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Research Article

Relationship of ABO blood groups and Rh factor with diabetes mellitus among the human population of district Swabi, Pakistan

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Abstract: Diabetes mellitus is a biochemical condition with various genetic and environmental aspects that are described by persistently high glucose levels with aggravation of fat, sugar, and protein metabolic activity due to flaws in insulin release, insulin activity, or both. All humans and several other species have four major blood types i.e. A, B, AB, and O. The study seeks to ascertain the existence of a link between ABO blood types, Rh factor and diabetes mellitus in district Swabi of Khyber Pakhtunkhwa, Pakistan. A six-month survey was conducted from July 2022 to December 2022. Individuals' sociodemographic data was collected at random using self-administered questionnaires. Clinical data was collected in the laboratory. The information was then entered and analysed using edition 2020 of SPSS. The Chi-Square test was implemented to calculate the results. Blood type B and Rh positive are more common, with a p-value for their link with diabetes less than 0.05 in the control group. The higher frequency and lower p-values indicate that diabetes mellitus and blood group B and Rh positive are positively correlated. It is suggested that this topic be expanded in other districts to comprehend the relationship of Rh and ABO blood types with diabetes mellitus.

Keywords: Chi-Square, Diabetes mellitus, Hyperglycemia, Insulin, Blood groups, ABO blood groups, Rh factor, Biochemical condition, Genetics, High glucose levels.

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1. Introduction

Diabetes mellitus is a metabolous problem with several underlying causes, which is marked by elevated blood glucose level (hyperglycemia) and aggravations within the metabolism of lipids, sugar, and proteins due to imperfections in the discharge of insulin, the activity of insulin, or both (Kerner & Bruckel, 2014; Rolgic, 2016; Ali *et al.*, 2022). High glucose levels are one of the metabolic problems that make up diabetes mellitus. People who have diabetes have a higher chance of contracting a variety of major illnesses that cause death, increasing the expense of clinical care, lowering life expectancy, and increasing mortality (Baena-Diez *et al.*, 2016).

Diabetes symptoms and signs include excessive urine (polyuria), excessive thirst (polydipsia), fatigue, cloudy vision, frequent infections or sluggish wound healing, cuts and injuries, weight loss while consuming more food (diabetes type 1), Hand or foot trembling, discomfort, or insensibility (diabetes type 2) (American Diabetes Association, 2020). The most prevalent metabolic disorder in the world is diabetes mellitus. In both developed and developing countries, it has an impact on people. By 2017, there were estimated to be 451 million people worldwide living with diabetes mellitus. By 2045, it is estimated that the number of people suffering from diabetes mellitus will reach up to 629 (Cho *et al.*, 2018; Jan *et al.*, 2023). The incidence of type 2 diabetes has now been fluctuating and progressively rising, with a mean frequency of 13.50% to 11.77% in 1999 in Pakistan. The mean prevalence of Sind ratio is 16.2% for men and 11.7% for women. The Punjab ratio is 12.1 % for men and 9.8 % for women. Baluchistan ratio is 13.3% and 8.9% for males and females, respectively. In contrast, the Khyber Pakhtunkhwa ratio is 9.2% for men and 11.6% for women (Meo *et al.*, 2016). Several studies reported that people with blood group A are more likely to acquire type 2 diabetes than people with other blood types; furthermore, a correlation between blood types of AB and O and diabetes mellitus (Navabi *et al.*, 2020), as well as a greater prevalence of Rh-positive blood groups in people with diabetes (Aggarwal *et al.*, 2018). Moreover, blood types O (-) and A (+) seem to be more susceptible to developing diabetes (Okon *et al.*, 2018). Another study showed a connection between blood types "ABO and Rh" and diabetes mellitus, a correlation between blood types "AB," "A," and "Rh positive" and diabetes. The "AB" groups showed the most significant differences, while the "A" groups showed the fewest differences (Sindhu *et al.*, 1988).

