Association of ABO Blood Groups with Ischemic and Hemorrhagic Stroke in Adults over 45 years: A Cross-Sectional Study at Jinnah Postgraduate Medical Center, Karachi.

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ABSTRACT:

Objective: To examine the relationship between ABO blood groups and ischemic and hemorrhagic stroke among adults aged over 45 years admitted to Jinnah Postgraduate Medical Center, Karachi.

Methodology: Our study was a cross-sectional analysis of neurology ward within six months. With the help of the non-probability consecutive sampling, we recruited 219 patients aged 45 years and above. Demographic, comorbid, and ABO blood groups data were obtained and analyzed. The chi-square test was used to determine associations between blood groups and clinical variables and a p-value of less than 0.05 was considered significant.

Results: Out of the 219 respondents, 65.3% were men and 86.8% resided in the urban set up. The hemorrhagic stroke was more common as compared to the ischemic stroke (68.9 versus 31.1). The group O was the most prevalent (52.5) and it was followed by A (37), B (20.5), and AB (27.9). Blood group A was found to have a high correlation with dyslipidemia (p=0.02), and blood group B was associated with a reduced frequency of lipid abnormalities (p=0.03). The male gender and smoking were significantly more prevalent in an individual of blood group AB (p=0.01), but smoking was less prevalent in an individual of blood group O (p=0.04). All the blood groups were not significantly correlated with the subtype of stroke.

Conclusion: A distinct behavioral and metabolic trends were observed. Blood group A was related to dyslipidemia, blood group B to lower lipid levels, and blood group AB to male gender and smoking, while smoking was less common in blood group O. These findings suggest that ABO blood groups may influence vascular risk indirectly through metabolic and behavioral factors. Further large-scale, multicenter studies are needed to confirm these associations and explore their biological mechanisms.

Keywords: ABO blood group, ischemic stroke, hemorrhagic stroke, dyslipidemia, vascular risk factors, Karachi.

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Introduction:

Stroke represents the second leading cause of death and the 3rd leading cause of physical disability globally, linked and attributing to an estimated 12.2 million new cases and 6.6 million deaths yearly.[1-2] Globally, approximately 25% (one in four) adults over the age of 25 do experience a stroke at any point of time.[3] As per the Global Burden of Disease Study (2019), stroke constitutes 143 million disability-adjusted life years (DALYs) lost each year, underscoring its impact on both mortality, morbidity and long-term disability.[1]

In Pakistan, stroke is becoming a growing public health concern. National numbers and estimates points to a prevalence of 4.8% among adults over 45 years, with an annual incidence of approximately 250 per 100,000 population, significantly larger and higher than the average in many high-income countries.[4-5] Underlying factors and determinants include poor control of hypertension (with a national prevalence of approximately 26%), high rates of prevalence od diabetes mellitus (17%), tobacco use (19%), and limited access to not only the curative but the preventive healthcare services, especially in remote and underserved areas by the poor population. In terms of clinical manifestation and classification, approximately 80-85% of strokes are ischemic, caused by thromboembolism, while 15-20% are hemorrhagic, and are solely due to rupture of cerebral vessels.[6-11]

Growing literature and evidence indicate that genetic and hematological factors, including ABO blood group, may affect the risk of stroke and its clinical subtypes.[12-13] ABO blood groups have proven to affect the levels of coagulation factors biologically, and the affect is seen on von Willebrand factor (vWF), Factor VIII and other clotting and coagulation proteins. Studies have shown that individuals with non-O blood groups (A, B, AB) have approximately 25-30% higher levels of vWF and Factor VIII in comparison to

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those who have blood group O.[14] Increased levels of these prothrombotic factors are associated with an enhanced risk of arterial thrombotic and embolic events, that includes but are not restricted to stroke (ischemic) alone. A meta-analysis of over "145,000 cases and 2,000,000 controls"[15] reported that individuals with blood group A have a 15–20% higher risk of ischemic stroke compared to those with blood group O. Contrary to this, individuals with blood group O, due to their low levels of vWF and Factor VIII, may have a slightly enhanced bleeding tendency, could potentially make the individuals susceptible to hemorrhagic stroke, although the association remains less robust and would require further investigation.[16]

