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Detection of Typhoid infection in Northern Technical University students and its correlation with blood groups

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ABSTRACT

Background: In many developing nations, typhoid fever is still a serious public health concern, especially for students and young adults. Blood group antigens, which can alter host–pathogen interactions, are one of several factors that may affect a person's vulnerability to typhoid infection. **Objective:** This study aimed to find out how common typhoid infection is among students and investigate how it relates to the blood types of ABO and Rh. **Methods:** A cross-sectional study was conducted among a group of students with febrile illness. Blood samples were collected and tested using the Widal test to detect serous Salmonella typhi. Blood classification was performed using standard agglomeration techniques. **Results:** 50 blood samples were collected, 21 (42%) female and 29 (58%) male. 34 students (68%) and three students (6%) had *Salmonella typhi* and *Salmonella para-typhi* infections. Group A+B+O individuals, especially females, appeared more susceptible to severe typhoid infections. Group AB showed limited infections, primarily mild in males, suggesting a potential protective effect. **Conclusion:** According to this study, there is a substantial relationship between the prevalence of typhoid infections among college students and particular blood types, where Blood group and gender influence Typhoid infection susceptibility and severity. Group B+ve females and A+ve males showed notable infection patterns, while other groups had lower or no infection rates. Comprehending these trends might facilitate the creation of focused health interventions and safeguards against typhoid infections in this demographic. To investigate the underlying causes of this connection, further investigation may be necessary.

Keywords: Typhoid fever; ABO blood groups, Widal test, *Salmonella typhi,* Disease susceptibility

1. Introduction

Enteric (Typhoid or Paratyphoid) fever is a serious infection caused by *Salmonella Typhi*. Usually, tainted food or water is the way it spreads. Once *Salmonella Typhi* are ingested, they proliferate and enter the bloodstream. Salmonella causes serious systemic infections in humans and other animals and serves as a model for other diseases caused by bacteria that live both intracellularly and extracellularly

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(1). In low- and middle-income nations, *salmonella typhi* is estimated to be responsible for tens of millions of cases and over 100 thousand fatalities (2). Enteric fever is a systemic infection acquired by ingestion of fecally contaminated food or water and is uncommon in environments with extensive access to sanitary facilities, clean water, and hygiene supplies (3). Typhoid fever patients are clinically distinguished by bacteremia and a range of symptoms that might make it challenging to distinguish them from other feverish infections. Severe instances may result in gastrointestinal perforation, sepsis, and even death (4). *S. typhi* is a gastrointestinal pathogen that is limited to humans and can cause chronic infection or typhoid fever if it is successfully transmitted. When left untreated, typhoid fever commonly results in death in pediatric or immunocompromised individuals (5). *S. typhi* is a gram negative. Salmonella stays inside phagocytes and proliferates there, utilizing a variety of genes and effectors to promote replication and avoid being killed inside the cell (6). Since Salmonella bacteria are intracellular once they have settled inside host cells, antibodies cannot reach the bacteria, making the possibility that humoral immunity plays a protective function difficult to envisage (7). Several pathogenic bacteria, such as *Salmonella typhi,* begin infection by adhering to the mucous membrane surface of a host cell, which is followed by the colonization of bacteria (8).

An expression system of carbohydrate antigens on human erythrocytes is known as the ABO blood type (9,10). The A and B antigens on erythrocytes are trisaccharides (11). All erythrocytes (except for the uncommon Bombay phenotype, which lacks ABO antigens) have a "H" di-saccharide on their surface (9). Since cell surface glycoconjugates are frequently used by infectious agents as receptors for attachment, variations in the glycosylation profiles of individuals with different ABO blood types may impact host-pathogen relationships and result in differences in susceptibility (12,13). During Landsteiner's discovery in 1901, Numerous illnesses, including stomach cancer and peptic ulcers, have been linked to the ABO blood group system (14). Blood types can be linked to both health and illness through functions that depend on their structure (15,16). The first human blood group identified in 1901 was the ABO blood group system. It is inherent in humans and is readily determinable, which has led to ongoing research on its relevance to a variety of disorders (17). Blood group antigens on red blood cells are biological markers that are permanent, stable, and unique to each individual; they are almost like fingerprints (18). Apart from the therapeutic significance of transplantation and blood transfusion, it is increasingly evident that ABO-antigens have biological significance and might be connected to disease prevention or resistance (19).

Blood group antigens are proteins or sugars that are bonded to various components in the red blood cell membrane. As an example, the antigens of the ABO blood group are sugars (19). Enzymes catalyze the transfer of sugar units throughout the series of reactions that result in their production. A person's DNA defines the type of enzymes they possess, and thus the type of sugar antigens that end up on RBC (20). While the antigens of the Rh blood group are proteins, the information required to make the protein antigens is included in an individual's DNA (21). The Rh-D gene encodes the D antigen, a large protein found on the membrane of red blood cells. Some people's red blood cells lack the Rh-D protein because they have a gene version that does not generate the D antigen (22).

