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"Genetic Analysis of ABO and Rh Blood Groups in Brahmin Population of Uttar Pradesh, India"

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Running Title:
Prevalence of ABO and Rh Blood Groups in Brahmin Population

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Abstract:

A series of glycoprotein and glycolipids on red blood cell surface constitute blood group antigens. These are A, B, AB and O in ABO blood group system and Rh in rhesus blood group system. These antigens are genetically controlled. Certain diseases have been shown to be associated with certain blood groups. In present study an attempt is made to study the distribution of ABO and Rh. (D) blood group systems among the Brahmin caste population of Uttar Pradesh State. A total of 200 unrelated Brahmin individuals from Uttar Pradesh were studied for the phenotype and allele frequency distribution of ABO and Rh (D) blood groups. The order of occurrence of ABO phenotypes is B>O>A>AB. The corresponding allele frequencies of O, A, and B alleles are found to be 0.5790, 0.1510 and 0.2697 respectively. The allele frequency of D (0.735) is more than d (0.265). The present study was compared with the other studies reported to understand the affinity between them.

Keywords:

Brahmin population, ABO blood groups, Rh blood group, Genotype, Allele frequency

Introduction:

The human blood groups have been studied extensively for their involvement in incompatibility selection. Various studies on ABO incompatibility (Matsunaga and Itoh, 1958; Takano and Miller, 1972; Banerjee, 1980; Srikumari et al., 1987) have produced evidences of high frequency of prenatal death among incompatible matings. Red blood cells contain a series of glycoproteins and glycolipids on their surface which constitute the blood group antigens. Production of these antigens is genetically controlled. There are many blood group systems on the basis of different blood group antigens – only ABO and Rh systems are important in clinical practice. ABO system consists of four main groups, A, B, AB and O which is determined on the basis of presence or absence of A and B antigens. These antigens are under control of three allelic genes, namely *IA*, *IB* and *i* which determine blood groups. *IA* produces A antigen, *IB* produces B antigen whereas *i* produces neither. IA and IB are mutant alleles and show codominance with each other but both are dominant over the wild type allele *i* (Gardener et al, 2001) . In Rh system blood groups are Rh-positive or Rh-negative on the basis of presence or absence of Rh antigens on red cell surface. Rh antigens are determined by three pairs of closely linked

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allelic genes located on chromosome 1. In clinical practice blood grouping is important because an antigen may, in certain circumstances, react with its corresponding antibody and cause harmful clinical effects like haemolytic transfusion reactions and haemolytic disease of newborn.

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 (Platt et al,1985; Horby et al,1989; Meade et al,1994; Green et al,1994). Estimates of gene's frequency provide very valuable information on the genetic similarity of different populations and to some extent on their ancestral genetic linkage, despite the cultural and religious differences of the two populations.

During the last four decades, numerous studies have been carried out on the genetic composition of various endogamous population groups in India like-Rajputs (Mukhopadhyay and Kshastriya, 2004; Pattanayak, 2006; Kumar et al, 2009a; Meitei and Kshatriya, 2010; Warghat et al,2011), Scheduled caste population (Thukral and Bhasin,1990; Kushwaha et al.,1990; Mandal, 1992; Patni and Yadav, 2003; Sidhu, 2003; Rai et al, 2009a, b), OBC (Prabhakar et al, 2005; Reddy and Reddy 2005; Kumar et al , 2008, 2009b,c; Rai et al,2009c: Dore Raj and Reddy ,2010) and Muslim population (Majumdar, 1943; Srivastava, 1975; Ara et al, 2008; Kumar et al, 2010; Rai and Kumar, 2010; Rai et al, 2010; Chakraborty, 2010). However, genetic studies among Brahmin in India are very limited. As per our knowledge not a single report is available on the Brahmin population of Uttar Pradesh. In view of the importance of blood groups in population characteristics, the present study is done to document the frequency of ABO, subgroup ABO and Rh(D) in Brahmin caste population of Uttar Pradesh (UP), India.

Materials and method:

The study was done in Brahmin population of Uttar Pradesh (UP), India. Over a period of six months period (October 2010 to March 2011), a total of 200 unrelated individuals of both genders belonging to the Brahmin caste from Jaunpur, Varanasi, Allahabad districts

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of UP were selected. Blood samples were collected from each subject and relevant data were also collected after taking written consent. Confidentially, of the data were maintained.

