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ABO and RH Blood Group Distribution among Blood Donors: A Retrospective Study at the Blood Centre, GT Base Hospital, Almora, Uttarakhand

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Abstract : *Blood group frequencies provide background information for blood component inventories and donor recruitment, especially in geographically difficult areas. Data from the hill areas of Uttarakhand are still sparse.*
Objective: To present the distribution of ABO and Rh(D) blood group among the blood donors at Blood Centre, GT Base hospital, Almora and compare the prevalence of Rh(D) negative donors with the published data in the region.
This was a single centre retrospective descriptive study with 793 eligible donor files between July and October 2026. ABO and Rh (D) frequencies were summarized as counts and percentages. The prevalence of Rh(D) negative was calculated using a Wilson 95% confidence interval. Published estimates were used as fixed proportions in exploratory exact binomial comparisons.
***Results:** Blood group A was recorded in 340 donors (42.9%), AB in 268 (33.8%), B in 100 (12.6%), and O in 85 (10.7%). Rh(D)-positive status was recorded in 762 donors (96.1%), and Rh(D)-negative status in 31 (3.9%; 95% CI approximately 2.8%–5.5%). The proportion of Rh(D)- negative was found to be less than the published figures for Haldwani (5.51%), Srinagar (6.49%) and multi centre India (5.39%). This is because the source manuscript report sections of the exact binomial p values are 0.051, 0.002, and 0.070 respectively, respectively, which would need to be recalculated from the specified testing convention prior to submission. Numbers for combined ABO–Rh(D) phenotype were not available.*
***Summary:** The contribution of Rh(D)-negative donors was small. This is a unique ABO distribution, especially high AB, which should be substantiated with primary registers. Full phenotype information and extended surveillance would enhance inventory planning.*

Keywords: ABO blood group; Rh(D); blood donors; blood centre; retrospective study; Uttarakhand

I. INTRODUCTION

ABO and Rh(D) blood groups are essential for safe transfusion. ABO incompatibility can lead to acute haemolytic transfusion reactions, while for Rh(D)-negative recipient the exposure to Rh(D)-positive red cells can lead to alloimmunization. The relevance of donor phenotypes to their availability, prior to the emergency, and to their recruitment for this purpose (Daniels, 2013; Reid et al., 2012) are important considerations.

The frequencies of blood groups vary geographically and donor group to donor group. An Indian study was conducted across multiple centres which reported inter-regional variation in the distribution of ABO groups and an overall frequency of Rh (D) negative about 5.4% (Agrawal et al., 2014). The predominant ABO blood group in Haldwani was group B with a frequency of 5.51% and in Srinagar, Garhwal, it was 6.49% for Rh(D)-negative frequency (Garg et al.,

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2014; Kumar & Modak, 2018). Such estimates are not necessarily representative of a donor population in Almora, a hill district with a distinct catchment and donor rates.

The present study was conducted to describe the distribution of the recorded ABO and Rh(D) blood group frequencies at the GT Base Hospital, Almora, from July to October 2026 and to place the observed frequency of Rh (D) negative blood group in context with the previously published estimates for this region. The planned eight-phenotype analysis was not able to be performed on the aggregated data that was available for manuscript redraft.

1.1 Objectives of the Study

- The aim of the study was to find the frequency and percentage distribution of ABO blood groups (A, B, AB and O) among eligible blood donors of GT Base hospital, Almora in July – October 2026.
- To calculate the percentage of Rh(D) positive donors, Rh(D) negative donors and a 95% CI for the Rh(D) negative percentage.
- To compare the observed Rh(D)-negative frequency with earlier studies conducted by the donor community in Uttarakhand and various centres in India, noting the variation in donor population and time periods.[1]
- To assess the implications of the observed donor-group profile for local planning of blood components and information needed for an 8-phenotype ABO–Rh analysis.[2]

1.2 Review of Literature

Raturi et al (2023)[3] did long-term red cell antigen phenotypings in donors from the lower and middle Himalayan region of Uttarakhand. Of the 5,407 samples available, 1,622 were group O and of these, 329 were phenotyped for a longer duration. Variation was found among the Rh and other antigens and recommended a rare-donor registry. Relevance: it illustrates the relevance of utilizing locally provided donor profiles in order to develop antigen matched transfusion and recruitment strategies in Uttarakhand. Research gap: its small sample of group O population and its extended antigen coverage would not provide a representative overall distribution of the population of Almora donors for blood group ABO–Rh.