All people and numerous different creatures have four chief blood groups i.e. A, B, AB, and O. Karl Landsteiner made the initial discoveries of blood types A, B, and O in 1901 (Race & Sagner, 1978). Landsteiner and Weiner, in 1940, discovered the Rh factor blood type system. Pre-transfusion testing has become obligatory because of the immunogenicity of rhesus factor and A and B antigens (Lefrere & Berche, 2010; Gundrajukuppam *et al.*, 2016). The rhesus system, also known as Rh D, is an antigen that is found on the outer layer of RBCs. It is closely connected to the ABO system. Rh+ or Rh status is determined by whether or not a person has the Rh antigen (Eldie *et al.*, 2016; Stumvoll *et al.*, 2005). Evidence from several studies suggests a connection between blood group and Rh proteins and diseases such as diabetes type 2, gastric illness, cancers of the salivary organs, duodenal ulcers, colorectal disease, thyroid problems, and ovarian tumours (Sartorius *et al.*, 2018). Diabetes mellitus is one of the main medical issues with a high mortality rate all over the world. Even though it is a genetic disorder, environmental circumstances significantly impact how the disorder manifests genetically. Therefore, it appears that several additional hereditary qualities and characteristics, as well as blood type, are related to diabetes mellitus (Pinkston & Cole, 1996).

There have been a few attempts to show a link between the ABO and Rh blood types and diabetes mellitus, but no similar research has ever been conducted in Swabi, and the results have been inconsistent. As a result, the current research was carried out at Swabi, a district of Khyber Pakhtunkhwa, Pakistan, to look into the potential connection between the ABO blood types, Rh factor and diabetes mellitus type II. The present study's aims and objectives were: 1) To evaluate whether there is a link between Rh factors, ABO blood types, and diabetes mellitus in the Swabi district of Khyber Pakhtunkhwa, Pakistan. 2) To identify the prevalence of Diabetes Mellitus in various blood types in Swabi. 3) To find out how ABO blood types, Rh factors, and diabetes mellitus are distributed across various demographic groupings in the community.

2. Materials and methods

The study was conducted in Pakistan's Khyber Pakhtunkhwa province's Swabi area. It comprises 56 union councils and four tehsils: Swabi, Topi, Lahore, and Razar. A six-month survey was conducted from July 2022 to December 2022 to gather information from the whole area. The study's source population was the whole human population, both male and female, from all tehsils in the district of Swabi. During the study, 6,000 individuals were studied. Out of which 1200 (20%) individuals were diabetic, the experimental group and 4,800 (80%) individuals were non-diabetic, the control group, 1500 individuals were taken from each tehsil of district Swabi. Materials like lancets, slides, syringes, blood antiserums, a chemistry analyser, and a glucose kit were used. The individuals' sociodemographic data was obtained at random using self-administered questionnaires. Ethical issues and principles were considered during data gathering during the fieldwork to perform a safe and ethically lawful research study. All study participants were informed about the investigation's risks and benefits. The individual was then extensively inspected, the necessary tests for the research study were done, and the data was gathered and documented in the questionnaire. In the laboratory, clinical data was gathered. A straightforward agglutination slide technique test determined the ABO and Rh blood types. In accordance with Chemelex, S.A. Spain's protocol, antisera A, B, and D were used. Blood glucose levels were measured using a semi-automatic chemistry analyzer and a reagent called a glucose kit in accordance with a protocol given by Biocor India and Chemelex, S.A., Spain. The accuracy of measuring instruments and chemicals was tested regularly. A and B cell suspensions were employed to evaluate the purity of anti-A and anti-B sera. Standard operating procedures were followed to ensure the quality of the laboratory results, including accuracy and cleanliness.

The information was thoroughly examined, arranged, and categorised. After that, the data was examined using SPSS version 2020, and the Chi-Square test was applied to determine the association between diabetes mellitus and the many factors that were kept under observation throughout data collection. The connection between diabetes mellitus, blood type, and the Rh factor received particular attention. Tables and figures were created using Microsoft Excel 2016. The study benefited the participants by informing them about their blood types and blood sugar levels.

