# PATTERN OF ERYTHROPOIETIN mRNA EXPRESSION IN ABO BLOOD GROUP PROSPECTIVE DONORS IN ILORIN, KWARA STATE, NIGERIA


## *ABSTRACT*

***Introduction***: Erythropoietin (EPO) is a critical hormone involved in the regulation of red blood cell production, primarily through its action on erythropoiesis in the bone marrow. Recent studies suggest that genetic and physiological factors, including ABO blood group, may influence EPO gene expression. This study explores the pattern of EPO mRNA expression in relation to ABO blood groups among prospective blood donors in Ilorin, Kwara State, Nigeria, aiming to better understand the molecular mechanisms behind red blood cell production and its potential impact on blood donation.

***Method***: One hundred and twenty (120) prospective blood Donors were recruited from hospitals within the three LGAs in Ilorin that provide blood transfusion services.Questionnaires were specifically designed for this study which was administered in an interviewer based manner. Venous blood was collected from all the donors into a plain bottle for serological screening with the help of expert laboratory scientists, Sandwich Enzyme Linked Immunosorbent Assay (ELISA) was done for serological estimation of erythropoietin. A commercially prepared monoclonal blood grouping reagent kit was used to determine the blood group of the donors. Real-time polymerase chain reaction (PCR) was used to measure EPO mRNA levels. Red Blood Cell profile (PCV, HBG, MCH, MCHC, MCV, RDW-SD, RDW-CF) were assayed using HaematologyautoanalyzerSysmex XN-350. Data obtained was analyzed through Statistical Package for the Social Sciences (SPSS) Version 27.0, with statistical significance set at $P<0.05$.

***Results***: Family replacement donors are the most prevalent group (p=0.045), with 73.3% of whole participants. The majority of participants were aged 21 to 35 years (64.2%) and predominantly male (91.7%). Approximately 70% were married with over half being university graduates. Blood group O Rh+ was the most prevalent (63 participants). Higher EPO gene expression was observed in individuals with O Rh+ (p=0.000) and B Rh+ (p=0.048). However, no significant associations were found between or serum EPO concentration and ABO blood group. Additionally, there were no significant variations in red blood cell parameters or correlations with donation frequency among the donors.

***Conclusion***: Individuals with blood groups O Rh+ and B Rh+ had higher EPO gene expression, indicating they may be well-suited for frequent blood donation due to their enhanced ability to regenerate red blood cells (RBCs). The findings emphasize the complexity of EPO regulation and its potential implications for blood donation practices.



***Keywords: Blood donation, Blood donor, ABO Blood group, Erythropoiesis, Erythropoietic Gene expression***


## *1. INTRODUCTION*

Blood donation plays a pivotal role in modern healthcare, providing essential support for a wide range of medical procedures, from surgeries and trauma care to cancer treatments and the management of chronic illnesses (Robert et al., 2019; McGann and Weyand, 2022). Globally, blood demand is immense, with the World Health Organization (WHO)



**Comment [WU1]:** What is the need of messenger RNA here in the title

**Comment [WU2]:** Remove it. The abstract never include the literature review.

**Comment [WU3]:** How could you select these donors from the population?

**Comment [WU4]:** Why you select the donors from hospitals why not from the community?

**Comment [WU5]:** It is better to say it as Anti sera, A, B and D.

**Comment [WU6]:** Was this value suggesting that it is improbable that the observed difference is the result of chance?

**Comment [WU7]:** The gene expression of this hormone may affect the production of ABO blood group but how can we say that blood group O individuals have more Erythropoietin (EPO). Those less frequent donors my h have much amount of blood group A or B

estimating that an average of 118.5 million units of blood are collected annually worldwide (Kralievits et al., 2015). However, developed countries, despite accounting for just 16% of the global population, collect 40% of this total, while many developing nations, like Nigeria, experience significant blood shortages (Blaise, 2022). Blood donation is associated with the removal of vital components such as red blood cells, plasma, and other elements (Umar et al., 2023). In healthy donors, the loss of red blood cells triggers a compensatory response, whereby the hormone erythropoietin (EPO) stimulates the production of new red blood cells to replace those lost during donation (Umar et al., 2023). The efficiency of this response is crucial to ensuring that donors do not develop anemia or experience other adverse effects from repeated donations (Vijayram et al., 2019; Karpova et al., 2022). Frequent blood donations without sufficient recovery time can lead to iron depletion and anemia, which in turn impairs erythropoiesis and can compromise the donor's health (Hod et al., 2022).

