Research Topic:

ABO BLOOD GROUP AND RHESUS FACTOR DISTRIBUTION AMONG FENDALL STUDENTS

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ABO Blood Group and Rhesus factor Distribution among Fendall Students

Chapter One: Introduction

Background of the Study

The term human blood group systems is defined by International Society of Blood Transfusion as systems in the human species where cell-surface antigens—in particular, those on blood cells—are controlled at a single gene locus or by two or more very closely linked homologous genes with little or no observable recombination between them, and include the common ABO and Rh- (Rhesus) antigen systems, as well as many others; thirty-five major human systems are identified as of November 2014 (Dean, 2016).

Among the various factors that contribute to a person's individuality are antigens attached to surface of red blood cells and naturally occurring antibodies that circulate in the serum. The ABO blood group and Rhesus (Rh) factor blood group are two of the most notable type groups in humans due to their importance and association with blood transfusion (Khattak, *et al.* 2008). The mode of inheritance of the ABO blood group follows the multiple allelic mode of inheritance and is quite stable to be used to exclude paternity in paternity issues. The Rh antigen is named after the rhesus monkey, Macaca mulatta where it was initially detected. There are two theoretical models that attempt to explain the pattern of inheritance. The Wiener system postulates a single gene locus with a series of at least ten multiple alleles. The Fisher system assumes the existence of at least three closely linked loci designated as C, D, and E. Both are currently in use and are still being studied. However, only the presence of the D antigen in the Fisher system serves as the basis for classification of the Rh blood group; this way, the mode of inheritance is simply single gene inheritance with accompanying dominance. The most notable medical importance of this blood group system is the occurrence of Rh incompatibility

between mother and fetus, which is a major factor in the development of erythroblastosis fetalis or hemolytic disease of the newborn (Dennis *et al*., 1998).

It was in 1901, that Austrian-American immunologist and pathologist Karl Landsteiner discovered human blood groups. Karl Landsteiner's work helps to determine blood groups and thus opened a way for blood transfusions which can be carried out safely. He was awarded the Nobel Prize in Physiology or Medicine in 1930 for this discovery (*Farhud et. al, 2013*).

Death of the patient was the result in most cases before 1900, when blood transfusion was attempted. Blood transfusion was made much safer by the discovery of blood groups, as blood of the same ABO group could be chosen for each patient. However, there were still many cases of unexplained blood transfusion reactions. Biologists still went in search of these unexplained questions (Farhud *et. al*, 2013).

In 1902, the fourth main type, AB was found by Decastrello and Sturli. It was the observations of Levine and Stetson in 1939, and Landsteiner and Weiner in 1940 that laid the foundations of our knowledge about the remaining major blood group, the Rhesus system. Once reliable tests for Rhesus grouping had been established, transfusion reactions became rare! For this discovery Landsteiner was awarded the Nobel Prize in Physiology or Medicine in 1930 (Farhud *et. al*, 2013).

The fact that a person with one blood type produces antibodies against another blood type, it is important that individuals be given compatible blood types for transfusions. For example, a person with blood type B makes antibodies against blood type A. If this person is given blood of type A, his or her type A antibodies will bind to the antigens on the type A blood cells and initiate a cascade of events that will cause the blood to clump together. This can be deadly as the clumped cells can block blood vessels and prevent proper blood flow in the cardiovascular system (Bailey, 2017).

Additionally, a person who is Rh- produces antibodies against Rh+ blood cells if exposed to them. A person can become exposed to Rh+ blood in instances such as a blood transfusion or a pregnancy where the Rh- mother has an Rh+ child. In the case of an Rh- mother and Rh+ fetus, exposure to the blood of the fetus can cause the mother to build up antibodies against the child's blood. This can result in hemolytic disease in which fetal red blood cells are destroyed by antibodies from the mother (Bailey, 2017).

Statement of the Problem

This study was conducted to investigate the ABO Blood group and Rh factor distribution among Fendall students of the University of Liberia. For the safe transfusion of blood from donor to recipient, it is necessary that donor's blood type (especially the ABO and Rh factors) be determined in order to avoid the negative immune response. According to the Nobel Prize website, mixing two different blood types can lead to blood clumping or agglutination. The clumped red cells can crack and cause toxic reactions. Blood group antigens are hereditarily determined and play a vital role in blood transfusion safety, understanding the genetics, inheritance pattern and disease susceptibility (Mathur *et. al*, 2017).

Significance of the Research

This research study is important because its findings will inform the appropriate stakeholders in the health sector about the sources of potential blood donors. Also, the findings of this study will add to the existing literature in field. Additionally, it is hoped that this research will serve as a reference for future research on the investigation of blood groups distribution within a given population.

