DISTRIBUTION OF ABO AND RHESUS BLOOD GROUP PHENOTYPES AMONG BLOOD DONORS AT AL- QAEEM HOSPITAL IN THE WEST OF IRAQ

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Abstract

International Society of Blood Transfusion has recently recognized 33 blood group systems. Apart from ABO and Rhesus system, many other types of antigens have been noticed on the red cell membranes.

Hence, a proper understanding of the blood group system ABO, their clinical significance, typing and cross-matching tests and current perspective are of paramount importance to prevent transfusion-related complications. The study and knowledge of blood groups is necessary for the purpose of dealing with blood diseases, which are still in the research stage.

ABO blood group antigens are the most immunogenic followed by Rhesus (D antigen). The frequency distribution of blood groups are varies among different regions and races of the world. This study aims to identify the frequency distribution of ABO blood group and rhesus factors within males and females blood donors in Al- Qaeem City in the west of Iraq.

Rhesus blood group system (Rh) Blood can be either RhD positive or RhD negative. Total 565 samples , includes 300 male with 265 female were analyzed.

Keywords: Phenotype; Rhesus Blood Groups; Antigens; Male and Female; Rh (D).

Introduction

The blood group systems have expanded to 33 systems containing more than 400 antigens, which can be expressed on glycoproteins, proteins, and glycolipids on the RBC's surface membrane (Mitra *et al.,* 2014). A blood group is defined as an antigen on the membrane of red blood cells (RBCs) that may trigger an immune response and subsequent production of alloantibody which may not be suitable for the recipients after transfusion, which cause some problems to them (Pourazar, 2007).

The discovery of blood groups started after the detection of an alloantibody with possible clinical implications for transfusion services. He was Austrian scientist Karl Landsteiner the first who discovered blood group system, A, B, and O blood types in

1900. Blood groups are critical for transfusion because the high of immunogenicity and clinical significance in transfusion service (King, 1994). After that, Alfred Von Decastello and Adriano Sturli discovered the fourth type AB, in 1902. Karl Landsteiner and Alexander S. Wiener discovered Rh blood group in the late 1930s (Negi , 2003).

Blood groups' frequency distribution varies among regions and races. Among blood group systems identified, ABO (with blood types A, B, AB, and O) and Rhesus (with Rh D-positive or Rh D-negative blood types) are the most important in transfusion medicine (Worlledge *et al.,* 1974) .

Different types of blood groups are hereditary and determined on the presence of surface antigens in the RBC, these groups play a vital role during transfusion. In 1900, Karl Landsteiner discovered ABO blood group system, which became an important milestone in the history of blood transfusion followed by discovery of Rh (D) antigen (Behra and Joshi, 2013). Distribution of ABO and Rh (D) blood groups varies between populations and races.

The studying of blood groups is an important parameter in various genetic studies for reliable geographical information and in blood transfusion process with associated diseases. They will eventually help in reducing morbidity and mortality rate. Knowledge of blood grouping is also essential for effective management of blood bank inventory (Behra and Joshi, 2013): (Eweidah *et al.,* 2012). Various genetic studies is also useful in identification of certain diseases, different migration patterns of population as well as it helps in resolving certain medico legal issues, basically paternity dispute (Pourazar , 2007).

The significant Rh antigens are referred to as D and related ones are C and E while antithetically related antigens are designated as c and e (Blaney and Howard, 2013).

Nearly 29 blood group systems and approximately 700 different types of blood group antigens were discovered (Worlledge *et al.,* 1974). So far ABO and Rhesus are the most significant blood group systems (Sharma *et al.,* 2013).

The cause of Hemolytic Disease of the Fetus and Newborn was linked to the Rh blood group system by Levine and Stetson in the year 1940 (Anushree *et al.,* 2017). Most cases of hemolytic disease of the newborn (HDN) that arise from an ABO incompatibility require no treatment (Murray and Roberts, 2007). Cases of severe hemolysis that require exchange transfusions are less common, and fetal hydrops is rare (Apecu *et al.,* 2016).

The most common cause of death from a blood transfusion is transfusion of incompatible ABO blood type due to a clerical error. These antigens are expressed

on the RBC surface and determine an individual's blood group (Gadwalkar and Kumar , 2008).

ABO and Rh blood group frequency distribution varies among different regions and races of the world. Blood group A was the most frequent in Japan, while blood group O was the predominant blood group among Chinese and Americans (Census, 2001): (Sutton ,1980).