Each subject, who accepted to participate in the study, received two sheets, (consent form, and questionnaire). The first sheet was a declaration form for each participant that she/he understood the project/study well, the second sheet was, a questionnaire that included profile/demographic data of the participants. The blood samples were collected by finger prick with sterile lancet and after cleaning the puncture site with 70% ethyl alcohol. A drop of monoclonal anti-A, anti-B, monoclonal/polyclonal anti-D (Span) was added to a drop of finger prick blood on clean slide and mixed well. Results of agglutination were recorded immediately for ABO blood groups and after 2 minutes in Rh(D) (Bhasin and Chahal, 1996). The gene frequencies for this system were calculated according to the method of Mourant et al. (1976).

Results and Discussion:

The distribution of ABO blood group phenotypes and their gene frequencies among the Brahmin population of UP is shown in table 1. In total 200 samples analyzed, phenotype B blood type has the highest frequency 42% (n=84), followed by O (30.5%; n=61), A (23.5%; n=47) and AB (4%; n=8). The overall phenotypic frequencies of ABO blood groups were B>O>A>AB (Fig 1). The O, A and B frequencies were 0.579, 0.151 and 0.269 respectively (Fig 2.). Total numbers of samples were also categorized by gender, 58 samples were of females and 142 of males (Table 2). In female samples 18 individuals have O blood group, 15 individuals have A blood group, 22 individuals have B blood group and 3 individuals have AB group. In 142 male samples, O, A, B and AB blood groups were found in 43, 32, 62 and 5 individuals respectively. In male and female samples the phenotypic frequencies were B> O> A>AB. Table 3 shows the proportion of Rh (D) phenotype occurs with a frequency of 93% and Rh (d) with 7% (Fig 4). The gene frequencies of D and d found to be 0.735 and 0.265, respectively (Table 3). The present study falls with in the ranges observed in some other reports from the UP state.

Very limited reports are available on the frequency of ABO and Rh blood groups in Brahmin caste group from India (Tewari and Bhasin, 1968; Mukhopadhyaya and Kshatriya, 2004; Guniyal, 2006) especially from UP population not a single report is

available. Mukhopadhyaya and Kshatriya(2004) reported the frequencies of O(0.4906) and B(0.3106) alleles in Brahmin population of Kasauli of Solan and their observation are found to be similar to that observed for various population groups of Western Himalayan region (Bhalla et al.,1980; Bhasin et al.,1992) Results of present study is comparable with ABO frequencies reported in some earlier studies of other caste groups of UP(Kumar et al,2009 a,b,c, 2010; Rai et al, 2009c) .

We compared our result with other studies carried out in different countries of the world like Britain, Nepal, Nigeria, Guinea, Bangladesh etc.(Marzhan et al,1998; Mwangin et al,1999; Pramanik and Pramanik , 2000; Loua et al, 2007; Firkin et al, 2008; Khan et al, 2009). A comparison of frequency of blood group with this study to other is shown in the table 4. Except Nepal and India (present study), frequency of O blood group is highest in Britain (47%), Nigeria, (54.2%), Guinea (48.9%) and Bangladesh (40.6%) and there is no marked difference in incidence of O blood group in these countries (Table 4). Difference is marked in case A group between Britain and Bangladesh (42% vs 26.6%) and is highest in Nepal (34%). In Britain B blood group is exceptionally low i.e. 8% whereas it is highest in our study (42%). Marked difference of incidence of AB group is observed between Nigeria and Bangladesh (2.8% vs 9.6%). Rh-negative frequency in present study is comparable with other Asian countries –Nepal and Bangladesh (between 3 to 3.3%) but is very high in Britain (17%).

Conclusion:

The frequency of ABO and Rh phenotypes in Brahmin appears to be similar to other caste data of UP population. The study results show that the most frequent blood group in the Brahmin caste group of UP is group B and the rarest is group AB and Rh-negative frequency is 3%. To summarize, we may say that although this population showed certain interesting features of polymorphism in markers studied, given the small sizes, the conclusions drawn can a best be tentative. The UP Brahmin population has not been very well genetically explored so far. Although partially, but present report may help to fill the lacuna present in genetic map of India especially UP. The difference of frequencies of different blood group antigen in our population raise the suspicion of difference in prevalence of some disease associated with blood group antigen. Further study may be done to find out association of diseases with specific blood group antigen.