3. Results

To ascertain how the Rh factor and ABO blood types relate to diabetes mellitus in the district's population, a study was carried out in Swabi, Khyber Pakhtunkhwa, Pakistan. Equal numbers

of data were collected from all four tehsils of the district, i.e., 1500 individuals from each, which makes a sample of 6000 individuals from the whole district. Out of this sample, 1200 (20%) individuals were diabetic and labelled as the experimental group, and 4800 (80%) were non-diabetic and labelled as the control group. Different variables were considered during data collection, like age, gender, area status, marital status, education, blood groups, Rh factor, insulin usage, family size, and family history of diabetes. The frequency and percentages of these variables are shown in Table-1. The data was examined using SPSS version 20 to determine any potential relationships between blood groups Rh factor and diabetes mellitus. The Chi-Square test was used on each variable to determine if there was a significant association between them. An association must have a p-value of 0.05 or less to be considered significant.

Table-1: Demographic data of study participants

Factors	Sub-factors	N	Percentage
Age	<18	80	13
	19-30	155	2.6
	31-50	2095	34.9
	50+	3670	61.2
Gender	Male	3735	62.3
	Female	2265	37.8
Area status	Urban area	4121	68.7
	Rural area	1879	31.3
Tehsil	Lahore	1500	25
	Razar	1500	25
	Swabi	1500	25
	Topi	1500	25
Marital status	Married	5239	87.3
	Unmarried	761	12.7
Education	Illiterate	4605	76.8
	Intermediate	1160	19.3
	Highly qualified	235	3.9
Blood group	A	1547	25.8
	B	2084	34.7
	AB	641	10.7
	O	1728	28.8
Rh factor	Positive	4802	80
	Negative	1198	20
Are you Diabetic	Yes	1200	20
	No	4800	80
Are you Using insulin	Yes	354	5.9
	No	5646	94.1
Family size	Up to 2	1766	29.4
	Above 2	4234	70.6
Family history of diabetes	Yes	3516	58.6
	No	2484	41.4

3.1. Relationship of diabetes mellitus with all the observed factors in district of Swabi

In the overall district Swabi, the statistical analysis of the data shows that there is no significant relationship between diabetes mellitus and variables like age, gender, area status, education, and family size, as their p-values are 1.000, 0.506, 0.140, 1.000, and 0.470, respectively, which are more than 0.05. On the other hand, there is a significant relationship between diabetes mellitus and variables like marital status, blood group, Rh factor, and family history of diabetes. The p-value for each is 0.000, which is less than 0.000, which shows a highly significant relationship between diabetes mellitus and the variables (Table-2).

Table-2: Relationship of diabetes mellitus with all the observed factors in the overall district Swabi

S.No.	Factors		Diabetes status		Chi-Square value	P-value
			Yes	No		
1	Age	<18	16 (1.3%)	64 (1.3%)	0.000	1.000
		19-30	31 (2.6%)	124 (2.6%)		
		31-50	419 (34.9%)	1676 (34.9%)		
		50+	734 (61.2%)	2936 (61.2%)		
		Total	1200 (100%)	4800 (100%)		
2	Gender	Male	757 (63.1%)	2978 (62%)	0.443	0.506
		Female	443 (36.9%)	1822 (38%)		
		Total	1200 (100%)	4800 (100%)		
3	Area status	Urban area	803 (66.9%)	3318 (69.1%)	2.177	0.140
		Rural area	397 (33.1%)	1482 (30.9%)		
		Total	1200 (100%)	4800 (100%)		
4	Marital status	Married	1114 (92.8%)	4125 (85.9%)	41.221**	0.000
		Unmarried	86 (7.2%)	675 (14.1%)		
		Total	1200 (100%)	4800 (100%)		
5	Education	Illiterate	921 (76.8%)	3684 (76.8%)	0.000	1.000
		Intermediate	232 (19.3%)	928 (19.3%)		
		Highly qualified	47 (3.9%)	188 (3.9%)		
		Total	1200 (100%)	4800 (100%)		
6	Blood group	A	286 (23.8%)	1261 (26.3%)	34.139**	0.000
		B	496 (41.3%)	1588 (33.1%)		
		AB	124 (10.3%)	517 (10.8%)		
		O	294 (24.5%)	1434 (29.9%)		
		Total	1200 (100%)	4800 (100%)		
7	RH factor	Positive	1083 (91.7%)	3702 (77.1%)	102.403**	0.000
		Negative	117 (8.3%)	1098 (22.9)		
		Total	1200 (100%)	4800 (100%)		
8	Family size	Up to 2	343 (28.6%)	1423 (29.6%)	0.522	0.470
		Above 2	857 (71.4%)	3377 (70.4%)		
		Total	1200 (100%)	4800 (100%)		
9	Family history of diabetes	Yes	788 (65.7%)	2728 (56.8%)	30.876**	0.000
		No	412 (34.3%)	2072 (43.2%)		
		Total	1200 (100%)	4800 (100%)		

