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# Epidemiology of ABO and Rhesus blood group frequencies in a Nigerian tertiary hospital: public health and transfusion-relevant patterns

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## Abstract

ABO and Rhesus (Rh) blood group frequencies vary by population and are relevant to transfusion compatibility and blood-bank planning. This retrospective study describes the distribution of ABO and Rh blood groups and their association with age and sex among 6,933 client records handled by the Blood Bank of Ekiti State University Teaching Hospital (EKSUTH), Ado-Ekiti, Nigeria, during 2023. The cohort comprised 3,538 males (51.0%) and 3,395 females (49.0%); adults (18–64 years) accounted for 79.3% (5,499/6,933). Blood group O was the most frequent ABO phenotype (4,094; 59.1%), followed by A (1,361; 19.6%), B (1,293; 18.7%), and AB (185; 2.7%); 93.2% of clients were Rh-positive. O-positive was the most common combined phenotype (54.9%), and AB-negative was the least common (0.2%). ABO group distribution differed significantly by age group ($\chi^2(12) = 60.8$, $p < 0.001$, Cramer's $V = 0.05$) and by sex ($\chi^2(3) = 36.9$, $p < 0.001$, Cramer's $V = 0.07$); both effect sizes were small. Rh status showed no significant association with age ($\chi^2(1) = 0.13$, $p = 0.714$). Blood group O was more frequent among males (62.1%) than females (55.9%), whereas A, B, and AB were modestly more frequent among females. These findings, drawn from a single tertiary-hospital client population that includes donors, transfusion recipients, and routine attendees, provide baseline data to support age- and sex-informed blood-inventory planning and donor recruitment at EKSUTH. Given the cross-sectional, hospital-based design, the findings should not be generalized to the wider Ekiti State or Nigerian population, and any inference about disease susceptibility or survival requires dedicated outcome-based studies.

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## 1. Introduction

The ABO and Rhesus (Rh) blood group systems play vital roles in the human body, influencing transfusion compatibility, susceptibility to disease, population genetics, and epidemiology [1, 2]. First documented by Karl Landsteiner in 1900, the ABO blood group system categorizes humans according to the presence of A and B antigens on red blood cells (RBCs) and corresponding antibodies in plasma [3]. It has significant clinical implications for transfusion medicine, organ transplantation, hemolytic disease of the newborn, and forensics [4, 5]. The Rh system, discovered in 1939, is identified by the presence or absence of the D antigen on RBCs and is a key determinant of maternal–fetal incompatibility, alloimmunization, and hemolytic disease of the newborn [6]. These two systems remain the most important blood group systems in clinical practice [7].

The distribution of ABO and Rh blood groups varies considerably among human populations because of selective pressures, including evolution, migration, genetic drift, natural selection, and environmental influences [8, 9]. Blood group O is most frequent among various African populations, whereas blood group A is frequent among certain European and some Asian populations [10, 11]. Similarly, Rh-positive status is overwhelmingly common worldwide, whereas Rh-negative frequency appears to be slightly higher among Caucasian populations than among African or Asian populations [12]. Regional blood-group distribution data are important for blood-bank management, donor-recruitment strategies, transfusion safety, and prevention of alloimmunization [13].

Beyond their role in transfusion compatibility, ABO blood groups have been implicated in differential susceptibility to infectious and non-infectious diseases. Individuals with non-O blood groups show a significantly higher risk of cardiovascular disease, thromboembolism, and some tumors [14]. Conversely, blood group O may be protective against severe malaria because infected RBCs show less rosetting [15]. ABO blood groups have also been linked to susceptibility to *Helicobacter pylori* infection, peptic ulcer disease, dengue, cholera, and severe coronavirus disease 2019 (COVID-19) infection [16, 17]. Rh-negative status is sometimes linked to various immunologically mediated conditions and hemolytic problems, especially those associated with maternal–fetal incompatibility [18].

Certain demographic factors, particularly age and sex, have also been reported to be important. Variation by age may result from differing mortality rates, cohort effects, or selection pressures; for example, some reports suggest that certain blood groups may be associated with better survival and lower disease incidence, particularly group O [19]. Differences by sex have been reported in some parts of the world, but such differences appear inconsistent across regions and ethnic groups [20].