Despite stroke remains the top cause of global mortality and morbidity and also in Pakistan, limited knowledge and research exists on genetic factors and genetic predispositions to stroke such as ABO blood groups. Evaluating their association with stroke subtypes may enhance risk stratification and characterization enabling planning early prevention strategies. This study aims to explore this relationship in a local clinical context.

Objective:

To determine the association between ABO blood groups and stroke subtype (ischemic or hemorrhagic) in adults aged ≥45 years at JPMC, Karachi.

Methodology:

The study was designed as a comparative cross-sectional investigation and was carried out at the neurology ward of Jinnah Postgraduate Medical Center (JPMC), Karachi, over a period of six months following approval of the synopsis by the College of Physicians and Surgeons Pakistan (CPSP). Participants were enrolled using a non-probability consecutive sampling technique. The required sample size was calculated using the WHO sample size calculator for two proportions, comparing the prevalence of AB blood group (5.1%) with O blood group (1.6%) among stroke patients from previous literature. With a 95% confidence level and 5% margin of error, the calculated sample size was 197 patients, and after accounting for a 10% non-response rate, the final sample size was estimated at 219 patients.[13]

Adults aged 45 to 65 years of any gender who presented with a radiologically confirmed diagnosis of ischemic or hemorrhagic stroke via CT or MRI within the study period at JPMC were included. Only patients with documented ABO blood group in hospital records or verified through testing at admission were considered. Patients with mixed-type strokes, strokes secondary to trauma, malignancy, or vascular malformations, known bleeding or clotting disorders unrelated to ABO blood group, or recurrent strokes with unverified initial stroke type were excluded.

Formal approval was obtained from the CPSP and the head of JPMC, and permission to collect data within the neurology wards was granted by the department. Confidentiality and privacy of participants were maintained, with all data coded to prevent personal identification. Informed consent was obtained and institutionalized patients were recruited and the data obtained through a structured questionnaire by trained people. Such data as sociodemographic factors, profile of clinical stroke, ABO and Rh blood groups, and significant cardiovascular and hematologic risk factors were collected. Blood group and stroke information were confirmed through the medical record or laboratory information where the necessary and all the questionnaires were analyzed by the investigator as complete and accurate.

The quantitative variables were age and time since stroke-onset, whereas the qualitative variable was gender, residence, education, occupation, stroke subtype, imaging modality, brain side, history of previous stroke, ABO blood group, Rh factor, source of blood group information, hypertension, diabetes mellitus, dyslipidemia and smoking history, heart disease, family history of stroke, prior antiplatelet and anticoagulant use. The confounders that could be identified included age, gender, hypertension, diabetes mellitus, dyslipidemia, smoking, heart disease, family history of stroke, and the use of antiplatelet or anticoagulant drugs.

The data were keyed and analyzed by use of SPSS 26. The baseline data were summarized as descriptive statistics. The AB blood group (A, B, AB, O), and ABO blood group (A, B, AB, O) were the main independent variables, and the stroke subtype (ischemic or hemorrhagic) was the dependent variable. They have been subjected to cross-tabulations, and the chi-square test has been used to determine the statistical relationship between ABO blood groups and stroke subtype with p 20.05 level of significance. Since it was possible to have confounding, stratified chi-square were done by category using age, gender, hypertension, diabetes mellitus and smoking status to determine whether associations were stable. Frequency tables and cross-tabulations were used to provide all the results with the interpretation of a chi-square value and p-values.