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Table 1. Distribution of the ABO blood group and their allele frequencies among Brahmin Population

Phenotype	Observed Number	Percentage	Expected Number	Allele frequency
O	61	30.5	67	0.5790
A	47	23.5	39.5	0.1510
B	84	42.0	77	0.2697
AB	08	04.0	16.3	

Table 2. Total number of samples classified according to gender

Sections	No. of O phenotype	No. of A phenotype	No. of B phenotype	No. of AB phenotype	Total
Females	18	15	22	03	58
Males	43	32	62	05	142
Total	61	47	84	08	200

Table 3. Rh blood group among Brahmin population

Phenotypes	Observed		Allele frequencies
	Number	Percentile	
Rh(Anti D)+	186	0.93	D=0.735
Rh(Anti D)-	14	0.07	d=0.265
Total	200	1.00	

Table 4. Comparison of percentage frequencies of ABO and Rh blood groups in different studies carried out in different countries

Countary	Study	O	A	B	AB	Rh-positive	Rh-negative
Britain	Firkin et al,2008	47	42	8	3	83	17
Nigeria	Mwahgin et al,1999	54.2	21.6	21.4	2.8	95.2	4.8
Guinea	Loua et al,2007	48.9	22.5	23.7	4.7	95.9	4
Nepal	Pramanik and Pramanik,2000	32.5	34	29	4	96.7	3.3
Bangladesh	Talukdar and Das,2010	40.6	26.6	23.2	9.6	96.8	3.2

India	Present Study	30.4	23.5	42	4	97	3

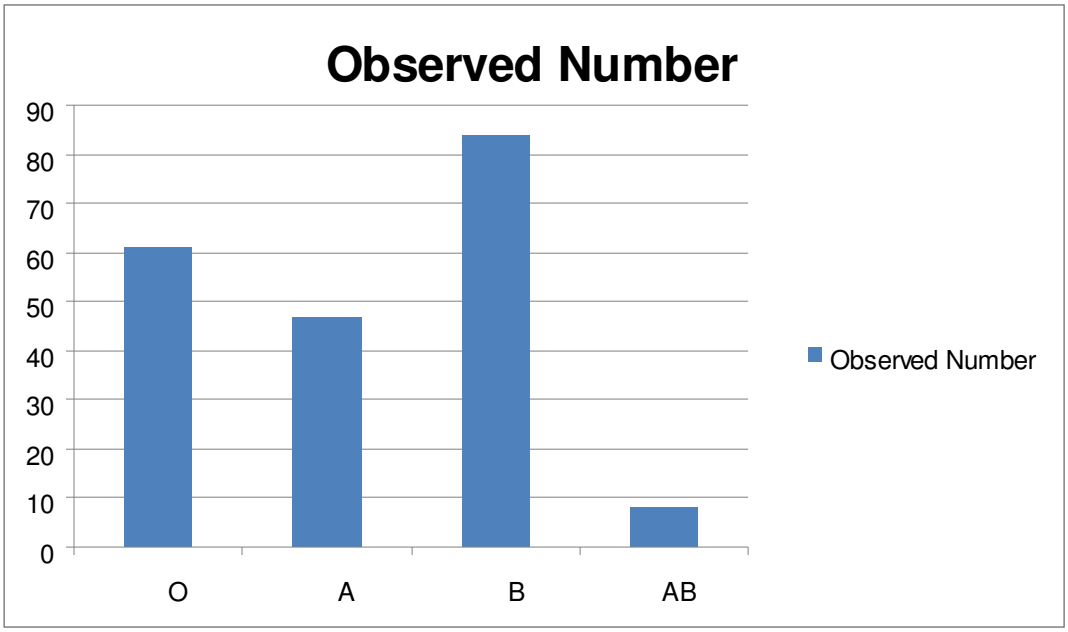

Figure1. Phenotypic number of different ABO groups observed

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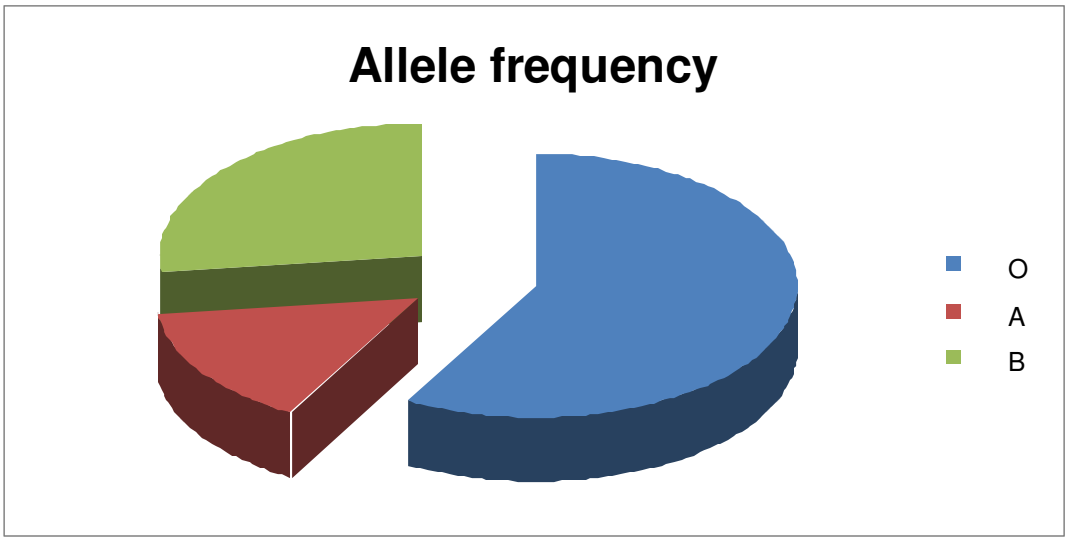