Studies conducted in Nigeria show a dominance of blood group O and Rh-positive phenotypes among various populations; however, few studies have specifically examined the relationship between blood-group distribution and demographic parameters such as age and sex. Tertiary health-care centers, such as Ekiti State University Teaching Hospital (EKSUTH), provide a useful setting for investigating these issues because they serve a mixed population and maintain blood-bank records. This study therefore aimed to determine the distribution of ABO and Rh blood groups among clients at EKSUTH, Nigeria, and to assess their association with age and sex, in order to provide more specific data on blood-group trends in this Nigerian hospital population.

## 2. Materials and methods

### *2.1. Study design and setting*

This retrospective observational study was performed at the Department of Haematology and Blood Transfusion, Ekiti State University Teaching Hospital (EKSUTH), Ado-Ekiti, Nigeria. EKSUTH is a tertiary health-care facility and a major referral center for the state and surrounding areas. The hospital provides comprehensive clinical care, including blood banking, transfusion medicine, and hematological investigations, and therefore provides an appropriate setting for investigating blood-group distribution. Ekiti State is in southwestern Nigeria, had an estimated population of 3,785,001 in 2020, and is predominantly characterized by the Yoruba ethnic group and Christianity.

### *2.2. Study population*

The study subjects were clients whose ABO and Rh blood groups were determined in the Blood Bank of EKSUTH between January 1 and December 31, 2023. The study included clients of all age groups, from infants (< 1 year) to older adults (≥ 65 years), across the five age categories defined in Section 2.5. ABO grouping was performed using both forward (cell) and reverse (serum) methods. Forward grouping was carried out by testing patients' RBCs with commercially prepared monoclonal anti-A, anti-B, and anti-AB antisera (Lorne Laboratories Ltd., United Kingdom), whereas reverse grouping involved testing patients' serum or plasma against known A and B reagent red cells to confirm ABO group assignment. Agglutination reactions were read macroscopically and, when necessary, confirmed microscopically according to standard blood-banking procedures. Any discrepancy between forward and reverse grouping was resolved by repeat testing using freshly prepared cell suspensions and serum samples before the final blood group was assigned. Rh(D) typing was performed using commercially prepared monoclonal anti-D antisera (Lorne Laboratories Ltd., United Kingdom). Samples initially typed as Rh(D)-negative were subjected to weak D (Du) testing using the indirect antiglobulin test according to the manufacturer's instructions before being reported as Rh(D)-negative. Known positive and negative control samples were included with each testing batch as part of routine internal quality control.

Table 1: Age distribution of study participants ($N$ = 6,933).

| Age group | *n* | % |
|---|---|---|
| Infants (< 1 year) | 502 | 7.2 |
| Children (1–12 years) | 534 | 7.7 |
| Adolescents (13–17 years) | 214 | 3.1 |
| Adults (18–64 years) | 5,499 | 79.3 |
| Older adults (≥ 65 years) | 184 | 2.7 |
| Total | 6,933 | 100.0 |

### *2.3. Inclusion and exclusion criteria*

The inclusion criteria were complete and reliable ABO and Rh blood-group results for clients of any age group or sex. Records with missing, questionable, or contradictory blood-group results, repeated records, or inadequate client information were excluded.

### *2.4. Sample size*

All eligible client records that met the inclusion criteria for the period January 1–December 31, 2023, were retrieved and analyzed, yielding 6,933 records. Because this represented a full census of eligible records for the study period rather than a randomly drawn sample, no separate sample-size or power calculation was performed.

### *2.5. Data collection*

Client records were extracted from the hospital blood-bank records using a structured data-extraction form designed for this purpose. Client demographic information, including age, sex, and hospital number, was obtained along with laboratory test results for ABO and Rh blood groups. Age was categorized into five groups: infants (< 1 year), children (1–12 years), adolescents (13–17 years), adults (18–64 years), and older adults (≥ 65 years). Blood groups were determined as part of routine management.

### *2.6. Blood-group determination*

ABO and Rh blood groups were determined using the agglutination method with commercially available antisera. Briefly, ABO groups were determined by testing patients' RBCs with anti-A, anti-B, and anti-AB sera. Rh grouping was determined by testing patients' RBCs with anti-D sera. Interpretation was performed macroscopically. All laboratory work was carried out by qualified personnel.

### *2.7. Data management*

All collected data were entered into a password-protected encrypted electronic database, with access restricted to research team members. Client data were retained using hospital numbers rather than directly identifiable client information, and a unique serial number was assigned to each client record for statistical analysis, thereby maintaining confidentiality throughout the study.

