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Hyperglycaemia and ABO Blood Groups: An Investigative Analysis among Young Adults of Hyderabad, Sindh, Pakistan

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ABSTRACT

Serious health problems include nerve damage, renal failure, and an increased risk of cardiovascular disease can result from chronic hyperglycemia. **Objective:** To investigate the relationship between hyperglycemia and ABO blood types in young adults from Hyderabad, Sindh. **Methods:** 582 randomly selected healthy individuals, 281 females and 301 males, aged 18 to 40, were recruited from various institutions for this cross-sectional study, which took place between January 2, 2021, and January 31, 2022. The data was gathered using the basic random approach. All participants gave their informed consent prior to recruitment. Descriptive statistics including mean, standard deviation, and frequency distributions were computed using the Chi-square test. Data collection was analyzed using SPSS version 20.0. **Results:** This study included 582 participants. In male individuals, the mean age was 27.83 ± 5.478, and in females, 22.27 ± 4.730. The mean BMI was 25.81 ± 5.08 in males and 24.00 ±4.90 in females. The 207 B blood group individuals were found to be obese, comprising 112 males and 95 females, followed by 195 individuals with blood group O, 128 individuals with blood group A, and 52 individuals with blood group AB. People who are Rh-positive and have blood group B were shown to be more likely to experience elevated hyperglycemia. **Conclusion:** Blood group B and Rh-positive status may be linked to higher hyperglycemia risk in young adults from Hyderabad, suggesting blood typing as a potential screening tool.

INTRODUCTION

Hyperglycemia is a multifactorial metabolic syndrome characterized by an increased blood sugar concentration. Hyperglycemia results from the pancreas's inefficiency in secreting the required amount of insulin or the decreased capability of body cells to respond to insulin [1]. Management of hyperglycemia in hospitalized patients is essential due to its association with increased morbidity, including cases triggered by physiological stress [2, 3]. Approximately 10.5% of the global population, or 537 million adults, were diagnosed with diabetes in 2023 [4]. It is projected that 783 million adults will have been diagnosed with diabetes in 2045, which is almost 46% more than the 2021 estimates [5]. The International Diabetes Federation (2023) report states that diabetes mellitus was the cause of 6.7 million fatalities in 2021. According to this, one person dies from diabetes mellitus every five seconds [6]. The ABO blood group system is the most commonly used blood group identification method in the world out of the 45 various blood group systems [7]. Based on the presence of specific antigens on the membrane of red blood cells, this

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system divided people into four groups. Genetic inheritance governs the ABO blood group system, which is linked to a number of physiological and pathological conditions. Numerous studies concluded that certain blood groups may be linked with particular health problems, including malaria, multiple infections, obesity, cardiovascular disease, and even certain types of cancer [8]. Certain medications have been identified as contributing factors to elevated blood glucose levels, either by impairing insulin secretion or increasing insulin resistance. Drug-induced hyperglycemia is an important but often overlooked cause of metabolic disturbance, necessitating careful evaluation of patient medication history when assessing glycemic abnormalities [9]. Studies have identified genetic and molecular factors that may contribute to the relationship between ABO blood group and glucose metabolism. Furthermore, studies have also concluded that blood groups may influence inflammatory and vascular responses, both of which play a crucial role in regulating glucose and insulin levels. However, genetic loci that control the ABO blood group also influence glucose and lipid metabolism, suggesting a probable genetic linkage [10]. Few studies identified that individuals having the B blood group are more likely to develop hyperglycaemia [11]. Other studies have suggested that individuals with blood group O may be protected against hyperglycemia [12]. Apart from established routes like insulin resistance, β cell dysfunction, and dietary/lifestyle variables, genetic variation at the ABO locus (chromosome 9q34.2) may also affect coagulation, endothelial, and inflammatory pathways, which in turn may affect metabolic syndrome. Glycosyltransferases (A-, B-, or inactive O enzyme) are encoded by the ABO gene, and non-O alleles are connected to increased levels of markers like vWF, ICAM 1, and P selectin mediators linked to endothelial dysfunction and insulin resistance through SNPs like rs505922 and rs507666. This suggests that non-O alleles may influence the risk of hyperglycemia [13, 14]. The majority of previous research was done on diagnosed patients and older populations, where there is a strong correlation between diabetes and other metabolic diseases. However, because obesity, physical inactivity, and bad eating habits are more common in younger adults, hyperglycemia is becoming more common in this demographic. In addition, compared to older populations, young individuals have different lifestyle patterns in terms of stress levels, sleep patterns, physical activity levels, and eating habits. These elements could affect how glucose is metabolized. Specific studies on young adults are limited; therefore, it was aimed to investigate the relationship between the ABO blood group and hyperglycemia in young adults from the Hyderabad district.

