Original Research Article

Frequency Distribution of ABO and Rhesus Blood Group system and their association with the prevalence of various clinical disorders among the Kashmiri Donors: *"A Possible Correlation or Just Random Distribution"*

Abstract

AIM:

The knowledge of blood group distribution is essential for inventory management and disease trends related to different blood groups. Besides being important in blood transfusion, ABO and Rh blood group system play an important role in forensic pathology, disease susceptibility and population genetics. The aim of the present study was to determine the frequency and distribution of ABO and Rh blood groups among MBBS/BDS students belonging to different geographical locations in the Kashmir valley, J&K India as well as the prevalence of various disorders among the students and their parents in relation to ABO and Rh blood groups

Study Design: A Comparative Study

Place and Duration of Study: Department of Physiology, Government Medical College Srinagar, Jammu and Kashmir, India

Methodology:

The ABO and Rh status was determined according to the classical slide test method. The prevalence of various disorders in the students and their parents was studied by self-administered questionnaire and all the required information was collected

Results:

The overall prevalence of the different blood groups followed the order: **O+ > A+ ≥ B+> O$^-$ >AB+>B$^-$**.The most common prevalent disorders associated with different blood groups were Diabetes, Hypertension, Hyperthyroidism, Hypothyroidism and Rheumatoid Arthritis. The other less prevalent disorders associated with several blood groups were PCOD, Gout, Myopia, Fatty Liver, Atrial Septal Defect, HBV infection and Vitiligo

Conclusions:

The results of the present and other studies indicates that if not the exact cause of disease, the individuals with different blood group antigens are susceptible to several disorders and other health problems. Further research investigations should be conducted at large scale in order to understand such possible connections between the blood groups and diseases if any such exist.

Keywords: ABO, Blood groups, Blood transfusion, Donors, Kashmir, Rhesus (Rh).

1. Introduction:

More than 20 different blood group systems have been identified and characterized since 1901, but only the ABO and Rhesus (Rh) blood groups remain most significant for clinical purposes. Both these systems are of great clinical importance in blood transfusion and organ transplantation. Numerous studies on the distribution of these 2 blood types in various populations around the world have been conducted. Their frequencies significantly vary between different geographic areas, thereby reflecting the underlying genetic and ethnic diversity among human populations [1].

The astounding ABO blood group system discovery is attributed to Austrian scientist Karl Landsteiner in 1900 [2] and was awarded with Nobel prize in 1930. The Alfred Von

Decastello and Adriano Sturli developed the AB blood group, the fourth blood type, in 1902 [3]. However, it comes in second in terms of clinical relevance. The ABO and Rh system genes located on chromosome 9 and chromosome1 respectively are genetically predetermined.

The prevalence of ABO and Rh blood groups varies across different geographical locations. The racial differences, geographic variance, various ethnic groupings, the outside environment, and genetic makeup are among the causes of such disparities [4–6]. The ABO and Rh blood group system not only play an vital role in transfusion safety and organ transplant, but the research on these blood group systems are of great importance in clinical studies, genetic studies and medico-legal issues like disputed paternity and anthropology [7,8]. Additionally, the significance of ABO blood group distribution is growing due to their association with certain disorders. Also, several studies have documented the ABO blood group system as the predictor of national suicide rate and genetic marker of obesity [9,10] and the involvement of the Rh blood group system in haemolytic disease of new-born [11].

Substantial epidemiological studies have broadly postulated the connection between ABO blood group and vulnerability to develop a number of diseases [12]. Also, studies have documented the associations of ABO blood types with various infectious [13,14] and non-infectious [13,15] diseases. Studies have documented the association between the ABO polymorphism and certain infectious diseases [16–18]. Reports have showed that O blood group individuals infected with cholera (Vibrio cholerae strains O1 El Tor and O139) had a greater frequency of severe infections than the non-O blood types [18]. A study conducted in Scotland in 1996 showed that O blood type patients were more vulnerable to infections like gastrointestinal outbreaks caused by Escherichia coli O157 and results in death of 87.5% among all the patients. According to G. Garratty, increased cases of cholera, plague, TB

infections, and mumps were also linked to blood type O, whereas Pseudomonas aeruginosa infection and smallpox prevalence were linked to blood type A, Salmonella, E. coli, Streptococcus pneumoniae, and gonorrhoea infections were more common in those with blood type B and increased rates of smallpox, E. coli, and salmonella infections were found to be linked with blood type AB. The individuals with blood group B were reported to have less risk of infection and other symptomatic disease with Norovirus, a strain-dependent pathogen, whereas the individuals with blood group O were reported to have at higher risk of infection [19,20]. The connection of ABO blood group with the peptic ulcer was the first one to be identified and the individuals with blood type O were shown to have higher susceptibility to peptic ulcers [19,20].