### *2.8. Statistical analysis*

The collected data were analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA) and Jamovi version 2.6. Descriptive statistics, including frequencies and percentages, were used to summarize the distribution of ABO and Rh(D) blood groups across age groups and sex. Associations between categorical variables (age group and sex) and blood-group type were evaluated using Pearson's chi-square ($\chi^2$) test of independence. The assumptions of the $\chi^2$ test were assessed by examining expected cell frequencies, and all analyses satisfied the required assumptions. Effect sizes were quantified using Cramer's $V$. All statistical tests were two-tailed, and exact $p$ values < 0.05 were considered statistically significant. Results were presented using contingency tables and bar charts generated with Microsoft Excel 2021 (Redmond, WA, USA) and IBM SPSS Statistics version 26.0.

## 3. Results

### *3.1. Demographic distribution*

The final analysis included 6,933 client records: 3,538 males (51.0%) and 3,395 females (49.0%), giving a male-to-female ratio of 1.04:1. By age group, adults (18–64 years) comprised 79.3% of records (5,499/6,933), followed by children aged 1–12 years (7.7%, 534/6,933), infants aged < 1 year (7.2%, 502/6,933), adolescents aged 13–17 years (3.1%, 214/6,933), and older adults aged ≥ 65 years (2.7%, 184/6,933) (Table 1; Figure 1).

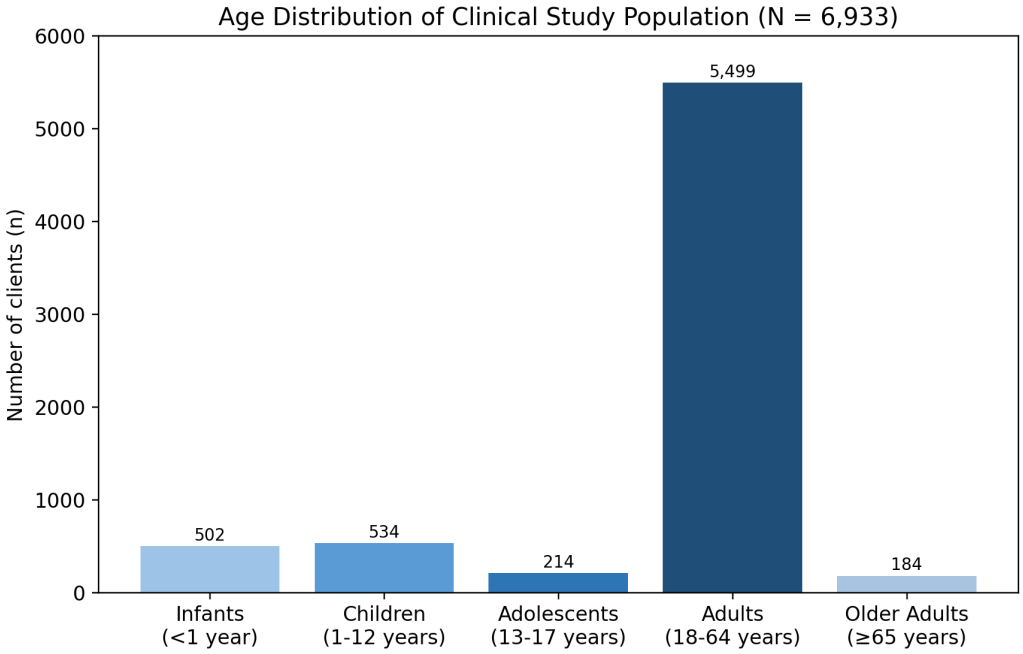


Figure 1: Age distribution of participants, showing the predominance of adults.

Table 2: ABO blood-group distribution.

| Blood group | *n* | % |
|---|---|---|
| A | 1,361 | 19.6 |
| B | 1,293 | 18.7 |
| AB | 185 | 2.7 |
| O | 4,094 | 59.1 |
| Total | 6,933 | 100.0 |

Table 3: Rhesus blood-group distribution.

| Rh group | *n* | % |
|---|---|---|
| Positive | 6,464 | 93.2 |
| Negative | 469 | 6.8 |
| Total | 6,933 | 100.0 |

Table 4: Combined ABO and Rhesus blood-group distribution.

| Blood group | *n* | % |
|---|---|---|
| A+ | 1,272 | 18.3 |
| A- | 89 | 1.3 |
| B+ | 1,215 | 17.5 |
| B- | 78 | 1.1 |
| AB+ | 173 | 2.5 |
| AB- | 12 | 0.2 |
| O+ | 3,804 | 54.9 |
| O- | 290 | 4.2 |
| Total | 6,933 | 100.0 |

