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## RESEARCH ARTICLE

### PREVALENCE OF PRINCIPAL ABO AND RHESUS BLOOD GROUP SYSTEMS OVER THE ENTIRE LEBANESE POPULATION

<sup>1</sup>Mahdi Tarhini, <sup>2</sup>Hussein Fayyad-Kazan, <sup>2</sup>Rawya Hijazi, <sup>2</sup>Adel Raei, <sup>4</sup>Mahmoud Youness, <sup>2</sup>Mohamad Ezzedine, <sup>2</sup>Bassam Badran and <sup>2,\*</sup>Ghada Kchour

<sup>1</sup>Faculty of Public Health V, Lebanese University, and Director of Laboratory and Blood Bank  
Department of Raei Hospital, Saida, Lebanon

<sup>2</sup>Laboratory of Cancer Biology and Molecular Immunology, Faculty of Sciences I,  
Lebanese University, Hadath, Beirut, Lebanon

<sup>3</sup>Raei Hospital, General Director

<sup>4</sup> Al Rassoul Al Aazam Hospital, Medical Research Director

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#### ABSTRACT

**Objectives:** ABO and Rhesus (Rh) blood group systems are the most clinically significant among the list of different identified blood groups. Prevalence of ABO and Rh blood groups over the entire Lebanese population was determined. **Design and Methods:** 103967 blood samples were typed for both ABO and Rh (antigen D) blood group antigens. **Results:** Upon considering the ABO but not RhD antigen, we identified the blood group O to be the most frequent (38%) and AB to be the least common (4%). Upon considering both ABO and RhD antigen, A RhD<sup>+</sup> blood group was the most frequent (34%) whilst AB Rh<sup>-</sup> was the least common (0.4%). RhD<sup>+</sup> blood groups were in the following order: A (33.86%)>O (33.09%)>B (17.79%)>AB (3.64%), while RhD<sup>-</sup> ones were: O (5.36%)>A (4.02%)>B (1.81%)>AB (0.43%). **Conclusions:** Overall, our data determines the prevalence of ABO and RhD blood groups over the entire Lebanese population which is indispensable for blood banks and transfusion policies.

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## INTRODUCTION

Blood, composed of plasma, red blood cells (RBCs), white blood cells (WBCs) and platelets, is an important body fluid being essential for survival. Human RBCs are characterized by a series of surface glycoproteins and glycolipids, corresponding to blood group antigens. Till date, about 700 RBCs antigens have been characterized and were classified, by the International Society of Blood Transfusion, into 30 blood group systems among which ABO and Rhesus (Rh) are clinically most important [Daniels et al., 2009]. The ABO blood group system, initially recognized by Landsteiner in 1900, served the foundation of blood banking and transfusion medicine and is of great importance in the field of organ transplantation [Garratty et al., 2000]. According to the ABO blood group system, individuals are characterized by one out of four major blood groups, A, B, AB and O, depending on the presence of A and/ or B surface antigens on their RBCs as well as the presence of anti-A and/ or anti-B antibodies in their sera.

**\*Corresponding author: Ghada Kchour,**

Laboratory of Cancer Biology and Molecular Immunology, Faculty of Sciences I, Lebanese University, Hadath, Beirut, Lebanon.

Individuals with blood group A has type A antigens but anti-B antibodies whereas individuals of blood group B express type B antigens but anti-A antibodies. Individuals with blood group AB has both type A and B antigens but neither anti-A nor anti-B antibodies. However, individuals with type O blood has neither type A nor type B antigens but both anti-A and anti-B antibodies. In case of incompatible blood transfusion, these antibodies can lead to fatal intravascular hemolytic reactions [Dean, 2005]. Later, in 1941, the Rh blood group system was defined [Garratty et al., 2000]. Among the different characterized Rh antigens, D antigen is the most clinically significant. Individuals are positive if they express RhD antigen on the surface of their RBCs and are RhD negative if this antigen is absent. Importantly, The immune system of RhD negative individuals can make anti-RhD antibodies following exposure to RhD antigen during blood transfusion or pregnancy, thus leading to detrimental hemolytic reactions [Dean et al., 1998; Lo et al., 1998]. The frequencies of ABO and RhD blood group systems vary between different races, communities, populations and regions [Bakare, 2006]. Determining the availability of different blood groups at local and regional levels would be highly beneficial for blood bank management and ensuring efficient blood transfusion services.

