ORIGINAL ARTICLE

ABO Blood Group and Its Associated Factors Among Type 2 Diabetes Mellitus Patients

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ABSTRACT

Introduction: ABO blood group can be associated with chronic diseases, for example, cancer and coronary heart disease, however it is not proven in Type 2 Diabetes Mellitus (T2DM). The aim of this study was to identify the association between the ABO blood group and disease control among T2DM patients at Kepala Batas, Penang. **Methods:** Approximately two mL vials of fresh blood were collected and typed using the tube method from 129 T2DM and 132 non-diabetic (control) patients, who visited the specialist clinic. The sociodemographic characteristics of the T2DM patients was analysed using descriptive analysis. The proportions of A, B, AB, and O blood groups among the diabetic and control patients were compared using the chi-square test. Any association between the ABO blood group and disease control was identified using the bivariate correlation test. **Results:** No significant association was found between the ABO group and T2DM patients ($p = 0.152$) when compared with the control group. However, blood group B was the most frequent among T2DM patients (33.3%) compared to blood group O within the control group (36.4%). Negative associations were observed between the ABO blood group and BMI ($r = 0.098$, $p = 0.268$), as well as the HbA1C value ($r = -0.065$, $p = 0.464$). **Conclusion:** No association was found between the ABO blood group and the associated risk factors (BMI and HbA1C). However, individuals with blood group B and risk factors, such as older age group, obesity, and high HbA1C value (more than 7.0%), should be monitored.
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INTRODUCTION

Diabetes currently affects nearly 451 million adults within the 18–99 years age range and this number could be higher by 2045 with 693 million affected globally (1). According to the Malaysian National Health and Morbidity Survey (NHMS IV), the frequency of T2DM has increased to 20.8% among 30 year-old and older adults. It currently affects 2.8 million individuals with different distributions among the various ethnicities (2).

Disease control among Malaysians with T2DM is gradually decreasing, with an increasing mean of haemoglobin A1c (HbA1C) level at 8.66% in 2008, in contrast with 8.0% in 2003 (3). Additionally, only

22% of people with T2DM reached HbA1C target of lower than 7%, which is the bottom rate since 1998. The Adult Diabetes Control and Management database showed ethnic distinctions in glucose control, whereby in Malaysia, Chinese individuals with T2DM showed the lowest mean of HbA1C levels at 7.8%, while Indian individuals showed the highest mean at 8.5% (4).

Other than the known roles of the ABO blood group in the field of transfusion medicine, ABO blood group can also be associated with chronic diseases, for example, cancer and coronary heart disease (5). This information has created an assumption that the ABO blood group might have a relationship with other chronic diseases, especially T2DM, a global emerging disease. The main aim of this study was to identify the association between the ABO blood group among T2DM patients and its associated factors. Sociodemographic characteristics, namely, age, gender, race, Body Mass Index (BMI), and HbA1C level were also studied. These data can be

used to develop preliminary preventive measures for managing individuals with high-risk factors of T2DM by looking at the proportions and patterns of the respective blood groups. Moreover, this study was aimed to fill the knowledge gap regarding T2DM, since there are limited studies that have looked into the association between the ABO blood group among T2DM patients and disease control. The progression into T2DM can be mitigated in high-risk individuals, if the associated factors are identified and managed earlier.

MATERIALS AND METHODS

Study Design and Participants
This cross-sectional study was conducted at the family medicine specialist (FMS) and outpatient clinic of the Advanced Medical and Dental Institute (AMDI), Universiti Sains Malaysia, Penang starting from August 2019 till March 2020. This study involved patients who visited the clinic for follow-up appointments with the specialist (diabetic group) and general visit (non-diabetic or control group). Malaysian citizens with T2DM in the age bracket of 18 to 75 years old were included as part of the diabetic group. Exclusion criteria included subjects with any psychiatric illness, have a history of diabetic ketoacidosis, were pregnant during this study period, anaemic, post-organ transplant, suffering end-stage renal failure, have infection, and a history of pancreas surgery. For non-diabetic group, Malaysian citizen non-diabetic patients attending AMDI's outpatient clinic from the age of 18-70 years old with venous plasma glucose less than 7.0 mmol/L (fasting) and less than 11.0 mmol/L (random) were recruited into this study. Participation of these subjects was based on informed consent.

Data Collection
This study involved 264 subjects, which consisted of 132 diabetic and 132 non-diabetic patients. Each subject allowed two mL of fresh blood to be collected in an EDTA container for ABO blood typing purpose using the tube method. EDTA tubes containing two mL of the subjects' fresh blood were centrifuged at 1,300 - 1,500 Ч g for 10 min to separate the whole blood into packed cell and plasma. The packed cell was then washed with saline three times and 3% red cell suspension was prepared using the washed red cells. Next, one drop of 3% red cell suspension was added into four different tubes, each containing different antisera (anti-A, anti-B, anti-AB, and anti-D) for forward typing, while two drops of plasma were mixed with A, B, and O reference cells for reverse typing. All tubes were centrifuged at 1,33 - 1,500 Ч g for 15 sec. The agglutination reactions were read and recorded based on the agglutination grading reaction table (Figure I). BMI and HbA1C data of the subjects were extracted from the Computerised Hospital Data (CARE2X) for further analysis.

