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Genetic Analysis of ABO and RH Blood Groups in Scheduled Caste Populations of Patna District (Bihar), India

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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 Scheduled caste population of District of Patna, Bihar, India. The study was restricted to four Prominent Scheduled Caste, namely the Dusadhs, the Chamars, the Pasis & the Musahars, residing in an around Patna, Bihar. The data were collected from the random sample of the persons who were subjected to immuno-haematological test to ascertain the prevalence of four different blood groups (A, B, AB & O) in them.All the populations exhibited different patterns of the incidence of ABO blood groups in them. Bloodgroup A was most prevalent (37.22%) among the Pasis in both the sexes. Blood group Bwas most frequent (34.11%) in both the sexes of Dusadhs. Among the Chamars, the blood group with highest incidence was AB (27.14 %).Bloodgroup O was most abundant among the Musahars (37.20%). The frequency of IO allele was found over 60% among the Musahars,but less than50% among the remaining three populations. The frequency of IB¬ alleale was approximately 30% among the Dusadhs and the Chamars, but decreased down to around 20% among the Pasis and the Musahars. The frequency of IA allele was higher among the Pasis (30%), but varied from 17% to 23% among the remaining three populations. The Musahars, therefore, appeared to have a distinct pattern of ABO blood groups and the frequencies of blood group alleles, compared to the remaining three Scheduled castes.

Keywords : Population •Scheduled Caste• Blood Group•Blood Group Alleles•

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INTRODUCTION

India, with its 1.2 billion people, represents one of the largest human biodiversity pools in the world. The caste based social organization, being practiced for centuries in India [14], has led to the formation of 4635 anthropologically well-defined human groups including as many as 3700 endogamous groups structured in the Hindu caste system as 'Jatis'[25]. Each of these groups, reproductively isolated from each other, constitutes a 'Mendelian population' with little or no gene flow between them; the resulting endogamy (marriages within the same caste) has naturally led to the evolution of different gene pools, one for each caste [4].The various evolutionary forces act upon such Mandelian populations and shape their specific genetic profile in due course of time.

An aboriginal but hetrogenous group of Hindu community has been explicity recognized as 'Scheduled castes' by the Constitution of India. They have an inferior social order in the hierarchy of Hindu caste-system, particularly categorized as 'untouchables'. In India, the state of Bihar has third largest population (over 16 million) of Scheduled castes in the country after Uttar Pradesh and West Bengal [6] with as many as 23 caste groups, each representing an endogamous unit. The most predominant Scheduled castes are the Chamars, the Dusadhs (each about 5 million), the Musahars (about 2.5 million), and the Pasis (about 1 million) which together comprise more than 90% of the Scheduled caste population of the state. Mostly rural based, members of each of these castes live separately in their small settlements on the fringe of villages.The Patnadistrict of Bihar, enclosing the capital city of the state and consisting of 23 community development blocks, covers an area of 3202 km^2. According to the Census Report (2011), it has the highest population (58.36 lac) as well as the highest population density (1823 person/km^2) in the state. Among its total Scheduled caste population of 9.2 lac, the Dusadhs have the highest

population followed by the Chamars, the Pasis and the Musahars.

The analysis of the prevalence of biogenetic (Mendelian) traits and the estimation of allele frequency of traits known to have monogenetic inheritance are extensively used to study the quantitative variation in different human populations (gene pools). In this regard, analysis of the genetic markers in human blood (such as blood groups) is of much relevance as such markers are genetically most polymorphic [6a, 22, 32]. As many facets of the population groups of Scheduled castes are still relatively unexplored and only a few workers have studied the prevalence of blood groups among some Scheduled castes in certain regions of Bihar [17, 18, 24],the present work aimed to analyze the genetic basis of ABO blood group polymorphism among the four major Scheduled castes (namely Chamar, Dusadh, Pasi and Musahar) of the district of Patna (Bihar), India.