A study by Liu et al in China showed that the frequency distribution of blood groups O, A, B, and AB was 35.54%, 31.90%, 24.14%, and 8.42%, respectively. The distribution of the Rh (D) negative group was found to be 0.55% among Chinese blood donors (Sutton ,1980) : (Raja *et al.,* 2016). A systematic review study in India revealed that O blood group (34.56%) was the predominant followed by B (34.10%), A (23.16%), and AB (8.1%). Based on Rh type, Rh (D) positive and Rh (D) negative population were 94.13% and 5.87%, respectively (Suresh *et al.*, 2015).

In U S A, the frequency distribution of blood group O varies from 39.8% in Asian donors to 56.5% in Hispanic donors, and the proportion of Rh (D) negative varies from 1.7% in Asian donors to 17.3% in White non-Hispanic donors (Agrawal *et al.*, 2014). Blood group A (43.8%) was the most frequent and AB the least frequent, and Rh positivity rate was 85% in Turkey (Sidhu , 2003).

In Ethiopia , blood group O was the dominant blood group followed by A, B, and AB, and the Rh-positive blood group account for the highest percentage (Tiruneh *et al.,* 2020). Studies in Nigeria and Uganda also revealed that blood group O as the most frequent blood group followed by blood group A, and B, and AB was the least frequent blood group (Bhavani, 2016): (Singh *et al.,* 2016).

Studies in Ethiopia showed that blood group O was the dominant blood group followed by A, B, and AB, and the Rh-positive blood group account for the highest percentage. (Kaur *et al.,* 2016): (Mehta and Mehta, 2016).

The Relation between Blood Groups with Some Diseases

The routine practice of blood typing and cross matching blood products should prevent adverse transfusion reactions caused by ABO antibodies. However, clerical error can result in "the wrong blood" being transfused into a patient, an error which can result in the death of the patient (Islam Barbhuiya *et al*., 2016): (Zerihun and Bekele, 2016).

No diseases are known to result from the lack of expression of ABO blood group antigens, but the susceptibility to a number of diseases has been linked with a person's ABO phenotype. Although such correlations remain controversial, while some observation revele that gastric cancer appears to be more common in group A

individuals (Apecu *et al*., 2016), whereas gastric and duodenal ulcers occur more often in group O individuals (Saad , 2016).

Other blood groups except O individuals have been shown to be at an increased risk of both arterial and venous disease (TorabizadeMaatoghi *et al*., 2016). On the other hand, blood groups O have significantly high risk of hepatitis B. HBV infection more in Rh Positive Donors. Rotavirus gastro enteritis was significantly more prevalent among blood group A patients; malaria patients with blood group A had high risk of anaemia compared to another blood groups. AB blood group had high risk of developing Dengue haemorrhagic fever, whereas O blood group patients have more susceptible to norovirus infection. SAR'S Corona virus is a new virus need to find out which blood group individuals susceptible to Covid-19 infection. A retrospective study was conducted to explore the relationship with lymphopenia which is a common feature of Covid 19 patients associated with severity of disease. The association between ABO blood groups and lymphocytes count was also investigated by (Ewald and Sumner, 2016).

Objective

The objective of this study was to determine the distribution and prevalence of ABO and Rh blood groups among blood donors at Iraqi western bank, based on the antigenic presence on the surface of red blood cells with respect to gender. This data is valuable to manage blood availability by blood type since this study showed the ABO and Rh blood distribution by donation site. Relevant data of blood donors were collected from blood bank department of the hospital.

Materials and Methods

After getting permission from the blood bank of the hospital, data were collected from donors 'of registration system in the west of Al- Anbar governorate from July 2018 to July 2021. Only donors of ABO, Rh blood group, sex, and site of blood donation based on the code were given from the blood bank. we did not use the data of other voluntary blood donor, like names , phone numbers and address. All the data were secured, protected, and accessed only by the investigators. Data of 565 blood donors were collected, and descriptive statistical frequency and percentage were used to show the difference in the frequency distribution of ABO and Rh blood groups among sex and blood donation site.

Samples were collected from voluntary non-remunerated blood donors maintaining the cold chain at 2–10°C with a cold box. After arrival at the blood bank, blood was arranged by blood unit number and stored in blood bank refrigerator (2–6°C). Forward ABO blood grouping was performed by slid method with known antisera (anti-A and anti-B). Rh group was determined by test tube method by using anti-D reagents.

ABO and Rh blood type of the blood donors stored into the computerized blood donor data management system. The data registered on an excel sheet on the blood bank blood donor data registration system were checked for completeness and transferred into SPSS version 23 for further analysis.