In this study, we aimed at providing information about the prevalence of ABO and RhD blood group systems over Lebanese population.

## MATERIALS AND METHODS

As an aim to include the whole Lebanese population, the following study was performed in the medical Laboratories of four different hospitals located in different Lebanese governorates: Bekaa, Nabateyeh, South, and Beirut. ABO and RhD blood typing was carried out for 103967 ethylene diamine tetra acetic acid (EDTA) collected blood samples after getting the consent to carry out this study. Blood samples were typed by the Test Tube method where 1 drop of 5% isotonic saline suspended RBCs was added to Anti A as well as Anti-B present in a clean, labeled test tubes. Routine testing for determining the ABO blood group system included not only testing the red cells with Anti-A and Anti-B (Cell or Forward Type) but also the serum with pooled A and B red cells (Serum or Reverse Type). Concerning Rhesus D antigen (RhD), Anti-D reagent was used to determine whether the blood sample is Rhesus positive or negative. The data was collected and the frequency of each particular blood group was calculated by totaling the number of Rhesus + or - blood groups divided by the total number of blood samples screened and the results were presented as percentages.

**Statistical analysis:** Statistical analyses were performed using SPSS version 20 for Windows (SPSS, Chicago, IL, USA). Population characteristics were compared using Chi-square test. P value <0.05 was considered significant.

## RESULTS

In the governorate of Beirut, a total of 52920 blood samples were tested for ABO grouping and RhD typing (Table 1). Blood group O was the most common in this population and showed a frequency of 39.76% (32.46% RhD positive and 7.29% RhD negative). The Blood group A was slightly less common and showed a frequency of 37.46% (32.76 % RhD positive and 4.69% RhD negative) followed by blood group B showing a frequency of 16.28% (14.5% RhD positive and 1.8% RhD negative) and finally blood group AB characterized by a frequency of 6.5% (5.8% RhD positive and 0.7% RhD negative) (Table 1). In the southern governorate, ABO and RhD blood grouping of 31692 donor samples was done. Blood group A showing a frequency of 38.13% (34.60 % RhD positive and 3.52 % RhD negative) and blood group O exhibiting a frequency of 37.01% (33.50 % RhD positive and 3.50 % RhD negative) were most frequent in this population (Table 2). On the other hand, blood group B [24.36% (22.28 % RhD positive and 2.1 % RhD negative)] and blood group AB [0.50 % (0.47 % RhD positive and 0.03 % RhD negative)] were less common (Table 2). In the Nabateyeh governorate, 10083 blood samples were typed for both ABO and RhD blood groups. Blood groups O and A were again most common, with blood group O showing a frequency of 36.73 % (32.72 % RhD positive and 4.01 % RhD negative) and blood group A exhibiting a frequency of 36.41 % (32.90 % RhD positive and 3.51 % RhD negative) (Table 3). Blood group B [21.03 % (19.12 % RhD positive and 1.92 % RhD negative)] and blood group AB [5.82 % (5.25 % RhD positive and 0.57 % RhD negative)] were less frequent in this governorate (Table 3).

