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ORIGINAL RESEARCH ARTICLE

BLOOD GROUP DISTRIBUTION AMONG DONORS AND PATIENTS IN A PRIVATE HOSPITAL IN GHANA: A CROSS SECTIONAL STUDY

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Conflict of interest: None declared

Abstract

Introduction: Blood is the most common body fluid, yet it is a scarce and valuable necessity. It nourishes cells and maintains homeostatic balance in the body. Cellular elements—red blood cells (RBC), white blood cells (WBC), and platelets—constitute 45% of whole blood, while plasma, composed of 92% water, accounts for the remaining 55%. Blood makes up approximately 7% of a person's weight. The average male has 14–18 grams, and the average female 12–16 grams of hemoglobin per 100 mL of blood. In 1900, Karl Landsteiner discovered the ABO blood grouping system, explaining why some transfusions succeeded while others failed.

Objective: This study assessed the distribution of ABO and Rhesus (Rh) blood groups among 2,996 donors and patients in a private primary hospital in Ghana, with particular focus on variations across ethnic groups.

Methods: A cross-sectional, retrospective, qualitative study was conducted at a private primary hospital in the Tema municipality, Ghana. Blood group data were retrieved from patient records and analyzed using Microsoft Excel with descriptive statistics and chi-test scores.

Results: Among Akans, the most prevalent blood group was O^+ (46%), followed by O^- (4.4%). Ga-Adangbes recorded A^+ (22.5%) and O^- (2.5%), while Northerners had B^+ (22.1%) and O^- (5%). Voltarians showed O^- (3.6%) and the highest distribution of AB^- (1.2%), the rarest blood type. Akans—comprising Asantes, Akwapims, Kwahus, and Fantes—formed the largest ethnic group[28], followed by Ga-Adangbes. Minority tribes showed 1.2% for both A^- and AB^-.

Conclusion: The findings reaffirm that blood group O^+ is the most prevalent, while AB^- is the rarest, aligning with national and regional trends across West Africa. Significantly, statistical analysis revealed that ethnic background and age group are strongly associated with variations in blood group distribution, while sex was not a determining factor. The predominance of O^+ among younger and middle-aged groups, and A^+ among individuals over 60, highlights potential implications for clinical transfusion planning, especially in elderly care.

Key words: Blood group distribution, ABO and Rhesus factor, Ethnic variation, Donors and patients, Ghana health system

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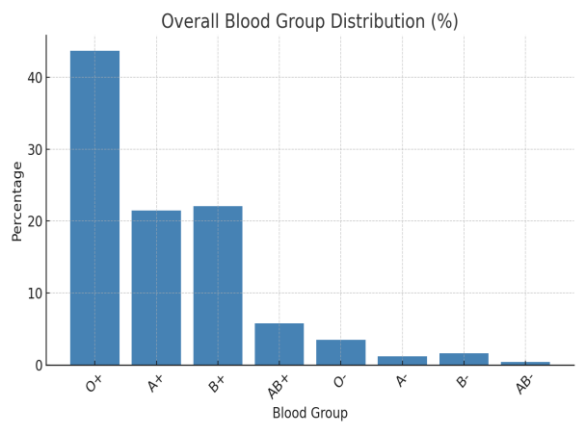
INTRODUCTION

Blood is the most common body fluid, yet it remains a scarce and invaluable resource in clinical care. It plays a vital role in nourishing tissues and maintaining homeostatic balance throughout the body. According to the Stanford School of Medicine, blood is a living tissue composed of cellular elements suspended in plasma. The red blood cells (erythrocytes), white blood cells (leukocytes), and platelets (thrombocytes) constitute approximately 45% of whole blood volume, while plasma—comprising 92% water—accounts for the remaining 55%.[1]

Leukocytes are further categorized into granulocytes and agranulocytes, both of which play a central role in immune defense by destroying pathogens. Erythrocytes contain hemoglobin (Hb), an iron-rich protein that facilitates oxygen transport from the lungs to tissues and the removal of carbon dioxide from tissues to the lungs. The average lifespan of a red blood cell is about 120 days.[1] Blood volume accounts for roughly 7% of an individual's total body weight, with hemoglobin concentrations typically ranging from 14–18 g/dL in males and 12–16 g/dL in females.[2]

In both acute emergencies and chronic medical conditions, a sudden reduction in hemoglobin levels can necessitate lifesaving blood transfusion. A loss of 0.5 liters of blood may result in a hemoglobin drop of approximately 1.5 g/dL, while transfusing one unit of blood typically increases hemoglobin levels by 0.8–1.0 g/dL.[3] Although a 20% blood volume loss is generally well tolerated in healthy adults, losses exceeding 30% often result in hypovolemic shock and demand urgent intervention, including fluid resuscitation and blood transfusion.[4]

