MEDICAL SCIENCE

Association of ABO blood groups and Diabetes Mellitus in King Abdulaziz University Hospital: A case-control study

Mohammed A Jan[1*], **Obadah S Mishiming**[1], **Abdulaziz G Aljohani**[1], **Ayar A Bukhari**[1], **Jalal M Al-Sayyad**[1], **Sohaib E Althagafi**[1], **Aseel Ahmed N Althagafi**[1], **Khaled A Yaghmour**[2]

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Authors' Affiliation:
[1]Medical Student, College of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia
[2]Assistant Professor, Consultant, Family Medicine Department, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia

[*]**Corresponding author**
Medical Student, College of Medicine, King Abdulaziz University, Jeddah,
Saudi Arabia
Email: Mohammedjan0844@gmail.com

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ABSTRACT

Background: Diabetes mellitus (DM) is a metabolic disorder resulting from decreased insulin production or increased cell resistance to insulin. The association between DM risk and 'ABO' blood groups have demonstrated by a few earlier kinds of research in the Jeddah region. In this study, we aimed to assess the relationship between ABO blood groups and DM at King Abdulaziz University Hospital (KAUH), Jeddah, Saudi Arabia. *Methodology:* The Institutional Review Board (IRB) at KAUH, Jeddah, Saudi Arabia, approved this proposal. The cases were taken from the database of patients diagnosed with Type 1 diabetes mellitus (T1D) or Type 2 diabetes mellitus (T2D), and controls were chosen randomly from family medicine clinics that came for routine checkups. Demographics, comorbidities, and lab values were collected and analyzed. *Results:* This study included 718 samples; 396 were females, 322 were males, the mean age was 42.55±11.22, 51.1% were diabetic, and the majority of them had T1D (52%). The most common comorbidities were hypertension (56.9%) and ischemic heart disease (IHD) (24.3%). Patients with T2D were more prone to develop comorbidities than patients with T1D (77.8% vs. 62.8%, p=0.03). Patients whose blood group was O- had a higher rate of IHD than the rest of the blood groups (p=0.02). No significant association was found between ABO blood groups and HbA1c. *Conclusion:* Blood group O is the most prevalent and is associated with developing IHD among people with diabetes. Hypertension was found to be the most common comorbidity, followed by IHD and heart failure.

Keywords: Endocrine, Diabetes mellitus, Hematology, Family Medicine, Blood groups

1. INTRODUCTION

One of the leading causes of global health problems and mortality worldwide

is diabetes mellitus (DM), a significant public health issue (Lovic et al., 2020). The World Health Organization (WHO) has reported that Saudi Arabia is placed second-highest country of prevalence of diabetes in the Middle East. Around 7 million of the Saudi population are diabetic, and almost 3 million are pre-diabetic (Al-Dawish et al., 2016). The prevalence of DM is about 20-25% in Saudi Arabia (Al-Dawish et al., 2016).

Diabetes mellitus is a metabolic syndrome characterized by hyperglycemia, an outcome of the inability or decreased insulin production or increased cell resistance to insulin. DM is classified into two types; Type 1 DM is the destruction of pancreatic beta cells, and absolute lack of insulin is hallmarks of this autoimmune condition, in which its incidence is high among children. Type 2 DM is caused by increased resistance of peripheral tissues to insulin, which is the most common type. It accounts for approximately 90%-95% of diabetic patients (Harris et al., 1987; Kim et al., 2002).

The main human blood group system is ABO, the difference between ABO blood groups is determent by the presence or absence of A and B antigens. There is a significant relation between ABO blood groups and some diseases such as gastric ulcers, duodenal ulcers, hepatitis B, vascular conditions, and cancer. Many attempts have been made to study this relationship in our continent. Researchers have demonstrated a link between diabetes mellitus risk and ABO blood groups, concluding that blood group O has the least risk (Fagherazzi et al., 2015).

A study conducted in Malaysia showed a negative association between ABO groups and DM type 2 (Kamil et al., 2010). Furthermore, another paper conducted in Qatar revealed that ABO antigens are associated with DM to be more common in blood group B (Bener and Yousafzai, 2014). The previously mentioned studies have attempted to analyze the correlation between the ABO blood grouping system and DM. However, there are limited studies in Saudi Arabia reporting this association. So, in this study, we aimed to assess the relationship between ABO blood groups and diabetes melilites at King Abdulaziz University Hospital (KAUH) in Jeddah, Saudi Arabia.

