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Relationship Between the Abo Blood Group Systems of *Toxoplasma gondii* Infected Patients in Wasit Province, Iraq

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ABSTRACT

Background and Objective: Toxoplasmosis is a widespread zoonotic disease caused by *Toxoplasma gondii*, a single-celled obligate coccidian parasite from the phylum Apicomplexa. It affects nearly one-third of the global population and can cause severe complications in immunocompromised individuals. This study investigated the relationship between ABO blood group distribution and *T. gondii* infection in women from Wasit Province, Iraq. **Materials and Methods:** A total of 170 suspected cases were initially screened. After excluding individuals with chronic diseases (e.g., diabetes, hormonal disorders), 88 women aged 18-45 years were selected, including 56 confirmed toxoplasmosis cases (further divided into aborted and non-aborted) and 32 healthy controls. Blood samples were analyzed for ABO blood group distribution and statistically assessed using Chi-square tests to determine significance ($p \leq 0.05$). **Results:** A statistically significant difference ($p \leq 0.05$) was observed between patients and controls regarding ABO blood group distribution. Blood group O showed a higher frequency among infected individuals, whereas no significant differences were found in the distribution of other blood groups. **Conclusion:** This study suggests a possible association between blood group O and increased susceptibility to *T. gondii* infection. Further large-scale studies are recommended to confirm this relationship and explore underlying immunological mechanisms. Limitations include the sample size and the exclusion of other risk factors.

KEYWORDS

Toxoplasma gondii, ABO blood groups, toxoplasmosis, blood type O, women's health, Wasit Province, Iraq

INTRODUCTION

Toxoplasmosis is a disease caused by a protozoan parasite called *Toxoplasma gondii* (*T. gondii*)[1]. This infection infects all animals, including humans[2], and is common worldwide[3]. The main sources of foodborne transmission of *T. gondii* to humans include undercooked meat, especially pork and lamb, and soil contaminated with cat feces on raw fruits and vegetables[4]. Primary *T. gondii* infection in pregnant women can lead to transmission, resulting in congenital toxoplasmosis[5]. This congenital disease can result in lesions ranging from mild to profound. It occurs in neonates, later in development, or during adolescence[6]. *Toxoplasma gondii* infection causes no clinical signs in 80% of cases in immunocompetent individuals, resulting in immunization characterized by persistent cysts in the brain, muscles, and retina[7]. The disorder may cause mixed anxiety and depression[8], and obsessive-compulsive disorder[9].

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The ABO blood group system consists of four types (A, B, AB, and O)[10]. The antigens of this system are not limited to red blood cells but are widely expressed in body fluids and tissues[11]. The Rh blood group system consists of two types (Rh-negative and Rh-positive) and contains at least 45 independent antigens. After the ABO system, it is the most clinically important in transfusion medicine[12]. The ABO and Rh blood groups have been linked to numerous bacterial, viral, and parasitic infections and disease severity, and excellent reviews exist on this topic[13]. Only a few studies have been reported to determine the relationship between ABO and Rh blood groups and the incidence of Toxoplasmosis. The results of these studies are conflicting. For example, in a study of military personnel in the Czech Republic, multivariate analysis showed that blood types A, B, or AB versus O were independent predictors of T. gondii seropositivity. In a study[14] of women undergoing miscarriage, a significant association was found between Rh blood type and *T. gondii* seropositivity. In a Brazilian study of pregnant women[15], *T. gondii* antibodies and ABO blood types were found[16].

The study aimed to determine the relationship between *T. gondii* seropositivity and ABO and Rh blood types in 90 individuals. The ABO and Rhesus blood types and IgG and IgM antibodies to *T. gondii* were determined using commercially available assays.

MATERIALS AND METHODS

Study subjects: This study was conducted in the Department of Biological Sciences, College of Science, University of Wasit, in collaboration with Al-Kut Women's and Children's Hospital, affiliated with Wasit Health Directorate, and some private clinics in Al-Kut city, Wasit Governorate, Iraq, during the period from December, 2024 to April, 2025. The study included 88 participants, aged 18-45 years, divided into 18 non-pregnant women without aborted pregnancy, 38 non-pregnant women with aborted pregnancy, clinically diagnosed with *Toxoplasma gondii* (based on IgM+antibodies), and 30 healthy controls. Verbal consent was obtained from the participants, and they all agreed to participate in the study.

Methods: Five milliliters of venous blood were drawn from both healthy patients. The blood sample was then divided into two groups:

- 1 mL of blood was placed in an EDTA anticoagulant tube for hematological assays
- 4 mL of blood were placed in gel and clot activator tubes for immunological tests
- Blood samples were separated using a centrifuge at 3,000 rpm for 5 min
- 40 microliters were used to perform the IgG antibody test, a standard diagnostic test for toxoplasmosis (*Toxoplasma gondii*)
- The samples were frozen at -40°C until immunological tests were completed

The diagnosis of women suspected of being infected with the toxoplasmosis parasite was based on the clinical symptoms of the infected women and as requested by the doctor. The Enzyme-linked Immunosorbent Assay (ELISA) method was used[17], as it is the most accurate method in immunological analyses and is available, less expensive and requires less effort for both patients and controls. It is the method approved for diagnosis by the Wasit Health Department.

