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ORIGINAL ARTICLE

Exploring the Association Between ABO Blood Groups and Blood Glucose Levels in Known Cases of Type 2 Diabetes Mellitus

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Abstract

Background/Aim: ABO blood types have long been linked to diverse predispositions to a number of diseases, including diabetes mellitus. Blood group B and type 2 diabetes are significantly positively correlated, while blood group O and DM have a negative correlation, according to several studies. This study focused a step further to evaluate whether blood type affects HbA_1c, postprandial blood glucose (PPBG) and fasting blood glucose (FBG) levels in individuals with type 2 diabetes.
Methods: A cross-sectional study was conducted on 90 patients with type 2 diabetes, aged 18 to 75 years, from the medicine department of RUHS Hospital in Jaipur, in May 2023. Detailed information regarding a number of important study variables, such as blood groups, HbA_1c levels, PPBG and FBG, were gathered through extensive laboratory tests. The gathered information was carefully examined utilising statistical methods in order to derive conclusions.
Results: Chi-square test revealed that blood groups and all blood sugar level variables in type 2 diabetic patients are independent attributes ($p > 0.05$) and no association exists between them.
Conclusion: The study concludes that type 2 diabetes, once developed, blood groups do not affect the severity and status of the disease, although they may have an initial contribution to susceptibility.

Key words: ABO blood group system; Diabetes mellitus, type 2; Blood glucose; Fasting; Postprandial period; Glycated haemoglobin.

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Introduction

In 2019, over 463 million persons aged 20 to 79 worldwide had diabetes mellitus (DM), mostly type 2 DM, which caused 4.2 million deaths each year. Notably, over 79 % of these fatalities occurred in poor and middle-income nations.[1]

ABO blood types, which were identified by Karl Landsteiner in 1900, have significant consequences on human health. Based on carbohydrate epitopes, the presence or absence of the "A" and "B" genes governs the ABO blood type.[2] The seven exons of the ABO gene, which is positioned on chromosome 9q34, contribute to the four main phenotypes "A", "B", "O" and "AB".[3] Blood groups have been linked to varying levels of susceptibility to different diseases. Studies have demonstrated links between particular blood types and the occurrence or severity of specific conditions. For example, blood type A is linked to an increased risk of coronary artery disease, but blood type O may have a lower risk because of enhanced fibrinolytic activity.[4] In addition, blood group O is believed to provide some defence against severe malaria, whereas blood group A might be at

greater risk for gastric ulcers induced by *Helicobacter pylori* and for developing gastric and pancreatic cancer.[5]

Numerous researches have investigated the relationship between ABO blood types and metabolic diseases like DM, obesity and insulin resistance. Evidence indicates that people with blood groups A and B may be more susceptible to type 2 DM than people with blood group O.[6, 7] Nonetheless, the precise mechanisms remain unknown.

A South-Asian study demonstrated that blood group O was negatively correlated with type 2 DM, while blood group B was significantly associated with the disease. Blood types A and AB were not found to be significantly associated with DM type 2.[7] The research question of this study focused on whether blood type affects fasting, postprandial glucose and HbA_1c levels in type 2 diabetic patients. As far as we are aware, this is the initial examination that investigates the association between ABO blood types and the severity of type 2 DM.

Methods

Following ethical approval (EC-P-38-22 granted in May 2023), a cross-sectional study was conducted involving 90 type 2 diabetic patients randomly selected from the general medicine department of RUHS Hospital, Jaipur, India. Participants in the study were aged between 18 and 75 years and were known cases of type 2 DM with a variable duration of illness ranging from one to ten years. Fasting (FBG) and post-prandial (PPBG) blood glucose and HbA_1c levels, along with blood group determination, were evaluated in the 90 patients who consented to participate. For the analysis, HbA_1c values were categorised as moderately elevated (> 6.5-9.0 %), high (≥ 9.01-11.0 %) and very high (≥ 11.01 %). Similar categories were established for fasting blood glucose, with values categorized as < 180 mg/dL, 181-250 and > 250 and for post-prandial sugar levels as >200-300, 301-400 and > 400 mg/dL.

In the end, statistical analysis was carried out on 80 patients with a positive Rh factor, while ten Rh-negative patients were excluded due to the small sample size unsuitable for statistical evaluation. Fasting blood glucose levels and HbA_1c levels were compared across blood groups for association in 80 patients while for post prandial blood glucose levels, only 62 patients were found suitable for analysis owing to six patients distributed across various blood groups in range above 400 mg/dL and 14 patients showing PPBG values less than 200 mg/dL (beyond the selected criteria).

