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Distribution of ABO and Rh Blood Group Alleles in Sahiwal district of the Punjab, Pakistan

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Abstract: A study was carried out to determine blood groups of a random population sample from urban and rural areas of Sahiwal district, Punjab province, Pakistan. Blood samples were collected from the patients visiting to the DHQ Hospital Sahiwal. A total of 20,010 subjects, comprising 3,901 (19.5%) female and 16,109 (80.5%) males, were screened for blood grouping. The objective of this study was to determine the frequency of different blood groups in this District, which would helpful in blood transfusion, organ transplantation, erythroblastosis fetalis, glaucoma and certain other diseases. The distribution of phenotypic frequencies for ABO group in the total sample were 22.0%, 36.9%, 9.9% and 31.3% for groups A, B, AB and O, respectively, while 87.1% of the subjects were Rh-positive. The calculated allelic frequencies were 0.182, 0.276 and 0.541, for group A, B and O, respectively, and 0.357 for d allele. From these studies it is concluded that phenotypically B group was dominant in both genders of the Sahiwal District with high allelic frequency of O group. These studies revealed that the gene frequencies in Sahiwal district are: O>B>A>AB.

Keywords: Alleles, gene frequency, blood groups, Rh factor, transfusion, Sahiwal district, Pakistan

INTRODUCTION

Since 1901, more than 20 distinct blood group systems have been characterized but the ABO and Rh blood groups remain the most important clinically [1]. The distribution of these 2 blood groups has been repeatedly investigated in various populations all over the world during the last half-century. The frequencies exhibit considerable variation in different geographic locations, reflecting the underlying genetic and ethnic diversity of human populations [2]. The relatively new science of DNA research applied to full-blooded, indigenous populations from around the world has led to the discovery and documentation of genetic markers that are unique to populations, forensic pathology, ethnicity and deep ancestral migration patterns [3]. The markers having very specific modes of inheritance, which are relatively unique to specific populations, are used, among other things, to assess ancestral and kinship probabilities [2, 4].

The blood groups may have some association with diseases like duodenal ulcer, diabetes mellitus, urinary tract infection, Rh and ABO incompatibility of newborn and all types of glaucomas [5-8]. All human populations share the same blood group systems; although they differ in the frequencies of specific types. The incidence of ABO and Rh groups varies very markedly in different part of the world and in different races. Even in Pakistan, there are some variations in different areas reflecting racial differences, evolution, their relation to disease and environment is being increasingly sought in modern medicine [9-10]. It is therefore, worth while to document the frequency of ABO and Rh blood groups in the different regions of Pakistan [11].

The gene symbols i or IO, IA and IB, are often used to denote these alleles. Two alleles, R and r are responsible for the inheritance of rhesus blood groups, with R denoting Rh+ve, and r being Rh–ve blood group allele. Gene frequency takes into consideration the numbers of various genotypes in the population, and the relative allele frequencies are determined by application of the Hardy-Weinberg Law [12].

The present study was carried out to record genotypic frequency of various alleles in blood

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groups in a population of Sahiwal district of Punjab, Pakistan, and to compare our results with other studies conducted in Pakistan and elsewhere in the world [13-16] and its future utility for the health sector planners.

MATERIALS AND METHODS

Subjects

A total of 20,010 subjects, belonged to both rural and urban areas of Sahiwal District of Punjab, Pakistan. Blood grouping was carried out over a period of 12 months from January 2009 to December 2009. These were categorized according to ABO/Rh system and allele frequency was computed according to Hardy-Weinberg law [12].

Collection of blood samples

A 2.0 ml sample of blood was drawn from the antecubital vein of each subject in a disposable syringe, and transferred immediately to a tube containing ethylene diamine tetra acetic acid (EDTA).

Determination of blood groups

Blood grouping (ABO and Rh) was done by the antigen-antibody agglutination test. The antisera used were obtained from Plasmatic (Kent, UK). Plasmatic ABO monoclonal reagents are *in vitro* culture supernatants of hybridized immunoglobulin secreting mouse cell-line. For determination of Rh factor, plasmatic anti D (1.0 g) Lo-Du and LO-Du2 monoclonal reagents, prepared from different antibody producing human B-lymphocyte cell lines, were used.

