Journal of Chemical Health Risks

www.jchr.org

**ORIGINAL ARTICLE**

# The Relationship between ABO and Rhesus Blood Groups with Toxoplasmosis in Thi-Qar Province, Iraq

Sukaina Rahman Neamah*[1], Younus Jasim Abdullah[2]

[1]*General Directorate of Education in Thi-Qar, Ministry of Education, Al Nasiriya city, Iraq*

[2]*Southern Technical University, Amara Technical Institute. Amara City, Iraq*

*(Received: 2 November 2020 Accepted: 25 January 2021)*

**KEYWORDS**

ABO blood group Rh factor;
*Toxoplasma gondii*;
Toxoplasmosis

**ABSTRACT:** *Toxoplasma gondii* infects people via the gastrointestinal tract (GIT) that stimulates humoral and cellular immune responses with specific antibodies. Within this same system, the presence of ABO blood group glycoconjugates also arises and can affect human sensitivity to *T. gondii* infection. During this paper, the frequency distribution of ABO, as well as Rh blood groups in different phenotypes were evaluated to investigate potential relationships with toxoplasmosis and to estimate the incidence of toxoplasmosis among pregnant women in Al-Nasiriya city. Data-including serology test results for toxoplasmosis and ABO phenotypes of blood groups in women attending Bint-AL Huda and AL-Shatra Hospital in Nasiriya city were collected from starting of (2013) until the end of (2014). It's have been analyzed using version 20 of SPSS. Results of 2861 participating women indicate high prevalence of toxoplasmosis are 1018 (35.6%), 767 (26.8%), 694 (24.3%) and 382 (13.4%) for B, A, O, and AB groups respectively. A large portion of them was Rh+ (70.33%). In conclusion, this research was a significant relationship between blood groups, Rh factor and toxoplasmosis. Toxoplasma was relatively high among women in Al-Nasiriya city and Rhesus positive factor, and Blood type B individuals were most affected.

## INTRODUCTION

Ever since the first description in the T. gondii, a North African rodent, by Nicolle and Manceaux in 1908, Toxoplasma gondii (T. gondii) has increasingly been recognized as the agent of a widespread zoonotic disease. T. gondii is a protozoan parasite in cyst-forming cells that causes toxoplasmosis, and is one of the main diseases of the world's major animal parasites. This intracellular parasite may infect all humans and nearly every warm-blooded animal, including birds and rodents [1]. Cats have been demonstrated to have the central role of the transmission, as a definitive host harboring the sexual parasitic cycle and spreading oocysts through feces.

Essentially, parasites are transmitted by oocyst-polluted food dispersed by different types of cats, and uncooked meat that contains tissue pouches or unpasteurized milk, which includes tachyzoite stage, as well as trans placenta [2]. This agent causes human and animal toxoplasmosis and is one of the most common chronic diseases infecting 33% of the world's population. The relative significance of different transmission routes in various regions remains uncertain, but difference is seen in the seroprevalence of human toxoplasmosis between and within countries. Most of the variation can be influenced by different factors like eating habits; presence of cats; hygienic conditions; climate; economy, social or cultural habits; as well as water quality [3, 4]. The seroprevalence of toxoplasmosis in the Arabic countries, show different rates as (58.2%) in Kuwait, (26%) in Jordan, (25%) in Saudi Arabia, and (81.4%) in Egypt by [5–8] respectively. The Prevalence rates of toxoplasmosis in

---

*Corresponding author: sukainarn2@gmail.com (S.R.Neamah)

DOI: 10.22034/jchr.2021.1916672.1227

Iraq were 37%, 40.6%, 41.7, 31.04, 16.2% by [9–13]. Human blood is divided into two major systems: ABO and RhD. RhD protein (which are produced by RhD genes and is the main component of Rh system) contains the strongest immunoglobulin, and D antigen is lost in about 16% of individuals (Rh-negative) due to RhD cancelation or rotation [14]. During recent decades, the connection between various infectious diseases and blood groups has been discussed with enthusiasm. It has been suggested that this connection may be due to interaction between microorganisms and red blood cell membranes, which can be justified by antigenic similarity, affinity to common receptors or antibody response deregulation [15]. ABO and Rhesus are the most significant blood group systems in medication and transplantation immunology which vary by the presence or absence of antigens on red platelets (RBCs) and antibodies in the blood plasma". In many parts of Iraq, including Al-Nasiriya city, Information about seroprevalence and related hazard factors for *T. gondii* infection in treating women is also minimal. So, the current study aimed to explore the relationship between the blood group system of ABO, as well as Rh factors and infection by *T. gondii* and determine the predominance of Toxoplasmosis among Iraqi women in Al- Nasiriya city throughout 2013 and 2014.

