



Research Article

The distribution of the ABO and rhesus blood groups among diabetes mellitus patients in Zintan City, Libya

Adell M Ahmed Abubakeer^{(1)*}, Retaj Ali Salem⁽²⁾, Amira Mohammed Ali⁽²⁾, Amani Altaher Mohammed⁽²⁾

(1) Department of Medical Laboratories, College of Medical Sciences and Technologies Al Rayaina, Al-Zintan University, Zintan, Libya

(2) Diabetes and Endocrine Treatment Center in Zintan, Libya

*Corresponding author's email: adell.abubakeer@uoz.edu.ly

ARTICLE INFO

ABSTRACT

Article History

Submitted July 23, 2024

Revised October 28, 2024

Accepted, November 25, 2024

Published, November 30, 2024

Keywords

ABO blood groups

Rhesus

diabetes mellitus

prevalence

DOI:

10.22219/farmasains.v9i2.35286

Numerous studies have explored the potential connection between ABO blood groups and the risk of developing specific illnesses in the literature. This study aimed to examine the distribution of ABO blood and rhesus (Rh) groups among patients with diabetes mellitus (DM) at the Endocrinology and Diabetes Center in Al-Zintan City, Libya. This cross-sectional study took place from October to December 2022, involving 144 blood samples (99 from diabetic patients and 45 from non-diabetic individuals aged 15 to 85 years). Ethical approval and informed consent were obtained from the Endocrinology and Diabetes Center in Al-Zintan, where all laboratory work and statistical analysis using SPSS were conducted. Of the diabetic patients, 46% were male and 53% were female. The test results showed no association between ABO and Rh blood groups in individuals with diabetes mellitus. Among diabetics, the O blood group was most prevalent at 49%, followed by A (34%), B (11%), and AB (5%). Rh+ was more common (n=88) than Rh- (n=11), with no significant difference (p=0.733). Gender distribution also showed no significant difference (p>0.05). The O blood group was more common in females (55.10%) than males (44.90%), and the B blood group was found more often in females (72.73%) than in males (27.27%). This research shows no significant relationship between ABO and Rh blood types and diabetes mellitus occurrence among patients at the endocrinology and diabetes center in Al-Zintan City. Blood

group variations do not influence diabetes prevalence or characteristics in this population.

1. Introduction

Diabetes Mellitus (DM) is a recognized global public health issue. It is one of the main contributors to ill health and premature mortality worldwide (WHO, 2006). Diabetes is a metabolic disease that causes increased blood sugar levels, called hyperglycemia. The pathophysiology of diabetes mellitus (DM) can be classified into two common types. In type-1 diabetes mellitus (T1DM), there is unavailability of insulin hormone in the patient's blood. Type 2 diabetes mellitus (T2DM) ranges from relative deficiency of insulin secretion to insulin resistance. Patients do not need insulin injections in T2DM; hence, this type of DM was previously called Non-Insulin Dependent Diabetes Mellitus (NIDDM) (WHO, 2006). The global prevalence of diabetes was estimated to be 10.5% in 2021, and it is projected to rise to 12.2% in 2045 (Sun et al., 2021). The majority of the 382 million people with diabetes are aged between 40 and 59, and 80% of them live in low- and middle-income countries. All types of DM are on the increase, with Type 2 DM in particular. The number of people with diabetes will increase by 55% by 2035 (Kumar et al., 2010).

In 1900, Karl Landsteiner discovered the ABO blood group system and identified four blood groups: A, B, AB, and O, each responsible for producing its own glycoprotein. The gene responsible for determining ABO blood type is present on chromosome number 9 and is called ABO Glycosyltransferase (IDF, 2015). Human ABO blood group antigens are glycoconjugates on red blood cells that influence transfusion phenotypes and play key roles in cellular physiology and pathology (Liumbruno et al., 2013). ABO antigens and their corresponding anti-A and anti-B isoagglutinins are important in blood transfusion and transplantation, though their physiological significance is still unclear (Franchini et al., 2013). The presence or absence of blood-type antigens affects susceptibility to certain infections (Page et al., 2021; Salem et al., 2021) and non-infectious diseases (Bahar et al., 2019).