Thediscovery of ABO blood groups by Karl Landsteiner (1900)was a milestone in the history of immuno-haematology [16]. He reported the presence of two antigens viz. A and B on the surface of RBCs and divided the human blood into three groups viz. A, B and O. Very soon, a fourth group viz. AB was discovered by De Castello and Sturli in 1902 [9]. Grouping of human blood into four categories (A, B, AB and O) depends upon the presence of A or B or the both blood group antigens or their complete absence in their red blood cells. The inheritance of blood group was suggested by Epstein and Ottenberg in 1908 [12]. In 1911, Von Dungern and Hirszfeld [10] established the Mendelian pattern of their inheritance. In 1924, Bernstein [2] determined the mechanism of inheritance of all the four blood groups of ABO system which were shown to be inherited as Mendelian characters by means of three alleles, i.e., I^A, I^B, and I^O of a single gene. The ABO locus is assigned to the distal end of long arm of human chromosome 9 ($9_q34.1$-$_q34.2$). Out of the three, the alleles I^A and I^B are dominant upon I^O and they themselves show co-dominance upon each other. The three alleles in various combinations form four different phenotypic groups which are A (I^AI^A or I^AI^O), B (I^BI^B or I^BI^O), AB (I^AI^B) and O (I^OI^O).

MATERIALS AND METHODS

Study design and subjects

A door-to-door immuno-haematological test was carried out to determine the blood-group frequency among the original inhabitants of the four populations of Scheduled castes of the district of Patna (Bihar) India that have the highest population in the region. A preliminary survey was conducted in different villages and urban mohallas in the various development blocks of Patna district, and 48 of them were randomly selected in 17 blocks for intensive survey and collection of data. More than 1000 persons each of Dusadh and Pasi communities, were surveyed while the number of persons surveyed in each of Chamar and Musahar populations remained limited to 700-800 owing to their shy nature, poor participation and lessco-operation in survey work.

Determination of blood group phenotypes

Theimmuno-haematological test, based on haemagglutination reaction, was performed by the process of slide-agglutination method [3, 8] with the help of monoclonal IgM antibodies (SpanClone, Span Diagnostics Ltd., Surat, India).Human RBCs possessing A and/or B antigen agglutinate with the corresponding antibody (anti-sera).Two circles were marked (as A, and B) on a clean slide where one drop of corresponding anti-serum was placed (i.e., antisera A at circle marked A andantisera B at circle marked B). One drop of fresh blood was placed on each of the marked area after pricking a left hand finger of the subject by a lancet sterilized needle (Amkay Products Pvt. Ltd., Vasai, Maharashtra) sterilized needle. Separate applicator sticks were used to mix blood with antisera and the slide was tilted back and forth for 2 minutes. Agglutination of RBCs with an antiserum indicated the presence of the corresponding antigen. Similarly, absence of agglutination of RBCs with an antiserum indicated the absence of the corresponding antigen. Results were analyzed within 2 minutes, as drying of the reaction mixture at the periphery may be misinterpreted as agglutination. Validity of anticera was checked at interval with known blood groups.

The blood group phenotypes were recorded for each of the four endogamous populations of Scheduled castes.The frequencies of three alleles (I^A, I^B, I^O) were calculated by the method suggested by Mourent et al. principle of Hardy-Weinberg genetic equilibrium using Bernstein's correction [17].

RESULT

All the fourpopulations (the Chamars, the Dusadhs, the Pasis and the Musahars) exhibiteddifferent patterns of the frequencies of various blood groups (Table 1). When the males and females were taken together, the blood group A was found most prevalent (37.22%) among the Pasis, while group Bappeared most frequent (34.11%) among the Dusadhs. Among The Chamars and the Musahars, the blood group with highest frequency,was AB (27.14%) and O (37.20%) respectively. Different patterns with highest frequencies of A, B, and O blood groups are also evident among the Saraswats in western India [5],Sansis of eastern Punjab [26]and Naga Vamsamof Andhra Pradesh [31].On the other hand, the blood groups AB, except among the Chamars, appeared to be least frequent in the

remaining three populations. It was 17.32% among the Dusadhs, 16.59% among the Pasis and 14.21% among the Musahars. Such a low frequency of AB blood has earlier been reported among the Sansis of Punjab [26] as well as in some non-Indian populations [1, 13].

The incidence of the four blood groups in the two sexes of each of the four populations was almost equal. The χ^2 values of the frequencies of various blood groups between the two sexes calculated for this porous ($p < 0.05$at 3 degree of freedom) appeared to be quite insignificant (Table 1).