## MATERIALS AND METHODS

### *Study population and samples*

The current study involved (2861) *T. gondii* infected pregnant women, who visited both of Bint AL Huda hospital (Main public maternity hospital in the province of Thi Qar, where it originated from, with the majority of women living in the province, including the center of the province and districts and sub-districts) and AL-Shatra hospital (Al-Shatra District Hospital, where patients in the Al-Shatra District and nearby areas are treated) in Thi Qar/ Nasiriya City in the period between (Jan. 2013 to Nov. 2014). All of them were subjected to the anti- *T. gondii* IgG antibodies as well as the ABO and Rh grouping systems. 5 ml of venous blood samples were collected from the study population then divided into two tubes, plan and EDTA tubes, blood samples in the plan tubes were centrifuged, 3000 / RPM for 5 minutes, to obtain serum for the serum identification of *T gondii*. Blood samples in the EDTA were used for detection of ABO and Rh phenotypes.

### *Diagnosis of Toxoplasmosis*

Infection with *T. gondii* was diagnosed in the study group depending on ELISA technique by using anti- *T. gondii* IgG antibodies ELISA kit performed by (Bio Check Diagnostics Company, USA).

### *Determination of Patent's ABO and Rh blood groups*

Detection of ABO and Rh phenotype of the study population is achieved the technique of standard test tube hemagglutination using industrial monoclonal anti-sera anti-A, anti-B, and anti-A, B for direct composition and regular red blood cells A1 and B for reverse typing (kits performed by Fresenius Kabi, Brazil. 2013). Then, anti-D antigen was identified in patients using direct agglutination technique between patient's blood and anti-D antibody [16].

### *Statistical analysis*

Results obtained in the present study were analyzed using SPSS (version 20; SPSS, Inc., USA) program. Tests of percentages, Chi-Square and LSD test for differences were applied. The probability level of $\leq 0.05$ was considered as statistically significant.

## RESULTS

Figure 1 illustrates the distribution of the (2861) *T. gondii* infected pregnant women according to the hospitals as well as the period of the diagnosis of *T. gondii* infection. There are (1675) cases of *T. gondii* infections (880 cases recorded at Bint-AL-Huda hospital and 795 cases recorded at AL-Shatra hospital) recorded in the first year (2013) of the study period. However, infections *T. gondii* were decreased to (1186) cases during the second year (2014) of the study period (872 occurred in Bint-AL-Huda hospital, while 314 occurred in AL-Shatra hospital). The percent of *T. gondii* infections were significantly higher (p value = 0.001, df=1) at 2013. No significant differences were found between the two hospitals in the meaning of total percent of *T. gondii* infections.

