

# Association of "ABO" and "Rhesus" Blood Types with Type 2 Diabetes in India

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## ABSTRACT

**Aims and Objective:** The purpose of this study is to determine the association between "ABO" and "Rhesus" blood types and type 2 diabetes in India.

**Material and Methods:** This study was carried out at Sardar Patel Medical College and associated group of Hospitals, Bikaner, Rajasthan, India from April 2021 to June 2021. This study included total 80 individuals out of whom 40 individuals were T2DM patients, and 40 individuals were non diabetic apparently healthy controls. All T2DM patients who had follow up at Medical College and Hospital, Bikaner, Rajasthan, India during the study period, volunteers, and apparently healthy blood donors who donated blood during the study period were included in the study. The collected data were entered and analyzed with SPSS version 20 (IBM, USA). Descriptive statistics were performed on sociodemographic and clinical data, and odds ratios and chi-square tests were performed.

**Results:** In India, blood group O and blood group AB were found to be more frequent in diabetes mellitus. When Chi-square test was applied, a statistically significant association was found between blood group O, AB and diabetes mellitus. The frequency of Rh positive blood type was found to be high in diabetic patients.

**Conclusion:** The results of this study suggest that ABO blood group phenotype is significantly associated with T2DM, and the mechanism of this association should be investigated in the future.

## KEY WORDS

blood groups, ABO blood groups, Type 2 diabetes

## INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disorder of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, protein and fat metabolism resulting from defects in insulin secretion or insulin action or both (WHO consultation 1999)<sup>1)</sup>. The incidence of DM has been linked with many factors such as genetic, environment, diet, obesity, and lack of exercise. DM is generally divided as insulin-dependent diabetes mellitus (IDDM or type 1), characterized by the body's failure to produce insulin and requires the person to inject insulin and non-insulin-dependent diabetes mellitus (NIDDM or type 2), characterized by high blood glucose in the context of insulin resistance and relative insulin deficiency<sup>2)</sup>. According to the International Diabetes Federation (IDF), approximately 415 million adults between the ages of

20 to 79 years had diabetes mellitus in 2015. DM is proving to be a global public health burden as this number is expected to rise to another 200 million by 2040<sup>3)</sup>.

The "ABO" blood group was first discovered by Karl Landsteiner in 1900. "ABO" and "Rhesus" blood group antigens are major human blood group system antigens with prime importance in transfusion medicine<sup>4)</sup>. The "ABO" system contains 4 major "ABO" phenotypes "A", "B", "O", and "AB" Many researchers have made attempts to determine the significance of particular ABO Phenotype for susceptibility to disease. Certain diseases show a strong association with the ABO Blood groups, notably peptic ulcer is much higher in blood group 'O'<sup>5)</sup>, whereas cancer of Stomach<sup>6)</sup>, tumors of salivary glands<sup>7)</sup> are more frequent in blood group 'A' individuals. Many reports have appeared in recent years suggesting an association between blood groups and DM. McConnell *et al.* studied 1333 diabetic patients and concluded increase frequency of A blood group among these diabetic patients<sup>8)</sup>. Tedeschi and cavazzuti

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**Table 1: Clinical data of DM patients**

Variables		Frequency	Percentage
Family history of DM	Yes	13	32.50
	No	27	67.50
Cigarette smoking habit	Yes	11	27.50
	No	29	72.50
Alcohol drinking habit	Nondrinker	25	62.50
	Light	5	12.50
	Moderate	7	17.50
	Heavy	3	7.50
Eat fruits and vegetables	Do not eat at all	12	30.00
	Some times	23	57.50
	Every day	5	12.50
Physical exercise	Inactive	24	60.00
	Medium	12	30.00
	Highly active	4	10.00
SBP	≤ 135	26	65.00
	> 135	14	35.00
DBP	≤ 85	29	72.50
	> 85	11	27.50
BMI	Underweight	3	7.50
	Normal weight	19	47.50
	Overweight	13	32.50
	Obese	5	12.50
Glycemic control	Good (FBS ≤ 152)	11	27.50
	Poor (FBS > 152)	29	72.50
TRG	≤ 150 mg/Dl	19	47.50
	> 150 mg/Dl	21	52.50
LDL	≤ 100 mg/Dl	24	60.00
	> 100 mg/dL	16	40.00
HDL	≥ 40 mg/dL	29	72.50
	< 40 mg/dL	11	27.50
TC	≥ 200 mg/dL	21	52.50
	>200 mg/dL	19	47.50