Results

Out of 565 blood donors, 300 (53.097%) were males, and 265 (46.902%) were females. Donors' age was 18- 24 years, students, from universities and high school. All donations were from voluntary non-remunerated blood donors. As showing in Table (1) for males and Table (3) for females.

Table (1): Distribution of ABO Blood Groups of Gender in Al-Qaeem City of the West Population in Iraq.

Male	**Distribution of ABO Blood Groups of Gender in Al-Qaeem City of the West Population/ Iraq**							
300 Cases	**A Phenotype**		**B Phenotype**		**AB Phenotype**		**O Phenotype**	
	Rh^+	120	Rh^+	58	Rh^+	18	Rh^+	75
	Rh^-	13	Rh^-	10	Rh^-	0	Rh^-	6
Total	**133**		**68**		**18**		**81**	

The prevalence of Rhesus positive and negative in Table (2) , in the present studied male population was found as 90.33% and 9.666%, respectively.

Table (2): Percentage Distribution of ABO Blood Group by Male Gender in Al-Qaeem City of the West Population in Iraq.

Male	**Percentage Distribution of ABO Blood Group by Male Gender**							
Male Total Cases	**No. of group A Rh^+**	**No. of group A Rh^-**	**No. of group B Rh^+**	**No. of group B Rh^-**	**No. of group AB Rh^+**	**No. of group AB Rh^-**	**No. of group O Rh^+**	**No. of group O Rh^-**
300	120	13	58	10	18	00	75	6
Percentage%	40%	4.333%	19.333%	3.333%	6 %	00%	25%	2%

The Most Common Blood Group

In Males

In Table (2) blood group A were 133 male (44.333%), including A^+, 40% (120) with A^- 4.333% (13), followed by O total 81 with the percent of (27%), including O^+ with 25% (75) and O^- with 2% (6), total B group with 68 person with total percent 22.666% divided between B^+ with 58 with percent (19.333%) and B^- of 10 with percent (3.333 %), then the lowest one was AB with total 18 person with 6% including only AB^+ was 18 person with 6%, while AB^- no body indicate.

Figure (1) shows the percentage of male blood groups in Al-Qaeem City.

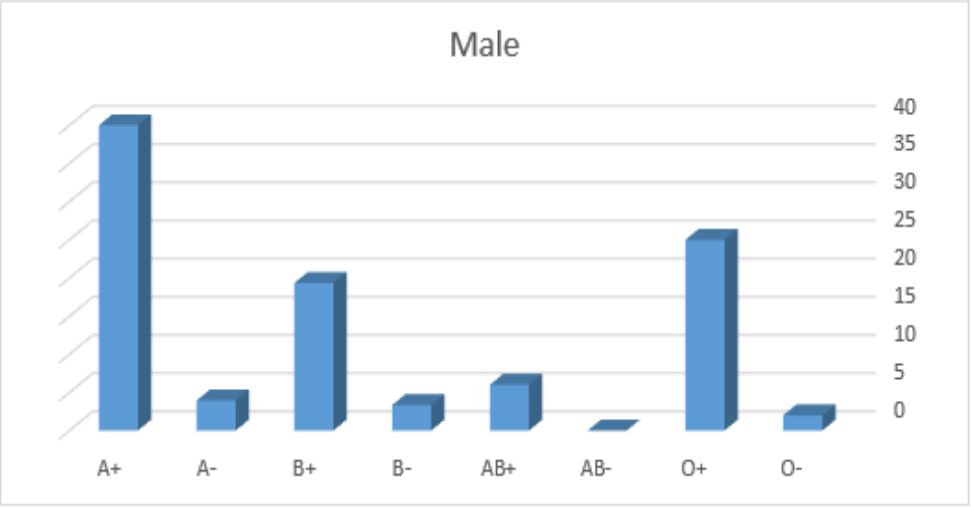

Figure (1): For the Percentages of Male Blood Groups in Al-Qaeem City.

It can be seen that the highest blood is group of A^+ 40% , then O^+ 25%, then B^+ 19.333% , then AB^+ 6 %, A^- 4.333% , B^- 3.333%, O^- 2% and the last one AB^- 00%.

In Females

Table (3): Distribution of ABO Blood Groups in Females of Al-Qaeem City of The western Iraq Population.

