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Assessment of the roles of ABO blood types and Rh factors in gestational diabetes mellitus

Mehmet Mete Kırlangıç[1], Mefkure Eraslan Şahin[2]

[1]Obstetrics & Gynecology Clinic, Tuzla State Hospital, Istanbul, Turkey
[2]Obstetrics & Gynecology Clinic, Kayseri City Hospital, Kayseri, Turkey

Abstract

Objective: Gestational diabetes mellitus (GDM) is a leading causes of both maternal and neonatal morbidity and mortality, the frequency of which is increasing gradually because of the increasing age and obesity of the pregnant woman. The aim of the present study was to evaluate ABO blood types and Rh factors and their roles in GDM prevalence.

Methods: This retrospective study was conducted in the Obstetrics & Gynecology Clinic of Tuzla State Hospital. Between January 1, 2015 and May 1, 2021, 1017 pregnant women who were admitted to our clinic were evaluated according to the presence of GDM using the hospital database system. The ABO blood types and Rh factors were determined in all patients and GDM prevalence was compared among the groups.

Results: The 1017 pregnant women had single- and double-step oral glucose tolerance tests and the ABO blood type results were included in the study. Of the 1017 women, 241 (23.70%) had GDM and 776 (76.30%) were normal. The mean maternal age of the group with GDM was 30.9±4.8 years and it was 27.8±5.4 years in the normal group, which was a statistically significant difference (p<0.001). Of the 1017 pregnant women, 474 (46.61%), 162 (15.93%), 316 (31.07%), and 65 (6.39%) had the blood types A, B, 0, and AB, respectively, with no difference observed among them in terms of the presence of GDM (p=0.592). There were 886 (87.12%) pregnant women in the Rh(+) group and 131 (12.88%) in the Rh(-) group; the groups were similar in terms of the presence of GDM (p=0.503).

Conclusion: Our results indicated that ABO blood types and Rh factors were not risk factors for GDM.

Keywords: ABO blood groups, Rh factors, gestational diabetes mellitus, GDM prevalence.

Introduction

Gestational diabetes mellitus (GDM) is a leading cause of both maternal and neonatal morbidity and mortality, the frequency of which is increasing gradually because of the increasing age and obesity of the pregnant women, which complicates ~10–15% of all pregnancies.[1,2] It is well documented that GDM is associated with preeclampsia, fetal anomaly, macrosomia, fetal death, and increased cesarean delivery rates, and it is a risk for the development of DM during the postpartum period.[3]

The presence of A and B antigens determine the ABO blood types.[4] The results of studies showed the association between ABO blood types and infections, cancer, cardiovascular diseases, and nervous system diseases; however, a potential relationship between ABO blood types and negative perinatal outcomes are controversial.[5–9] ABO antigens are responsible for the regulation of factors such as tumor necrosis factor (TNF)-alpha E-selectin, sICAM-1, P-selectin, and interleukin (IL)-6 that cause type 2 DM.[10] In some studies, the ABO blood types were observed to be a protective factor for GDM; however, it was observed to be a risk factor in others, and some reports reported that there is no association between GDM and blood types.[11–15] The

Correspondence: Mehmet Mete Kırlangıç, MD. Obstetrics & Gynecology Clinic, Tuzla State Hospital, Tuzla, İstanbul, Turkey.
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ORCID ID: M. M. Kırlangıç 0000-0002-9750-1594; M. Eraslan Şahin 0000-0001-6484-9132

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purpose of the current study was to evaluate the roles of ABO blood types and Rh factors in GDM prevalence.

Methods

In this retrospective study, we evaluated 1017 pregnant women who underwent single- and double-step oral glucose tolerance tests (OGTTs) during the 24–28 weeks of follow-up at the Obstetrics & Gynecology Clinic of Tuzla State Hospital between January 1, 2015 and May 1, 2021, using data from the hospital database. The study was approved by the Ethics Committee of the Faculty of Medicine of Marmara University (decision no: 09.2021.872) and was conducted in accordance with the Declaration of Helsinki.

