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Research Report

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The Impact of Demographic Characteristics and Blood Group Distribution of Syrian Blood Donors on the Blood Stock Management of the Turkish Red Crescent

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Abstract

Aim: This study analyzes blood group distribution among Syrian and local blood donors in Türkiye, focusing on ABO and Rh types to understand donation patterns and stock management.

Materials and Methods: A retrospective study included 77,588 Syrian and 4,358,976 local donors who donated to the Turkish Red Crescent from 2019 to 2021. Donor data were analyzed by age, gender, education, and blood type using statistical tests in OpenEpi.

Results: Syrians made up 1.75% of donors, peaking in Kilis (16.16%) and lowest in Hatay (0.77%). They were mostly male (84.8%) and younger (mean age 31.5 years). Blood type O and B were more common, while A was less frequent. Rh (+) prevalence was higher.

Conclusion: Syrian donors' distinct blood group distribution affects stock management. Higher O and B type frequencies and demographic differences require tailored recruitment and inventory strategies. Regional variations highlight the need for targeted collection efforts to ensure a stable, compatible blood supply.

Keywords: ABO and Rh blood groups; Blood stock management; Turkish blood donors; Syrian blood donors.

Introduction

The civil war that began in the Syrian Arab Republic in 2011 resulted in the displacement of a significant portion of the civilian population. Since that time, an increasing number of Syrian Arab Republic citizens have sought international protection in Türkiye. Our country has extended "temporary protection" to these Syrian refugees. As of September 2024, the Directorate of Migration Management reports that the number of Syrians who have migrated to Türkiye stands at 3,095,039[1], which represents approximately 3.6% of Türkiye's total population[2].

Numerous blood group systems have been defined by the International Society of Blood Transfusion[3]. Among these, the ABO and Rh blood group systems have garnered particular attention due to their immunogenicity in blood transfusions. Consequently, these blood groups are routinely examined during transfusion practices[4]. The distribution of ABO and Rh blood groups varies by region and ethnicity. For instance, a study in the United States revealed that the prevalence of the O blood type was 39.7% among Asian donors and 56.5% among Hispanic donors, while RhD-negative donors accounted for 1.7% of Asian donors and 7.2% of Hispanic donors[5]. Similarly, regional and ethnic variations in ABO and Rh blood type distributions have been reported in populous countries like China and India[6,7].

This study investigated the distribution of ABO and Rh blood types among Syrians who donated blood to the Turkish Red Crescent (TRC) in four provinces of Türkiye where the Syrian population constitutes over 20% of the local population [Kilis (73.70%), Hatay (25.97%), Gaziantep (21.72%), Şanlıurfa (20.07%)]. Understanding the distribution of Syrian donors and comparing it with the local population's blood type distribution can aid in developing rational, evidence-based strategies for blood collection and donor management.

Materials and Methods

The TRC meets approximately 90-91% of the country's need for blood and blood components. The criteria for donating blood to TRC include being aged between 18 and 70 years, weighing over 50 kg, being in good health, having a hemoglobin value of no less than 12.5 g/dL for female donors and 13.5 g/dL for male donors, maintaining a normal heart rate (50-100 beats per minute), and having normal blood pressure (systolic blood pressure: 90-180 mmHg, diastolic blood pressure: 60-100 mmHg)[8].

All donors fill out the written informed consent and inquiry forms prior to donating blood. In this context, Syrian blood donors with a residential address, who are issued a temporary identification number by the Republic of Türkiye and can communicate with the blood collection doctors, complete the forms created in Arabic and Turkish.

This retrospective cross-sectional study was conducted with 77,588 Syrian blood donors who donated blood to the TRC during the three-year study period from January 2019 to December 2021. The control group consisted of 4,358,976 non-Syrian regular and voluntary blood donors who donated blood to the TRC in the same period. The study protocol was approved by the TRC Research Ethics Committee (Approval No: 01/2022; Approval Date: 25/07/2022). To avoid any deviation in blood group distribution, only one donation from each donor was considered in the study.

Additionally, two study groups were formed: donors aged 18-34 and donors aged ≥35, based on the study's[9] results preceding this study, with a view to obtaining a balanced distribution in terms of age groups. Preliminary analyses determined that the rates of Syrian donors who were illiterate and graduates of elementary and middle school were significantly higher than those of the control group, whereas the rates of Syrian donors who were graduates of high school and

had higher educational levels were significantly lower. For this reason, the sample was further divided into two groups: donors with ≤8 years of education (illiterate donors, graduates of elementary and middle school) and donors with ≥9 years of education (graduates of high school, and donors who had an associate, undergraduate, graduate, or doctorate degree).

The data of the donors were obtained from the TRC database. In the immunohematology laboratories, blood groups were determined using two methods performed in parallel. These methods included the gel centrifuge method, which was performed using Grifols kits (Grifols, Spain) in the Grifols device (Grifols-Erytra, Spain), and the microplate method, which was performed using Diagast kits (Beckman Coulter, France) in the Beckman Coulter PK 7400 device (Beckman Coulter, Japan).