RESULTS

Phenotypic and allelic frequencies of ABO blood groups in the studied population, with gender distribution, are given in Table 1. The distribution of phenotypes in the total sample was 22.0%. 36.9%, 9.9% 29.3% and 31.3% for groups A, B, AB and O, respectively, and the distribution of the alleles were 0.182, 0.276 and 0.541, for A, B and O, respectively, revealing that in district Sahiwal the phenotypically B group was dominant with high allelic frequency of O group. The distribution of phenotypes and allelic frequencies of various Rh blood group antigens in the studied populatio is presented in Table 2. Distribution of phenotypes in the total population sample was 87.1% Rh-positive and 12.9% Rh-negative and distribution of alleles for Rh-positive antigen was 0.643 and 0.357 Rh-negative antigen.

The distribution of allele frequencies of blood group ABO antigens in the sampled population of Sahiwal district with earlier studies on different populations, suggesting the dominance of O group is given in Table 3. Table 4 compares the distribution of allele frequencies of Rh factor antigens in the Sahiwal district population with earlier studies on different populations, suggesting the dominance of Rh positive group.

Table 1. Distribution of phenotypic and allelic frequencies of various ABO blood group system in the studied population of district Sahiwal.

Sex	Phenotypes					Allelic frequency		
	A	B	AB	O	Total	p	q	r
Male	3515 (21.8 %)	5835 (36.2%)	1480 (9.2%)	5279 (32.8%)	16109	0.169± 0.006	0.261± 0.007	0.572± 0.008
Female	888 (22.8%)	1539 (36.6%)	489 (12.5%)	985 (27.8%)	3901	0.196± 0.005	0.298± 0.006	0.510± 0.007
Total	4403 (22.0%)	7374 (36.9%)	1969 (9.9%)	5864 (31.3%)	20010	0.182± 0.005	0.276± 0.004	0.541± 0.005

Table 2. Distribution of phenotypic and allelic frequencies of various Rh blood group in the studied population at district Sahiwal.

Sex	Phenotypes			Allelic frequency	
	Rh+	Rh	Total	D	d
Male	14520 (90.1 %)	1589 (9.9%)	16109	0.686± 0.010	0.314± 0.010
Female	3277 (84.0%)	624 (16.0%)	3901	0.600± 0.012	0.400± 0.012
Total	17797 (87.1%)	2213 (12.9%)	20010	0.643± 0.011	0.357± 0.011

Table 3. Compares the distribution of allele frequencies of ABO blood group antigens in the Sahiwal district population with earlier studies elsewhere.

Population	Frequency of blood groups (%)				Reference
	A	B	AB	O	
Kuwait	0.2900	0.2300	0.1400	0.3500	[17]
Britain	0.4170	0.0860	0.0300	0.4670	[18]
Kenya	0.2620	0.2200	0.0440	0.4748	[19]
Nigeria	0.2443	0.2388	0.0275	0.4894	[20]
Hungary	0.2766	0.1218	0.0423	0.5553	[21]
Ukraine	0.2360	0.2250	0.0704	0.5760	[22]
Aborigines	0.3900	0.0000	0.000	0.6100	[03]
Turky	0.1220	0.1213	0.0085	0.7398	[23]
American Indian	0.0390	0.0110	0.000	0.9500	[24]
Bororo	0.0000	0.0000	0.000	0.1000	[3]
Rawalpindi (Pakistan)	0.2701	0.3350	0.0893	0.3031	[25]
Peshawar (Pakistan)	0.2800	0.3400	0.0700	0.3100	[26]
Swabi (Pakistan)	0.2760	0.3040	0.0880	0.3220	[27]
India	0.2470	0.3750	0.0530	0.3250	[18]
Hazara (Pakistan)	0.2400	0.3200	0.1100	0.3300	[28]
Bahawalpur(Pakistan)	0.2100	0.3600	0.0600	0.3700	[29]
Wah Cant (Pakistan)	0.1813	0.2450	0.0517	0.5400	[30]
Mandi Bauddin (Pakistan)	0.1583	0.2832	0.0448	0.5522	[14]
Gujrat (Pakistan)	0.1740	0.2229	0.0435	0.5596	[13]
Sahiwal (Pakistan)	**0.1744**	**0.2837**	**0.0494**	**0.5419**	Present study

Table 4. Frequency of Rh antigens in different populations.

