DISSERTATION SUBMITTED FOR THE MASTER'S DEGREE IN MEDICAL PHYSIOLOGY

TITLE

"Association Between ABO blood group and Hemoglobin Level In Medical Undergraduates"

SUBMITTED BY

SAYYID SAMAN ALI

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INTEGRAL INSTITUTE OF MEDICAL SCIENCES & RESEARCH

INTEGRAL UNIVERSITY LUCKNOW-226026, U.P

ASSOCIATION BETWEEN ABO BLOOD GROUP AND HEMOGLOBIN LEVEL IN MEDICAL UNDERGRADUATE

SUBMITTED TO INTEGRAL UNIVERSITY

In partial fulfillment of the requirements of degree of
Master of Science
In
Medical Physiology
by

SAYYID SAMAN ALI

Enrolment No- 2000102304

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DECLARATION BY CANDIDATE

I hereby declare that this dissertation entitle **"Association between ABO Blood Group and hemoglobin level in medical undergraduate"** is a bona fide & genuine research work carried out by me under the guidance of **Prof. (Dr.) Khaleel Ahmad Manik** Professor and Head, Department of Physiology and under the co-supervision of **Dr. Ausaf Ahmad**, Associate Professor, Department of Community Medicine and **Dr. Mayank Anand**, Assistant professor , Department of Pathology.

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This is to certify that the dissertation entitled **"Association of ABO Blood Group and hemoglobin level in medical undergraduate"** is a bona fide & genuine research work carried out by **Sayyid Saman Ali** under the guidance of **Prof. (Dr.) Khaleel Ahmad Manik**, Professor & head, Department of Physiology and under the co-supervision of **Dr. Ausaf Ahmad**, Associate Professor, Department of Community Medicine and **Dr. Mayank Anand**, Assistant Professor, Department of Pathology in partial fulfillment of requirement for the degree of Master of Science in Medical Physiology. The research methods and procedures described have been done by the candidate and result observed by the Guides periodically.

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CERTIFICATE BY THE GUIDE AND CO-GUIDE

This is to certify that **SAYYID SAMAN ALI,** student of M.Sc MEDICAL PHYSIOLOGY; Integral University has completed her dissertation entitled **"Association of ABO Blood Group and hemoglobin level in medical undergraduate"** successfully. She has completed this work from the department of Physiology, Integral Institute of Medical Sciences and Research, Integral University under the guidance of **PROF. (DR.) KHALEEL AHMAD MANIK**. The dissertation was a compulsory part of her M.Sc. degree. I wish her good luck and bright future.

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I hereby declare that the Integral Institute of Medical Sciences & Research, Integral University, Lucknow shall have the rights to preserve, use and disseminate this dissertation/ thesis in print or electronic format for academic /research purpose. I will publish the research paper related to my dissertation only with the consent of my guide.

ACKNOWLEDGEMENT

Firstly, I express my sincere gratitude to my Lord for providing me light and guidance whenever I needed it the most. I begin in Thy Name.

My heartfelt thanks to **Prof. (Dr.) Khaleel Ahmad Manik,** Professor and Head, Department of Physiology, Integral Institute of medical science & research, Integral University, Lucknow, for her support and encouragement.

YOU, MY REVERED TEACHER

A GUIDE, INSPIRATIONAL PROFESSOR

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"Family and friends make performance better"

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CONTENTS

CHAPTER 1

INTRODUCTION

ABO blood group was first described by Austrian Pathologist Karl Landsteiner in 1900, based on the presence or absence of specific antigens on human red blood cell after noting the patterns of agglutination during blood transfusions. [1]

ABO system is the result of polymorphism of complex carbohydrates with different antigen structure of glycoproteins and glycolipids expressed on the surface of erythrocytes.

There are 33 blood groups recognized by the International Society of Blood Transfusion. [2]

The major blood groups are A, B, AB and O with either Rh +ve or Rh -ve . On the surface of red cell membrane specific antigens are present which determines the blood group of an individual genetically. [3]

Human ABO blood type antigens exhibit alternative phenotypes and genetically derived glycoconjugate structures that are located on the red cell surface which play an active role in the cells physiology. [4]

Blood group antigens are secondary gene products, whereas various glycosyltransferase enzymes that help attach the sugar molecules to the oligosaccharide chain are primary gene

products. These carbohydrate components are perceived as extraneous by the immune system of others and produce antibodies to them. [5]

The expression of A or B antigens, and thereby an individual's blood group, is the result of allelic combinations of genetic variants in the ABO gene on chromosome 9. [6]

The membrane of the human red blood cell contains a variety of blood group antigens. The most important and best known of these is A and B antigens. A and B agglutinogens are complex oligosaccharides differing in their terminal sugars.

In antigen A, the terminal sugar is Nacetylgalactosamine while in B antigen, the terminal sugar is galactose. Basically, these antigens are carbohydrates present on the backbone of the cell

membrane of RBCs, either as glycosphingolipids or glycoproteins, and are secreted into plasma and body fluids as glycoproteins. [7]

H substance is the precursor of ABO blood group on which A and B antigens are added, and H substance is formed by addition of fructose to glycoprotein or glycolipid backbone. Then, addition of N-acetyl galactosamine produces A antigen and galactose the B antigen.[8]

The antibodies against red cell antigens are called agglutinins & demonstrable agglutinins are present in 50% of newborns only that have been filtered across the placenta.

All individuals produce antibodies to ABH carbohydrate antigen that they lack; thus, A blood group individual produces anti-B, 'B' blood group anti-A, 'AB' blood group-neither A nor B and O blood group produces both anti A and B.

The individuals are divided into four major blood groups A, B, AB & O according to the presence of these antigens and agglutinins.[9]

HEMOGLOBIN

Hemoglobin (Hb) is a conjugated protein present in red blood cells and it constitutes more than 90% of the dry weight of these cells. It facilitates the transportation of oxygen from lungs to the tissues, and carbon dioxide from tissues to the lungs. To ensure adequate tissue oxygenation, a sufficient hemoglobin level must be maintained.

Normal Hb level for male is 14 to 18 g/dl and for female is 12 to 16 g/dl. Hb is synthesized in the precursors of red cells during their development in the bone marrow. It appears in the early normoblast stage and attains maximum concentration in the late normoblast stage.[10]

In 1973 Dr. G. S. Adair gave Dr. Max Perutz crystals of horse hemoglobin. This led to the elucidation of the structure of hemoglobin. [11]

Hemoglobin comprises up of 4 subunits, each having one polypeptide chain and one heme group. All hemoglobin carries the same prosthetic heme group iron protoporphyrin 9 associated with a polypeptide chain of 141 (alpha) and 146 (beta) amino acid residues.

The ferrous ion of the heme is linked to the N of a histidine. The porphyrin ring is wedged into its pocket by a phenylalanine of its polypeptide chain. The polypeptide chains of adult

hemoglobin themselves are of two kinds, known as alpha and beta chains, similar in length but differing in amino acid sequence. [12]

There is variation in the values of blood Hb level among individuals due to age, sex, race, occupation, socio-economic status and various diseased conditions.

Male and female have different mean hemoglobin levels. Women have 12% less Hb level when compared with age-matched men. [13]

Genetic variations in the Hb concentration are also caused by genes that are responsible for encoding RBC membrane and its enzyme. [14]

There are very few studies which have reported the difference in blood Hb levels among individuals of different blood groups.

In a study done among the Bengali family in Kolkata, India, low Hb levels were observed in A, and O blood groups. [15]

Another study done in Darjeeling district of West Bengal, India among Dhimals B blood group individuals have higher mean Hemoglobin levels than the other Blood groups. [16]

On the basis of these information this study aims to know the mean Hb values for various blood groups and to find out if there is any significant difference in the values in different blood group.