Statistical Analyses

Categorical variables were expressed as frequency and percentage values within 95% confidence intervals. The annual distribution of categorical variables was assessed using the extended Mantel-Haenszel Chi-Square linear trend test. The probability of being a blood donor based on different predictor variables was estimated using the Odds Ratio with 95% confidence intervals, while the significant relationship between groups was evaluated using Chi-square tests (corrected Yates and Mantel-Haenszel). All statistical analyses were performed using OpenEpi: Open-Source Epidemiologic Statistics for Public Health version 3.01 software, and two-sided probability (*p*) values of <0.05 were considered statistically significant.

Results

The mean age (mean ± SD) of Syrian blood donors was 31.5 ± 9.4 years, while the mean age of blood donors in the control group was 34.8 ± 9.3 years. The percentages of male and female donors among Syrian blood donors were 84.8% and 15.2%, respectively, compared to 83.2% and 16.8% in the control group.

During the three-year study period, the rate of Syrians among all blood donors was 1.75%. In the four provinces where the ratio of the Syrian population to the local population exceeds 20%, the rate of Syrian blood donors among all blood donors was 16.16% in Kilis, 6.64% in Gaziantep, 4.97% in Şanlıurfa, and 0.77% in Hatay. The annual rate of Syrian blood donors increased statistically significantly, both overall and on a provincial basis (see Table 1).

The rate of male donors among Syrian blood donors was significantly higher than that of male donors in the control group. Additionally, the rates of donors with ≤ 8 years of education and those aged 18-34 were significantly higher than those in the control group. This data did not differ by province, except for the rate of blood donors aged 18-34 in Kilis, which was significantly lower than that of the control group (see Table 2).

The distribution of blood donors by ABO and Rh blood types is illustrated in Figure 1, Figure 2, and Table 3. The frequencies of donors with O and B blood types were significantly higher among Syrian blood donors compared to the control group, with odds ratios of 1.19 (1.17-1.20), $p<0.001$ for type O and 1.31 (1.29-1.34), $p<0.001$ for type B. Conversely, the frequency of donors with blood type A was significantly lower among Syrian blood donors, with an odds ratio of 0.70 (0.69-0.71), $p<0.001$. Additionally, the frequency of donors with blood type AB was significantly higher among Syrian blood donors compared to the control group, with an odds ratio of 1.03 (1.01-1.06), $p<0.05$; however, AB blood type remained the least common in both groups. Furthermore, the frequency of blood donors with Rh (+) blood type was significantly higher among Syrian blood donors than in the control group, with an odds ratio of 1.34 (1.31-1.38), $p<0.001$.

From the perspective of blood stock management, the frequencies of donors with O Rh (+), B Rh (+), and AB Rh (+) blood types were significantly higher among Syrian blood donors compared to the control group. Conversely, the frequencies of donors with A Rh (+), A Rh (-), AB Rh (-), and O Rh (-) blood types were significantly lower in Syrian blood donors. On a provincial basis, in Gaziantep, the rate of Syrian blood donors with A Rh (+) blood type was significantly lower, while the rates of Syrian blood donors with AB Rh (+) and AB Rh (-) blood types were significantly higher compared to the control group. In Şanlıurfa, however, the rate of Syrian blood donors with AB Rh (+) blood type was significantly lower, whereas the rate of Syrian blood donors with O Rh (+) blood type was significantly higher compared to the control group (see Table 4).

According to Table 4, the results of the comparisons between overall Syrian blood donors across Türkiye and the control group, as well as between Syrian blood donors in Kilis, Hatay, Gaziantep, and Şanlıurfa provinces and the control group, did not overlap significantly. Therefore, data from the four provinces with the highest local and Syrian populations in Türkiye, where the ratio of Syrians to the local population is less than 10% (Ankara, Bursa, İstanbul, and İzmir), were analyzed (see Table 5). The results of this analysis were broadly consistent with the average values in Türkiye.

Discussion

This study evaluated the distribution of Syrians donating blood to the TRC by year, gender, age, educational level, and ABO & Rh blood groups, comparing them with local voluntary blood donors from the same period. Research from around the world indicates that participation rates in blood donation are generally lower among minority and immigrant groups[8,9]. For instance, in the United Kingdom, the rate of blood donors is 22.1 per 1,000 Caucasian Britons, compared to 1.84 per 1,000 African Britons and 1.59 per 1,000 Bangladeshi Britons[10]. Similarly, in the United States, the donor rate is reported as 11 per 1,000 Caucasian Americans, 6 per 1,000 African Americans, and 3 per 1,000 Hispanics[11]. Another study in the U.S. found that African-Americans are about 0.8% likely to be donors, while those of Asian, Hispanic, or other ethnic origins have about a 0.9% likelihood[12]. In comparison, this study found that Syrian blood donors constituted 1.75% of all donors, a higher rate than those reported in other studies.