Population	Allele Frequency		Reference
	Rh+	Rh-	
China	1.0000	0.0000	[31]
Germany	0.9500	0.0500	[32]
Nigeria	0.9430	0.0570	[20]
Mandi Bauddin (Pakistan)	0.9140	0.0860	[14]
Azad Jammu and Kashmir	0.8480	0.1520	[33]
Kenya	0.8030	0.1970	[19]
Gujrat (Pakistan)	0.7958	0.2042	[8]
Peshawar (Pakistan)	0.7680	0.2320	[34]
Wah Cantt (Pakistan)	0.7390	0.2710	[30]
Islamabad (Pakistan)	0.7290	0.2710	[25]
Mirpur (Pakistan)	0.7010	0.2990	[35]
Bannu (Pakistan)	0.6720	0.3280	[36]
Sahiwal (Pakistan)	**0.643**	**0.357**	Present study

DISCUSSION

By comparing the data shown in Table 3 with the present study under discussion (O=0.541, A=0.182 and B=0.276), it has been observed that the population of Sahiwal region is very close to Hungry, Ukraine, Wah Cant., Gujrat and Mandi Bahauddin population, and is different from the population of Kuwait, Germany, Turkey, American India, Bannu, Rawalpindi, Peshawar, Swabi, India, Hazara, Bahawalpur and other Districts. This data is similar to the previous finding that there is an equal dominance of group O and B in the Indo-Pak subcontinent, in contrast to dominance of only O group in the British and African populations [18-20]. It also has been previously described that the type O group is the oldest blood and shows a connection to high animal protein consumption; individuals generally produced higher stomach acids and experience more incidence of gastric ulcer diseases than the other groups [13]. Inspite of these problems with O group population several significant implications are also observed.

Firstly, it provides information to blood banks regarding the higher need for blood group O for transfusion purpose particularly for obstetrics, surgical purposes and during disasters. Secondly, studies concerning possible association between ABO blood group and cardiovascular diseases have confirmed that persons of group A are affected more with coronary heart disease, ischemic heart disease, venous thrombosis and atherosclerosis, while its low in people with blood group O which stated to have protective effect against some diseases [8, 9, 36].

These studies suggest that the people of the District Sahiwal are seemed to be more close to the Hungry and Ukraine peoples and the heterogeneity in the Sahiwal district population is may be due to the different genetic and environmental factors, which helps the expression of blood groups alleles A and B among the Pakistani populations. However, this requires further investigation on Pakistani population.

In terms of presence of Rh antigens, the data from several studies on China, Germany, African and Pakistani populations are compared in Table 4, along with the allele frequency of R and r. The findings of the present study (R= 0.643, r= 0.357) are inconsistent with the results obtained in an earlier study carried out in the population of Mirpur, Bannu, Lahore and Islamabad, where the allele frequency of Rh-positive (R) has been found very close to the to the population of Sahiwal. However, the allele frequency of Rh positive was less than the population of Azad Jummu and Kashmir, Gujrat, Mandi Bauddin, China, Germany and Nigeria (Table 4). Indicating, the progressively reduction of Rh-positive and the dominance of Rh nagitive group in Sahiwal region of the Punjab, Province of the Pakistan.

Studies of associations between various diseases and the ABO blood groups have shown elevated relative risks for some categories of disease. The study provides in depth information of the relative distribution of various alleles in the population and promises help in planning for future health challenges, especially for blood transfusion services, cardiovascular diseases and different organ transplantation studies [8,9,37] in the Sahiwal district.