Operational Definitions:

- **Ischemic Stroke:** Stroke that was either confirmed through clinical or symptomatic evidence of sudden loss of consciousness, seizures, or altered sensorium which was confirmed through CT or MRI that showed infarction within vascular boundaries as reported in the patient record.
- **Hemorrhagic Stroke:** Type of stroke that is associated with intracerebral or intraventricular hemorrhage established by imaging and treated in a neurology or neurosurgery unit.
- **ABO Blood Group:** Blood type (A, B, AB, or O) of the patient as reported in the laboratory report of hospitals at the time of admission or as reported by earlier documented test results.

Results:

It was in this study that we enrolled 219 patients with age of 45 and above. There were slightly above 54.3 percent women between the ages of 56 and 65 and the rest (45.7 percent) were between 45 and 55 years. The proportion of men to Females was close to two to one with men forming close to two-third of the study population (65.3%). The catchment population of the hospital was represented as most of the patients were urban (86.8%). Hemorrhagic stroke was the most frequent form of stroke and was identified as 68.9 and 31. 1 of all the cases respectively in relation to ischemic stroke. Case was most commonly in the right cerebral hemisphere (45.7%), then in the right hemisphere (29.2%), multiple sites (15.1) and at the brainstem (10).

The prevalence of comorbid conditions was very high among the participants. The most common was hypertension that was found in 84 percent of patients, with 60.7 percent having dyslipidemia and 62.6 percent having reported having smoked. Almost half of the participants (44.7) have family history of stroke and only 27.4% had a history of heart disease. Unemployment was an issue with 59.4 percent of the study population being unemployed, the level of

education was low with 35.2 percent having obtained secondary education, 26 percent had primary and 25.6 percent of the population being illiterate.

Table No 1: Distribution of baseline characteristics among the study participants.

Variable	n (%)
Age	
45 to 55 years	100 (45.7)
56 to 65 years	119 (54.3)
Gender	
Male	143 (65.3)
Female	76 (34.7)
Residence	
Urban	190 (86.8)
Rural	29 (13.2)
Type of Stroke	
Ischemic	68 (31.1)
Hemorrhagic	151 (68.9)
Site of lesion	
Right hemisphere	100(45.7)
Left hemisphere	64 (29.2)
Brainstem	22 (10)
Multiple	33 (15.1)
Hypertension	
Yes	184 (84)
No	35 (16)
Dyslipidemia	
Yes	133 (60.7)
No	86 (39.3)
Smoker	
Yes	137 (62.6)
No	82 (37.4)
H/O Heart disease	
Yes	60 (27.4)
No	159 (72.6)
Family H/O Stroke	
Yes	98 (44.7)
No	121 (55.3)
Occupational status	
Employed	89 (40.6)
Unemployed	130 (59.4)
Educational level	
Illiterate	56 (25.6)
Primary	57 (26)
Secondary	77 (35.2)
Higher	29 (13.2)
ABO blood group	
A	81 (37)
B	45 (20.5)
AB	61 (64.2)
O	115 (64.2)
Rh factor	
Positive	99 (45.2)
Negative	120 (54.8)

The frequency distribution of the ABO blood groups demonstrated that blood group O was the commonest with 52.5 percent of the participants with it, then came blood group A (37%), blood group B (20.5 percent), and blood group AB (27.9 percent). The Rh-negative (54.8) was a little more prevalent than Rh-positive (45.2).

Table No 2: Distribution of patient characteristics according to the B blood group.