METHODS

This cross-sectional study was carried out with permission from the University of Sindh, Jamshoro's Research Ethics Committee, Letter No. ERC/1601, to look into the connection between ABO blood types and hyperglycemia in the young people living in District Hyderabad who are between the ages of 18 and 40. Every participant gave their informed consent. Participants were selected based on preset criteria to get the most accurate results. Participants included those who knew their blood types, did not have diabetes, were not pregnant, did not smoke, and did not have an addiction. This study excluded participants who did not live in the Hyderabad district, were over 40, had a diagnosis of diabetes, were pregnant, were active smokers, had a genetic disorder associated with obesity, had hypothyroidism, polycystic ovary syndrome, Cushing syndrome associated with obesity, or were drug addicts. Eight to twelve hours before to the test, participants were told to avoid eating or drinking anything other than water. This entails abstaining from coffee, tea, sugary drinks, and snacks. In order to avoid dehydration during the fasting period, drinking water is typically advised. The automatic capillary method was used to analyze blood sugar levels using a glucometer (Easy Max by Biotechnology Corp, Made in China). Reference range for fasting blood: normal 70–100 mg/dl; rise > 100 mg/dl. The Statistical Package for the Social Sciences (SPSS), Version 20.0, was used to analyze the data. To summarize the individuals' clinical and demographic traits, descriptive statistics such as mean, standard deviation, and frequency distributions were calculated. The relationship between high blood sugar and ABO blood groups was evaluated using the Chi-square test. Crude Odds Ratios (ORs) were calculated using logistic regression analysis to further assess the strength of this association. A statistically significant p-value was defined as less than 0.05.

RESULTS

Five health-related variables were compared between people with different ABO blood groups (A, B, AB, and O) in Table 1. These variables included age, Body Mass Index (BMI), Fasting Blood Sugar (FBS), Systolic Blood Pressure (SBP), and Diastolic Blood Pressure (DBP). The F-value represents the result of the ANOVA (Analysis of Variance) test, and the P-value indicates the statistical significance of the result. The mean ages across blood groups are similar, ranging from 24.56 ± 5.40 (O group) to 25.58 ± 6.13 (A group). The P-value (0.294) indicates no statistically significant difference in age among blood groups. An essential difference in BMI is observed across blood groups (P = 0.003). Individuals with blood group B had the highest mean BMI (25.96 ± 5.66), suggesting a possible association between blood group B and higher Body Mass Index (BMI). A

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statistically significant difference was observed in fasting blood sugar levels (P = 0.036). Blood group B again showed the highest mean Fasting Blood Sugar (FBS) level (100.90 ± 31.01). In contrast, AB and O groups had lower values, indicating that individuals with blood group B may be at a higher risk for hyperglycaemia. Systolic Blood Pressure (SBP) varied significantly between blood groups (P = 0.003). The mean SBP was higher in blood group B (121.28 ± 13.52) than in blood group O (115.70 ± 15.55). A significant difference was also found in Diastolic Blood Pressure (DBP) (P = 0.008), with group B again having the highest value (81.41 ± 10.33) and group O having the lowest (78.20 ± 9.41).