In Australia, it was found that 17.2% of African refugees and immigrants had donated blood at least once in their lifetime, and 2.4% had donated blood in Australia[13]. A 2010 study in the U.S. reported that although African Americans make up 12.6% of the population, only 4.9% had donated blood before[14]. Conversely, a study in Germany indicated that 11.4% of immigrants donate blood[15]. In the present study, 2.06% of Syrians donated blood to TRC, despite making up 4.4% of the population of Türkiye. Among the four provinces with a Syrian-to-local population ratio exceeding 20%, the percentage of Syrian blood donors was highest in Kilis (16.16%), followed by Gaziantep (6.64%), Şanlıurfa (4.97%), and Hatay (0.77%). Notably, the annual rate of Syrian blood donors increased significantly both overall and on a provincial basis, suggesting that we may expect a higher rate of Syrian blood donors in the future.

A U.S. study[12], found that African-American and Hispanic minority donors were more likely to be women, while Asian minority donors were more likely to be men. The study also noted that the male-to-female ratio of donors born in Mexico and Latin American countries was similar to U.S.-born donors, but slightly higher for those born in other foreign countries. In this study, the number of male donors was significantly higher than female donors among both Syrians and the control group.

Similar to this study, an Australian study[13], found that the ratio of male to female donors was higher among both immigrants and the local population. A study conducted in Saudi Arabia also reported a higher ratio of male to female donors[16]. Furthermore, this study found that the rate of female Syrian blood donors was significantly lower than that of the control group (15.2% vs. 16.8%). This could be due to factors like anemia, pregnancy, breastfeeding, or childbirth, as well as cultural differences.

In this study, those younger than 35 years of age donated blood at a higher rate than those aged 35 and older in both groups. Additionally, the donation rate for those younger than 35 was significantly higher among Syrian donors compared to the control group. Similarly, a U.S. study found that minority and non-U.S.-born donors tend to be younger than Caucasian and U.S.-born donors[12].

Studies have also explored the link between educational level and blood donation. In an Australian study, 48% of donors were high school graduates or had higher degrees, while only 26.5% of sub-Saharan African immigrant donors fell into this category[13]. A U.S. study found that 40% to 45% of African-American and Hispanic donors had a high school diploma or lower degrees, with their educational levels being lower compared to Caucasian and Asian donors, who had comparable educational levels[12]. In this study, Syrian donors with ≥ 9 years of education had a higher donation rate compared to those with ≤ 8 years of education (56.5% vs. 68.5%), similar to the control group. However, contrary to other studies, Syrian donors with ≥ 9 years of education had a significantly lower donation rate compared to the control group.

The most common blood type among Syrian donors and in the control group was O and A, respectively, with A following O in the Syrian group and O following A in the control group. B and AB blood types followed in both groups. The rate of B blood type among Syrian donors was higher than in the control group. Interestingly, comparisons between Syrian blood donors across Türkiye and those in Kilis, Hatay, Gaziantep, and Şanlıurfa provinces showed differences. For example, in Kilis and Hatay, the rate of blood type A was higher than O among Syrian donors, similar to the control groups. Most studies show that blood type O is the most common among Arabs, consistent with Syrian donors across Türkiye. A meta-analysis of 32 publications from Saudi Arabia confirmed that blood type O is dominant[17]. The discrepancy in blood type distribution in Kilis and Hatay may be due to smaller sample sizes and the fact that only healthy individuals aged 18-65 can donate blood.

An interesting finding was that in Şanlıurfa, donors with blood type O were more common than those with blood type A (35.24% vs. 34.98%), similar to the general Arab population. This discrepancy may be due to the presence of Arab and Kurdish populations in eastern and southeastern Türkiye[18], including Şanlıurfa. Studies show that blood type O is dominant among Kurds as well as Arabs[19,20]. Moreover, more than 20% of both Arabs and Kurds have blood type B[17,20]. The high percentage of B blood type donors in Şanlıurfa (20.36% among Syrians and 16.29% in the control group) might be attributed to this dominance among Kurds and Arabs.

From a blood stock management perspective, the frequencies of donors with O Rh (+), B Rh (+), and AB Rh (+) blood types were significantly higher, while those with A Rh (+), A Rh (-), AB Rh (-), and O Rh (-) were significantly lower among Syrian donors compared to the control group. Interestingly, the results varied between overall Syrian donors and those in Kilis, Hatay, Gaziantep, and Şanlıurfa. For instance, in Gaziantep, the rate of AB Rh (-) donors was higher than in the control group, whereas in Şanlıurfa, the rate of AB Rh (+) donors was lower compared to the control group. In Kilis and Hatay, Syrian donors' blood types were consistent with those of the control groups. These findings can aid in blood stock management in Şanlıurfa and Gaziantep.

Strengths & Limitations

The major strengths of this study include its large sample size and multicenter design. Additionally, since the study population consisted of donors to TRC, which meets approximately 90-91% of Türkiye's blood needs, the representativeness of the study is enhanced. However, the fact that the study only included healthy TRC donors aged 18-65 may limit representativeness and be considered a limitation.

Conclusion

Our study has shown that Syrian blood donors in Türkiye have a distinct blood group distribution compared to the local population. These differences have significant implications for blood stock management and transfusion services, necessitating strategic planning. Specifically, the higher prevalence of O and B blood types among Syrian donors requires adjustments in blood stock management to accommodate this distribution. Additionally, the demographic characteristics and education levels of Syrian donors also affect donation rates, emphasizing the need to consider these factors when planning donation campaigns.