Erythropoietin is a critical hormone produced primarily in the kidneys, which regulates the proliferation of erythroid progenitor cells in the bone marrow (Sun et al., 2021). Its production is typically triggered by low oxygen levels in the body, a process that enhances red blood cell production (Tichil et al., 2024).The regulation of erythropoietin production is largely governed by hypoxia-inducible factors (HIFs), which respond to oxygen levels in the blood (Suresh et al., 2019). In blood donors, erythropoietin plays a crucial role in the recovery process by stimulating the production of new red blood cells to replace the ones lost during donation (Martinez and Johnson, 2023). The expression of EPO mRNA serves as an important marker of the body's ability to mount an adequate erythropoietic response in response to blood loss, such as that caused by donation (Tsiftsoglou, 2021). However, various factors, including genetic polymorphisms, underlying health conditions, and environmental influences such as altitude, can affect erythropoietin mRNA expression (Nath et al., 2021). The expression of EPO mRNA serves as an essential marker of erythropoietic activity and can provide valuable insights into the ability of donors to maintain hematological balance.Despite extensive research on erythropoietin, there remains a gap in understanding erythropoietin mRNA expression specifically within the population of blood donors in Ilorin, Kwara State, Nigeria, making this an important area of study.

In Nigeria, blood donor eligibility is predominantly assessed based on hemoglobin levels and serological screening for infections, with hemoglobin cutoffs set at 13.5 g/dl for men and 12.0 g/dl for women (Akanmuet al., 2019). While these measures are critical for ensuring donor health and blood quality, they do not provide a comprehensive picture of erythropoietic function. In many Nigerian health institutions, donor deferrals due to low hemoglobin levels are a significant challenge. Studies indicate that up to 54.7% of potential donors in some regions are deferred for this reason, highlighting the urgent need for more nuanced screening and donor management strategies (Olusanya et al., 2022).This rising rate of deferrals negatively impacts the available blood supply. While hemoglobin estimation is a routine part of donor screening, it does not provide a complete picture of erythropoietic functionor the capacity of donors to recover from blood loss(Okafor et al., 2023), especially in cases where erythropoietin regulation might be insufficient to maintain red blood cell production. By focusing on erythropoietin mRNA expression, there isa need for more advanced screening approaches, including the

**Comment [WU8]:** This citation is too old. The health aspect of the research is more advisable with in two –three years otherwise it seems like mathematical formula that stands for long period of time. This is health issue.

molecular quantification of EPO mRNA expression, to better assess erythropoietic potential and minimize the risk of anemia among donors.

***Key research questions guiding this study include:***

(1) Are there variations between the demographic factors such as age, gender, and health status?

(2) Are there differences in erythropoietin mRNA expression, serum erythropoietin levels, and red blood cell profiles among donors of different ABO blood groups?

(3) Is there a correlation between erythropoietin mRNA expression and red blood cell profile in blood donors?

**The hypothesis** being tested is whether erythropoietin mRNA expression differs significantly across ABO blood groups, with the **alternative hypothesis** positing that such differences do exist. Ultimately, this study aims to provide a more comprehensive understanding of erythropoiesis in prospective blood donors of ABO blood groups and contribution to the overall safety and sustainability of blood donation practices in Nigeria.

## *2. MATERIALS AND METHOD*

### *2.1 Sample Selection,Population and Area*

A total of one hundred and twenty (120) prospective blood donors were recruitedfrom ten hospitals within the sixteen LGAs in Ilorin, Kwara state. A pre-donation questionnaire was created and administered through interviews to collect demographic information, as well as data on lifestyle and drug use. Informed consent was obtained from all participants using a consent formprior tosample collection.The recruitment criteria used for sample selection is shown in figure 1.

### *2.2 Ethical Approval*

Ethical approval was sought and gotten from the Kwara State ministry of health, Ilorin with approval number; **ERC/MOH/2024/08/335**.

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**Comment [WU10]:** What were your objectives?

**Comment [WU11]:** Since there are so many sample selection techniques for your sample. How could you select these 120 blood donors for your study. Even the sample size is too small and such sample cannot make inference for the population.