Globally, someone requires a blood transfusion every two seconds.[5] Whole blood remains foundational to modern transfusion medicine and serves as the basis for multiple therapeutic components. Through centrifugation, donated whole blood is often separated into red blood cells, fresh frozen plasma, cryoprecipitate, and platelet concentrates—enabling individualized patient treatment and optimal resource use.[6]



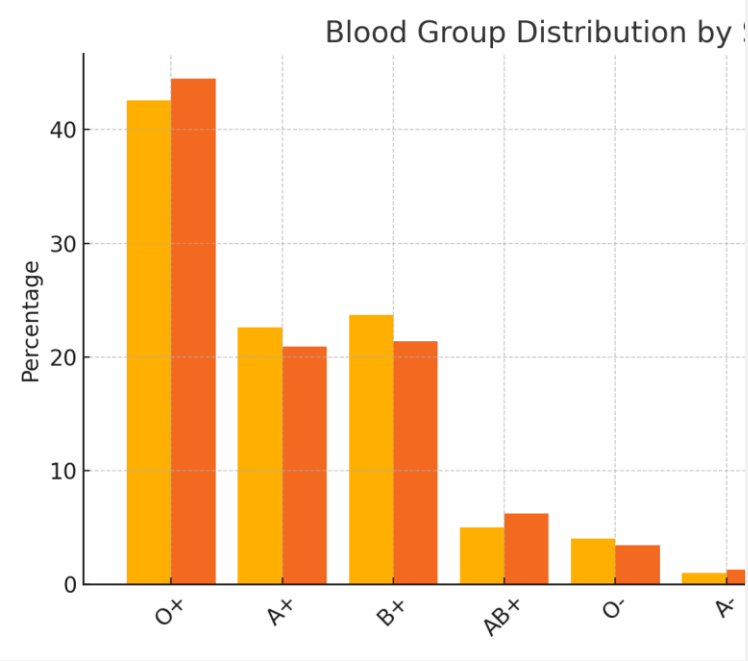
Blood types are classified into four major groups—A, B, AB, and O—based on the ABO blood grouping system, first discovered by Dr. Karl Landsteiner in 1901, with further contributions from Decastrello and Sturli, who identified the AB group.[7] Blood transfusions require strict compatibility testing between the donor and recipient, which includes determining both ABO and Rhesus (Rh) blood group systems prior to transfusion to prevent adverse reactions.

Once blood is donated, it undergoes rigorous screening and processing to ensure safety for transfusion. The collected whole blood is typically separated by centrifugation into its major components: red blood cells, plasma, platelets, and albumin proteins. Due to the potential for transfusion-transmissible infections, all donated blood is tested in accordance with current safety protocols. These include screening for Human Immunodeficiency Virus types 1 and 2 (HIV-1/2), Human T-cell Lymphotropic Virus types 1 and 2 (HTLV-1/2), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and syphilis (using the VDRL test), as outlined by the World Health Organization.[8] Additionally, platelet products are tested for bacterial contamination, as their storage at room temperature poses a higher risk for microbial growth.

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Discovery and Classification of Blood Group Systems

In 1900, Karl Landsteiner of the University of Vienna discovered the reason why certain blood transfusions were successful while others could be fatal. By mixing red blood cells and serum samples among his laboratory staff, Landsteiner observed agglutination reactions—where antibodies in the serum caused clumping of incompatible red cells. From these experiments, he identified three blood groups: A, B, and C. The group C was later renamed “O” from the German *ohne*, meaning "without" or "zero." The fourth blood group, AB, was later discovered in 1902 by Decastrello and Sturli.[7]

Following Landsteiner’s discovery of the ABO blood group system in 1901, additional blood group systems were identified throughout the 20th century. In 1940, Landsteiner, alongside American physician Alexander Wiener, discovered the Rhesus (Rh) blood group system.[4,9] For his work in immunohematology, Landsteiner received the Nobel Prize in Physiology or Medicine in 1930.[4]

The gene responsible for determining the ABO blood type is located on chromosome 9 (9q34.1) and is known as the ABO glycosyltransferase gene.[8,9,13] It has three main alleles—A, B, and O—which encode glycoproteins (antigens) that determine an individual’s ABO blood type. The combination of alleles inherited from both parents dictates the specific antigens present on the surface of red blood cells.[8,11]

To date, over 35 human blood group systems have been recognized, with the ABO and Rh systems being the most clinically significant. These classifications are standardized by the International Society of Blood Transfusion (ISBT).[9] Although all humans can be grouped into the main ABO and Rh systems regardless of ethnicity, there are also minor blood group systems, including Duffy, Lutheran, Kell, Kp, Kidd, and Xg.[8,10] These are less commonly encountered but clinically relevant in transfusion medicine.