2. METHODOLOGY

This case-control paper was approved by the Institutional Review Board at King Abdulaziz University Hospital, Jeddah, Saudi Arabia (Reference number: 338-22). The data of 1631 patients have been collected by simple random method through hospital records from 2019 to 2022. The cases were taken from the database of patients diagnosed with DM type 1 or 2, and controls were collected randomly from the family medicine clinic that came for routine checkups. If their blood glucose levels were less than 6.1 mmol/l and they had never taken any medication for diabetes, they were considered healthy.

The number of patients who fulfilled the inclusion criteria was 367 cases diagnosed with Diabetes Mellitus and 271 control patients. We included all patients diagnosed with DM aged from 1-59 in KAUH and excluded subjects with secondary DM like drug-induced DM, gestational DM, and all patients above 60 years of age.

Clinical data

All patients' clinical data fulfilling criteria were acquired through hospital records. Information about age, gender, nationality, BMI, Diabetes status, and type of diabetes was retrieved. The following comorbidities were additionally considered: Hypertension, malignancy, coronary heart diseases, congestive heart failure, cerebrovascular events, autoimmune disorders, thyroid diseases, chronic liver disease, rheumatological conditions, respiratory disease, and chronic renal failure. Phenotypes ABO and Rh, hemoglobin A1c (HA1C), fasting blood glucose (FBG), random blood glucose (RBG), and Point-of-care blood glucose testing (POCT for BG) were all collected as well.

Statistical method

The Statical Program for social science (SPSS) version 21 was utilized for data analysis. Mean and standard deviation was used to express normal distribution values such as age and BMI. Categorical data such as age groups, sex, diagnosis and type of diabetes, and blood groups were expressed by frequency. Chi-square was used for categorical variables to identify the association between the blood groups and the occurrence of comorbidities. An Independent T-test assessed the relationship between age and Body mass index (BMI) with comorbidities. One-way ANOVA was used to determine the association between the blood groups and the rate of individual comorbidities. The P-value was set at <0.05.

3. RESULTS

Socio-demographic characteristics

This study included 718 patients; 55.2% were females, 44.8% were males, and the mean age was 42.55±11.22. In addition, 51.1% of the total samples were diabetic, with the majority having type 1 diabetes (52%). Table 1 demonstrates the social characteristics of the participants.

Table 1 Socio-demographic characteristics

	N	%
Sex		
Male	322	44.8%
Female	396	55.2%
Nationality		
Saudi	415	57.8%
Non-Saudi	303	42.2%
Age group		
18-29	110	15.3%
30-49	359	50.0%
50-60	249	34.7%
Diabetes status		
Diabetic	367	51.1%
Not diabetic	351	48.9%
Type of diabetes		
Type 1	191	52.0%
Type 2	176	48.0%
	Mean	SD
Age (years)	42.55	11.22
BMI	27.98	6.42

Notes: Age data are expressed as mean ± standard deviation, and others are expressed as numbers (N) & percentages (%).
Abbreviations:
N: Number, SD: Standard deviation

Comorbidities among patients with diabetes

Numbers and rates of different comorbidities were calculated among all diabetic patients, demonstrating that 70% had comorbidities. The most common were hypertension and ischemic heart diseases (56.9% and 24.3%). Figure 1 shows the different comorbidities among patients with diabetes.

We further evaluated the effect of different variables on the occurrence of these comorbidities. We found that the type of diabetes has a significant impact, as patients with type 2 diabetes were more prone to develop comorbidities than patients with type 1 diabetes (77.8% vs. 62.8%, p=0.03). Moreover, patients in the age group of 30-49 had the highest rate of comorbidity occurrence, which was 97.6% compared with 89.5% in patients aged 18-29 and 52.5% among patients aged 50-60 (p≤0.001). However, both BMI and gender didn't have any significant effects on the occurrence of comorbidities.

Blood groups

The most common blood group presented among the sample was O+, followed by A+ (41.9% and 31.2%). Moreover, similar blood group distribution was present when assessing the most common blood groups among diabetic patients only. Figure 2 illustrates the different blood groups among diabetic and non-diabetic patients.