Finally, blood grouping for 9272 donor samples, issued from the Bekaa governorate, was carried out (Table 4). Blood group A showing a frequency of 40.98 % (38.61 % RhD positive and 2.37 % RhD negative) was the most frequent in this governorate (Table 4). Blood group O was less common and showed a frequency of 37.76 % (35.6 % RhD positive and 2.17 % RhD negative) followed by blood group B exhibiting a frequency of 20.72 % (19.84 % RhD positive and 0.87 % RhD negative) and finally blood group AB characterized by a frequency of 0.54 % (0.43 % RhD positive and 0.11 % RhD negative) (Table 4). In order to get information about the total percentages of the different blood groups in the Lebanese population, we summed up the total percentages, of each blood group, obtained from each of the 4 different governorates (Tables 5, 6). In fact, the huge number of patients included in this study could enable the obtained results to be generalized over the entire Lebanese population. In total, our results identified the A RhD<sup>+</sup> (33.86%) blood group to be the most frequent among the Lebanese population whilst the AB RhD<sup>-</sup> blood group appeared to be the least common in Lebanon (0.43%). It is noteworthy that there is a highly significant relationship between the ABO blood group system and the region as revealed by pearson Chi square test (2873.6; Cramer's V= 0.096; p value less than 0.0001). Moreover, there is a highly significant relationship between blood group (D/Rh) and the region as revealed by pearson Chi square test (975.13; Cramer's V= 0.097; p value less than 0.0001).

## DISCUSSION

ABO and RhD blood groups represent an important multipurpose system that is highly useful in population genetic studies, in solving forensic issues especially those related to paternity/maternity determination and in predicting the possibility of hemolytic diseases in newborns. Interestingly, a series of reports are also associating specific blood groups with certain diseases [6–10]. Further, these blood group systems are well known for their significance in blood transfusion and during transplantation procedures. Extensive research was, therefore, invested on characterizing the prevalence of these blood groups all over the world where their frequencies appeared to vary between different ethnic groups, populations and regions. Since no such study has yet been carried out in Lebanon, the aim of this work was to characterize the distribution of ABO and RhD blood group systems over the Lebanese population. In fact, 103967 blood donor samples, derived from 4 different Lebanese governorates: Bekaa, Nabateyeh, South, and Beirut were included in this study. A major output of our work, is the determination, for the first time, the frequencies of the ABO and RhD blood group systems over the populations of each of the indicated governorates and consequently over the Lebanese population. The blood groups A RhD<sup>+</sup> and O RhD<sup>+</sup> appeared to be always the most frequent ones in the 4 tested governorates, thus they are the most common among the Lebanese population with A RhD<sup>+</sup> blood group (33.86 %) being slightly more frequent than O RhD<sup>+</sup> (33.09 %). Remarkably, and despite that, our results showed that, among the Lebanese population, O RhD<sup>-</sup> blood group (5.36 %) was somewhat more common than A RhD<sup>-</sup> (4.02 %) blood group. This data is of special interest due to the wide demand for O RhD<sup>-</sup> blood group which serves as the universal donor in urgent cases of blood transfusions. Of great importance, AB RhD<sup>-</sup> blood group was the least available blood type in all of the tested governorates and thus in Lebanon (0.43%).

**Table 1. Distribution of ABO and RhD blood groups among 52920 donor samples within governorate of Beirut**

Blood Type	Number of donors	Percentage (%)	Overall Percentage of RhD <sup>+</sup> and RhD <sup>-</sup> for each blood type
A RhD <sup>+</sup>	17341	32.76	37.46
A RhD <sup>-</sup>	2484	4.69	
O RhD <sup>+</sup>	17182	32.46	39.76
O RhD <sup>-</sup>	3859	7.29	
B RhD <sup>+</sup>	7666	14.5	16.28
B RhD <sup>-</sup>	952	1.8	
AB RhD <sup>+</sup>	3066	5.8	6.5
AB RhD <sup>-</sup>	370	0.7	

**Table 2. Distribution of ABO and RhD blood groups among 31692 donor samples within governorate of South**

Blood Type	Number of donors	Percentage (%)	Overall Percentage of RhD <sup>+</sup> and RhD <sup>-</sup> for each blood type
A RhD <sup>+</sup>	10966	34.60	
A RhD <sup>-</sup>	1118	3.52	38.13
O RhD <sup>+</sup>	10618	33.50	37.01
O RhD <sup>-</sup>	1110	3.50	
B RhD <sup>+</sup>	7064	22.28	24.36
B RhD <sup>-</sup>	656	2.1	
AB RhD <sup>+</sup>	150	0.47	0.50
AB RhD <sup>-</sup>	10	0.03	