Globally, the distribution patterns of blood groups vary widely across different populations and continents, influenced by factors such as genetics, climate, altitude, and disease prevalence.[8,12] According to Farhud and Zarif Yeganeh’s review on the evolution of blood types, three main hypotheses have been proposed regarding the emergence and mutation of blood groups:

1. Environmental Selection Hypothesis – Global distribution patterns depend on environmental factors such as climate, altitude, and exposure to diseases.
2. Mutation-from-O Hypothesis – Blood groups A and B evolved from successive mutations of blood group O, which is considered the most resistant to infectious disease.
3. AB-Origin Hypothesis – AB blood group is proposed as the original type, with A, B, and O arising through mutation.[8,11,12]

The Rh blood group system is the most important after ABO. It includes over 50 defined antigens, among which the five principal antigens—D, C, c, E, and e—are the most clinically significant.[10] The commonly used terms “Rh factor,” “Rh-positive,” and “Rh-negative” refer specifically to the presence or absence of the D antigen. The Rh system is critical for maternal-fetal compatibility, particularly in cases of Rh-negative mothers carrying Rh-positive fetuses.

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ORIGINAL RESEARCH ARTICLE

In 1939, Levine and Stetson published the first clinical case of hemolytic disease of the newborn (HDN) due to Rh incompatibility.[10] This condition arises when an Rh-negative mother becomes sensitized to the D antigen during pregnancy, producing antibodies that cross the placenta and attack the fetal red blood cells. This immune response can result in severe hemolytic anemia, leading to complications such as hydrops fetalis, brain damage, or fetal death.

Two nomenclature systems exist for the Rh group: the Fisher-Race system (using the CDE terminology) and the Wiener system (using Rh–Hr notation). The Fisher-Race system, most commonly used today, posits that separate genes control the expression of each antigen (e.g., a D gene for D antigen). The Wiener system, by contrast, theorized a single gene locus producing multiple antigens.[10]

Blood Group Effects on Nutrition, Disease Infection, Immunity, and General Health

Dr. Peter J. D'Adamo, a naturopathic physician and author of *Eat Right for Your Type*, proposed that knowing one's blood type is a powerful tool for understanding how the body reacts to food, susceptibility to diseases, immune responses, and even stress adaptation. According to D'Adamo, a single drop of blood contains a biochemical signature as unique as a fingerprint.[14]

In his theory—widely known as the blood type diet—he links each blood group to specific ancestral patterns of nutrition and lifestyle. For example, Type O, believed to be the earliest evolved blood group, is said to benefit from a diet high in animal protein and low in dairy, wheat, and grains. Gluten and certain legumes, including lentils, corn, kidney beans, and cabbage, are cited as potential contributors to weight gain and inflammation in individuals with Type O blood. D'Adamo also recommends vigorous physical activity such as aerobics, martial arts, running, and contact sports, though he advises a physician's consultation beforehand.[14]

For individuals with Type A blood, D'Adamo recommends a primarily vegetarian diet featuring fresh, pure, and organic foods. He claims that Type A individuals are predisposed to chronic illnesses like heart disease, cancer, and diabetes, and that calming exercises such as yoga and tai chi can support their immune function.[14]

Type B individuals are described as having a robust immune system and flexible digestion. They are said to resist many degenerative diseases better than other groups but may be more susceptible to autoimmune conditions such as chronic fatigue, lupus, and multiple sclerosis. Moderate exercises that promote mental balance, like swimming, hiking, cycling, and tennis, are recommended.[14]

Type AB, the most recently evolved blood group, is viewed as the most biologically complex. It is thought to combine traits from both Type A and Type B. D'Adamo advocates a mixed approach to diet and exercise for this group, suggesting that they engage in activities suited for both A and B types. Type AB individuals reportedly face fewer allergy issues but are at elevated risk for anemia, heart disease, and cancer.[14]

In terms of immunity and disease susceptibility, Type O is said to be more prone to environmental intolerance, especially to grains and potatoes, which may trigger inflammatory responses such as arthritis. Type A and B individuals are described as more prone to diabetes, while Types A and AB are thought to have a higher incidence of cancer and lower survival rates.[14]