CHAPTER 2

REVIEW OF LITERATURE

1. Ramalingam L, Raghavan GV. Performed a cross sectional study in 2020, "Association between blood groups and hemoglobin levels in rural population of Kanchipuram district of Tamil Nadu" found that B +ve were the most common blood group. A total no. Of 269 subjects were recruited for the study. The randomly selected population consisted of 158 males and 111 females. Among all the population O –ve blood group was the least of all the blood groups with the prevalence of around 0.4%. The result of this study showed that there was a significantly high value of hemoglobin occur in the individuals having O +ve blood group than A +ve blood group. [3]

2. William G Murphy performed his study in 2014. "The sex difference in hemoglobin levels in adults-mechanisms, causes, and consequences" found that men and women have different mean hemoglobin levels. Women have 12% less hemoglobin levels when compared to age-matched men.[12]

3. Sudip Datta Banik et al. performed a cross sectional study in 2008, "Age-sex variation with hemoglobin level among the adult Dhimals at Naxalbari in West Bengal INDIA" found that B blood group individuals have higher mean hemoglobin levels than other blood groups among Dhimals at Naxalbari of Darjeeling district of West Bengal.[15]

4. DP Mukherjee et al. in 1983 in an anthropological investigation of 114 Bengali families of Sodepur industrial suburb of Calcutta, found that the average hemoglobin level is lower in males with A Blood group than those with other blood groups.[14]

5. Bibhupada Mahapatra et al. performed their study in 2019, "A comparative analysis of total hemoglobin level and red blood cells count in ABO blood group of healthy adults" found the comparable differences in blood hemoglobin values in different types of ABO blood groups. A total no. Of 227 healthy students of age group 18-22 years old of both genders were included in this study for analysis. The result of this study concludes that both hemoglobin level and red blood cell count were significantly high in males as compared to females. [16]

6. Amit Agrawal et al. performed a study in 2014, "ABO and Rh group distribution and gene frequency; the first multicentric study in INDIA" reported that the most common blood group

in our country was O(37.12%), followed by B(32.26%), then A(22.28%) and AB(7.74%) being the least prevalent.[17]

7. James P. Ebben et al. performed a cross sectional study in 2006, "Hemoglobin level variability: Associations with comorbidity, Intercurrent events, and hospitalizations" found lower levels of hemoglobin in A and O blood groups. [18]

8. Garima Shah, Bikram Shah performed a study in 2021, "Correlation between blood groups and blood hemoglobin levels in pregnant females of rural area of Himachal Pradesh" found that A+ is the commonest blood group followed by B+. Total of 120 pregnant females age ranging from 19-38 years have been taken in this study. [19]

9. R.E. Akhigbe, S.F. Ige, A.O. Afolabi, O.M. Azeez et al. performed a study in 2009, "Prevalence of hemoglobin variants, ABO and Rhesus blood groups in Ladoke Akintola University of Technology, Ogbomosho Nigeria" reported that the most frequent among the study population was blood group O (53.12%), while the blood group AB was least prevalent (2.85%). The prevalence of blood group A and blood group B were 21.03% and 22.73%, respectively. This was a retrospective study a total of 1122 students, which included 573 males and 549 females of comparable age range between 18-25 years, were selected. [20]

10.M M Hoque, SD Adnan et al. performed a study in 2016, "Relationship between serum Iron profile and blood groups among the voluntary blood donors of Bangladesh" found that the most prevalent blood group was B (35.0%) followed by O blood group (33.0%). Donors with blood group O had lowest hemoglobin level. This was a prospective study that includes 100 healthy voluntary donors of age group 18-49 years. [21]

11. Muhammad Kamil, Hamid Ali Nagi Al- Jamal and Narazah Mohd Yusoff performed a study in 2009, "Association of ABO blood groups with diabetes mellitus" found that Blood group O was most dominant in the control group among males and females. However in the patient group, blood group B was dominant among females and blood group O was dominant among male. There was no significant differences in gender distribution among control and patient group.It was a case control study conducted at Kapala batas hospital , Penang Malaysia involving 70 patients with diabetes mellitus and 140 healthy controls. Samples were tested for ABO blood groups using ID card gel method.[22]

12. IfeoluwaTemitayo, Oyetunde Timothy performed a study in 2013, "Frequency distribution of hemoglobin variants and rhesus blood groups among pregnant women" found that blood group O was the most prevalent followed by blood group A and blood group AB. The occurance of Hb variants and the different ABO blood groups varied significantly with the prevalence of p=<0.05.[23]

13. Bikas Mondal, Debidas gosh, Biplab kumar biswas, Soumyajit maiti performed a study in 2011, "Prevalence of hemoglobinopathy, ABO and rhesus blood groups in rural areas of west Bengal, India" found that blood group O was the highest (35.8%) and the least percentage distribution was blood group AB (6.68%). The frequencies of A(+), B(+), AB(+,) and O(+) blood groups were 22.44%, 33.61%, 6.58%, and 35.07%**,** respectively. This study was carried out on 958 patients of different ages ranging from child to adults.[24]

14. UG Egesie, OJ Egesie, Usar, Johnbull performed their study in 2008, "Distribution of ABO, Rhesus blood and haemoglobin electrophoresis among the undergraduate students of Niger Delta State University, Nigeria" found that blood group O had the highest percentage distribution of 49% followed by blood groups A and B with 22% respectively and the least percentage distribution of 7% was blood group AB. A total no. 200 undergraduate students were included in this study for analysis.[25]

15. Muhammad Haqir Tahlil et al. performed a retrospective cross-sectional study in 2017, "Distribution and Frequency of ABO and Rhesus (D) Blood Groups in Somalia: A Retrospective Study on Students of Jazeera University, Mogadishu-Somalia" found that blood group O was the most prevalent (61%), followed by A (27%), B (10%), and AB (2%). The distribution of O+, A+, B+, AB+ were 62%, 27%, 9% and 2.0% while that of O-, A-, B- and AB-were 57%, 27%, 12% and 3%, respectively. A total no. of 1811 subjects were included in this study for analysis.[26]

16. AA Bakare, MA Azeez, JO Agbolande performed a study in 2004, "Gene frequencies of ABO and rhesus blood groups and haemoglobin variants in Ogbomoso" found that 3824 (50 %) were blood group O, 1750 (22.9 %) were blood group A, 1629 (21.3 %) were blood group B and 450 (5.9 %) were blood group AB. A total no. 7653 individuals were recruited in this study.[27]

17. Erhabor O, Adias T, Jeremiah ZA performed a study in 2010, "Abnormal hemoglobin variants, ABO, and Rhesus blood group distribution among students in the Niger Delta of Nigeria" found that the distribution of the various blood groups indicated that 46% were blood group O, 26.6% were group A, 23.6% were group B while 3.8% were group AB. Two hundred and four apparently healthy students of African descent comprising 124 males (60.8%) and 80 (39.2%) females with a mean age 24.5 ± 6.5 years took part in this study.[28]

18. Onaiwu T Ohingbomuan, Nosakhare et al. performed a retrospective cross-sectional study in 2018, "Gene Frequencies of Hemoglobin Genotype, ABO and Rhesus Blood Groups among Students Population of a Private University in Nigeria-Implications for Blood Banking" found that blood group O had the highest frequency (59.7%) followed by blood groups A, B, and AB with21.6%, 16.6% and 2.0% respectively. The ABO gene frequencies from our study showed O>A>B>AB pattern, while ABO with Rhesus combination gave the following pattern: O+>A+>B+>O->AB+>A->B->AB- with values 57.1%, 20.8%, 15.9%, 2.6%, 1.8%, 0.8%,0.7%, and 0.3% respectively. A total of 1900 participants were eligible for the study comprising 1069 (56.3%) females and 831 (43.7%) males with a mean age of 19.5 years. [29]