Note: **p-value < 0.01

3.2. Relationship of diabetes mellitus with blood group in district Swabi

When compared to non-diabetics, those with diabetes have a lower percentage of blood group A (23.8%) than those without diabetes (26.3%). In people with diabetes, the proportion of blood group B is higher than in those without diabetes; it is 41.3% in people with diabetes compared to 33.1% in people without diabetes (Figures 1 and 2). The percentage of people with blood type AB who also have diabetes is 10.3%, compared to 10.8% in the non-diabetic population. When compared to non-diabetics, people with diabetes have a lower percentage of blood group O (24.5%) than non-diabetics (29.9%). People with blood group B have a higher risk of developing diabetes mellitus because the percentage of blood group B is higher in people with diabetes than in non-diabetics. Blood group B has a high frequency in diabetes patients (496), followed by blood groups O (294), A (286), and AB (286). The p-value for the association between blood group and diabetes mellitus is 0.000, indicating a powerful association (Table 2, Figures 1, 2 and 3).

Figure 1: The frequency of blood group in diabetic individuals in district Swabi

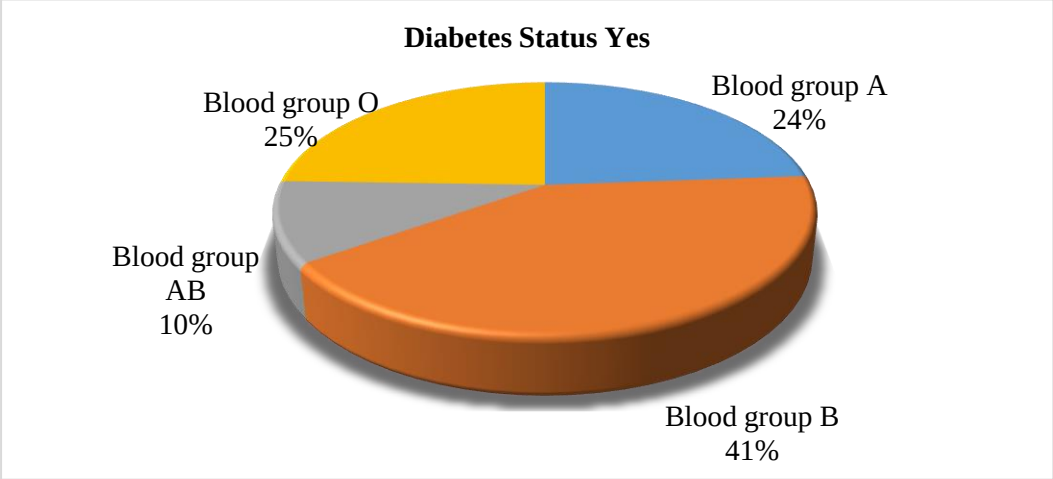


Figure 2: The frequency of blood groups in the non-diabetic individuals in district Swabi