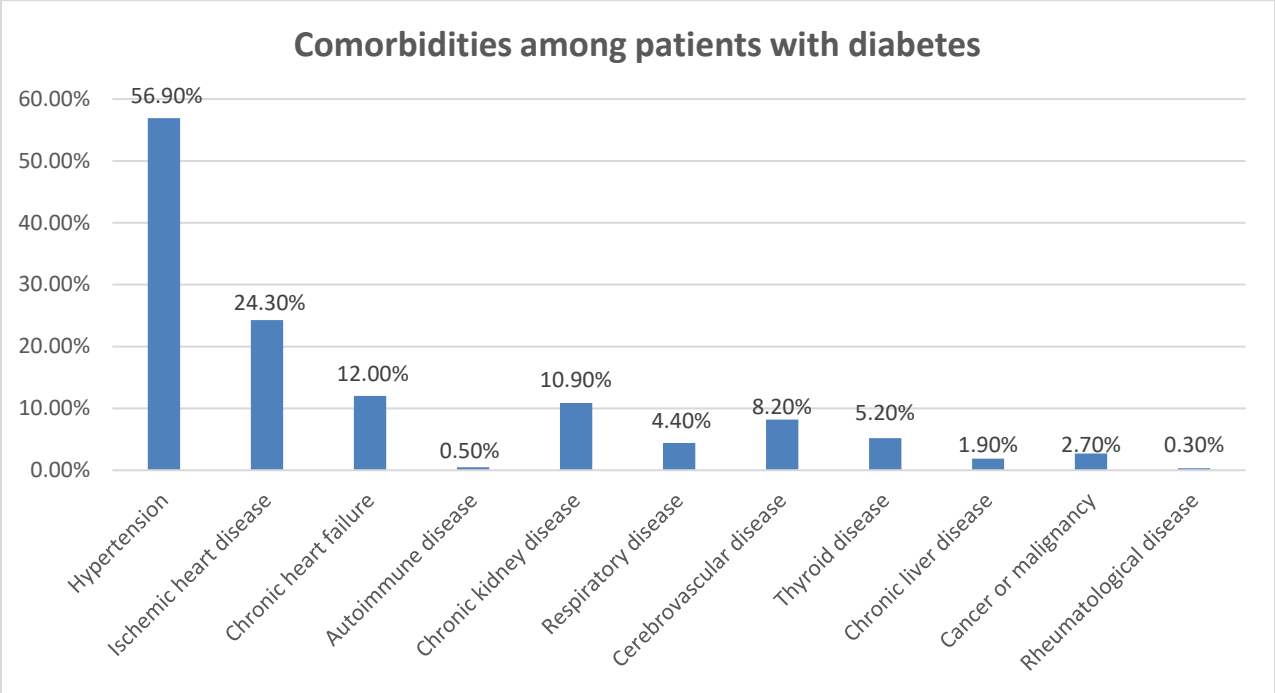

Figure 1 Different comorbidities among patients with diabetes

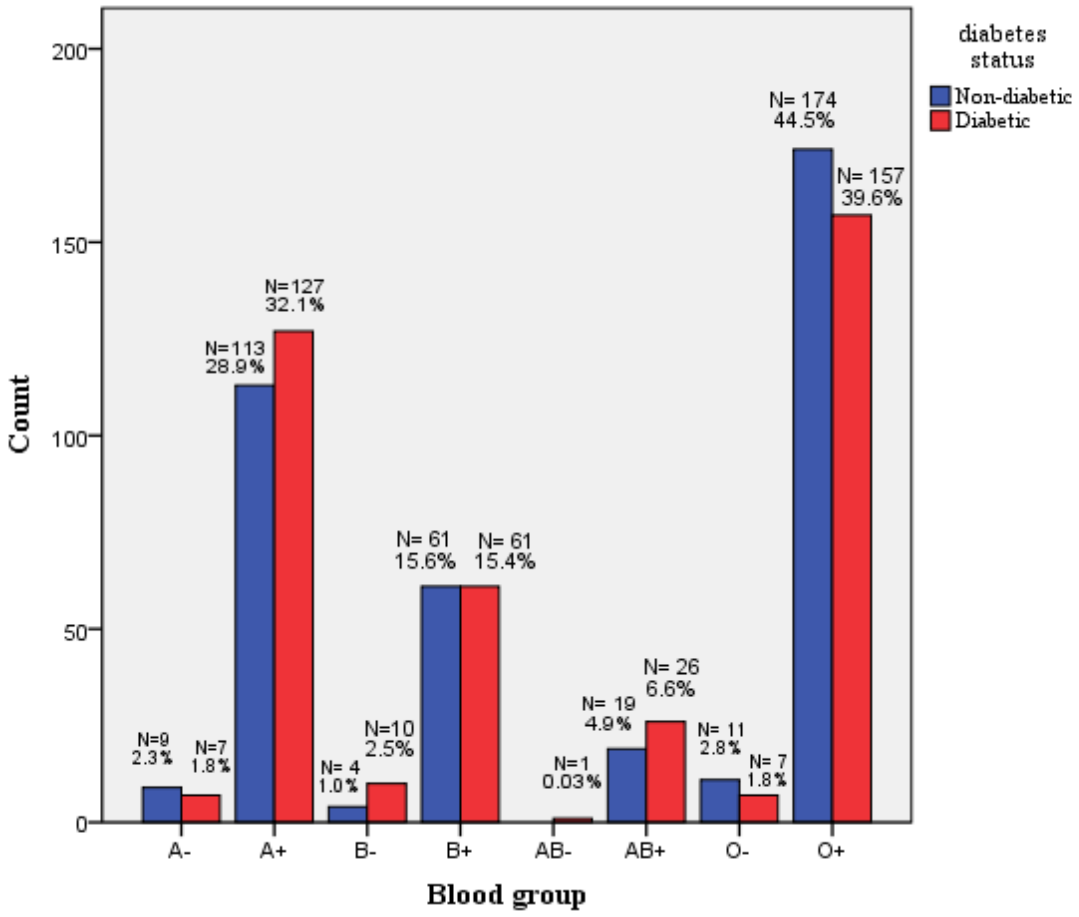

Figure 2 Blood groups among diabetic and non-diabetic patients

N: Number, %: Percentage

There was no significant relationship between the type of blood group and the occurrence of comorbidities among patients with diabetes. However, when assessing the relationship between each comorbidity individually, the kind of blood group significantly affected the development of ischemic heart diseases. Patients whose blood group was O- had a higher rate of ischemic heart diseases than the rest of the blood groups (p=0.02). Blood groups did also affect the occurrence of other comorbidities, but none were significant. Table 2 demonstrates the relationships between different blood groups and their effects on the occurrence of comorbidities.

Table 2 The relationships between different blood groups and their effects on the occurrence of comorbidities

	A-	A+	B-	B+	AB-	*AB+*	*O-*	*O+*	*P=value*
Hypertension									
%	60.0%	55.0%	50.0%	59.6%	100%	50.0%	71.4%	57.9%	*0.968*
Ischemic heart disease									
%	40.0%	20.8%	0.0%	35.1%	0.0%	8.3%	57.1%	24.8%	*0.022**
Chronic heart failure									
%	0.0%	12.5%	25.0%	14.0%	100%	16.7%	0.0%	9.7%	*0.241*