The ABO and Rhesus (Rh) are the major human blood group systems. An individual's blood group is genetically predetermined and plays a vital role in understanding genetics and disease susceptibility (Dodiya et al., 2016). The gene for the ABO group is located on chromosome 9, while the gene for the Rh system is found on chromosome 1. The ABO system consists of four major phenotypes: "A," "B," "O," and "AB," which are determined based on the presence or absence of A and B antigens on the surface of red blood cells. The Rh system depends on the presence or absence of Rh antigens and is classified as Rh positive or Rh negative (Ranadhir et al., 2014). Previous studies link ABO blood groups to various diseases, including cancer, cardiovascular issues, cognitive disorders, and metabolic conditions like hypertension, obesity, dyslipidemia, and diabetes (Abegaz et al., 2021).

The clinical significance of the ABO and Rh blood group system antigens extends into transfusion medicine and their involvement in the development of different diseases such as coronary heart disease (Bahar et al., 2019), thyroid disorders (Prakash et al., 2020), gastroduodenal ulcers (Alkebsi et al., 2018), Von Willebrand disease (Ward et al., 2020), and diabetes mellitus (Aggarwal et al., 2015). The presence or absence of blood group antigens induces blood membrane changes both morphologically and functionally. The structure-dependent functions of blood types have indirect effects on susceptibility to certain diseases like diabetes mellitus (Getawa et al., 2022; Reetu et al., 2018). Studies have shown that the ABO and Rh blood group antigens are among the genetic determinants that contribute to the occurrence of type 2 diabetes mellitus (Dodiya et al., 2016; Meo et al., 2016; Fagherazzi et al., 2015).

There is strong evidence in the literature that there is an association between ABO blood group and certain diseases. Despite some epidemiological studies discussing the linkage between ABO blood group and the risk of developing diabetes mellitus, findings were not consistent and not yet clarified. Therefore, this study is designed to investigate the distribution of the ABO blood group among diabetes mellitus patients at the Diabetes and Endocrine Treatment Center in Zintan, Libya.

2. Materials and Methods

This research was a cross-sectional study carried out at the Endocrinology and Diabetes Center in Al-Zintan. A total of 144 participants were involved, consisting of 99 diabetic patients and 45 healthy individuals, aged from 15 to 85 years. Blood samples were collected via cubital venipuncture using a disposable 5 ml syringe and placed in labeled EDTA anticoagulant bottles. A drop of blood from each patient was placed on a white tile, and antisera A, B, and O were added which employed known anti-A and anti-B serum from ARENABioscienc, Egypt. The mixtures were gently rocked for 60 seconds to observe for agglutination. The study spanned three months, from October to December 2022. The agglutination test results were recorded right after mixing samples. Blood drop A with agglutination was classified as group A, and drop B as group B. If both showed agglutination, they were classified as group AB; if neither did, it was classified as group O. For rhesus factor testing, agglutination in the rhesus blood drop indicated that it was rhesus positive, while non-agglutination indicated rhesus negative. In cases of uncertainty, the test results were examined under a microscope or were confirmed through reverse grouping using known group A and B red blood cells (Bamidele et al., 2013).

Ethical Clearance

This study was conducted at the Endocrinology and Diabetes Center and received approval from the Ethics Committee. Informed consent was obtained from all participants, who were randomly assigned to either the healthy group or the diabetic group. Data collection for this study was authorized by the center and took place in their laboratory department.

Statistic Analysis

The data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS). Frequencies and percentages were determined using the Chi-square test (χ^2), with a P-value below 0.05 regarded as statistically significant.

