO and Rhesus systems prevalence of group B along with Rhesus (D) positive (B+) was 34.432%, group O along with Rhesus (D) positive (O+) was 24.664%, group A along with Rh (D) positive (A+) was 20.604% and group AB along with Rhesus (D) positive (AB+) was 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 O > B > A > AB. Prevalence of group O along with Rhesus (D) negative (O-) was the highest and was 4.171%. Then after prevalence of group B along with Rhesus (D) negative (B-) was 3.571%, group A along with Rhesus (D) negative (A-) was 2.666% and group AB along with Rhesus (D) negative (AB-) was 0.468%.

722
Table 1: Prevalence of ABO and Rhesus (Rh) blood groups in and around Faisalabad.

<table>
<thead>
<tr>
<th>Rh group</th>
<th>ABO group</th>
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<tr>
<td></td>
<td>Rh Positive</td>
<td></td>
<td></td>
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<tr>
<td>No.</td>
<td>225,000</td>
<td>376,000</td>
<td></td>
<td>269,000</td>
<td>104,000</td>
<td>974,000</td>
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<tr>
<td>percentage</td>
<td>20.604</td>
<td>34.432</td>
<td></td>
<td>24.664</td>
<td>9.524</td>
<td>89.094</td>
</tr>
<tr>
<td>Rh Negative</td>
<td></td>
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<tr>
<td>No.</td>
<td>29,000</td>
<td>39,000</td>
<td></td>
<td>45,000</td>
<td>5,000</td>
<td>118,000</td>
</tr>
<tr>
<td>percentage</td>
<td>2.056</td>
<td>3.571</td>
<td></td>
<td>4.171</td>
<td>0.458</td>
<td>10.806</td>
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<tr>
<td>Total for ABO</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>254,000</td>
<td>415,000</td>
<td>314,000</td>
<td>109,000</td>
<td>1092,000</td>
<td></td>
<td></td>
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<tr>
<td>%ABO</td>
<td>23.269</td>
<td>38.004</td>
<td></td>
<td>28.755</td>
<td>9.381</td>
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Table 2: Sex specific prevalence of ABO and Rhesus (Rh) blood groups in and around Faisalabad.

<table>
<thead>
<tr>
<th>Rh group</th>
<th>ABO group</th>
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<tbody>
<tr>
<td></td>
<td>Rh Positive</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Male (%)</td>
<td>49(21.777)</td>
<td>68(29.333)</td>
<td>52(23.111)</td>
<td>28(12.444)</td>
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<tr>
<td>Female (%)</td>
<td>26(24.299)</td>
<td>32(29.306)</td>
<td>26(24.299)</td>
<td>10(9.345)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh Negative</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (%)</td>
<td>9(4.000)</td>
<td>9(3.565)</td>
<td>13(5.777)</td>
<td>6(2.604)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (%)</td>
<td>7(6.542)</td>
<td>1(0.889)</td>
<td>4(3.738)</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25.777%</td>
<td>32.989%</td>
<td>28.989%</td>
<td>12.444%</td>
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<td></td>
</tr>
</tbody>
</table>

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 87.049% 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 32.988% and female 31.775%) and group O (male 28.888% and female 28.032%) 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 28.900%) were same for both sexes. Group A positive and negative populations existed in females (24.295, 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 Asian areas. These differences may be due to a high degree of dissimilarity with distant Pakistani 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 (Tomlin and Gurtovaya, 1999). Previously Mukhni (1994) has detected the irregular genetic-population structure of residents of the Donetsk Province in Russia with respect to the ABO and Rh systems with a general formula A > O > B > AB, the only exception being Slavyanek where it was O > A > B > AB (Mukhni, 1994). Therefore gene frequencies with respect to ABO system in present study differed essentially from the Russian population.

Distribution of ABO and Rh (D) blood groups among four endogamous groups of Andhra Pradesh India showed a general trend of B greater than O greater than A greater than AB. For this reason we compared our own results with the data of other investigators concerning other Asian populations. Blood group B was found to be the most frequent: 45% in indigenous African doners, 45% in the general donor population and 34% among Asian donors. The frequency of blood group B was 33%, group A 28%, 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 89.064%
individuals were Rh negative. In a blood group distribution study in Nairobi 90% of the Asian donors were Rh 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 (Afta et al., 1977). Region under study therefore shows a relatively high frequency of Rh negative genes 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 Vaddapalli Ayangar Brahmins were Rh (D)-positive while other populations showed a low frequency of D allele (Raddi et al., 1980). This similarity in frequency of Rh (D) genes in India and Pakistan can be attributed to the common history of these populations.

Gene frequencies for ABO along with Rh (D) positive were similar as for only ABO and can be shown with a general formula B > A > 0, 0 > A > B. Gene frequencies for ABO along with Rh (D) negative were different as for only ABO and ABO along with Rh (D) positive systems. These gene frequencies with respect to ABO along with Rh(D) negative can be shown with a general formula 0 > A > B > 0, A > B > 0, B > A > 0, A > 0 > B. This means that group B was more frequent than group A when it was inherited along with Rh (D) positive and group A was more frequent than group B when it was inherited along with Rh (D) negative group.

Previously, the predominance of blood group A in women has been reported in Russian Federation (Tomlin and Gurtovaya, 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 Rh system their was equal prevalence in males and females for both Rh (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 (24.295, 6.542% respectively) as compared to males (21.777, 4.00% 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 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 Rh (D) positive and group A was more frequent than group B when it was inherited along with Rh (D) negative group.

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References