19. Emmanuel Etim et al. performed a study in 2016, "Distribution of ABO, Rh D blood groups and hemoglobin phenotypes among pregnant women attending a tertiary hospital in Yola, Nigeria" found that blood group O was the most prevalent (47.7%) among subjects, followed by A (26.6%), B (22.2%), and AB (3.5%). A total no. of 2226 records of women attending antenatal care was analyzed. The most and least prevalent was blood group O and AB, 47.7% and 3.5% respectively.[30]

20. Onaiwu Tola Ohingbowman et al. performed a study in 2019, "Hemoglobin Genotype, ABO/Rhesus Blood Groups and Malaria among Students Presenting to a Private University Health Centre in Nigeria" found that blood group O (60.5%) had the highest distribution followed by group B (19.9%), A (17.5%) and AB (2.1%). A total of 2294 subjects participated in the study comprising 1039 (45.3%) males and 1255 (54.7%) females.[31]

21. Hemlata Chaurasia, Smita Rani Pradhan et al. performed a cross sectional study in 2022, "Blood group and gender -wise hemoglobin level among blood doners" found that the overall hemoglobin level was 13.8 (13.2−14.1) g/dL. Male had higher hemoglobin 13.8 (13.2−14.2) g/dL than females 13 (13−13.5) g/dL, $P < 0.0001$. There was no difference in hemoglobin in A, AB, B, and O blood group in overall, males, and females. Total data of 7026 blood donors (6658 [94.76%] males and 368 [5.24%] females) were analyzed in this study.[32]

22. Rita Kumari performed a study in 2021, "Association between blood group and blood hemoglobin levels in rural population of Bihar region" found that adults with B blood group have less Hb count than O blood group. A total no. of 100 individuals were included in this study.[33]

RESEARCH QUESTION

IS THERE ANY STATISTICAL DEPENDENCE OF HEMOGLOBIN LEVEL AND ABO BLOOD GROUP SYSTEM??

HYPOTHESIS:

NULL HYPOTHESIS (H0)

There is no significant association between ABO blood group and blood hemoglobin levels.

ALTERNATE HYPOTHESIS (H1)

There is a significant association between ABO blood group and blood hemoglobin levels.

CHAPTER 3

AIM & OBJECTIVES

AIM:

The aim of this study is to determine the association between ABO blood group and blood hemoglobin level in medical undergraduates.

OBJECTIVE:

- To determine the blood groups of all subjects.
- To determine the hemoglobin level of all subjects.
- To find out if there are any significant differences in hemoglobin level of different blood groups.

CHAPTER 4

MATERIALS AND METHODS

TYPES OF STUDY- Cross-sectional study.

PLACE OF STUDY- The study was performed in the Department of Physiology at Integral Institute of Medical Science and Research, Lucknow (U.P)

DURATION OF STUDY-December2022 to June2023

SUBJECT SELECTION- All the first-year medical students who came to the department of Physiology IIMS&R for the practicals were taken following the inclusion and exclusion criteria.

INCLUSION CRITERIA –

- Apparently healthy male and female.
- Age group 18 to 30 year was included in the study.

EXCLUSION CRITERIA-

- Subjects with Bleeding Disorders.
- History of Drug and Alcohol intake.
- Smokers.

COLLECTION OF DATA

PRINCIPLE OF ABO BLOOD GROUPING:

ABO blood group system, the classification of human blood based on the inherited properties of red blood cells (erythrocytes) as determined by the presence or absence of the antigens A and B, which are carried on the surface of the red cells. Persons may thus have type A, type B, type O, or type AB blood.

- A cross-sectional study was carried out on the subjects performing their practicals in the hematology laboratory (department of physiology) at Integral Institute of Medical Science and Research, Lucknow.
- Subjects were selected on the basis of inclusion and exclusion criteria and who was willing to participate.
- Blood group of the subject was determined by the slide agglutination method using Antiserum A, B and D.
- Blood was collected by finger prick method. The procedure was done under strict aseptic precaution.
- Take clean glass slides and put blood drops on it and add one drop of each antiserum on it with help of dropper mix them well.
- Wait for ten minutes, examine the presence of agglutination, confirm the finding:
    1. If there is no agglutination, the RBCs remain separated and evenly distributed.
    2. If agglutination occurs, the RBCs form clump and lose their outline.

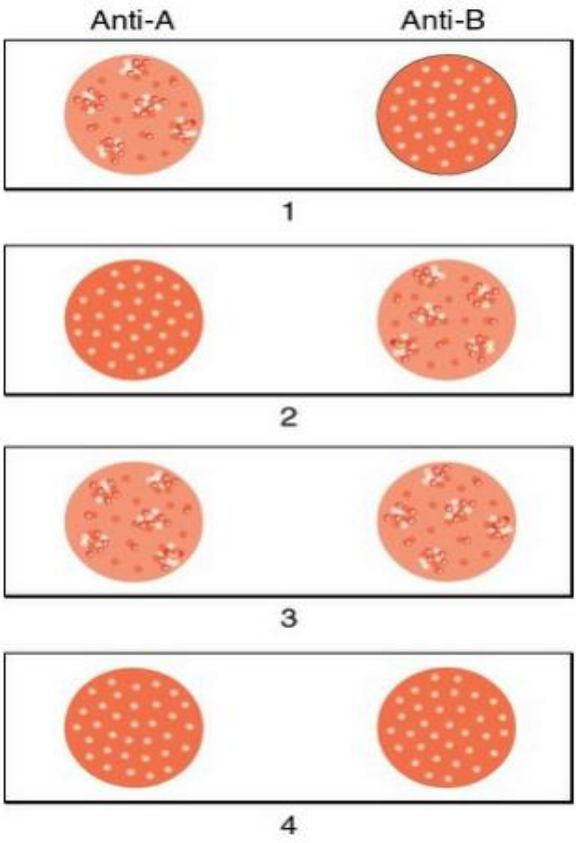
PRINCIPLE OF HEMOGLOBIN

The principle for this method is that a blood sample is added to N/10 hydrochloric acid; hemoglobin present in RBCs is converted to acid hematin which forms a dark brown colored substance.

- Blood hemoglobin level was estimated by using Sahli's Hemoglobinometer.
- Blood hemoglobin values of different blood groups was then tabulated.

DETERMINATION OF ABO BLOOD GROUP

The ABO blood group of an individual can be determined by mixing one drop of suspension of his/her red cells (in isotonic saline) with a drop each of antiserum A (containing α agglutinins) and antiserum B (containing β agglutinins) separately on a glass slide. The antiserum A cause agglutination (clumping of RBCs having A antigens and antiserum B cause agglutination of RBCs having B antigens). The blood group of the individual was shown by the presence of agglutination with one, both or none of the sera.



Determination of blood groups—the RBCs showing agglutination with antisera are:

1. of blood group 'A' with antisera A; 2. Of blood group B with antiserum B; 3. Of blood group 'AB' with antiserum A and B (both); and 4. of blood group 'O' with none.