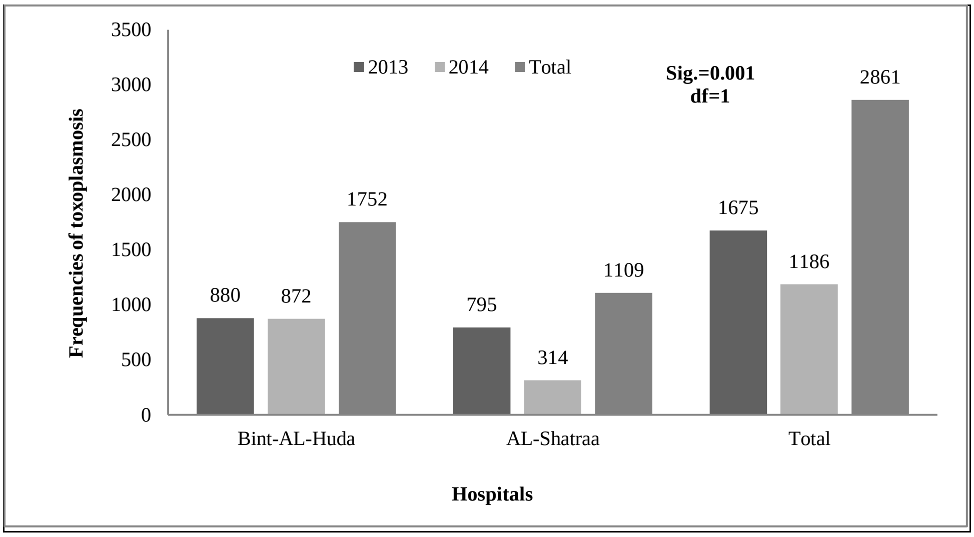

**Figure 1**. The distribution of *T. gondii* according to the hospitals and the period of the diagnosis of infection

The frequencies of ABO blood groups among *T. gondii* infected pregnant women, seen in Figure 2, are significantly variable (p value= 0.004). The blood group (B) is the most frequent phenotype among all of the study population overall the period, two years, of the current study, as, (35.6%) of the *T. gondii* infected pregnant women have the B blood phenotype. The results also showed that the blood group A was the second highest blood phenotypes among pregnant women with *T. gondii* infection followed by blood group O then AB with percent reached (26.8 %, 24.3, and 13.4% respectively).

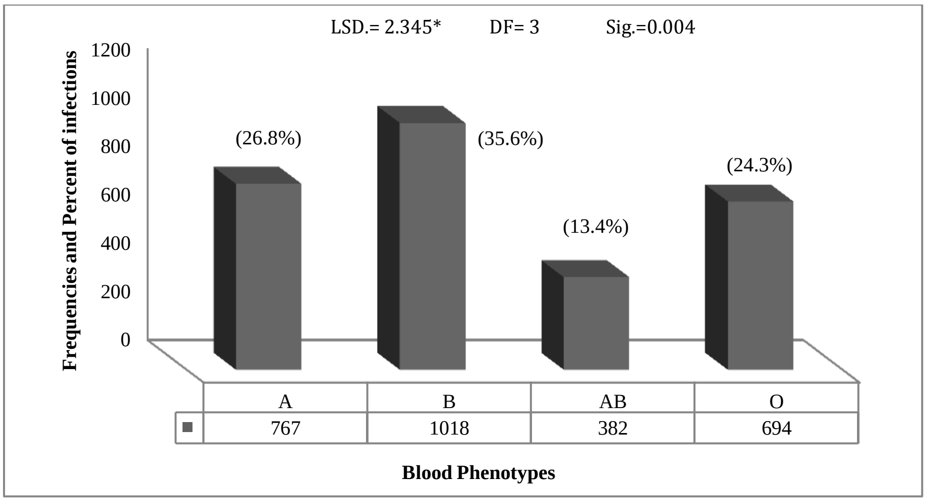

**Figure 2.** Frequencies and percentages of ABO blood groups in women with *Toxoplasma gondii* infection.

In the same context, Table 1 is showing the frequencies of blood phenotypes for the pregnant women diagnosed with toxoplasmosis according to the time of infection as well as the hospital where the infection was diagnosed. The cases of toxoplasmosis were significantly higher (p value= 0.001 for the two years) at Bint-Al-Huda hospital during both of 2013 and 2014, and among all blood phenotypes.

**Table 1.** Frequencies of ABO blood groups in women with Toxoplasma gondii infection according to the time of infection and the hospital.