Purpose of the Study

The intents of this research were:

1. to determine the ABO blood group and Rhesus factor frequency distribution among Fendall students of the University of Liberia;
2. to determine the frequency distribution of the ABO blood group among the students;
3. to determine the frequency distribution of Rh blood group among the students; and
4. to determine the prevalent blood types among the students.

Delimitations of the Study

The research took place in District Number One in Montserrado Count. Specifically, the research study was restricted to students of the Fendall Campus of the University of Liberia. ABO blood group and Rh Factors were the foci.Participants were selected on a volunteer basis.

Limitations of the Study

The researcher used small number of participants. The materials needed for the conduct of the study was limited in number. Findings of this study cannot be generalized to the entire student population at Fendall Campus.

Chapter Two: Literature Review

There are several articles and journals published on the Determination of Gene Frequency and Distribution of the ABO and Rh blood groups system in human immunity, blood transfusion and organ transplantation. The literature review comprises of few articles that report on Analysis, Determination and Gene frequency of the ABO and Rh blood group systems in human.

Analysis of the Blood Type and Group among Undergraduate Physics Students of Dilla University, Ethiopia

Atire(2015) reported in the Journal of Hereditary Genetics the analysis of the blood type and group among undergraduate physics students of Dilla University, Ethiopia. Blood samples were taken from the voluntary Physics students of Dilla University and test was carried on various ethnic groups. The researcher observed that blood groups vary among each ethnic group. The distribution of blood group O was the highest with percentage frequency of 38.33, 29.44 and 28.88%, followed by blood group A and blood group B, and the least percentage frequency is that of blood group AB with 3.33% among each ethnic groups. The highest Rh-blood types were 91.66% Rh-positive blood types followed by 8.34% Rh-negative blood types.

A hospital based study to find the distribution of ABO and Rh blood group in the local population of Sikkim, NorthEastern India

Mathur et. al (2017) reported in the Journal of Public Health the distribution of blood groups (ABO and Rh) subtypes A1, A2, A1B & A2B and Bombay blood group in the local population of Sikkim. A total of 262 blood samples were collected over a period of two months from voluntary blood donors, which included hospital staff, visitors and patients and local inhabitants of Sikkim. Their result show that out of the total sample the most common blood group was O blood group comprising 34.73% followed by B group (28.24%), A (22.91%) and AB (14.12%). 98.4% of the total samples were Rh positive. Blood group A and AB were further sub-typed the distribution of A1 antigen was 98.3% and A1B was 89.7% respectively

among A and AB blood groups. According to the result, the distribution of Blood group O was highest in the study region closely followed by B, A and AB. Almost all the samples showed positivity for Rh.

Blood Groups Distribution and Gene Diversity of the ABO and Rh (D) Loci in the Mexican Population

The Blood Groups Distribution and Gene Diversity of the ABO and Rh (D) Loci in the Mexican Population were reported in BioMed Research International. The researcher tested the Blood groups in 271,164 subjects from 2014 to 2016.The ABO blood group was determined by agglutination using the antibodies anti-A, Anti-B, and Anti-D for the Rh factor, respectively. They discovered that the overall distribution of ABO and Rh (D) groups in the population studied was as follows: O: 61.82%; A: 27.44%; B: 8.93%; and AB: 1.81%. For the Rh group, 95.58% of people were Rh(D),and 4.42% were Rh(d).

Distribution of ABO and Rh-D blood groups in the Benin area of Niger-Delta: Implication for regional blood transfusion

According to the report of Enosolease *et. Al* (2008) in the Asian Journal of Transfusion on the Distribution of ABO and Rh-D Blood Groups in the Benin Area of Niger-Delta, O was the most frequent distributed phenotype in the study population with a percent of 53.22%, followed by group A with 23.74%. Rh negative was reported to be 5.46%, while Positive was 94. 54%.

Chapter Three: Research Methodology

Research Setting

This research will be conducted on the Fendall Campus of the University of Liberia in November, 2018. Test to determine the ABO Blood group and Rhesus factor among volunteer dormitory students was performed at the General laboratory of the Department of Biological sciences, Fendall Campus, University of Liberia in November, 2018.

Materials & Methods

Study Design

A cross-sectional study was conducted on Fendall Campus students who volunteered to participate in the exercise.

Population/ Sample Size of the Study

The selection of participants was performed using a nonprobability sampling as each individual volunteered to donate. The study was conducted on twenty five (25) volunteer students.

Blood Sample Collection Method

The ABO and Rh-blood group's tests Blood samples from each donor was taken by using 70% alcohol pads and piercing the fingers of donors with sterile disposable lancets.

Screening method

Test to determine the ABO Blood group and Rhesus factor among blood donors was done at the General laboratory of the Department of Biological Sciences, Fendall campus, University of Liberia. The slide method was used to determine blood types. ABO blood groups were determined from each sample by agglutination using Anti-A and Anti-B and Anti-AB antibodies and Rh factors were determined by agglutination using Anti-D antibody on the slides.

