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Original Research Article

Association between Serum Levels of Lipid Profile and ABO Blood Group in Healthy Sudanese Individuals

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Abstract

Background: Lipids are essential in many facets of life, and the ABO system is the paramount system in the transfusion process. This research seeks to correlate serum levels of total cholesterol, triglycerides, HDL-C, LDL-C, and ABO blood type in healthy Sudanese adults. ***Methods:*** A cross-sectional community-based study was undertaken in Khartoum State, Sudan, from March 2020 to August 2021. Two hundred healthy people were enlisted, including 50 from blood group A, 50 from blood group O, 50 from blood group B, and 50 from blood type AB. The blood lipid profile was assessed using an auto chemistry analyzer, and statistical analysis was conducted using SPSS version 25. ***Results:*** A significantly elevated serum cholesterol level (p value = 0.004) and triglycerides (p value = 0.000) were seen across various blood types, with the AB blood group exhibiting the highest levels of both serum cholesterol and triglycerides. There exists a positive link between serum cholesterol levels and age in blood groups O, B, and AB, with correlation coefficients of r=0.399 (P=0.004), r=0.431 (P=0.002), and r=0.403 (P=0.004), respectively. A positive association exists between serum triglycerides and age in blood groups A and O, with coefficients r=0.463 (P=0.001) and r=0.408 (P=0.003), respectively. There exists a significant association between LDL-C and age in blood groups B and AB (r=0.385, P=0.006; r=0.463, P=0.001, respectively). ***Conclusion:*** Individuals with the AB blood group have elevated serum cholesterol and triglyceride levels compared to other blood groups, with a positive association shown between age and cholesterol, triglycerides, and LDL-C across various blood types.

Keywords: lipid profile, cholesterol, ABO blood group, triglycerides.

INTRODUCTION

The ABO blood type system has three primary alleles: two co-dominant alleles (A and B) and one recessive allele (O) [1,2]. The A and B alleles of the ABO locus encode A and B glycosyltransferase activities, which transform the precursor H antigen into A or B determinants, with the A and B antigens possessing an additional saccharide unit compared to the O unit (N-acetylgalactosamine and galactose, respectively). Individuals with Group O lack transferase enzymes and have the unaltered H-antigen [3]. The ABO antigens are expressed on the surface of red blood cells as well as on several human cells and organs, including epithelia, platelets, vascular endothelium, and neurons [4]. Coronary heart disease (CHD) is a complex condition. The etiology of congenital heart disease (CHD) is complex and seems to entail interactions between genetic and environmental variables. Blood constitutes an individual's definitive and immutable identity. Despite the identification of almost 400 blood group antigens, the ABO and Rh systems are acknowledged as the primary therapeutically important blood type antigens. Clinical investigations indicate that persons with the A phenotypic blood group have increased susceptibility to cardiovascular illness [6,7]. Subsequent investigations clarified that ABO blood types, especially non-O blood groups, are linked to significant cardiovascular risk factors and/or an elevated incidence of cardiovascular events [8,9]. Nonetheless, there exists minimal agreement about the extent and importance of ABO effects at the population level and whether it pertains uniformly to all illnesses or primarily influences thrombotic pathways and conditions [10]. This research

intends to correlate serum levels of total cholesterol, triglycerides, HDL-C, LDL-C, and ABO blood type in healthy Sudanese persons.