GDM was screened using a single-step (75-g OGTT) or double-step (50- to 100-g OGTT) test at 24–28 weeks of gestation. For single step screening, the patients screened at 24–28 weeks of gestation using the single-step 75-g oral glucose tolerance test (OGTT) according to the criteria of the International Association of Diabetes and Pregnancy Study Group (IADPSG) were analyzed. One or more higher values in the patients who underwent the 75-g OGTT test (i.e., fasting ≥92 mg/dL, first hour ≥180 mg/dL, and second hour ≥153 mg/dL) were considered to be GDM.[16,17]

For double-step screening, a 3-h diagnostic test was conducted using a 100-g OGTT in patients with glucose >140 mg/dL. Two or more higher values in the patients who underwent a 100-g OGTT test (e.g., fasting ≥95 mg/dL, first hour ≥180 mg/dL, second hour ≥155 mg/dL, third hour ≥140 mg/dL) were considered to be GDM.[3,18] ABO blood types and Rh factors were also recorded from the hospital database for each pregnant woman. The women were compared according to these blood types and factors for GDM and other demographic characteristics.

Statistical analyses

Statistical analyses were performed using the SPSS software (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY, USA). The variables were investigated using visual (histograms, probability plots) and analytical methods (Kolmogorov-Smirnov test) to determine whether they are normally distributed or not. Descriptive analyses were presented using means and standard deviations for normally distributed variables. The Pearson's chi-squared test or Fisher's exact test was used to compare the groups. One-way ANOVA was used to compare parameters among the blood groups. Levene test was used to assess the homogeneity variances. An overall p-value of less than 0.05 was considered statistically significant.

Results

We evaluated 1017 pregnant women in the present study. GDM was diagnosed in 241 (23.70%) of these women; 776 (76.30%) of them were considered normal. Of the 1017 pregnant women, 474 (46.61%) had blood type A, 162 (15.93%) had blood type B, 316 (31.07%) had blood type 0, and 65 (6.39%) had blood type AB. There were 886 (87.12%) pregnant women with Rh(+) factor and 131 (12.88%) pregnant women with Rh(-) factor.

The ABO blood types for maternal characteristics and GDM prevalence are compared in **Table 1**. Maternal age, nulliparity, body mass index (BMI) at screening, personal or family history of diabetes, smoking, and ethnicity were observed to be similar among the groups (p=0.358, p=0.741, p=0.754, p=0.658, p=0.735, and p=0.888, respec-

Table 1. Comparison of ABO blood types with maternal characteristics and GDM prevalence.

Characteristics	A (n=474)	B (n=162)	0 (n=316)	AB (n=65)	p-value
Maternal age, years	28.66±6.83	27.95±4.76	29.03±6.32	28.97±5.61	0.358
BMI at screening, kg/m²	26.85±6.84	27.01±3.15	26.98±4.31	27.96±5.01	0.754
Nulliparity, n (%)	154 (32.49)	51 (31.48)	98 (31.01)	23 (35.38)	0.741
Ethnicity, n (%)	449 (94.73)	153 (94.44)	299 (94.62)	61 (93.85)	0.888
Smoking, n (%)	43 (9.07)	11 (6.79)	34 (10.76)	8 (12.31)	0.735
Personal or family history of diabetes, n (%)	25 (5.24)	10 (6.17)	19 (6.01)	8 (12.31)	0.658
GDM prevalence, n (%)	116 (11.41)	40 (3.93)	67 (6.59)	18 (1.77)	0.592

BMI: body mass index; **GDM:** gestational diabetes mellitus.

Table 2. Comparison of Rh blood factors with maternal characteristics and GDM prevalence.

Characteristics	Rh(+) (n=886)	RH(-) (n=131)	p-value
Maternal age, years	28.65±6.27	28.79±5.16	0.800
BMI at screening, kg/m²	26.88±5.66	27.33±4.48	0.745
Nulliparity, n (%)	280 (31.60)	45 (34.35)	0.711
Ethnicity, n (%)	784 (88.49)	117 (89.31)	0.689
Smoking, n (%)	75 (8.47)	14 (10.71)	0.668
Personal or family history of diabetes, n (%)	43 (5.32)	12 (9.16)	0.314
GDM prevalence, n (%)	213 (20.94)	28 (2.75)	0.503

BMI: body mass index; **GDM:** gestational diabetes mellitus.

tively). GDM was detected in 116 (11.41%), 40 (3.93%), 67 (6.59%), and 18 (1.77%) patients in blood type groups A, B, 0, and AB, respectively. A positive GDM test result was observed to be similar among the blood types (p=0.592).

