Genbinesia 1 (3): 133-137 (2022)
doi: https://doi.org/10.55655/genbinesia.v1i3.27
http://journal.genbinesia.or.id/

RESEARCH ARTICLE

GENBINESIA
Journal of Biology

Frequency of ABO blood system type alleles in students of UIN Sunan Ampel Surabaya

Radinal Kautsar[1], Siti Aisyah Bisri Putri[1], Nabillah Ayu Azzahara[1], Humayra Qurrata Aini[1,*], Brian Pramana Aprilio Pradiptaadi[1], Salsa Nabila[1], Robiatush Sholichah Arrohmah[1], Yuanita Rachmawati[1]

[1]*Department of Biology Graduate Program, UIN Sunan Ampel Surabaya, Surabaya, Indonesia*
[*]*Correspondence: humayraqurrata@gmail.com*

Received:
05 July 2022
Accepted:
20 July 2022
Published:
28 July 2022

Abstract

The commonly used human blood group system is the ABO system. Determination of blood group is important in blood transfusion activities. The purpose of this study was to determine the frequency of the ABO blood group system and the frequency of the ABO blood group allele in students of the Biology and Science Education study program at UIN Sunan Ampel Surabaya. Determination of blood group was carried out by the Slide Test method which was carried out randomly with a sample of 90 people. Determination of blood group is done by the principle of agglutination that occurs between antigens and antibodies. The results showed the frequency of blood group ABO system: A (20%); B (24%); AB (10%); O (46%). IA allele frequency (0.13); IB (0.07); IO (0.8). The proportion of the highest frequency of blood type is blood type O. These results indicate that the distribution of blood type O among students at UIN Sunan Ampel Surabaya is relatively the same as the results of other studies conducted in Indonesia.

Keywords: ABO, Allele frequency, Blood group

Introduction

Blood is a vital component that makes up the living things. Blood plays a role in the process of transporting substances to all parts of the body of living things. Blood is a complex fluid consisting of liquids and solids. The liquid part is in the form of blood plasma, while the solid part includes erythrocytes, leukocytes, and platelets[1]. Erythrocytes are the most dominant cells in the composition of blood. In one millilitre of blood contains about 4.5-6 million erythrocytes. This also forms red blood[2]. In general, blood often grouped into 4 groups or blood types A, B, AB, and O[3]. Blood type is a system of blood grouping based on the type of antigen contained in it. The ABO blood group system was first discovered in 1900 by Karl Landsteiner by mixing erythrocytes and the blood serum of his staff[4].

Blood type is considered essential in human life. This is because blood type is hereditary or inherited by parents[5]. In addition, blood type is very important to know for the benefit of donors, proper blood transfusion and identification in forensic medical cases such as identification in criminal cases[4]. ABO blood type is determined based on the presence or absence of antigens and antibodies in the blood[4]. ABO is a genetic marker that can be used in human population studies. In addition, this blood grouping system also plays a role in the mechanism of blood transfusion and incompatible mating. The ABO blood grouping system is determined by three different alleles (multiple alleles), namely I^A, I^B, and I^O. The frequency of blood types in the ABO blood grouping system varies throughout the world and is not found in equal numbers even in an ethnic group[6].

Determination of blood group ABO system is done to determine the type of blood group in humans being examined. Determination of blood type in this system is usually done using the Slide method. This method is based on the principle of the reaction between antigens (agglutinogens) on the surface of erythrocytes with agglutinins in serum/blood plasma that form clots or agglutinations. The slide method is often used because it is considered a simple method that is fast and easy to do for checking blood types[3]. Based on the foregoing, the researchers conducted a study related to the examination of ABO and Rhesus blood groups using serum antigens A, B, AB, and D.

Materials and methods

Study area

This research was conducted at the Integrated Laboratory of UIN Sunan Ampel Surabaya.