Statistical Analysis
Data related to the subjects were analysed using SPSS, version 24. A descriptive analysis was conducted to describe the sociodemographic characteristics of the T2DM subjects, who visited the specialist clinic at AMDI. Categorical variables were expressed as percentages. A chi-square test was conducted to compare the proportion of the ABO blood group between T2DM and non-diabetic subjects. To determine the associations between the blood group of the subjects and their HbA1C and BMI levels, a bivariate correlation test was conducted. P-value of less than 0.05 (<0.05) was used to indicate a positive association.

Ethical Approval
This study has been approved by the Research and Ethics Committee, School of Medicine, Universiti Sains Malaysia no USM/JEPeM/19010052.

RESULTS

From a total of 264 subjects, only the data for 261 subjects (129 diabetic, 132 non-diabetic) were obtained for this study, while three subjects were excluded due to missing data in the CARE2X system.

Sociodemographic characteristics of T2DM patients
The summarised sociodemographic characteristics of the study population are shown in Table I. Most of the T2DM patients, who visited the FMS clinic, were range from 5 9 to 68 years old (42.6%), male (52.7%), Malay (95.3%), and overweight (39.5%).

Proportion comparison of the ABO blood group between T2DM and non-diabetic patients
The overall proportion comparison of the ABO blood group between T2DM and non-diabetic patients are

Table I: Sociodemographic characteristics of T2DM patients attending AMDI's FMS clinic

Variables	Patients (N=129)	Percentages (%)
Age (years)		
29 – 38	6	4.7
39 – 48	12	9.3
49 – 58	33	25.6
59 – 68	55	42.6
69 – 79	23	17.8
Gender		
Male	68	52.7
Female	61	47.3
Races		
Malay	123	95.3
Chinese	4	3.1
Indian	2	1.6
BMI		
Normal (18.5-24.9)	28	21.7
Overweight (25.0- 30.0)	51	39.5
Obese (>30.0)	50	38.8

represented in Table II. No significant association was found between the ABO blood group and T2DM (χ^2 = 5.290, df = 3, p = 0.152), which meant that both patients and control group had similar ABO blood group distributions. However, blood group B had the highest frequency (33.3%) among the subjects in the diabetic group compared to blood group O (36.4%) among those in the non-diabetic group.

Table II: Proportion comparison of ABO blood group between T2DM patients and non-diabetic patients at AMDI

Blood group	T2DM patients (N=129)	Non-diabetic patients (N=132)	χ^2	df	P value
A	33(25.6%)	38(28.8%)			
B	43(33.3%)	43(32.6%)			
AB	11(8.5%)	3(2.3%)	5.290	3	0.152
O	42(32.6%)	48(36.4%)			

Association between the ABO blood group among T2DM patients, and their HbA1C value and BMI

The results of the correlation test between the ABO blood group among T2DM patients, and their HbA1C value and BMI are shown in Table III. No significant relationship was found between the ABO blood group of T2DM patients with BMI (r = 0.098, p = 0.268), and HbA1C (r = -0.065, p = 0.464) respectively.

Table III: Correlation between ABO blood group in T2DM with HbA1C and BMI

Dimension	ABO Blood Group in T2DM (r)	Significant (p)
BMI	0.098	0.268
HbA1C	-0.065	0.464

DISCUSSION

The global prevalence for diabetes according to age groups is approximately 5% in the 35–39 year-old age group, 10% in the 45–49 year-old age group, 15% in the 55–59 year-old age group, and 20% in the 65–69 year-old age group (6). Individuals between 59 and 68 years old (or categorised as senior citizens in Malaysia) can be found in a greater number among T2DM patients in this study at 42.6%. The outcome of this study is similar to the NHMS 2015 report, whereby the risk of getting diabetes mellitus is higher at 39.1% among 70–74 year-old citizens. Older adults are highly vulnerable to the development of T2DM due to the combined effects of increased insulin resistance and impaired pancreas function due to the aging process (7).

Most of the findings from Western European or Asian populations indicated that the prevalence of T2DM in men is much higher than in women (8, 9). In this study,

the number of male patients was higher than the number of female patients by 5.4%. However, the NHMS 2018 report presented that the number of elderly adults screened for diabetes was higher among female than among male citizens. A study conducted in Saudi Arabia also reported a marginally higher rate of female patients developing diabetes compared to male patients (10).