Variables	Blood group A Yes n (%)	Blood group A, No n (%)	P value
Age			
45 to 55 years	36 (36)	64 (64)	0.78
56 to 65 years	45 (37.8)	74 (62.2)	
Gender			
Male	45 (31.5)	98 (68.5)	0.02
Female	36 (47.4)	40 (52.6)	
Residence Status			
Urban	69 (36.3)	121 (63.7)	0.59
Rural	12 (41.4)	17 (58.6)	
Type of stroke			
Ischemic	28 (41.2)	40 (58.8)	0.38
Hemorrhagic	53 (35.1)	98 (64.9)	
Hypertension			
Yes	66 (35.9)	118 (64.1)	0.43
No	15 (42.9)	20 (57.1)	
Dyslipidemia			
Yes	57 (42.9)	76 (57.1)	0.02
No	24 (27.9)	62 (72.1)	
Smoking status			
Yes	44 (32.1)	93 (67.9)	0.05
No	37 (45.1)	45 (54.9)	
H/O heart disease			
Yes	20 (33.3)	40 (66.7)	0.49
No	61 (38.4)	98 (61.6)	
Family H/O stroke			
Yes	38 (38.8)	60 (61.2)	0.62
No	43 (35.5)	78 (64.5)	
Occupational status			
Employed	28 (31.5)	61 (68.5)	0.16
Unemployed	53 (40.8)	77 (59.2)	
Educational level			
Illiterate	27 (48.2)	29 (51.8)	0.20
Primary	20 (35.1)	37 (64.9)	
Secondary	26 (33.8)	51 (66.2)	
Higher	08 (27.6)	21 (72.4)	

As we cross-tabulated the attributes of the patients in terms of blood group A, we determined that women were highly likely to fall in the category compared to men (p=0.02). Dyslipidemia was more observed in people with blood group A (p=0.02), which may lead to the suggestion of a positive correlation between this type of blood and lipid abnormalities. Status regarding smoking showed a tendency to be significant (p=0.05) with slightly few smoking people having blood group A. Age, residence, hypertension, and subtype of stroke were other characteristics that did not have any significant association with this group.

Conversely, patients of blood group B lacked considerable relations with the majority of clinical or demographic fac-

tors. Nonetheless, dyslipidemia was much less prevalent in this category (p=0.03), that can be considered as a relatively more favorable lipid profile. No considerable difference was observed between any individual with blood group B and those with other blood groups in terms of age, sex, smoking habit, hypertension and history of heart disease.

There were certain significant patterns in the distribution of blood group AB. There was significant difference between men and women in the way men had blood group AB more than women (p=0.01), and smokers among AB blood group carriers had also higher prevalence (p=0.01). Nevertheless, none of the significant associations were detected in terms of age, residence, comorbidities, including hypertension and dyslipidemia, and the type of stroke.

Table No 3: Distribution of patient characteristics according blood group B.

Variables	Blood group B Yes, n (%)	Blood group B No, n (%)	P value
Age			
45 to 55 years	20 (20)	80 (80)	0.85
56 to 65 years	25 (21)	94 (79)	
Gender			
Male	28 (19.6)	115 (80.4)	0.62
Female	17 (22.4)	59 (77.6)	
Residence Status			
Urban	40 (21.1)	150 (78.9)	0.63
Rural	05 (17.2)	24 (82.8)	
Type of stroke			
Ischemic	12 (17.6)	56 (82.4)	0.47
Hemorrhagic	33 (21.9)	118 (78.1)	
Hypertension			
Yes	38 (20.7	146 (79.3)	0.93
No	07 (20)	28 (80)	
Dyslipidemia			
Yes	21 (15.8)	112 (84.2)	0.03
No	24 (27.9)	62 (72.1)	
Smoking status			
Yes	26 (20.4)	109 (79.6)	0.95
No	17 (20.7)	65 (79.3)	
H/O heart disease			
Yes	14 (23.3)	46 (76.7)	0.53
No	31 (19.5)	128 (80.5)	
Family H/O stroke			
Yes	21 (21.4)	77 (78.6)	0.77
No	24 (19.8)	97 (80.2)	
Occupational status			
Employed	16 (18)	73 (82)	0.43
Unemployed	29 (22.3)	101 (77.7)	
Educational level			
Illiterate	10 (17.9)	46 (82.1)	0.86
Primary	13 (22.8)	44 (77.2)	
Secondary	17 (22.1)	60 (77.9)	
Higher	05 (17.2)	24 (82.8)	

The patients with blood group O were found to have very similar characteristics with the general cohort. Though, the majority of the associations were not statistically significant, smoking was significantly lower among those who had blood group of O (p=0.04). Such trend can indicate that there is a behavioral or vascular risk predisposition that is not equal to the non-O blood groups. No definite relationships were found between blood group O and age, gender, and residence, hypertension or subtype stroke.

