

# Association of ABO and Rh Blood Group with Transfusion Transmitted Infections (TTI) among Blood Donors in North India

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## ABSTRACT

**Background:** The present study was conducted with the aim to determine the pattern of distribution and to detect any association of transfusion transmitted infections (TTI) with ABO and Rh blood groups.

**Methods and Findings:** A retrospective study was conducted at the blood bank of Jawaharlal Nehru Medical College and Hospital (JNMCH), Aligarh Muslim University (AMU), Aligarh, U.P., India over a period of two years. A total of 36,614 healthy donors were included in the study. All the donor blood bags were screened for HbsAg, HIV, HCV, Syphilis and Malaria. The most common blood group was B positive (34.91%) while the least common was AB negative (0.61%). The total seroreactivity of TTI was 5.59%. Out of the total, 2.38% cases were reactive for HBsAg, 0.35% for HIV, 1.27% for anti HCV, 1.29% for syphilis and 0.29% for Malaria. Maximum seroreactivity was seen in bloodgroup B positive (1.79%) followed by O positive (1.54%) and then A positive (1.28%). A significant association was seen between Rh positive bloodgroup and HBsAg seropositivity (P value of 0.0459). In VDRL positive donors, there was significant association between VDRL infection and AB bloodgroup with a p value of 0.0331.

**Conclusion:** This study provides the prevalence of ABO and Rh blood group and also their association with the transfusion transmitted infections (TTI). This study shows a significant association between Rh positive bloodgroup and HBsAg and also significant association was seen between AB positive bloodgroup and VDRL infection.

**Keywords:** ABO, Rh, Blood group, TTI

## INTRODUCTION

Of the 33 Blood Group Systems outlined by the International Society of Blood Transfusion, ABO is the most important [1]. The distribution of ABO and Rh varies in different population groups and an understanding of their distribution helps in an efficient delivery of transfusion services [2].

Blood transfusion is an essential part of medicine. It is vital, noble and necessary. However, it carries with it the risk of transfusion transmitted diseases. Some of these diseases, like ABO and Rh incompatibilities of newborn, duodenal ulcer, gastric carcinoma, diabetes mellitus and venous thromboembolism shows an association with a particular type of blood group while others are directly transmitted as a result of transfusion [3]. These are mostly infectious diseases and occur because blood group antigens function as a receptor for the attachment of microorganisms [4].

The Transfusion Transmitted Infections can be broadly classified as viral, parasitic, bacterial, and spirochetal. Amongst the viral infections are those transmitted by Hepatitis B virus (HBV), Human Immunodeficiency Virus (HIV 1 and 2), Hepatitis C virus

(HCV), Cytomegalovirus (CMV), and Human T Cell Lymphoma virus (HTLV 1 and 2). Malaria, Filariasis, Babesiosis, Chagas disease, Leishmaniasis and Toxoplasmosis form the main bulk of parasitic infections while spirochetal infections include Syphilis, Lyme disease and Leptospirosis. Among bacterial infections, Brucellosis is transmissible by blood [5]. The risk of transmission of transfusion transmitted diseases (TTD) is 1% per transfusion [6].

According to NACO 2016-17 report, the annual requirement of blood for transfusion is estimated to be 12.8 million units of blood. India ranks third in harboring HIV infected individuals [7] HIV infection due to blood transfusion has been documented on many occasions. In a recent study conducted at a Regional Blood transfusion centre in North India, the prevalence of HIV was found to be 0.32% among blood donors while that of HBV, HCV, Malaria and Syphilis was 1.61%, 0.73%, 0.06% and 1.62% respectively [8].

In a study conducted to determine the relationship between blood groups and transfusion transmitted diseases, it was found that the highest number of HBsAg positive cases were A positive, maximum number of HIV positive cases were O positive while

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seropositivity for HCV was equally high in blood groups O positive and B positive [9].

In view of ensuring safety in blood transfusions and reducing the risk of transfusion transmitted diseases, it is pivotal that careful selection of donors be done. The present study was undertaken with the aim of investigating the prevalence of TTIs among blood donors and also if possible to find any association of ABO and Rh blood groups with TTIs at the Blood Bank of Jawaharlal Nehru Medical College and hospital (JNMCH), Aligarh.

## METHODS

The study was conducted at a tertiary care centre, Jawaharlal Nehru Medical College and Hospital (JNMCH), AMU, Aligarh, Uttar Pradesh, India. It was a two-year study starting from January 2017 to December 2018. During this period a total of 36,614 donors had donated blood in the blood bank, out of which 34,783 were males (95%) and 1831 were females (5%). All the donated blood bags were screened for transfusion transmitted infections (TTI). Serological tests were performed for HBV surface antigen (HBsAg), HCV antibodies (anti-HCV), anti-HIV -1 and 2, Venereal disease research laboratory test (VDRL), and Malaria parasite (MP) antigen. The serum samples of donors were tested by immunometric technique (chemiluminescence) for the assessment of HBsAg, HCV antibodies and anti HIV 1&2. For syphilis, rapid plasma reagin (RPR) card test was used whereas for malarial antigen rapid diagnostic kit of Alere Trueline was used.

