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Research Article

PHENOTYPIC AND ALLELIC DISTRIBUTION OF ABO AND Rh-D BLOOD GROUPS IN BLOOD TRANSFUSION CENTER OF AVICENNA MILITARY HOSPITAL, MARRAKECH, MOROCCO

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ABSTRACT

Introduction: the purpose of our work was to present new national statistical of phenotypic and genotypic prevalence of ABO and Rhesus (D) blood groups using a new sample.

Materials and Methods: This study was carried out in the department of blood transfusion center of the Avicenna Military hospital Marrakech on a sample of 8077 young recruits between 1/1/2015and 12/31/2015. This is a military population from different Moroccan region, composed by 98% of men and 2% of women, whose ages range between 18 and 21 years. Results: The blood group "O" was found in approximately half of the samples (49,01%), the rate of group A (31.47%) was two times higher than that of group B (15.15%), group AB was the least frequent (4.35%).

We note a clear predominance of the Rh positive subjects (89.86%) compared to the Rh negative subjects (10.13%) in our Moroccan population. Regarding the frequency of the genotypes of our population we have the following results: O allele was the most common, its prevalence was 89.82%, the A allele was in second position with a frequency of 19, 90 %, allele B was the least frequent (10, 28%). The allele D (RH1) (68.17%) was dominant over the d (RH-1) allele (31.82%).Discussion and conclusion: Our results are compared to previous similar studies carried out in Morocco and in other countries. These results are identical to those found in Mediterranean countries and shows that Morocco is in an intermediate situation between the countries of Europe and those of Sub-Saharan Africa.

KEYWORDS: ABO blood group, Rhesus blood group

INTRODUCTION

Erythrocyte blood group can be defined as the set of allotypic variations genetically transmitted, detected by specific antibodies on red cell surface. The ABO blood group system was first discovered in 1900 by Karl Landsteine. Other antigens will be discovered subsequently and classified on systems. Monitoring of hemolytic disease of the newborn enabled Levine and

Stetson to discover the Rh system in 1939. The majority of these antigens are inherited by Mendelian way[1] [2].

The study of these systems, in transfusion requirements, demonstrated the existence of genetic variation among human populations. The distribution of alleles system in the world has been widely studied; it is often associated with changes in genetic structure of human populations and natural selection.

The objective of our work is to present new national statistics of phenotypic and genotypic prevalence of ABO and Rhesus system (D) using a new sample from the Moroccan population.

Our results are compared with those of previous Moroccan studies and those of foreign countries.

MATERIALS AND METHODS

This study was conducted in blood Transfusion center of the Avicenna Military Hospital Marrakech Morocco; on a sample of 8077 young recruits drawn during 2015.This is a military population from different regions of Morocco formed of 98% of men and 2% of women, whose ages are between 18 and 21 years.

Samples were collected on EDTA (ethylenediaminetetracetic acid) vacuum tube, stored at 4°C and tested at the latest within 24 hours after collection. The ABO-blood group typing was performed according to an agglutination technique using the two complementary tests: Beth Vincent globular test and serum test of Simonin. A first manipulator performed both tests on Biorad gel card Figure 5; in parallel a second manipulator performs characterization by the method of Beth Vincent on opaline plate with another series of test sera. The reagents used were from monoclonal origin: Anti-A, Anti-B and anti-AB Figure 6 The standard Rh typing was performed at the laboratory temperature (22 ° C) on plate, positive and negative control (red cells known D + and D-) were tested simultaneously with the red blood cells of each sample. The reagents used (anti - D) were IgM monoclonal origin: Anti -D

The allele frequencies were calculated using two statistical methods: Bernstein's formula for the ABO system and the Landsteiner and Wiener method for Rh [3]:

The Bernstein's formula:

p: the frequency of gene A

q: the frequency of gene B

r: the frequency of gene O

$p = 1 - (O + B)^{1/2}$ B = the frequency of phenotype B

$q = 1 - (O + A)^{1/2}$ A= frequency of phenotype A

$r = O^{1/2}$ O = the frequency of phenotype O

The Landsteiner and Wiener method:

$d = (Rh)^{1/2}$

$D = 1 - (Rh)^{1/2}$

d = frequency of the allele corresponding to Rh negative

D = frequency of allele corresponding to Rh positive

Rh = the frequency of Rh-negative phenotype

RESULTS

A - Phenotypic Frequencies

1. ABO system Table 1, Figure 1

We found that groups of ABO system were predominant in the following descending order: group O, group A, group B and group AB.