### *3.2. ABO and Rhesus blood-group frequencies*

The observed ABO blood-group frequencies showed that blood group O was the most frequent (4,094; 59.1%), followed by blood group A (1,361; 19.6%), blood group B (1,293; 18.7%), and blood group AB (185; 2.7%) (Table 2). In the Rh system, 6,464

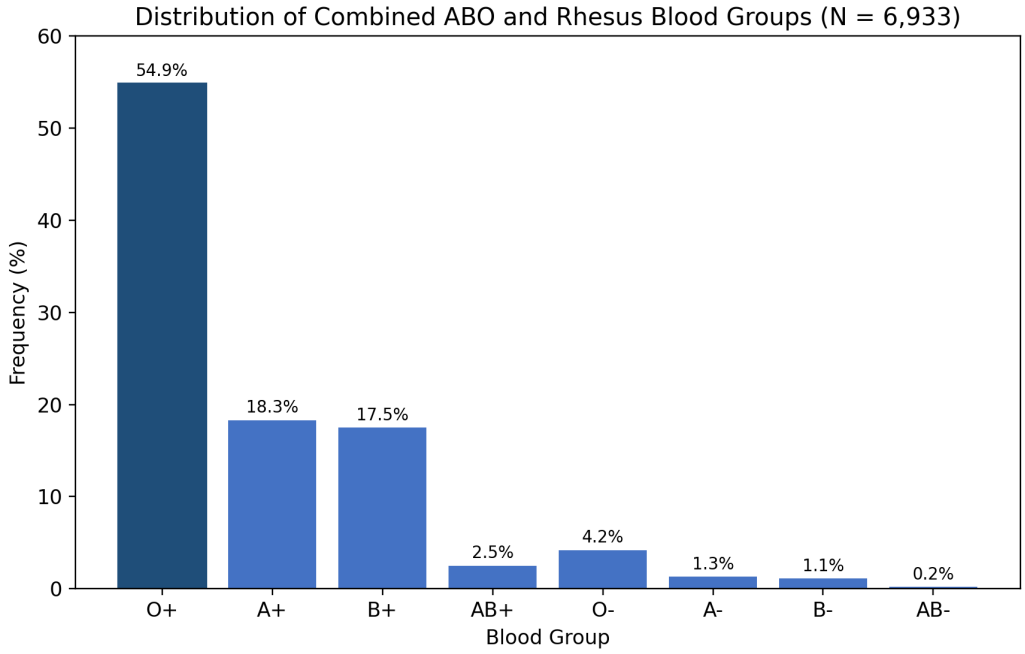


Figure 2: Combined ABO and Rh blood-group distribution, highlighting O+ as the most frequent group and AB- as the least frequent group.

Table 5: Association between age group and ABO blood groups ($N$ = 6,933).

| Age group | A, *n* (%) | B, *n* (%) | AB, *n* (%) | O, *n* (%) | Total |
|---|---|---|---|---|---|
| Infants (< 1 year) | 135 (26.9) | 103 (20.5) | 8 (1.6) | 256 (51.0) | 502 |
| Children (1–12 years) | 125 (23.4) | 122 (22.8) | 23 (4.3) | 264 (49.4) | 534 |
| Adolescents (13–17 years) | 49 (22.9) | 44 (20.6) | 5 (2.3) | 116 (54.2) | 214 |
| Adults (18–64 years) | 1,007 (18.3) | 998 (18.1) | 143 (2.6) | 3,351 (60.9) | 5,499 |
| Older adults (≥ 65 years) | 45 (24.5) | 26 (14.1) | 6 (3.3) | 107 (58.2) | 184 |
| Total | 1,361 | 1,293 | 185 | 4,094 | 6,933 |

$\chi^2$ = 60.8, df = 12, $p < 0.001$.

participants (93.2%) were Rh-positive, whereas 469 (6.8%) were Rh-negative (Table 3). In the combined ABO and Rh systems, the most common blood group was O-positive (3,804; 54.9%), and the least common was AB-negative (12; 0.2%) (Table 4; Figure 2).