Recently, there has been an increase in the voluntary return of Syrians to their home country. According to statements from Interior Minister Ali Yerlikaya, as of December 9, 2024, 81,576 Syrians have returned voluntarily, safely, and with dignity[21]. This trend may lead to a decrease in the number of Syrian blood donors in Türkiye, impacting blood stock management. Therefore, blood donation strategies must be continuously updated and adapted to account for dynamic population movements. Additionally, efforts to increase local donor participation are crucial for ensuring the sustainability of blood stocks.

Ethics Committee Approval

This study was approved by Turkish Red Crescent Blood Services General Directorate Ethical Board (Approval No: 01/2022; Approval Date: 25/07/2022).

Research Involving Human Participants

This study involves blood donors, who complete a pre-donation questionnaire to assess their eligibility. The questionnaire includes a statement indicating that their data may be used for scientific research, and donors provide written consent by signing the form. Therefore, no additional informed consent was obtained. All data were retrieved from the Turkish Red Crescent database.

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work. Concept and design: A.K. Acquisition, analysis, or interpretation of data: A.K., M.Y, M.N.G., K.K. Drafting of the manuscript: A.K., M.N.G., Critical review of the manuscript for important intellectual content: A.K., M.Y., K.K., F.M.Y. Supervision: M.Y, M.N.G., K.K., F.M.Y.

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Conflict of Interest

The authors have no conflicts of interest to declare. All authors meet the authorship criteria.

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Data Availability

The data that support the findings of this study are available on request from the corresponding author, however, the data are not publicly available due to privacy or ethical restrictions.

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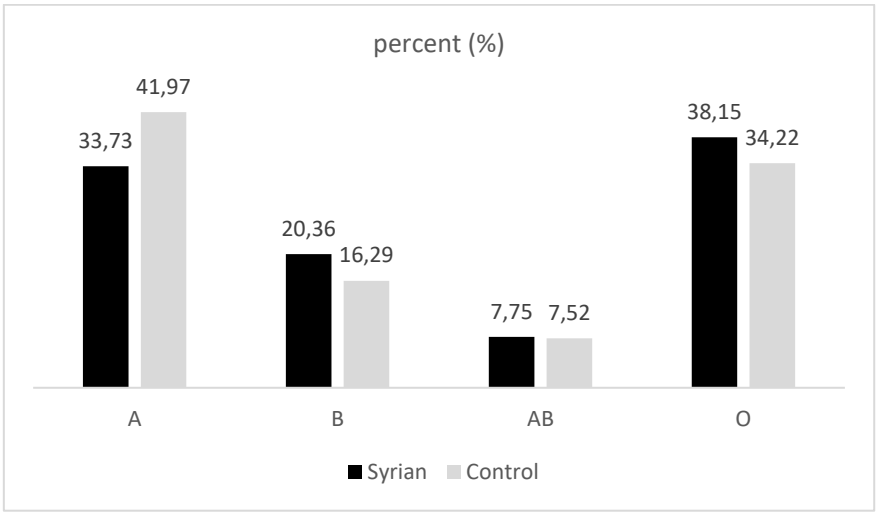

Figure 1. Distribution of Syrian blood donors and donors in the control group by ABO blood types

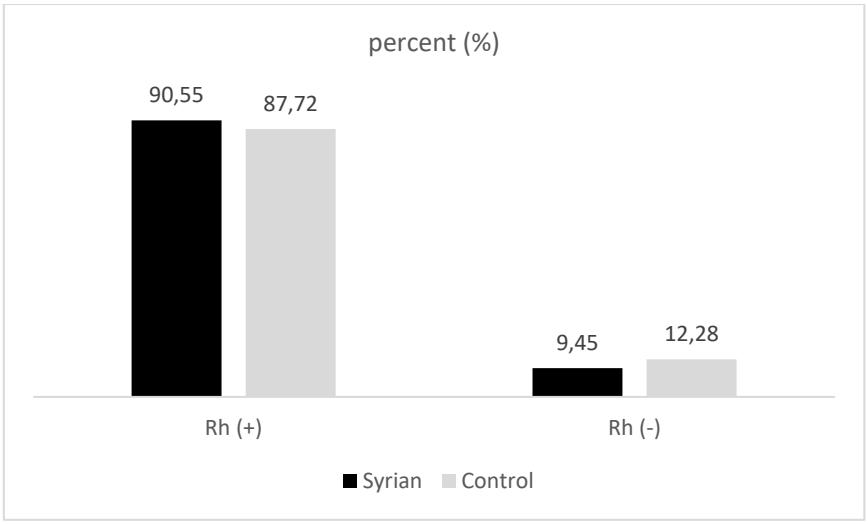

Figure 2. Distribution of Syrian blood donors and donors in the control group by Rh blood types

Table 1. Distribution of overall and province-based Syrian blood donors by year. (CI: Confidence Interval; S: Syrian; C: Control)