Statistical analysis: The statistical program Statistical Package for the Social Sciences-SPSS (2019) was used in data analysis to divide the proportions into blood groups among those infected with toxoplasmosis compared to the control in the studied sample, and the significant differences between the means were compared using the Chi-square test at the possible level (0.05 and 0.01).

RESULTS AND DISCUSSION

The current study demonstrates a relationship between the ABO blood group system and the incidence of Toxoplasmosis, as shown in Table 1. The study showed a significant difference for blood group O, with the largest number of infected individuals being blood group O, representing 41.07% of the total,

Table 1: Numbers and percentages of blood type distribution among those infected with toxoplasmosis compared to the healthy group

	Toxoplasmosis patients (N = 56)		Controls (N = 32)		
Blood groups	N	%	N	%	p-value
O	23	41.07	6	18.75	0.0016**
B	17	30.35	7	21.87	0.0412*
AB	9	16.07	9	28.12	0.708 NS
A	7	12.50	10	31.25	0.244 NS
p-value	--	0.0084**	--	0.741 NS	---

*($p \leq 0.05$) and **($p \leq 0.01$)

compared to the control group, which recorded a lower percentage of infected individuals being blood group O, representing 18.75%. This was followed by blood groups B, AB, and A, representing 30.35, 16.07, and 12.5% of the total, 56 infected individuals, respectively. This is compared to the control group, which had blood group B, AB, and A, representing 21.87, 28.12, and 31.25%, respectively, of the total, 32 individuals

The current study is consistent with a previous study by Darweesh *et al.*[18], in which the O group recorded the highest percentage compared to the rest of the groups, which reveals the existence of a relationship between *Toxoplasma gondii* and blood groups. It was noted that the results of this study are consistent with a recent study conducted in Diyala and Conrad[19]. This is attributed to the fact that the molecules that determine the ABO system of blood groups are composed of carbohydrates present in the structures of glycoproteins[20].

However, the mechanism of adherence of microorganisms to the mucous membranes of hosts is not entirely clear, and gluco-conjugates of the ABO system are likely involved in this process. Studies have confirmed the existence of a relationship between the blood of parasite infection and blood groups, which suggests that there are otential receptors for *Toxoplasma gondii* with blood group receptors[21].

In many countries worldwide, more than 50% of the population is infected with Toxoplasmosis during their lifetime[22]. Chronically infected individuals who carry this parasite for life differ from healthy individuals in terms of personality traits[23], suicidality, obsessive-compulsive disorder, Alzheimer's disease[24,25], Parkinson's disease, and autism[26]. The degree of changes typically increases with the duration of the toxoplasmosis infection. Several studies have shown that the severity of toxoplasmosis-associated changes is related to the Rh phenotype of infected patients[27]. Therefore, this study aimed to determine the prevalence of *Toxoplasma* seropositivity in Rh-positive and Rh-negative blood groups and to evaluate the relationship between the prevalence of *Toxoplasma* seropositivity and Rh phenotype. This study is consistent with a previous study by Flegr *et al.*[28], which confirmed that the overall seroprevalence of *Toxoplasma* infection was 32.34 and 33.35% in individuals with Rh-positive and Rh-negative blood groups.

Given that Rh-positive blood types (85%) are more common in humans than Rh-negative blood types (15%), the results of this study confirm the higher prevalence of *Toxoplasma* infection in Rh-positive blood types. On the other hand, in many regions of Africa, Asia, and both Americas, the prevalence of toxoplasmosis among the population is much higher due to the abundance of different cat species. Therefore, parasites may play a role in the origin and persistence of Rh polymorphism through the observed differences in the frequency of specific Rh phenotypes in different geographic regions[29].

CONCLUSION

This study suggests a possible association between the ABO blood group system and *Toxoplasma gondii* infection in women aged 18-45 years, particularly among those with a history of abortion. The findings highlight the importance of monitoring blood group distribution as a potential marker for assessing susceptibility to toxoplasmosis. However, larger-scale studies are essential to confirm and validate these preliminary observations.

SIGNIFICANCE STATEMENT

This study identified a potential link between the ABO blood group system and susceptibility to *Toxoplasma gondii* infection, particularly in women aged 18-45 years. These findings could be beneficial for enhancing early diagnosis and improving targeted prevention strategies in at-risk populations. By highlighting blood group O as potentially more susceptible, the study provides new insights into the role of blood groups in toxoplasmosis. It also underscores the importance of blood group monitoring in managing reproductive health, especially in women with a history of abortion. This research will help uncover critical areas of host-parasite interactions and immunogenetics that have remained unexplored. Consequently, a new theory on the relationship between blood groups and parasitic susceptibility may emerge.

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