

## ALLELIC, GENOTYPIC AND PHENOTYPIC FREQUENCY OF ABO AND RHESUS (D) BLOOD GROUPS IN NOAKHALI, FENI AND SHERPUR DISTRICTS OF BANGLADESH

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### Abstract

**Background:** Genetic characteristics (allelic and genotypic frequencies; phenotypic distribution) of ABO and rhesus (D) blood group systems of Bengali population from Feni, Noakhali and Sherpur districts are unknown. This has stimulated us to conduct the study. **Materials and methods:** A retrospective study (2013-2015) was done from blood group data obtained from the registers of the blood banks in district hospitals of Feni, Noakhali and Sherpur. Hardy-Weinberg formula was used to determine allele and genotype distribution. **Results:** Total subjects from the three centers were 8058. Observed allelic (O > B > A) and phenotypic frequency (O > B > A > AB) was similar in all centers. Allele frequency range was I<sup>A</sup> 0.1826 to 0.1946, I<sup>B</sup> 0.2082 to 0.2292 and I<sup>O</sup> 0.5768 to 0.6092. Rhesus (D) allele frequency was I<sup>d</sup> 0.1315 to 0.1615 and I<sup>D</sup> 0.8385 to 0.8685. Rhesus negative blood groups were scarce (%). **Conclusion:** Genetic characteristics of ABO and rhesus blood group genes of studied population are in agreement with the existing data about Bangladeshi population.

### Key words

Blood group; Bangladesh; Allele; Genotype; Phenotype.

### Introduction

There are over 50 human blood groups<sup>1</sup>. ABO and rhesus systems are of main importance because of frequent and potentially severe transfusion related reactions.

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Blood groups are genetically determined biological characteristics. The genes of the two systems are located in chromosome 9 (ABO) and 1 (rhesus) respectively<sup>2</sup>. Factors determining blood groups include geographical distribution, racial origin, natural selection and genetic phenomenon<sup>2</sup>. Determination of genetic characteristics of blood groups is the simplest form of genetic analysis for a given population. It builds up data bank for blood transfusion service. Data on blood groups and their genetic characteristics involving Bangladeshi population is sparse. We determined phenotypic frequency, allelic and genotypic distributions of the genes of the ABO and rhesus (D) systems from the population of three previously unexplored districts of Bangladesh.

### Materials and methods

A retrospective study was conducted in three district hospitals of Bangladesh. They are Noakhali, Feni and Sherpur districts. Blood group data were collected from the blood donor register of blood bank for the year 2013 to 2015.

For calculating the allelic and genotypic distribution we used the Hardy-Weinberg formula. This is a standard formula used in population genetics to determining gene frequency of certain biological characteristics in a given population. A brief description of this formula is given below. Details available in the paper of Agrawal et al<sup>3</sup>.

### Hardy-Weinberg formula:

The allelic and genotypic frequencies remains stable in successive generations, provided that there is no intervening external factors such mutation, population migration and natural selection in a very large population with random mating. This principle was used by Hardy and Weinberg to derive a formula.

### ABO system:

Frequency of three blood group alleles A, B and O are expressed as p, q and r respectively. Based on the Hardy-Weinberg formula; the frequencies of

the O, A, B and AB phenotypes are determined as  $r^2$ ,  $(p^2 + 2pr)$ ,  $(q^2 + 2qr)$  and  $2pq$  respectively. Individual allele frequency calculated from following formula-

1.  $r = \sqrt{\text{frequency of O phenotype}}$
2.  $p = \sqrt{\text{frequency of A phenotype} + \text{frequency of O phenotype}} - r$
3.  $q = \sqrt{\text{frequency of B phenotype} + \text{frequency of O phenotype}} - r$

#### Rhesus system:

In rhesus system d and D allele are designated as u and v respectively. Individual allele frequency calculated by following formula-

1.  $u = \sqrt{\text{frequency of d phenotype}}$
2.  $v = 1 - u$

Phenotypic frequencies were expressed in percentage. Frequencies of allele and genotypes are expressed in decimal according to convention. Comparison between groups was done using chi-square test with a level of significance of  $p < 0.05$  at 95% confidence interval.

#### Results

Frequency of different blood groups of ABO system is presented in table I. Phenotypic frequency in all three districts was  $O > B > A > AB$ .

**Table I :** Frequency of blood groups of ABO system

Blood group	Noakhali			Feni			Sherpur		
	n	%	CI	n	%	CI	n	%	CI
A	429	26.01	23.96 - 28.19	850	26.25	24.77 - 27.80	822	25.88	24.42 - 27.46
B	548	33.23	31.00 - 35.54	1063	32.84	31.24 - 34.48	937	29.53	27.98 - 31.15
O	551	33.41	31.17 - 35.72	1077	33.27	31.67 - 34.91	1187	37.42	35.75 - 39.12
AB	121	7.33	6.18 - 8.70	247	7.63	6.76 - 8.60	226	7.12	6.28 - 8.07
Total	1649			3237			3172		

