THE ANALYSIS OF BLOOD TYPE DISTRIBUTION OF THE ABO AND Rh SYSTEM IN THE POPULATION OF TUZLA CANTON (BOSNIA AND HERZEGOVINA)

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Abstract: *The aim of this study was to show the blood groups distribution of ABO and Rh system in the Tuzla Canton area. To determine whether there are statistically significant differences in the distribution of blood groups of ABO and Rh system in relation to the urban and rural subgroups, then according to the gender of the respondents, and compared to the previous surveys in BiH. The research was done by a retrospective study, on a sample of 6.000 volunteer blood donors. Compared to the total sample, it was determined that the O blood group appeared as the most common with frequency of 38.25%, blood group A with frequency of 37.35%, and for blood group B a frequency is 17.22%. For blood group AB the lowest recorded frequency was 7.18%. Blood groups distribution of ABO and Rh system in the Tuzla Canton is quite homogenous and it is within the scope of the expected values for this area.*

Key words: *ABO Blood Group System, Rh system, Tuzla Canton*

INTRODUCTION

The best researched system of genetic control of blood group types is the ABO system. Questions from this area enabled the discovery of causes of agglutination of erythrocytes in recipients after the fusion [1] In humans, depending on whether the A or/and B antigen is on the surface of their erythrocytes, they have A, B or AB blood group, if antigen is not present then the person will have a O blood group. Distribution of basic blood groups varies depending on the different populations. [2]. Blood group A is the most common blood group in Europe and Australia, B blood group is the most common blood group in eastern Asia. Its frequency decreases towards west, especially in Western Europe. Blood group O is the most common blood group in Americas, especially in Central and Southern America, and most parts of Africa, and it is least frequent in central parts of Europe and Asia. [3]. Antigen synthesis of Rh systems is controlled by three closely positioned genes. Those genes are marked by letters D, C and E. Each of these genes has multiple allele variants. The most active and most immunogenic is the D-antigen. Every person who has this antigen on its erythrocytes are members of Rh+ blood group, and persons without it are members of Rh- blood group. [4]. Aim of this research was to show the distribution of blood groups of ABO and Rh systems in the population of examinees and to process the obtained data and compare them with referential data from literature for certain parts of BiH and to highlight the eventual differences in distribution.

METHODS AND MATERIALS

Results of this paper are based on retrospective analysis of the sample of 6.000 examinees from the Tuzla canton area. Data are obtained on the University Clinical Center Tuzla, on the transfusiology clinic, from the official card database of voluntary blood donors, with the permission of Ethical committee. Gender distribution was as following: 4671 (77.85%) examinees were males, and 1329 (22.15%) were females. Obtained data about the distribution of blood groups according to ABO and Rh systems were classified and processed in relation to subsample (urban-rural) and according to the gender of examinees. Statistical importance of differences was tested by use of corresponding statistical methods (χ^2test).

RESULTS AND DISCUSSION

Research was carried through on the population of 6.000 examinees from the Tuzla canton area. Results were processed in relation to subsample (urban-rural), and according to the examinee gender. By analyzing the data from the table 1, it can be observed that the A group is the most common with 49.20% in Sapna, and least common rural Banovići with 28.50%. The highest percentage of B group (27.00%) is recorded in rural Banovići, and the lowest (12.30%) was recorded in Sapna. The highest frequency of AB blood group (11%) was recorded in rural Kladanj, and the lowest was recorded in Lukavac. The highest frequency of O blood group (44.75%) was recorded in rural Lukavac, and the lowest (28.75%) was recorded in Čelić municipality (table 1.).

Table 1: Frequency of blood group phenotypes in ABO systems in Tuzla Canton populations (urban-rural)