| Blood groups | -2013 |  | Total | -2014 |  | Total |
|---|---|---|---|---|---|---|
|  | Bint-AL-Huda Hospital | AL-Shatra Hospital |  | Bint-AL-Huda hospital | AL-Shatra hospital |  |
| A | 214 | 193 | 407 | 271 | 89 | 360 |
|  | 12.80% | 11.50% | 24.30% | 22.80% | 7.50% | 30.40% |
| B | 362 | 256 | 618 | 289 | 111 | 400 |
|  | 21.60% | 15.30% | 36.90% | 24.40% | 9.40% | 33.70% |
| AB | 71 | 155 | 226 | 97 | 59 | 156 |
|  | 4.20% | 9.30% | 13.50% | 8.20% | 5.00% | 13.20% |
| O | 233 | 191 | 424 | 215 | 55 | 270 |
|  | 13.90% | 11.40% | 25.30% | 18.10% | 4.60% | 22.80% |
|  | 880 | 795 | 1675 | 872 | 314 | 1186 |
| Total | 52.50% | 47.50% | 100.00% | 73.50% | 26.50% | 100.00% |
|  | Chi-Square = 50.463, df=3, sig.=0.001 |  |  | Chi-Square = 16.387, df=3, sig.=0.001 |  |  |

Our results also found a significant difference (p value= 0.0001) in the occurrence of Rh factors among the study group as seen in Table 2. There are 2012 (70.33%) pregnant women, suffering from *T. gondii* infection, carry the Rh factor in their genome. 1218 (42.60%) of them were registered at Bint-AL-Huda hospital (639 during 2013 and 579 during 2014), while, 794 (27.80%) were registered at AL-Shatra hospital, Table 2. Otherwise, 849 (29.67%) of the pregnant women with *T. gondii* infection were found to lack the Rh gene in their genome, representing the (Rh -ve) phenotype. 534 (18.70%) of them were registered at Bint-AL-Huda hospital (241 during 2013 and 293 during 2014), while, 315(11%) of them were registered at AL-Shatra hospital (195 during 2013 and 120 during 2014) Table 2. These results may indicate a correlation between the presence of Rh factor and *T. gondii* infection at least in the time when the study was conducted.

**Table 2.** Frequencies and percentage of Rh factor among *T. gondii* infected pregnant women according to the year of infection and hospital.

| **Year** | **Bint-AL-Huda** |  | **AL-Shatra** |  | **Total** |  | **Total** |
|---|---|---|---|---|---|---|---|
|  | **Rh-** | **Rh+** | **Rh-** | **Rh+** | **Rh-** | **Rh+** |  |
| **2013** | 241 | 639 | 195 | 600 | 436 | 1239 | 1675 |
|  | 8.40% | 22.30% | 6.80% | 21.00% | 15.24 | 43.31 | 58.50% |
| **2014** | 293 | 579 | 120 | 194 | 413 | 773 | 1186 |
|  | 10.20% | 20.20% | 4.20% | 6.80% | 14.44 | 27.02 | 41.50% |
| **Total** | 534 | 1218 | 315 | 794 | 849 | 2012 | 2861 |
|  | 18.70% | 42.60% | 11.00% | 27.80% | 29.67 | 70.33 | 100.00% |
|  |  |  | df=1 | Sig. = 0.0001 |  |  |  |