D'Adamo also highlights unique responses to certain food components. For instance, he notes that soybeans may offer a protective benefit to Type A individuals. Soy contains a lectin that mimics A-type antigens and binds to certain cancer cells, theoretically making them more recognizable to the immune system.[14]

Controversy and Scientific Scrutiny

Despite the widespread popularity of the blood type diet, its scientific foundation remains controversial. Multiple systematic reviews, including one published in the *American Journal of Clinical Nutrition*, have concluded that there is insufficient evidence to support personalized diets based on blood type. Critics argue that while many recommendations made in the blood type diet align with general healthy eating (e.g., reducing

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processed food, increasing physical activity), the specific link to blood types has not been validated through controlled clinical trials.[19]

Nevertheless, the theory has contributed to increased public interest in personalized nutrition and continues to be studied for its potential to improve health outcomes in specific populations.

Blood Group Effects on Health, Disease, and Transfusion Compatibility

Numerous studies have explored the relationship between blood group systems and a wide array of physiological and pathological conditions. One such study, published by Henry J. Speedway in the British Medical Journal on April 18, 1982, reported a striking ratio of blood group A to O (9:5) between anterior and posterior myocardial infarctions, suggesting a higher prevalence of blood group A in anterior infarction cases.[15] Further research indicates that individuals with blood group O may have a reduced risk of heart disease but an increased susceptibility to peptic ulcers. Blood group A individuals are more prone to microbial infections, although women with type A blood reportedly have higher fertility rates. Meanwhile, people with blood groups AB and B have been found to carry an elevated risk of pancreatic cancer.[15 16]

In a 2010 article, Nil Güler, Mehmet Turgut, and Düzgüt Ozatli explored the link between Duffy blood groups and malignancies. They traced early human migration patterns from Africa and explained how gene expressions, such as those governing ABH and Lewis antigens in body secretions, may influence susceptibility to pathogens like Helicobacter pylori, Norovirus, cholera, and malaria.[16]

The article "Beyond Human Immunohematology: The Role of ABO Blood Group" by Giancarlo and Massimo Franchim highlighted gene-wide association studies (GWAS) linking the ABO locus to elevated levels of plasma lipids and inflammatory biomarkers—such as intercellular adhesion molecules, E-selectin, P-selectin, and tumor necrosis factor-alpha—recognized as poor prognostic factors in coronary heart disease.[17]

Dr. Peter J. D'Adamo's recent work extends the conversation on blood group A's association with cancer. He noted that many tumor antigens exhibit "A-like" structures, potentially explaining why individuals with blood types A and AB are more prone to developing certain malignancies. Conversely, autoimmune disorders appear to be more prevalent in individuals with blood group O.[14 16]

A 2009 study by Muhammad Kamil and colleagues at the Advanced Medical and Dental Institute, University of Sains, Malaysia, evaluated 70 patients with diabetes mellitus and 140 healthy controls. Their findings revealed a negative association between blood groups A and O with type 2 diabetes, suggesting lower susceptibility in individuals with these blood types. They recommended larger studies in diverse ethnic populations for further validation.[18]

The ABO blood group system has also been linked to behavioral theories, particularly in East Asia. The "blood type theory of personality," known as ketsueki-gata in Japan, suggests that ABO blood types predict personality traits and compatibility. Despite being regarded as pseudoscience by most academics, the theory remains culturally influential in Japan, South Korea, and Taiwan.[19]

According to this theory, Type A individuals are reserved, punctual, and law-abiding; Type O individuals are outgoing, passionate, and considered "warrior spirits"; Type B individuals are self-sufficient and independent, while Type AB individuals are often serious and solitary. Genetic studies have shown that the ABO gene locus on chromosome 9q34 is closely linked with dopamine beta-hydroxylase and platelet monoamine oxidase (MAO) activity, enzymes implicated in mood and behavior, offering a partial scientific explanation for these claims.[19]

In transfusion medicine, understanding blood group compatibility is critical to patient safety. Since Karl Landsteiner's foundational work in 1901, ABO compatibility has become the basis for safe blood transfusions. An incompatibility reaction occurs when the recipient's antibodies attack the antigens on donor red blood cells, causing agglutination—a potentially life-threatening response.[20]

Individuals with blood group AB have both A and B antigens on their red blood cells but lack anti-A or anti-B antibodies in their

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plasma, making them universal recipients. However, they can only donate to other AB individuals. Group A individuals possess A antigens and anti-B antibodies and can receive A or O blood. Group B individuals have B antigens and anti-A antibodies and can receive B or O blood. Group O individuals lack A and B antigens but have both anti-A and anti-B antibodies, making them universal donors.