3. Results and Discussions

A total number of 144 (99 diabetics and 45 non-diabetics). data was analyzed using the Chi-square test to determine any association between ABO and Rh blood groups among male and female diabetes mellitus patients. The results were presented as percentages and absolute frequencies.

Table 1 indicates that there is no association between the ABO blood group and the Rh blood group concerning diabetes mellitus. The O blood group had the highest frequency among diabetic subjects (49, 49%; $P < 0.543$), followed by group A (34, 34%; $P < 0.070$), group B (11, 11%; $P < 0.425$), and group AB (5, 5%; $P < 0.000$). For the Rh system, the frequency of Rh+ was higher ($n=88$, %) than Rh- ($n=11$, %). The difference between phenotype frequencies was not significant ($p=0.733$).

The distribution of ABO/Rh blood groups by gender in diabetes mellitus showed no significant difference ($p > 0.05$). Specifically, the distribution of the ABO blood group was similar between genders: males ($n=46$, %) and females ($n=53$, %), with no significant difference ($p > 0.05$). The O blood group had the highest frequency among females (55.10%; $P < 0.543$) compared to males (44.90%; $P < 0.543$), followed by group B in females (72.73%) compared to males (27.27%).

When looking at the Rh blood system by gender, the O Rh+ blood group had the highest frequency among the Rh blood groups (87.76%; $P < 0.543$) compared to AB Rh- (0%; $P < 0.000$). Overall, there was no association between the ABO and Rh blood systems among male and female diabetes mellitus patients for blood groups A ($p=0.070$), B ($p=0.425$), AB ($p=0.000$), and O ($p=0.543$).

Table 1. The Distribution of the ABO and Rh blood group in diabetes mellitus patients

Blood Group	Rhesus Group		Sexes		Diabetics (n = 99 (%))	p-value
	+	-	Male	Female		
	(n= 88(%))	(n= 11(%))	(n = 46 (%))	(n = 53 (%))		
A	31 (91,18)	3 (8,82)	17 (50,00)	17 (50,00)	34 (34,34)	0,070
B	9 (81,82)	2 (18,18)	3 (27,27)	8 (72,73)	11 (11,11)	0,425
AB	5 (100,00)	0	4 (80,00)	1 (20,00)	5 (5,05)	0,000
O	43 (87,76)	6 (12,24)	22 (44,90)	27 (55,10)	49 (49,49)	0,543

Several studies have assessed the relationship between diabetes mellitus and the ABO and Rh blood groups. Some studies have suggested a potential association between blood groups and diabetes, while others have found no such link. For instance, some studies have indicated that individuals with certain blood types, such as type O or type B, may have a reduced risk of developing type 2 diabetes, whereas other studies have not found any significant association between blood type and diabetes risk (Ward et al., 2020; Sharma et al., 2014). One study reported that individuals with blood group B had a higher prevalence of T2DM compared to other blood groups (Walle et al., 2023). Another study highlighted that blood group A was more commonly associated with diabetes mellitus compared to controls, suggesting a potential link between this blood group and diabetes (Kishore et al., 2020). A study conducted at the Hamad Medical Corporation between April 2011 and December 2012 found a correlation between blood groups and diabetes mellitus in Qatar. Blood group B was more prevalent among diabetics, while group O was less common compared to nondiabetic individuals. Additionally, blood group distribution varied by ethnicity, with group B being more common in diabetic men and groups A and B more frequent in diabetic women (Bener et al., 2014). The findings have been inconsistent and have varied from one region to another.

In this study, we observed that individuals with blood type O had the highest frequency among diabetic subjects, followed by individuals with blood types A, B, and AB. Additionally, the presence of Rh+ was higher than Rh- in diabetic individuals. Several studies have assessed the potential relationship between diabetes mellitus and the Rh blood group, but the findings have been inconsistent due to population variations (Kumar et al., 2015). Our study findings align with other research, including studies conducted in Bangladesh, India, and western Algeria, which also found no association between ABO blood groups and diabetes mellitus (Anstee, 2010; Dali et al., 2011).