**Table II :** Frequency of individual rhesus blood groups

District	A		B		O		AB	
	+Ve	-Ve	+Ve	-Ve	+Ve	-Ve	+Ve	-Ve
Noakhali	423 (98.60%)	6 (1.40%)	535 (97.09%)	16 (2.91%)	531 (96.89%)	17 (3.11%)	117 (96.69%)	4 (3.31%)
Feni	839 (98.70%)	11 (1.30%)	1033 (97.18%)	30 (2.82%)	1045 (97.02%)	32 (2.98%)	240 (97.16%)	7 (2.84%)
Sherpur	797 (96.95%)	25 (3.05%)	918 (97.97%)	19 (2.03%)	1179 (99.32%)	8 (0.68%)	223 (98.67%)	3 (1.33%)

**Table III :** Allelic and genotype distribution of ABO and rhesus (D) blood groups

	Noakhali	Feni	Sherpur
ABO system			
Allele frequency			
I <sup>A</sup>	0.1928	0.1946	0.1826
I <sup>B</sup>	0.2292	0.2286	0.2082
I <sup>O</sup>	0.5780	0.5768	0.6092
Genotype frequency			
AA	0.0372	0.0378	0.0329
AO	0.2229	0.2244	0.2214
BB	0.0525	0.0523	0.0425
BO	0.2649	0.2638	0.2530
OO	0.3341	0.3327	0.3742
AB	0.0884	0.0890	0.0760
Rhesus system			
Allele frequency			
I <sup>d</sup>	0.1615	0.1572	0.1315
I <sup>D</sup>	0.8385	0.8428	0.8685
Genotype frequency			
DD/Dd	0.9739	0.9753	0.9827
dd	0.0261	0.0247	0.0173

Only the frequencies of blood group B ( $p=0.005$ ) and O ( $p=0.0008$ ) of Sherpur significantly differed from Noakhali and Feni.

Rhesus positive blood group in Sherpur was 98.27% ( $n = 3117$ , CI 97.75 to 98.67) rhesus negative 1.73% ( $n = 55$ , CI 1.33 to 2.25). In Noakhali rhesus positive was 97.39% ( $n = 1606$ , CI 96.50 to 98.06) and negative 2.61% ( $n = 43$ , CI 1.94 to 3.50). In Feni 97.53% ( $n = 3157$ ; CI 96.94 to 98.01) rhesus positive and 2.47% ( $n = 80$ , CI 1.99 to 3.06) are negative. Detailed individual description of rhesus blood groups given in table II.

Allelic and genotypic distributions are given in Table III. Allelic frequency was  $O > B > A$ .

#### Discussion

The population in our study was Bengali. Our observed phenotypic frequency was  $O > B > A > AB$ . This frequency was similar to the districts from eastern part of Bangladesh -Comilla, Chittagong and Rangamati<sup>4-7</sup>. While  $B > O > A > AB$  pattern was observed in Dhaka, Rajshahi, Khulna and Barisal i.e. the western and central part of the country<sup>8-11</sup>. In Dinajpur  $O > A > B > AB$  distribution was described<sup>12</sup>. Chakraborty et al

(Assam) and Nag et al (West Bengal) also observed  $O > B > A > AB$  phenotypic frequency among Indian Bengali population<sup>13,14</sup>. By ethnicity this phenotypic distribution of Bengali is different from those described in Chakma and Tanchangya ( $B > A > O > AB$ ) Marma ( $B > O > A > AB$ ) Tripura ( $A > B > AB > O$ ) Garo ( $A > B > O > AB$ ) Khasia ( $O > A = B > AB$ ) and Manipuri ( $A > O > B > AB$ ) population from Rangamati, Sylhet and Mymensingh region<sup>7,15</sup>.

Allele frequency ( $O > B > A$ ) was similar to the prior studies on Rangamati, Chittagong, Comilla, Sylhet, Dhaka, Barisal, Jessore, Faridpur, Khulna, Dinajpur and Rajshahi districts from Bangladesh<sup>4-12,15-17</sup>. In prior Bangladeshi studies ABO allele frequencies ranged from  $I^A$  - 0.1301 to 0.2062,  $I^B$  - 0.1803 to 0.2516 and  $I^O$  - 0.5553 to 0.6371<sup>5</sup>. Our observed allele frequencies also lie within this range.

So the available genetic information suggests that though individual allele values are variable with geographic location; ABO allele frequency is similar for Bengali population throughout Bangladesh. The allele frequency was also similar for the Chakma, Tanchangya and Marma ( $O > B > A$ ). However, it differed from the Manipuri, Khasia and Garo ( $O > A > B$ ); Tripura ( $A > O > B$ )<sup>7</sup>.

Rhesus negative group was scarce in the studied population (1.73 to 2.61%). This value is within the range observed for Bengali population in different parts of Bangladesh<sup>4-12, 15-17</sup>. However, most of the ethnic minorities of Bangladesh have lower frequency of negative groups than Bengali community.<sup>7</sup>This once again shows the need to build up donor database for these rare blood groups for emergency lifesaving situations.

Current findings will help build up local database in studied areas for transfusion purpose and generated data for comparative population genetics.

#### Conclusion

Allelic frequencies of ABO blood groups among population in Noakhali, Feni and Sherpur district are consistent with the existing data on Bangladeshi population.

#### Disclosure

All the authors declared no competing interest.

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