

Research Article

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The Pattern of Distribution of ABO Blood Groups in Kaduna Metropolis, Nigeria

Victoria Moltong Yilwa

Department of Biological Sciences, Nigerian Defence Academy, P.M.B. 2109, Kaduna, NIGERIA

Email for Correspondence: vmvilwa@yahoo.com

ABSTRACT

The study was undertaken to assess the distribution of the ABO blood groups in Kaduna metropolis, Nigeria. Blood group types of forty-three thousand, nine hundred and nineteen (43,919) people were collected from eight different hospitals in Kaduna metropolis over a period of four years. These hospitals are easily accessible by all groups and classes of people because of their location. Phenotypic and allelic frequencies were determined to understand the distribution pattern of the ABO blood groups. A chi-square test was carried out to test whether the population was in Hardy-Weinberg equilibrium. The O blood group occurred with the highest frequency (44.13%), while the AB blood group had the lowest occurrence of 3.98%. Blood group A was more predominant (29.12%) than B blood group (22.77%). The O allele had the highest allelic frequency (0.67), while the A and B alleles were lower (0.19 and 0.14 respectively). The ABO blood group system was found to be in Hardy-Weinberg equilibrium.

Key words: ABO blood group, antigen, Hardy-Weinberg, allelic frequency, genotypic frequency, distribution, phenotypic frequency

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INTRODUCTION

The ABO blood groups were the first to be discovered in 1901 by the Austrian immunologist, Karl Landsteiner. The ABO blood groups are the most basic system of blood typing and the most important in assuring safe blood transfusion. The ABO system consists of three alleles: A, B, and O, in which the A and B alleles are co-dominant, but both are dominant over the O allele. The blood of humans is generally divided into four groups: A, B, AB, and O, based on the presence or absence of two distinct antigens (antigen A, including A1 and A2; and antigen B) present on the surface of the red blood cells. A blood group is classified "A" if it has the A antigen, "B" if it has a B antigen, and "AB" if it has both A and B antigens. If the blood has neither antigen A nor B, the blood is called "type O". An antigen is a substance foreign to the body that induces the immune system of the body to produce antibodies. An antibody is a substance capable of reacting specifically with particular antigens. For instance, blood that contains red cells with the "A" antigen has antibodies against type B cells. If therefore, blood type A is transfused with blood from group B, it can result in the destruction of the red cells by the antibodies in the "A" blood. Type O people do not produce ABO antibodies therefore their blood can safely be transfused into others with different ABO blood types. They are universal blood donors. The "AB" blood does not select against any ABO type because it does not make any antibodies.

People with "AB" blood can receive type A, B, AB or O blood, and they are universal receivers of transfusions. The frequency of the four ABO blood groups varies in populations throughout the world. Variation may even occur in different groups within a given country as ethnic groups intermarry.

No blood group is more advantageous than the other, so any differences that exist may be small and statistically insignificant. Type B blood is higher in Asia, with a maximum in Northern India, lower in Europe and Africa (Encyclopedia Britannica, 2009; Beckman, 2008) and lowest in Americas and Australia (O'Neil, 2012). There are

relatively high-frequency pockets in Africa. It is absent in most Australian Aborigines (Encyclopedia Britannica, 1997). Overall in the world, B is the rarest ABO blood allele (O'Neil, 2012).

Most populations have migrated and mixed. It is with this view in mind that the study was carried out. The information that will be obtained from this study would be useful in assessing and understanding relationships between populations.

MATERIALS AND METHODS

Data were obtained from eight different hospitals located in Kaduna metropolis over a period of four (4) years. These hospitals were: Ahmadu Bello University Teaching Hospital (ABUTH), New General Hospital, 44 Army Reference Hospital, St Gerald Hospital, City Clinic, Belmont Hospital, Lafiya Specialist Hospital, and Alheri Specialist Hospital. The data were analyzed statistically to determine phenotypic and allelic frequencies, and also to test whether the populations are in Hardy-Weinberg equilibrium.