Based on race or ethnicity, the findings of this study showed that the highest number of T2DM patients consisted of Malay individuals. This was mainly because they were the major inhabitants in this sampling area. The NHMS 2015 report for the prevalence of diabetes among Malaysian citizens disclosed that Indian individuals have the highest prevalence of T2DM compared to other ethnicities, followed by Malay individuals (2). These numbers are supported by the Adult Diabetes and Control Management database. Nonetheless, further research needs to be conducted to address the race-related risks of developing T2DM in a certain population.

Obesity has always been related to the risk of having T2DM as a result of insulin resistance development in obese individuals. The results of this study have shown that most T2DM patients were in the overweight and obese category. These basic findings were consistent with the results reported by (11) that looked at the clinical characteristics of T2DM patients, whereby 63% of their BMI values were over 30 or in the obese category. Therefore, BMI is one of the monitored parameters in the management of T2DM patients.

This study has shown that the ABO blood group was not statistically associated with the diabetic status (DM versus non-diabetic) of the subjects. Both DM and non-diabetic groups had similar distributions of each component of the ABO blood group. Nevertheless, the frequency of blood group B was slightly higher among T2DM patients compared to the high frequency of non-diabetic patients with blood group O. A similar pattern of results was found by Shrestha et al. (2014), whereby no association was found between the ABO blood group and T2DM, and blood group B appearing as the most frequent among diabetic patients (12). Mandal et al. (2018) also reported blood group B as having the highest count among diabetic patients, even though statistical significance was not achieved (13). Another study that involved a larger sample size (3,283 subjects) indicated a positive association between the ABO blood group and T2DM by illustrating that blood group B was commonly found among T2DM patients. The P-value was < 0.001 when compared to the healthy population that can be found with blood group O (14). Although research works on the association between the ABO blood group and T2DM demonstrated different outcomes, blood group B was consistently found in a substantial number of diabetic patients compared to other blood groups. Therefore, a large number of subjects with blood group

B can be considered for further research.

One of the risk factors that contribute to the development of T2DM is having a high BMI or being obese. Therefore, BMI needs to be taken into consideration in the management of T2DM patients. This present study considered whether the ABO blood group among T2DM patients can be related to BMI as a parameter of disease control. However, the findings of this study showed no statistical significance between the ABO blood group and BMI in T2DM patients; hence, no correlation between ABO, T2DM, and BMI. The outcome of this current study was in line with a previous study that included 1,171 participants. They also found no significant relationship between the ABO blood group and obesity or high BMI value among the population of Saudi Arabia (15). In a research conducted among the Ghanaian population by Smith et al. (2018), no association was found between the ABO blood group and BMI; hence, ABO was concluded as having no direct association with obesity (16). On the other hand, Jawed et al. (2018) reported a significant positive association between blood group O and obesity in a research on a cohort of female university students (17). However, the health status of these participants was unknown, unlike in the present study where the patients have been diagnosed and treated for T2DM. Moreover, the previous study had only involved females in the same age range. Therefore, their findings could not be compared directly with the present study, which specifically targeted T2DM patients.

HbA1C is a key parameter that reflects self-disease control of patients with T2DM. Given the limited number of studies on the association between the ABO blood group and HbA1C level among patients with T2DM, this study conducted a correlation test based on the obtained data to directly observe the association between these two variables. Our findings revealed no significant association among T2DM patients, since the ABO and HbA1C values were not strongly linked to each other. However, based on the distributions of the ABO blood group and HbA1C values, most T2DM patients with HbA1C value ranging from 7.9% to 6.5% have blood group B (53.5%). Ibrahim Albaroodi et al. (2019) illustrated comparable outcomes, with no significant frequency differences between the ABO blood group and HbA1C values among diabetic patients; therefore, implying no direct association between the two (18). Nevertheless, their study also found a statistically significant association between the ABO blood group and fasting blood sugar (FBS) level, which is another monitored parameter in the management of T2DM patients.

Larger sample sizes should be considered to achieve more powerful and significant outcomes. In addition, a multicentre study should be performed instead of a single-centre study, since it might be useful to generally reflect the whole population. Detailed inclusion and exclusion criteria for the control group should also be taken into consideration to ensure no undiagnosed case of T2DM can occur. Other risk factors such as family history, lipid level and hypertension should be assessed as certain factor increase the risk of developing T2DM. As a final point, FBS should be considered for future studies to compare it with HbA1C value.

CONCLUSION

Overall, the descriptive analysis on the sociodemographic characteristics of the subjects showed that elderly adults, who were 59 years old and older, overweight, and had blood group B, were found more frequently among T2DM patients in the targeted population at AMDI, USM. Nevertheless, the statistical analysis revealed no significant association between the ABO blood group among T2DM patients and disease control parameters. Hence, there was no association between the ABO blood group and the associated risk factors (BMI and HbA1C), which indicated that the ABO blood group had no direct contribution to the occurrence and disease control of T2DM. However, preliminary monitoring should be considered in the management of individuals with blood group B and underlying risk factors, such as older age group, health problems linked to obesity, and high HbA1C value (more than 7.0%), since most T2DM patients have been found with these risk factors.

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