### *3.3. Relationship between age and blood groups*

A significant relationship was found between age group and ABO blood group ($\chi^2$ = 60.8, df = 12, $p < 0.001$, $N$ = 6,933, Cramer's $V$ = 0.05, indicating a small effect). The pattern across age groups was not monotonic: the proportion of group O was 51.0% among infants, 49.4% among children, 54.2% among adolescents, 60.9% among adults, and 58.2% among older adults. Group A accounted for 26.9%, 23.4%, 22.9%, and 18.3% in the first four groups, respectively, but rose again to 24.5% among older adults rather than declining steadily with age (Table 5; Figure 3). Because this is a cross-sectional comparison of different age groups sampled at a single time point, these differences may reflect cohort effects, differences in referral patterns between age groups, or the mixed donor, patient, and routine-attendee composition of the sample, rather than any biological process occurring within individuals as they age. An individual's ABO and Rh phenotype is genetically fixed at birth and does not change with age.

No significant association was observed between age and Rh blood-group distribution ($\chi^2$ = 8.0, df = 4, $p$ = 0.092), with Rh-positive prevalence remaining relatively constant across age groups (Table 6).

There was a statistically significant, though small, association between sex and ABO blood group ($\chi^2$ = 36.9, df = 3, $p < 0.001$, Cramer's $V$ = 0.07). Blood group O was more common among males (62.1%) than among females (55.9%), whereas groups A, B, and AB were each modestly more common among females (20.6%, 20.1%, and 3.4%, respectively) than among males (18.7%, 17.3%, and 1.9%, respectively) (Table 7; Figure 4). Given the small effect size, this difference, while statistically significant at this sample size, reflects a modest shift in proportions rather than a marked divergence between sexes. It is also consistent with the possibility that male and female clients were drawn somewhat differently from the underlying donor, patient, and routine-attendee mix, which was not stratified in this dataset.

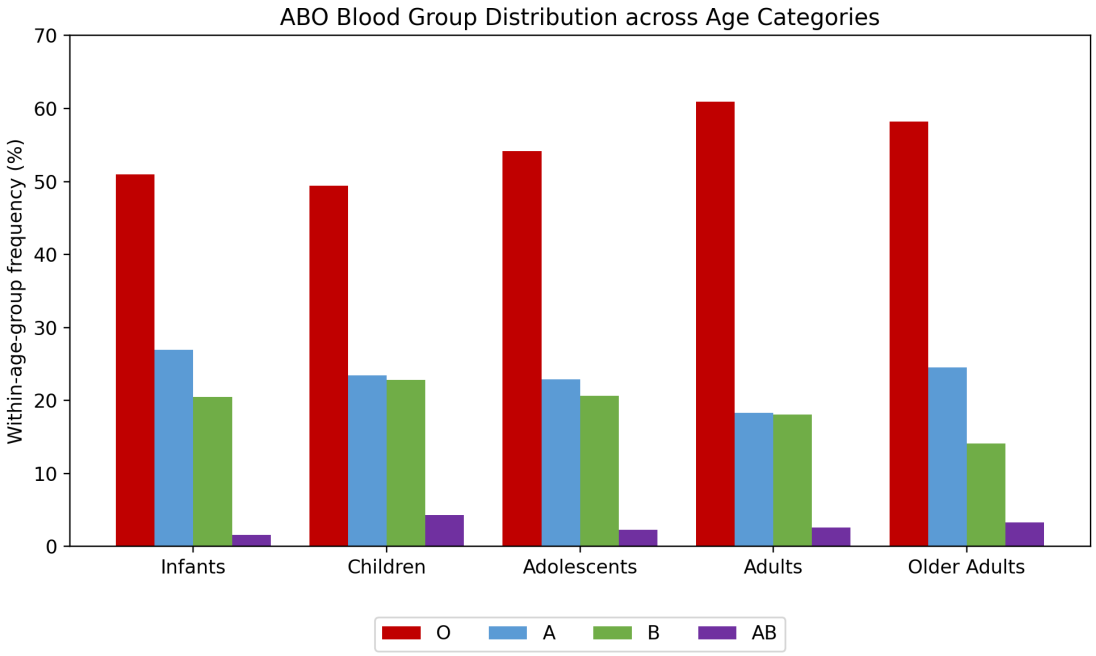


Figure 3: ABO blood-group distribution across age categories, showing variation in blood-group proportions by age group.