Autoimmune disease									
%	0.0%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	*0.462*
Chronic kidney disease									
%	0.0%	10.8%	12.5%	12.3%	0.0%	12.5%	0.0%	11.0%	*0.995*
Respiratory disease									
%	0.0%	3.3%	12.5%	5.3%	0.0%	8.3%	14.3%	2.4%	*0.325*
Cerebrovascular disease									
%	20.0%	8.3%	0.0%	5.3%	0.0%	4.2%	28.6%	9.0%	*0.385*
Thyroid disease									
%	10.0%	8.3%	0.0%	0.0%	0.0%	0.0%	0.0%	5.5%	*0.147*
Chronic liver disease									
%	0.0%	1.7%	0.0%	1.8%	0.0%	0.0%	0.0%	2.8%	*0.953*
Hyperlipidemia									
%	20.0%	8.3%	0.0%	8.8%	0.0%	4.2%	0.0%	6.2%	*0.769*
Cancer or malignancy									
%	0.0%	1.7%	0.0%	5.3%	0.0%	0.0%	0.0%	2.1%	*0.398*
Rheumatological disease									
%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%	*1.000*

Abbreviations:
%: Percentage, *: Statistical significance was set at p <0.05

We further assessed the blood type's effect on the mean HbA1c levels in diabetic patients. Patients with blood groups O- (8.52±2.53), B- (8.60±2.80), and A+ (8.70±2.78) had the lowest levels compared with the rest. However, the relationship was not significant (p=0.379). A similar association was assessed with the mean levels of POCT, but it was also not significant (p=0.982). Figure 3 illustrates the relationship between the different blood groups and the mean level of HbA1c.