METHODS

A cross-sectional community-based study was undertaken in Khartoum State, Sudan, from March 2020 to August 2021. A total of 200 healthy people were registered, matched by age and sex, with ages ranging from 20 to 60 years and a BMI of less than 25. There were 50 individuals with A blood group, 50 with O blood group, 50 with B blood group, and 50 with AB blood group. Participants with hypertension, cardiovascular illnesses, obesity, and gastrointestinal disorders were excluded from this research. Data were gathered using a questionnaire. Five milliliters of venous blood were collected into two separate containers: a plain container for serum extraction post-centrifugation for lipid profiling, and an EDTA container for whole blood collection for ABO testing. The blood levels of total cholesterol, triglycerides, and high-density lipoproteins were measured using an automated chemistry analyzer (Cobas 311), while low-density lipoprotein was estimated using the Friedewald formula (LDL-C = Total cholesterol – HDL-C – Triglycerides/5). The slide technique was used for ABO typing. Testing with anti-sera reveals that the presence of agglutination signifies the existence of the appropriate antigen, while the lack of agglutination shows its nonexistence [12]. The research received approval from the scientific committee of the Clinical Chemistry Department of the College of Medical Laboratory Sciences, Sudan University of Science and Technology, and informed permission was acquired from all participants. Normal and pathological control sera were analyzed to ensure the precision of the findings. The data were analyzed using SPSS version 25; a one-way ANOVA test was used for variable comparison, and Pearson's correlation test was utilized to determine correlations, with a significance threshold set at P-value < 0.05.

RESULTS

The distribution of gender among the research population is shown in Figure 1.

The results indicate a significant difference ($p<0.05$) in serum cholesterol and triglyceride levels across all blood groups, whereas no significant difference was seen in HDL-C and LDL-C levels ($p>0.05$), as reported in (Table 1).

A notable disparity exists in the total cholesterol levels between blood group O and group B (P=0.041), as well as between group B and group AB (P=0.000), as seen in (Table 2).

A substantial difference in triglyceride levels was seen between blood group A and group AB (P=0.000), as well as between group B and group AB (P=0.000), as given in **(**Table 3).

No significant variation in serum HDL-C levels across various blood types was revealed in **(**Table 4).

The amount of serum LDL-C exhibited no significant change across various blood types, as indicated in (Table 5).

Demonstrated a strong positive connection between age and total cholesterol levels in blood groups O, B, and AB. A notable positive association exists between age and triglyceride levels in blood groups A and O, as well as a strong positive correlation between age and LDL-C levels in blood groups B and AB, as given in (Table 6).

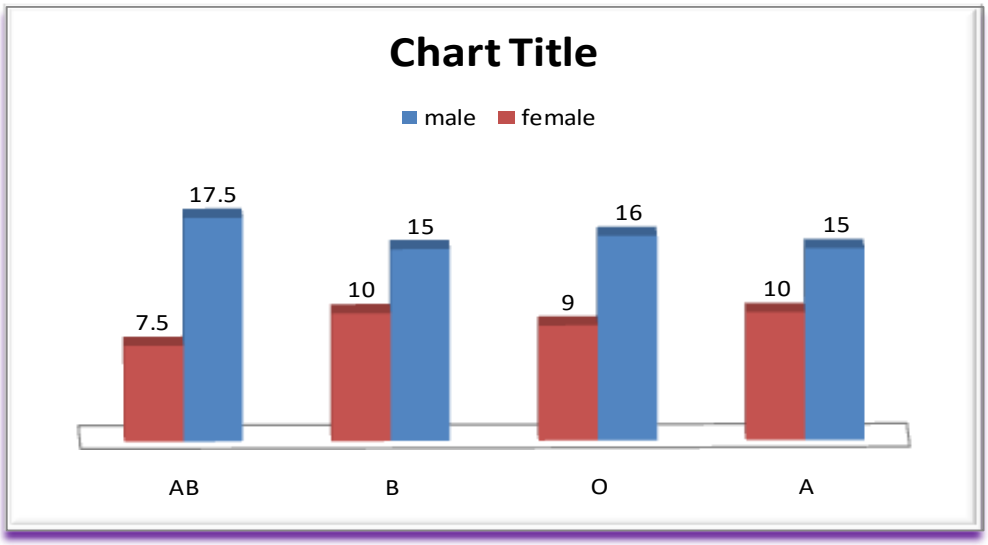

Figure 1: Demographic distribution (percentage%) of subjects between different blood groups

Table 1: ANOVA Table of Mean ± SD of cholesterol, Triglycerides, LDL-C, HDL-C for different blood groups