Population	N	Blood group %			
		A%	B%	AB%	0%
Tuzla – urban	900	35.10	14.80	8.55	41.55
Tuzla – rural	600	38.20	16.50	5.80	39.50
Kladanj – urban	100	38.00	15.00	11.00	36.00
Kladanj – rural	100	40.00	19.00	6.00	35.00
Živinice – urban	200	37.00	19.00	5.50	38.50
Živinice – rural	400	34.00	19.00	7.50	39.50
Banovići – urban	100	36.00	19.00	6.00	39.00
Banovići – rural	200	28.50	27.00	10.00	34.50
Kalesija – urban	250	40.00	18.00	5.20	36.80
Kalesija – rural	350	46.30	14.00	4.30	35.40
Srebrenik –urban	200	30.50	21.50	10.00	38.00
Srebrenik – rural	400	40.20	18.00	6.80	35.00
Lukavac – urban	200	30.00	21.50	2.00	36.50
Lukavac – rural	400	35.50	13.25	6.50	44.75
Gradačac – urban	150	41.30	17.30	7.40	34.00
Gradačac – rural	350	33.14	18.00	7.72	41.14
Gračanica – urban	150	34.00	20.00	10.70	35.30
Gračanica – rural	400	42.25	14.50	7.00	36.25
Čelić – urban	160	38.75	21.90	10.60	28.75
Sapna – rural	130	49.20	12.30	8.50	30.00
Doboj east – rural	130	44.60	17.70	6.20	31.50
Teočak – rural	130	36.15	18.50	9.20	36.15
Total	6000	37.35	17.22	7.18	38.25

By analyzing the distribution of blood groups in ABO system in population of examines on Tuzla canton area, it was concluded that the highest frequency is of the O blood group (38.25%), the next most frequent blood group was A blood group (37.35%), then B blood group (17.22%) and the least common blood group was AB blood group (7.18%).

Table 2: Frequency of blood groups according to the ABO system in selected samples of BiH population

Location	A%	B%	AB%	0%	Reference
BiH	42.00	15.00	7.00	36.00	[5]
Bosanska Krajina	40.00	18.00	7.00	35.00	[6]
Banja Luka	39.68	17.55	7.46	35.31	[7]
Bihać	39.00	20.11	7.08	33.81	[7]
Banja Luka (1990)	39.00	16.00	7.00	37.00	[8]
Banja Luka (1998)	40.00	17.00	6.00	37.00	[8]
Doboj (1991)	40.00	17.00	7.00	36.00	[9]
Doboj (2000)	43.00	10.00	5.00	43.00	[9]
Banja Luka	36.68	18.22	6.98	38.13	[10]
Prijedor	35.77	15.17	7.67	41.96	[10]
Trebinje	42.74	14.77	8.01	34.58	[10]
Gradiška	39.37	14.30	7.33	39.08	[10]
North-eastern Bosnia	46.00	15.00	6.00	33.00	[11]
Tuzla canton	37.35	17.22	7.18	38.25	Tuzla canton, 2017

By comparing the obtained data with the data from the literature (table 2) for the BiH area [5] where the determined frequency of blood group A is 42.00%, B - 15%.00, AB – 7.00% and O – 36.00%, we can conclude that existing

differences in the distribution of blood groups in ABO system on Tuzla canton area are not statistically significant in relation to this research (χ^2=0,99; 0,90>p>0,80).

Table 3: Phenotype frequency of blood groups in ABO systems in Tuzla canton populations

Examined populations	Blood group (%)				
	N	A	B	AB	0
Tuzla	1500	36.30	15.50	7.50	40.70
Kladanj	200	39.00	17.00	8.50	35.50
Živinice	600	35.00	19.00	6.80	39.2
Banovići	300	31.00	24.30	8.70	36.00
Kalesija	600	43.67	15.67	4.67	36.00
Srebrenik	600	37.00	19.20	7.80	36.00
Lukavac	600	33.70	16.00	5.00	45.30
Gradačac	500	35.60	17.80	7.60	39.00
Gračanica	550	40.00	16.00	8.00	36.00
Čelić	160	38.75	21.87	10.63	28,75
Sapna	130	49.20	12.30	8.50	30.00
Doboj-Istok	130	44.60	17.70	6.20	31.50
Teočak	130	36.15	18.47	9.23	36.15
Total	6000	37.35	17.22	7.18	38.25

By analyzing the data from the table 3, it can be noticed that the blood group A is the most common in Sapna with frequency of 49.20% and least common in Banovići with 31.00%. The highest frequency of B blood group (24.30%) is registered in Banovići, and the lowest was registered in Sapna (12.30%). The highest frequency of AB blood group (10.63%) is registered in Čelić municipality, and the lowest (4.67%) was registered in Kalesija. The highest frequency of O blood group (45.30%) is registered in Lukavac municipality, and the lowest (28.75%) was registered in Čelić.