Years	Total (S) n	Total (C) n	% (95% CI)	Kilis (S) n	Kilis (C) n	% (95% CI)	Hatay (S) n	Hatay (C) n	% (95% CI)	Gaziantep (S) n	Gaziantep (C) n	% (95% CI)	Şanlıurfa (S) n	Şanlıurfa (C) n	% (95% CI)
2019	15079	1238925	1.20 (1.18-1.22)	745	3779	16.47 (15.42-17.58)	130	26157	0.49 (0.42-0.59)	1346	36087	3.59 (3.41-3.79)	824	21160	3.75 (3.51-4.01)
2020	15521	1175480	1.30 (1.28-1.32)	386	2590	12.97 (11.81-14.23)	204	28203	0.72 (0.63-0.82)	2381	36973	6.05 (5.82-6.29)	1327	25487	4.95 (4.69-5.22)
2021	46988	1944571	2.36 (2.34-2.38)	717	3216	18.23 (17.05-19.47)	417	42243	0.98 (0.89-1.08)	6086	64949	8.57 (8.36-8.77)	2154	35605	5.70 (5.48-5.94)
Statistical values	6734.57*			3.93*			50.65*			1007.24*			110.48*		
	***p* <0.001**			***p* < 0.05**			***p* <0.001**			***p* <0.001**			***p* <0.001**		
	* It refers to the values of the "Extended Mantel-Haenszel chi-square for linear trend"														

Table 2. Rates of Syrian blood donors by demographic characteristics. (OR: Odds ratio; CI: Confidence Interval; S: Syrian; C: Control)

Demographic parameters		Total (S) n (%)	Total (C) n (%)	OR (95% CI)	*p*	Kilis (S) n (%)	Kilis (C) n (%)	OR (95% CI)	*p*	Hatay (S) n (%)	Hatay (C) n (%)	OR (95% CI)	*p*	Gaziantep (S) n (%)	Gaziantep (C) n (%)	OR (95% CI)	*p*	Şanlıurfa (S) n (%)	Şanlıurfa (C) n (%)	OR (95% CI)	*p*
Gender	**Male**	65797 (84.8)	3628494 (83.2)	1.123 (1.101-1.146)	**<0.001**	1603 (86.7)	7803 (81.4)	1.41 (1.24-1.59)	**<0.001**	685 (91.2)	86537 (89.6)	1.21 (0.94-1.55)	0.14	8950 (91.2)	113777 (82.4)	2.12 (1.98-2.27)	**<0.001**	4092 (95.1)	74881 (91.0)	1.85 (1.61-2.11)	**<0.001**
	Female	11791 (15.2)	730482 (16.8)			245 (13.3)	1782 (18.6)			66 (8.8)	10066 (10.4)			863 (8.8)	24232 (17.6)			213 (4.9)	7371 (9.0)		
Years	**18-34**	52458 (67.6)	2320662 (53.2)	1.833 (1.806-1.861)	**<0.001**	943 (51.0)	5739 (59.9)	0.74 (0.68-0.81)	**<0.001**	608 (81.0)	57885 (59.9)	2.83 (2.36-3.39)	**<0.001**	6203 (63.2)	78411 (56.8)	1.28 (1.23-1.34)	**<0.001**	2581 (60.0)	47364 (57.6)	1.09 (1.03-1.17)	**< 0.05**
	≥35	25130 (32.4)	2038314 (46.8)			905 (49.0)	3846 (40.1)			143 (19.0)	38718 (40.1)			3610 (36.8)	59598 (43.2)			1724 (40.0)	34888 (42.4)		
Education (years)	**≤ 8**	33763 (43.5)	1375215 (31.5)	1.672 (1.648-1.696)	**<0.001**	1343 (72.7)	3310 (34.5)	3.88 (3.52-4.26)	**<0.001**	250 (33.3)	31563 (32.7)	1.03 (0.88-1.19)	0.72	7197 (73.3)	57493 (41.7)	3.54 (3.39-3.69)	**<0.001**	3191 (74.1)	41162 (50.0)	2.73 (2.55-2.91)	**<0.001**
	≥ 9	43825 (56.5)	2983761 (68.5)			505 (27.3)	6275 (65.5)			501 (66.7)	65040 (67.3)			2616 (26.7)	80516 (58.3)			1114 (25.9)	41090 (50.0)		

The significant relationship (*p* value) between groups was evaluated using Chi-square tests (corrected Yates and Mantel-Haenszel).

Table 3. Distribution of overall Syrian blood donors and the blood donors in the control group by AB0&Rh blood types. (S: Syrian; C: Control)