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REFERENCES

1. Amin-ud-Din M, N. Fazeli, M. Rafiq & S. Malik. Serological study among the municipal employees of Tehran, Iran. Distribution of ABO and Rh blood groups. *Haematology* 7: 502–4 (2004).
2. Sigmon, J.M. Basic principles of the ABO and Rh blood group systems for hemapheresis practitioners. *Journal of Clinical Apheresis* 7(3): 158–62 (1992).
3. Cavalli-Sforza, L.L., P. Menozzi & A. Piazza. *The History and Geography of Human Genes*. Princeton, New Jersey (1994).
4. David. J. A. The relationship between blood groups and disease. *Blood* 115: 4635-4643 (2010).
5. Akhtar, M.N., A. Tayyib, T. Tasneem & A.R. Butt. ABO blood group in patients with peptic ulcer disease: Association with secretor status. *Annuals of King Edward Medical University* 9: 238-40 (2003).
6. Qureshi, M.A & R. Bhatti, Frequency of ABO blood groups among the diabetes mellitus type 2 patients. *Journal of College of Physician and Surgeons Pakistan* 13: 453-5 (2003).
7. Ziegler, T., N. Jacobsohn & R. Funfstuck, Correlation Between blood group phenotype and virulence properties of Escherichia coli in patients with chronic urinary tract infection. *International Journal of Antimicrobial Agents* 24: 70-5. 5 (2004).
8. Khan, M.I., S. Micheal, F. Akhtar, A. Naveed A. Ahmed & R. Qamar. Association of ABO blood groups with glaucoma in the Pakistani population. *Canadian Journal of Ophthalmology* 44: 582-586 (2009).
9. Alam M. ABO and Rhesus blood groups in potential blood donors at Skardu (Northern Areas). *Pakistan Journal of Pathology* 16: 94–97 (2005).
10. Khan, M.S., F. Subhan, F. Tahir, B.M. Kazi, A.S. Dil & S. Sultan. Prevalence of blood groups and Rh factor in Bannu region NWFP (Pakistan). Pak. J. Med. Res. 43: 8–10 (2004).
11. Khaliq, M.A., J.A. Khan, H. Shah, & S.P. Khan. Frequency of ABO and Rh (D) blood group in Hazara division (Abbottabad). Pak. J. Med. Res. 23: 102–103 (1984).