SAMPLE SIZE ESTIMATION

The sample size will be calculated using the formula-

$n= z^2p\ (1-p)/d^2$

Where sample size=n,

P=40% [3]

1-p=q=60%

Confidence level 95%, so Z score=1.96,

Margin of error (d) =10%

Calculated sample size =92

Final sample size=100 [34]

STATISTICAL ANALYSIS

Statistical analysis was performed by using non parametric test with SPSS software version 23. The value of *P* was checked to determine the significant differences in the hemoglobin values between each blood group. [3]

SIGNIFICANCE OF STUDY

- Through this study, quantitative information regarding the mean values and differences in blood hemoglobin levels among ABO blood groups obtained.
- The blood groups prone to anemia could be determined.
- Preventive measures can be adopted and nutritional advices can be given to such individuals.
- Future studies can be done among larger population to support the information and also to find out what type of anemia the particular blood group individuals are prone to.[3]

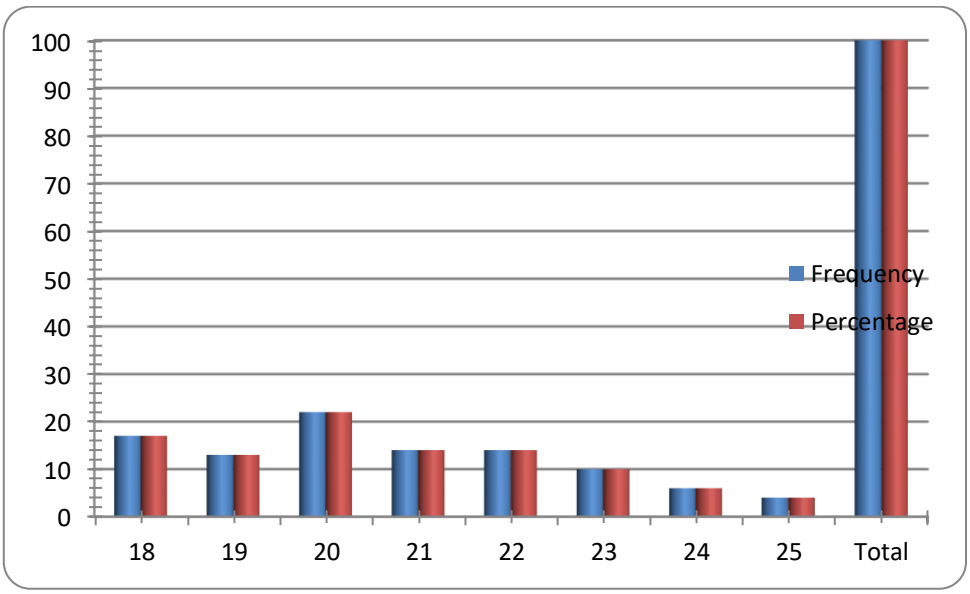
CHAPTER 5

RESULT

Table 1. Distribution According to their age

Age	Frequency	Percentage
18	17	17
19	13	13
20	22	22
21	14	14
22	14	14
23	10	10
24	6	6
25	4	4
Total	100	100

Fig 1. Shows distribution according to their age

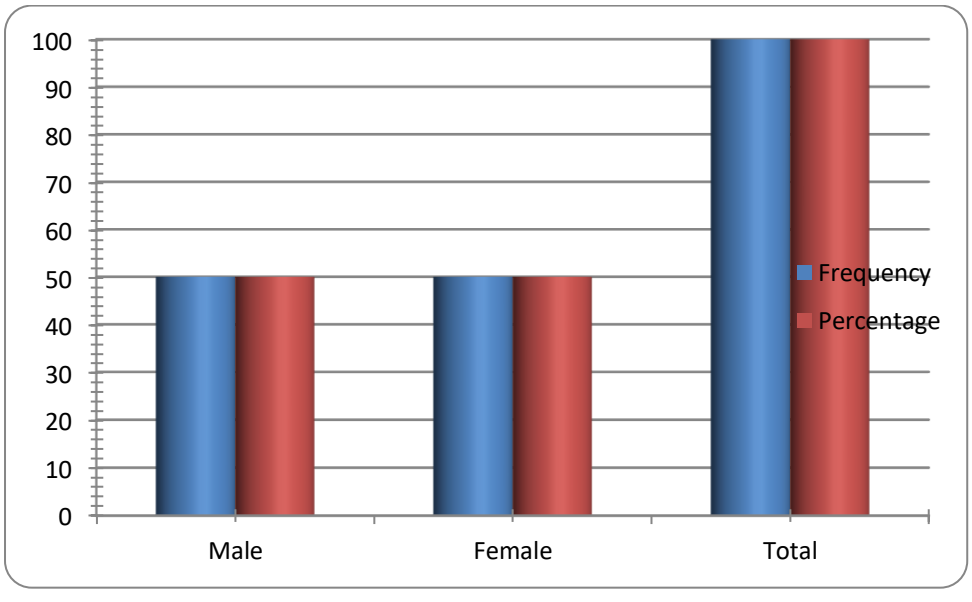


There are 17 individuals in the age group of 18, 13 in the age group of 19, 22 in the age group of 20, 14 in the age group of 21, 14 in the age group of 22, 10 in the age group of 23, 6 in the age group of 24, and 4 in the age group of 25. This represents 17% of the total population, 13% of the total population, 14% of the total population, 10% of the total population, 6% of the total population, and 4% of the total population.

Table 2. Distribution according to their gender

Gender	Frequency	Percentage
Male	50	50
Female	50	50
Total	100	100

Fig 2- Shows distribution according to their gender

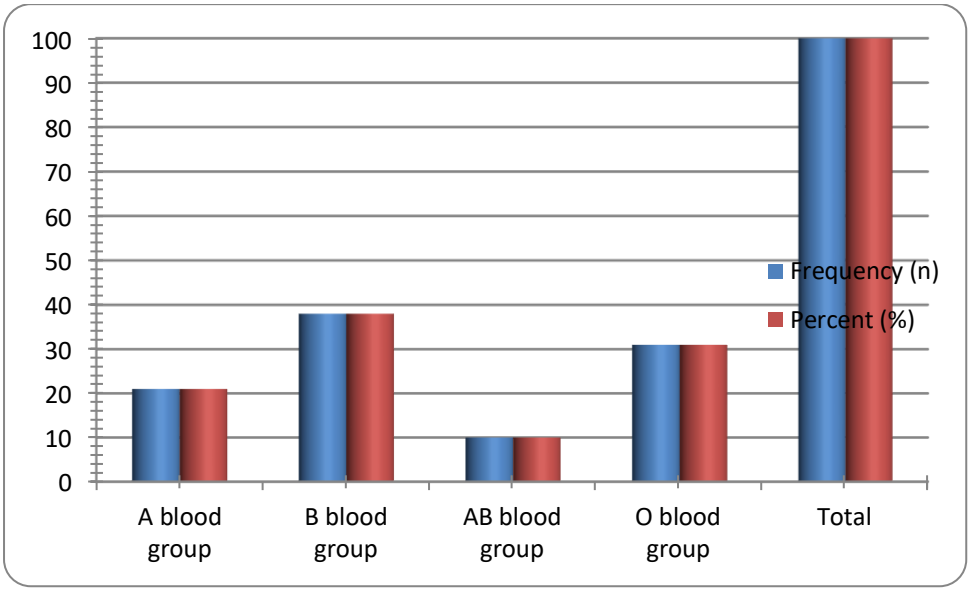


The provided table illustrates the distribution of male and femaleamong the total selected population (n=100). There are 50 male individuals and 50 female individuals. This represents 50% male of the total population and 50% female of the total population.