## DISCUSSION

As we stated in the introduction of this study, the fluctuation in the occurrence of the toxoplasmosis in this region of the world may be caused by several factors which include; underlying health conditions, socio-economic status, in addition to population density in each of these countries. Furthermore, the disparity in the proportion of infected regions depends on a variety of variables, such as: environmental impacts, conventional practices and cleanliness conditions in these regions. In addition to the presence of infection pathways for pregnant women, which is raising domestic cats, or by cats polluting residential gardens and vegetables with feces containing the infectious Oocyst stage. The lifestyle, health awareness among the population as well as the abundance of the transporters of the parasite from the cats to the human in several ways also may be a significant contributor to the incidence of toxoplasmosis as the authors believe. In addition to their important role in the genetic, population migration studies as well as blood banking applications, ABO and Rh blood groups are also useful in clinical studies, resolving certain medico-legal issues, particularly in disputed cases of paternity [17]. Recently, studies of blood phenotypes suggest potential links with various infectious diseases. Such a correlation may be due to interaction between microorganisms and red blood cell membranes, which can be justified by antigenic similarity, affinity to common receptors or antibody response deregulation [15]. In this study we aimed to explore the relationship between the ABO blood group system as well as Rh factors with *T. gondii* infections in pregnant women. We found that the majority of cases of *T. gondii* infection occurred in pregnant women carrying the blood group B (35.6%), followed by women with blood group A (25.9%) and the lowest rates in the blood group O (22 %) and AB (16.5%). In this context, Naeini *et.al.* in 2019, found that women with class B+ blood were more susceptible to toxoplasmosis [18]. While Shaapan *et al*., in Egypt [19] asserted that class A women are the most susceptible to toxoplasmosis by 86%. The current results also agree with studies that showed that this parasitic infection is associated with blood groups B and AB [20-22]. Nevertheless, important correlations between toxoplasma and the blood group AB, A and O were revealed by Mahmudvand *et al*., [23], Shaddel *et al*., [24] and Elsheikha *et al*. [25]. On the other hand, Rodrigues *et al*., 2011 found that there is no relationship between blood phenotypes and *T. gondii* disease [26-29]. Also, this parasite may use glycoconjugates as potential receptors, which portray the blood phenotypes of the ABO blood bunch framework. The gastrointestinal tract expresses these glycosylated molecules, which is also used as the main toxoplasmosis route. It's possible that the ABH glycoconjugate profile containing the B antigen sets up a danger for toxoplasmosis [20, 30]. Alzamily showed that blood group A people would turn into a favored objective for the infection, which uses the phenotype-deciding glycotransferase, playing out a further (blood bunch A-particular (An allelic) mucin-type (hybrid binding while O people was related with a lower chance for the infection contrasted and non-O blood groups [31]. Furthermore, findings have shown that Rh. factor modulates the body's reactions to anti-toxoplasmic antibodies as reported by Fleeger *et al,* in 2009 [32]. But in 2014, it is far from what Parnell did in America [33]. Additionally, findings have shown that Rh +ve phenotypes modulate the body's reactions to anti-toxoplasmic antibodies as reported by Fleeger *et al,* in 2009 [32,33]. Notwithstanding, the Rh proteins work as particle siphons situated on the erythrocyte layer, and are commonly associated with controlling the particle balance in some fundamental compartment of nerve or muscle tissues. This is especially significant in subjects with inabilities because of the nearness of *Toxoplasma* cysts in the nerves and muscle tissues [34,35]. Many people that are tainted with the toxoplasmic parasite have no symptoms or signs. People with symptoms can suffer from fever, swollen lymph nodes particularly in the neck, headache, pains and muscle discomforts, sore throat. Toxoplasmosis is especially serious for people who have weakened immune systems. For these people, they're at risk of developing brain inflammation; thus causing headaches, seizures, confusion and coma,a lung infection, causing cough, fever, and shortness of breath and eye pain. Toxoplasmosis in an unborn baby can be life-threatening for the baby soon after birth. Typically, the diagnosis of toxoplasmosis in humans is made by serological testing (IgG and IgM), stained tissue samples and molecular techniques [36,37].

## CONCLUSIONS

The importance of human blood groups are highlighted, particularly in women diagnosed with *T. gondii*. B-group members were more likely to be infected, followed by A, O and AB groups respectively. Also, a positive Rh factor is considered a marker for higher rates of susceptibility to infection than negative. A statistically significant relationship was observed between the Rh blood group and ABO manifestations with toxoplasmosis.

## ACKNOWLEDGEMENTS

The author thanks and would like to give high appreciation to the Department of Parasitology of Bint-AL Huda and AL-Shatra Hospitals in Al- Nasiriya city for their assistance during this study.

### *Ethical consideration*

Permission to perform this research was provided by the Administrative Ethics Committee of the health board. The collection of Blood samples of persons was carried out under the direction of public health technicians in accordance with the principles specified and applicable defined scientific guidelines.

### *Conflicts of interest*

All authors declare that there is no any conflict of interest.

## REFERENCES

1. Sudan V., Jaiswal A.K., Shanker D., 2013. Recent trends in the diagnosis of Toxoplasmosis. Clin Rev Opinions. 5(2), 11–7.

2. Robert-Gangneux F., Darde M.L., 2012. Epidemiology of and diagnostic strategies for toxoplasmosis. Clinical Microbiology Reviews. 25(2), 264-296.