The frequency of I^O, though highest in all four Scheduled caste populations, was most frequent (more than 60%) among the Musahars,but it was less than 50% among the remaining three populations. The highest frequency (approximately 30%) of I^B allele wasfound among the Dusadhs and the Chamars,butits lowest frequency (about 20%)was reported among the Pasis and the Musahars. The frequency of I^A allele was higher among the Pasis (30%) but varied from 17% to 22% among the Dusadhs, Chamars and Musahars (Table 2). Based on frequency of blood group allelesthe expected number of individuals of four blood groups was calculated using Hardy-Weinberg equation, and compared with the observed values obtained during the survey. The χ^2- values obtained during such comparison were indicative of significant differences in each of the four populations (Table 3). It means that none of the populations was in the state of genetic equilibrium for this trait and so the individuals of different blood groups can be said to have different survival rates.

DISCUSSION

Analysis of results revealed that all the four populations differed significantly with each other in the patterns of the incidence of the four blood groups in them (Table 4),clearly indicatingthe existence of biological distinctiveness in the local populations. Moreover, the Musahars appeared to display a blood group pattern quite different from the pattern observed in the remaining three Scheduled caste populations. Such differences in gene frequencies have also been found among Kanet (a Scheduled tribe) and Koli (a Scheduled caste) of Kinnar district of Himachal Pradesh, India[19]. Significant differences between populations have been reported among the nine endogamous groups of Kumbhars from Maharastra, India[11]. Nentsi tribal populations from north-western Siberia also differ from each other in the distribution of ABO blood group system [28].

The progress in molecular biology has also made it possible to analyze the genetic polymorphism at the DNA level in the human population in Indian sub-continent [20]. Studies based on the analysis of mitochondrial DNA and Y-chromosome revealed a close genetic affinity between certain Scheduled caste populations and tribal groups [30]. The Musahar population of Bihar (India) exhibits a much closer genetic affinity with a tribalgroup (Munda) of the neighbouring state (Jharkhand) than to any Scheduled caste population; the former (the Musahars) is thought to have undergone language shift from Mundari, an Austro-Asiatic language to Hindi, an Indo-European language (7, 29]. Moreover, occurrence of the highest incidence of O blood group (compared to other blood groups) and the highest frequency of I^O allele (compared to other alleles) among Musahars can be said to be in conformity with the outcome of the analysis of genetic polymorphism at the molecular level, showing that Musahars are quite different from rest of three scheduled caste populations (the Chamars, the Dusadh and the pasis).

Musahars are said to be the original inhabitants of India. The English Commissioner Sir H.H.Risley (1891) was the first to define Musahars and surmised them as an aboriginal tribe.They are outcaste within outcastes, forming a neglected, ostracised, deprived and starved group. They scour harvested fields to collect scraps and grains that have fallen unnoticed or follow field rats to their burrows to scrape out stored grain. In tough times, even undigested grains from cow dung is washed, cooked and eaten. They do not own any land and almost invariably work as landless agricultural labourers. In fact, their condition of living is sub-human [9]. The identity of Musahar community is trapped within the orbit of bonded labourer under the Kamioty system. In this system, as soon as a child attains puberty, his father wants him to get married and then goes to his master to seek financial help. In lieu of this, the child who is getting married, is supposed to serve the master throughout his life [15]. Musahars are, therefore, one of the most marginalized groups in India that have suffered total discrimination.

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Table 1 Frequency distribution of ABO blood groups among four Scheduled Caste populations

Population	Sex	Sample size	Frequency of ABO Blood groups								χ^2 between two sexes at df = 3
			A		B		AB		O		
			No.	%	No.	%	No.	%	No.	%	
Dusadh	M	751	185	24.63	254	33.82	123	16.38	189	25.17	
	F	369	92	24.93	128	34.69	71	19.24	78	21.14	2.67*
	M+F	1120	277	24.73	382	34.11	194	17.32	267	23.84	
Chamar	M	544	152	27.94	121	22.24	143	26.29	128	23.53	
	F	156	37	23.72	32	20.51	47	30.13	40	25.64	4.24*
	M+F	700	189	27.00	153	21.86	190	27.14	168	24.00	
Pasi	M	804	303	37.69	194	24.13	128	15.92	179	22.26	
	F	166	58	34.94	41	24.70	33	19.88	34	20.48	2.80*
	M+F	970	361	37.22	235	24.23	161	16.59	213	21.96	
Musahar	M	544	131	24.08	132	24.26	83	15.26	198	36.40	
	F	136	37	27.21	27	19.85	17	12.50	55	40.44	2.42*
	M+F	680	168	24.71	159	23.38	100	14.71	253	37.20	