Table 3. Distribution of ABO blood groups of respondents

ABO blood groups	Frequency (n)	Percent (%)
A blood group	21	21
B blood group	38	38
AB blood group	10	10
O blood group	31	31
Total	100	100

Fig 3- shows distribution of ABO blood groups of respondents

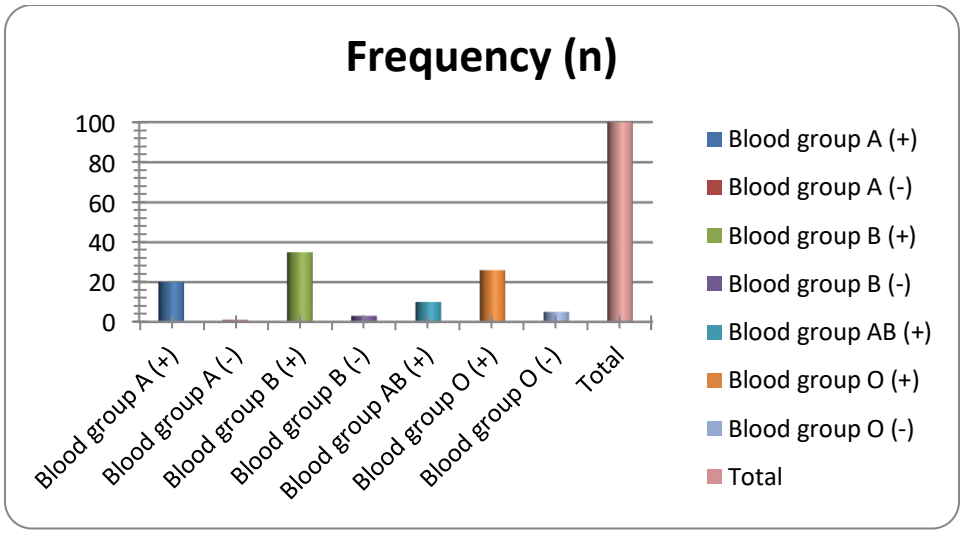


This table shows the distribution of ABO group among the selected population. (n=100)
It represents the frequencies and percentage of each blood group.
21 individuals have blood group A, which account for 21% of the population respectively.
38 individuals have blood group B, which accounts for 38% of the population respectively.
10 individuals have blood group AB, which accounts for 10% of the population respectively.
31 individuals have blood group O, which accounts for 31% of the population respectively.

Table 4. Distribution of ABO (+/-) blood groups

Blood group ABO (+/-)	**Frequency (n)**	**Percent (%)**
Blood group A (+)	20	20
Blood group A (-)	1	1
Blood group B (+)	35	35
Blood group B (-)	3	3
Blood group AB (+)	10	10
Blood group O (+)	26	26
Blood group O (-)	5	5
Total	100	100

Fig-4 shows distribution of ABO blood groups of respondents



The provided table illustrates the distribution of ABO blood groups, including both positive (+) and negative (-) types, in a specific population. It presents the frequencies and percentages of each blood group.

20 individuals have blood group A (+), accounting for 20% of the population.

1 individual has blood group A (-), representing 1% of the population.

35 individuals have blood group B (+), comprising 35% of the population.

3 individuals have blood group B (-), accounting for 3% of the population.

10 individuals have blood group AB (+), making up 10% of the population.

26 individuals have blood group O (+), representing 26% of the population.

5 individuals have blood group O (-), accounting for 5% of the population.

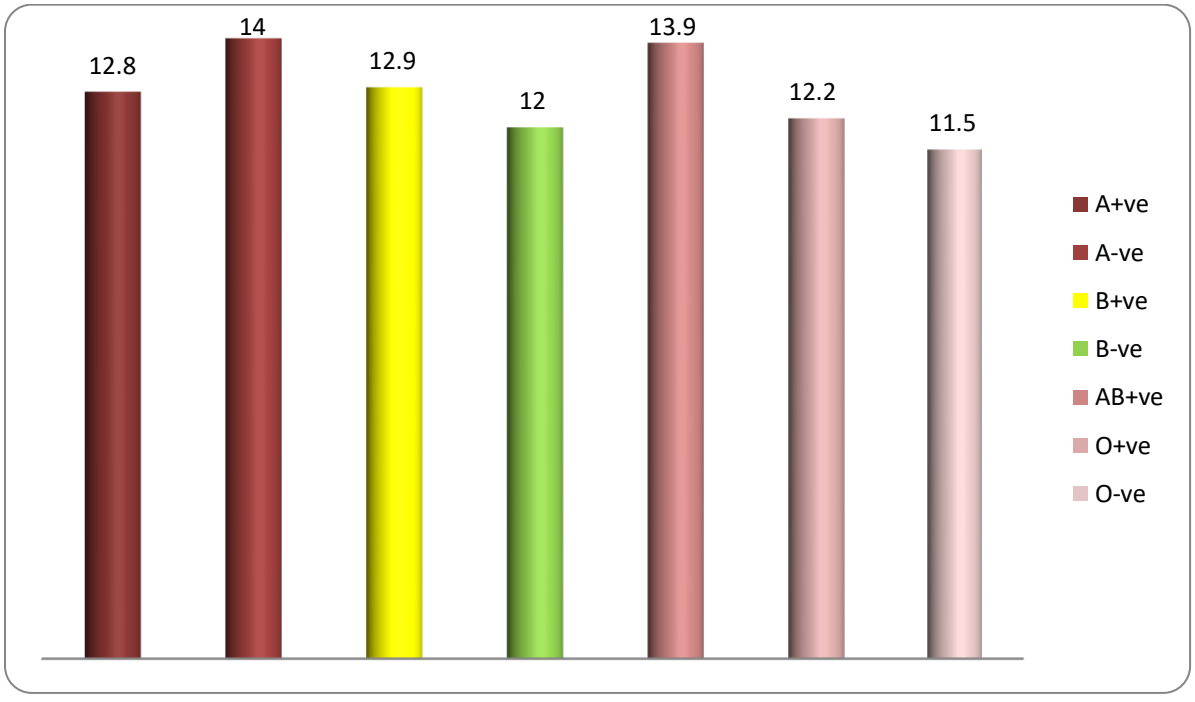
The "Total" row indicates that the frequencies and percentages sum up to 100, as it represents the entire population.

This table provides a concise overview of the distribution of ABO blood groups and can serve as a foundation for further analysis or interpretation regarding blood group characteristics or their associations with other variables of interest.

Table-5. Mean hemoglobin values of different blood groups.

Blood group ABO (+/-)	Mean Hb values (g/dL)
Blood group A+	12.8
Blood group A-	14
Blood group B +	12.9
Blood group B-	12
Blood group AB+	13.9
Blood group O +	12.2
Blood group O-	11.5

Fig -5 Shows mean hemoglobin values of different blood groups



This table represents the mean values of Hb level in different ABO blood groups.

Blood group A+ve has mean Hb level of 12.8 g/dl respectively.

Blood group A-ve has mean Hb level of 14 g/dl respectively.

Blood group B+ve has mean Hb level of 12.9 g/dl respectively.

Blood group B-ve has mean Hb level of 12 g/dl respectively.

Blood group AB+ve has mean Hb level of 13.9 g/dl respectively.

Blood group O+ve has mean Hb level of 12.2 g/dl respectively.

Blood group O-ve has mean Hb level of 11.5 g/dl respectively.

Table 6. Association of ABO blood groups with blood hemoglobin levels.