**Comment [WU12]:** Which demographic parameters were used. ABO blood group and this hormone (erythropoietin) is directly linked to ethnic group, age, health status, blood glucose level, .....).

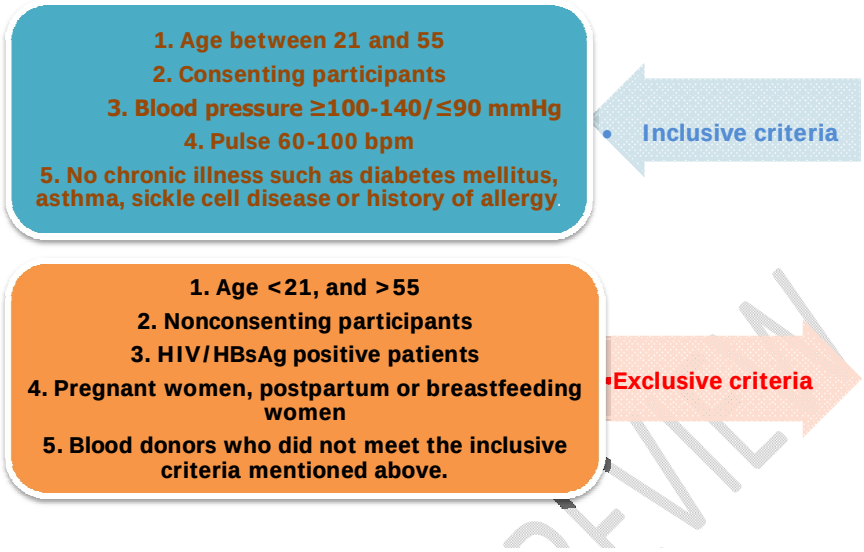


**Figure 1: The inclusive and exclusive used for sample selection.**

***2.3 Sample Size Calculation***

The formula used is shown below as described by Lambeet al., (2024):

$$n=\frac{Z^2P(1-P)}{d^2}$$

This is a sample size calculation formula for a study based on a given confidence level, prevalence, and precision.

- **n** = Sample size (the number of participants needed).
- **Z** = Statistic corresponding to the confidence level (1.96 for 95% confidence).
- **P** = Expected prevalence (0.08 or 8% in this case).
- **(1 - P)** = The complement of the prevalence (0.92).
- **d** = Precision or the margin of error (set at 0.05, or 5%).

Substituting the values:

- (1 - P) = 1.0 - 0.08 = 0.92
- Using the equation:
  n = (1.96)^2 × 0.08 × (0.87) / (0.05)^2,
  the required sample size (n) was calculated to be 120.

***2.4 Sample Collection***

About 5mls of venous whole blood sample each was collected from eligible prospective donor into EDTA bottle and plain bottle. The blood in the plain bottle was centrifuged to obtain serum for serological assessment of erythropoietin. A portion ofblood in EDTA bottle was used for hematological tests (red blood cell profile) while the other portion

wascentrifuged to obtain plasma which was then stored at –20°Cfor molecular assessment of erythropoietin.

***2.5Biochemical and Hematological Analyses***

Amonoclonal blood grouping reagent kit [LORNE LAB. LTD. BERKS, U.K. REF: 610010E] comprising of anti-A, anti-B anti-AB and anti-D were used to determine the blood group of the donors. Red Blood Cells profile was assayed using HaematologyautoanalyzerSysmex XN-350. Sandwich Enzyme Linked Immunosorbent Assay (ELISA) kit was used for serological estimation of erythropoietin (E-EL-H3640, LOT: GY02260H7587). The level of EPO mRNA expression was measured using real-time polymerase chain reaction (RT-PCR).

***2.6Statistical Analysis***

Demographics and Laboratory data were analyzed using Statistical package for social sciences (SPSS) version 27.0. Categorical data were represented as frequencies and percentages, while continuous variables were expressed as means and standard deviations (SD). The association between categorical variables was evaluated using the chi-square test, Student t-test was applied to compare the means of continuous variables. Pearson's correlation coefficient was used to examine the relationship between ABO blood groups and EPO mRNA expression. $P < 0.05$ was considered to be statistically significant.