Table 1: Basic Characteristics of Individuals According to ABO Blood Group System

Variables	A (130) Mean ± SD	B (205) Mean ± SD	AB (50) Mean ± SD	O (197) Mean ± SD	F	P
Age	25.58 ± 6.131	25.52 ± 6.210	24.82 ± 4.952	24.56 ± 5.402	1.241	0.294
BMI	24.813 ± 4.574	25.964 ± 5.66	24.230 ± 5.23	24.154 ± 4.52	4.798	0.003
Blood Sugar Fasting	100.28 ± 35.08	100.90 ± 31.01	92.64 ± 32.28	93.41 ± 24.79	2.877	0.036
Systolic Blood Pressure	117.16 ± 19.35	121.28 ± 13.52	116.64 ± 12.61	115.70 ±15.55	4.693	0.003
Diastolic Blood Pressure	80.65 ± 9.54	81.41 ± 10.33	79.20 ± 8.41	78.20 ± 9.41	4.024	0.008

Table 2 presented the distribution of ABO and Rh blood groups among a total of 582 participants, divided by gender (301 males and 281 females). The frequencies (N) and percentages (%) for each blood group type are reported for the overall population, as well as for male and female subgroups. Blood group B is the most common overall (35.5%), and it is also the most common in both males (37.2%) and females (33.8%). Blood group O follows closely, accounting for 33.5% of the total, with a slightly higher percentage in females (35.5%) compared to males (31.5%). Blood group A accounts for 21.99% of the overall population, with a higher frequency in males (23.5%) compared to females (20.2%). Blood group AB is the least common overall (8.9%), with a slightly higher prevalence in females (10.3%) than in males (7.6%). The majority of the population is Rh positive (91.7%), with similar proportions in males (92.6%) and females (90.7%). Only 8.2% of participants are Rh negative, with a slightly higher percentage in females (9.3%) than males (7.3%).

Table 2: Distribution of Participants (n=1164)

Variable	Overall Frequency (%)	Male Frequency (%)	Female Frequency (%)
A	128 (21.99)	71 (23.5)	57 (20.2)
B	207 (35.5)	112 (37.2)	95 (33.8)
AB	52 (8.9)	23 (7.6)	29 (10.3)
O	195 (33.5)	95 (31.5)	100 (35.5)
Rh Positive	534 (91.7)	279 (92.6)	255 (90.7)
Rh Negative	48 (8.2)	22 (7.3)	26 (9.3)

The association between ABO and Rh blood types and FBG levels was shown in this table, which divided participants into two groups according to normal (<100 mg/dL) and increased (>100 mg/dL) FBG levels. Using blood group O and Rh-positive as reference categories, the odds ratio (OR) with 95% CI and p-values are presented to show the strength and statistical significance of correlations. Blood Group O (Reference Group): 74.35% of individuals had normal FBG, and 25.64% had increased FBG. Compared to group O, blood group A displayed a greater percentage of elevated FBG (33.59%). A 46% increased risk was indicated by the OR = 1.46, but this difference was not statistically significant (p = 0.214). The largest percentage of elevated FBG was seen in blood group B (41.06%). With an OR = 2.20 (95% CI: 1.34–3.61), the risk of hyperglycemia is more than double that of the statistically significant group O (p = 0.000). Although it was not statistically significant (p = 0.223), Blood Group AB had the lowest percentage of elevated FBG (17.30%) and an OR of 0.47, suggesting a protective trend. 32.77% had elevated FBG and 67.22% had normal FBG in the Rh-Positive (Reference Group) group. Rh-Negative: 75.00% had normal FBG and 25.00% had elevated FBG; there was no discernible difference between Rh-negative and Rh-positive people (p = 0.361), with an OR of 0.90.

Table 3: The Association of ABO and Rh Blood Groups with Fasting Blood Sugar

Blood Group	Normal FBG <100 mg/dl Frequency (%)	Increased FBG >100 mg/dl Frequency (%)	OR (95% CI)	p-Value
O (n = 195)	145 (74.35)	50 (25.64)	Reference	–
A (n = 128)	85 (66.40)	43 (33.59)	1.46 (0.83–2.56)	0.214
B (n = 207)	122 (58.93)	85 (41.06)	2.20 (1.34–3.61)	0.000
AB (n = 52)	43 (82.69)	9 (17.30)	0.47 (0.19–1.17)	0.223
Rh Factor	Normal FBG <100 mg/dl	Increased FBG >100 mg/dl	OR (95% CI)	p-Value
Rh-Positive (n = 534)	359 (67.22)	175 (32.77)	Reference	–
Rh-Negative (n = 48)	36 (75.00)	12 (25.00)	0.90 (0.41–2.01)	0.361