	A	O	B	AB	P
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Cholesterol	161.5 ± 39.2	163.8 ± 32.6	148.4 ± 35.0	176.0 ± 42.5	0.004
Triglyceride	117.0± 63.5	134.8 ± 101.5	111.2 ± 65.1	191.2 ± 130.6	0.000
HDL-C	42.5 ± 11.6	41.1 ± 9.1	40.4 ± 11.0	40.3 ± 13.3	0.733
LDL-C	97.6 ± 34.8	95.7 ± 26.8	85.8 ± 27.1	96.8 ± 35.5	0.205

Table 2: ANOVA table of comparison of means of total cholesterol among the different blood groups

	Comparing groups		Mean Difference	Sig.
Cholestrol mg/dl	A	O	-2.360	0.754
		B	13.100	0.083
		AB	-14.560	0.054
	O	B	15.460	0.041
		AB	-12.200	0.106
	B	AB	-27.660	0.000

Table 3: ANOVA table of comparison of means of Triglycerides (TG) among the blood groups

	Comparing groups		Mean Difference	Sig.
TG mg/dl	A	O	-17.84	0.346
		B	5.78	0.760
		AB	-74.20	0.000
	O	B	23.62	0.213
		AB	-56.36	0.003
	B	AB	-79.98	0.000

Table 4: ANOVA table of comparison of means of HDL-C among the blood groups

	Comparing groups		Mean Difference	Sig.
HDL-C mg/dl	A	O	1.40	0.539
		B	2.18	0.339
		AB	2.28	0.318
	O	B	0.78	0.732
		AB	0.88	0.700
	B	AB	0.10	0.965

Table 5: ANOVA table of comparison of means of LDL-C among the blood groups

	Comparing groups		Mean Difference	Sig.
LDL-C mg/dl	A	O	1.88	0.765
		B	11.80	0.061
		AB	0.80	0.899
	O	B	9.92	0.115
		AB	-1.08	0.864
	B	AB	11.00	0.081

Table 6: Correlation between study variables and age within different blood groups

		blood group A	blood group O	blood group B	blood group AB
		Age	Age	Age	Age
Cholestromg/dl	R. value	0.03	0.399	0.431	0.403
	p. value	0.837	0.004	0.002	0.004
TG mg/dl	R .value	0.463	0.408	0.181	0.101
	p. value	0.001	0.003	0.208	0.486
HDL-C mg/dl	R. value	-0.192	0.001	0.210	-0.124
	p. value	0.182	0.994	0.144	0.392
LDL-C mg/dl	R .value	-.0160	0.175	0.385	0.463
	p. value	0.910	0.224	0.006	0.001