In Delhi regional transfusion-centre study (2023), group B was found to be the commonest ABO blood group (around 37.7%) followed by group O (29.3%), group A (23.1%) and group AB (10.0%) with 5.01% negative (Rh(D-)). The investigators also calculated allele and genotype frequencies assuming Hardy–Weinberg equilibrium. Relevance: The dataset from a large number of donors in northern India is a useful reference for the present study. Research gap: the population recruited to a metropolitan referral centre may be different to the population recruited to a hospital in a hill-district with regards to their recruitment patterns and demographic composition.

Beyond the common blood group antigens ABO and D, there are other antigen types, such as ABO, Rh (D, C, c, E and e) and Kell, which were studied by Banerjee et al. (2024)[4] in a South Indian centre. Relevance: the relevance of the work to clinical use of locally prepared blood-group profiles and antigen-aware inventory planning. Research gap: results of southern India are not applicable to Uttarakhand and there is no extended Rh or Kell typing performed here.

A retrospective study was conducted at a rural university blood centre in Uttar Pradesh on 45,067 donors of the rural Uttar Pradesh between 2018 and 2023. It revealed that 97.6% were male, 73% for the first time and about 4% were Rh-

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negative. Most frequent reported group was B-positive. Relevance: The results show the importance of the characteristics of donors in determining the observed frequencies of blood groups and service planning. There are no equivalent subgroup analyses in the Almora dataset because sex of the donor, first time or recruitment category were not recorded.5

Almora: Jain et al. (2026)6 presented data on 3,102 donors from January 2025 to June 2026. The ABO distribution was A 30.7%, B 30.0%, O 27.3% and AB 12.0%, with Rh(D) positivity of approximately 94.4%. Relevance: this is a particularly local comparator for the present July – October 2026 donor series. Research gaps: The AB percentage is very different from that of the current dataset (33.8%), suggesting that the data should be checked for differences in the source register, coding and donor selection process before being considered as population differences.

Literature synthesis and research gap

Some recent data suggests that there may be variation in ABO and Rh(D) distribution in Indian blood centres which may be due to donor selection as well as geographical area. The present study is a brief description of Almora donor register for a short period of time. The eight combined phenotypes and the count of O-negative should not be reported with the AB proportion being so high, without performing the AB proportion check against source records.7

II. MATERIALS AND METHODS

Retrospective descriptive single-centre study done with using the routine donor records of the Blood Centre, GT Base Hospital, Almora, Uttarakhand, India.8

The study period and participants were detailed in records from July through October 2026 were evaluated. From the source manuscript it is reported that all 793 eligible unique donor records (with documented ABO and Rh(D) results) were included. Each entry that failed to provide legible typing and those submitted by the same donor were disqualified. No figures are reported for the number of records screened and excluded.

. The data obtained included the ABO blood group (A, B, AB, O) and Rh-D (positive/negative). Structured extraction form was used and direct donor identifiers were not included in the analysis. Original manuscript suggests combined phenotypes were also to be extracted, but the eight-cell frequency table was not provided.9

All counts and percentages were based on a denominator of 793. The 95% confidence intervals for Wilson are binomial proportions. Exploratory test (two-sided, 95% significance) was conducted against published proportions of 5.51%, 6.49% and 5.39% for Rh(D)-negative blood samples. Due to the different periods and donor groups, it is not possible to make population level comparisons. It was not described what kind of adjustment was made for multiple comparisons.

Records were de-identified and permission from hospital and blood-centre was gained, the source says. Before submission, the details and reference number of the institutional ethics committee approval or institutional ethics committee consent waiver must be confirmed; the approval or consent waiver can not be assumed.10

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III. RESULTS

The analysis included 793 eligible donor records. Group A accounted for the largest proportion (42.9%), followed by AB (33.8%), B (12.6%), and O (10.7%). The counts sum to 793.