Also, people with blood type AB were shown to have a higher chance of developing cognitive impairment as revealed by a large prospective case-control study, independent of geographic region, age, race, and gender [13]. The studies have also documented the greater incidence of cancer in A blood type people as compared to O blood type people [21] and compared to blood type O individuals, blood type A individuals were shown to have higher incidence of cancer of the stomach (22%), ovaries (28%), salivary glands (64%), cervix (13%), uterus (15%), and colon/rectum (11%) [13,21]. The similar associations of ABO blood group systems have earlier been reported in case of other diseases like hypertension [13,22], Hyperlipidemia [23], Diabetes Mellitus [13,24] and Malaria [19,25].

In view of the above possible associations of the ABO blood group and different diseases, it becomes imperative to have the necessary information about the distribution of ABO blood group system and their possible associations with different diseases. The data generated from such studies will greatly help the caregivers in the timely management of various disorders in

the individuals who are at high risk of developing certain disorders associated with the specific blood groups.

2. Aim of the study

The aim of the present study was to determine frequency and distribution of ABO and Rh blood groups among MBBS/BDS students belonging to different geographical locations in the Kashmir valley, J&K India. Additionally, the study examined whether any correlations, if any, existed between the disorders and blood groups, as well as the prevalence of various disorders among the students and their parents in relation to ABO and Rh blood groups.

3. Material and Methods

The current study was conducted over the course of five (5) months from January 2022 to May 2022 in the Haematology Laboratory at the Department of Physiology, Government Medical College, Srinagar, JK, India. A total of 200 MBBS/BDS students were enrolled for the current study. The written informed consent was taken from all the MBBS/BDS students before the conduction of the study. The proper medical examination was carried and the blood samples were taken for the estimation of ABO and Rh-D blood grouping. The ABO and Rh status was determined according to the slide test method as described elsewhere [26]. Briefly, a drop of anti-A, anti-B and anti-D serum was placed on the left side of 3 slides and one drop of saline on the right side of each slide. A drop of donor's blood was mixed with anti-A, anti-B and anti-D separately. The ABO and Rh blood groups were determined on the basis of agglutination of the serum-cell mixtures. The findings were compared with the cells in the saline controls. A positive agglutination is observed as lattices of red cells while as, a negative reaction is represented by uniform distribution of red cells on the slide under microscope.

The prevalence of various disorders in the students and their parents was studied by self-administered questionnaire and all the required information was collected.

4. Results

Out of 200, only 101 MBBS/BDS students with an average age of 18-25 yrs gave their informed consent and were enrolled for the study. The 39 (38%) participants were boys and the rest 62 (61%) were girls among total of 101 students. Therefore, the frequency of girls was more as compared to boys. The frequency of ABO and Rh blood group systems was calculated in 101 participants and presented in table 1. The "+" or "–" indicates the presence of antigen D and is referred as Rh positive and Rh negative. The Blood group O^+ was found to be most prevalent. It was followed by the blood group A^+ and B^+ which were found to be equally prevalent. The frequencies of the other blood groups were in the order of O^-, AB^+ and B^-. Our results didn't find any prevalence of the blood groups A^- and AB^-. Therefore, the overall prevalence of the different blood groups followed the order: **O+ > A+ ≥ B+> O- >AB+>B-**.