2. Materials and methods

2.1. Blood grouping

Blood from 50 samples of university students was tested for their blood groups as follows:

Three drops of blood from each of the blood grouping antisera. Anti-A, anti-B, and anti-D (Bio-Research for Medical Diagnostics) Jordan were added and mixed thoroughly by rocking for 60 seconds and observed for agglutination.

Blood group A was determined by agglutination with anti-A, but blood group AB was shown by ag-

glutination with both anti-A and anti-B. When there is no agglutination with either anti-A or anti-B, blood group O is present. The blood group was further categorized based on whether they had a positive or negative reaction to anti-D antisera for the rhesus blood group. Anti-D agglutination indicates rhesus positive, whereas non-agglutination indicates rhesus negativity.

2.2. WIDAL test/reaction

Venous blood samples were collected from university students. 50 samples left to clot, then samples of blood was centrifuged for five minutes at 1000 rpm, after this time, in each test tube, the blood samples were divided into two layers, with the serum on top and the red blood cells underneath. A drop of each serum and a drop of the commercially available antigen were put on a sterile slide using a micropipette. (i.e., the O and H for *S.typhi*, the O and H antigens of *S. paratyphi* B as Fig. 1) Agglutination was checked after manufacturing plasmatic laboratories were added and well mixed by shaking for 60 seconds. A sample was considered positive for the Salmonella antigen if it agglutinated with it within the allotted period. Agglutination that occurred outside of the designated timeframes was considered a false positive.

Figure 1: Widal test reagents

3. Results

Among 50 blood samples taken from students, 21 (42%) were female and 29 (58%) from male. The result showed A+ve: Females (5 samples, 83.3%), Males (9 samples, 100%). Males have a stronger representation in this group. A-ve Solely females (1 sample, 16.7%), no males reported. B+ve Females (6 samples, 100%), Males (8 samples, 80%). All female B group samples are B+ve, and 20% of males are B-ve. B-ve Males only (2 samples, 20%). O+ve Females (6 samples, 85.7%), Males (7 samples, 87.5%). Both genders have similar ratios.

O-ve Both genders are underrepresented (females: 1 sample, 14.3%; males: 1 sample, 12.5%). AB+ve Females (1 sample, 50%), Males (2 samples, 100%). Strong male representation.

AB-ve Females only (1 sample, 50%); no male representation. Differences in Gender A-ve, B-ve, and AB-ve are lacking in females, while B-ve is not lacking in males. Males have predominance in A+ve and AB+ve groups as shown in Table 1. Widely Shared Blood Types, B+ve becomes universal for females (100%), while A+ve becomes universal for males (100%). The genres in O+ve are the most balanced.

Results are shown in Table 2. Infection with *Salmonella typhi* O in female 1(20%) at titer 1/160 and 2(40%) at 1/320 in A+ve and 1(100%) at 1/160 in

A-ve. In males, the infection was equal 1(25%) at 1/160 and 1/320 in A+. In *Salmonella typhi* H the ratio was 1(16.7%) at 1/160 and 1/320 in female with A+ve and 1(100%) at 1/160 in A-ve while in male 2(66.7%), 1(33.3%) at 1/160 and 1/320 respectly. In *Salmonella* O *paratyphi* B, males with A+ve blood group showed infection at 1/160.

In (table 3) B+ve females, high mild (66.7%) at 1/160 and strong (33.3%) at 1/320 infections for *S. typhi* O, and exclusively strong infections (100%) at 1/320 for *S. typhi* H. B+ve males, predominantly mild infections (71.4% for *S. typhi* O, 42.9% for S. typhi H), with some no infection cases (28.6% and 42.9%, respectively). B-ve Individuals, mostly no infection (1/80 titer), except for one male with a mild *Salmonella* H *paratyphi* B at 1/320.

In O+ve, the infection of *S. typhi* O in males was higher, 50% at 1/160 and 25% at 1/320, while in females 25% at 1/160. The infection of *S. typhi* H was moderate in women, 33.3%, and 50% in males, as shown in Table 4.

AB+ve Males exhibited mild infections (1/160 titer) for both *S. typhi* O and H antigens (50% each), with no strong infections (1/320). AB-ve Females, showing no infection (1/80 titer) for *S. typhi* O and H antigens (100%), indicating no active infection in this subgroup. No infections were observed for *S. paratyphi* antigens in either gender, as shown in Table 5.

Table 1: The chart illustrates the prevalence of blood groups amongst females and males in a sample of 50 individuals, along with their respective ratios.

Blood groups	total	Female Samles	Ratio %	Male Sample	Ratio %
A+ve	15	5	83.3	9	100
A-ve		1	16.7	-	-
B+ve	16	6	100	8	80
B-ve		-	-	2	20
O+ve	15	6	85.7	7	87.5
O-ve		1	14.3	1	12.5
AB+ve	4	1	50	2	100
AB-ve		1	50	-	-

Table 2: Ratio of Typhoid infection among blood group A, titer 1/80 indicates no infection, but 1/160 indicates a mild infection, and 1/320 indicates a strong infection.