Blood group ABO	**Mean ± SD**
Blood group A	12.8571±1.74028
Blood group B	12.97368±1.56804
Blood group AB	13.9±2.024846
Blood group O	12.16129±1.4628
Total	100

The provided table presents the mean values and standard deviations (SD) of different ABO blood groups. Blood group A has a mean value of 12.8571 with a standard deviation of 1.74028, Blood group B has an average value of 12.97368 with a standard deviation of 1.56804, Blood group AB has an average value of 13.9 with a standard deviation of 2.024846, and Blood group O has an average value of 12.16129 with a standard deviation of 1.4628. The "Total" row represents the sum of all blood groups, which is 100. The table provides information on the mean values and standard deviations of the measured parameter for different ABO blood groups, allowing for a comparison and understanding of the variation in the parameter across these blood groups

Hypothesis 1:

There is no significant association between ABO blood group and blood hemoglobin levels.

Table 7. Anova test for Association of ABO blood groups with blood hemoglobin levels.

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	25.95134	3	8.650446	3.287077	0.02403	2.699393
Within Groups	252.6387	96	2.631653			
Total	278.59	99				

The ANOVA test examines the variation between groups (blood groups) and within groups (individuals within each blood group) to determine if there are significant differences in blood hemoglobin levels based on ABO blood groups.

The p-value associated with the between groups variation is 0.02403. Since this p-value is less than the chosen significance level (α), typically 0.05, we reject the null hypothesis. This suggests that there is evidence of a significant difference in blood hemoglobin levels among the ABO blood groups.

The F-statistic of 3.287077 indicates the ratio of between-group variation to within-group variation. The higher the F-statistic, the stronger the evidence against the null hypothesis.

The critical F-value (F crit) of 2.699393 is the cutoff value that separates significant results from non-significant ones. If the calculated F-statistic is greater than the critical F-value, it supports rejecting the null hypothesis. In summary, the ANOVA test indicates that there is a significant association between ABO blood groups and blood hemoglobin levels based on the p-value of 0.02403.

CHAPTER 6

DISCUSSION

Introduction:

The present study aimed to investigate the association between ABO blood groups and blood hemoglobin levels. An analysis using the ANOVA test was conducted to examine the variation between groups (blood groups) and within groups (individuals within each blood group) and determine if there are significant differences in blood hemoglobin levels based on ABO blood groups. The results demonstrated a significant association between ABO blood groups and blood hemoglobin levels, providing valuable insights into the potential impact of ABO blood groups on hematological parameters.

Significance of ABO Blood Groups in Hematology:

ABO blood groups are well-known in the field of transfusion medicine and have been extensively studied in relation to various health outcomes. The ABO blood group system is based on the presence or absence of antigens on the surface of red blood cells, including A, B, and O antigens. These antigens have been associated with different clinical characteristics and susceptibilities to certain diseases, including their potential influence on blood hemoglobin levels. [35]

Association between ABO Blood Groups and Blood Hemoglobin Levels:

The findings of the current study revealed a significant difference in blood hemoglobin levels among the ABO blood groups. The obtained p-value (0.02403) indicated that the likelihood of observing such differences due to chance alone was very low. The calculated F-statistic (3.287077) further supported the rejection of the null hypothesis, indicating a strong association between ABO blood groups and blood hemoglobin levels.

These results align with previous research suggesting an association between ABO blood groups and hematological parameters. For instance, a study by Atapattu et al. (2016) found significant differences in hemoglobin levels across different ABO blood groups, with individuals belonging to certain blood groups demonstrating higher or lower hemoglobin levels compared to others.[36] Similarly, a meta-analysis by Cheng et al. (2019) reported an association between ABO blood groups and red blood cell parameters, including hemoglobin levels, supporting the notion of a genetic link between ABO blood groups and hematological characteristics.[37]

Potential Mechanisms:

The underlying mechanisms responsible for the observed association between ABO blood groups and blood hemoglobin levels remain to be fully elucidated. However, several hypotheses have been proposed. One possible explanation is that the ABO antigens may modulate the expression or activity of genes involved in hematopoiesis or erythrocyte metabolism, consequently impacting hemoglobin synthesis and degradation (Franchini et al., 2017).[38]

Another hypothesis suggests that the association between ABO blood groups and blood hemoglobin levels could be influenced by the relationship between ABO antigens and inflammation. Previous studies have shown that ABO blood groups are associated with variations in circulating inflammatory markers (Zhang et al., 2015).[39] Inflammation has been linked to alterations in hematological parameters, including hemoglobin levels, through its effects on iron metabolism and erythropoiesis (Bolton-Maggs & Cohen, 2017).[40] Therefore, it is plausible that ABO blood groups may indirectly affect hemoglobin levels by modulating the inflammatory response.

Implications and Future Research:

The significant association between ABO blood groups and blood hemoglobin levels has implications for both clinical practice and research. In clinical settings, considering an individual's ABO blood group when interpreting hemoglobin levels may provide additional insights and contribute to a more comprehensive understanding of hematological parameters.

Future research should aim to investigate the clinical implications of this association, such as its relevance in the diagnosis and management of anemia or other hematological disorders.

Furthermore, it would be valuable to explore the underlying genetic and molecular mechanisms that link ABO blood groups to blood hemoglobin levels. Investigating the expression patterns of genes involved in hemoglobin synthesis and erythrocyte metabolism among different blood groups could provide a deeper understanding of the observed differences in hemoglobin levels. Additionally, studies exploring the role of ABO antigens in modulating inflammatory responses and their impact on hematological parameters would shed light on the complex interplay between ABO blood groups and blood hemoglobin levels.

CHAPTER 7

CONCLUSION

The findings of this study demonstrate a significant association between ABO blood groups and blood hemoglobin levels. These results support the notion that ABO blood groups contribute to variations in hematological parameters, including hemoglobin levels. The observed association holds potential clinical implications and warrants further investigation into the underlying mechanisms. Understanding the influence of ABO blood groups on blood hemoglobin levels can contribute to improved patient care, personalized medicine approaches, and a more comprehensive understanding of hematological parameters.

CHAPTER 8

LIMITATIONS OF THE STUDY

The present study has certain limitations such as:

- Small Sample Size.
- Different ethnicity and various age groups individual were included in the study.

CHAPTER 9

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ANNEXURE I(A)

INFORMED CONSENT FORM (FOR CASE)

1. I **SAYYID SAMAN ALI** MSC third year student medical physiology IIMS&R Lucknow.
2. I am not associated with your treating doctor panel.
3. There will be no charges /fees/any consideration given or taken for the study.
4. Your identity will be confidential and information and result of your history examination will not be revealed to any other except you if u desire.
5. The study has nothing to do with your treatment and is not going to hamper if you refuse to participate.
6. The study has nothing to do with your current treatment but may improve the knowledge and understanding of disease process and that knowledge may or not be helpful in future.
7. After knowing the all above detail would you like to participate in our study? Yes/ No

Name of the patient Signature of the Research Scholar:

Signature:

CONSENT FORM

I…….aged…….W/O,D/O,S/O……..……. R/O……..…here with state that I have been duly informed about the study titled **"ASSOCIATION BETWEEN ABO BLOOD GROUP AND BLOOD HEMOGLOBIN LEVEL IN MEDICAL UNDERGRADUATES"** its prospects and consequences. I hereby give informed and written consent for the collection of my blood sample for the above said study only.