from Italy showed an increased frequency of blood group B among diabetics<sup>9</sup>). Sidhu *et al.* and Shyamalkoley suggested that there is no association between the distribution of the ABO blood types and diabetes mellitus<sup>10,11</sup>). The pathophysiologic mechanisms for the association between ABO blood group phenotypes with T2DM and associated factors are not well understood, hence the current study was carried out to assess the association of the ABO and Rh blood groups with T2DM and associated factors among adults with T2DM attending at Government Medical College and Hospital, Bikaner, Rajasthan, India

## METHODS AND MATERIALS

This study was carried out at Sardar Patel Medical College and associated group of Hospitals, Bikaner, Rajasthan, India from April 2021 to June 2021. This study included total 80 individuals out of whom 40 individuals were T2DM patients, and 40 individuals were non-diabetic apparently healthy controls. All T2DM patients who had follow-up at Sardar Patel Medical College and associated group of Hospitals, Bikaner. During the study period, volunteers, and apparently healthy blood donors who donated blood during the study period were included in the study. Identification of T2DM from T1DM was done by analyzing the patient's chart during data collection.

A pretested semi structured questionnaire was used by the trained

**Table 2: The association of ABO blood group phenotypes with T2DM**

Blood groups	T2DM patients	%	Controls	%	$\chi^2$	P value
A	11	27.50	13	32.50	14.5520	0.0020*
B	2	5.00	8	20.00		
AB	13	32.50	1	2.50		
O	14	35.00	18	45.00		
Rh 'D'+	36	90.00	37	92.50		
Rh 'D'-'	4	10.00	3	7.50	0.1570	0.6920

nurses to collect the socio demographic and clinical data. Height and weight of study participants were measured with stadiometer and digital weight scale respectively. Blood pressure was measured with manual sphygmomanometer.

The ABO blood group of study participants was determined by the slide method using known anti-A and anti-B sera. The Rh blood group of participants was determined with the slide method and those tested Rh negative were tested again by the test tube method with anti-D and anti-human globulin sera. Triglyceride (TRG), low-density lipoprotein (LDL), high density lipoprotein (HDL), total cholesterol (TC), and fasting blood glucose levels of DM patients were determined by fully auto analyzer. Glucose, TRG, and TC were determined using glucose oxidase- peroxidase, and cholesterol oxidase peroxidase methods, respectively.

The questionnaire was pretested on participant's equivalent to 5% of the sample size of the study for its accuracy, consistency, and to estimate the time needed to complete the questionnaire prior to actual data collection. One-day training was given for data collectors on the objective of the study, consenting, techniques of interview, laboratory test procedures, and their quality control. Socio demographic and clinical data were collected by trained nurses under the supervision of the principal investigator, and the quality of measuring devices was checked daily.

The data obtained was entered and analyzed by SPSS version 20 (IBM, USA). Descriptive statistics were performed for socio demographic and clinical data, and odds ratio and chi-square values were derived to show the correlation between the ABO blood groups and DM and DM-associated factors. The bivariable logistic and multivariable regression analyses were employed. Variables having a P value ≤ 0.2 were incorporated into multivariable logistic regression analysis, and a P value < 0.05 was considered statistically significant. Ethical clearance was obtained from the Research and Ethical Review Committee of the institute.

## RESULTS

Thirteen (32.50%) of T2DM cases had a family history of DM. Out of 40 T2DM cases, 27.50%, 27.50% 37.50%, 70.00%, and 57.50% were cigarette smokers, alcohol drinkers, eat fruits and vegetables some- times, and 60.00% did not perform physical exercise and 47.50% had normal BMI, respectively. Forty (72.50%) of T2DM patients had poor glycemic control. Among T2DM patients 52.50%, 60.00%, 72.50%, and 52.50% showed normal TRG, LDL, HDL, and TC, respectively (Table 1).

Among DM patients, blood group O in 14 (35.00%) was the most frequent followed by AB in 13 (32.50%), A 11 (27.50%), and B in 2 (5.00%), and 36 (90.00%) were Rh 'D' positive. Among healthy controls blood group O in 18 (45.00%) was most frequent followed by A in 13 (32.50%), B in 8 (20.00%), and AB in 1 (2.50%), and 37 (92.50%) were Rh 'D' positive. ABO blood groups were significantly associated with T2DM with a chi-square value of 14.5520 and P value of 0.0020, but Rh blood group was not associated with T2DM (Table 2).