## ***3. RESULTS***

**Table 1:** Family replacement donors are the most prevalent group (p=0.045), with 73.3% of whole participants. The majority of participants were aged 21 to 35 years (64.2%) and predominantly male (91.7%). Approximately 70% were married, and educationally, the least level observed was primary school, while more than half were university graduates and about half were skilled worker.Less than 3% of participants reported a history of alcohol use or smoking. The most common blood donation frequency was first-time donation (51.7%). Also, the majority of the participants (72%) reported engaging in moderate physical exercise (p=0.048).

**Figure 2:**Figure 2 displayed the frequency of ABO Rhesus factors of the participants. As revealed on the bar chart, the frequency of each blood group among the total number of participant is as follow, A Rh+(10), B Rh+(34), AB Rh+ (4), O Rh+ (63), A Rh- (3), B Rh- (2), and ORh- (4). Hence, O Rh+ has the highest prevalence among the prospective blood donors.

**Table 2 and3:** No association was observed in serum erythropoietin concentration across different demographic factors (age, gender, frequency of donation, type of donor, and physical exercise) and ABO blood group. Additionally, no association was observed in the expression of the erythropoietin gene andacross different demographic factors (age, gender, frequency of donation, type of donor, and physical exercise)

**Comment [WU13]:** What are the other types of donors belongs to?

**Comment [WU14]:** Have you used anti sera D?

**Comment [WU15]:** How could you say that no relationship between ABO blood group and erythropoietin concentration? So your study was invalid?

**Table 4:**Participants with blood group O+ and B+ only showed high expression of erythropoietin mRNA (p=0.000, 0.048 respectively). However, no significant association was observed among other blood groups.

Comment [WU16]: What is this implies? Is it feasible when P value is = 0

**Table 5:**The outcome of the comparative analysis revealed no significant differences comparing the plasma levels of different RBC profile parameters (PCV, HBG, MCH, MCHC, MCV, RDW-SD and RDW-CF) and serum erythropoietin concentration to ABO blood group and Rhesus factor among the potential donors in Ilorin.

**Table 1: Demographic characteristics of the participants**

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| **Demographic Characteristics** | | **Frequency (%)** | **P-value** |
|---|---|---|---|
| Type of donation | Voluntary<br>**Family replacement**<br>Commercial | 15 (12.5)<br>**88 (73.3)**<br>17 (14.2) | 0.045* |
| Age (years) | **21-35**<br>36-45<br>46-55 | **77 (64.2)**<br>34 (28.3)<br>9 (7.5) | 0.115 |
| Gender | **Male**<br>Female | **110 (91.7)**<br>10 (8.3) | 0.987 |
| Marital status | Single<br>**Married** | 37 (30.8)<br>**82 (68.3)** | 0.762 |
| Frequency of donation | **1st timer**<br>Occasionally<br>Yearly/regularly | **62 (51.7)**<br>11 (9.2)<br>47 (39.2) | 0.452 |
| Educational level | Primary<br>Secondary<br>**Tertiary** | 10 (8.3)<br>45 (37.5)<br>**65 (54.2)** | 0.452 |
| Occupation | Students<br>Civil servant<br>**Artisans**<br>Business man<br>Farmer | 8 (6.7)<br>38 (31.7)<br>**44 (36.7)**<br>25 (20.8)<br>5 (4.2) | 0.623 |
| History of alcoholism | Yes<br>**No** | 1 (0.8)<br>**119 (99.2)** | 0.837 |
| History of cigarette smoking | Yes<br>No | 3 (2.5)<br>117 (97.5) | 0.823 |
| Physical exercise | Mild<br>**Moderate**<br>High | 7 (5.8)<br>**73 (60.8)**<br>40 (33.3) | 0.048* |

Data were presented in frequencies and percentages. Chi-square Test was used to determine the significant of association between the variables at P< 0.05 (95% confidence level) with degree of freedom 1.