Table 1. ABO blood group distribution among eligible donors (N = 793).

ABO group	Number (n)	Percentage (%)
A	340	42.9
AB	268	33.8
B	100	12.6
O	85	10.7
Total	793	100.0

Table 2. Rh(D) status distribution (N = 793).

Rh(D) status	Number (n)	Percentage (%)
Positive	762	96.1
Negative	31	3.9
Total	793	100.0

The proportion of women who were Rh(D) negative was 31/793 (3.91%) and had a Wilson 95% confidence interval of about 2.8%–5.5%. There were about 24.6 times more Rh(D)-positive donors than Rh(D)-negative donors. The source manuscript reports exploratory exact binomial p values of 0.051 versus Haldwani, 0.002 versus Srinagar and 0.070 versus the multicentre Indian estimate. These reported values should be verified prior to publication. The number of donors who are O-negative could not be determined (as were not available A+, A−, B+, B−, AB+, AB−, O+, O−), nor could the most or least common combined phenotype.11

IV. DISCUSSION

The more salient finding was that group A was the predominant and the frequency of group AB was relatively high. The distribution of the ABO blood group phenotype was distinctly different from the published reports from Haldwani and Srinagar where group B was the most common and group AB was the least common ABO blood group (Garg et al., 2014;12 Kumar & Modak, 2018). While AB discrepancies may be caused by local population structure and/or donor selection, this is especially crucial with primary data verification. The distribution could not yet be interpreted as a population genetic basis because original typing records and extraction codes and tabulation procedure have not yet been investigated.

Donors with the Rh(D) negative phenotype made up 3.9% of the subjects of the study. This was also at a lower rate than the range of 5% to 6.5% reported in the regional studies cited. The donor series, however, was not representative in terms of length of time, as it was only four months from one centre and comparisons across centres and times may have suffered from differences in recruitment and donor eligibility. Therefore statistical comparisons with published fixed proportions are regarded as exploratory.

Phenotype-specific inventory decisions involve balancing the needs of donor supply with clinical utilization. An up-to-date recall register and recruitment of Rh(D)-negative individuals can aid contingency planning. Unfortunately, the present data set does not provide an estimate of the number of O negative individuals, as ABO and Rh(D) were not

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correlated. The unusually low percentage of group O also needs to be considered prior to drawing conclusions about emergency red-cell stores. Likewise, the meanings of group AB frequency vary according to the red-cell and plasma parts (Daniels, 2013;13 Reid et al., 201214).

This analysis demonstrates how the simple, unobtrusive use of blood-centre records is a valuable surveillance tool. The main drawbacks are the limited observation time, single-centre design, absence of donor demographic or donation-type information, missing combined phenotype counts and non-existent ethics documentation. A full eight phenotype table, a longer time period and component demand as well as donor supply should be taken into account for further analyses.15

V. CONCLUSION

The present study of 793 donor records at GT Base Hospital Almora gives a preliminary picture of the distribution of ABO blood groups and Rh (D) status of the blood donors. The most common ABO blood type phenotype observed was group A and 3.9% of the donors were Rh(D)-negative. These results help in the description of the local donor profile and can serve as a valuable reference in future research on the distribution of blood group in the region.

The extremely high reported rate of group AB, however, requires confirmation with original donor records in order to be published. The full ABO–Rh(D) cross tabulation should also be examined for consistency and accuracy of results. Furthermore, if applicable, inferential statistical analysis and the relevant ethics approval/exemption information should be confirmed prior to submission to journals.

Further research with larger donor numbers and extended observation periods might provide more accurate estimates of the local blood group frequencies. Continuous monitoring of ABO and Rh(D) distribution also can be used to guide donor recruitment, ensure blood inventories and ensure availability of compatible blood products. Overall, the results provide a preliminary local reference and need to be verified and systematically monitored to further enhance the scientific and practical value.

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