Blood Groups	Total (S) n (%)	Total (C) n (%)	Kilis (S) n (%)	Kilis (C) n (%)	Hatay (S) n (%)	Hatay (C) n (%)	Gaziantep (S) n (%)	Gaziantep (C) n (%)	Şanlıurfa (S) n (%)	Şanlıurfa (C) n (%)
A	26171 (33.7)	1829451 (41.9)	688 (37.2)	3558 (37.1)	306 (40.8)	38097 (39.4)	3490 (35.57)	51582 (37.4)	1461 (33.9)	28774 (34.9)
B	15800 (20.4)	710109 (16.3)	370 (20.0)	1973 (20.6)	118 (15.7)	16868 (17.5)	1920 (19.57)	26290 (19.1)	957 (22.2)	18079 (21.9)
AB	6016 (7.8)	327961 (7.5)	150 (8.1)	791 (8.3)	55 (7.3)	7060 (7.3)	832 (8.48)	10273 (7.5)	265 (6.2)	6412 (7.8)
O	29601 (38.2)	1491455 (34.2)	640 (34.6)	3263 (34.0)	272 (36.2)	34578 (35.8)	3571 (36.39)	49864 (36.1)	1622 (37.7)	28987 (35.2)
Rh (+)	70259 (90.6)	3823793 (87.7)	1637 (88.6)	8543 (89.1)	678 (90.3)	86367 (89.4)	8764 (89.31)	123209 (89.3)	3898 (90.6)	74136 (90.1)
Rh (-)	7329 (9.5)	535183 (12.3)	211 (11.4)	1042 (10.9)	73 (9.7)	10236 (10.6)	1049 (10.69)	14800 (10.7)	407 (9.5)	8116 (9.9)

Table 4. Distribution of Syrian blood donors and the blood donors in the control group by ABO&Rh blood types in the provinces where the ratios of Syrians to the local population are the highest. (OR: Odds ratio; CI: Confidence Interval; S: Syrian; C: Control)

Blood Groups	Total (S) n (%)	Total (C) n (%)	OR (95% CI)	*p*	Kilis (S) n (%)	Kilis (C) n (%)	OR (95% CI)	*p*	Hatay (S) n (%)	Hatay (C) n (%)	OR (95% CI)	*p*	Gaziantep (S) n (%)	Gaziantep (C) n (%)	OR (95% CI)	*p*	Şanlıurfa (S) n (%)	Şanlıurfa (C) n (%)	OR (95% CI)	*p*
A Rh +	**23631 (30.5)**	**1612267 (37.0)**	**0.75 (0.74-0.76)**	**<0.001**	606 (32.8)	3186 (33.2)	0.98 (0.89-1.07)	0.70	273 (36.4)	34225 (35.4)	1.04 0.89-1.21)	0.59	**3121 (31.8)**	**46196 (33.5)**	**0.93 (0.89-0.97)**	**<0.001**	1335 (31.0)	25951 (31.6)	0.98 (0.92-1.04)	0.46
non A Rh +	**53957 (69.5)**	**2746709 (63.0)**			1242 (67.2)	6399 (66.8)			478 (63.6)	62378 (64.6)			**6692 (68.2)**	**91813 (66.5)**			2970 (69.0)	56301 (68.4)		
A Rh -	**2540 (3.3)**	**217184 (5.0)**	**0.65 (0.62-0.68)**	**<0.001**	82 (4.4)	372 (3.9)	1.12 0.92-1.37)	0.29	33 (4.4)	3872 (4.0)	1.1 0.78-1.56)	0.59	369 (3.8)	5386 (3.9)	0.96 (0.87-1.07)	0.48	126 (2.9)	2823 (3.4)	0.85 (0.72-1.02)	0.08
non A Rh -	**75048 (96.7)**	**4141792 (95.0)**			1766 (95.6)	9213 (96.1)			718 (95.6)	92731 (96.0)			9444 (96.2)	132623 (96.1)			4179 (97.1)	79429 (96.6)		