3. Dubey J.P., Hotea I., Olariu T.R., Jones J.L., Darabus G., 2014. Epidemiological review of toxoplasmosis in humans and animals in Romania. Parasitology. 141(3), 311–25.

4. AL Azawi B.M., AL-Waeli F.MS., 2015. Studies on the effect of infected cases of parasite *Toxoplasma gondi*i on some sex hormones. World Journal of Pharmaceutical Research. 4(10), 2413-2423.

5. AL-Nakib W., Ibrahim M.E., Hathout H., Moussa M.A., Deverajan L.V., Thornburn H., Yusuf A.M., 1983. Seroepidmiology of viral and Toxoplasma infection during pregnancy among Arab women of child breading age in Kuwait.Intr. Epidermal. 12(2), 220.

6. Abdel –Hafez S.K., Shbeeb I., Ismail N.S., Abdel-Rahman F., 1986. Serodiagnosis of Toxoplasma gondii in habitually abortion women and other adults from north Jordan. Folia Parasitol. 33, 7-13.

7. AL-Meshari A.A., Chowdhury M.N., Chattopadhyay S.K., Desilva S.K., 1989. Screening of Toxoplasmosis in pregnancy. Int J Gyanaecol Obstet. 29(1), 39-45.

8. Soliman M., EL-Naggar H.M., EL-Chareb M.E., 2001. Toxoplasma antibodies in normal and complicated pregnancy. J Egypt Soc Parasitol. 31, 37-46.

9. AL-Sabbak M., 1999. The rate of affected toxoplasmosis out come on pregnancy. Basra J Soc. 51, 58-92.

10. Abdul-Ridha R.A.H., 2000. Biochemical changes in the aborted toxoplasmosis seropositive women .M.Sc.Thesis. College of Science. AL-Mustansiriyah University. pp 70

11. AL-Deen M.M., 2002. Seroepidemiological study on toxoplasmosis in women with history of abortion. M.Sc. Thesis College of Medicine. AL-Nahrain University. pp 139

12. Kareem S.S., 2008. Prevalence, serodiagnosis and some immunological aspects of toxoplasmosis among women in Baghdad province. M.Sc. Thesis. College of health and Medical Technology. Technical Foundation.

13. AL-Shikhly M.A.H., 2010. Early detection of toxoplasmosis percentage in pre-marital females by immunological methods. M.Sc. Thesis. College of Science. Baghdad University. pp 147.

14. Alemu G., Mama M., 2016. Assessing ABO/Rh blood group frequency and association with asymptomatic malaria among blood donors attending Arba Minch blood bank, South Ethiopia. Malaria research and treatment.

15. Pourhassan Abolfazl., 2014. Association between ABO blood/rhesus grouping and hepatitis B and C: a case-control study. Pak J Biol Sci. 17(6), 868-71.

16. Kaya H., Gundo M., Akarsu E., Kiki I., Tekin B., 1999. The distrubition of blood groups in Erzurum. Medical Journal of Atatürk University. 31, 20-22.

17. Khan M.S., Subhan F., Tahir F., Kazi B.M., Dil A.S., 2004. Sultan S. Prevalence of blood groups and Rh factor in Bannu region. Pakistan Journal of Medical Sciences. 43(1), 8–10.

18. Naeini K.M., Soureshjani E.H., Jafari M., Parchami S., Karimi G., Abdizadeh R., 2019. Prevalence of *Toxoplasma gondii* Infection in Healthy Volunteer Blood Donors Using Serological and Molecular Methods from Chaharmahal and Bakhtiari Province, Southwest Iran. Jundishapur J Microbiol. 12(5), 91042

19. Shaapan R.M., Abd El Wah W.M., Abd El Had MED., Elfadaly H.A., Ahmed Hamd D., 2018. *Toxoplasma gondii* infection and associated sociodemographic and behavioral risk factors among blood donors. Asian J Epidemiol. 11(2), 52–8.

20. Kolbekova P., Kourbatova E., Novotna M., Kodym P., Flegr J., 2007. New and old risk-factors for *Toxoplasma gondii* infection: prospective cross-

sectional study among military personnel in the Czech Republic. Clin Microbiol Infect. 13(10), 12-7.