Table 6: Association between age group and Rhesus blood groups ($N$ = 6,933).

| Age group | Rh+, $n$ (%) | Rh-, $n$ (%) | Total |
|---|---|---|---|
| Infants (< 1 year) | 464 (92.4) | 38 (7.6) | 502 |
| Children (1–12 years) | 494 (92.5) | 40 (7.5) | 534 |
| Adolescents (13–17 years) | 192 (89.7) | 22 (10.3) | 214 |
| Adults (18–64 years) | 5,137 (93.4) | 362 (6.6) | 5,499 |
| Older adults (≥ 65 years) | 177 (96.2) | 7 (3.8) | 184 |
| Total | 6,464 | 469 | 6,933 |

$\chi^2 = 8.0$, df = 4, $p = 0.092$.

Table 7: Association between sex and ABO blood groups ($N$ = 6,933).

| Sex | A, $n$ (%) | B, $n$ (%) | AB, $n$ (%) | O, $n$ (%) | Total |
|---|---|---|---|---|---|
| Male | 662 (18.7) | 611 (17.3) | 68 (1.9) | 2,197 (62.1) | 3,538 |
| Female | 699 (20.6) | 682 (20.1) | 117 (3.4) | 1,897 (55.9) | 3,395 |
| Total | 1,361 | 1,293 | 185 | 4,094 | 6,933 |

$\chi^2 = 36.9$, df = 3, $p < 0.001$.

Table 8: Association between sex and Rhesus blood groups ($N$ = 6,933).

| Sex | Rh+, $n$ (%) | Rh-, $n$ (%) | Total |
|---|---|---|---|
| Male | 3,303 (93.4) | 235 (6.6) | 3,538 |
| Female | 3,161 (93.1) | 234 (6.9) | 3,395 |
| Total | 6,464 | 469 | 6,933 |

$\chi^2 = 0.13$, df = 1, $p = 0.714$.

No significant association was observed between sex and Rh blood group ($\chi^2 = 0.13$, df = 1, $p = 0.714$), with Rh-positive and Rh-negative distributions being similar across sexes (Table 8).

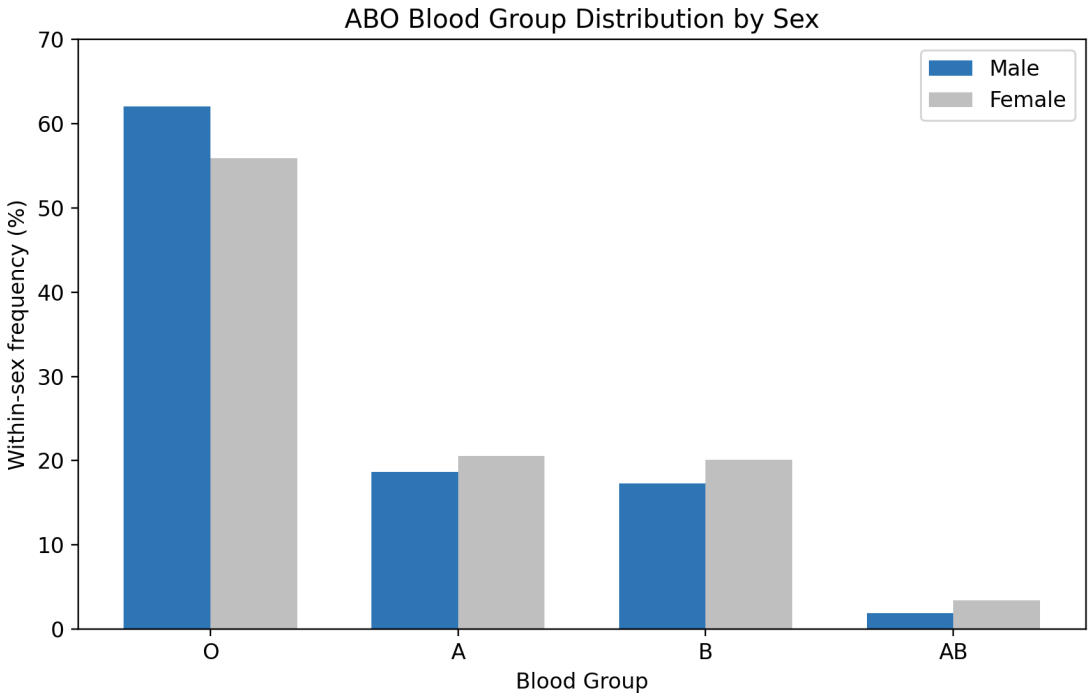


Figure 4: ABO blood-group distribution by sex, demonstrating a higher frequency of blood group O among males and higher frequencies of A, B, and AB among females.