## RESULTS

Out of the total 36,614 donors, 34,783 (95%) were males and 1831 (5%) were females. The most common blood group was B positive (34.91%) while the least common was AB negative (0.61%) (Table 1). The prevalence of Rh positive blood group was 94.52% were as Rh negative blood group was only 5.48% (Table 2). Overall seroreactivity of TTI was 5.59% (2047/ 36,614). Out of the total seroreactive cases, 93.7% (1918 cases) had Rh positive blood group and remaining 6.3% (129 cases) had Rh negative blood group (Table 2). Among the seroreactive donors, 872 (2.38%) cases were reactive for HBsAg, 127 cases (0.35%) for HIV, 467 cases (1.27%) for anti HCV, 474 cases (1.29%) for Syphilis and 107 cases (0.29%) for Malarial antigen (Table 3). Overall maximum seroreactivity was seen blood group B positive (1.79%) followed by O positive (1.54%) and then A positive (1.28%). The prevalence of TTI in relation to ABO blood group including Rh is shown in Table 3.

On statistical analysis a significant association was seen between Rh positive blood group and HBsAg seropositivity (P value of 0.0459).

**Table 1:** Prevalence of different blood groups during 2017 and 2018.

Blood group	2017	2018	Total	% of Total
A+	3982	4258	8240	22.5
A-	253	235	488	1.33
B+	6167	6614	12,781	34.91
B-	343	384	727	1.98
AB+	1772	1786	3558	9.71
AB-	103	122	225	0.61
O+	4961	5069	10,030	27.39
O-	277	288	565	1.54
Total	17,858	18,756	36,614	-

Also in VDRL positive donors, there was a significant association between VDRL infection and AB blood group with a p value of 0.0331 (Table 4).

A logistic regression model was built to evaluate main study variables (PRBC irradiation and leukoreduction status, storage time, hemoglobin concentration (hematocrit was not considered due to collinearity issues), and patient previous TAE history and use of premedication) association with FNHTR. This final multivariate model incorporated all collected data (124 observations - 117 subjects from previously mentioned groups plus 7 additional control subjects). Variables were selected in a backward stepwise approach and maintained in the final model only if they presented statistical significance. Final model is detailed in Table 5. Eventually, two PRBC factors remained in the multivariable model: storage time and hemoglobin concentration. For each increase in 1 day of storage time, FNHTR chance increased a mean of 6.7% (95% CI 0.4%-13.4%); while for each elevation of 1 g/dL of hemoglobin, a mean increase of 49.1% (95% CI 17.5%-89.3%) in the chance of FNHTR was observed.

## DISCUSSION

Association of Blood Group with various diseases has been commonly observed. The aim of our study was to determine the prevalence of ABO and Rhesus blood groups among blood donors and their association with TTIs.

There were a total of 36,614 donors, of which 95% (34,783) were males and 5% (1831) were females. This result is comparable to the studies done by Chandekar et al., in which also the majority of donors were males [10-14].

The most common blood group in our study was B positive (34.91%), similar to the observation made by Anumanthan et al., Nigam et al. and Tyagi et al. where the most common blood group was also B positive [15-17]. However, the studies done by Talib, et al., Bashwari et al. and Abdullah found blood group O to be the most common [18-20].

The prevalence of Rh negative blood group in our study was 5.48%. The least common blood group in our study was AB negative (0.61%) which was similar to the study by Ngassaki-Yoka et al. [21].

Overall seroreactivity of TTI was 5.59% which was slightly more than the study by Sharma et al. which showed 4.20% as the total percentage of TTIs [22].

Overall maximum seroreactivity was seen with blood group B positive (1.79%), similar to the observation made by Sinha et al. followed by O positive (1.54%) and then A positive (1.28%) [23].

**Table 2:** Prevalence of TTI among Rh positive and RH negative blood groups.

	TOTAL (%)	HBSAG (%)	HIV (%)	HCV (%)	VDRL (%)	MALARIA (%)	TOTAL (%)
RH +	34,609 (94.52)	811 (2.34)	119 (0.34)	435 (1.25)	452 (1.30)	101 (0.29)	1918 (93.7)
RH -	2005 (5.48)	61 (3.04)	8 (0.40)	32 (1.59)	22 (1.09)	6 (0.30)	129 (6.3)
TOTAL	36,614	872 (2.38)	127 (0.35)	467 (1.27)	474 (1.29)	107 (0.29)	2047 (5.59)