Figure2. Allelic frequencies of A, B, and O blood groups in Brahmin Samples Analyzed

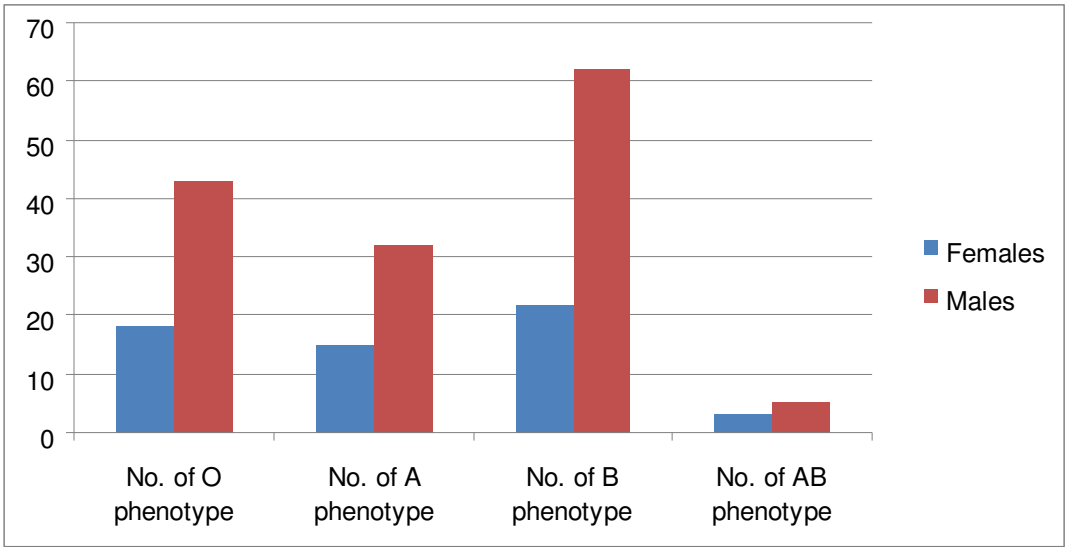

Figure3. Gender-wise categorization of different ABO blood groups phenotypes

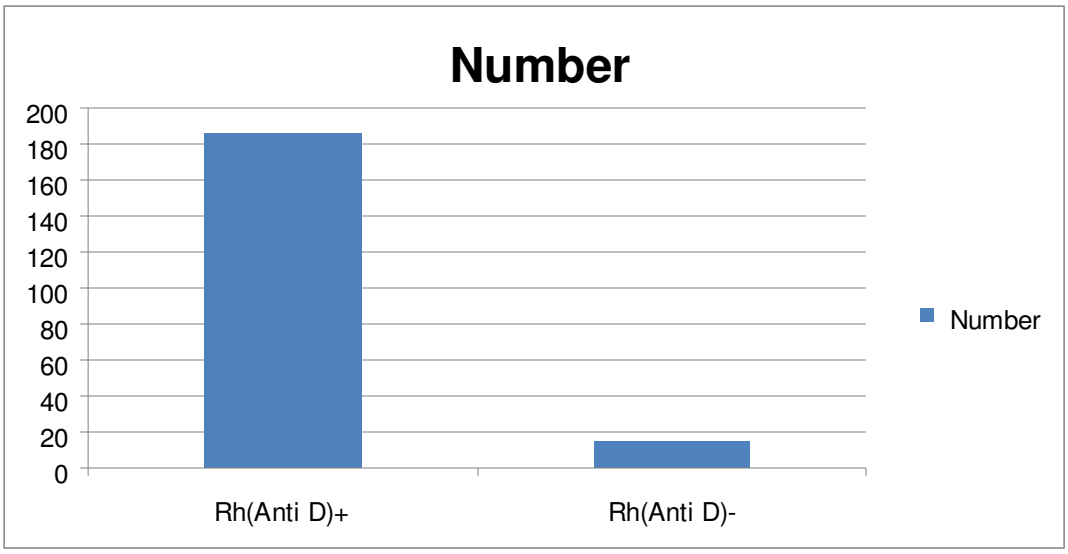

Figure 4. Phenotypic number of Rh-positive and Rh-negative observed

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