Female	**Distribution of ABO Blood Groups in Female Gender**							
265 Cases	**A Phenotype**		**B Phenotype**		**AB Phenotype**			**O Phenotype**
	Rh^+	90	Rh^+	60	Rh^+	15	Rh^+	77
	Rh^-	11	Rh^-	3	Rh^-	3	Rh^-	6
Total	**101**		**63**		**18**			**83**

In Table (3) it can be seen that from 265 female cases there was different phenotypes, as shown the total number of A Rh^+ and A Rh^- phenotype was 101%, divided between 90% A^+, with 11% A^-, Then O phenotype with total of 83% divided with O^+ 77% and O^- 6%, then B phenotype with total number 63% divided between B^+ 60% and B^- with 3%, then lowest percent of AB with total number 18% divided between AB^+ 15% and AB^- 3% .

Table (4): Female Gender Numbers and Distribution of ABO Blood Groups with Percent in Al-Qaeem City.

Female	**Female Percentage Distribution of ABO Blood Group in Al-Qaeem City of the Iraqi West Population**							
Female Total Cases	**No. of group A Rh^+**	**No. of group A Rh^-**	**No. of group B Rh^+**	**No. of group B Rh^-**	**No. of group AB Rh^+**	**No. of group AB Rh^-**	**No. of group O Rh^+**	**No. of group O Rh^-**
265	90	11	60	3	15	3	77	6
Percentage%	33.962%	4.150%	22.641%	1.132%	5.660%	1.132%	5.283%	2.264%

In Table (4) From the total number of females cases, the most common blood group was phenotype A with 101 female with 38.112% percent , including type A^+ with 33.962% (90), and A^- with 4.150% (11), then 83 of group O, including 77 group O^+ with percent 5.283%, and 6 group O^- with percent 2.264%, then 63 person of B group with 60 B^+ with 22.641%, and 3 person of B^- with 1.132%, and then 18 AB^+ which is the lowest percent number including 15 person AB^+ with 5.660%, and 3 person AB^- with 1.132%.

Considering ABO and Rh blood group altogether blood group in Table (4), Phenotype A Rh^+ with (33.962%) was the predominant blood group followed by B positive (22.641%), then AB Rh^+ (5.660%), then O Rh^+ (5.283%), then A Rh^- (4.150%), then O Rh^- (2.264%), and then B Rh^- with AB Rh^- was the same percent (1.132%) .

Table (4), data were subjected in to the results of SPSS statistics program as showed in Figure (2) for percentages of female blood groups in Al-Qaeem City.

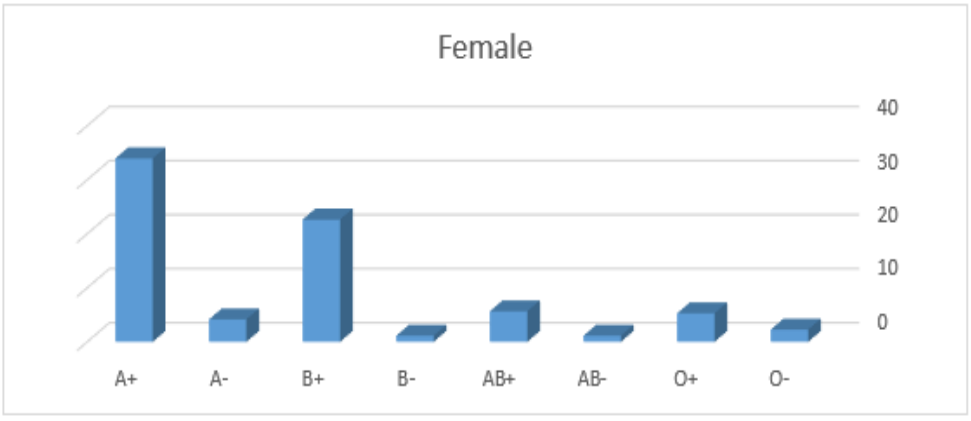

Figure (2): Represents Table (4) Data and Shows the Distribution of ABO Blood Groups Percentage Among Females of Al-Qaeem City of Western Iraq Population.

In Females

In Table (4), Overall, females ABO positive group pattern found was shown by the formula A > B > AB > O which was similar among Rh-positive females individuals, while Rh-negative females' pattern was found as A > O, and then similar patterns of B and AB.

Table (5): Distribution of ABO Blood Groups Among Males and Females in Al- Qaeem City.

