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ORIGINAL ARTICLE

FREQUENCY OF ABO, RH AND ABO-RH BLOOD GROUPS IN STUDENTS OF GOMAL MEDICAL COLLEGE, D.I.KHAN, PAKISTAN

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ABSTRACT

Background: Blood group of an individual is commonly determined by ABO & Rh status. The objectives of the study were to determine the frequency of ABO, Rh and ABO-Rh blood groups in students of Gomal Medical College, D.I.Khan, Pakistan.

Materials & Methods: This cross-sectional study was conducted in the Department of Community Medicine, Gomal Medical College, D.I.Khan, Pakistan from April 1 to May 23, 2019. The population being accessible was taken as sample. Sample size was 452. Our research variables (attributes) were ABO (A, B, AB, O), Rh (positive and negative) and ABO-Rh (A+, B+, AB+ O+, A-, B-, AB-, O-) respectively. All variables being nominal were described by count and percentage. The estimated parameters were given as confidence interval for proportion at 95% confidence level. The observed frequency of ABO, Rh and ABO-Rh blood groups was tested against their expected frequency using chi-square goodness of fit test.

Results: Out of 452 students, the frequency of ABO blood group was; A 127 (28.12%), B 165 (36.53%), AB 57 (12.62%) & O 103 (22.73%); Rh blood group was; Rh+ 408 (90.33%) & Rh- 44 (9.67%) and ABO-Rh was; A+ 116 (25.60%), B+ 148 (32.05%), AB+ 50 (11.30%), O+ 91 (20.10%), A- 11 (2.40%), B- 17 (03.70%), AB- 7 (1.50%) & O- 12 (2.60%). The observed frequency of ABO & ABO-Rh blood groups was significantly different whereas of Rh blood group was similar to expected prevalence.

Conclusion: In our population, most common blood group was B+ and the least common was AB-. The observed frequency of ABO & ABO-Rh blood groups was different while of Rh was same as expected. Awareness of blood groups in populations will help in the effective management of blood banks record in routine as well as during blood related life emergency situations.

KEY WORDS: Blood Groups; ABO Blood-Group System; Rhesus Blood-Group System; Medical Students; Blood Banks.

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1. INTRODUCTION

1.1 Background: Blood group of an individual is commonly determined by ABO & Rh status. ABO Blood-Group System and Rhesus Blood-Group System are based on the presence or absence of antibodies & antigens substances on the surface of red blood cells. There are four ABO (A, B, AB & O) and two Rh blood groups (Rh+ & Rh-), resulting in eight possible sub-blood groups: A+, B+, AB+ O+, A-, B-, AB- & O-.

Our population of interest was students of Gomal Medical College (GMC), D.I.Khan, Pakistan. Our variables of interest were presence (yes/ no) of ABO, Rh and ABO-Rh blood groups in this population. We will first present their frequencies in global and then regional, national and local populations.

According to Wikipedia, the frequency of ABO blood group in USA was; A 42.0%, B 4.9%, AB 9.1% & O 44.0%, whereas for Pakistan was; A 23.26%, B

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37.97%, AB 9.97% & O 28.8%.[1]

In an Asian study by Mwangi, et al.,[2] done on blood donors in 1999, the frequency of group A was 26%, B 33%, AB 7% and O 49%. in Asian & African populations.

In another study on 155 medical students by Akingbola, et al.,[3] in Nigeria, in 2016, the frequency of blood group A was 23.2%, B 24.5%, AB 2.6% & O 49.7%.

In a study by Niroula, et al.,[4] in a medical college of Nepal in 2018, out of 11,960 subjects, the frequency of blood group A was 28.66%, B 27.66%, AB 6.89%, O 34.80% and Rh+ 96.79% & Rh- 3.21%.

In a study on 120 Nepalese medical students, by Pramanik T, et al.,[5] in year 2000, A was 34%, B 29%, AB 4% and O 32.5% and Rh+ 96.66% & Rh- was 3.33%.

In another study by Das PK et al.,[6] in 2001 on blood donors in a blood bank in Velore, India, out of 150,536 blood donors A was 28,372 (18.85%), B 49,202 (32.69%), AB group 7,930 (5.27%) and O 58,330 (38.75%) and Rh+ were 142,311 (94.53) & Rh- 8,225 (5.47%).

Singh S, et al.,[7] India, in a study among 150,536 blood donors from 1988 to 1999 found out that blood group A was 173 (28.82%), B 229 (38.16%), AB 71 (11.82%) and O 131 (21.82%) and Rh+ was 93.83% & Rh- 6.17%.