Gender	Number	Percentage (%)
Boys	39	38
Girls	62	61
Total	101	

Table 1: Distribution of participants enrolled for the study

Blood Group	Boys	Girls	Total	Percentage (%)
A+	13	17	30	29 %
A^-	-	-	-	-
B^+	11	19	30	29 %
B^-	1	1	2	1.98 %
AB^+	1	2	3	2.9 %
AB^-	-	-	-	-

O^+	12	19	31	30 %
O^-	1	4	5	4.9 %

Table 2: Percentage Distribution of ABO and Rh Blood Group Systems ("+"Rh positive, "–" Rh negative)

Blood Group	Rh Positive	Rh Negative	Total
A	30 (29 %)	0	30
B	30 (29 %)	2	32
O	31 (30 %)	5	36
AB	3 (3 %)	0	3

Table 3: Percentage Distribution of Rh Blood Group System

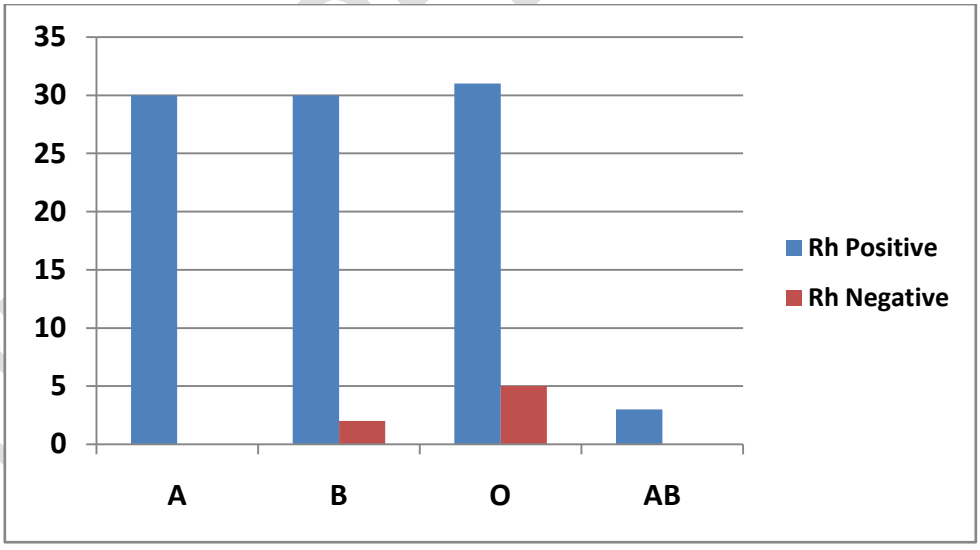

Figure 1: Distribution of ABO and Rh Blood Group System

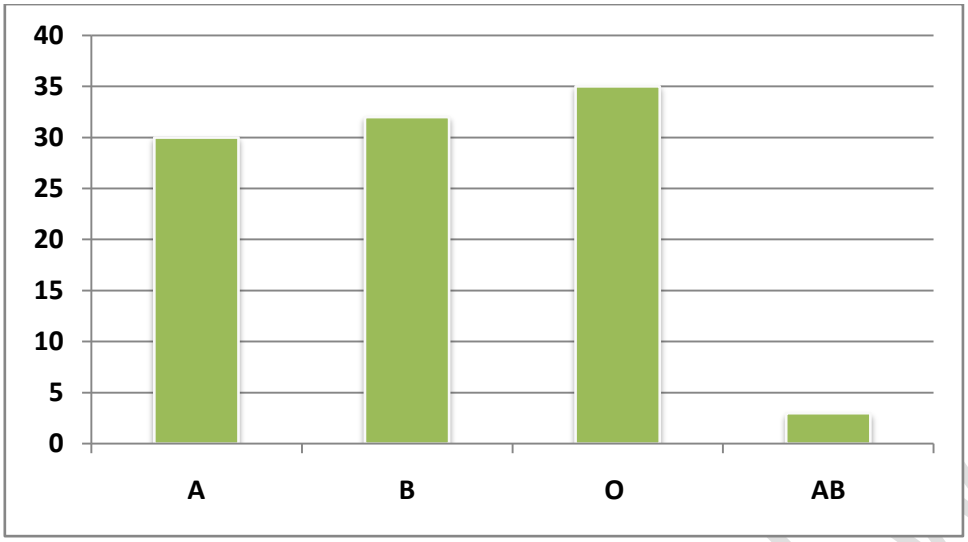

Figure 2: Overall Distribution of ABO Blood Groups

The most common prevalent disorders associated with different blood groups were Diabetes, Hypertension, Hyperthyroidism, Hypothyroidism and Rheumatoid Arthritis. The other less prevalent disorders associated with several blood groups were PCOD, Gout, Myopia, Fatty Liver, Atrial Septal Defect, HBV infection and Vitiligo. These presences of these disorders were studied in students, their parents, siblings and uncle with a self-administered questionnaire.