Binary logistic regression analysis indicated that blood group B individuals were 2.12 times more risk to develop T2DM as compared to other ABO blood groups (OR: 1.9259; 95% CI: 0.6953 -5.3348). On the other hand, blood group AB was protective against T2DM as compared to other blood groups (OR: 2.0526; 95% CI: 0.1786 -23.5905). further, blood group B+ was protective against T2DM as compared to other blood groups (OR: 2.0204; 95% CI: 1.0003 -5.8287). The details are presented in the above table 3.

**Table 3: Association of the ABO and Rh blood group phenotypes with T2DM**

Study group	Non-A	%	A	%	COR	95% CI	P value
Control	27	67.50	13	32.50	1		
DM	29	72.50	11	27.50	0.7877	0.3020 to 2.0552	0.6259
	Non-B	%	B	%			
Control	32	80.00	8	20.00	1		
DM	27	67.50	13	32.50	1.9259	0.6953 to 5.3348	0.2074
	Non-O	%	O	5.00			
Control	22	55.00	18	45.00	1		
DM	26	65.00	14	35.00	0.6581	0.2675 to 1.6189	0.3623
	Non-AB	5.00	AB	%			
Control	39	97.50	1	2.50	1		
DM	38	95.00	2	5.00	2.0526	0.1786 to 23.5905	0.5638
	Rh+	5.00	Rh-	5.00			
Control	37	92.50	3	7.50	1		
DM	36	90.00	4	10.00	1.3704	0.2863 to 6.5587	0.6933
	Non-B+	5.00	B+	5.00			
Control	33	82.50	7	17.50	1		
DM	28	70.00	12	30.00	2.0204	1.0003 to 5.8287	0.0499*
	Non-O+	5.00	O+	5.00			
Control	23	57.50	17	42.50	1		
DM	27	67.50	13	32.50	0.6514	0.2618 to 1.6207	0.3567

\*p &lt; 0.05

**Table 4: Association of ABO blood group phenotypes with biochemical and anthropometric measurements**

Variables	Non-A	%	A	%	COR	95% CI	P value
SBP	Normal	19	47.50	5	12.50	1	
	Hypertensive	10	25.00	6	15.00	2.2800	0.5553 to 9.3614
LDL	Normal	17	42.50	8	20.00	1	
	Abnormal	12	30.00	3	7.50	0.7188	0.1605 to 3.2190
HLD	Normal	23	57.50	8	20.00	1	
	Abnormal	6	15.00	3	7.50	1.4375	0.2895 to 7.1379
TC	Normal	16	40.00	5	12.50	1	
	Abnormal	13	32.50	6	15.00	1.4769	0.3663 to 5.9554
	Non-B		B				
SBP	Normal	15	37.50	8	20.00	1	
	Hypertensive	12	30.00	5	12.50	0.7813	0.2024 to 3.0161
DBP	Normal	18	45.00	10	25.00	1	
	Hypertensive	9	22.50	3	7.50	0.6000	0.1315 to 2.7384
TC	Normal	12	30.00	8	20.00	1	
	Abnormal	15	37.50	5	12.50	0.5000	0.1295 to 1.9303
Alcohol	No	22	55.00	8	20.00	1	
	Yes	5	12.50	6	15.00	3.3000	1.0090 to 13.8790

\*p&lt;0.05

Family history of DM, physical exercise, DBP, BMI, TRG, and HDL cholesterol were not statistically associated with ABO blood group phenotypes. Similarly, SBP (OR = 2.2800, P = 0.2527) was not associated with blood group A; individuals with blood group A were 2.2800 times more at risk to be hypertensive as compared to other blood groups. Increased alcohol drinking habit (AOR = 3.3000, P = 0.0498) and association is found to be statistically significant with blood group B. But rests of the parameters are not associated with blood group A and blood group B (Table 4).

## DISCUSSION

The aim of this study is to determine the association between ABO and Rh blood group phenotypes and T2DM and its associated factors in India. many studies were conducted to explore the association between ABO and Rh blood groups and diabetes. However, the results were inconsistent and varied by region. While some researchers have found a link between blood type and diabetes, others have found no link.