In general, the analysis was unable to show statistically significant correlation between ABO blood groups and the kind of stroke, be it an ischemic or hemorrhagic one. However, a number of trends could be noted. The subjects who were A blood group were more likely to be dyslipidemic, and the subjects of blood group B were less likely to have lipid disorders. The blood group of AB was more prevalent in men and smokers whereas blood group O was linked with smaller percentage of smokers. Even though these associations were not applicable to the stroke type, they could be indicative of having differences in cardiovascular risks profile among blood groups. The results imply that although the ABO mechanism may not be the direct determinant of the occurrence of the ischemic or hemorrhagic

Table No 4: Distribution of patient characteristics according to blood group AB.

Variables	Blood group AB Yes; n (%)	Blood group AB No n (%)	P value
Age			
45 to 55 years	31 (31)	69 (69)	0.34
56 to 65 years	30 (25.2)	89 (74.8)	
Gender			
Male	49 (34.3)	94 (65.7)	0.01
Female	12 (15.8)	64 (84.2)	
Residence Status			
Urban	55 (28.9)	135 (71.1)	0.35
Rural	06 (20.7)	23 (79.3)	
Type of stroke			
Ischemic	17 (25	51 (75)	0.52
Hemorrhagic	44 (29.1)	107 (70.9)	
Hypertension			
Yes	51 (27.7)	133 (72.3)	0.91
No	10 (28.6)	25 (71.4)	
Dyslipidemia			
Yes	38 (28.6)	95 (71.4)	0.76
No	23 (26.7)	63 (73.3)	
Smoking status			
Yes	49 (35.8)	88 (64.2)	0.01
No	12 (14.6)	70 (85.4)	
H/O heart disease			
Yes	19 (31.7)	41 (68.3)	0.43
No	42 (26.4)	117 (73.6)	
Family H/O stroke			
Yes	27 (27.6)	71 (72.4)	0.92
No	34 (28.1)	87 (71.9)	
Occupational status			
Employed	30 (33.7)	59 (66.3)	0.11
Unemployed	31 (23.8)	99 (76.2)	
Educational level			
Illiterate	10 (17.9)	46 (82.1)	0.26
Primary	17 (29.8)	40 (70.2)	
Secondary	24 (31.2)	53 (68.8)	
Higher	10 (34.5)	19 (65.5)	

stroke, it may be the determinant of the modulation of metabolic and behavioral risks factors which may lead to determining individual susceptibility element.

Table No 5: Distribution of patient characteristics according to the blood group O.

Variables	Blood group O Yes, n (%)	Blood group O No, n (%)	P value
Age			
45 to 55 years	13 (13)	87 (87)	0.53
56 to 65 years	19 (16)	100 (84)	
Gender			
Male	20 (14)	123 (86)	0.71
Female	12 (15.8)	64 (84.2)	
Residence Status			
Urban	26 (13.7)	164 (86.3)	0.32
Rural	06 (20.7)	23 (79.3)	
Type of stroke			
Ischemic	12 (17.6)	56 (82.4)	0.39
Hemorrhagic	20 (13.2)	131 (86.8)	
Hypertension			
Yes	29 (15.8)	155 (84.2)	0.27
No	03 (8.6)	32 (91.4)	
Dyslipidemia			
Yes	16 (12)	117 (88)	0.17
No	16 (18.6)	70 (81.4)	
Smoking status			
Yes	15 (10.9)	122 (89.1)	0.04
No	17 (20.7)	65 (79.3)	
H/O heart disease			
Yes	07 (11.7)	53 (88.3)	0.44
No	25 (15.7)	134 (84.3)	
Family H/O stroke			
Yes	13 (13.3)	85 (86.7)	0.61
No	19 (15.7)	102 (84.3)	
Occupational status			
Employed	14 (15.7)	75 (84.3)	0.69
Unemployed	18 (13.8)	112 (86.2)	
Educational level			
Illiterate	10 (17.9)	46 (82.1)	0.55
Primary	07 (12.3)	50 (87.7)	
Secondary	09 (11.7)	68 (88.3)	
Higher	06 (20.7)	23 (79.3)	