Statistical analysis was conducted using Minitab 14. The Chi-square test was used to evaluate the relationship between blood groups and blood sugar levels in diabetes mellitus; a p-value of less than 0.05 was considered significant.

Results

The mean age of 90 recruited patients was 51.51 years, with 41 male and 49 being female.15 patients had blood group A, 32-B, 10-AB and 33 observed blood group O. The mean HbA_1c level of all patients was 9.67 ± 2.08 %, mean fasting blood glucose was 195.21 ± 63.57 mg/dL and postprandial blood glucose level was 274.28 ± 79.54 mg/dL.

Due to statistical limitations, the study variables and their correlation with ABO blood types were finally examined in 80 Rh-positive recruited patients. Null hypothesis (H0) assumed that the ABO blood group and fasting/ postprandial and HbA_1c sugar levels are independent attributes and blood group is not associated with the blood sugar levels. The alternative hypothesis (H1) was tested in either case. The results for the blood group and fasting blood level are shown in Table 1. On statistical evaluation, the values came out to be: $\chi^2 = 8.71$, df = 6, p = 0.19. The null hypothesis was accepted since the p-value was higher than 0.05, indicating that the patient's blood group has no impact on their fasting sugar levels and that the two variables are independent.

Similarly, the association of the blood groups and postprandial glucose levels was evaluated. The results are shown in Table 2. The p-value was greater than 0.05 inferring that blood group and postprandial sugar levels are independent of each other ($\chi^2 = 0.35$, df = 3, p = 0.95).

Likewise, analysis between groups and HbA_1c again accepted the null hypothesis and settled that blood groups and HbA_1C blood levels are independent attributes ($\chi^2 = 3.50$, df = 6, p = 0.74) (Table 3).

Table 1: Distribution of patients across blood groups and fasting blood glucose levels

Blood group	Total patients n (%)	Fasting blood glucose < 180 mg/dL n (%)	Fasting blood glucose 181-250 mg/dL n (%)	Fasting blood glucose > 250 mg/dL n (%)
A+ observed	12 (15.00 %)	6 (7.50 %)	3 (3.75 %)	3 (3.75 %)
A+ expected	12 (15.00 %)	6 (7.50 %)	4 (5.00 %)	2 (2.50 %)
AB+ observed	8 (10.00 %)	5 (6.25 %)	3 (3.75 %)	0 (0.00 %)
AB+ expected	8 (10.00 %)	4 (5.00 %)	3 (3.75 %)	1 (1.25 %)
B+ observed	28 (35.00 %)	14 (17.50 %)	13 (16.25 %)	1 (1.25 %)
B+ expected	28 (35.00 %)	15 (18.75 %)	9 (11.25 %)	4 (5.00 %)
O+ observed	32 (40.00 %)	19 (23.75 %)	7 (8.75 %)	6 (7.50 %)
O+ expected	32 (40.00 %)	18 (22.50 %)	10 (12.50 %)	4 (5.00 %)

Table 2: Patient distribution by blood group and postprandial glucose levels*

Blood group	Total patients n (%)	Postprandial glucose 200-300 mg/dL n (%)	Postprandial glucose 301-400 mg/dL n (%)
A+ observed	8 (10.00 %)	6 (7.50 %)	2 (2.50 %)
A+ expected	8 (10.00 %)	6 (7.50 %)	2 (2.50 %)
AB+ observed	5 (6.25 %)	4 (5.00 %)	1 (1.25 %)
AB+ expected	5 (6.25 %)	3 (3.75 %)	2 (2.50 %)
B+ observed	22 (27.50 %)	15 (18.75 %)	7 (8.75 %)
B+ expected	22 (27.50 %)	16 (20.00 %)	6 (7.50 %)
O+ observed	27 (33.75 %)	19 (23.75 %)	8 (10.00 %)
O+ expected	27 (33.75 %)	19 (23.75 %)	8 (10.00 %)

** Percentages (%) are calculated based on a total of 80 patients for consistency and Chi-square test was used on applicable dataset;*

Table 3: Patient distribution by blood group and glycated haemoglobin (HbA1c) levels*