Abbreviations: M= male, F=female
* Insignificant difference (p>0.05)

Table 2Frequency of ABO blood group alleles (I^A, I^B and I^O) in the four Scheduled caste populations

Population	Sex	I^A	I^B	I^O
Dusadh	M	0.2040	0.2943	0.5017
	F	0.2189	0.3213	0.4598
	M+F	0.2086	0.3031	0.4883
Chamar	M	0.2323	0.2826	0.4851
	F	0.1962	0.2974	0.5064
	M+F	0.2242	0.2859	0.4899
Pasi	M	0.3025	0.2257	0.4718
	F	0.2919	0.2556	0.4525
	M+F	0.3007	0.2307	0.4686
Musahar	M	0.1744	0.2223	0.6033
	F	0.1866	0.1775	0.6359
	M+F	0.1769	0.2132	0.6099

Abbreviations: M= male, F=female

Table 3Expected and observed number of persons of ABO blood groups in the four Scheduled caste populations

Population		A ($p^2 + 2pr$)	B ($q^2 + 2qr$)	AB ($2pq$)	O (r^2)	χ^2 between observed and expected (df = 3)
Dusadh	Expected	277	434	142	267	25.27*
	Observed	277	382	194	267	
Chamar	Expected	184	253	90	168	150.78*
	Observed	189	153	190	168	
Pasi	Expected	361	261	135	213	7.59*
	Observed	361	253	161	213	
Musahar	Expected	168	208	51	253	58.61*
	Observed	168	159	100	253	

*Significant difference ($p<0.05$)

Table 4 χ^2- value for the incidence of the four blood groups between pairs of scheduled caste populations

	Dusadh	Chamar	Pasi	Musahar
Dusadh		<0.05	<0.05	<0.05
Chamar	42.48*		<0.05	<0.05
Pasi	44.59*	36.54*		<0.05
Musahar	44.29*	47.33*	53.39*	

*Significant difference

Lower triangle indicates the χ^2 valueswhile the upper triangle represent their corresponding p values at df = 3

Graphs

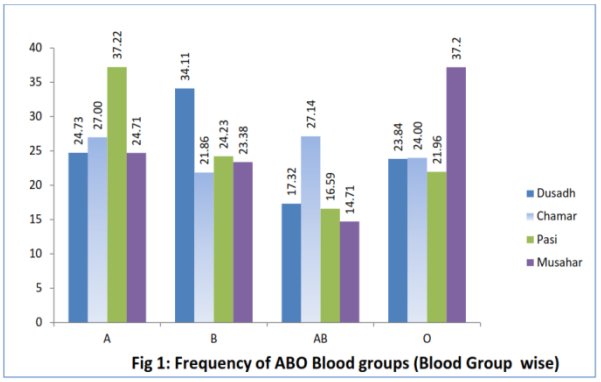

Fig 1: Frequency of ABO Blood groups (Blood Group wise)

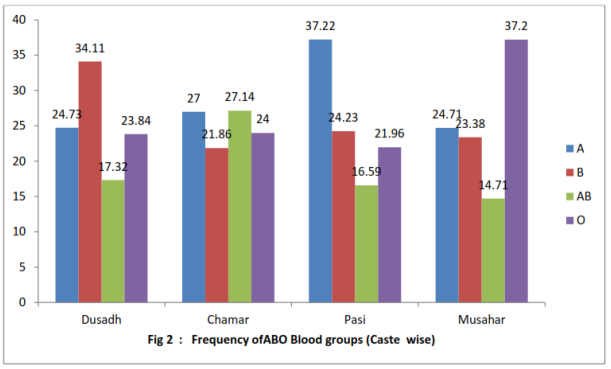

Fig 2 : Frequency ofABO Blood groups (Caste wise)

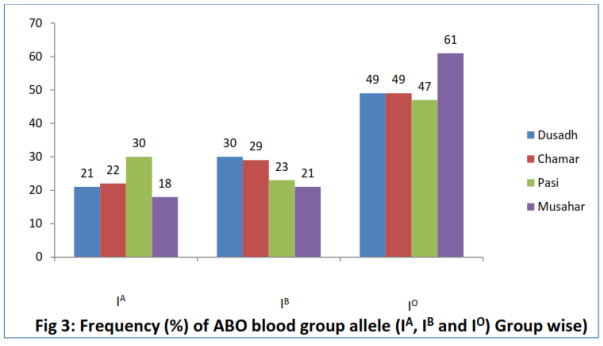

Fig 3: Frequency (%) of ABO blood group allele (I^A, I^B and I^O) Group wise)