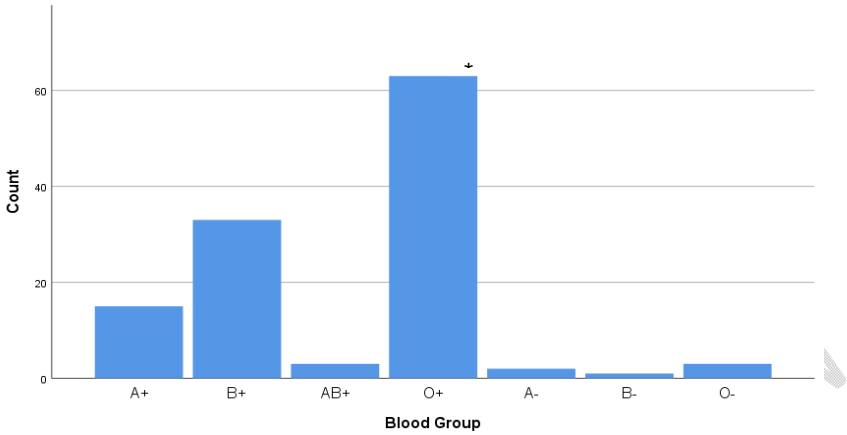


**Figure 2: Bar chart showing the ABO and Rhesus group pattern of the participants.** Data were presented in frequencies and percentages*= Highest frequency

**Table 2: Comparison of serum erythropoietin concentration in relation to demographical data**

| **Demographic and donation data** | | **Mean±SD** | **P-value** |
|---|---|---|---|
| Age (years) | 21 – 35<br>36 – 45<br>46 –55 | 50.21 ± 34.69<br>44.97 ± 34.63<br>43.87± 34.57 | 0.456 |
| Gender | Male<br>Female | 46.98 ± 35.01<br>41.61 ± 31.61 | 0.621 |
| Type of donation | VD<br>FRD<br>CD | 45.40 ± 34.71<br>45.29 ± 35.16<br>52.88 ± 35.22 | 0.704 |
| Frequency of donation | 1st timer<br>Occasionally<br>Yearly/regular | 33.82 ± 32.57<br>43.35 ± 34.32<br>53.86 ± 34.96 | 0.218 |
| Physical exercise | Mild<br>Moderate<br>High | 44.14 ± 35.65<br>47.80 ± 34.67<br>49.28 ± 33.84 | 0.746 |
| ABO blood group | **A +**<br>**B +**<br>**AB +**<br>**O +**<br>**A -**<br>**B -**<br>**O -** | 42.28±40.56<br>47.77±31.71<br>42.44±37.02<br>48.21±35.12<br>31.97 ± 32.23<br>32.87± 34.17<br>30.21 ± 34.86 | 0.947 |

**Comment [WU18]:** Where is your erythropoietin concentration value in the table. You wer measured it.

The values are mean ± standard deviation, Student t-test was used to compare the means at P< 0.05is consideredstatistical significant. SD = Standard deviation, FRD = Family replacement donor, VD = Voluntary donor, CV = Commercial donor.

**Table 3: Erythropoietin mRNA expression in relation to demographic characteristics**

| Characteristics | | Low | Normal | High | P-value |
|---|---|---|---|---|---|
| **Age (years)** | 21 – 35<br>36 – 45<br>46– 55 | 21 (17.5)<br>19 (15.8)<br>3 (2.5) | 12 (10)<br>6 (5)<br>2 (1.6) | 42 (50.4)<br>14 (11.7)<br>1 (0.8) | 0.502 |
| **Gender** | Male<br>Female | 46 (38.3)<br>4 (3.3) | 19 (15.8)<br>3 (2.5) | 45 (37.5)<br>3 (2.5) | 0.580 |
| **Type of donation** | VD<br>FRD<br>CD | 5 (4.2)<br>44 (36.7)<br>7 (5.8) | 2 (1.7)<br>14 (11.7)<br>3 (2.5) | 8 (6.7)<br>29 (24.2)<br>8 (6.7) | 0.592 |
| **Freq. of donation** | 1st time<br>Occasionally<br>Yearly | 31 (25.8)<br>19 (15.8)<br>11 (9.2) | 7 (5.8)<br>9 (7.5)<br>6 (5) | 19 (15.8)<br>13 (10.8)<br>5 (4.2) | 0.510 |
| **Physical exercise** | Mild<br>Moderate<br>High | 3 (2.5)<br>40 (33.3)<br>13 (10.8) | 1 (0.8)<br>11 (9.2)<br>7 (5.8) | 2 (1.7)<br>26 (21.7)<br>17 (14.2) | 0.576 |

The values are finding (%).Chisquare Test was used to determine the significant of association between the variables at P< 0.05 (95% confidence level) with degree of freedom 1.