A comparison between the Rh factors and maternal characteristics and GDM prevalence is shown in **Table 2**. Maternal age, nulliparity, BMI at screening, personal or family history of diabetes, smoking, and ethnicity were observed to be similar among the groups (p=0.800, p=0.711, p=0.745, p=0.314, p=0.668, and p=0.689, respectively). Of the 1017 pregnant women, 886 (87.12%) had the Rh(+) factor and 131 (12.88%) had the Rh(-) factor. Of these, 213 (20.94%) with Rh(+) and 28 (2.75%) with Rh(-) factor had GDM, and GDM prevalence was similar between the groups (p=0.503).

A comparison among the ABO blood types with the Rh factor subgroups and the maternal characteristics and GDM prevalence is provided in **Table 3**. When we subclassified the women into subgroups A Rh(+), A Rh(-), B Rh(+), B Rh(-), 0 Rh(+), 0 Rh(-), AB Rh(+), and AB Rh(-), 100 (9.83%), 16 (1.57%), 33 (3.24%), 7 (0.68%), 63 (6.19%), 4 (0.39%), 17 (1.67%), and 1 (0.09%), respectively, were identified and no statistical difference was observed among the groups based on the presence of GDM (p=0.691).

Discussion

The aim of the present study was to evaluate the ABO blood types and Rh factors and their roles in GDM. The key findings were as follows: *(i)* GDM was diagnosed in 241 (23.70%) of the pregnant women, *(ii)* ABO blood types were not risk factors for GDM, and *(iii)* and Rh factors were not risk factors for GDM.

Although the underlying mechanism has not been fully elucidated, recent studies on the genome-wide association between ABO blood types and various diseases have reported that genetic variation in the ABO locus is related with sE-selectin, ICAM-1, P-selectin, associated with type 2 diabetes and hypertension.[19–21] From their genome-wide association study, Qui et al.[19] declared that the ABO locus is a critical determinant

Table 3. Comparison of ABO blood types and Rh factor subgroups with maternal characteristics and GDM prevalence.

Characteristics	A Rh(+) (n=411)	A Rh(-) (n=63)	B Rh(+) (n=135)	B Rh(-) (n=27)	O Rh(+) (n=278)	O Rh(-) (n=38)	AB Rh(+) (n=62)	AB Rh(-) (n=3)	p-value
Maternal age, years	28.70±7.0	28.40±5.2	27.71±4.7	29.15±4.9	28.99±5.6	28.89±5.4	28.85±6.3	32.67±1.5	0.576
BMI at screening, kg/m²	26.65±8.2	27.42±3.4	26.1±4.7	28.11±2.5	26.87±7.8	27.5±3.1	27.81±4.0	28.45±1.7	0.687
Nulliparity, n (%)	132 (32.1)	22 (34)	41 (30)	10 (37)	85 (0.31)	13 (34)	22 (35)	1 (33)	0,851
Ethnicity, n (%)	391 (95)	58 (92)	128 (95)	25 (93)	265 (0.95)	34 (90)	58 (94)	3 (100)	0.758
Smoking, n (%)	38 (9)	5 (8)	8 (6)	3 (11)	29 (0.10)	5 (13)	7 (11)	1 (33)	0.645
Personal or family history of diabetes, n (%)	21 (5)	4 (6)	7 (5)	3 (11)	15 (0.05)	4 (11)	7 (11)	1 (33)	0.495
GDM prevalence, n (%)	100 (24.3)	16 (25.4)	33 (24.4)	7 (25.9)	63 (22.66)	4 (10.5)	17 (27.4)	1 (33.3)	0.691

BMI: body mass index; **GDM:** gestational diabetes mellitus.

for plasma sE-selectin levels and the genetic-inferred ABO blood types are related with the risk of type 2 diabetes. They also showed that the blood type B is associated with a lesser risk than the blood type O.[19] In their high-resolution genome-wide association study of serum sE-selectin patients with type 1 diabetes, Paterson et al.[20] identified the major loci influencing levels. They observed highly significant evidence for an association ($p=10^{-29}$) with rs579459 near the ABO blood type gene, which accounts for 19% of the variance in E-selectin levels and stated that ABO is an important locus for serum sE-selectin levels.[20]