Our study found no association between the frequency distribution of A, B, AB, and O blood groups and diabetes mellitus ($p > 0.05$). Furthermore, no significant results were found when the data was

analyzed by sex or age. These results are consistent with several other studies. The increased prevalence of blood type O in diabetics compared to control subjects is an intriguing finding. While these studies provide insights into the distribution of ABO and Rhesus blood groups among diabetes patients, it is important to consider the genetic, environmental, and lifestyle factors that also play a crucial role in the development of diabetes.

The study had some limitations, including a relatively small sample size and a limited number of blood markers. Despite these limitations, the study's strengths include its population-based design, setting it apart from most other case-control studies. Future studies should aim to increase the sample size and consider additional blood markers.

4. Conclusions

This study showed that the O blood group was most prevalent and Rh+ was more common in diabetic patients. However, our findings did not confirm a significant association between diabetes mellitus and ABO blood groups in the Zintan City, Libya. Therefore, future research with larger sample sizes and more blood markers are needed to further explore this association.

5. Acknowledgment

We are very grateful to all who assisted us in conducting our study, especially the Diabetes and Endocrine Treatment Center in Zintan, which helped us collect the data.

6. References

- Abegaz, S.B. (2021). Human ABO blood groups and their associations with different diseases. *Biomed Res Int.* 2021: 6629060.
- Aggarwal, T., Singh D, Sharma B, et al. (2015). Association of ABO and Rh blood groups with type 2 diabetes mellitus in Muzaffarnagar city. *National Journal of Physiology, Pharmacy and Pharmacology.* 8(2). DOI: 10.5455/njppp.2018.8.0830324082017.
- Alkebsi, L., Ideno Y, Lee J-S, et al. (2018). Gastroduodenal ulcers and ABO blood group: the Japan nurses' health study. *J Epidemiol.* 28(1):34–40. doi: 10.2188/jea.JE20160204.
- Anstee, D.J. (2010). The relationship between blood groups and disease. *Blood.* 115(23):4635-43. doi: 10.1182/blood-2010-01-261859.
- Bahar, A., Asadian L, Abediankenai S, et al. (2019). Coronary heart disease and ABO blood group in diabetic women: a case-control study. *Sci Rep.* 9: 1–6. <https://doi.org/10.1038/s41598-019-43890-4>
- Bamidele, O., Arokoyo, D.S., & Akinbola, A.O. (2013). Distribution of ABO and rhesus blood groups among medical students in Bowen University, Iwo, Nigeria. *Annals of Biological Research.* 4:1-6.
- Bener, A., Yousafzai MT. (2014). The distribution of the ABO blood groups among diabetes mellitus patients in Qatar. *Niger J Clin Pract.* 17(5):565-8. doi: 10.4103/1119-3077.141418
- Dali, S.M., Aour, M.A. (2011). The relationship between ABO/rhesus blood groups and type 2 diabetes mellitus in Maghnia, western Algeria. *Official journal of the South African Academy of Family Practice/Primary Care,* 53(6): 569-572. DOI: 10.1080/20786204.2011.10874154.
- Dodiya, D., Patel A, Jadeja J. (2016). Association of ABO blood groups with diabetes mellitus. *Int J Basic Appl Physiol.* 5:63–6.