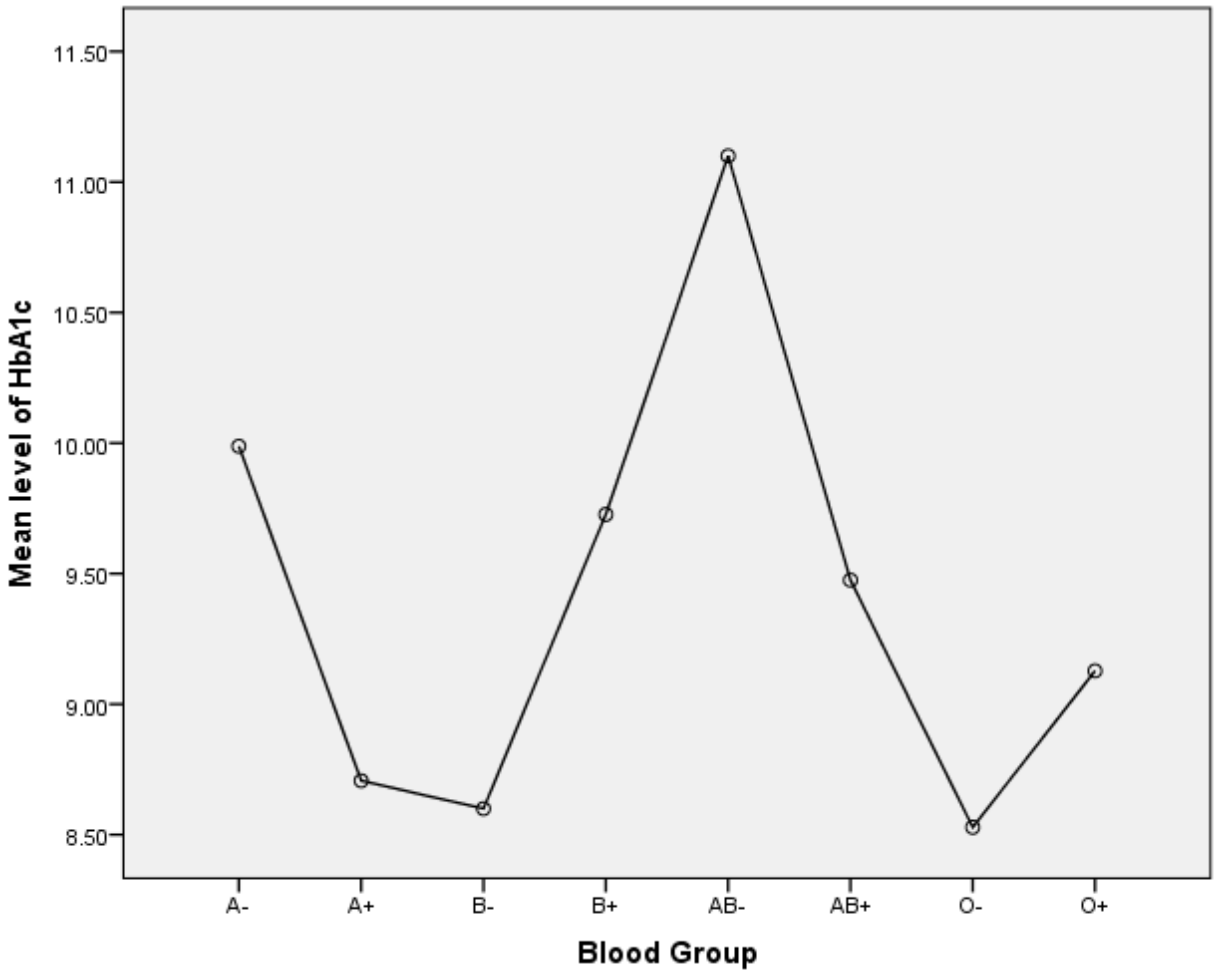

Figure 3 The relationship between the type of blood group and the mean level of HbA1c

4. DISCUSSION

Our study found that the most common blood group was O-positive, with a prevalence of 41.9%. It was also the most prevalent blood group in diabetic (39.5%) and non-diabetic (44.5%) groups. Previous research has indicated that blood group O is the most common across all regions of Saudi Arabia, which is consistent with our findings (Belali, 2022; Sarhan et al., 2009). However, neighboring countries have reported that group B is significantly more common in diabetic patients (Bener and Yousafzai, 2014). Similar results have been found in countries such as Pakistan and Malaysia, where blood group B is most prevalent (Kamil et al., 2010; Parente et al., 2020).