Group O represented about half of the people phenotyped (49.01%);

The rate of Group A (31.47 %) is twice higher than that of group B (15.15%); AB Group was the least frequent (4.35%).

2. Antigens D Figure 2

We found a predominance of Rh positive (89.86%) compared to Rh negative (10.13%) in our Moroccan population.

B - Genotypic frequencies

1. ABO system Figure 3

The O allele was the most frequent (69.82%) followed by the A allele (19.9%); the B allele was the least frequent (10.28%).

2. D gene Figure 4

D gene was predominant; its frequency was 68.17%.

Table 1: Frequency ABOD phenotypes and genotypes ABOD in the population study

Phenotype	Number	Number of samples tested	Prevalence phenotype	Prevalence genotypique
O	3959	8077	0,4901	0,6982
A	2542	8077	0,3147	0,199
B	1224	8077	0,1515	0,1028
AB	352	8077	0,0435	
D (RH1)	7258	8077	0,8986	0,6817
d (RH-1)	819	8077	0,1013	0,3182

Figure 1: Frequency of ABO phenotypes in the population studied

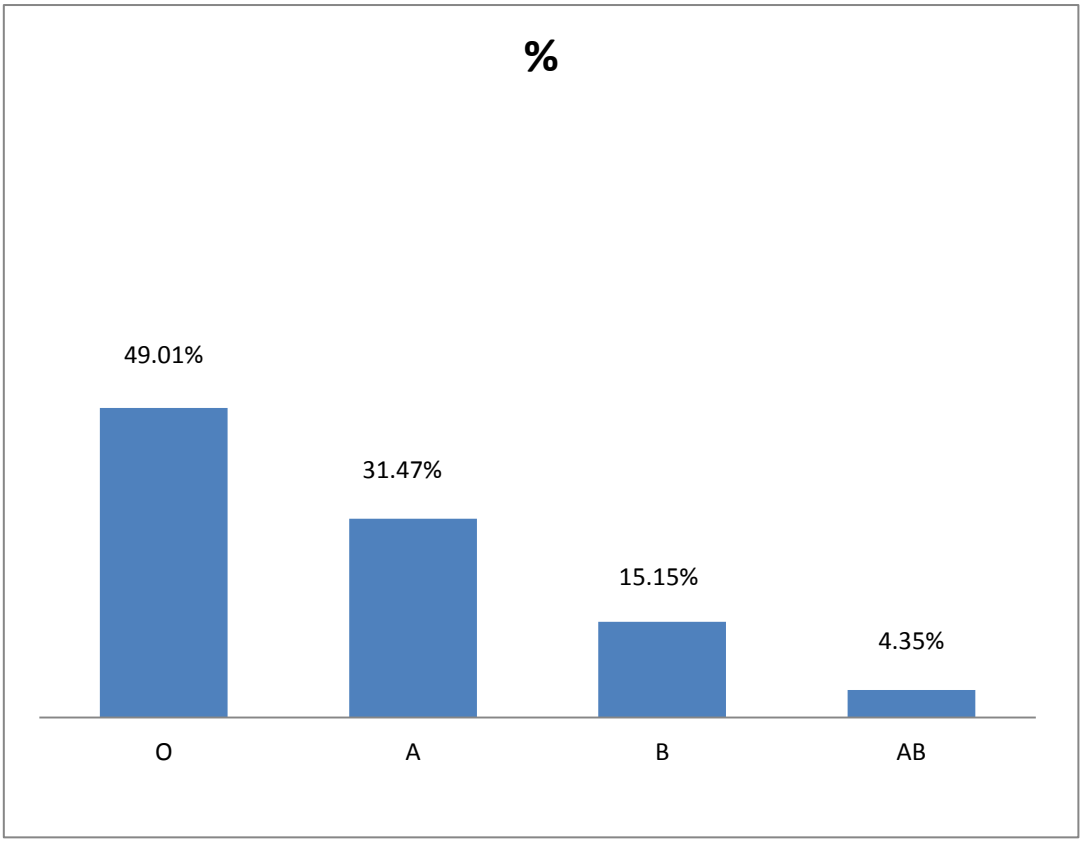

Figure 2: Frequency of D phenotypes in the population studied

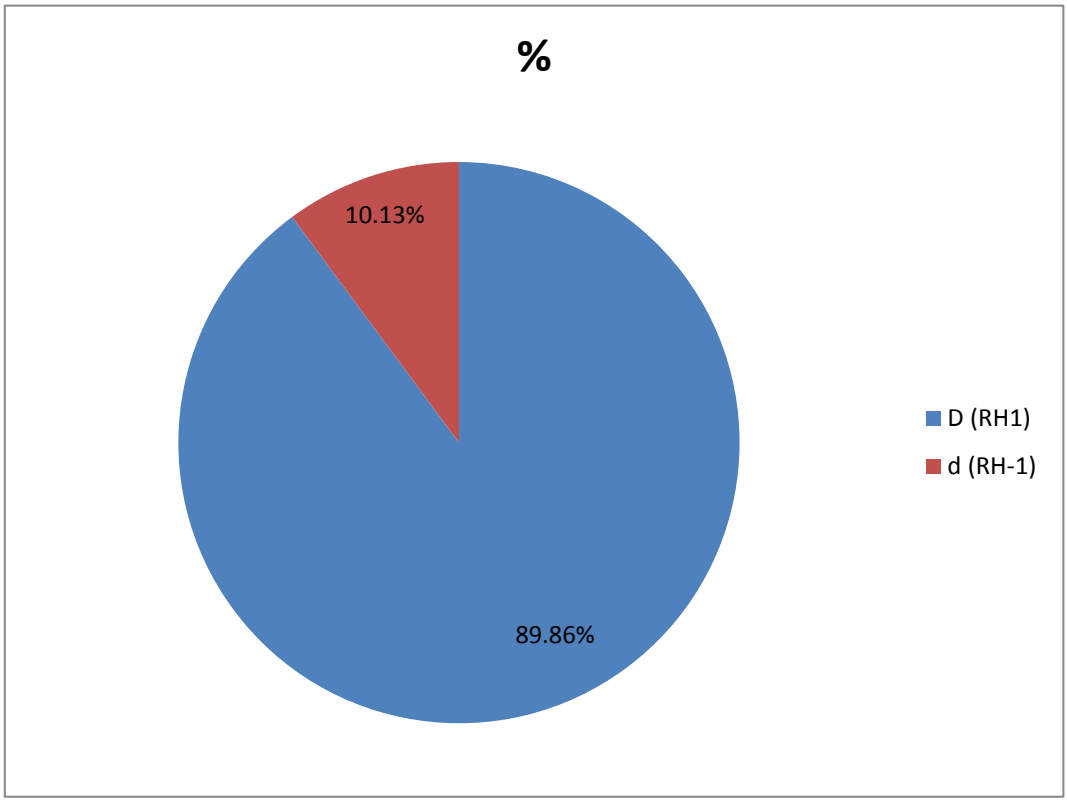

Figure 3: Frequency of ABO genotypes in the population studied