The results of the present study indicated that ABO blood types and Rh factors were not risk factors for GDM. The results of recent studies that have investigated a possible relationship between ABO blood types and GDM risk have been variable, inconsistent, and different from one region to another. In their study on Iranian pregnant women, Seyfizadeh et al.[21] reported that those with blood type AB have higher blood glucose than those with blood type A during their second trimester.[21] In their study, Karagöz et al.[13] evaluated 233 Turkish pregnant women who were diagnosed with GDM and found a significant difference among the women with GDM and control groups by the distribution of ABO blood types. In that study, there was an increased percentage of blood type AB in women with GDM than in the control group. When the women were compared according to the DM, the ratio of those with blood type O was higher than that of other blood types, while the ratio of those with blood type B was lower. A comparison of ABO blood types and Rh factors found a significant difference in the ratio of those who develop DM, which is higher in patients with Rh(+) factor among all, except blood type B. The authors suggested that pregnant women with blood type AB have an increased risk of GDM, which indicates that clinicians must ensure that those women are followed up.[13]

Similarly, Shimodaira et al.[12] suggested that Japanese pregnant women with blood type AB are at risk for GDM; however, Zhang et al.[11] reported that women with blood type A, B, or O (i.e., non-AB) have an higher risk of developing GDM than those with blood type AB. Sensitivity analyses showed that their results were consistent using criteria from the World Health Organization. The adjusted OR comparing those with non-AB blood types with those with blood type AB for the development of GDM was occurred among women with a family history of diabetes (OR: 2.69; CI: 1.21–5.96) and attenuated among those without it (OR: 1.33; CI: 1.03–1.71). The authors declared that blood type AB is a protective factor against GDM in Chinese pregnant women.[11] The study by Fagherrazzi et al.[14] on the association between blood types and type 2 DM showed that specific ABO blood types are related with a risk of the disease, and that those with blood type O have the lowest risk of occurring type 2 DM. The results of their study also indicated that those with blood types A Rh(+) , A Rh(-), B Rh(+), and AB Rh(+) have a higher risk of type 2 DM than those with blood type 0;[15] however, the difference among all the of results of these studies were interpreted in another study as being the difference between a diversity of races, ethnic origins, and socioeconomic groups.[15]

Study limitations

There were some strengths and limitations to the present study. First, the retrospective design of the study and the fact that GDM screening was conducted using both single- and double-step OGTTs (although both are recommended and accepted methods in screening) can be suggested to be important study limitations.[3,16,18] Second, the large sample size and family history, BMI at the time of screening, smoking, gravida, and parity information enabled us to analyze these variables as risk factors; however, because the study was conducted at a single center, it is not appropriate to compared the results for the entire Turkish population, and it is well known that the prevalence of GDM varies among different regions of Turkey.[1] Third, our study also suffers from the common problems with retrospective studies in that there was a lack of data, and the reliability of the results are associated with classification bias. Different results have been produced from different studies; therefore, we suggest that generalizations cannot be made on diseases by selecting a specific sample because these different studies were not screened as a whole.

Conclusion

Our results indicated that ABO blood types and Rh factors are not risk factors for GDM. Additional studies with predetermined subclasses within specific populations would help to demonstrate whether blood types, including the Rh factors, are risk factors for GDM within the current population or not.

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Compliance with Ethical Standards: The authors stated that the standards regarding research and publication ethics, the Personal Data Protection Law and the copyright regulations applicable to intellectual and artistic works are complied with and there is no conflict of interest.