Ahmed M, et al.,[8] in 2019 in Karachi, Pakistan found out that out of 3,521 subjects, A was 849 (24.1%), B 1167 (33.1%), AB 252 (7.2%) and O 1253 (35.6%) and Rh+ was 3209 (91.1%) & Rh- 312 (8.9%).

Iqbal et al.,[9] in 2009 in 4426 blood donors in Rawalpindi/ Islamabad, Pakistan found out that blood groups A+, AB+, O+, A-, B-, and O- were 21.5%, 9.8%, 29.7%, 1.8%, 2.9%, and 2.5% respectively.

Nazli et al.[10], in the female population of Peshawar, Pakistan in 2015, found that A was 134 (31.2%), B 136 (31.7%), AB 43 (10.1%) and O 116 (27%).

In a study by Asif et al.,[11] conducted in D.I.Khan, Pakistan in 2018, out of 4941 army recruits, D.I.Khan, Pakistan, A+ was 1107 (22.4%), B+ 1650 (33.4%), AB+ 372 (7.5%), O+ 1377 (27.9%), A- 102 (2.1%), B- 153 (3.1%), AB- 48 (1.0%) and O- 132 (2.7%).

1.2 Research Problems (RPs) and Knowledge Gaps (KGs):

We don't know the frequency of ABO, Rh and ABO-Rh blood groups in students of GMC, D.I.Khan, Pakistan. We also don't know the difference of observed frequency of ABO, Rh and ABO-Rh blood groups than expected frequency in students of GMC, D.I.Khan? The unawareness of six pieces of information were our six Research Problems and unavailability of such information online regarding our specified population became our six Knowledge Gaps.

1.3 Research Questions:

RQ 1- RQ 3: What is the frequency of ABO, Rh and ABO-Rh blood groups in students of GMC, D.I.Khan, Pakistan?

RQ 4- RQ 6: Is the observed frequency different from expected frequency of ABO, Rh and ABO-Rh blood groups in students of GMC, D.I.Khan, Pakistan?

We have formulated three Research Hypotheses. These are probable answers to the last three questions (RQ 4- RQ 6) derived from the results of many other similar population studies. Data collection & analysis from our population will be done to see if our observed answers match our probable answers or otherwise? These all eight steps constitute "Marwat's Logical Trajectory of Research Process", used in many research papers.[12-15]

Many studies regarding frequency of different blood groups in various areas of the country have been done but no study was done on the students of GMC making a justification for us to conduct this survey. The significance of this survey would be to create awareness about the blood groups status in students of GMC.

1.3 Research Objectives (ROs):

RO 1- RO 3: To determine the frequency of ABO, Rh and ABO-Rh blood groups in students of GMC, D.I.Khan, Pakistan.

RO 4- RO 6: To compare the observed frequency against the expected frequency of ABO, Rh and ABO-Rh blood groups in students of GMC, D.I.Khan, Pakistan.

1.4 Research (Null) Hypotheses:

H_{01}: The observed frequency of ABO blood group is similar to the expected frequency in students of GMC, D.I.Khan, Pakistan. (RO 4)

H_{02}: The observed frequency of Rh blood group is similar to the expected frequency in students of GMC, D.I.Khan, Pakistan. (RO 5)

H_{03}: The observed frequency of ABO-Rh blood groups is similar to the expected frequency in students of GMC, D.I.Khan, Pakistan. (RO 6)

2. MATERIALS AND METHODS

2.1 Design, Setting & Duration: This was a cross-sectional survey done from April 1 to May 23, 2019 in the Department of Community Medicine, Gomal Medical College, D.I.Khan, Pakistan. It was a research project by 4th year MBBS students as a part of Community Medicine curriculum, supervised by Prof. Dr. Iftikhar Ahmad.

2.2 Population & Sampling: The population included total strength of students of GMC, D.I.Khan i.e. 479. The population being accessible was taken as sample. All the students were eligible. Those who were absent or those who refused to be included, were not eligible. As 27 students were absent, so a sample size of 452 students was selected. It is a part of admission process in GMC to test the blood

groups of all the students.

2.3 Data Collection Plan:

ABO (A, B, AB, O), Rh (positive and negative) and ABO-Rh (A+, B+, AB+ O+, A-, B-, AB- & O-) blood groups were our three research variables with their respective attributes. The data type for all variables was nominal. A structured Performa was used as data collection tool to collect primary data from students based on self-reporting. Secondary data was collected through literature research.