DISCUSSION

The correlation between ABO blood groups and serum lipid profiles has been examined across several populations [13, 14]. Numerous studies indicate that persons with blood type A exhibit elevated cholesterol levels compared to other blood groups [15], while those with blood types B and AB have heightened triglyceride levels [16]. Additionally, those with blood type O possess greater levels of HDL-C and lower levels of LDL-C (17). The current research demonstrated a considerable rise in the mean levels of cholesterol and triglycerides across various blood types, with the AB blood group exhibiting the highest mean levels of both cholesterol and triglycerides. This conclusion aligns with the research conducted by [18], which indicated that the prevalence of cardiovascular disease risk is greatest in blood type AB. Research conducted on the Italian population indicated that triglyceride levels were elevated in individuals with blood type AB, while another report highlighted a considerably increased incidence of ischemic heart disease among this blood group. Numerous researchers have been provided with an explanation for the correlation between cholesterol levels and ABO blood groups. According to [19], the association is contingent upon cholesterol's role in the erythrocyte membrane, as it modulates the biophysical properties of the membrane bilayer. Additionally, cholesterol is crucial for regulating membrane protein transporters and cellular functions. Conversely, several investigations have shown that serum cholesterol levels are elevated in patients with blood group A [20], but serum triglyceride levels show no correlation with the ABO blood group system [14]. These studies contradict our current research. This research found a considerable elevation in the mean serum cholesterol levels between blood groups O and B, as well as between blood groups B and AB. Additionally, there was a notable rise in the mean triglyceride levels between blood group AB and the other blood types. Furthermore, there is no substantial correlation between LDL-C, HDL-C, and ABO blood type. Our research concurs with the findings of study [13]. This research demonstrates a substantial positive association between age and cholesterol levels in O, B, and AB blood groups, age and triglycerides in A and O blood groups, and age and LDL-c in B and AB blood groups. Numerous variables, including lifestyle, food, and environmental influences, may contribute to this outcome. Our work, corroborated by others, indicated the significant importance of the ABO blood type in the risk of developing arterial thrombotic events and emphasized the need of including this modifiable variable into the thrombotic risk assessment scores [21]. Our research, corroborated by another done in Nigeria, indicates that the prevalence of cardiovascular disease risk is greatest in blood type AB, followed by groups A, B, and O, respectively. This data suggests that, since the lipid profile is a hereditary factor, family history may significantly influence the development and pathogenesis of cardiovascular disease risk factors [22]. A supported investigation indicated that blood type O may exhibit a greater susceptibility to dyslipidemia, implying an elevated risk for diseases related to lipid metabolism [23]. No substantial correlation exists in the serum concentrations of total cholesterol, triglycerides, and lipoproteins among the various blood types. These observations contradict the results of Amirzadegan *et al.*, and Airhomwanbor*et al.*, [24, 25]. A lack of relationship between ABO blood types and serum lipid profiles has also been reported in the Iranian and Saudi Arabian populations, respectively. Contiero *et al.*,[26], studying an Italian population, found no correlation between total, HDL-, and LDL-cholesterol levels and ABO blood types; however, triglyceride levels were elevated in persons with the B antigen (B+AB) compared to those without it. This study's results contradict those of Iheanacho *et al.*,[27], who conducted research in Aba Metropolitan and discovered that persons with blood type A are genetically more prone to cardiovascular illness than those with blood group O. Hypercholesterolemia is regarded as a risk factor for the onset of ischemic heart disease [28]. Additionally, higher low-density lipoprotein cholesterol, reduced high-density lipoprotein cholesterol, and increased triglycerides are significant risk factors for cardiovascular diseases [29]. It was noted that individuals with blood type AB have elevated levels of total cholesterol, triglycerides, and low-density lipoprotein in comparison to other blood groups. A reduced amount of high-density lipoprotein was also seen in blood group AB. Therefore, indicating that blood group AB is more likely exposed to me. This result aligns with the findings of Meade *et al.*,[30], which demonstrated a greater prevalence of ischemic heart disorders in individuals with blood group phenotypic AB compared to groups O, A, or B. Comparable results have been shown by Girgla *et al.*,[31] and Farah *et al.*,[32], demonstrating a substantial association between phenotypic AB and serum lipid parameters in the North Indian and Saudi Arabian populations, respectively. Given that elevated serum cholesterol and diminished high-density lipoprotein cholesterol are recognized as significant risk factors for cardiovascular disease, our findings suggest that individuals with blood type AB may possess an increased susceptibility to these conditions. The lipid profile is influenced by hereditary factors, and family history may significantly contribute to the emergence of risk factors for cardiovascular illnesses. The research indicated blood group AB based on aberrant lipid parameter values. It is, nevertheless, crucial to recognize that several variables significantly contribute to the development of clinical cardiovascular disorders. We believe that environmental variables may serve as a significant predisposing element in the relationship between ABO blood type and the development of cardiovascular illnesses. It is concluded that a more comprehensive investigation with a much larger sample size should be conducted to validate the results, particularly the connection of blood type AB and Rhesus factor with lipid profile.

CONCLUSION

Individuals with the AB blood group have elevated levels of serum cholesterol and triglycerides compared to other blood types, and there is a positive link between age and cholesterol, triglycerides, and LDL-C across other blood groups.

Conflict of Interests: The authors declare that there is no conflict of interest in this publication.

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