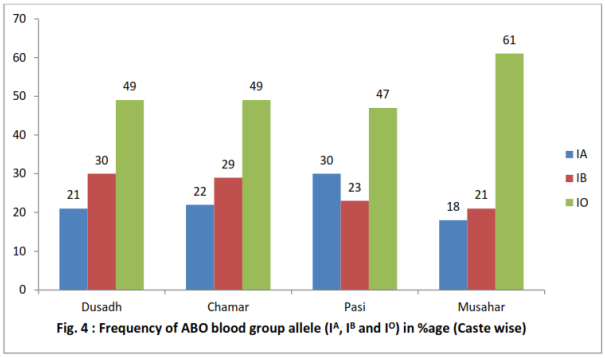

Fig. 4 : Frequency of ABO blood group allele (I^A, I^B and I^O) in %age (Caste wise)

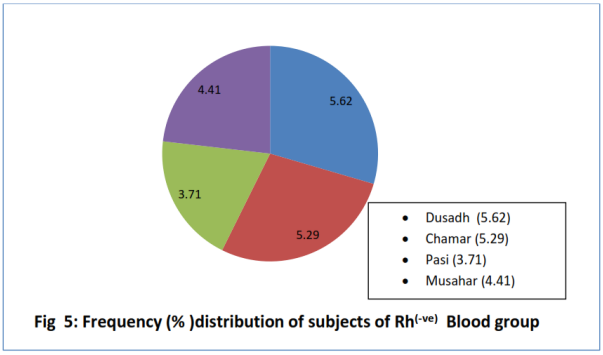

Fig 5: Frequency (%)distribution of subjects of $Rh^{(-ve)}$ Blood group

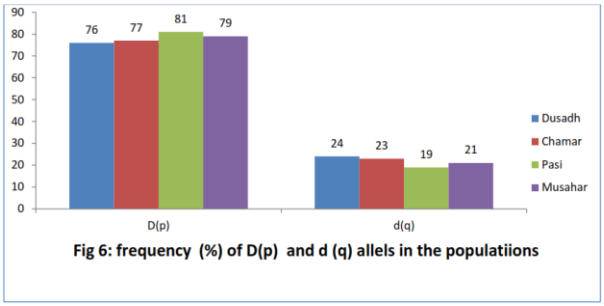

Fig 6: frequency (%) of D(p) and d (q) allels in the populatiions

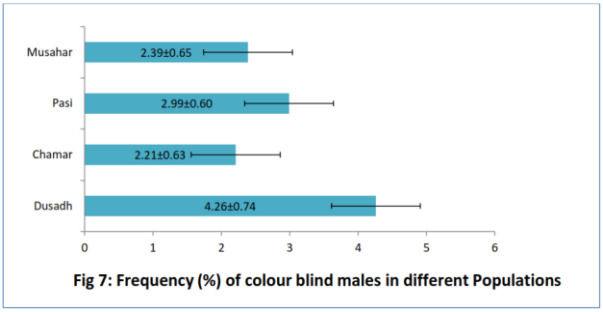

Fig 7: Frequency (%) of colour blind males in different Populations

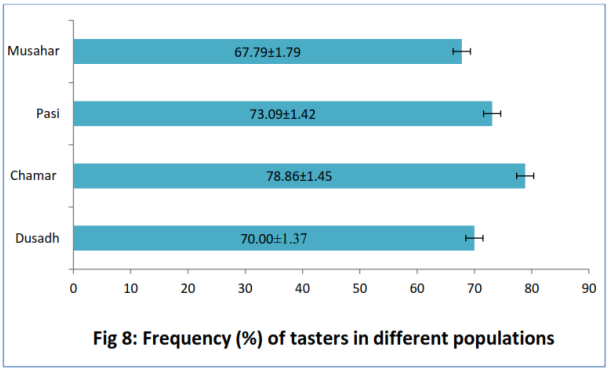

Fig 8: Frequency (%) of tasters in different populations

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