12. Mollison, P.L., C.P. Engelfriet & M. Conteras. Immunology of red cells. In: *Blood Transfusion in Clinical Medicine*, 9th ed. Blackwell Scientific Publication p. 87–88 (1993).
13. Anees, M & M. Shabir. Distribution of ABO and Rh blood groups in Gujrat region, Punjab, Pakistan. *Proc. Pakistan Acad. Sci.* 42: 233-238 (2005).
14. Anees, M., J. Aksa, & H. Iftikhar, Distribution of ABO and Rh blood groups in Mandi Bauddin region, Punjab, Pakistan. *Proc. Pakistan Acad. Sci.* 44: 289-294 (2007).
15. Khan, M.N., M.N. Khan, I. Khaliq, A. Bakhsh, M.S. Akhtar, & M. Amin-ud-Din. Distribution of ABO and Rh D blood groups in the population of Poonch district, Azad Jammu and Kashmir. *Eastern Mediterranean Health Journal* 15: 717-21 (2009).
16. Gaertner, H., J. Lyko & S. Lyko. The antigens ABO and Rh (D) in Nigeria population. *Hamdard Medicus* 37: 81-91 (1994).
17. Al-Bustan, S., S. Al-Bustan, M. El-Zawahri, D. Al-Azmi & A.A. Al-Bashir. Allele frequencies and molecular genotyping of the ABO blood group system in a Kuwaiti population. *International Journal Hematology* 75: 147-153 (2002).·
18. Talib, V.H. *Hand book of Medical Laboratory Technology,* 2nd ed. CBS Publishers, New Delhi, India. p. 205-210 (1991).
19. Lyko, J., H. Gaertner, J.N. Kaviti, M.W. Karithi & B. Akoto. The blood groups antigens ABO and Rh in Kenyans. *Hamdard Medicus* 35: 59-67 (1992).
20. Odokuma, E.I, A.C. Okolo & P.C. Aloamaka. Distribution of ABO and rhesus blood groups in Abraka, Delta State, Nigeria. *Nigerian Journal Physiological Sciences* 89-91 (2007).
21. Tuaszik, T. Heterogeneity in the distribution of ABO blood groups in Hungary. *Gene Geoger.* 9:169-176 (1995).
22. Mukhin, V.N. Gene frequencies and heterozygosity of the population of Donetsk Province, Ukraine by the alleles of the ABO and Rhesus systems. *Tsitol Genet.* 33: 10-30 (1999).
23. Akbas, F., M. Aydin. & A. Cenani. AB0 blood subgroup allele frequencies in the Turkish population. *Anthropologischer Anzeiger* 61(3):257-60 (2003.)
24. Mourant, A.E., A.C Kipec & K. Domenjewska. *The Distribution of Human Blood Groups*. Oxford Press, London. p. 10-19 (1976).
25. Khan, M. M., N. Farooq, N. Qamar, F. Tahir, F. Subhan, B.M. Kazi, M. Fiyaz & K.A. Karamat. Trend of blood groups and Rh factor in the twin cities of Rawalpindi and Islamabad. *Journal of Pakistan Medical Association* 56: 299-302 (2006).
26. PMRC. Some normal parameters of Pakistani in the Peshawar area 1976-1982. *Pakistan Medical Research Council*, KMC p. 21 (1982).
27. Khurshid, B., M. Naz, M. Hassan & S.F. Mabood. Frequency of ABO and Rh (D) blood groups in district Swabi N.W.F.P (Pakistan). *Journal of Science and Technology, University of Peshawar* 16:5-6 (1992).
28. Khaliq, M.A., J.A Khan, H. Shah, & S.P. Khan. Frequency of ABO and Rh (D) blood groups in Hazara Division (Abbottabad). *Pakistan Journal Medical Research* 23: 102-103 (1984).
29. Yousaf, M., N. Yousaf, & A. Zahid. Pattern of ABO and Rh (D) Blood groups distribution in Bahawalpur Division. *Pakistan Journal Medical Research* 27: 40-41 (1988).
30. Khan, I.M., G.A. Khan, & A. Akbar. *Gene frequency of ABO and Rh blood group system in Wah Cantonment.* Botany Department, Peshawar University, Pakistan (1982).
31. Min, S., Z.L. Hu, P.T. Dong, Y. L. Xiao, R..L. De & C.Z. Zhi. Relationship between ABO blood groups and carcinoma of esophagus and cardia in Chaoshan inhabitants of China. *World Journal Gastroenterology* 7: 657-661 (2001).
32. Wagner, F.F., D. Kasulke, M. Kerowgan, & W.A. Flegel. Frequencies of the bloods group ABO, Rhesus D category VI. Kell and of clinically relevant high frequency antigens in Southwestern Germany. *Infusions her Transfusions medicine* 22: 285-290 (1995).
33. Rashid, M. *Gene frequency of ABO blood groups in Azad Kashmir*. M.Sc. Thesis, Department of Botany, University of Peshawar, Peshawar, Pakistan (1983).
34. Parveen, N. *Incidence of ABO and Rh system in Lahore area*. M.Phil. Thesis, University of Peshawar, Peshawar, Pakistan (1983).
35. Khalid, M & M.A. Qureshi. Frequencies of the blood group antigens and corresponding alleles in the population of Mirpur, Azad Jummn Kashmir. *Journal of Animal and Plant Sciences.* 16: 96-97 (2006).
36. Khan, M.S., F. Subhan, F. Tahir, B.M. Kazi, A.S. Dil, S. Sultan, F. Deepa, F. Khan & M.A. Sheikh. Prevalence of blood groups and Rh factor in Bannu District (NWFP) Pakistan. *Pakistan Journal Medical Research* 43:8-10 (2004).
37. Kazunari, T., I. Hideki, O. Kazuya, S. Tomokazu & S. Hiroki. Antibody-mediated rejection: a single center experience at Tokyo Women's Medical University. *Clinical Transplant* 363-369 (2006).