**Table 3: Distribution of ABO and RhD blood groups among 10083 donor samples within governorate of Nabateyeh**

Blood Type	Number of donors	Percentage (%)	Overall Percentage of RhD <sup>+</sup> and RhD <sup>-</sup> for each blood type
A RhD <sup>+</sup>	3317	32.90	36.40
A RhD <sup>-</sup>	354	3.51	
O RhD <sup>+</sup>	3299	32.72	36.73
O RhD <sup>-</sup>	405	4.01	
B RhD <sup>+</sup>	1928	19.12	21.03
B RhD <sup>-</sup>	193	1.92	
AB RhD <sup>+</sup>	530	5.25	5.82
AB RhD <sup>-</sup>	57	0.57	

**Table 4. Distribution of ABO and RhD blood groups among 9272 donor samples within governorate of AL- BEKAA**

Blood Type	Number of donors	Percentage (%)	Overall Percentage of RhD <sup>+</sup> and RhD <sup>-</sup> for each blood type
A RhD <sup>+</sup>	3580	38.61	40.98
A RhD <sup>-</sup>	220	2.37	
O RhD <sup>+</sup>	3300	35.6	37.76
O RhD <sup>-</sup>	201	2.17	
B RhD <sup>+</sup>	1840	19.84	20.72
B RhD <sup>-</sup>	81	0.87	
AB RhD <sup>+</sup>	40	0.43	0.54
AB RhD <sup>-</sup>	10	0.11	

**Table 5: The Overall Statistical data for each blood group in the 4 Lebanese Governorates out of 103967 tested donor samples**

Blood Group	Nabateyeh	Beirut	South	Bekaa	Total Numbers of donors for each blood group	Total percentages (%) of each blood group
A RhD <sup>+</sup>	3317	17341	10966	3580	35204	33.86
A RhD <sup>-</sup>	354	2484	1118	220	4176	4.02
O RhD <sup>+</sup>	3299	17182	10618	3300	34399	33.09
O RhD <sup>-</sup>	405	3859	1110	201	5575	5.36
B RhD <sup>+</sup>	1928	7666	7064	1840	18498	17.79
B RhD <sup>-</sup>	193	952	656	81	1882	1.81
AB RhD <sup>+</sup>	530	3066	150	40	3786	3.64
AB RhD <sup>-</sup>	57	370	10	10	447	0.43

**Table 6. The overall Statistical data of both RhD + and - for each blood group in the 4 Governorates**

Blood Group	Nabateyeh	Beirut	South	Bekaa	Total number of donors of both RhD <sup>+</sup> and RhD <sup>-</sup> for each blood group	Total percentages of donors of both RhD <sup>+</sup> and RhD <sup>-</sup> for each blood group
A	3671	19825	12084	3800	39380	37.89
O	3704	21041	11728	3501	39974	38.44
B	2121	8618	7720	1921	20380	19.60
AB	587	3436	160	50	4233	4.07

This extremely low availability of AB RhD<sup>-</sup> blood group is highly critical and our data should alarm the unprepared Lebanese blood banks and hospitals for stocking enough AB RhD<sup>-</sup> blood units otherwise serious problems will be faced in case of requesting such blood units for urgent blood transfusions. B RhD<sup>-</sup> blood group also showed low availability (1.81 %) among the Lebanese population and thus precautions should be taken. In total, using these data, the Lebanese ministry of health can emphasize on making much more organized blood transfusions at the level of the different governorates.

Rh:	Rhesus
EDTA :	Ethylene Diamine Tetra Acetic acid
RBCs:	Red Blood Cells
RhD:	Rhesus D antigen

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