2.4 Data Analysis Plan:

2.4.1 Descriptive Statistics & Estimation of Parameters: All variables, being categorical were described by count & percentage. The estimated population parameters were given as proportion confidence interval (CI) at 95% confidence level using an online calculator.[16]

2.4.2 Hypotheses Testing: The observed and expected frequency of ABO, Rh and ABO-Rh blood groups respectively in GMC population will be substantiated by using chi-square goodness-of-fit test.[17,18] at alpha .05 using an online statistical calculator.[19]

3. RESULTS

3.1 Descriptive Statistics & Estimating Parameters:

3.1.1 Frequency of ABO blood group: Out of 452 students, 292 (64.6%) were boys and 160 (35.4%) were girls. The most frequent ABO blood group was B as given in Table 3.1.2 along with population parameters as CI at 95% CL.

3.1.3 Frequency of Rh blood group:

Out of 452 students, the most frequent Rh blood group was Rh+ as given in Table 3.1.3 along with population parameters as CI at 95% CL.

3.1.4 Frequency of ABO-Rh blood group: Out of 452 students, the most frequent ABO-Rh blood group in our sample was B+ 148 (32.05%) given in

Table 3.1.2 Frequency of ABO blood group in students of GMC, D.I.Khan, Pakistan (n= 452)

Variable	Attributes	Sample Statistics		95% CI for Proportion	
		Frequency	Percentage	Lower	Upper
ABO blood group	A	127	28.12	23.96	32.24
	B	165	36.53	32.06	40.94
	AB	57	12.62	09.54	15.66
	O	103	22.73	18.93	26.67
Total		452	100.0	Population Parameters	

Table 3.1.3: Frequency of Rh blood group in students of GMC, D.I.Khan, Pakistan (n= 452)

Variable	Attributes	Sample Statistics		95% CI for Proportion	
		Count	Percentage	Lower	Upper
Rh blood group	Positive	408	90.33	87.57	93.33
	Negative	44	09.67	06.97	12.43
Total		452	100.00	Population Parameters	

Table 3.1.4: Frequency of ABO-Rh blood groups in students of GMC, D.I.Khan, Pakistan (n= 452)

Variable	Attributes	Sample statistics		95% CI for proportion	
		Count	Percentage	Lower	Upper
ABO-Rh blood groups	A+	116	25.60	21.63	29.69
	B+	148	32.05	28.41	37.06
	AB+	50	11.30	08.17	13.95
	O+	91	20.30	16.43	23.82
	A-	11	2.40	01.01	03.85
	B-	17	3.70	02.00	05.51
	AB-	07	01.50	00.41	02.68
	O-	12	02.60	01.17	04.13
Total		452	100.00	Population Parameters	

Table 3.1.4 along with population parameters as CI at 95% CL.

Hypotheses Testing:

3.2.1 Comparison of observed and expected frequency of ABO blood group in GMC, D.I.Khan, Pakistan (H_{01}): The observed frequency of ABO blood group was compared to the expected frequency from a local study by Ahmed et al.,[8] in year 2019 in Karachi, Pakistan. Our observed counts and expected counts are given in Table 3.2.1.1. Sample of 3541 was not comparable, so expected counts & percentages were adjusted. (Table 3.2.1.1)

Chi-square (X^2) goodness-of-fit[17-19] test was used to test the significance of difference between the two distributions of sample & population at alpha .05. Putting observed and expected counts and running the test, p-value came to be less than alpha. $H_0$1 was rejected, showing no good fit between the expected & observed counts or the observed frequency of blood groups ABO in our population is significantly different from what we expected from the adjusted expected count and percentage from the study by Ahmed, et al.[8] (Table 3.2.1.2)

3.2.2 Comparison of observed and expected frequency of Rh blood group in students of GMC, D.I.Khan, Pakistan (H_{02}):

The observed frequency of ABO blood group was compared to the expected frequency of a local study by Ahmed M et al., 2019 in Karachi, Pakistan[8]. Our observed counts and expected counts are given in table 3.2.2.1. Sample of 3521was not comparable, so expected counts & percentages were adjusted. (Table 3.2.2.1)