B Rh +	**14329 (18.5)**	**625056 (14.3)**	**1.35 (1.32-1.37)**	**<0.001**	327 (17.7)	1772 (18.5)	0.96 0.86-1.07)	0.42	102 (13.6)	15155 (15.7)	0.85 (0.69-1.04)	0.11	1717 (17.5)	23521 (17.0)	1.03 0.98-1.08)	0.24	864 (20.1)	16341 (19.9)	1.01 (0.94-1.09)	0.76
non B Rh +	**63259 (81.5)**	**3733920 (85.7)**			1521 (82.3)	7813 (81.5)			649 (86.4)	81448 (84.3)			8096 (82.5)	114488 (83.0)			3441 (79.9)	65911 (80.1)		
B Rh -	1471 (1.9)	85053 (2.0)	0.97 (0.92-1.02)	0.27	43 (2.3)	201 (2.1)	1.09 0.83-1.44)	0.53	16 (2.1)	1713 (1.8)	1.20 0.74-1.97)	0.46	203 (2.1)	2769 (2.0)	1.03 (0.90-1.18)	0.67	93 (2.2)	1738 (2.1)	1.02 (0.84-1.25)	0.83
non B Rh -	76117 (98.1)	4273923 (98.0)			1805 (97.7)	9384 (97.9)			735 (97.9)	94890 (98.2)			9610 (97.9)	135240 (98.0)			4212 (97.8)	80514 (97.9)		
AB Rh +	**5407 (7.0)**	**286579 (6.6)**	**1.06 (1.04-1.09)**	**<0.001**	134 (7.3)	695 (7.3)	1.0 (0.85-1.18)	0.99	51 (6.8)	6308 (6.5)	1.04 0.79-1.38)	0.77	**733 (7.5)**	**9151 (6.6)**	**1.13 (1.05-1.21)**	**<0.001**	**239 (5.6)**	**5776 (7.0)**	**0.79 (0.69-0.89)**	**<0.001**
non AB Rh +	**72181 (93.0)**	**4072397 (93.4)**			1714 (92.7)	8890 (92.7)			700 (93.2)	90295 (93.5)			**9080 (92.5)**	**128858 (93.4)**			**4066 (94.4)**	**76476 (93.0)**		
AB Rh -	**609 (0.8)**	**41382 (1.0)**	**0.83 (0.76-0.90)**	**<0.001**	16 (0.9)	96 (1.0)	0.88 (0.56-1.39)	0.60	4 (0.5)	752 (0.8)	0.68 (0.26-1.82)	0.47	**99 (1.0)**	**1122 (0.8)**	**1.22 (1.01-1.48)**	**<0.05**	26 (0.6)	636 (0.8)	0.789 0.54-1.15)	0.21
non AB Rh -	**76979 (99.2)**	**4317594 (99.0)**			1832 (99.1)	9489 (99.0)			747 (99.5)	95851 (99.2)			**9714 (99.0)**	**136887 (99.2)**			4279 (99.4)	81616 (99.2)		
O Rh +	**26892 (34.7)**	**1299891 (29.8)**	**1.24 (1.22-1.26)**	**<0.001**	570 (30.8)	2890 (30.2)	1.03 0.9-1.13)	0.55	252 (33.6)	30679 (31.8)	1.08 (0.93-1.26)	0.29	3193 (32.5)	44341 (32.1)	1.02 (0.98-1.06)	0.40	**1460 (33.9)**	**26068 (31.7)**	**1.10 1.04-1.17)**	**<0.05**
non O Rh +	**50696 (65.3)**	**3059085 (70.2)**			1278 (69.2)	6695 (69.8)			499 (66.4)	65924 (68.2)			6620 (67.5)	93668 (67.9)			**2845 (66.1)**	**56184 (68.3)**		
O Rh -	**2709 (3.5)**	**191564 (4.4)**	**0.79 (0.76-0.82)**	**<0.001**	70 (3.8)	373 (3.9)	0.98 (0.78-1.22)	0.83	20 (2.7)	3899 (4.0)	0.65 0.42-1.02)	0.06	378 (3.9)	5523 (4.0)	0.96 (0.87-1.06)	0.46	162 (3.8)	2919 (3.5)	1.06 (0.91-1.23)	0.46
non O Rh -	**74879 (96.5)**	**4167412 (95.6)**			1778 (96.2)	9212 (96.1)			731 (97.3)	92704 (96.0)			9435 (96.1)	132486 (96.0)			4143 (96.2)	79333 (96.5)		