The results of this study showed that people with blood types O and

AB were more likely to suffer from DM; the association between ABO blood type and DM was statistically significant. Also, people with positive Rh blood type were more likely to have diabetes, but the association between Rh blood type and diabetes was not statistically significant.

Different clinical studies have shown that individuals of the O phenotype blood group are more susceptible to Diabetes mellitus diseases. Our study has increased association of blood group O with DM. Similar results were found with Karagoz *et al.*,<sup>12</sup> Zhang *et al.*,<sup>13</sup>. Karagoz *et al.*<sup>12</sup> investigated the association of various blood groups with the incidence of DM. They found a substantial difference between the distribution of "ABO" blood groups and gestational DM. They noticed higher risk of gestational DM in patients with blood group "AB" and "O". Moreover, "Rh+ve" factor was also considered a risk factor. Zhang *et al.*<sup>13</sup> determined the association of blood types "ABO" and the risk of gestational diabetes. They reported that, females with blood groups "A", "B" or "O" have high association with gestational DM as compared with blood type "AB".

Agarwal *et al.*<sup>14</sup> also observed similar results in their study. There was an increased frequency of blood group AB and blood group O in DM. they also noticed decreased association of diabetes with blood group B.

Whereas Bener and Yousafzai<sup>15</sup> study demonstrated that, blood type "B" was significantly common and blood group "O" was significantly less common in diabetic patients compared to healthy non-diabetic population. In addition, Qureshi and Bhatti<sup>16</sup> found that the incidence of blood type "B" was significantly common and blood group "O" was low in type 2 diabetics as compared to the general population.

Waseem *et al.*<sup>17</sup> observed a higher fraction of blood group "AB" among diabetics (15.0%) as compared to controls (10.0%). Blood groups "A" and "B" were less communal in diabetic group as compared to normal subjects. Blood group "O" was equally distributed among both groups. However, "Rh-ve" blood type was more common in the diabetic group.

S.A. Meo *et al.*<sup>18</sup> study indicated subjects with blood group "B" were at high risk while subjects with blood group "O" were at low peril of evolving type 2 diabetes. It is suggested that subjects with blood group "B" should be closely monitored by physicians as these subjects have an increased risk of type 2 diabetes. Whereas in our study we noticed that incidence of blood group "B" was low in type 2 diabetics as compared to the general population.

Moinzadeh *et al.*<sup>19</sup> evaluated 8126 participants, 5143 were male and 2983 were female. They observed that blood group "B+ve" was more frequent in diabetic patients (30.8%) compared to control group 24.9%. However, Sharma *et al.*<sup>20</sup> did not find an association with "ABO" blood groups with T2DM. In western Algerian population, 280 patients with type 2 diabetes mellitus and 271 healthy controls studied by Dali Sahi M *et al.*<sup>21</sup>, and they confirmed that there was no association between ABO/Rh blood group and diabetes mellitus

The possible reasons for this conflicting results regarding the association between ABO blood groups and DM could be sample size, age and gender distribution, and a difference in racial and environmental factors.

The association between "ABO", Rhesus blood types and incidence of type 2 diabetes is still not well understood. The recent genome-wide association studies suggest that the "ABO" blood group antigen enhances the general body inflammatory state. Single nucleotide polymorphisms at the "ABO" locus are linked with two serum markers of inflammation, tumor necrosis factor (TNF)-alpha and soluble intercellular adhesion molecule<sup>22,23</sup>. Increased expression of TNF-alpha has been associated with inflammation<sup>24</sup>. It is well known that systemic inflammation is a major cause of insulin resistance, which ultimately leads to the development of type 2 diabetes<sup>25,26</sup>. Experimental and epidemiological studies suggest that "ABO" blood type b and type 2 diabetes may be interrelated due to the widespread genetic and immunological basis of the disease. Although diabetes is highly influenced by lifestyle, it may be possible to infer immunologically vulnerable people from their blood type.

## CONCLUSION

In the present study, ABO blood type was found to be significantly

associated with T2DM. In the present study, O blood group was found to be positively associated with T2DM and B blood group was found to be negatively associated. It can be concluded that blood type may be a risk factor and can help in the assessment of diseases. Future studies are needed to determine if blood type is still relevant after adjusting for lifestyle and other factors, but the risk of diabetes with blood type should be examined immunologically.

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