Blood Group	Male	Female	Total %
A^+	40% (120)	33.962% (90)	73.962% (210)
A^-	3.942% (13)	4.150% (11)	8.0 92% (24)
B^+	19.333% (58)	22.641% (60)	41.974% (118)
B^-	3.333 % (10)	1.132% (3)	4.465% (13)
AB^+	6% (18)	5.660% (15)	11.660% (33)
AB^-	00% (00)	1.132% (3)	1.132% (3)
O^+	25% (75)	5.283% (77)	30.283% (152)
O^-	2% (6)	2.264% (6)	4.264% (12)
Total %	99.608% (300)	76.224% (265)	175.832% (565)

The data presented in Table (5) of the 565 cases (300 males and 265 females) are presented in Figures (3), (4), and (5).

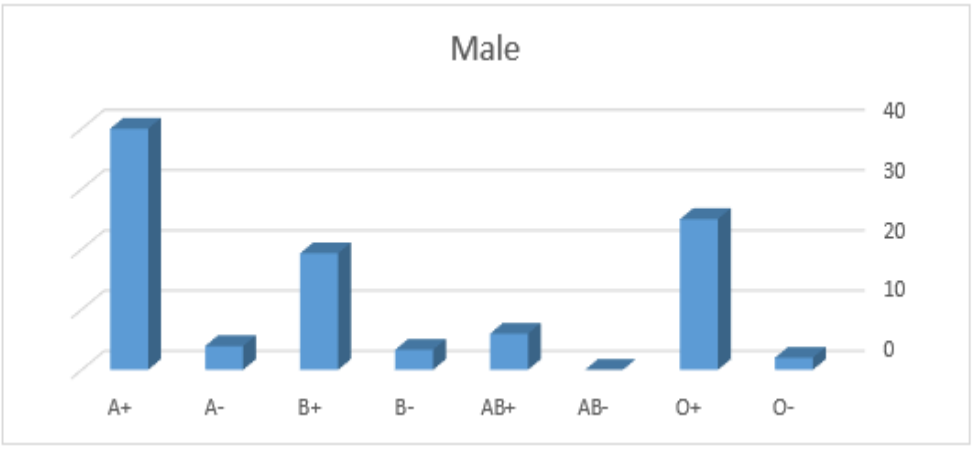

Figure (3): The Distribution of ABO Blood Groups Among Males of Al-Qaeem City.

Figure (3) shows the percentage of males: A^+ 40%, O^+ 25%, B^+ 19.333%, AB^+ 6%, A^- 3.942%, B^- 3.333%, O^- 2%, and AB^- 00% .

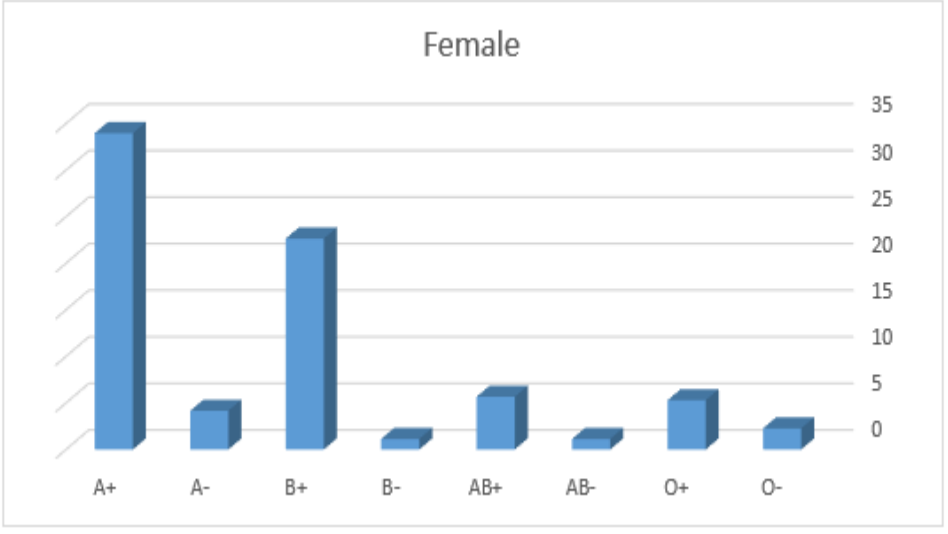

Figure (4): The Distribution of ABO Blood Groups Among the Females of Al-Qaeem City.

Figure (4) shows that the highest percentage among females is A^+ 33.962%, then B^+ 22.641%, then AB^+ 5.660%, then O^+ 5.283%, then A^- 4.150%, then O^- 2.264%, then AB^- 1.132%, then the lowest B^- 1.132%.