O-negative blood, in particular, is used in emergencies due to its lack of A, B, and Rh antigens, minimizing transfusion complications. Nonetheless, inappropriate transfusion can result in serious reactions, including hemolysis, hemoglobinuria, renal failure, disseminated intravascular coagulation (DIC), hypotension, and shock. Management protocols include immediate cessation of transfusion, intravenous fluids (e.g., 0.9% sodium chloride), diuretics (e.g., furosemide), corticosteroids (e.g., hydrocortisone), and antihistamines (e.g., chlorpheniramine).[21]

Proper identification of both the patient and the blood unit is crucial before transfusion, and O-negative red cells should be used if the patient's blood type is unknown.

Methods of determining blood groups

Here's a clean and scholarly revision of your section on ABO Typing, Testing Methods, and Global Blood Group Distribution, with clarity, flow, and academic structure. Citations and appendix references are preserved in Vancouver format:

ABO Typing and Testing Methods

ABO blood typing is a standard clinical procedure used to determine an individual's blood group. It involves separating red blood cells (RBCs) from plasma through centrifugation and then performing two key tests: the front (or forward) type and the back (or reverse) type. With advances in technology, automated analyzers have become increasingly common for this purpose.[22,23]

Forward (Front) Typing

Forward typing involves mixing a person's RBCs with commercially prepared antisera—specifically, anti-A and anti-B antibodies. The test relies on visual agglutination to determine blood group: if agglutination occurs with anti-A, the person likely has A antigens; if it occurs with anti-B, they likely have B antigens. However, the test is not conclusive on its own, and additional verification is needed.[22 23]

Reverse (Back) Typing

Reverse typing evaluates the individual's plasma by mixing it with reagent RBCs known to carry either A or B antigens. If agglutination is observed when type A reagent cells are used, the individual likely has anti-A antibodies, suggesting they are not blood type A. Conversely, the absence of agglutination may indicate type compatibility. This method provides cross-verification with forward typing, but again, is not independently definitive.[22]

Mixed Field Reactions and Interference

Mixed field reactions occur when two different ABO groups are present in the same blood sample, often as a result of massive transfusions, bacterial infections, or malignancies, leading to discordant typing. For example, a transfusion of O-negative RBCs into a non-O recipient may cause inconsistencies between forward and reverse typing results.[24]

In this study, ABO and Rhesus grouping was conducted using the tile method, where a drop of blood from each subject was placed on a clean white tile in three locations. Anti-A, anti-B, and anti-D reagents were then added, and agglutination was observed after 60 seconds of gentle rocking. In cases of ambiguity, results were confirmed microscopically and verified using reverse grouping with known type A and B red cells.[5]

Automated Analyzer Method

Automated analyzers offer efficient, standardized blood typing. These systems involve loading patient blood tubes—typically containing EDTA anticoagulant—into a tray. The analyzer centrifuges the samples to separate RBCs from plasma, resuspends the RBCs in saline, and distributes the diluted samples into microplates containing antisera reagents. Blood group determination is based on agglutination observed between the RBCs and corresponding antibodies. A monitor displays results, and integrated computer systems can assist with documentation and verification.[23]

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Global Distribution of Blood Groups

Globally, the distribution of ABO blood groups is non-uniform, reflecting complex evolutionary, genetic, and environmental histories. Blood group A is relatively widespread, with about 21% of the global population possessing the A allele. It is commonly found in Europe and some isolated populations.[24]

Blood group B is less common overall, representing approximately 16% of humanity. It has the highest frequency in Central Asia and Africa, and the lowest among Indigenous populations in the Americas and Australia.[24]

Blood group O is the most prevalent worldwide, comprising roughly 63% of the global population. It is found in the highest concentrations in Central and South America, where the frequency can approach 100%. In contrast, Eastern Europe and Central Asia show the lowest frequencies of blood group O, coinciding with higher B allele prevalence .[24] [25]

Blood Grouping Data in Africa: The Need for Regional Research

Upon further review, there appears to be no consolidated data on the blood grouping system for the African continent as a whole. To date, South Africa remains the only African country with a published national-level record of blood group frequency distribution.