Signature/thumb impression of the patient:

Signature/thumb impression of the witness: Signature of research scholar

ANNEXURE I(B)

INFORMED CONSENT FORM (FOR CONTROL)

1. I **SAYYID SAMAN ALI** M.SC third year student medical physiology IIMS&R Lucknow.
2. I am not associated with your treating doctor panel
3. There will be no charged /fees/any consideration given or taken for the study.
4. Your identity will be confidential and information and result of your history examination will not be revealed to any other except you if u desire.
5. The study is not going to hamper if you refuse to participate.
6. The study will/will not be beneficial for you but may improve the knowledge and understanding of disease process and that knowledge may or may not be helpful in future.
7. After knowing the all above detail would you like to participate in our study? Yes/ No

Name of the subject Signature of the Research Scholar:

Signature:

CONSENT FORM

I……aged…….W/O,D/O,S/O……
R/O……..…here with state that I have been duly informed about the study titled **"ASSOCIATION BETWEEN ABO BLOOD GROUP AND BLOOD HEMOGLOBIN LEVEL IN MEDICAL UNDERGRADUATES"**, its prospects and consequences. I hereby give informed and written consent for the collection of my blood sample for the above said study only.

Signature/thumb impression of the patient:

Signature/thumb impression of the witness: Signature of research scholar:

अनुलग्नक I (ए)

सूचित सहमति फॉर्म (मामले के लिए)

1. मैं सैय्यद समन अली एमएससी थर्ड ईयर स्टूडेंट मेडिकल फिजियोलॉजी आईआईएमएस आर लखनऊ।

2. मैं आपके ट्रीटिंग डॉक्टर पैनल से जुड़ा नहीं हूं।

3. अध्ययन के लिए कोई शुल्क /शुल्क /दिया गया या दिया गया कोई विचार नहीं होगा।

4. आपकी पहचान गोपनीय होगी और जानकारी और आपके इतिहास की परीक्षा का परिणाम किसी अन्य के अलावा आपके लिए नहीं होगा यदि आप चाहते हैं।

5. अध्ययन का आपके उपचार से कोई लेना -देना नहीं है और यदि आप भाग लेने से इनकार करते हैं तो आप बाधा नहीं डालेंगे।

6. अध्ययन का आपके वर्तमान उपचार से कोई लेना -देना नहीं है, लेकिन रोग प्रक्रिया के ज्ञान और समझ में सुधार हो सकता है और यह ज्ञान भविष्य में सहायक हो सकता है या नहीं।

7. उपरोक्त सभी विस्तार को जानने के बाद क्या आप हमारे अध्ययन में भाग लेना चाहेंगे? हां नहीं

रोगी का नाम: अनुसंधान विद्वान का हस्ताक्षर

हस्ताक्षर:

सहमति पत्र

मैं..... आयु .....

पुत्री/पुत्र/पत्नी.....पता.....

.....। यहाँ राज्य के साथ कि मुझे "मेडिकल अंडरग्रेजुएट्स में एबीओ ब्लड ग्रुप और ब्लड हीमोग्लोबिन स्तर के बीच संबंध" शीर्षक से अध्ययन के बारे में विधिवत जानकारी दी गई है। , इसकी संभावनाएं और परिणाम। मैंने अनुसंधान कार्य के विवरण को बहुत अच्छी तरह से जाना है और मैं उसी के लिए अपनी सहमति देता हूं।

रोगी के हस्ताक्षर/अंगूठे की छाप: गवाह के हस्ताक्षर/अंगूठे की छाप:

अनुसंधान विद्वान के हस्ताक्षर:

अनुलग्नक I (बी)

सूचित सहमति फॉर्म (नियंत्रण के लिए)

1. मैं सैय्यद समन अली एमएससी थर्ड ईयर स्टूडेंट मेडिकल फिजियोलॉजी आईआईएमएस आर लखनऊ।

2. मैं आपके ट्रीटिंग डॉक्टर पैनल से जुड़ा नहीं हूं।

3. अध्ययन के लिए कोई शुल्क /शुल्क /दिया गया या दिया गया कोई विचार नहीं होगा।

4. आपकी पहचान गोपनीय होगी और जानकारी और आपके इतिहास की परीक्षा का परिणाम किसी अन्य के अलावा आपके लिए नहीं होगा यदि आप चाहते हैं।

5. अध्ययन का आपके उपचार से कोई लेना -देना नहीं है और यदि आप भाग लेने से इनकार करते हैं तो आप बाधा नहीं डालेंगे।

6. अध्ययन का आपके वर्तमान उपचार से कोई लेना -देना नहीं है, लेकिन रोग प्रक्रिया के ज्ञान और समझ में सुधार हो सकता है और यह ज्ञान भविष्य में सहायक हो सकता है या नहीं।

7. उपरोक्त सभी विस्तार को जानने के बाद क्या आप हमारे अध्ययन में भाग लेना चाहेंगे? हां नहीं

रोगी का नाम: अनुसंधान विद्वान का हस्ताक्षर

हस्ताक्षर:

सहमति पत्र

मैं..... आयु .....
पुत्री/पुत्र/पत्नी.....पता.....
.....। यहाँ राज्य के साथ कि मुझे "मेडिकल अंडरग्रेजुएट्स में एबीओ ब्लड ग्रुप और ब्लड हीमोग्लोबिन स्तर के बीच संबंध" शीर्षक से अध्ययन के बारे में विधिवत जानकारी दी गई है। , इसकी संभावनाएं और परिणाम। मैंने अनुसंधान कार्य के विवरण को बहुत अच्छी तरह से जाना है और मैं उसी के लिए अपनी सहमति देता हूं।

रोगी के हस्ताक्षर/अंगूठे की छाप: गवाह के हस्ताक्षर/अंगूठे की छाप:

अनुसंधान विद्वान के हस्ताक्षर:

INSTITUTIONAL ETHICS COMMITTEE (IEC)

IIMS&R INTEGRAL UNIVERSITY, LUCKNOW

IEC/IIMS&R/2023/12

CERTIFICATE

This is to certify that research work entitled **"Association Between ABO Blood Group and Hemoglobin Level in Medical Undergraduates"** submitted by **Sayyid Saman Ali** for ethical approval before the Institutional Ethics Committee IIMS&R. The above mentioned research work has been approved by Institutional Ethics Committee, IIMS&R with consensus in the meeting held on **30th December 2022**.