Discussion:

This paper has discussed the correlation of ABO blood groups and the incidence of ischemic and hemorrhagic stroke in adults aged 45 and above, admitted in the neurology ward of Jinnah Postgraduate medical center, Karachi. Despite the fact that the analysis did not indicate a significant correlation between the type of blood group and the subtype of stroke, some significant patterns were revealed that illuminated the interaction between ABO phenotypes and vascular and behavioral risk factors in the population under study.

The demographic population of those involved in the study revealed a strong presence of males and urban population that is similar with the previous statistical data on stroke epidemiology. The greater percentage of males would be indicative of differences in gender exposure to modifiable risk factors, including smoking, stress, and hypertension, or differences in obtaining healthcare and preventive measures in other aspects. This group experienced more hemorrhagic than ischemic stroke, which is different as compared to the rate of stroke in Western populations where the latter is so. The same results of local and African trials indicate that the incidence of hemorrhagic stroke could also be considered to be associated with insufficient blood pressure regulation and late hypertension treatment.

The most common comorbid conditions that were identified were hypertension, dyslipidemia, and smoking, which highlights how the conditions persistently play a role in the pathophysiology of stroke. The incidence of hypertension in socioeconomically disadvantaged backgrounds is high in this cohort and is similar to other studies previously done in the same area along with the rest of the world that hypertension is the most important modifiable risk factor both in ischemic and hemorrhagic strokes. The frequent dyslipidemia and tobacco usage points also to the role of lifestyle-related predictors to the cerebrovascular disease as it was also observed by Eze et al. in stroke subjects of Nigeria.

This distribution of ABO blood groups was very close to that of the Pakistani population in general with group O the most common and A, B and AB coming next. The fact that we found no statistically significant difference of ABO groups in relation to stroke type is in line with a previous observation by Muhammad et al., who also found no significant correlation in their local cohort. However, our data is consistent with new evidence that non-O blood groups could pose an increased risk of developing a thrombotic cardiovascular disease. A massive meta-analysis by Lilova and colleagues that involved over 145000 cases, and two million controls showed that people with blood groups A and AB were more likely to develop a stroke of the ischemic nature, myocardial infarction, and peripheral vascular disease than those with blood group O. It is thought that this relationship is due to the increased levels of von Willebrand factor (vWF) and factor eight in non-O individuals that contribute to the increased platelet adhesion and clotting, and therefore raising the risk of thrombosis.

The fact that dyslipidemia was much more prevalent among participants with the blood group A also speaks in favor of the idea that ABO antigens might have any effect on lipid metabolism. The same studies have provided similar results in cardiovascular risk studies and metabolic characteristics with blood group A being linked to adverse lipid profiles and increased atherogenicity. The article by Hong et al. discovered that people with blood group A exhibited more severe disease of the coronary artery and more complicated lesions than those of other blood groups. Similarly, in a population of Ghana, Smith et al. have revealed that blood group A was also positively associated with higher body mass index and lipid levels, whereas blood group B appeared rather more favourable metabolically, but these results need to be further confirmed with an increased number of studies, and multicentrally.