21. Flegr J., Novotna M., Fialova A., Kolbekova P., Gasova Z., 2010. The influence of RhD phenotype on toxoplasmosis- and age-associated changes in personality profile of blood donors. Folia Parasitologica. 57(2), 143–150.

22. Skallova A., Novotna M., Kolbekova P., Gasova Z., Vesely V., Flegr J., 2005. Decreased level of novelty seeking in blood donors infected with Toxoplasma.Neuroendocrinol Lett. 26, 480–486

23. Mahmoudvand H., Saedi Dezaki E., Soleimani S., Baneshi M.R., Kheirandish F., Ezatpour B., 2015. Seroprevalence and risk factors of *Toxoplasma gondii* infection among healthy blood donors in south-east of Iran. Parasite Immunol. 37(7), 362–7.

24. Shaddel M., Mirzaii-Dizgah I., Hoshangi M., 2014. Anti-*Toxoplasma gondii* antibody levels in blood supply of Shiraz Blood Transfusion Institute, Iran. Iran J Parasitol. 9(1), 120–4.

25. Elsheikha H.M., Azab M.S., Abousamra N.K., Rahbar M.H., Elghannam D.M., Raafat D., 2009. Seroprevalence of and risk factors for *Toxoplasma gondii* antibodies among asymptomatic blood donors in Egypt. Parasitol Res. 104(6), 1471–6.

26. Rodrigues A.CF., Uezato S., Vono M.B., Pandossio T., Spegiorin LC.JF., Oliani A.H., 2011. Non-association between anti-*Toxoplasma gondii* antibodies and ABO blood group system. The Journal of Venomous Animals and Toxins including Tropical Diseases. 17(2), 184-189

27. Kolbekova P., Kourbatova E., Novotna M., Kodym P., Flegr J., 2007. New and old risk-factors for *Toxoplasma gondii* infection: prospective cross-sectional study among military personnel in the Czech Republic. Clinical Microbiology Infection. 13(10), 12-7.

28. Boulanger M.J., Tonkin M.L., Crawford J., 2010. Apicomplexan parasite adhesins: novel strategies for targeting host cell carbohydrates. Curr Opin Struct Biol. 20(5), 551-9.

29. Anstee D.J., 2010. The relationship between blood groups and disease. Blood. 115(23), 4635-43.

30. Carruthers V., Hakansson S., Giddings O.K., Sibley D., 2000. *Toxoplasma gondii* uses sulfated proteoglycans for substrate and host cell attachment. Infect Immun. 68(7), 4005-11.

31. Alzamily I.A., Fadhil A.K., 2020. Susceptibility of ABO system for infection of COVID-19. International Journal of Pharmaceutical Research . 12(2). 353

32. Flegr J., Klose J., Novotna M., Beren-reitterova M., Havlice J., 2009. Increased incidence of traffic accidents in Toxoplasma infected military drivers and protective effect RhD molecule revealed by a large-scale prospective cohort study. BMC Infectious Disease. (9), e72.

33. Parnell L.L., 2014. Examination of Possible Protective Effect of Rhesus D Positive Blood Factor on Toxoplasma-related Depressive Symptoms in Pregnancy. PhD. College of Nursing University of South Flori-da.

34. Kustu S., Inwood W., 2006. Biological gas channels for $NH_3$ and $CO_2$: evidence that Rh (Rhesus) proteins are $CO_2$ channels. Transfusion Clinical Biology. (13), 103–110.

35. Novotna M., Havlicek J., Smith A.P., Kol-bekova P., Skallova A., Klose J., 2008. Toxoplasma and reaction time: role of toxoplasmosis in the origin, preservation and geographical distribution of Rh blood group polymorphism. Parasitology. (135), 1253–1261.

36. WHO. Estimates of the Global Burden of Foodborne Diseases. http://www.euro.who.int/ en/ health-topics/disease-prevention/ food-safety (2015).

37. Robert-Gangneux F., Darde M.L., 2012. Epidemiology of and diagnostic strategies for toxoplasmosis. Clinical Microbiology Reviews. 25, 264-296.