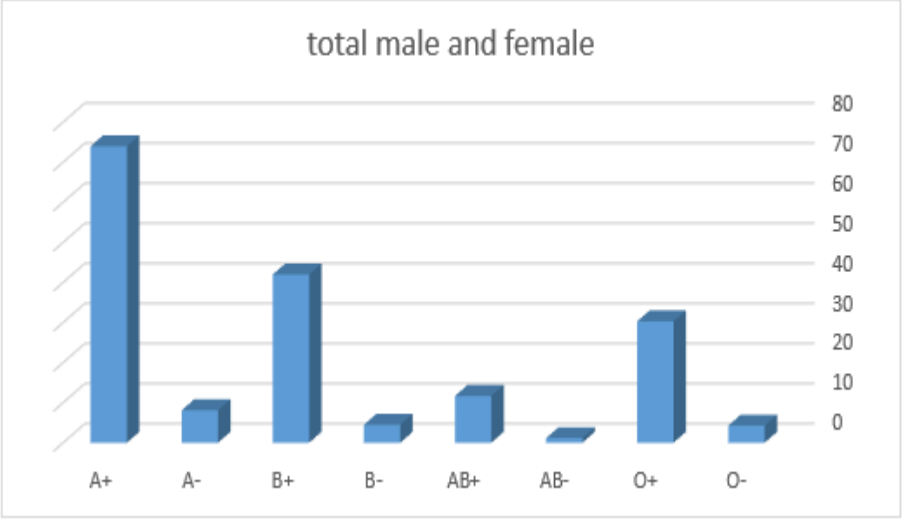

Figure (5): The Distribution of the Total of ABO Blood Groups of Al-Qaeem City.

Figure (5) shows that the highest is A^+ 73.962%, then B^+ 41.974%, then O^+ 30.283%, then AB^+ 11.660%, then A^- 8.0 92%, then B^- 4.465%, then O^- 4.264% and the lowest is AB^- 1.132% .

Table (6):Total Percentage Distribution of ABO Blood Group for each Genders in Al-Qaeem City.

Total Percentage Distribution of ABO Blood Group for each Genders in Al-Qaeem City of the West Population / Iraq				
	A Phenotype	**B Phenotype**	**AB Phenotype**	**O Phenotype**
Male	43.942%	22.666%	6%	27%
Female	38.112%	23.773%	6.792%	7.547%
Total	82.054%	46.439. %	12.792%	34.547%

In Table (6), the highest number of total phenotype percent in male and female in A is 82.054%, and B is 46.439%, then O phenotype 34.547%, and the lowest one AB is 12.792%.

Table (6) data are presented on Figure (6), (7), and (8).

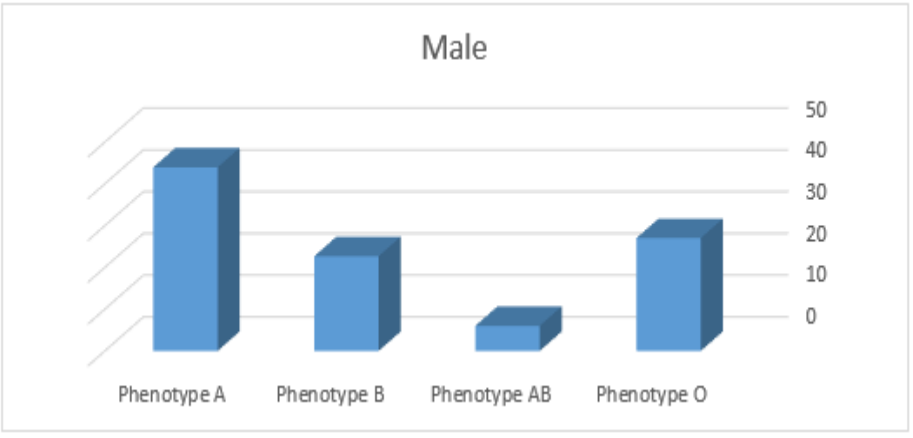

Figure (6): Percentage of Male Gender Blood Groups in Al-Qaeem City.

In Figure (6), the highest percentage in male in Phenotype A is 43.942%, the second percentage in Phenotype O is 27%, then Phenotype B is 22.666%, then comes the lowest Phenotype AB which is 6%.