**Table 3:** Prevalence of TTI among different blood groups.

Blood group	HBsAg (%)	HIV (%)	HCV (%)	VDRL (%)	MALARIA (%)	TOTAL (%)
A+ (8240)	208 (2.52)	21 (0.25)	104 (1.28)	108 (1.31)	29 (0.35)	470 (1.28)
A- (488)	17 (3.48)	3 (0.61)	9 (1.84)	2 (0.04)	1 (0.02)	32 (0.08)
B+ (12,781)	279 (2.18)	39 (0.31)	143 (1.12)	161 (1.25)	35 (0.27)	657 (1.79)
B- (727)	16 (2.20)	2 (0.27)	12 (1.65)	10 (1.37)	2 (0.27)	42 (0.11)
AB+ (3558)	82 (2.30)	15 (0.42)	55 (1.54)	60 (1.68)	14 (0.39)	226 (0.61)
AB- (225)	6 (2.67)	4 (1.78)	5 (2.22)	3 (1.33)	1 (0.44)	15 (0.04)
O+ (10,030)	242 (2.41)	44 (0.44)	133 (1.32)	123 (1.22)	23 (0.23)	565 (1.54)
O- (565)	22 (3.89)	3 (0.53)	6 (1.06)	7 (1.23)	2 (0.35)	40 (0.10)
TOTAL	872 (2.38)	127 (0.35)	467 (1.27)	474 (1.29)	107 (0.29)	2047 (5.59)

**Table 4:** Significant association (p value) between TTI and blood groups.

TTI	No. Of Reactive Bags	P VALUE					
		A	B	AB	O	RH POSITIVE	RH NEGATIVE
HBSAG	872	0.1681	0.0578	0.8134	0.3778	0.0459	0.0548
HIV	127	0.1376	0.1836	0.1161	0.0793	0.0633	0.096
HCV	467	0.8546	0.0951	0.0722	0.6915	0.1883	0.225
VDRL	474	0.7455	0.7106	0.0331	0.4653	0.646	0.4824
MALARIA	107	0.3073	0.6194	0.2096	0.203	0.9523	0.9523

**Table 5:** Variables in the final model.

	Place	HIV (%)	HBsAg (%)	HCV (%)	Syphilis (%)
North India	Delhi	0.56	2.23	0.66	-
	Haryana	0.3	1.7	1	0.9
	Lucknow	0.23	1.96	0.85	0.01
South India	Karnataka	0.44	1.86	1.02	1.6
West India	Maharashtra	0.07	1.09	0.74	0.07
East India	West Bengal	0.28	1.46	0.31	0.72

However, this finding differed from many studies that found a higher seroprevalence of TTI in blood group O positive [24].

The World Health Organization has placed India in the intermediate zone (2-7%) of prevalence of hepatitis B for HBsAg [25]. In our study, among the seroreactive donors, maximum cases (2.38%) were reactive for HBsAg. The same was observed by Sinha et al. in his study [23]. Several other studies by Tyagi and Tyagi, Nigam et al, Bobde et al. and Deshpande et al. also showed maximum seropositivity for HBsAg [16,17,26,27].

We also observed that the highest number of HBsAg positive cases were Rh positive. Sharma et al., Sreedhar et al. and Sinha et al. also showed a significant association between Rh positive blood group and HBsAg seropositivity [22,23,28]. However, the maximum seroreactive cases for HIV and HCV were seen in AB negative blood group which was in concordance with the study undertaken by Tyagi et al. that observed that negative blood groups were more prone to TTI [17]. In a study conducted by Sharma et

al., AB negative blood group showed an increased seropositivity for hepatitis C (1.54%) which was again consistent with our study [22].

In the present study, 1.29% of the total donors tested positive for syphilis. Amongst VDRL positive donors, there was a significant association between VDRL infection and AB blood group with a P value of 0.0331. This value was lower than that observed by Chikwem et al. where *T. pallidum* accounted for 3.57% of all TTIs [29]. However Garg et al. observed that the prevalence of syphilis among the donors was 0.22% [30].

In a study conducted by Chandra et al. and Bhawani et al., syphilis positive donors were 0.01% and 0.08 % respectively [31,32]. Compared with the above studies, the prevalence of syphilis was higher in our study.

A total of 107 cases (0.29%) were positive for malarial parasite. However, this finding differed from many studies where there was not a single case of malarial parasite positivity [22,23]. This might

be due to the fact that Aligarh city of Uttar Pradesh where the study was conducted falls under the endemic zone for malaria, while most of the studies were done in the non-endemic zone of malaria.

This study, therefore, reflects the correlation between blood group antigens and the transfusion transmitted infections and also highlights the importance of routine screening of blood and its components for safe transfusion and prevention of blood borne transmitted infection.

## CONFLICT OF INTEREST

There are no conflicts of interest to disclose from author

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