Some studies have been conducted at local or ethnic levels in other countries, notably in Nigeria. One such study was carried out by the Department of Physiology and Anatomy at Bingham University in Karu, Nasarawa State. Researchers investigated the blood group distribution among 200 adults (77 males and 123 females) who attended the Federal Medical Centre in Lokoja, Kogi State. The aim was to generate reliable data for medical planning and blood donation services.[27]

The study concluded the following:

- Blood group O was the most dominant in both male and female participants.
- Blood group AB was the least represented among both sexes.
- Among males, the second most common group was A, whereas among females, it was B.
- Rhesus (Rh) factor analysis indicated a predominance of Rh-positive individuals.[27]

These findings support the notion that variations in blood group distribution serve as a more accurate biological marker of human diversity than arbitrary categories such as race or skin color. Therefore, based on previous localized studies, it is of critical importance to establish Ghana's national blood group distribution pattern. Such data are vital not only for improving the effectiveness of blood banking and transfusion services but also for planning targeted public health interventions and managing emergency medical care.

Blood Group Distribution in Ghana

While extensive research has been conducted in Ghana regarding blood transfusion practices, the clinical use of blood products, and transfusion safety protocols, there remains a notable lack of national-level data on the ABO and Rhesus (Rh) blood group distribution across the entire population.

Instead, localized studies have focused on specific ethnic groups, particularly the Akan and Ewe populations—two of the largest ethnic groups in the country.

A study among the Akan ethnic group, which includes subgroups such as the Fantes, Ashantis, Kwahu, and Akwapims, found that:

- Blood group O was the most common, accounting for approximately 50% of the population.
- Blood group AB was the least common, recorded at around 3%.
- The remaining blood types were A and B, occurring in nearly equal proportions, with B slightly more prevalent than A in most subgroups.[28]

In a similar study focused on the Ewe ethnic group, researchers found the following distribution:

- Blood group O was again the most frequent, at 48.5%.
- Blood group B followed at 25%, then group A at 21.4%.

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- The least common blood type was AB, representing 4.6% of the total sample.[29]

These ethnic-based findings underscore the need for a comprehensive national study to map the distribution of blood types across all regions and populations in Ghana. Such data is essential for optimizing donor recruitment, improving inventory management in blood banks, and guiding transfusion strategies in both emergency and elective care.

Aim

To determine the blood distribution of donors and patients in different ethnic groups in Ghana

Significance of this Research to Blood Banks in Ghana

The major challenges for any blood bank are supply and storage [22]. This challenges may be caused at the national level due to the lack of policies to resource the blood bank in terms of personnel's and other logistics such as refrigerators, adequate technical staff, inefficiency of the blood bank services or the lack of public commitment to donate blood either through lack of publicity or their lack of knowledge on blood donation, its importance and misconception. The results from this research will serve as a guideline. With an aging population and advancement in medical treatment requiring blood transfusions as demand for blood and blood products soars. The study seeks to improve on the knowledge of all the blood banks, medical personnel and the public at large, on the blood group distribution pattern, which will serve as the basis for major life decision making in respect to the commonest and least commonest blood types in the country which will assist in stocking of blood and blood product in the country. This research will uncover the need to pursue related topics for further research.

Ethical Issues in Methodology

All questionnaire used will include the patients identification number and not their names, patients age, sex, ethnicity and will indicate whether client is donating blood or a patient and also the patient's blood type. It will ensure the confidentiality since data collected will not include patients' identity. A minor invasive procedure was used determine their blood group and Rhesus type by the laboratory technicians. Clinic attendance is considered as an open consent since data will only be used among health providers and student for the future benefit of the client and there will be no disclosure of patients' identity. There are no risks involved in this research. If any, the risk involved is equivalent to taking blood samples for any other laboratory investigation's but rather, people would benefit from knowing their blood group and rhesus status as well as having easy accessibility to needed blood due to good stocking using the outcome of this study.

Data collection

The study is a retrospective type with a cross sectional approach that seeks to establish the blood distribution pattern to help our health care system be informed and to make informed decisions. The study is a qualitative study approach that will be used to solicit the necessary data and analysis within Narh-Bita in Tema Municipal Assembly of the Greater Accra Region. The differences in the research designs lie in the sampling procedures, and the data collection instruments used, and the methods of gathering and analyzing data [30, 31]. A data collation and analytical table was constructed shown in (Table 8) with the assistance of my supervisor which was used in filling in the collected data and was directed towards identifying the common blood types within the selected locality and it's environ. It was designed to include the biological and socio-demographic data such as the age, sex, level of education and ethnicity and blood group among other pertinent information which will help discover the variants and common grounds. Information was gathered from the laboratory recorded data of participants and patients folders within the hospital into the data collation table. Sampling strategies in qualitative research typically aim to represent a wide range of perspectives and experiences, rather than to replicate their frequency in the wider population (Ziebland & McPherson, 2006)[31]. Therefore, a total sample size of 2951 which is about Sixty percent of its attendance was used for the study. The number involved both males and females.