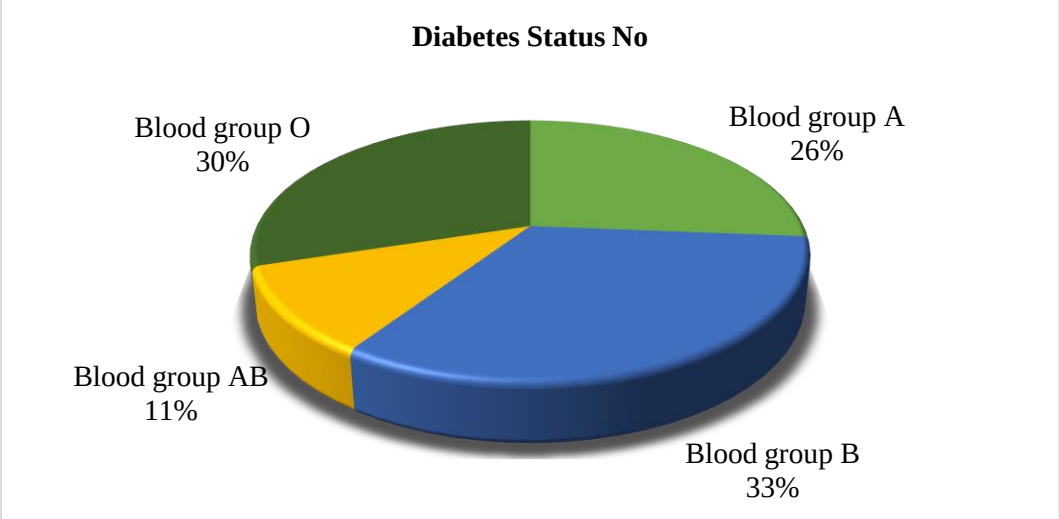
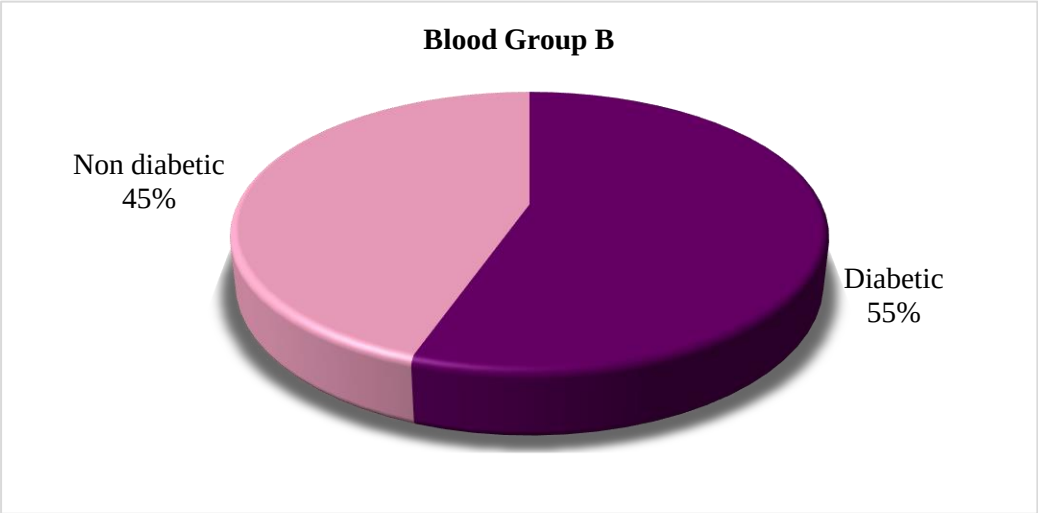


Figure 3: The frequency of blood group B in diabetic and non-diabetic individuals



3.3. Relationship of diabetes mellitus with Rh factor in district Swabi

Rh positivity is more common in people with diabetes than in those without diabetes; it is 91.7% in people with diabetes and 77.1% in people without diabetes. In people with diabetes, the percentage of Rh-negative blood cells is lower than in people without diabetes; it is 8.3% in people with diabetes and 22.9% in people without diabetes. This demonstrates that people with Rh-positive blood have a higher chance of developing diabetes than people with Rh-negative blood. Rh positives are more common than Rh negatives in diabetic patients. The p-value for the association between diabetes mellitus and the Rh factor is less than 0.05, indicating a powerful association. (Table-2, Figures 4 and 5).