On the other hand, Nepal's findings align with ours, with blood group O being the most common (Shrestha et al., 2013). Although there are variations in the literature, we recommend conducting a study that includes individuals from different ethnicities and countries to examine the prevalence of blood groups in various regions of the world and their relationship with DM. Our study also found that hypertension was the most common comorbidity among diabetics, with a prevalence of 56.9%. This finding is consistent with several other studies that have reported hypertension as a common comorbidity among people with diabetics, with a significant impact on mortality (Strain and Paldánius, 2018; Teck, 2022).

The relationship between hypertension and diabetes is likely due to the effects of hypertension on the vascular system (Strain and Paldánius, 2018). Our study also found that the second and third most common comorbidities among diabetics were IHD and heart failure, which are also affected by hypertension. Therefore, physicians must stress the importance of glycemic control not only to their patients but also to their patients' families.

According to our research findings, the specific type of diabetes mellitus (DM) a patient has can significantly impact their likelihood of developing coexisting medical conditions. Notably, individuals with type 2 DM are more susceptible to comorbidities than those with type 1 DM (77.8% versus 62.8%, p=0.03). In Kazakhstan, a study on the epidemiology of DM types also revealed that type 2 DM has a greater prevalence of comorbidities, such as hypertension and coronary artery disease (Galiyeva et al., 2022).

This disparity may be attributed to the fact that type 2 DM patients are often diagnosed at an older age and are, therefore, more likely to experience complications, whereas type 1 DM patients are diagnosed at a younger age and receive routine follow-up care from their physician.

Our investigation shows a noteworthy correlation between possessing O-negative blood and being diagnosed with IHD, with a statistical value of (P=0.022). This outcome contradicts a study in Pakistan by Sharif et al., (2014), which established that individuals with blood type A were at a higher risk of developing IHD. Similarly, a study conducted in Finland by Parente et al., (2020) and Sharif et al., (2014) identified blood type A as a risk factor for IHD, particularly in those with microalbuminuria. These divergent findings may be attributed to the prevalence of Group O blood type in Saudi Arabia. Several studies have reported it as the most common blood group in various country regions (Belali, 2022; Sarhan et al., 2009).

Based on our research, we have discovered that there is no concrete link between different blood types and HbA1c levels (p=0.379). To our knowledge, this is the only study conducted in our area to explore this connection. Despite our findings lacking statistical significance, we believe that further investigation is necessary to understand this relationship better. By conducting a more in-depth analysis with more extensive sample size and incorporating ethnicity as a variable, we could advance the current knowledge within this field. The study has a few limitations that should be noted. Firstly, it was conducted in a single center, and only one ethnic group was included in the study. Additionally, the data for some patients was poorly documented. Conducting multicenter and multiethnicity research is recommended to make more relevant comparisons.

5. CONCLUSION

This paper aimed to study the association between diabetes melilites and ABO blood groups at KAUH, Jeddah, Saudi Arabia. We found Blood group O to be the most prevalent among our sample. A significant relationship existed between having the same blood group and IHD. It could be explained by the overall high prevalence of blood group O in our country, regardless of whether it is related to DM. We recommend conducting a multiethnic, multicenter study to explore the variations among different regions and better understand these variables' associations.

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Authors' Contribution

Concept of the study: Obadah, Ayar, khaled
Design of the study: Mohammed, Obadah, Khaled
Data collection: Ayar, Aseel, Jalal, Sohaib, Obadah, Abdulaziz, Mohammed
Analysis: Mohammed, Abdulaziz, Khaled
Literature review: Sohaib, Aseel, Jalal, Obadah, Ayar, Mohammed, Abdulaziz
Writing the manuscript: Mohammed, Abdulaziz, Aseel, Sohaib, Obadah, Ayar, Jalal
Review the manuscript: Khaled, Abdulaziz, Mohammed, Ayar

Ethical consideration

No conflicts of interest are associated with this study's publication, and it has no financial support. The study was approved by the King Abdulaziz University's ethics committee (Reference number: 338-22).

