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ORIGINAL RESEARCH

Gene frequencies of ABO and Rh (D) blood group allelles in Bhopal, Madhya Pradesh

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ABSTRACT
Present work was carried out to study and document the gene frequency of ABO and Rh (D) blood group alleles in the local population of Bhopal, M.P as limited information is available in Central India.1000 subjects from both genders were randomly selected from PCMS & RC, Bhopal from March 2015 to August 2015. Blood group typing was done by the open slide test method. We analysed allelic frequencies based on Hardy-Weinberg equations. Phenotype frequency for B and Rh +ve blood group was highest in overall study population. The allele frequencies of O, A, B and AB groups in the combined data were found to be 0.53, 0.18, 0.29 and 0.10 respectively. Allelic frequency for Rh +ve and Rh –ve was 0.78 and 0.22. This distribution do not differ significantly ($p>0.05$) from those expected under Hardy-Weinberg law. This study will be useful for clinicians, geneticists and pathologists.

Key words: ABO Blood Group, Rh Factor, Gene Frequency, Alleles, Hardy-Weinberg equation.

INTRODUCTION

Nineteen blood group systems have been identified so far which vary in their frequency of distribution amongst various races of mankind. These include the ABO, Rhesus, MNS, Lutheran, Kell, Lewis, Duffy, Kid, Diego, Cartwright, Cotton, Sid, Scianna, Yt, Aubergen, Ii, Xg, Indian, and Dombrock systems (1). The ABO blood group system was first discovered in 1900 by Landsteiner (2,3). The Rh system was later described by both Landsteiner and Weiner in 1940 by their joint work (3). Since the discovery, attention of scientists has been greatly focused on these two blood group systems because of the fact that they are highly polymorphic and immunogenic especially in human.

ABO gene is located on the long arm of the ninth human chromosome (9q34.1) while the Rh(D) gene encoding the Rh protein is located on chromosome 1p34–p36 .(4,5)

The classification of blood groups into type A, B, AB and O in ABO system, Rh-positive and Rh-negative in Rhesus system is based on the presence or absence of inherited antigenic substances on the surface of the red blood cells. The antigens may be proteins, carbohydrates, glycoproteins and glycolipids depending on the blood group system (6). ABO and Rhesus (Rh) blood group antigens are hereditary characters and are useful in population genetic studies, researching population migration patterns, as well as resolving certain medicolegal issues, particularly of disputed paternity and more importantly in compatibility test in blood transfusion practice. The need for blood group prevalence studies is multipurpose, as besides their importance in evolution, their relation to disease and environment is being increasingly sought in modern medicine (7-10).

There is limited information available on the gene frequencies of the ABO and Rhesus blood group in Central India. So, our aim is to provide information on the distribution pattern of phenotypic and genotypic frequency of alleles in the blood groups of people living in Bhopal, Madhya Pradesh.

METHODS

The study was carried out in People's Hospital and Research Center, Bhanpur, Bhopal, Madhya Pradesh from March 2015 to August 2015. Blood Samples from a total of 1000 unrelated individuals of both sexes were drawn from finger pricks, under all aseptic precautions. Samples were analyzed for ABO and Rh (D) blood groups by slide agglutination method by mixing a drop of blood with anti-sera (anti-A, anti-B and anti-D), manufactured by Tulip Diagnostics (P) Limited, Old Goa, India by using separate glass rods. Blood groups were determined on the basis of agglutination. Allele frequencies were calculated under the assumption of Hardy–Weinberg equilibrium

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and expressed as percentages. Chi-square test was used to compare observed allelic and genotypic frequency distributions of the blood group and Rh antigens to that expected under the Hardy–Weinberg by using S2ABO estimator program. Approval from research ethical committee has been taken prior to study.

RESULTS

As shown in Table I, we observed that the ABO blood group frequencies occurred in the following order B > O > A > AB (40.0% > 28.8% > 24.9% > 6.3%) respectively, among the overall individuals sampled. Blood group B has the highest frequency while blood group AB has the lowest frequency.

Table I: Phenotypic Distribution of ABO and Rh blood groups.

Blood Groups	A	B	AB	O	Total
Rh+ ve No. (%)	234 (23.4 %)	388 (38.8 %)	60 (6 %)	269 (26.9 %)	951 (95.1)
Rh- ve No. (%)	15 (1.5 %)	12 (1.2 %)	03 (0.3 %)	19 (1.9 %)	49 (4.9 %)
Total No. (%)	249 (24.9 %)	400 (40 %)	63 (6.3 %)	288 (28.8 %)	1000 (100 %)

No. – Number of individuals

In Table II, it is shown that overall blood group distribution pattern was same for both male and female **(**B > O > A > AB). As regards the Rhesus blood group system, we found that 95.1% of the sampled population were Rh(D)+ve while 4.90% were Rh(d)-ve . Comparatively, we observed higher proportions of Rh +ve and Rh -ve in males than females.