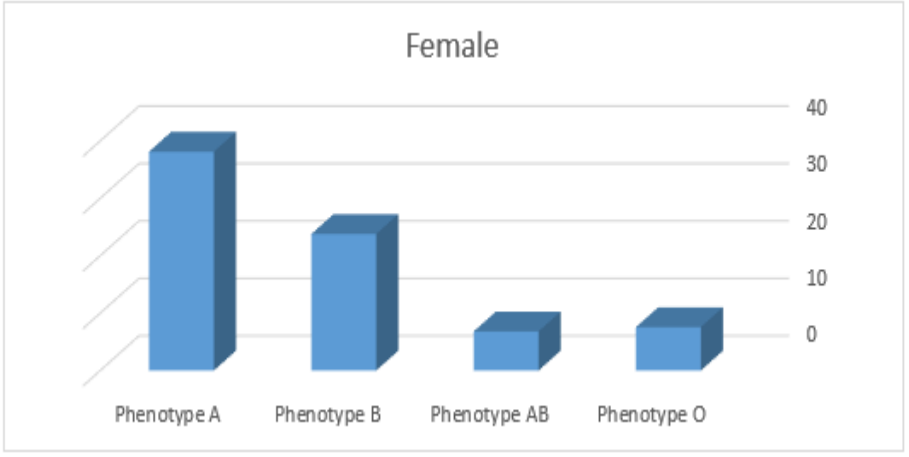

Figure (7): The Distribution of Females Blood Groups in Al-Qaeem.

In Figure (7), we can see that the highest percentage in Phenotype A is 38.112%, the second is Phenotype B 23.773%, then is Phenotype O 7.547%, and the last is Phenotype AB 6.792%.

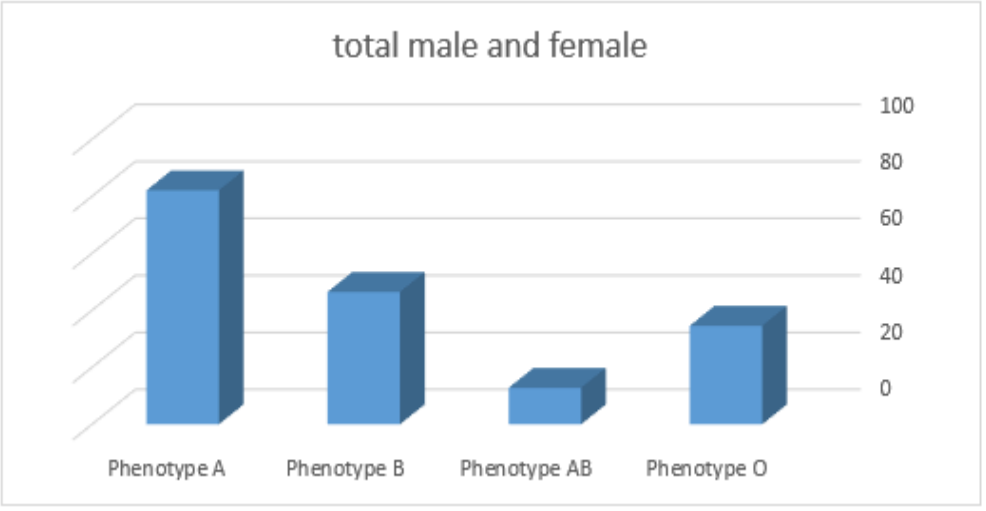

Figure (8): Shows the Total Percentage of both Females and Males; the Highest is 82.054% in Phenotype A with 82.054%, the second is Phenotype B 46.439%, then is Phenotype O 34.547%, and Finally Comes Phenotype AB 12.792%.

In Tables (5) and (6), males ABO group pattern was shown by formula Rh-positive; A > O > B > AB which was similar among Rh-positive male individuals, while Rh-negative males' pattern was found as A > B > O > AB.

While in the same Table (5), female results regards Rh-positive; A > B > AB > O, but Rh in negative females' pattern was found as A > O >, then AB = B (1.132).

It can also be noticed that in Table (5) the total level of Rhesus for each type of blood groups entirety for both of males and females respectively was A^+> B^+> O^+> AB^+> A^-> B^-> O^-> AB^-.

In females, the total prevalence of Rhesus positive and negative in Table (5) is 67.546% and 8.678%, respectively.

Discussion and Recommendation

In this study, males were more involved in blood donation than females. This difference might be because of the differences between female donors and male donors; in females these differences result from certain medical grounds such as low hemoglobin levels, low body weight, pregnancy, and breastfeeding.

The results showed that all the positive phenotype percentages among males were more higher than the percentages of females, except B^+. Positive phenotypes in males were A^+ (40%), B^+ (19.333%), AB^+ (6%), O^+ (25%), while positive phenotypes in females were A^+ (33.962%), B^+ (22.641%), AB^+ (5.660%), O^+ (5.283%).