## 4. Discussion

The findings of this study on ABO and Rh blood-group distribution among 6,933 clients of Ekiti State University Teaching Hospital (EKSUTH), Ado-Ekiti, and the associations with age and sex provide valuable information. The overall client cohort showed a near-equal male-to-female ratio (1.04:1); however, because donors, transfusion recipients, and routine clients were not analyzed separately, this cannot be interpreted as evidence of equal sex representation specifically within donation or transfusion services. Earlier findings from India and some parts of Nigeria reported male predominance [21–23]. However, the present finding of no sex dominance is in line with studies reporting increased female blood donation in more recent times [24, 25].

Consistent with most reports from Nigeria and other parts of sub-Saharan Africa, blood group O was the most prevalent phenotype in this study (59.1%), followed by A (19.6%), B (18.7%), and AB (2.7%), with a large majority of clients being Rh-positive (93.2%) [22, 24, 26–28]. A broadly similar predominance of blood group O has been reported among blood donors in Tanzania (52.3–63.0%, depending on the study population) [29] and Cameroon (48.6–48.8%) [30], consistent with blood group O being characteristic of many sub-Saharan African populations. By contrast, a large national study from Morocco found blood group A at a substantially higher frequency (32.9%) than is typical in sub-Saharan Africa, alongside a still-predominant but comparatively lower share of blood group O (46.8%) [31]. This illustrates that ABO distribution varies not only between continents but also across African regions. Other reports from parts of the United States, India, and Pakistan have documented a higher prevalence of blood group A and a lower frequency of blood group O, supporting genetic and population-specific variation in ABO blood groups [9, 32, 33].

There is speculation that a particular blood group could have a survival advantage in a given environment. The predominance of blood group O in African populations could be attributed to survival advantage against parasitic invasion, such as *Plasmodium falciparum* malaria, which cannot efficiently invade and cause rosette formation with O red blood cells [15]. The high prevalence of Rh-positive status in this population (93.2%) has practical implications for hemolytic disease of the fetus and newborn (HDFN): HDFN risk from RhD incompatibility arises specifically when an RhD-negative mother carries an RhD-positive fetus and becomes alloimmunized. A lower prevalence of RhD-negative individuals in this population correspondingly reduces the number of pregnancies at risk of this specific incompatibility, underscoring the continued importance of RhD screening and anti-D prophylaxis for the RhD-negative minority [34].

The present study found a statistically significant relationship between age and ABO blood-group distribution ($p < 0.001$). Blood group A and B proportions were generally lower in adults than in infants and children, although the pattern was not strictly monotonic: group A rose again from 18.3% in adults to 24.5% in older adults, group O declined from 60.9% in adults to 58.2% in older adults, and group AB fluctuated across age groups (Table 5). This has seldom been reported in the literature, although some studies indicate that individuals with blood group O may have better survival than others because of reduced susceptibility to

ischemic heart disease, thromboembolic episodes, and serious infections. This may partly explain the higher relative frequency of blood group O observed among older adults in this cross-sectional sample, although it cannot be confirmed without longitudinal or cohort data [14, 16, 35–37]. The AB group slightly increased with age, possibly owing to a survival advantage; however, given the small sample size, this finding should be interpreted carefully.

The statistically significant association between sex and ABO blood group showed that blood group O was more prevalent in males (62.1%), whereas the other groups were more prevalent in females. Studies reporting a male predilection for blood group O also exist; in contrast, reports of no difference between sexes have also been published [27, 38]. Because the ABO and RhD loci are autosomal rather than sex-linked, this observed sex difference is unlikely to reflect sex-linked inheritance. Possible explanations include sampling variation, differences in the composition of the male and female client subgroups (donors, transfusion recipients, and routine clients), or chance. Further studies with subgroup stratification would be needed to clarify the source of this association. No association was observed between sex and Rh blood group, indicating that Rh blood-group distribution is sex-independent, as reported in several other studies [39].

Understanding ABO and Rh blood-group distribution is important for blood-bank operations and transfusion services. The abundance of O and Rh-positive groups can be used for transfusion planning. Blood inventory can be better organized, with emphasis on ensuring sufficient supply of less common blood groups such as AB-negative [40]. The observed age- and sex-related variations in ABO blood-group distribution generate hypotheses for future disease-specific research. Further well-designed epidemiological and mechanistic studies are required to determine whether these demographic patterns are associated with susceptibility to particular diseases or have implications for targeted preventive interventions [36, 41].