Informed consent

Not applicable.

Funding

This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

REFERENCES AND NOTES

1. Al-Dawish MA, Alwin-Robert A, Braham R, Al-Hayek AA, Al-Saeed A, Ahmed RA, Al-Sabaan FS. Diabetes Mellitus in Saudi Arabia: A Review of the Recent Literature. Curr Diabetes Rev 2016; 12(4):359-368. doi: 10.2174/1573399811666150724095130
2. Belali TM. Distribution of ABO and Rhesus Types in the Northern Asir Region in Saudi Arabia. J Blood Med 2022; 13 :643-648. doi: 10.2147/JBM.S383151
3. Bener A, Yousafzai MT. The distribution of the ABO blood groups among diabetes mellitus patients in Qatar. Niger J Clin Pract 2014; 17:565–8. doi: 10.4103/1119-3077.141418
4. Fagherazzi G, Gusto G, Clavel-Chapelon F, Balkau B, Bonnet F. ABO and Rhesus blood groups and risk of type 2 diabetes: Evidence from the large E3N cohort study. Diabetologia 2015; 58:519-22. doi: 10.1007/s00125-014-3472-9
5. Galiyeva D, Gusmanov A, Sakko Y, Issanov A, Atageldiyeva K, Kadyrzhanuly K, Nurpeissova A, Rakhimzhanova M, Durmanova A, Sarria-Santamera A, Gaipov A. Epidemiology of type 1 and type 2 diabetes mellitus in Kazakhstan: Data from unified National Electronic Health System 2014-2019. BMC Endocr Disord 2022; 22(1):275. doi: 10.1186/S12902-022-01200-6
6. Harris MI, Hadden WC, Knowler WC, Bennett PH. Prevalence of diabetes and impaired glucose tolerance and plasma glucose levels in US population aged 20-74 yr. Diabetes 1987; 36:523-34. doi: 10.2337/diab.36.4.523
7. Kamil M, Al-Jamal HAN, Yusoff NM. Association of ABO blood groups with diabetes mellitus. Libyan J Med 2010; 5:1 –4. doi: 10.3402/ljm.v5i0.4847
8. Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes: A systematic review. Diabetes Care 2002; 25:1862–8. doi: 10.2337/diacare.25.10.1862
9. Lovic D, Piperidou A, Zografou I, Grassos H, Pittaras A, Manolis A. The Growing Epidemic of Diabetes Mellitus. Curr Vasc Pharmacol 2020; 18(2):104-109. doi: 10.2174/1570161115666190405165911
10. Parente EB, Harjutsalo V, Lehto M, Forsblom C, Sandholm N, Groop PH; FinnDiane Study Group. Relationship between ABO blood groups and cardiovascular disease in type 1 diabetes according to diabetic nephropathy status. Cardiovasc Diabetol 2020; 19:68. doi: 10.1186/s12933-020-01038-z
11. Sarhan MA, Saleh KA, Bin-Dajem SM. Distribution of ABO blood groups and Rhesus factor in Southwest Saudi Arabia. Saudi Med J 2009; 30:116-119. https://smj.org.sa/content/30/1/116
12. Sharif S, Anwar N, Farasat T, Naz S. ABO blood group frequency in Ischemic heart disease patients in Pakistani population. Pak J Med Sci 2014; 30:593-595. doi: 10.12669/pjms.303.4502
13. Shrestha L, Malla U, Mahotra NB. ABO and Rh blood groups and their ethnic distribution in a teaching hospital of Kathmandu, Nepal. J Nepal Med Assoc 2013; 52:311-315. https://www.jnma.com.np/jnma/index.php/jnma/article/view/2112
14. Strain WD, Paldánius PM. Diabetes, cardiovascular disease and the microcirculation. Cardiovasc Diabetol 2018; 17:57. doi: 10.1186/s12933-018-0703-2
15. Teck J. Diabetes-Associated Comorbidities. Prim Care 2022; 49:275-286. doi: 10.1016/j.pop.2021.11.004