Chi-square (χ^2) goodness-of-fit test[17-19] was used to test the significance of difference between the two distributions of sample & population, at alpha .05. Putting observed and expected counts and running the test, p-value came to be less than alpha. $H_0$1 was accepted, showing good fit between the expected & observed counts or the observed frequency of blood groups Rh in our population was similar to what we expected from the adjusted expected count and percentage from the study of Ahmed, et al.[8] (Table 3.2.2.2)

Table 3.2.1.1: Frequency & adjusted frequency of ABO blood group in students of GMC, D.I.Khan, Pakistan (n= 452)

Variable	Attributes	Observed Counts	Observed %	Expected Counts	Expected %	Adjusted Expected Counts	Expected %
ABO blood group	A	127	28.10	849	24.1	109	24.10
	B	165	36.50	1167	33.1	150	33.20
	AB	57	12.60	252	7.2	32	07.10
	O	103	22.80	1253	35.6	161	36.60
Total		452	100.00	3541	100	452	100.00

Table 3.2.1.2: Comparison of observed and expected frequency of ABO blood group in students of GMC, D.I.Khan, Pakistan (n= 452)

Variable	Attributes	O	E	O-E	$(O-E)^2$	$(O-E)^2/E$	χ^2	d.f.	P-value
ABO blood group	A	127	109	18.0	324	2.97	44.898	3	.00001
	B	165	150	15.0	225	1.50			
	AB	57	32	25.0	625	19.53			
	O	103	161	-58.0	3364	20.89			
Total		452	452	0	4538	44.898	$H_0$1 rejected at alpha .05		

O= Observed Counts, E= Expected Counts, χ^2= Chi-square value, d.f.= Degree of freedom

Table 3.2.2.1: Frequency & adjusted frequency of Rh blood group in students of GMC, D.I.Khan, Pakistan (n= 452)

Variable	Attributes	Observed Counts	Observed %	Expected Counts	Expected %	Adjusted expected Counts	Expected %
Rh blood group	Rh+	408	90.26	3209	91.1	412	91.13%
	Rh-	44	09.74	0312	08.9	40	8.87%
Total		452	100.00	3521	100	452	100.00

3.2.3 Comparison of observed and expected frequency of ABO-Rh blood groups in students of GMC, D.I.Khan, Pakistan (H_{03}):

The observed frequency of ABO-Rh blood groups were compared to the expected frequency of a local study by Asif, et al.,[11] in 2018 in D.I.Khan, Pakistan.[8] Our observed counts and expected counts are given in table 3.2.3.1. Sample of 4941 was not comparable, so expected counts & percentages were adjusted (Table 3.2.3.1).

Chi-square (X^2) goodness-of-fit[17-19] test was used to test the significance of difference between the two distributions of sample & population, at alpha .05. Putting observed and expected counts and running the test, p-value came to be less than alpha. $H_0$1 was rejected, showing no good fit between

Table 3.2.2.2: Comparison of observed and expected frequency of Rh blood group in students of GMC, D.I.Khan, Pakistan (n= 452)

Variable	Attributes	O	E	O-E	(O-E)2	(O-E)2/E	χ^2	d.f.	P-value
Rh blood group	Positive	408	412	-4	16	0.40	0.80	1	.50769
	Negative	44	40	4	16	0.40			
Total		452	452	0	32	0.80	H01 accepted at alpha .05		

O= Observed Counts, E= Expected Counts, χ^2= Chi-square value, d.f.= Degree of freedom

Table 3.2.3.1: Frequency & adjusted frequency of ABO-Rh blood groups in students of GMC, D.I.Khan, Pakistan (n= 452)

Variable	Attributes	Observed Counts	Observed %	Expected Counts	Expected %	Adjusted expected Counts	expected %
ABO-Rh blood groups	A+	116	25.60	1107	22.4	101	22.00%
	B+	148	32.05	1650	33.4	150	33.00
	AB+	50	11.30	372	7.5	34	8.00
	O+	91	20.10	1377	27.9	125	28.00
	A-	11	02.40	102	2.1	10	2.00
	B-	17	03.70	153	3.1	15	3.00
	AB-	07	01.50	48	1.0	05	1.00
	O-	12	02.60	132	2.7	12	3.00
Total		452	100.00	4941	100.00	452	100.00

Table 3.2.3.2: Comparison of observed with expected frequency of ABO-Rh blood groups in students of GMC, D.I.Khan, Pakistan (n= 452)