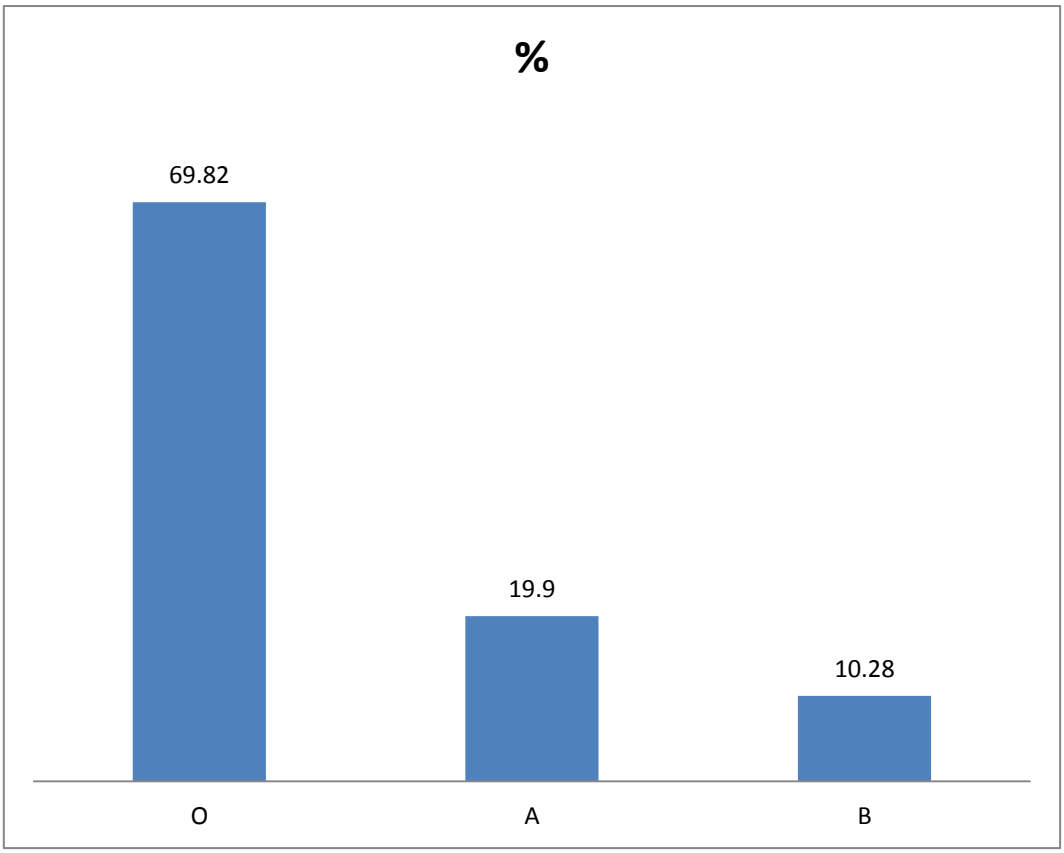

Figure 4: Frequency of genotypes "D" and "d" in the population studied

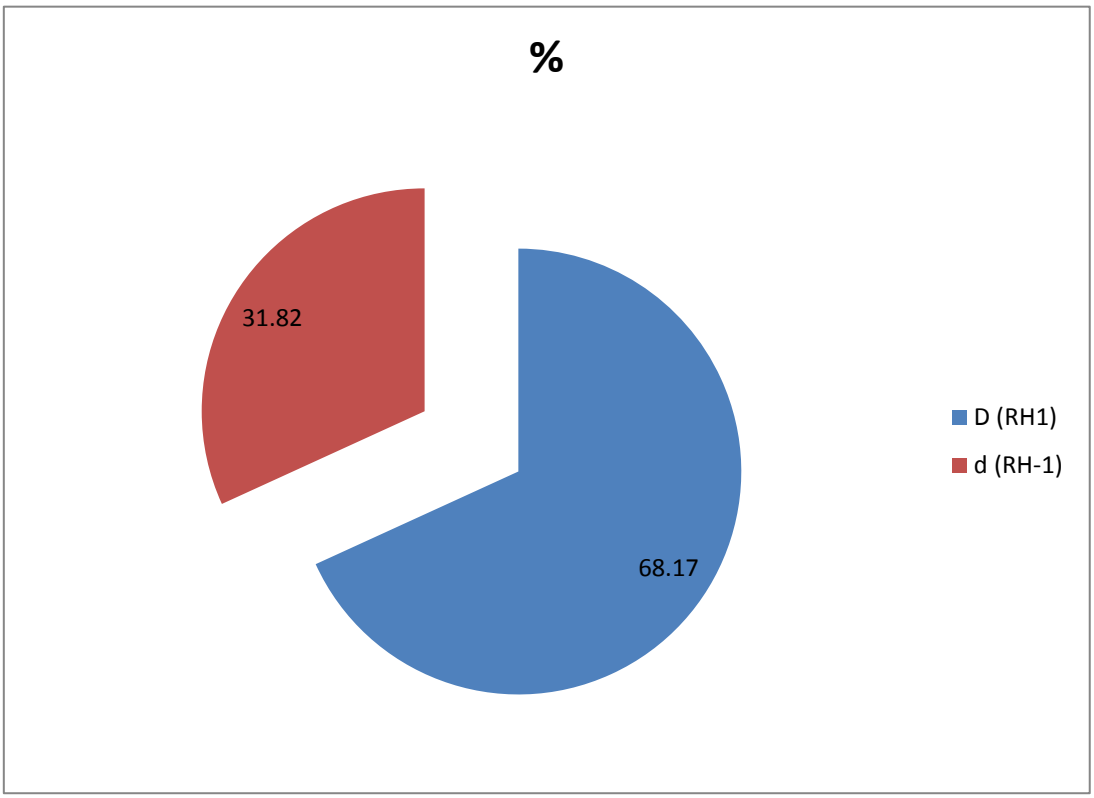

Figure 5: BioRad Gel Card

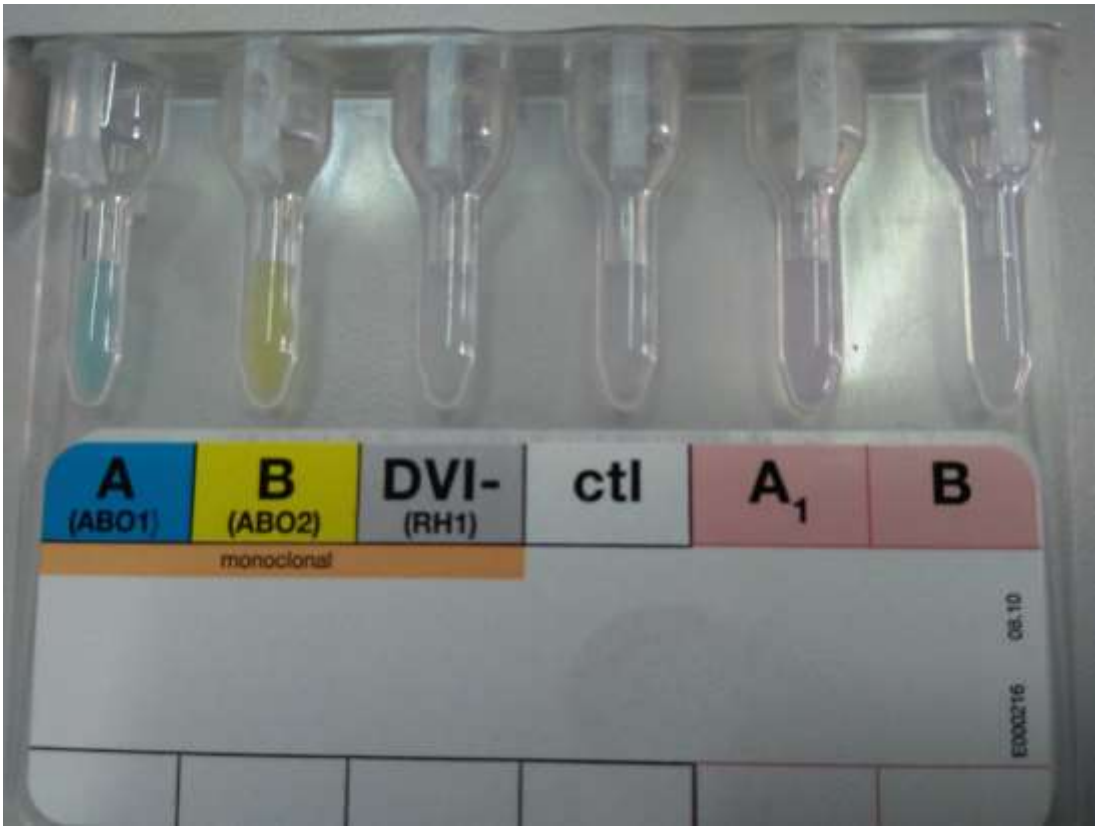

Figure 6: Commercial monoclonal blood grouping antisera

Table 2: Frequency of ABO phenotypes in different studies

	A%	B%	O%	AB%
Britain [5]	42	8	47	3
USA [6]	41	9	46	4
Nigeria [7]	21,6	21,4	54,2	2,8
Ethiopia [8]	28,11	23,35	43,08	5,44
Guinea [9]	22,5	23,7	48,9	4,7
SaudiArabia [10]	24	17	52	4
Pakistan [11]	22,4	32,4	30,5	8,4
Nepal [12]	34	29	32,5	4
India [1]	28,38	31,89	30,99	8,72

Southern Italy [3]	33,65	15,27	49,97	4
Tunisia [13]	30,94	17,83	46,18	5
Our study	31,47	15,15	49,01	4,35
Morocco 2004 [3]	33,89	15,68	46,05	4,33
Morocco 2002 [14]	31,67	15,64	47,41	5,35

Table 3: D Antigen phenotypes frequencies in different studies

Population	Rh+(D)%	Rh-(d)%
Britain [5]	83	13
USA [6]	85	15
Nigeria [7]	95,2	4,8
Ethiopia [8]	92,06	7,94
Guinia [9]	95,9	4,1
Saudi Arabia [10]	93	7
Pakistan [11]	93	7
Nepal [12]	96,7	3,3
India [1]	95,36	4,64
Southern Italy [3]	69,38	30,62
Tunisia [13]	90,81	9,14
Algeria [15]	91,53	8,47