Figure 4: the relationship of diabetes mellitus with Rh factor in the district of Swabi

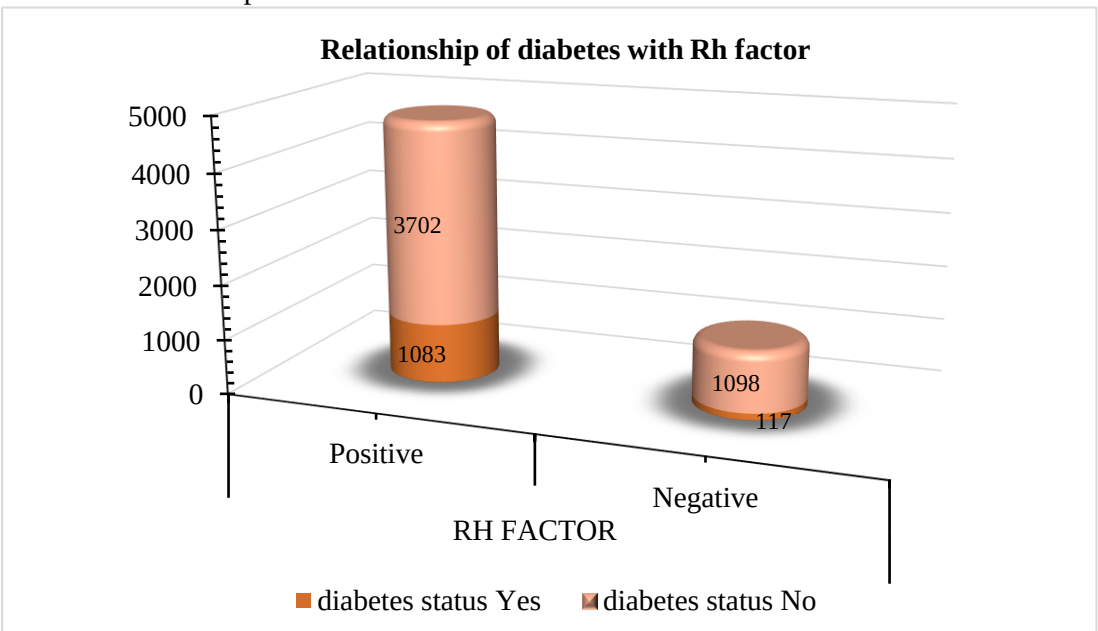
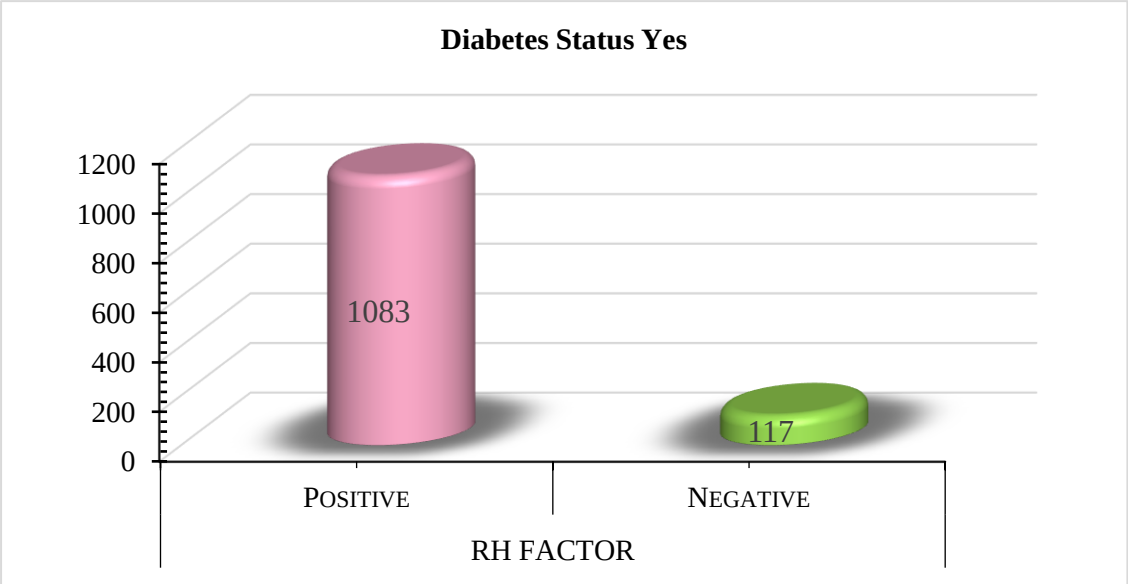