By observing the each municipality of Tuzla canton separately and analyzing the relevant statistical data for BiH (A-42.00%, B-15.00%, AB-7.00% i 0-36.00% [5]), it can be noticed that statistically significant differences occur in Banovići municipality (χ^2=9.06; 0.05>p>0.02), and for the Čelić municipality (χ^2=6.74; 0.10>p>0.05), where the differences are on the limit of statistical significance.

By observing the examined population in relation to sub-sample (urban-rural), it can be noticed that in the urban areas the most common blood group is O with 38.88%, then A with 35.68%, B with 17.72% and AB with 7.72%, while in rural areas the most common blood group is A with 38.47%, then O with 37.83%, B with 16.88% and AB with 6.82% (table 4).

By comparing the data obtained by the analysis of frequency of blood groups in ABO system in urban population of Tuzla canton (A-35.68%, B-17.72%, AB-7.72%, 0-38.88%) with the data from literature for BiH area (A- 42.00%, B-15.00%, AB-7.00% i 0- 36.00% [5] it can be concluded that the differences are not statistically significant (χ^2=1.75; 0.80>p>0.50).

By comparing the data obtained by the analysis of frequency of blood groups in ABO system in rural population of Tuzla canton (A-38.47%, B-16.88%, AB-6.82%, 0-37.83%) with the data from literature for BiH area (A- 42.00%, B-15.00%, AB-7.00% i 0- 36.00% [5] it can be concluded that the differences are not statistically significant (χ^2=0.63; 0.90>p>0.80).

Table 4: Frequency of the blood groups in ABO system in relation to subsample (urban - rural) in population of Tuzla canton

Subsample	N	A	B	AB	0	p	q	r
Urban	2410	35.68	17.72	7.72	38.88	0.24	0.14	0.62
Rural	3590	38.47	16.88	6.82	37.83	0.26	0.13	0.61
Total	6000	37.35	17.22	7.18	38.25	0.25	0.13	0.62

By comparing the obtained data which relate to total frequency of blood groups of ABO system in the examined population of Tuzla canton (A-37.35%, B-17.22%, AB- 7.18% , 0-38.25%) with the data from the literature for the BiH area (A-42.00%, B-15.00%, AB-7.00% i 0-36.00% [5] we can notice that there is a decrease in percentage of A group (around 5%), while there is an increase in O blood group (around 2%). Also, there is an increase in B group percentage

(2%), while the frequency of AB blood group is virtually unchanged. It can be claimed that the O group is the most frequent blood group which contrasts the former data obtained from the researches in BiH, which claimed that the most common blood group is A. Reason for that could be the migratory movements of population. These differences are not statistically significant (χ^2=0.99; 0.90>p>0.80).

If we observe the allelogenes frequency (p, q, r) for ABO system of blood groups in population of Tuzla canton in relation to subsample (urban-rural) and total sample, we can conclude that the most common allele is I^o (r), which is to be expected because he is present on both gene loci within the O blood group, and one locus within the blood groups A and B. Obtained data do not significantly differ from the data obtained in the research executed on the BiH area (p-0.28, q-0.12, r-0.60, [5], and these differences are not statistically significant (χ^2=0.47; 0.90>p>0.75).

By analyzing the frequency data of blood groups in ABO system in the Tuzla canton according to the gender of examinees (table 5), it was determined that the most common blood group in women is O (39.70%), then A (35.50%), B (17.50%) and AB (7.30%). In males, the most common blood group is A (37.90%), then O (37.40%), then B (17.10%) and AB (7.60%).

By comparing the obtained data of blood group frequency in females in the Tuzla canton area (A-35.30%, B-17.50%, AB-7.30%, 0- 39.70%) with relevant data for BiH area (A- 42.00%, B-15.00%, AB-7.00% i 0- 36.00% [5] it can be concluded that the differences are not statistically significant (χ^2=1,88; 0.80>p>0.50).

By comparing the obtained data of blood group frequency in males in the Tuzla canton area (A-37.90%, B-17.10%, AB-7.60%, 0-37.40%) with relevant data for BiH area (A- 42.00%, B-15.00%, AB-7.00% i 0- 36.00% [5] it can be concluded that the differences are not statistically significant (χ^2=0.90>p>0.80).