DISCUSSION

The goal of the current study was to look into any connections between young people' hyperglycemia and their ABO blood type. B blood group participants were more prevalent in this study, which is consistent with earlier reports [15]. 67.86% of people had normal fasting blood sugar, while 32.13% had elevated blood sugar. Individuals with the B blood group were more likely to develop hyperglycemia, followed by those with the A, O, and AB blood groups, and Rh-positive individuals were more prone to the condition than Rh-negative individuals. A cross-

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sectional comparative research of people with and without diabetes mellitus (D.M.) found that people with the B blood group are more likely to experience hyperglycemia. Additionally, it is proposed that blood group and hyperglycemia are related since both have a wide genetic and immunological foundation [16]. Sulaiman *et al.*, conducted a study in Mardan, Pakistan, which also agreed with these findings that the B blood group is more prone to develop hyperglycaemia; this study was conducted on students of Abdul Wali Khan University [17]. The findings of this investigation are also supported by another study carried out in Iraq by Pandey [18]. A study conducted at Karachi by Anwar *et al.*, revealed agreement with these findings that the B blood group was more prone, but disagreed with blood group AB, which was safer in this study [19]. Similarly, Gotawa agreed with these findings [10]. The findings of this study, which found a negative correlation between the ABO blood group and elevated FBS and diabetes, are in conflict with a Malaysian study by Kamil *et al.* Additionally, compared to healthy individuals, those with type 2 DM had a greater distribution of the B blood group; however, this difference did not reach statistical significance [20]. Hedge found that blood groups A and O were more likely to develop hyperglycemia than blood groups AB and B, in contrast to this finding [21]. The genetic expression of this disease may be influenced by geographical and ethnic characteristics, which could account for these inconsistent findings. Ewald D. *et al.*, found that the ABO blood group is one of the hereditary host variables that changes the intestinal microbiota's composition and affects metabolism by changing energy balance, glucose metabolism, and low-grade inflammation [22]. A potential genetic link between ABO blood groups and cardiovascular disease has been suggested because of the role played by the ATP-binding cassette transporter A2 (ABCA2) gene, which is crucial for controlling cholesterol, as well as the ABO blood type system [23]. The ABO gene is located on chromosome 9 (locus 9p34). This proximity suggests that ABO blood types may have an impact on plasma lipid levels. (8). The involvement of ABO genotypes in regulating circulating levels of Total Cholesterol (TC) and Low-Density Lipoprotein (LDL), two known causative risk factors for atherosclerotic cardiovascular disease, is supported by evidence from Genome-Wide Association Studies (GWAS) and later meta-analyses [24]. Furthermore, a large meta-analysis involving 46 lipid-focused GWAS studies identified a significant relationship between ABO gene variants, specifically Single-Nucleotide Polymorphisms (SNPs), and lipid levels [25].

CONCLUSIONS

The results of this study show that among young individuals in Hyderabad, Sindh, there is a substantial correlation between fasting blood glucose levels and ABO blood classes. Individuals with blood group B demonstrated a notably higher risk of hyperglycaemia compared to other blood groups, particularly when contrasted with the reference group (blood group O). While blood groups A and AB showed non-significant trends toward increased and decreased risk, respectively, the Rh factor did not show any significant association with fasting blood glucose levels. These results suggest that blood group B may be a potential genetic marker for increased susceptibility to hyperglycaemia, warranting further investigation in larger, diverse populations. It is important to recognize the various limitations of this study. Because it is a cross-sectional study, it can only identify connections rather than causative relationships between ABO blood types and hyperglycemia. The results may not be as generalizable to other demographics because the sample was restricted to young adults in Hyderabad, Sindh. Additionally, critical confounding factors such as diet, physical activity, socioeconomic status, and family history of diabetes were not accounted for, which could influence fasting blood glucose levels. The study also lacked genetic analysis to explore underlying mechanisms linking ABO blood groups to glucose metabolism. Furthermore, the relatively small number of participants with blood group AB and Rh-negative status may have limited the statistical power for detecting associations in these subgroups.

Authors Contribution

Conceptualization: SA
Methodology: SA, AM, HL, NM
Formal analysis: SA, SFM, KRL
Writing, review and editing: SA, SFM, ZAL

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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