Salmonella's antigens	Blood groups						
	gender	Group A+ve			Group A-ve		
		1/80	1/160	1/320	1/80	1/160	1/320
S. typhi O	female	2(40%)	1(20%)	2(40%)	-	1(100%)	-
	male	2(50%)	1(25%)	1(25%)	-	-	-
S. typhi H	female	4 (66.6%)	1(16.7%)	1(16.7%)	-	1(100%)	-
	male	-	2(66.7%)	1(33.3%)	-	-	-
Salmonella O *paratyphi* B	female	2(100%)	-	-	-	-	-
	male	1(50%)	1(50%)	-	-	-	-
Salmonella H *paratyphi* B	female	2(100%)	-	-	-	-	-
	male	2(100%)	-	-	-	-	-

Table 3 Ratio of Typhoid infection among blood group B, titer 1/80 indicates no infection, but 1/160 indicates a mild infection, and 1/320 indicates a strong infection.

Salmonella's antigens	Blood groups						
	gender	Group B+ve			Group B-ve		
		1/80	1/160	1/320	1/80	1/160	1/320
S. typhi O	female	-	2(66.7%)	1(33.3%)	-	-	-
	male	2(28.6%)	5(71.4%)	-	2(100%)	-	-
S. typhi H	female	-	-	2(100%)	-	-	-
	male	3(42.9%)	3(42.9%)	1(14.2%)	2(100%)	-	-
Salmonella O *paratyphi* B	female	1(100%)	-	-	-	-	-
	male	3(100%)	-	-	1(100%)	-	-
Salmonella H *paratyphi* B	female	1(100%)	-	-	-	-	-
	male	3(100%)	-	-	-	-	1(100%)

Table 4 Ratio of Typhoid infection among blood group O, titer 1/80 indicates no infection, but 1/160 indicates a mild infection, and 1/320 indicates a strong infection.

Salmonella's antigens	Blood groups						
	gender	Group O+ve			Group O-ve		
		1/80	1/160	1/320	1/80	1/160	1/320
S. typhi O	female	3(75%)	1(25%)	-	1(100%)	-	-
	male	1(25%)	2(50%)	1(25%)	-	-	-
S. typhi H	female	2(66.7%)	1(33.3%)	-	1(100%)	-	-
	male	2(50%)	2(50%)	-	-	-	-
Salmonella O *paratyphi* B	female	4(100%)	-	-	-	-	-
	male	3(100%)	-	-	1(100%)	-	-
Salmonella H *paratyphi* B	female	4(100%)	-	-	-	-	-
	male	3(100%)	-	-	1(100%)	-	-

Table 5 Ratio of Typhoid infection among blood group AB, titer 1/80 indicates no infection, but 1/160 indicates a mild infection, and 1/320 indicates a strong infection.

Salmonella's antigens	Blood groups						
	gender	Group AB+ve			Group AB-ve		
		1/80	1/160	1/320	1/80	1/160	1/320
S. typhi O	female	-	-	-	1(100%)	-	-
	male	1(50%)	1(50%)	-	-	-	-
S. typhi H	female	-	-	-	1(100%)	-	-
	male	1(50%)	1(50%)	-	-	-	-
Salmonella O *paratyphi* B	female	-	-	-	-	-	-
	male	-	-	-	-	-	-
Salmonella H *paratyphi* B	female	-	-	-	-	-	-
	male	-	-	-	-	-	-

4. Discussion

Interest in the possible function of blood types in infectious diseases has persisted since the ABO blood group was discovered. It was believed that the relationship between the antigen of the infecting organism and the blood group was what caused the correlation of blood types with illnesses. Since blood types are genetically defined characteristics with known polymorphic expression among people and communities, they are frequently the focus of epidemiological research. The current study revealed that 34 (68%) and 3 (6%) of students were infected with *Salmonella typhi* and *Salmonella paratyphi*. Typhoid fever and paratyphoid affect this age group because of their prolonged gathering and lack of interest in the cleanliness of food and drink sources, and combined use of sanitary facilities without sufficient, regular sterilization, which causes surfaces and hands to become contaminated.

Blood groups A and B showed the greatest levels of typhoid, followed by blood group O, while blood group AB was more resistant to typhoid infection, and this is conformity with the study of (23), results demonstrated that children had *Salmonella typhi* and *Salmonella paratyphi* infections in (31.33%) and (34.33%) of cases, respectively. The highest typhoid/paratyphoid rate was observed among blood group O; thus, it was the most susceptible group. The least was noticed among the blood group AB children, which is the most resistant. A study confirmed the relationship between blood groups and typhoid fever, where the O group was most sensitive to infection (24).

Conclusion

According to this study sample, there is a substantial relationship between the prevalence of typhoid infections among college students and particular blood types, where Blood group and gender influence Typhoid infection susceptibility and severity. Group B+ve females and A+ve males showed notable infection patterns, while other groups had lower or no infection rates. Comprehending these trends might facilitate the creation of focused health interventions and safeguards against typhoid infections in this demographic. To investigate the underlying causes of this connection, further investigation may be necessary.

Conflict of interest: NIL
Funding: NIL

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