Procedures

The blood samples used came from the blood of students of UIN Sunan Ampel Surabaya. The ABO system blood group testing is carried out using the Slide test method with the principle of antigen reacting with antibodies that form agglutinogens (blood clots). The antigens used in this study were anti-A, anti-B, and anti-AB.

Data analysis

The parameters tested in this study included the calculation of the frequency of the ABO blood group system and the allele frequencies of I^A, I^B, and I^O. The calculation of the frequency of alleles in the ABO blood group system uses the following formula: $(p + q + r)^2 = 1$

Results

This study used blood samples from 90 students of UIN Sunan Ampel Surabaya. Determination of the sample was carried out randomly on students of the Biology and Science Education study program. The results of the number of blood groups obtained in this study showed on **Table 1**.

Table 1. Results of blood type.

Blood type	Amount	Percentage (%)
A	18	20
B	21	24
AB	10	10
O	41	48
Total	90	100

Resource: Authors, 2022

Blood type is something that is passed down from parents to their offspring[5]. This results in a combination of alleles resulting from mating in the ABO system. After obtaining the results of the ABO blood group system, allele frequencies were calculated based on the Hardy-Weinberg formula. The results of the calculation of the allele frequency are as follows on **Table 3**.

Table 2. Combination of ABO system marriage that produces blood type O and AB offspring.

Combination of Parents	Genotype	Phenotype	Phenotype percentage (%)
A × A	$I^AI^O \times I^AI^O$	O	25
A × O	$I^AI^O \times I^OI^O$	O	50
B × B	$I^BI^O \times I^BI^O$	O	25
B × O	$I^BI^O \times I^OI^O$	O	50
O × O	$I^OI^O \times I^OI^O$	O	100
A × B	$I^AI^O \times I^BI^O$	O	25
		AB	25
	$I^AI^A \times I^BI^B$	AB	100

Resource: Amania et al.[7].

Table 3. Results of allele frequency calculation.

Allele	Allele frequency
I^A	0.13
I^B	0.07
I^O	0.8
Total	1

Resource: Authors, 2022.

Discussion

The results of the examination of determining the blood group in all samples showed that the most common blood group was blood type O, while the blood group with the least was blood group AB. This is in line with the results of research conducted by Garini et al.[8], where the sample individuals with blood type AB are the least. Individuals with blood type AB have two antigens on their blood cells, namely A and B, so this blood type is very rare in the world.

The population and distribution of the ABO blood group varies greatly in the world. This is influenced by population size and race as well as variations in genetic characteristics and allele distribution[8]. According to Hikma et al.[6], blood type O is the most common in the world, although in some countries such as Norway and Sweden, blood type A is more dominant.

Individuals with blood type O can donate blood to people with any ABO blood type, so blood type O is called the universal blood group. This can happen because individuals with blood type O do not have antigens on their blood cells, but produce antibodies against antigens A and B. While blood type AB is a universal recipient blood group, where individuals with this blood type can receive donors from any ABO blood group. Considering individuals with blood type AB have A and B antigens on their blood cells and do not form antibodies against A or B antigens[9].

Based on **Table 2**, it is known that the largest proportion of allele frequencies is the IO allele. This is in line with the results of research conducted by Amania et al.[7], where the highest allele frequency is the I^O allele with a value of 0.68. The frequency of this allele may change, as the population increases at the time of a new school term. At the community population scale, changes in allele frequency are influenced by several factors, including population size, migration, mutation, selection, and non-random

mating[7,10].

Conclusions

Based on the results of the research that has been obtained, it can be concluded that the highest frequency of ABO system blood groups among students of the Biology and Science Education study program at UIN Sunan Ampel Surabaya is blood type O, while the blood group with the least amount is blood type AB. The highest allele frequency was I^O worth 0.8, while the lowest allele frequency was I^B worth 0.07.

Acknowledgments

The authors' highest gratitude goes to the Integrated Laboratory of UIN Sunan Ampel Surabaya, for providing sufficient tools, materials, and research location of this research.

Conflicts of Interest

There are not potential conflicts of interest.

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