Our Study	89,86	10,13
Morocco 2002 [3]	91	9

Table 4: Genotypic frequencies of ABO system in different studies

Population	A	B	O
Morocco 2004 [14]	0,2141	0,1053	0,6777
Morocco 2002 [3]	0,205	0,11	0,688
Our study	0,199	0,1028	0,6982
Algeria [3]	0,2093	0,123	0,6677
Tunisia[13]	0,192	0,122	0,686
Nigeria [7]	0,149	0,1443	0,7068
Germany [16]	0,279	0,081	0,64

DISCUSSION

Red cells contain several membrane antigens, genetically determined, and defining the erythrocyte blood groups. We know twenty antigen systems that characterize many groups simultaneously present in the same individual. The most important for transfusion are the ABO and Rh blood group systems [4].

ABO System

The ABO system is defined by the presence on the surface of red blood cells either an antigen A (group A) or B antigen (group B) or both antigens (group AB), or neither of them (group O), which classifies all human blood in one of four groups A, B, AB, O.

The serum of a subject contains the natural iso-antibodies (anti-A or anti-B) corresponding to the antigen absent on its erythrocytes; when the red cell carries the two antigens, the serum does not contain any iso-antibodies. It contains both anti-A and anti-B if the red cell contains none of the two antigens.The blood grouping is done by two methods: the Beth Vincent method that searches antigens on red blood cells by using anti-A test serum, anti-B and anti-AB; and the Simonin method that searches antibody in serum using erythrocytestest (A, B, AB, O). The concordance of results obtained with both methods is necessary to affirm the group A, B, O [4].

Rh System

The Rhesus system is a complex system with multiple antigens. On the red cells of subjects called Rh (+) is found an antigen D or RH1, which is absent in Rh (-) individuals. On red blood cells are also found: C antigen (Rh 2), or c antigen (Rh 4); E antigen (Rh3) or e antigen (Rh5). These antigens are transmitted genetically as haplotypes blocks. The three haplotypes most common are DCe , DCE

and dce [4]. It is sufficient generally, for the needs of the clinic, to distinguish Rh (+) and Rh (-).

However, it is preferable to determine the full Rhesus phenotype. The determination of the Rhesus group is currently performed using monoclonal anti-sera.

A- Phenotypic Frequencies

1. ABO system Table 2

Our results, indicated a national rate of groups A, B, AB and O, confirming the frequencies found in previous studies [3] [14].

These frequencies were comparable to that of the Mediterranean countries (Tunisia and southern Italy) [3; 13].The prevalence of ABO phenotypes among Moroccans was intermediate between that of Sub-Saharan Africa and that of Europe [3] [7] [8] [9].

2. D Antigens Table 3

For the Moroccans, the D antigen was predominant compared to the d phenotype. According to the Table III, the frequency of D phenotype, was comparable to that of the Maghreb countries (Algeria and Tunisia), similar to that of Sub-Saharan Africa and significantly increased compared to the Mediterranean countries and the countries of Western Europe.In the countries of Asia, the prevalence of D antigen was higher compared to that of Morocco. Concerning the D antigen, Moroccans are closer to the black than the white race.

B – Genotypic frequencies

69 % of Moroccans had an O allele, 20% had the A allele and 11% had B allele. As shown in Table 4, Morocco like all the populations studied, showed O group allelic frequency significantly higher compared to A and B alleles. The prevalence of A allele increased from south to north. The prevalence of the B allele was distributed inversely and increased from north to south.The prevalence of group A and B in Morocco and in the Arab Maghreb countries were intermediate between Sub-Saharan Africa(South) and Western Europe (North).The O allele had a higher prevalence in Morocco, Tunisia, Algeria and Sub-Saharan Africa compared to that found in Europe.

CONCLUSION

We determined the phenotypic and genotypic frequencies in the ABO and RH (D) systems in Moroccan population. Our results were compared to that of other Moroccan and foreign previous studies.

These results were similar to those found in Mediterranean countries and showed that Morocco is in an intermediate situation between the European countries and those of Sub-Saharan Africa. These results imply the character mainly Caucasoid of the Moroccan population associated with a considerable Negroid character, demonstrated by the frequency of the B allele and D allele.

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