**Table 4: Association between the participants ABO Rhesus positive blood group and Erythropoietin mRNA expression**

| Blood group | EPO mRNA expression | Freq. (%) | Chi-square value | P-value |
|---|---|---|---|---|
| **A +** | Low<br>Normal<br>High | 6 (5)<br>6 (5)<br>3 (2.5) | 1.23 | 0.549 |
| **B +** | Low<br>Normal<br>High | 7 (5.8)<br>9 (7.5)<br>18 (15) | 6.05 | 0.048* |
| **AB +** | Low<br>Normal<br>High | 1 (0.8)<br>0<br>3 (2.5) | 3.54 | 0.173 |

| | | | | |
|---|---|---|---|---|
| **O +** | Low<br>Normal<br>High | 32 (26.7)<br>7 (5.8)<br>22 (18.3) | 1.52 | 0.000* |
| **A-** | Low<br>Normal<br>High | 0 (0)<br>3 (2.5)<br>0 (0) | 3.41 | 0.275 |
| **B -** | Low<br>Normal<br>High | 0 (0)<br>2 (1.6)<br>0 (0) | 2.24 | 0.217 |
| **O-** | Low<br>Normal<br>High | 1 (0.8)<br>0 (0)<br>3 (2.5) | 3.62 | 0.263 |

Data were presented in frequencies and percentages. Chi-square Test was used to determine the significant of association between the variables atP<0.05 (95% confidence level).

**Table 5: Comparison of level of serum erythropoietin and RBC profile in relation to different ABO Rhesus positive blood group**

Comment [WU19]: Which of these shows significant difference and why?

| RBC profile | **A Rh+** | **B Rh+** | **AB Rh+** | **O Rh+** | **p-value** |
|---|---|---|---|---|---|
| **PCV (%)** | 41.57 ±4.32 | 42.21±3.72 | 45.33±4.51 | 41.56±3.39 | 0.061 |
| **HBG (g/dL)** | 14.88±1.54 | 14.91±1.71 | 16.03±1.19 | 14.72±1.32 | 0.342 |
| **RBC(x10$^{12}$/L)** | 5.31±2.05 | 4.84±0.58 | 4.78±0.25 | 4.76±0.81 | 0.381 |
| **MCH** | 34.48±2.61 | 31.63±4.47 | 37.00±1.00 | 33.30±3.25 | 0.926 |
| **MCHC** | 35.52±1.70 | 34.60±2.65 | 37.33±1.52 | 38.72±2.57 | 0.501 |
| **MCV** | 87.75±15.7 | 90.99±8.40 | 98.66±2.08 | 92.35±9.53 | 0.472 |
| **RDW-CV** | 9.36±2.38 | 9.73±1.62 | 10.43±2.88 | 10.09±1.67 | 0.460 |
| **RDW-SD (fL)** | 37.57±7.28 | 38.68±4.94 | 40.70±2.65 | 39.81±4.09 | 0.340 |

The values are expressed as mean ± standard deviation, Student t-test was used to compare the means and p< 0.05is consideredstatistical significant.PCV = Packed cells volume, HBG = hemoglobin level, RBC = red blood cell.MCH = mean corpuscular hemoglobin, MCHC = mean corpuscular hemoglobin concentration, MCV = mean corpuscular volume, RBC = red blood cells count.

## ***DISCUSSION***

Comment [WU20]: The discussion part is nice. Go a head.

Erythropoietin plays a critical role in stimulating red blood cell (RBC) production (Ghosh et al., 2024). Its regulation is not a major determinant of blood donation outcomes in healthy individuals. But, the process of RBC production and recovery following blood donation may be influenced by other factors, such as iron levels, and recovery time between donations. For regular blood donors, the ability to produce new RBCs efficiently is critical for both their health and the sustainability of the blood supply (Gammonet al., 2023). Repeated blood donations without adequate recovery time can also strain the body's ability to maintain optimal red blood cell production, potentially leading to decreased oxygen-carrying capacity and overall fatigue, which underscores the importance of proper donor management and recovery protocols (Jahret al., 2021).