5. Discussion:

The study was conducted to examine the distribution frequency of ABO and Rh blood group system in the medical students of Kashmir valley. The study was conducted in the Department of Physiology, GMC Srinagar. The average age of students who voluntary participated in the study was 18- 25 years of age. The students were from different regions of Kashmir valley. Our results showed that blood group O^+ as the most prevalent blood group followed by the A^+ and B^+ which had a similar prevalence among the positive blood groups. The results also showed 93% of Rh^+ and 7 % of Rh^- blood groups. And among the negative blood groups O^- was the most common followed by B^- blood groups. Our study results

showed the prevalence of blood group AB+ after O- blood group. It is interesting to note that our study results didn't find any prevalence of the blood groups A^- and AB^- blood groups. A study conducted by Andalibi et al., 2020, showed the blood group O had the highest frequency (33.7%) followed by A, B, and AB blood groups as 30.2%, 27.7%, and 8.2% respectively [27]. Also, in other 2 studies were carried out in Pakistan and India, showed blood group B as the common blood group, followed by O, A, and AB [28,29]. Also a study conducted in Saudi Arabia showed O as the most prevalent blood group followed by A, B, and AB [30]. These findings from several studies are comparable to our study findings. This study of the frequency distribution of blood groups in the young adult population is critical for the development of a blood group database to determine easily available blood groups and the ones which are difficult to obtain. This may provide an important tool for determining the direction of voluntary donor recruitment camps as required for different regions across the state. Such information shall aid in the management of blood bank inventories and timely transfusion services to the needy.

The distribution of ABO and Rh blood group system vary from population to population. The comparison of our results of the frequency of the distribution of ABO and Rh blood group system with other studies are given below in the table 4 and table 5.

	A	**B**	**AB**	**O**	**Rh^+**	**Rh^-**
Present Study	29.00	29.00	3.00	30.00	91.00	7.00
Bangalore[36]	23.85	29.95	6.37	39.82	94.2	5.79
Chittoor[37]	18.95	25.79	7.89	47.37	90.6	8.42
Vellore[38]	18.85	32.69	5.27	38.75	94.5	5.47
Shimoga-Malnad[39]	24.27	29.43	7.13	39.17	94.93	5.07

Davanagere[40]	26.15	29.85	7.24	36.76	94.8	5.52
Eastern Ahmedabad[41]	23.3	35.5	8.8	32.5	94.2	5.8
Punjab[42]	21.9	37.6	9.3	9.3	97.3	2.7

Table 4: Comparison of Present Study with studies conducted across India (in percentage)

	A	**B**	**AB**	**O**	**Rh^+**	**Rh^-**
Present Study	29.00	29.00	3.00	30.00	91.00	7.00
Pakistan[43]	23.85	38	10	10	89.1	10.9
Nepal[44]	34	29	4	33	96.7	3.33
Britain[45]	41.7	8.6	3	46.7	83	17
USA[46]	41	9	4	46	85	5
Niger Delta[47]	23.8	20.7	2.8	52.7	93.9	62.12

Table 5: Comparison of Present Study with studies conducted outside India (in percentage)

The results of the above-mentioned studies conducted across different regions of India as well as conducted globally are comparable to our study findings. It is also important to mention that in countries like Britain, USA and Niger delta blood group O is the most prevalent followed by blood group A and are similar to our study findings. These differences may reflect a difference in population genetics belonging to different geographical regions.