Data Analysis Procedure

Data collected from the study on the ABO Blood group and Rh factor distribution among Fendall Dormitory students are reported simple percentage tables using Microsoft word 2010 and Microsoft Excel 2010.

Chapter Four: Result and Discussion

Result

The results depict the distribution of ABO blood groups and Rh blood group among volunteer students of university of Liberia, Fendall campus. The study included 25 samples collected from volunteer student of Fendall dormitory, University of Liberia. Out of the total sample, the most prevalent blood group was O group [52%], followed by A group [24%], and

B (16%) as shown in tables I and three. Additionally, Rh positive was 96% and negative was 4% as seen in table II.

Table I: ABO Blood Group Distribution

ABO Blood Group	frequency	Percentage
A	6	24
B	4	16
AB	2	8
O	13	52
TOTAL	25	100

Table II: Rhesus factor Distribution

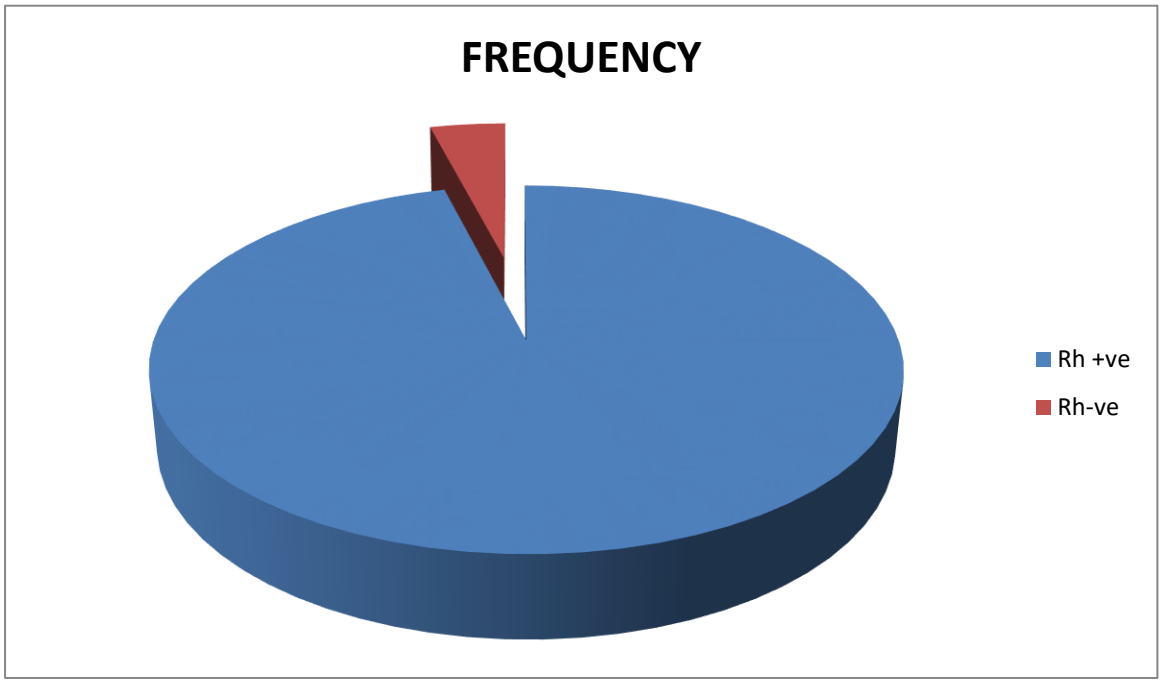

Table III: ABO & Rh Blood Groups Distribution

Blood group	Frequency	Percentage
A+	6	24

A-	0	0
B+	4	16
B-	0	0
AB+	2	8
AB-	0	0
O+	12	48
O-	1	4
TOTAL	25	100

Discussion

The Distribution of ABO blood groups varies among donors' population. As indicated in table I, the distribution of blood group O was the highest with percentage 52%, followed by blood group A (24%) and blood group B (16%).

Similarly, Canizalez-Román et *al*, (2018) stated that the overall distribution of ABO in the population studied was as follows: O: 61.82%; A: 27.44%; B: 8.93%; and AB: 1.81%. Futhermore, Enosolease *et al.* (2008) reported that the distribution of ABO the group 'O' (53.22%) is the most frequently encountered phenotype in that the distribution of ABO. These studies showed that the most prevalent blood group was O follow by A and B.