This study reveals two major discoveries about blood donors in Nigeria. Over 70% of participants were family replacement donors, reflecting a cultural trend in sub-Saharan Africa where familial ties drive blood donation, often to meet immediate needs(Okocha et al., 2019; Nyakunga, 2023). Additionally, 72% of participants engaged in regular physical exercise, improving donor health. Interesting finding was the high rate of moderate physical exercise among participants, with over 72% engaging in regular physical activity. This is a positive indicator, as physical fitness is associated with better cardiovascular health**,** increased hematopoiesis, and fewer complications during and after blood donation (Schloss et al., 2020). Engaging in moderate physical exercise may also help stimulate erythropoietin production, promote the formation of red blood cells, and improve the quality of blood donated (Gibson *et al*., 2024), thereby reducing the risk of adverse effects for both donors and recipients (Avanciniet al., 2021).O Rh+ was the most common blood group among participants and its significance lies in its role as the universal donor for plasma and red blood cell transfusions, making it especially crucial for blood transfusion programs.

The key finding of this study is the higher expression of EPO mRNA in blood groups O+ and B+. While the literature on the association between ABO blood group and EPO expression is limited, several studies have suggested that blood group antigens might play a role in various physiological processes (Kronstein-Wiedemann et al., 2023). The findings in this study suggest a potential link between specific ABO blood groups (O+ and B+) and higher EPO mRNA expression. This association was particularly strong in participants with blood groups O Rh+ and B Rh+. Blood group O+ individuals generally have been found to possess lower levels of von Willebrand factor (vWF) and Factor VIII, which reduces their risk of thrombosis compared to non-O+ blood groups (Ward et al., 2020). These differences in hemostatic factors can influence vascular responses to hypoxia, potentially affecting erythropoietin (EPO) gene expression (Bermudez et al., 2020). Lower vWF levels in blood group O+and B+ individuals may impact oxygen delivery and blood flow characteristics, potentially altering hypoxia-driven pathways and EPO genes expression. However, these associations underline the complex interplay between ABO blood groups, coagulation factors, and physiological responses to oxygen deprivation.Another potential explanation could be related to genetic or epigenetic factors associated with the ABO blood group locus (Groot et al., 2020). In agreement with our findings, variations in genes linked to erythropoiesis, including those

involved in erythropoietin synthesis or receptor signaling, could interact with O+ and B+ blood group antigens, thereby influencing the expression of the EPO gene.

Despite the notable association between blood group O+ and B+ and increased EPO expression, no significant correlations were found between EPO mRNA expression or serum EPO concentration and some demographic factors, such as age, gender, type of donor, donation frequency, or physical exercise. These findings suggest that the variations in EPO expressionobserved across blood groups are independent of commonly studied factors in blood donation research (Kronstein-Wiedemann *et al.*, 2023; Kurhaluka*et al.*, 2024). For instance, while regular physical exercise and moderate physical activity were associated with increased health benefits in many donor populations, these factors did not appear to influence EPO gene expression in the present study.

Another aspect of the study focused on comparing the plasma levels of various red blood cell (RBC) profile parameters such as packed cell volume (PCV), hemoglobin concentration (HGB), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular volume (MCV), red cell distribution width (RDW). The findings from this analysis indicated that there were no significant differences in any of these RBC profile parameters when stratified by blood group or Rh factor. These results suggest that while erythropoietin is crucial for regulating red blood cell production, serum erythropoietin concentration and the associated RBC profile parameters, such as PCV and hemoglobin levels, may not be directly influenced by blood group type or Rhesus factor in healthy and non-anemic prospective donors (Kalra and Auron, 2024) used in this study. It is important to consider that erythropoietin levels can fluctuate based on a variety of factors, including donor health status, hydration levels, and recent donation history. In this study where healthy prospective blood donors were selected, these variations were minimized, resulting in the lack of significant differences observed between the blood groups. Moreover, other biological factors that influence erythropoiesis, such as kidney function, iron status, and overall health, may have had a more substantial impact on erythropoietin levels and RBC profile parameters than ABO and Rh status.

**In conclusion, p**rospective donors with blood groups O Rh+ and B Rh+ who exhibit higher EPO gene expression are likely to be excellent candidates for frequent blood donation. Their enhanced ability to regenerate RBCs efficiently makes them valuable to the blood donation system, ensuring that their contributions are both safe for them and beneficial for recipients. This study highlights the complexity of erythropoietin regulation and its potential implications for blood donation practices. This study provides a foundation for further research into the factors that influence the expression of erythropoiesis genes in other blood groups (A+, B+, AB+) for blood donation safety.

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