By analyzing the frequency of ABO system blood groups in the Tuzla canton area in both sexes and comparing the obtained data with the relevant data from the literature (A-42.00%, B-15.00%, AB-7.00%, 0-36.00%) [5] it can be noticed that the obtained values are not statistically significant (χ2 =2.62; 0.50>p>0.25) (table 5).

Table 5: Frequency of the ABO system blood groups according to examinee gender

Population	Blood group (%)					
	Sex	N	A%	B%	AB%	0%
Tuzla	♀	395	33.42	16.46	6.33	43.80
	♂	1105	37.38	15.11	7.87	39.64
Kladanj	♀	43	46.51	18.60	9.30	25.58
	♂	157	36.94	16.56	8.28	38.22
Živinice	♀	149	32.89	25.50	3,36	38,26
	♂	451	35.70	16.85	7.98	39.47
Banovići	♀	79	34.18	17.72	5.06	43.04
	♂	221	29.86	26.70	9.95	33.48
Kalesija	♀	108	46.30	15.74	3.70	34.26
	♂	492	43.09	15.65	4.88	36.38
Srebrenik	♀	153	39,22	15.69	7.19	37.91
	♂	447	36.24	20.36	8.05	35.35
Lukavac	♀	156	26.92	12.82	5.77	54.49
	♂	444	36.04	17.12	4.73	42.12
Gradačac	♀	65	26.15	20.00	4.62	49.23
	♂	435	37.01	17.47	8.05	37.47
Gračanica	♀	102	41.18	19.61	6.86	32.35
	♂	448	39.73	15.18	8.26	36.83
Čelić	♀	32	40.63	25.00	9.38	25.00
	♂	128	38.28	21.09	10.94	29.69
Sapna	♀	14	64.29	14.29	0.00	21.43
	♂	116	48.28	12.07	9.48	30.17
Doboj-Istok	♀	14	35.71	7.14	0.00	57.14
	♂	116	45.69	18.97	6.90	28.45
Teočak	♀	19	31.58	10.53	15.79	42.11
	♂	111	36.94	19.82	8.11	35.14
Total	♀	1329	35.50	17.50	7.30	39.70
	♂	4671	37.90	17.10	7.60	37.40

Rh factor distribution in relation to subsample (rural-urban) in the Tuzla canton was compared with the corresponding distribution in BiH (Rh+ 85.00% i Rh- 15.00%) [12] and with the data from the ex-Yugoslavia (Rh+ 85.00% i Rh- 15.00% [13], so it can be concluded that there are some differences in Rh factor distribution in the subsample, but those differences are not statistically significant ($\chi 2=0.83$; $0.50>p>0.30$). Also based on these data, it can be concluded that the differences which can be noticed in the total distribution sample of Rh factor in the Tuzla canton area are not statistically significant ($\chi 2=0.43$; $0.80>p>0.50$).

Table 6: Rh factor frequency in relation to the subsample (urban-rural) in Tuzla canton

Examined subsample	Total number	Rh +	Rh -	Rh + (%)	Rh - (%)
Urban	2410	2002	408	83.07	16.93
Rural	3590	2957	633	82.37	17.63
Total	6000	4959	1041	82.65	17.35

By comparing the distribution of blood groups in ABO system within the examined populations of Tuzla canton, by the principle "each with each", it can be concluded that there are no statistically significant differences, except the Banovići municipality and Čelić municipality. The reason for the different frequency of blood groups in ABO system in Banovići probably lays in very intensive migratory movements on this area caused by war. It is assumed that the differences occurring Čelić are result of relative isolation of this population because of predominantly rural population and the effects of genetic drift.

CONCLUSION

Distribution of blood groups in ABO and Rh systems on the Tuzla canton area is quite homogenous and is within the limits of expected values for this area. There is a decrease in blood group A, and increase in blood group O and a slight increase in blood group B, while the distribution of blood group AB is quite uniform and without the bigger changes in relation with former researches. Analysis of frequency of allelogenes p, q and r is within the limits of determined values for the BiH area. In the case of gender distribution there are no statistically significant differences. Distribution of Rh+ blood group is decreased in relation to Rh- blood group which can probably be caused by migratory movements.

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