Variable	Attributes	O	E	O-E	$(O-E)^2$	$(O-E)^2/E$	χ^2	d.f.	P-value
ABO-Rh blood groups	A+	116	101	15.0	225	2.22	20.14	3	.00001
	B+	148	150	-2.0	4	0.006			
	AB+	50	34	16.0	256	7.52			
	O+	91	125	-34.0	1156	9.24			
	A-	11	10	1	1	0.10			
	B-	17	15	2	4	0.26			
	AB-	07	05	2	4	0.80			
	O-	12	12	0	0	0.00			
Total		452	0			20.14	$H_0$3 rejected at alpha .05		

O= Observed Counts, E= Expected Counts, χ^2= Chi-square value, d.f.= Degree of freedom

the expected & observed counts or the observed frequency of blood groups ABO-Rh in our population is significantly different from what we expected from the adjusted expected count and percentage from the study by Asif, et al.[11] (Table 3.2.3.2)

4. DISCUSSION

4.1 Frequency of ABO blood group in students of GMC, D.I.Khan, Pakistan:

The frequency of A, B, AB and O in our sample of medical students was 127 (28.10%), 165 (36.50%), 57 (12.60%) and 103 (22.80%) with estimated population prevalence as 23.96%-32.24%, 32.06%-40.94%, 9.54%-15.66% and 18.93%-26.67%. The most common blood group was B+ and the least common was AB-.

Similar to our study, Asif et al.[11] gave B group as 36.5% (1803/4941) in army recruits in a study in D.I.Khan, Pakistan in 2017.

Higher than our study was the prevalence of blood group B as 37.97% for Pakistan[1] and by Singh. et al.,[7] in year 2018 blood group B was 38.16%.[7]

Lower prevalence of B was found in USA[1] having B as 10%. In another study on 120 Nepalese medical students, by Pramanik T, et al, 2000, B was 29%.[5] In a study done in Nepal in 2018 B was 27.66%. In a study by Ahmed M, et al., 2019, Karachi, group B were 33.1%[8]. In another study, out of 429 women at Peshawar, Pakistan, blood groups B was 32%.[11]

4.2 Frequency of Rh blood group in students of GMC, D.I.Khan, Pakistan: The frequency of Rh+ and Rh- in our sample was 90.33% and 9.67% with estimated population prevalence as 87.57%-93.33% and 6.97%-12.43% respectively.

Similar to our study in Karachi, Rh+ was 91.1% and Rh- was 9%,[9] whereas in Rawalpindi/ Islamabad based study by Iqbal. et al., in 2009, Rh+ was 92.2% and Rh- was 7.8%.[10]

Higher prevalence of Rh+ than our study was shown by study done in Nepal with Rh+ as 96.79%.[5] In another study from Nepalese students, Rh+ was 97%,[6] and in an Indian study, Rh+ was 93.83%.[7]

No studies showed lower prevalence than ours regarding Rh+ or Rh-.

Our observed frequency of Rh+ 90.33% was similar to what we expected from the adjusted expected count and percentage from a study by Ahmed, et al.[8] (Table 3.2.2.2). No studies could be identified from literature with hypothesis testing.

4.3 Frequency of ABO-Rh blood groups in students of GMC, D.I.Khan, Pakistan: The frequency of ABO-Rh blood groups were A+ 116 (25.60%), B+ 148 (32.05%), AB+ 50 (11.30%), O+ 91 (20.10%) A- 11 (2.40%), B- 17 (03.70%), AB- 07 (1.50%) and O- 12 (2.60%).

In a study by Asif. et al, conducted in D.I.Khan in 2018, out of 4941 recruits, Pakistan, A+ was 1107 (22.4%), B+ 1650 (33.4%), AB+ 372 (7.5%), O+ 1377 (27.9%), A- 102 (2.1%), B- 153 (3.1%), AB- 48 (1.0%) and O- 132 (2.7%).[11]

Our observed frequency of A+ was higher than what we expected 36.60% from a study by Asif. et al.[11] (Table 3.2.1). No studies could be identified from literature with hypothesis testing.

5. CONCLUSIONS

In our population, most common blood group was B+ and the least common was AB-. The observed frequency of blood groups ABO & ABO-Rh was different while of Rh was same as expected. Awareness of blood groups in populations will help in the effective management of blood banks record in routine as well as during blood related life emergency situations.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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None declared.

AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	SA, JA, MSK,
Acquisition, Analysis or Interpretation of Data:	SA, JA, MSK, RHK, MU, MS, AK, AK
Manuscript Writing & Approval:	SA, JA, MSK, AK, RHK, MR, SU, BU, AZ, RU

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.