- Fagherazzi, G., Gusto, G, Clavel-Chapelon, F, Balkau, B, Bonnet, F. (2015). ABO and Rhesus blood groups and risk of type 2 diabetes: evidence from the large E3N cohort study. *Diabetologia*. 58(3):519-22. doi: 10.1007/s00125-014-3472-9.
- Franchini, M., Liumbruno GM. (2013). ABO blood group: old dogma, new perspectives. *Clin Chem Lab Med*. 51: 1545–1553.
- Getawa, S., Bayleyegn B, Aynalem M, Worku YB, Adane T. (2022). Relationships of ABO and Rhesus blood groups with type 2 diabetes mellitus: a systematic review and meta-analysis. *J Int Med Res*. 50(10):3000605221129547. doi: 10.1177/03000605221129547.
- International Diabetes Federation – IDF, (2015). IDF Diabetes Atlas 7th ed. Brussels, Belgium: IDF.
- Kishore, J., Tulika, Shruti., Radha, Kumari., Sudhir, Kumar, Prasad., Harsha., M. (2020). The Distribution of the ABO and Rh (D) Blood Types in Type II Diabetes Mellitus Patients. *International Journal of Contemporary Medical Research*. 7(1). doi: 10.21276/IJCMR.2020.7.1.45
- Kumar, P.R., B, A., R, M., Bhansali, S., Dutta, P., Thakur, J.S., Sachdeva, N., Bhadada, S.K. And Walia, R. (2010). Utility of glycated hemoglobin in diagnosing type 2 diabetes mellitus: a community-based study. *The Journal of Clinical Endocrinology & Metabolism*. 95(6): 2832-2835. <https://doi.org/10.1210/jc.2009-2433>.
- Kumar, V., Abbas, A.K. and Aster, J.C. (2015). *Robbins & Cotran Pathologic Basis of Disease*. 9th Edition, Elsevier, Philadelphia.
- Liumbruno, G.M., Franchini M. (2013). Beyond immunohematology: the role of the ABO blood group in human diseases. *Blood Transfus*. 11: 491–499.
- Meo, S.A., Rouq, F.A., Suraya, F., Zaidi, S.Z. (2016). Association of ABO and Rh blood groups with type 2 diabetes mellitus. *Eur Rev Med Pharmacol Sci*. 20(2):237-42.
- Page, M.J., McKenzie JE, Bossuyt PM, et al. (2021). The PRISMA (2020) statement: an updated guideline for reporting systematic reviews. *Int J Surg*. 88: 105906.
- Prakash, B.G., AR B, Mehta P. (2020). ABO Blood Group and its Unusual Relationship with Thyroid Disorders. *Indian Journal of Public Health Research & Development*. 11(5), 329-333. <https://doi.org/10.37506/ijphrd.v11i5.9342>
- Ranadhir, M., Nitasha M, Rath G. (2014). Blood group systems. *Indian J Anaesth*. 58:524–28.
- Reetu, K., Ranabir, S., Anjana, Y. (2018). Is there an association between abo blood groups and type 2 diabetes mellitus?. *Annals of International Medical and Dental Research*. 4(4):2395-2822. DOI: 10.21276/aimdr.2018.4.4.PH1.
- Salem, G.I., Gamal NM, Talaat EA, et al. (2021). Clinical impact of the ABO blood type in patients with rheumatic diseases: Is there a link to the ABO and Rhesus? *Mediterr J Rheumatol*. 32: 237–242.
- Sharma, S., Jayant, K., Choudhary, R. , Soni, N.D. (2014). Study of Association between ABO Blood Groups and Diabetes Mellitus. *Scholars Journal of Applied Medical Sciences (SJAMS)*. 2(1A):34-37. DOI: 10.36347/sjams.2014.v02i01.006.
- Sun, H., Saeedi, P., Karuranga, S., et al. (2021). Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract*. doi: 10.1016/j.diabres.2021.109119.
- Walle, M., Addisu, Tesfaye., Fasil, Getu. (2023). The association of ABO and Rhesus blood groups with the occurrence of type 2 diabetes mellitus: A comparative cross-sectional study. *Medicine*, doi: 10.1097/md.00000000000034803
- Ward, S.E., O'Sullivan JM, O'Donnell JS. (2020). The relationship between ABO blood group, von Willebrand factor, and primary hemostasis. *Blood*. 136(25):2864-2874. doi: 10.1182/blood.2020005843.
- WHO, R. (2006). The prevention of diabetes and its complications. Retrieved from <http://www.who.int/diabetes/preventionflyer/en/> (Accessed Jul 23 2024).