Negative phenotypes among males were A^- (3.942%), B^- (3.333 %), AB^- (00%) and the last one O^- (2%). While negative phenotypes among females were A^- (4.150%), B^- (1.132%), AB^- (1.132%), O^- (2.264%).

It can be concluded that the percentages of phenotypes blood groups in the west region of Iraq are more prevalent for the total level of Rhesus for each type of blood group in both male and female respectively: Positive as $A^+ > B^+ > O^+ > AB^+$: and negative as $A^- > B^- > O^- > AB^-$.

In contrast, in another study of blood groups of both sexes in Kurds Region in north of Iraq, it has been noticed that blood group O^+ is regarded as a generous and more precious blood group encouraging more donation (Oluwadare and Shonekan, 2008). The results of his search for the Kurds prevalence respectively as $O^+ > A^+ > B^+ > AB^+$. The most common blood group was O^+ (37.16%), followed by blood groups A^+ (32.47%) and B^+ (23.84%), while blood group AB^+ regards at the lowest prevalence (6.53%) then The more lowest prevalence was AB^- (0.51%). The difference in the pattern of blood groups O^-, A^-, B^-, and AB^- in men and women was inconsequential (Jaff, 2010).

In my study positive results were as $A^+ > B^+ > O^+ > AB^+$ percentages respectively were 73.96% ,41.97%, 30.28%, and then 11.66%.

Compared to previous studies in Kurds region, my results were as follows, O^+ be on the average of (30.28%) which regards as few lower than O^+ of Kurdish area with (37.16%) as more precious blood group encouraging more donation (Oluwadare and Shonekan, 2008).

The blood donation system in Iraq differs from many other countries in that the family and relatives of the recipient are responsible for providing blood units of the same recipients' blood group available for transfusion, with its consequences in amplification of the number of donations of high incidence blood groups like group A^+ (73.96), B^+(41.97), and O^+ (30.28), and then AB^+ (11.66) Rh positive and low incidence of donation of less frequent blood groups like A^- (8.09%), B^- (4.46%), O^- (4.26%), and then AB^- (1.13%) Rh negative.

There were no significant differences in both ABO and Rh blood groups in men and women. This is because blood groups are of autosomal inheritance, thus, frequencies are not different in both sexes, and, therefore, in blood group studies from all populations. Blood groups are reported for men and women together which dependent on differences of Geographic regions and genetic frequency (Mourant *et al*., 1976).

Concerning ethnicity-related prevalence, in Saudi Arabia the blood group O had the highest prevalence and AB the lowest percentage among the ethnicities which

indicates a significant difference from other parts of the world (Torabizademaatoghi, J. *et al* ., 2016).

In my study, the result of AB^+ and AB^- was the lowest and are similar to the other neighboring countries. O^+ percentage is near to close compared to other studies, and the reason for the results of some differences from other countries, may be that the patient's relatives or friends who donate like group A^+ which is the more highest from other neightering countries.

In Jordan, the results of the phenotypic distribution indicated that 38.36% of the donors were type A^+ (36.62%), O^+ (18.04%), and AB^+ (6.98%). From these results we can conclude that these differences may be because of genetic differences at Geographical cline of allele frequency of group-specific component (GC) (Hanania *et al*, 2007).

The study in Syria indicate Arabs more often have blood groups A and O (46.25 and 37.50%) respectively and less frequently group B (13.13%); AB group in Arabs is a rare blood group (3.12%) (Sakharov and Nofal, 1996).

Data about the frequency of blood groups among donors in the Middle East are rare. In this study, only the fundamental examinations such as for ABO and D antigens were performed, but examinations such as for Rh and Kell phenotypes were not performed. The researcher suggest more studies to the correlation between blood groups and some diseases which are related to the blood such as heart diseases, autoimmune diseases, infectious diseases, diabetes, Cancer and overweight (Kenth, 2010).

Conclusion

Among both males and females donors, in positive blood groups, A^+ was the most common followed by B^+, O^+, then AB^+. Among the negative blood groups, A^- was the most common followed by B^-, then O^- , and the lowest percent was AB^- 53.097% of the total cases were males and 46.902% were females.

Most of blood donors' blood group were Rh-positive with total number of (157.879%), and about (17.953%) of the total donations were Rh-negative donor. Blood group A was the predominant in males and females and the lowest was AB phenotypes.

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