Table II: Gender wise Phenotypic Distribution of ABO and Rh blood groups.

	A	B	AB	O	Rh+	Rh-
Male No. (%)	146 (14.6 %)	227 (22.7 %)	30 (3.00 %)	177 (17.7 %)	546 (54.6 %)	34 (3.40 %)
Female No. (%)	103 (10.3 %)	173 (17.3 %)	33 (3.30 %)	111 11.1 %)	405 (40.5 %)	15 (1.50 %)
Total No. (%)	249 (24.9 %)	400 (40.0 %)	63 (6.30 %)	288 (28.8 %)	951 (95.1 %)	49 (4.90 %)

No. – Number of individuals

Table III indicates the overall allele frequencies for the ABO and Rh antigens in the studied population by using the extension of the Hardy–Weinberg law. For ABO blood group the allelic frequencies were 0.18, 0.29 and 0.53 for A, B and O alleles respectively. This occurred in the order O > B > A. The phenotypic frequencies were A = 22.32 %, B = 39.15 %, AB = 10.44 % and O = 28.09 %. On the rhesus status, the allelic frequencies for D and d alleles were 0.78 and 0.22 respectively, the genotypic frequencies were DD = 0.6064, Dd = 0.3446 and dd = 0.0490, while the phenotypic frequencies were D = 95.10 % and d = 4.90 %.

Table III: Gene frequencies of ABO and Rh blood group alleles.

Blood group system	Gene (allele)	Allele frequency	Genotype	Frequency	Phenotype	Frequency (%)
ABO	**A (p)**	0.18	**AA**	0.0324	**A**	22.32
			AO	0.1908	**A**	
	B (q)	0.29	**BB**	0.0841	**B**	39.15
			BO	0.3074	**B**	
			AB	0.1044	**AB**	10.44
	O (r)	0.53	**OO**	0.2809	**O**	28.09
Rhesus	**D**	0.78	**DD**	0.6064	**Rh(D)+ve**	95.10
			Dd	0.3446	**Rh(D)+ve**	
	D	0.22	**Dd**	0.0490	**Rh(D)-ve**	4.90

Table IV, graph I represents comparison between observed and expected values for ABO blood group in the tested population. The observed and expected values were A (24.9%, 22.15%), B (40.0%,37.3%), AB (6.3%,9.23%) and O (28.8%, 31.32%).We found that the distribution and proportion of individuals having ABO blood antigens did not differ from those expected under Hardy–Weinberg equilibrium with goodness-of-fit χ^2 for ABO = 1.86_____, df= 1 , P >0.05 which is statistically insignificant.

Table IV: Observed versus expected frequencies of the ABO blood group individuals.

Phenotype	Observed number	Phenotypic frequency in %	Expected Number
A	249	24.9 %	221.5
B	400	40.0%	373
AB	63	6.3 %	92.3
O	288	28.8%	313.2