Blood group	Total patients n (%)	HbA_1c 6.5-9 % n (%)	HbA_1c 9.01-11 % n (%)	HbA_1c > 11 % n (%)
A+ observed	12 (15.00 %)	4 (5.00 %)	3 (3.75 %)	5 (6.25 %)
A+ expected	12 (15.00 %)	6 (7.50 %)	3 (3.75 %)	3 (3.75 %)
AB+ observed	8 (10.00 %)	5 (6.25 %)	2 (2.50 %)	1 (1.25 %)
AB+ expected	8 (10.00 %)	4 (5.00 %)	2 (2.50 %)	2 (2.50 %)
B+ observed	28 (35.00 %)	13 (16.25 %)	9 (11.25 %)	6 (7.50 %)
B+ expected	28 (35.00 %)	13 (16.25 %)	8 (10.00 %)	7 (8.75 %)
O+ observed	32 (40.00 %)	16 (20.00 %)	7 (8.75 %)	9 (11.25 %)
O+ expected	32 (40.00 %)	15 (18.75 %)	8 (10.00 %)	9 (11.25 %)

**HbA1c = glycated haemoglobin: 6.5-9 % = 48-75 mmol/mol; 9.01-11 % = 75-97 mmol/mol; > 11 = 97 mmol and above;*

Discussion

According to Indian research, the commonest blood group in the country was 'O' (37.12 %), closely followed by 'B' (32.26 %).[8] In relation to presented data, 40 % of diabetes mellitus patients had blood group O and 35 % had blood group B. Several epidemiological and genetic investigations have tried to study the relation between prevalence of type 2 DM and ABO blood types, although the results tend to be inconsistent.[9, 10] McConnell and colleagues identified a relationship between diabetes and blood group A as early as the 1950s.[11] Another study identified blood group B as a risk factor for developing type 2 DM.[12] Studies restricted to pregnant women reported that

though women having blood group AB had more chances of developing gestational diabetes mellitus (GDM), women with blood group O and GDM both were more likely to develop diabetes later in life.[13, 14] In contrary, research in the Arar city population found a remarkable association between DM and Rh blood types but did not show that any specific ABO blood group was highly probable to develop diabetes mellitus.[15]

Various theories have been suggested to account for the possible connection between blood types and glucose metabolism. One theory implicates genetic factors, as the ABO blood group gene (known as ABO glycosyltransferase) resides on chromosome 9, which also harbours genes involved in glucose regulation. Variations in this area may affect insulin secretion or glucose management. Another theory pertains to the influence of the gut microbiome. It seems to suggest that blood groups can modify the composition of the gut microbes, hence influencing metabolism and insulin sensitivity. Certain bacterial strains may preferentially adhere to specific blood group antigens, which could impact digestion and glucose absorption. Research has indicated that individuals with blood group 'O' exhibit reduced levels of von Willebrand factor, potentially offering vascular advantages and influencing glucose metabolism through enhanced endothelial function. Variations in inflammatory markers among blood groups (such as von Willebrand factor and interleukins) may influence glucose homeostasis, as chronic inflammation is a recognized contributor to insulin resistance.[16-18]

Presented study glanced at the association between blood group type and status of type 2 DM status, taking into account fasting, postprandial and HbA_1c blood sugar levels and found that these are independent variables, with the patient's blood group having no effect on the severity of diabetes. This represents a novel study, as we were unable to find any comparable research. Nonetheless, a study on 792 pregnant Iranian women found that those with blood group AB had greater fasting blood glucose levels in the second trimester than those with blood group A.[19] Another noteworthy study that looked at the relationship between certain blood groups in people with type 2 diabetes and microvascular problems discovered no significant correlation between diabetes and disorders such neuropathy, nephropathy and retinopathy. Using blood type O as a reference, blood groups AB and A had a lower risk of developing neuropathy than blood group O. However, no difference in relative risk was seen between the start of nephropathy and retinopathy.[20]

Main limitation of this study is that this was a single-centric study that focused only at Rh-positive blood groups. Furthermore, it did not include subgroup analysis based on disease duration, therapy, or complications over time.

Conclusion

The study did not find any association between ABO positive blood groups and fasting, postprandial, or HbA_1c blood glucose levels in known cases of type 2 DM, implying that diabetes severity varies independently from blood group classification. The study concludes that DM once developed; blood groups may not affect the severity and status of disease although they may have initial contribution in susceptibility. Further studies on larger population are required to congeal the findings.

Ethics

The study was granted clearance by the Institutional Ethics Committee of RUHS-CMS, Jaipur, Rajasthan, decision No EC-P-38-22, dated 29 May 2023.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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Data access

The data that support the findings of this study are available from the corresponding author upon reasonable individual request.

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