The potential associations between the blood type and different disorders have been the topic of interest since the early 1900s. The various diseases like cancer, cardiovascular disease, infections and hematologic disorders, cognitive disorders, circulatory diseases, metabolic diseases, and malaria have all been linked to ABO blood group system. To this end our study also tried to examine the possible connections between the various disorders and ABO blood groups. Our results showed the prevalence of Hepatitis B infection in O blood group subjects and their family. A study by Jing et al., 2020 showed the decreased risk of HBV infection by 8% in subjects with blood group B when compared with non-B blood group (RR=0.92, 95% CI 0.86 to 0.98) [31]. Also, the subjects with blood group O had a 12% increased risk of HBV infection (RR=1.12, 95% CI 1.01 to 1.24) and the results are in concordance with our findings. Our results also find a single case of oesophageal squamous cell carcinoma (ESCC) in relation to blood group O. However, it is important to note in this regard that a study by Chen et al., 2021 showed the significantly elevated risk of ESCC for blood type B and AB, with the highest risk for type AB (OR, 95%CI: 1.34, 1.07–1.67) compared to blood group O [32]. Also a study by Zhang et al, 2020 showed blood type O had a worse disease-free survival (DFS) and overall survival (OS) than non-O in patients who were male, younger, and had ESCC ($P<0.05$) in oesophageal cancer patients [33] .

The one of the most common prevalent disorders associated with different blood groups in the Kashmir valley was hypertension. The results of our study indicate that the prevalence of hypertension was maximum in the blood group B followed by blood group A and blood group O. In this regard it is interesting to note that Sayed and Amin, 2015 also showed the maximum rate of hypertension in blood type B followed by blood type A and blood type AB and the results concur with our study findings [23]. Also, in other study conducted by Sadiq et al., 2017 found that the B blood group was more susceptible to hypertension as compared to blood group O and A and results are comparable to our findings [34]. Also, Jha et al., 2021

reported that blood group B has the highest prevalence of obesity and the development of both pre-hypertension and hypertension and blood group AB has the lowest risk of developing hypertension and obesity [35]. The pathophysiology of hypertension is multifactorial and therefore it is not surprising that several studies including the present study have found various links and connections between the hypertension and blood group types.

Our study results also found that an increased frequency of Diabetes in the blood type A followed by blood type B, blood type O and blood type AB (A>B>O>AB). However, other studies have shown that the individuals with blood type O shows the lower most risk of T2DM, and the blood type B were at the uppermost risk, followed by type AB and type A individuals and no such statistical significance for type AB people [13,24]. Such possible associations and connections between the diabetic and blood groups have been reported long back. In this connection, a study by Buckwalter, 1964 showed an increased frequency of the disease in persons of blood type B and a decreased frequency in those of blood type AB [36]. However, given the contradictory findings in relation to diabetes, this might likely represents a random distribution of blood types within diabetes mellitus patients rather than a cause and effect relationship between the ABO blood groups and diabetes mellitus. Further studies in large cohort of samples are needed to understand the possible associations or correlation between the prevalence of diabetes and ABO blood group systems if any.

Our results also indicate that the individuals with the blood group A are more prone to develop thyroid disorders followed by Blood group B and blood group O. However, blood group AB didn't show any such preponderance with thyroid disorders. The blood groups B and O showed equal preponderance with thyroid disorders. However, Prakash et al., 2020 showed that the people with blood group O are more prone for developing thyroid disorders followed by A and B [37]. Further research needs to be done to determine the correlation between the thyroid disorders and blood group antigens. The other less prevalent disorders

associated with several blood groups examined by our study were PCOD, Gout, Myopia, Fatty Liver, Atrial Septal Defect, HBV infection and Vitiligo.

6. Conclusion

Substantial studies have shown the association between ABO blood group types and several diseases whereas other studies have shown the contradictory results. The inconsistent nature of the results makes it difficult to associate or correlate the different blood group antigens with prevalence of different disorders. However, it is clear from the results of the present and other studies that if not the exact cause of disease, the individuals with different blood group antigens are susceptible to several disorders and other health problems. Further research investigations should be conducted at large scale in order to understand such possible connections between the blood groups and diseases if any such exist. These studies are of great importance in awareness of the public who are at high risk of developing disorders and also in the screening of high-risk blood groups which can later be trained to modify their health behaviour, lifestyles and other aspects to improve their public health. Furthermore, the multicentric prospective studies of the state should be conducted to obtain necessary required information regarding the ABO and Rh blood group frequency distribution on a regional and state level. Such vital information shall aid in better planning of the blood transfusion related management and future health challenges.

Limitations of the study

1. Lesser number of subjects participated due to voluntary nature of the study
2. Sample size was not enough to study zone/district wise frequency distribution

Consent:

The written informed consent was obtained from the patients before enrolling into the study.

Ethical Clearance: Not required

Data Availability Statement: All the data is available in this manuscript

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