Figure 5: The distribution of Rh factor among diabetic individuals in the district of Swabi



4. Discussion

In the present study, we observed a positive correlation between blood types, the Rh factor, and diabetes mellitus, and it is noted that diabetic patients have a high frequency of blood group B, which blood group O follows. In contrast, the frequency of blood types A and AB is lower in diabetic patients in district Swabi. Additionally, the percentage of Rh-positive blood cells is higher in diabetic individuals than in Rh-negative blood cells, suggesting that people with blood type B and a positive Rh factor have an increased risk of developing diabetes mellitus in district Swabi.

Our findings are consistent with and supported by the earlier studies as reported by Ghafar *et al.* (2022), indicating that people with blood types B and O have a higher prevalence of diabetes mellitus, while the ratio is lower in those with blood types A and AB. Rh-positive individuals have a greater prevalence of diabetes mellitus than Rh-negative individuals in Karachi, Pakistan.

The same results are reported in Sharjeel *et al.* (2021), a strong correlation between blood group B and diabetes mellitus type 2 ($p = 0.006$), and the correlation is most vital in those with blood type B in Lahore. Tasneem *et al.* (2021) revealed that blood group B is the most common ($p = 0.001$) and that type 2 diabetes patients are more likely to be Rh-negative than the control group in Lahore. Anwar *et al.* (2019) reported that blood group B is much more common among people with diabetes than other blood types in Karachi, Pakistan.

Furthermore, Shams *et al.* (2017) observed and found that individuals with blood type B had a greater probability of developing diabetes mellitus in Mardan, Pakistan. Qureshi and Bhatti (2003) observed a connection between diabetes and a higher prevalence of blood type B in diabetics as opposed to pre-diabetics in Hyderabad, Sindh, Pakistan. However, some research demonstrates a beneficial connection between blood groups and diabetes mellitus, in contrast to current findings, while others suggest the reverse.

5. Conclusion

This study found a relationship between ABO blood groups, RH factors, and diabetes mellitus, with a particularly significant correlation between blood group B, Rh-positive, and diabetes mellitus in district Swabi of Khyber Pakhtunkhwa, Pakistan. The percentage of blood group B is higher in diabetics than in non-diabetics, i.e. the percentage of blood group B is 41% in diabetics and 33% in non-diabetics. Similarly, Rh positivity is more common in people with diabetes than in those without diabetes; it is 91.7% in people with diabetes and 77.1% in people without diabetes. Blood type B and Rh positive are more common in diabetic patients, with a p-value for their link with diabetes being less than 0.05. The higher frequency and lower p-values indicate that diabetes mellitus and blood group B and Rh positive are positively correlated. Thus, people with blood type B and positive Rh factors have a higher chance of developing diabetes. High-risk individuals have to undergo routine diabetes screening tests. Long-term therapies like dietary restriction and exercise can help at-risk people.

Declaration of conflict of interest

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