References

1. Sahin M, Madendag I. Evaluation of the prevalence of gestational diabetes mellitus in Kayseri city hospital: a cross-sectional study. Journal of Surgery and Medicine 2019;3:715–7. [CrossRef]
2. Akdemir E, Sahin E, Madendag Y, Sahin ME, Madendag IC, Acmaz G, et al. Effect of preeclampsia and preeclampsia severity on insulin, HOMA-IR, and betatrophin levels in non-diabetic pregnant women. Placenta 2020;100:54–9. [PubMed] [CrossRef]
3. ACOG Practice Bulletin No. 190: gestational diabetes mellitus. Obstet Gynecol 2018;131:e49–64. [PubMed] [CrossRef]
4. Storry J, Olsson ML. The ABO blood group system revisited: a review and update. Immunohematology 2009;25:48-59. [PubMed]
5. Cooling L. Blood groups in infection and host susceptibility. Clin Microbiol Rev 2015;28:801–70. [PubMed] [CrossRef]
6. Zhang B-L, He N, Huang Y-B, Song F-J, Chen K-X. ABO blood groups and risk of cancer: a systematic review and meta-analysis. Asian Pac J Cancer Prev 2014;15:4643–50. [PubMed] [CrossRef]
7. Wu O, Bayoumi N, Vickers M, Clark P. ABO (H) blood groups and vascular disease: a systematic review and meta-analysis. J Thromb Haemost 2008;6:62–9. [PubMed] [CrossRef]
8. Vasan SK, Rostgaard K, Ullum H, Melbye M, Hjalgrim H, Edgren G. ABO blood group and dementia risk – a Scandinavian record-linkage study. PLoS One 2015;10:e0129115. [PubMed] [CrossRef]
9. Franchini M, Mengoli C, Lippi G. Relationship between ABO blood group and pregnancy complications: a systematic literature analysis. Blood Transfus 2016;14:441. [PubMed] [CrossRef]
10. Kiechl S, Paré G, Barbalic M, Qi L, Dupuis J, Dehghan A, et al. Association of variation at the ABO locus with circulating levels of soluble intercellular adhesion molecule-1, soluble P-selectin, and soluble E-selectin: a meta-analysis. Circ Cardiovasc Genet 2011;4:681–6. [PubMed] [CrossRef]
11. Zhang C, Li Y, Wang L, Sun S, Liu G, Leng J, et al. Blood group AB is protective factor for gestational diabetes mellitus: a prospective population-based study in Tianjin, China. Diabetes Metab Res Rev 2015;31:627–37. [PubMed] [CrossRef]
12. Shimodaira M, Yamasaki T, Nakayama T. The association of maternal ABO blood group with gestational diabetes mellitus in Japanese pregnant women. Diabetes Metab Syndr 2016;10(2 Suppl 1):S102–S5. [PubMed] [CrossRef]
13. Karagoz H, Erden A, Ozerhan Ozer KE, Cetinkaya A, Avci D, Karahan S, et al. The role of blood groups in the development of diabetes mellitus after gestational diabetes mellitus. Ther Clin Risk Manag 2015;11:1613–7. [PubMed] [CrossRef]
14. 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. [PubMed] [CrossRef]
15. Liu Y-H, Koda Y, Soejima M, Pang H, Wang B-J, Kim D-S, et al. The fusion gene at the ABO-secretor locus (FUT2): absence in Chinese populations. J Hum Genet 1999;44:181–4. [PubMed] [CrossRef]
16. International Association of Diabetes and Pregnancy Study Groups Consensus Panel; Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P, et al. International Association of Diabetes and Pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes Care 2010;33:676–82. [PubMed] [CrossRef]
17. Kırlangıç MM, Açmaz G, Şahin E, Madendağ Y, Özdemir F, Müderris II. The assessment of the perinatal outcomes of the patients who underwent quad screening test. Perinat J 2020;28:28–35. [CrossRef]
18. Carpenter MW, Coustan DR. Criteria for screening tests for gestational diabetes. Am J Obstet Gynecol1982;144:768–73. [PubMed] [CrossRef]
19. Qi L, Cornelis MC, Kraft P, Jensen M, van Dam RM, Sun Q, et al. Genetic variants in ABO blood group region, plasma soluble E-selectin levels and risk of type 2 diabetes. Hum Mol Genet 2010;19:1856–62. [PubMed] [CrossRef]
20. Paterson AD, Lopes-Virella MF, Waggott D, Boright AP, Hosseini SM, Carter RE, et al.; Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Research Group. Genome-wide association identifies the ABO blood group as a major locus associated with serum levels of soluble E-selectin. Arterioscler Thromb Vasc Biol 2009;29:1958–67. [PubMed] [CrossRef]
21. Seyfizadeh N, Seyfizadeh N, Yousefi B, Borzoueisileh S, Majidinia M, Shanehbandi D, et al. Is there association between ABO blood group and the risk factors of unfavorable outcomes of pregnancy? J Matern Fetal Neonatal Med 2015;28:578–82. [PubMed] [CrossRef]