The main limitation of this study is its single-center nature, which may not adequately reflect state or national blood-group distributions. It was also retrospective and therefore did not cover all aspects of clinical or genetic analysis that could explain why blood groups differed by age and sex. A multicenter prospective study covering state or national populations and including genetic analysis would be helpful [42, 43]. In addition, the study population comprised a mix of blood donors, transfusion recipients, and routine clinic clients drawn from a single tertiary hospital; therefore, it is not a representative community sample. Blood donors are typically healthier and predominantly adult, whereas transfusion recipients may reflect disease-specific referral patterns. These findings should therefore be interpreted as characteristic of an EKSUTH hospital client population rather than of Ekiti State or Nigeria as a whole.

Overall, this study established a preponderance of O and Rh-positive blood groups in the study population and observed age- and sex-based differences in ABO blood-group distribution. This information may be valuable for managing blood supply and for epidemiological studies.

### *4.1. Limitations*

This study has several limitations. First, it is a single-center, hospital-based study conducted at one tertiary referral center in Ekiti State; its findings describe the EKSUTH client population and should not be generalized to Ekiti State, Nigeria, or any other population without further study. Second, the study population combines blood donors, transfusion recipients, and routine attendees, three groups with plausibly different age, sex, and health profiles. Because client-category counts were not available in the extracted dataset, the analyses could not be stratified by category, and the extent to which this pooling may have influenced the observed age and sex associations could not be quantified. Third, the study is retrospective and cross-sectional and did not include disease-outcome, genetic, or mortality data. It therefore cannot support any causal or survival-related interpretation of the observed age or sex differences, including any relationship between blood group O and longevity, which would require a dedicated longitudinal or population-based study. A multicenter prospective study with client-category stratification and, where relevant, disease-outcome and genetic data is recommended to build on these findings.

## 5. Conclusion

1. Among clients of the EKSUTH Blood Bank in 2023 ($N$ = 6,933), the most common ABO blood group was O (59.1%), followed by A (19.6%), B (18.7%), and AB (2.7%); most clients were Rh-positive (93.2%) rather than Rh-negative (6.8%).
2. ABO blood-group distribution differed significantly, though with a small effect size, by age group ($\chi^2(12) = 60.8$, $p < 0.001$, Cramer's $V = 0.05$) and by sex ($\chi^2(3) = 36.9$, $p < 0.001$, Cramer's $V = 0.07$). Blood group O was more frequent among males (62.1%) than females (55.9%), whereas groups A, B, and AB were modestly more frequent among females. Rh status showed no significant association with age or sex.
3. Because the age-group pattern was non-monotonic and derived from a cross-sectional, single-center, mixed-population sample, these findings describe the current EKSUTH client population rather than a longevity- or survival-related effect of blood group O. They should not be interpreted as evidence of a causal relationship between blood group and survival.
4. These data provide baseline, EKSUTH-specific information that can support local blood-inventory planning, with particular attention to recruiting and retaining donors with rarer phenotypes such as AB-negative (0.2% of this cohort) and O-negative, A-negative, and B-negative combinations, rather than concentrating recruitment on already dominant groups.

5. Reported associations in the wider literature between ABO blood group and susceptibility to specific infectious or non-infectious diseases were not tested in this study, which collected blood-group and demographic data only. Any application of the present findings to disease-prevention targeting would require dedicated outcome-linked research at EKSUTH or elsewhere.

### *5.1. Recommendations*

1. A multicenter prospective study, ideally with client-category stratification (donor, transfusion recipient, and routine attendee) and, where feasible, genetic and environmental data, is recommended to confirm and extend the age- and sex-related patterns described here.
2. Donor-recruitment and retention efforts should prioritize rarer phenotypes, particularly AB-negative and other Rh-negative combinations, to maintain adequate stock of these groups while sustaining the supply of common O-positive and A-positive groups.
3. A dedicated, outcome-linked study, such as a longitudinal or case–control study, is needed before any relationship between blood group O and longevity or reduced disease burden can be inferred for this population.
4. Local blood transfusion services may use these EKSUTH-specific baseline frequencies for inventory planning; extrapolation to state- or national-level policy would require multicenter data.

## Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki for medical research involving human subjects. Ethical approval was obtained from the Ethics and Research Committee of EKSUTH (Protocol Number: EKSUTH/A67/2024/09/059). Because the study involved retrospective analysis of anonymized data, informed consent was not required; however, all data were handled confidentially and stored securely.

## Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request, subject to institutional approval.

## Declaration of competing interest

The authors declare that they have no conflicts of interest.

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