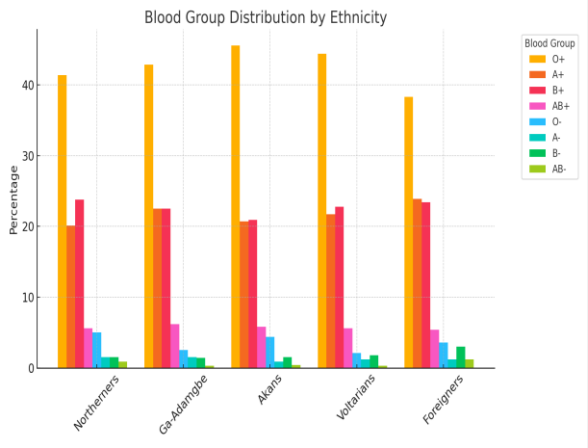
Data Analysis

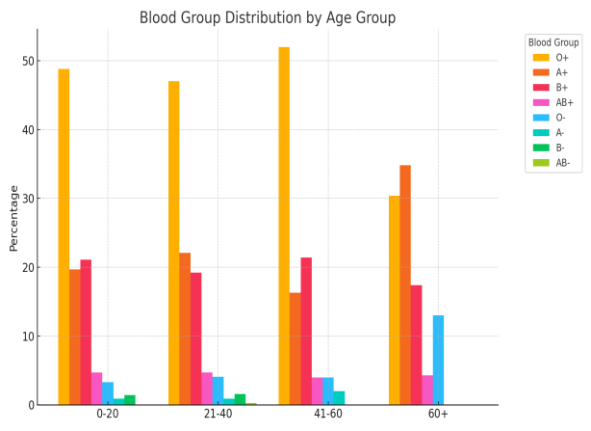
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The results of the entire study will be analyzed using Excel sheet to do percentages and distribution analysis with charts. Descriptive statistics such as percentages, mean, standard and proportions will be computed where appropriate.





Statistical Analysis

Chi-square tests were performed to evaluate whether blood group distributions significantly differed by sex, ethnic group, and age group.

A chi-square test was performed to examine whether the distribution of ABO blood groups (O^+, A^+, B^+, AB^+) is independent of ethnic group (Akan, Ga-Adangbe, Northerners, Voltarians, Foreigners).

Test Results:

- Chi-square statistic (χ^2): 27.00
- Degrees of freedom (df): 12
- p-value: 0.0077

Sex-Based Blood Group Distribution: Chi-Square Test

A chi-square test was conducted to assess whether ABO blood group distribution (O^+, A^+, B^+, AB^+) varies significantly between males and females.

Test Results:

- Chi-square statistic (χ^2): 4.61
- Degrees of freedom (df): 3
- p-value: 0.203

Age-Based Blood Group Distribution: Chi-Square Test

A chi-square test was conducted to evaluate whether blood group distribution (O^+, A^+, B^+, AB^+) is significantly associated with age groups (0–20, 21–40, 41–60, 60+).

Test Results:

- Chi-square statistic (χ^2): 47.51
- Degrees of freedom (df): 9
- p-value: 3.16×10^{-7}

Since the p-value is far below 0.05, the result is highly statistically significant, suggesting that:

There is a strong association p-value<0.05 between age group and blood group distribution.

This supports the discussion's observation that A^+ is more common among the elderly, while O^+ dominates in younger populations, which has implications for transfusion planning and emergency care.

Discussion

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Overall Blood Group Distribution

Data reviewed from Narh-Bita Hospital, which serves as a representative private facility in the region, indicates that blood group O^+ is the most prevalent, accounting for 43.7% of patients Blood groups A^+ and B^+ follow closely, representing 21.5% and 22.1%, respectively. Among the Rh-positive types, AB^+ is the rarest. The Rh-negative population accounted for 6.8% of all blood samples, with O^- as the most common Rh-negative type (4%) and AB^- as the rarest.

This Rh-negative frequency is slightly higher than the expected 5% observed in the general Sub-Saharan African (Negroid) population. As noted by Acquaye et al. (2004), the O blood group accounts for approximately 50% of the Ghanaian and West African population.[28] The current study's O frequency of 47.2% aligns closely and is not statistically different from the 48.1% reported by Acquaye et al. in 1992.[29] This consistency strengthens the reliability of the hospital's sample in reflecting national trends.