Dr.Q.S.Ahmed
(Member Secretary)
IRC/IEC
IIMS &R

Master ChartSubject 1-100

Sr. No	NAME OF SUBJECT	GENDER	AGE	ENROLLMENT NO.	MOBILE NO.	HB LEVEL	BLOOD GROUP
1	SHIVANI	FEMALE	24	2200100126		12	B+
2	OSHIMA SAXENA	FEMALE	23	200100237	9889892037	14	AB+
3	NAMRATA KUMARI	FEMALE	23	2200100414		12	A+
4	MAHIMA	FEMALE	24	2100100879	638802346	13	B+
5	SAMRA JAMEEL	FEMALE	19	200103028	9569592420	10	O_
6	ZAARA WARSI	FEMALE	18	2200102989	7880388524	12	A+
7	NOORI KHURSHEED	FEMALE	18	2200103081	9263355103	11	A+
8	ZAINAB SIDDIQUI	FEMALE	20	2200102457	9696844132	12	B+
9	SHIVANI KUMARI	FEMALE	18	2200100378		12	O+
10	CHAWATI J NISHAD	FEMALE	19	2200101260		11	O+
11	BHAVYA NIGAM	FEMALE	21	2200100004	6387383129	12	B+
12	MEHVISH KHAN	FEMALE	21	2200100028	8470848969	13	O+
13	HERA FATIMA	FEMALE	21	2200101002	8825387006	11	O+
14	SAHIBA PARVEEN	FEMALE	21	2200100314	7349918533	12	B+
15	FARIYA	FEMALE	18	2200102248	7355633090	13	B+
16	TANUSHKA GUPTA	FEMALE	22	2200100307	8077657866	11	O+
17	REHMAT JAHAN USMANI	FEMALE	24	2102300101	8081959361	12	A+
18	FARHEEN MALIK	FEAMLE	21	2102300173	8866479107	11	O+
19	SHEWATA SINGH	FEMALE	22	2200104165	9580737321	11	O+
20	RUBI VERMA	FEMALE	24	2200100062	9696472549	11	B+
21	RAMSHA TAREEK	FEAMLE	20	2200103720	9307468241	11	B+
22	ZEBA PARVEEN	FEMALE	20	2200103070	7766955486	10	B+
23	RIMSHA PARVEEN	FEMALE	22	2200103069	7543829645	11	A+
24	SHIFA FAROOQUI	FEMALE	20	2200102701	6391888918	12	B+
25	JAYDA ALWANDI	FEMALE	20	2200104529	6387898674	11	O+
26	POOJA KUMARI	FEMALE	20	2260103015	9695980868	12	O_
27	IQRA EKHLAQ	FEMALE	20	2200100458	8879466784	11	O_
28	MAHEK MADHESIYA	FEMALE	19	2200101211	8081534453	12	B+
29	TANISHKA GUPTA	FEMALE	22	2200100308	9792933375	12	O+
30	FARHA NAAZ	FEMALE	20	2200103222	9263757572	13	B+
31	SABIYA SIDDIQUE	FEAMLE	18	2200100158	8052107318	11	O+
32	NIHARIKA GUPTA	FEAMLE	18	2202300169	7060778739	9	O+

33	NIYATI PANDEY	FEMALE	20	2202300131	6387416710	12	O+
34	PRACHI SAHI	FEMALE	18	2202300147	7009915833	10	AB+
35	ROSHNI YADAV	FEMALE	20	22023000112	9450078237	12	B+
36	RIZA PARVEEN	FEMALE	21	2202300086	9450078237	11	A+
37	SAMEERA MASOOD BATIN	FEMALE	21	2202300091	9007941984	12	B+
38	SHEEBA CHAUHAN	FEMALE	25	2202300191	6395028534	11	O+
39	SHAHINA NOOR	FEMALE	22	2202300151	6388944118	12	O+
40	SHIVANI SURYAVANSHI	FEMALE	18	2202300082	7735032745	10	A+
41	SAUMYA GUPTA	FEMALE	20	2202300100	9971490984	13	B+
42	SAMIKSHA YADAV	FEMALE	20	2202300179	9026887919	13	O_
43	SANSKRITI YADAV	FEMALE	20	2202300117	8296805333	10	O+
44	MANTASHA PATWEEN	FEMALE	18	2200100460	9334009731	12	O+
45	NAZIA	FEMALE	21	22001006794	7319926794	12	A+
46	NAHID MUSTAFA	FEMALE	21	2200100606	8538943686	11	AB+
47	FARHA NAAZ	FEMALE	20	2200103222	9263757572	10	B+
48	NARGISH	FEMALE	20	2200100366	6388685763	11	A+
49	AYERAH FATAMA	FEMALE	18	2200103039	6204329920	10	B_
50	PAWAN KUMAR	MALE	22	2200100040	8853367443	14	B+
51	HIMANSHU RAZ	MALE	22	2200103429	9523122107	14	A+
52	SACHIN KUMR GUPTA	MALE	23	2200100161	6386296476	14	B+
53	RISHABH VERMA	MALE	23	2200100339	9559665800	15	B+
54	ABISHEK KUMAR	MALE	18	2200100722	8430303130	13	A+
55	ASHWANI MISHRA	MALE	23	2200100760	8127656700	14	O+
56	SAIF KHAN	MALE	25	2200100328	9415777334	14	A_
57	IRSHAD KHAN	MALE	20	2200103794	9918484501	15	A+
58	JAWED AKRAM	MALE	21	2200100243	7352280106	15	AB+
59	RISHABH KUMAR	MALE	23	2200101392	8114510034	14	B+
60	TALHA NIHAL	MALE	22	2102322153	9918057058	13	A+
61	SURAJ YADAV	MALE	20	2102300205	9625916798	13	0+
62	NEERAJ YADAV	MALE	24	2200100038	9129773635	16	AB+
63	RISHABH KUMAR	MALE	23	2200101392	9559665800	14	B+
64	ANOOP DIWEDI	MALE	25	220010040	8574243423	16	AB+
65	MOHAMMAD AMAN ALAM	MALE	22	2200103008	9415191383	15	AB+
66	IRFAN SHEIKH	MALE	19	2200103000	9569848109	15	AB+
67	ZAMEER AHMAD	MALE	18	2200103009	6393410931	13	O+

68	VISHAL SINGH	MALE	20	2200102988	7651878275	14	O+
69	M0HAMMAD SHAH FAHED	MALE	18	2200103032	7786825931	15	O+
70	MOHAMMAD FAISAL	MALE	20	2200103097	7705872428	14	O+
71	ABISHEK MANAV	MALE	22	2200102240	9616160005	15	B+
72	MOHAMMAD RIZWAN	MALE	23	2200102297	7985518333	13	O_
73	MOHAMMAD AZEEM	MALE	22	2200102994	7272878712	15	A+
74	MITHLESH KUMAR	MALE	19	2200102236	9765831852	15	B+
75	DHEERAJ SINGH	MALE	19	2200103047	7266047538	14	O+
76	MUBASSIR KHAN	MALE	19	2200102226	8081273438	13	A+
77	VISHAL UPADHYAY	MALE	18	2200102294	8795898651	13	B+
78	MOHAMMAD FAHAD	MALE	18	2200102250	8545908476	15	B+
79	SHASHANK KURIL	MALE	20	2200100438	7084873439	13	O+
80	MOHAMMAD ARISH BEG	MALE	21	2200100533	9336046773	17	A+
81	ANKUR SHARMAF	MALE	22	2200101431	8299349321	14	AB+
82	MOHD SHABAN	MALE	24	2200103565	8176808034	15	B-
83	MIRZA DANISH BEIG	MALE	21	2200101170	9118343686	15	B+
84	FAIZAN KHAN	MALE	23	2200100778	8874124346	14	B+
85	KSHITIZ SRIVASTAV	MALE	19	2200102976	8299605009	14	B+
86	DEEPAK	MALE	22	2200103052	8175070478	14	O+
87	ALI ABBAS	MALE	19	2200103281	7678852295	14	O+
88	MOHAMMAD SAIF	MALE	20	2200100820	9838139887	13	AB+
89	MD AMAN AHMAD	MALE	20	2200100160	6204495044	14	A+
90	FAIZ KHAN	MALE	21	2200100173	7808137561	15	A+
91	NOOR MOHD MIRZA	MALE	19	2202300229	9519993991	13	B+
92	PRARABDHA SACHAN	MALE	18	2202300140	8423215831	12	B+
93	AMAR ANEES	MALE	21	2202300097	8800174462	13	B+
94	BELAL IRSHAD KHAN	MALE	23	2202300181	9610060557	13	B+
95	ARSHAD ALAM	MALE	22	2202300180	9456606998	13	B+

96	SAAD JUNAID	MALE	19	2202300183	7505150609	13	A+
97	AYUSH SINGH	MALE	18	2202300224	7266080410	12	A+
98	ARMAN KUSHWAHA	MALE	19	2202300172	8467944032	16	B+
99	SHISHIR SRIVASTAV	MALE	25	2202300130	7309107140	15	B+
100	SAMIKSHA SINGH	FEMALE	19	2202300189	9793920300	11	B-
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