RESULTS

The results obtained are shown in Table 1. The data collected from the various hospitals were pooled and used as a single population. The frequencies of the four main phenotypes O, A, B, and AB, are presented in Table 2. Blood group O has the highest occurrence with a value of 44.13%, blood groups A and B have relatively high percentages, with blood group A having a higher value (29.12%) than blood group B (22.77%). Blood group AB has the lowest with a value of 3.98%.

Table 1: The Various Blood Group Phenotypes Obtained from Eight Different Hospitals Located in Kaduna Metropolis

S. no	Hospital	O	A	B	AB	Total
1.	ABUTH	3745	1716	1570	359	7390
2.	New General Hospital	2721	2533	2216	233	7703
3.	44 Army Reference Hospital	1694	1283	878	208	4063
4.	St. Gerald Hospital	1341	563	526	72	2502
5.	City Clinic	2024	1404	878	175	4481
6.	Belmont Hospital	2770	1412	1034	350	5566
7.	Lafiya Specialist Hospital	2926	2220	1566	238	6950
8.	Alheri Specialist Hospital	2162	1659	1331	112	5264
9.	Total	19383	12790	9999	1747	43919

Table 2: Phenotypic Frequencies of the ABO Blood Groups in Kaduna Metropolis

Blood Group	Number of Individuals	Frequency (%)
O	19383	44.13
A	12790	29.12
B	9999	22.77
AB	1747	03.98
Total	43919	100.00

Results of the allelic frequency calculations given in Table 3 show that the O allele has the highest value (0.67), while the A and B alleles were lower (0.19 and 0.14 respectively). The result of the test of goodness-of-fit of the ABO blood groups to the Hardy-Weinberg equilibrium showed that there was no significant difference ($X^2 = 1.462$; Table 4), indicating that the population is in Hardy-Weinberg equilibrium.

Table 3: Allelic Frequencies of the A, B, and O alleles Among Human Populations in Kaduna

Allele	Frequency
O	0.67
A	0.19
B	0.14
Total	1.00

Table 4: Test of Goodness-of-fit to the Hardy-Weinberg Equilibrium for ABO Blood Types of Human Populations of Kaduna

	O	A	B	AB	Total
Observed numbers (O)	19383	12790	9999	1747	43919
Expected proportions	0.44	0.29	0.23	0.04	1.00
Expected numbers (E)	19324.36	12736.15	10101.37	1756.76	43919
$X^2 = (O - E)^2 / E$	0.166	0.225	1.037	0.034	1.462ns

ns = not significant at 0.05 probability level

DISCUSSION

Various distribution patterns of the ABO blood group exist in different populations of the world. In some populations, such as the early Europeans races, the A blood group is more predominant, the Asiatic races are characterized by high frequencies of A and B (Beckman, 2008), while in most populations the O blood group is common. From the results obtained during this study, the O blood group is the most common, while the AB blood group is the least occurring. This finding agrees with reports of other authors such as *Odokuma, et al. (2007)*, *Pughikumo et al. (2014)*, *Musa et al. (2015)*, *Anifowoshe, et al. (2016)*, and *Zerihun and Bekele (2016)*, they also reported a higher percentage of O blood group, lower A and B blood groups, and few AB blood group. Encyclopedia (2009) reported that *Blood group O is the most common blood type throughout the world.*

The high frequency of the O allele could be because O blood group has the advantage of being able to donate to the other group types (universal donor). The very low frequencies of the A and B alleles could also be due to the fact that the AB blood group cannot donate blood for transfusion to the other groups other than its type.

The population studied is in Hardy-Weinberg proportions for the ABO gene locus, suggesting that the allelic frequencies of the ABO blood groups will not change from generation to generation as long as there is random mating.

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Author's Biography:

Dr Victoria M. Yilwa is a Lecturer and Researcher with the Department of Biological Sciences, Nigerian Defence Academy, Kaduna. She Has a Ph.D. in Genetics and Plant Breeding from the University of Jos, Nigeria. She has published several articles in Genetics, Plant Breeding and Biological Sciences.

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