Blood Group Distribution by Ethnicity

Across the major ethnic groups, group O^+ remains the most frequent. Among the Akan, who constitute the largest ethnic group in the area, O^+ accounts for 46%. Within the Ga-Adangbe group, A^+ is highest at 22.5%, while B^+ is most prevalent among Northerners at 22.1%. Notably, O^- is most frequent among Northerners (5%), followed by Akan (4.4%), Voltarians (3.6%), and Ga-Adangbe (2.5%).

Interestingly, Voltarians recorded the highest percentage of AB^- (1.2%), the rarest blood type globally. This variation may be attributed to genetic diversity and sample size distribution. The Akan population comprises several subgroups including the Asante, Akwapim, Kwahu, and Fante, making it the largest demographic in the dataset.[28] The Ga-Adangbe, composed of Ga (western) and Adangbe (eastern) subgroups, represent the second largest group.[31] Voltarians (largely Ewe), include subgroups such as the Anlo, Bey, Gen (coastal), and Peki, Ho, Kpando, and Tori (inland).

Despite the Northern Region being geographically the largest in Ghana, it has a relatively smaller population in the hospital sample. This may reflect sociocultural preferences, geographic distance, and financial limitations associated with accessing private healthcare. Minor ethnic groups such as Dagomba, Gonja, Mamprusi, Nanumba, and Kokomba were also represented.[33]

Additionally, foreign nationals living and working in Ghana, some affiliated with international companies, also contributed to the hospital's patient population. Among them, O^+ accounted for 38.3%, A^+ for 23.9%, and B^+ for 23.4%, with both A^- and AB^- recorded at 1.2% each.

Since the p-value (0.007) < 0.05, the result is statistically significant, indicating that there is a significant association between ethnicity and ABO blood group distribution among the populations sampled.

This supports the discussion's observations that blood group distribution patterns differ slightly across ethnic groups in Ghana.

Blood Group Distribution by Sex

The majority of participants were female (n = 2,049), compared to 947 males, due in part to antenatal care attendance and regular company-based checkups. Despite this gender imbalance, blood group O^+ was the most common among both sexes. Both males and females recorded B^+ as the second most common (23.7% and 21.9%, respectively), followed by A^+ (22.6% in males and 20.9% in females). All other blood types showed similar distributions across both sexes.

Since the p-value 0.203 > 0.05, the result is not statistically significant. This indicates that there is no significant association between sex and ABO blood group distribution in the studied population.

Blood Group Distribution by Age

The 21–40 age group dominated the dataset, representing the active working class and primary healthcare seekers. Across all age groups, O^+ remained the most prevalent blood group, with one exception: among individuals aged 60 and above, A^+ was the most frequent (34.8%), followed by O^+ at 30.4%.

This age-specific variation is clinically relevant, particularly in blood donation and transfusion planning. The high proportion of

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O^+ among younger adults ensures its availability, which is critical given that O^+ is considered a universal donor type for Rh-positive recipients. Among Rh-negative groups, O^- remains the most prevalent, offering valuable utility in emergencies due to its universal compatibility.

Since the p-value (3.16×10^{-7}) < 0.05, the result is highly statistically significant, suggesting that there is a strong association between age group and blood group distribution.

This supports the discussion's observation that A^+ is more common among the elderly, while O^+ dominates in younger populations, which has implications for transfusion planning and emergency care.

Conclusion

This study provides comprehensive insight into the distribution of ABO and Rhesus (Rh) blood groups among patients and donors in a private hospital in Ghana, with stratified analysis by sex, age, and ethnicity. The findings reaffirm that blood group O^+ is the most prevalent, while AB^- is the rarest, aligning with national and regional trends across West Africa.

Significantly, statistical analysis revealed that ethnic background and age group are strongly associated with variations in blood group distribution, while sex was not a determining factor. The predominance of O^+ among younger and middle-aged groups, and A^+ among individuals over 60, highlights potential implications for clinical transfusion planning, especially in elderly care.

These patterns underscore the critical need for expanded, nationwide data collection on blood group frequencies in Ghana to inform equitable distribution of blood products, enhance blood bank inventory systems, and support policy development in transfusion medicine. Ethnic and demographic considerations should be integrated into national health planning to improve the safety and accessibility of blood transfusion services.

Recommendations

Policies on blood donation and storage of blood and blood products must be strengthened and blood banks instituted at all health facilities

Further studies should be done to explore patients' knowledge and attitude to blood types and blood donation and transfusion.

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