Out of the total 25 samples, it was seen that 24 were Rh positive which comes out to be 96% while only one (1) was Rh negative as depicted in table II. This observation also correlates with the Atire which showed the high number of Rh positive subjects. Moreover, Canizalez-Román et al, (2018) arrived at a similar result where 95.58% of people were Rh (D), and 4.42% were Rh (d). The prevalence of Rh positive and negative subjects is quite similar to that found in Mexico, Ethiopia as well as the rest of the world.

Chapter Five: Conclusion and Recommendation

Conclusion

This study concludes that the gene frequency distribution of Blood group O+ is highest among participating students and is closely followed by A+ and B+. Almost all the samples showed positivity for Rh. The distribution of Rh negative is very low among the volunteer students. Meanwhile there is a need for a study on a larger population to be done as this was carried on a smaller population.

Recommendation

There following are hereby recommended:

- Appropriate health institution in the study area to keep track of potential blood donors
- Establishment national programs that speed up blood donation and transfusions needed in clinical practice.

REFERENCE:

Adrián Canizalez-Román, Abraham Campos-Romero, José A. Castro-Sánchez, Mario A. López-Martínez, Francisco J. Andrade-Muñoz, Cinthia K. Cruz-Zamudio, Tania G. Ortíz-Espinoza, Nidia León-Sicairos, Alma M. Gaudrón Llanos, Jorge Velázquez-Román, Héctor

Flores-Villaseñor, Secundino Muro-Amador, Jesús J. Martínez-García, and Jonathan Alcántar-Fernández(2018). Blood Groups Distribution and Gene Diversity of the ABO and Rh (D) Loci in the Mexican Population: *BioMed Research International, Vol.* 1925619

Atire, F.A (2015). Analysis of the Blood Type and Group among Undergraduate Physics Students of Dilla University, Ethiopia: *Hereditary Genet 4*: 140. doi:10.4172/2161-1041.1000140

Adeyemo O. A and Soboyejo O. B (2006). Frequency distribution of ABO, RH blood groups and blood genotypes among the cell biology and genetics students of University of Lagos, Nigeria: *Afr J Biotechnol* 5: 2062-2065.

Bangham J. (2014). "Blood groups and human groups: Collecting and calibrating genetic data after World War Two," Studies in History and Philosophy of Science PartC :*Studies in History and Philosophy of Biological and Biomedical Sciences*,vol.47,pp.74– 86,2014. 4.

Dean, Laura (2005). Blood Groups and Red Cell Antigens. Bethesda, MD, USA: *National Center* for Biotechnology *Information* (NCBI), *National Library of Medicine*, *National Institutes of Health*. Retrieved 19 February 2016.REF,

Daniels, G.L. , Fletcher, A. , Garratty, G. , Henry, S. , Jorgensen, J. , Judd, W.J , Levene, C. , Lomas-Francis, C. , Moulds, J.J. , Moulds, J.M , Moulds, M. , Overbeeke, M. , Reid, M.E , Rouger P , Scott M , Sistonen, P. , Smart, E. , Tani, Y. , Wendel, S. and Zelinski, T.(2004) . Blood group terminology : from the International Society of Blood Transfusion committee on terminology for red cell surface antigens. *Vox Sang*. ;87:304–16

Enosolease Mathew Ebose. and Bazuaye Godwin Nosa.(2008) Distribution of ABO and Rh-D blood groups in the Benin area of Niger-Delta: Implication for regional blood transfusion: *Asian J Transfus Sci*.; 2(1): 3–5.doi: 10.4103/0973-6247.39502

FARHUD, Daruish D. and YEGANEH, Marjan Zarif (2013).A Brief History of Human Blood Groups : *Iranian J Publ Health,* Vol. 42, No.1, Jan 2013, pp. 1-6

Hussain R, Fareed M, Shah A, and Afzal, M (2013). Prevalence and gene frequencies of A1 A2 B O and Rh(D) blood group alleles among some Muslim populations of North India: *Egypt J Med Hum Genet* 14: 69-76.

Khan MS, Subhan F, Tahir F, Kazi B. M, Dil A. S, Sultan S.(2004) Prevalence of blood groups and Rh factor in Bannu region NWFP (Pakistan): *Pak J Med Res.*, 43(1):8-10.

Khattak I.D., T.M. Khan, P. Khan, S.M. Ali Shah, T. Khattak, and A. Ali. (2008). Frequency of ABO and Rhesus blood groups in District Swat, Pakistan : *Journal of Ayub Medical College Abbotaba*d, 20(4): 127-129.

Khaliq MA, Khan JA, Shah H, Khan SP.(1984). Frequency of ABO and Rh (D) blood group in Hazara division (Abbottabad). *Pak JMed Res,* 23:102-3.

Landsteiner, K. and Wiener A.S.(1940). An agglutinable factor in human blood recognized by immune sera for rhesus blood: *ProcSocExpBiol Med*, 43:223-4