There was also a clear trend among people whose blood group is AB since they had higher chances of being male and undergoing smoking. It is possible that the tendency to cluster the risk factors in blood group AB is caused by the behavioral patterns. Conversely, individuals who had blood group O were less likely to smoke which was also in line with the results that reported that group O persons tend to

have lower thrombotic and cardiovascular risk. The hypothesis of potential ABO-phenotype variability in health-related behaviors and disease-related susceptibility was also supported by the Lindemann-large population study by Liu et al. which also revealed the possibility of influence of ABO phenotypes on vascular and metabolic risks indirectly through adoption of behavioral and biochemical mechanisms.

The biological mechanisms of these associations are multifactorial, and the study is still ongoing. ABO antigens are found on the endothelial surfaces and on the plasma proteins in addition to red blood cells where they impact coagulation, lipid transportation, and inflammatory situations. It has been known that non-O blood groups have more plasma concentrations of vWF and factor VIII which put them at a hypercoagulable condition and at more risk of hyperthrombosis. This may also cause the abnormal cholesterol metabolism and elevated levels of total cholesterol and low -density lipoprotein which is being attributed to blood group A and is likely to cause atherosclerotic plaque formation and vascular events. These processes might be one of the reasons as to why our research found a more prevalence of dyslipidemia of participants with blood group A despite no direct correlation of blood group with subtype of stroke.

The findings of the research are in accordance with the international literature that examines the cardiovascular consequences of the ABO phenotypes. Kaya et al. showed that A blood group was linked to more complex lesions in the coronary artery of patients with stable coronary disease, in addition to supporting the idea of ABO blood groups in the determination of the vascular pathology. On the same note, evidence by Hong et al. showed that there were higher amounts of non-O blood groups among patients who had advanced coronary artery diseases. These results when combined indicate ABO antigens as possible AMO of cardiovascular risk, which might change risk, affecting susceptibility in both hemostatic and metabolic ways, but not in direct determination of the type of disease.

This work has its shortcomings. The design employed is cross-sectional, and does not allow the conclusion to be made that group A had a cause in the occurrence of stroke. It was also done in one center at a tertiary level and hence there could be no generalizability of the results. Also, laboratory parameters like vWF, factor eight, and detailed lipid subfractions were not measured, which would have given a better understanding of the possible mechanisms of pathophysiological process. In spite of these shortcomings, this study adds important information in Pakistan where the study to analyze the hematologic and metabolic parameters of stroke is underrepresented.

Finally, the current paper revealed that there is no significant correlation between ABO blood groups and the nature of stroke. Nonetheless, the blood group A confirmed themselves to have a higher prevalence of dyslipidemia; the blood group B had a lower prevalence of lipid abnormalities; men and smokers were more represented among people with blood group AB; and the prevalence of smoking was lower among people with blood group O. These results indicate that ABO blood groups do not have a direct effect on the vascular risk based on the metabolic mechanism and behavioural mechanism but can act indirectly after the ABO type indeed determines the type of stroke. The need to further elucidate these associations and to understand the negotiated interplay between these factors and ABO phenotype subsequently requires in the future large, prospective studies that investigate these associations using biochemical and genetic analysis.

Limitations:

There are a number of limitations that need to be taken into account in this study. It did not generate a causal relationship between ABO blood groups and stroke subtypes because it was based on the cross-sectional design. The study was conducted at one tertiary care academic hospital in Karachi, which can restrict the extrapolation of the results to other positions or places of study. Although the use of consecutive sampling was feasible in clinical setting, it could have caused selection bias. We have not determined biological variables like von Willebrand factor, factor VIII or intensive lipid profiles, which might have given us additional understanding about the mechanisms behind the observed relationships. Even though the sample size was adequate in exploratory analysis, it might not have been adequately large to identify some minor divergences among less prevalent blood groups. Additional large scale and more diverse population studies will be significant in the future to validate these results and to investigate these results in more detail in a multicentric fashion.

Conclusion:

The results imply that the ABO blood type can control vascular risk via metabolism and behavioral mechanisms and not directly in the type of stroke. These findings require further extensive, multicentric studies to support the finding as well as to investigate the biological processes which could account these associations.

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