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Total	1000	100	1000

Graph I: Observed versus expected frequencies of the ABO blood group individuals

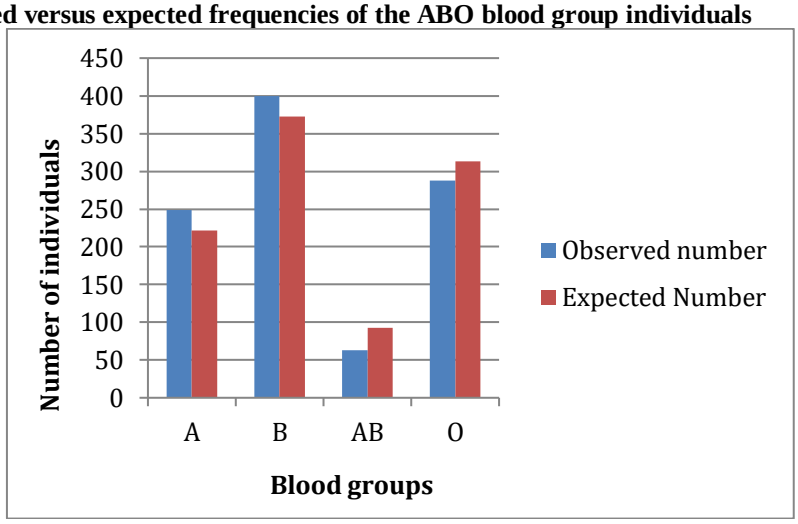
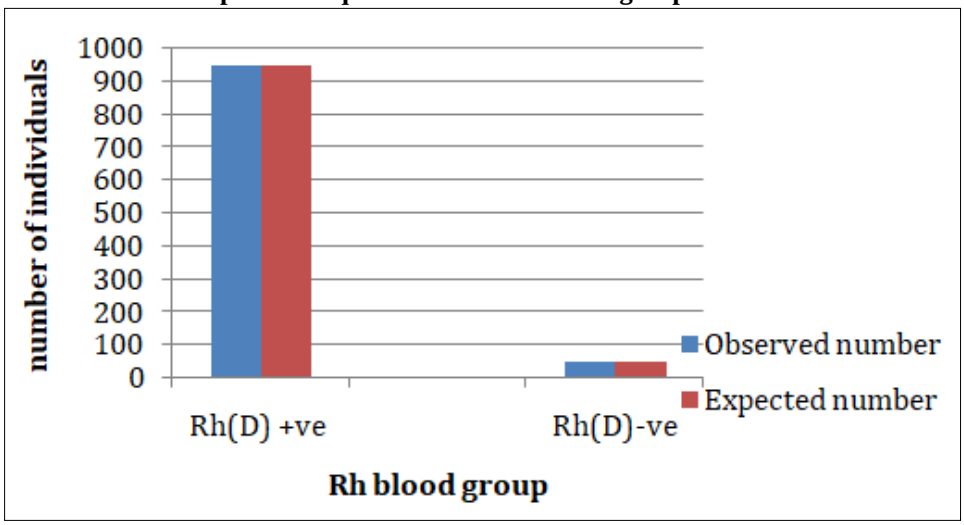


Table V, graph II represents comparison between observed and expected values for Rhesus blood group in the studied population. The observed frequency for Rh positive was 97.0% and the expected was 96.7% while the observed frequency for Rh negative was 3.0% however the expected value was 3.3%. The distribution and proportion of individuals having Rh blood antigens did not differ from those expected under Hardy–Weinberg equilibrium (Goodness-of-fit χ^2 for Rh = 0.1025, df= 1, P> 0.05) which is statistically insignificant.

Table V: Observed versus expected frequencies of the Rh blood group individuals.

Phenotype	Genotype	Genotype Frequency	Observed number	Expected number
Rh positive	**DD**	0.6064	951	952
	Dd	0.3446		
Rh negative	**dd**	0.0490	49	48
Total		1.000	1000	1000

Graph II: Observed versus expected frequencies of the Rh blood group individuals.



DISCUSSION

It is well known that ABO and Rh blood group systems are of great importance in blood transfusion and organ transplantation and has a paramount importance that the donor blood cells must match those of the recipient; otherwise, donor blood cells may be destroyed by antibodies present in the plasma of the recipient. Furthermore, the susceptibility to several diseases has been associated with the ABO phenotype, but such correlation remains controversial (11,12,13).

In this study, we observed that phenotypic frequencies of ABO **(**B > O > A > AB) and Rh blood groups, were similar to the previous findings on the other parts of India (14,15). The implication of this finding is that blood group B is the most readily available blood

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group in the population of central India for blood transfusion.

Gene frequencies with respect to ABO system for the present study can be shown with a general formula O >B >A >AB which does not seem to deviate from the studies carried out previously in different parts of the India (16) and world (17,18) . It is found that phenotype A has very less allelic frequency than phenotype B and phenotype O.

Thus, the gene segregation for ABO systems always followed a particular pattern for its distribution in different ethnic groups with exceptional cases. However, in the studies conducted in population of Bangalore by Periyavan et al (19) and among the blood donors in Vellore by P K Das et al (20) ; O was the most prevalent blood group. Similarly, blood group A was the most prevalent in the studies conducted on Nepalese medical students by Pramanik and Pramanik (21).

Such contradictions are probably due to immensely different sample sizes, geographical environments and ethnic groups in the study populations.

Surekha et al (22) reported high incidence of breast cancer in blood group B individuals. K Akhtar et al (23) noticed high incidence of gastrointestinal and gall bladder cancers in B blood group individuals.

Kamlesh G et al (24) reported 57.1% of genitourinary cancers in blood group B individuals.

In our study, Rh positive group constitutes 95.1% of the subjects which is coherent with all other researches done in India and all around the world.

CONCLUSION

Different blood groups were related with various diseases including cancers showing that there is an inherited association between them.

Information from our study will be useful for pathologists and clinicians for planning the blood transfusion program and predicting the risk to control the development of various diseases including cancers.

Also, it will be helpful to researchers and geneticist dealing with population genetics in enlightening the factors for the observed distribution patterns of these genetic markers in Central India.

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