"non-..." groups were considered as the reference group. The significant relationship (*p* value) between groups was evaluated using Chi-square tests (corrected Yates and Mantel-Haenszel).

Table 5. Distribution of Syrian blood donors and the blood donors in the control group by ABO&Rh blood types in the provinces with the highest Syrian and local population. (OR: Odds ratio; CI: Confidence Interval; S: Syrian; C: Control)

Blood Groups	Total (S) n (%)	Total (C) n (%)	OR (95% CI)	*p*	Ankara (S) n (%)	Ankara (C) n (%)	OR (95% CI)	*p*	Bursa (S) n (%)	Bursa (C) n (%)	OR (95% CI)	*p*	İstanbul (S) n (%)	İstanbul (C) n (%)	OR (95% CI)	*p*	İzmir (S) n (%)	İzmir (C) n (%)	OR (95% CI)	*p*
A Rh +	**23631 (30.5)**	**1612267 (37.0)**	**0.75 (0.74-0.76)**	**<0.001**	**1207 (27.5)**	**112840 (37.2)**	**0.64 (0.60-0.68)**	**<0.001**	**546 (36.2)**	**54601 (38.9)**	**0.89 (0.81-0.99)**	**< 0.05**	**9631 (31.6)**	**292594 (37.6)**	**0.78 (0.76-0.79)**	**<0.001**	**196 (25.5)**	**94952 (37.5)**	**0.57 (0.48-0.67)**	**<0.001**
non A Rh +	**53957 (69.5)**	**2746709 (63.0)**			**3190 (72.5)**	**189414 (62.7)**			**961 (63.8)**	**85815 (61.1)**			**20856 (68.4)**	**486398 (62.4)**			**573 (74.5)**	**158282 (62.5)**		
A Rh -	**2540 (3.3)**	**217184 (5.0)**	**0.65 (0.62-0.68)**	**<0.001**	**128 (2.9)**	**15239 (5.0)**	**0.57 (0.48-0.68)**	**<0.001**	**59 (3.9)**	**7726 (5.5)**	**0.70 (0.54-0.91)**	**< 0.05**	**988 (3.2)**	**42855 (5.5)**	**0.58 (0.55-0.62)**	**<0.001**	**20 (2.6)**	**12399 (4.9)**	**0.52 (0.33-0.81)**	**<0.001**
non A Rh -	**75048 (96.7)**	**4141792 (95.0)**			**4269 (97.1)**	**287015 (95.0)**			**1448 (96.1)**	**132690 (94.5)**			**29499 (96.8)**	**736137 (94.5)**			**749 (97.4)**	**240835 (95.1)**		
B Rh +	**14329 (18.5**	**625056 (14.3)**	**1.35 (1.32-1.37)**	**<0.001**	**861 (19.6)**	**44740 (14.8)**	**1.39 (1.29-1.50)**	**<0.001**	**223 (14.8)**	**18109 (12.9)**	**1.17 (1.02-1.35)**	**< 0.05**	**5771 (18.9)**	**104293 (13.4)**	**1.48 (1.44-1.53)**	**<0.001**	**136 (17.7)**	**37072 (14.6)**	**1.25 (1.04-1.51)**	**< 0.05**
non B Rh +	**63259 (81.5)**	**3733920 (85.7)**			**3536 (80.4)**	**257514 (85.2)**			**1284 (85.2)**	**122307 (87.1)**			**24716 (81.1)**	**674699 (86.6)**			**633 (82.3)**	**216162 (85.4)**		
B Rh -	1471 (1.9)	85053 (2.0)	0.97 (0.92-1.02)	0.27	97 (2.2)	6067 (2.0)	1.10 (0.90-1.34)	0.35	28 (1.9)	2764 (2.0)	0.94 (0.65-1.37)	0.75	**536 (1.8)**	**15662 (2.0)**	**0.88 (0.81-0.95)**	**< 0.05**	13 (1.7)	4974 (2.0)	0.86 (0.49-1.48)	0.60
non B Rh -	76117 (98.1)	4273923 (98.0)			4300 (97.8)	296187 (98.0)			1479 (98.1)	137652 (98.0)			**29951 (98.2)**	**763330 (98.0)**			756 (98.3)	248260 (98.0)		
AB Rh +	**5407 (7.0)**	**286579 (6.6)**	**1.06 (1.04-1.09)**	**<0.001**	281 (6.4)	21250 (7.0)	0.90 (0.80-1.02)	0.09	101 (6.7)	9228 (6.6)	1.02 (0.84-1.25)	0.84	**2221 (7.3)**	**49785 (6.4)**	**1.144 (1.09-1.19)**	**<0.001**	41 (5.3)	17568 (6.9)	0.76 (0.55-1.04)	0.08
non AB Rh +	**72181 (93.0)**	**4072397 (93.4)**			4116 (93.6)	281004 (93.0)			1406 (93.3)	131188 (93.4)			**28266 (92.7)**	**729207 (93.6)**			728 (94.7)	235666 (93.1)		
AB Rh -	**609 (0.8)**	**41382 (1.0)**	**0.83 (0.76-0.90)**	**<0.001**	**27 (0.6)**	**3107 (1.0)**	**0.59 (0.41-0.87)**	**< 0.05**	15 (1.0)	1512 (1.1)	0.92 (0.56-1.53)	0.76	**249 (0.8)**	**7992 (1.0)**	**0.80 (0.71-0.91)**	**<0.001**	9 (1.2)	2469 (1.0)	1.20 (0.62-2.32)	0.56
non AB Rh -	**76979 (99.2)**	**4317594 (99.0)**			**4370 (99.4)**	**299147 (99.0)**			1492 (99.0)	138904 (98.9)			**30238 (99.2)**	**771000 (99.0)**			760 (98.8)	250765 (99.0)		
O Rh +	**26892 (34.7)**	**1299891 (29.8)**	**1.24 (1.22-1.26)**	**<0.001**	**1639 (37.3)**	**86115 (28.5)**	**1.48 (1.39-1.58)**	**<0.001**	**492 (32.6)**	**39706 (28.3)**	**1.23 (1.10-1.37)**	**<0.001**	**10056 (33.0)**	**227990 (29.3)**	**1.18 (1.15-1.21)**	**<0.001**	**329 (42.8)**	**73193 (28.9)**	**1.84 (1.59-2.12)**	**<0.001**
non O Rh +	**50696 (65.3)**	**3059085 (70.2)**			**2758 (62.7)**	**216139 (71.5)**			**1015 (67.4)**	**100710 (71.7)**			**20431 (67.0)**	**551002 (70.7)**			**440 (57.2)**	**180041 (71.1)**		
O Rh -	**2709 (3.5)**	**191564 (4.4)**	**0.79 (0.76-0.82)**	**<0.001**	**157 (3.6)**	**12896 (4.3)**	**0.83 (0.71-0.98)**	**< 0.05**	**43 (2.9)**	**6770 (4.8)**	**0.58 (0.43-0.79)**	**<0.001**	**1035 (3.4)**	**37821 (4.9)**	**0.69 (0.66-0.74)**	**<0.001**	25 (3.3)	10607 (4.2)	0.77 (0.52-1.15)	0.19
non O Rh -	**74879 (96.5)**	**4167412 (95.6)**			**4240 (96.4)**	**289358 (95.7)**			**1464 (97.1)**	**133646 (95.2)**			**29452 (96.6)**	**741171 (95.1)**			744 (96.7)	242627 (95.8)		

"non-..." groups were considered as the reference group. The significant relationship (*p* value) between groups was evaluated using Chi-square tests (corrected Yates and Mantel-Haenszel).