**Bulletin of Environment, Pharmacology and Life Sciences**
Bull. Env.Pharmacol. Life Sci., Vol 11[2] January 2022 : 147-150

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

**ORIGINAL ARTICLE** **OPEN ACCESS**

# Susceptibility of Human Population to Malaria Concerning Blood Groups, Age and Sex

**Nagabhushan Reddy, M.*, Oliva Grace, R. & Kumara Swamy, M.**
School of Life Sciences, Rayalaseema University, Kurnool-518007 (A.P.), India.
* Corresponding Author's Email: mnabhushr@gmail.com

**ABSTRACT**
*Malaria remains a leading cause of morbidity and mortality worldwide, despite prevention and control efforts. Studies on the association of blood groups with malaria are less informative and further age and sex with malaria are very limited. Hence to study the susceptibility of the human population to malaria concerning their blood groups, age and sex. Human individuals both admitted and outpatients were divided into '7' groups according to their age (between 1 to 70 years) & sex. Alongside the serum samples were collected. Hospital-based case-control study has been done to determine the susceptibility of human individuals to malaria concerning their blood groups, age and sex. DMR test, where Values are means (n=6) which do not share common superscript differ significantly at p<0.05. This study finds that the occurrence of malaria is more in human individuals with blood group $B^+$, followed by A, O, AB and age groups between 1-10 years and 51-70 years of males and females where males are more susceptible to malaria than females.*
**KEYWORDS:** Age group, Blood group, Epidemiology, Malaria, Plasmodium, Sex, Susceptibility.

Received 01 .01.2022 Revised 19.01.2022 Accepted 22.01.2022

## INTRODUCTION

Malaria is one of the most prevalent human infections worldwide. In India malaria continues to pose major public health particularly *Plasmodium falciparum*. However, all age groups may be at risk of severe disease during malaria epidemics, which occur either when changes in the physical environment (caused by climatic variation, agricultural projects or mining) increase the capacity of mosquitoes to transmit the disease or when population displacements (natural disasters, war) expose non-immune populations to infection[1].

In Mexico, Central and South America, the Mediterranean, Asia and Oceania, both *P. falciparum* and ***P. vivax*** are endemic. Disease caused by *P. ovale* ***and*** *P. malariae* is relatively rare. Our understanding of the transmission and pathogenesis of this disease has evolved considerably from the 18th-century belief that malaria was miasmatic in origin (***mal***, bad; ***aria***, air)[2]. Accurate interpretation of malaria smears remains problematic in many established clinical laboratories. Important shortcomings of rapid antigen detection tests (RDTs) include their inability to quantitate parasitemia and suboptimal test performance with low-level parasitemia [3] and that of Polymerase chain reaction (PCR) test though the sensitive and highly specific test in detecting extremely low numbers of parasites is expensive[4].

A relationship between blood groups and disease was first hypothesized by Kaipainen and Vuorinen[5] in 1960 and the gene involved in different blood groups were discovered in 1990[6]. Ageing is accompanied by a decline in immune system function and immune alteration which increases susceptibility to infections[7]. Hence we thought that there could be a significant relationship between A, B, AB, O, Rh blood groups, age and sex of humans and occurrence of malaria, its severity and studied them in both the admitted & outpatients.

## MATERIAL AND METHODS

This study was done for 18 months i.e. from July 2018 to December 2019. Human individuals both admitted and outpatients were divided into '7' groups according to their age (between 1 to 70 years) & sex. Alongside the serum samples were collected. Diagnosis for malaria was done by staining the blood smear[8]. Blood groups were determined by standard haemagglutination assays[9] and these procedures were followed in accordance with ethical standards as per the guidelines laid down by the central ethical

committee of the Indian Council of Medical Research. This study and the collection of data were carried out with the approval of the institutional review board.

Statistical analysis of the data was analyzed by 'DMR test' and observed that the individuals of different age groups from 1 to 70 years distinguishing males and females along with their blood groups suffering from malaria, where $p<0.05$ considered as significant. Individuals not being diagnosed with malaria are treated as controls in the respective sample size and total sample size too.

## RESULTS

The collected data of the present study indicate that the occurrence of malaria is more in the individuals of the $B^+$ blood group (in more than 50% of the tested individuals) followed by $A^+$ both in male and female patients (Tables – 1 & 2). The order of occurrence of malaria based on blood groups is $B^+ > A^+ > O^+ > AB^+ > A^- > AB^- > O^- > B^-$. Regarding age groups, the three age groups i.e. 1-10 years and the other two between 51-70 years in both the males and females are more susceptible to malaria than the other age groups indicating $p<0.05$ is significant.

The other interesting aspect is based on the sex of the individuals that we observed males are more prone to malaria when compared to females (Table – 3) and it reflects in the affected %. As the $B^+$ blood group is present in the majority of the individuals as is being observed even, it is more prone to malaria than by $A^+$ blood group with the same features. $A^-$ / AB / $O^-$ blood groups being rare the same phenomenon with respect to the occurrence of malaria also.

**Table – 1:** Occurrence of malaria – blood groups, age groups, sex.

| Blood group | Males | | | | | | | | Females | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Age group [in years] | | | | | | | | Age group [in years] | | | | | | |
| | 1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | | 1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 |
| $O^+$ | 8 | 2 | 2 | 1 | 2 | 4 | 2 | | 6 | 2 | 2 | 1 | 3 | 2 | 2 |
| $O^-$ | 0 | 0 | 0 | 0 | 1 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $B^+$ | 12 | 4 | 6 | 6 | 8 | 12 | 7 | | 10 | 3 | 5 | 4 | 6 | 10 | 6 |
| $B^-$ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $A^+$ | 8 | 2 | 0 | 2 | 4 | 8 | 6 | | 3 | 1 | 0 | 1 | 3 | 6 | 8 |
| $A^-$ | 1 | 0 | 0 | 0 | 0 | 0 | 2 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $AB^+$ | 2 | 1 | 0 | 0 | 0 | 0 | 1 | | 5 | 1 | 0 | 1 | 1 | 0 | 1 |
| $AB^-$ | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| Total | 32 | 9 | 8 | 9 | 15 | 25 | 18 | | 24 | 7 | 7 | 7 | 13 | 20 | 17 |

Sample size 'N' = 50, for each age group of males and females;

**Table – 2:** Malaria in different age groups.

| Sex | Age group [in years] | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | 1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | |
| Males | $32^{g}$ | $9^{b}$ | $8^{a}$ | $9^{bc}$ | $15^{d}$ | $25^{f}$ | $18^{e}$ | 116 [350] |
| Affected % | 30 | 8 | 7 | 8 | 14 | 23 | 17 | 33.14 |
| Females | $24^{g}$ | $7^{a}$ | $7^{ab}$ | $7^{abc}$ | $13^{d}$ | $20^{f}$ | $17^{e}$ | 95 [350] |
| Affected % | 25 | 7 | 7 | 7 | 14 | 21 | 18 | 27.14 |

The number in the parentheses is the total no. of individuals tested; Sample size 'N' = 50, for each age group of males and females; Controls are the unaffected individuals from respective sample size; Values are means [n=6] that do not share common superscript differ significantly at $p<0.05$.

**Table – 3:** Malaria in different blood groups and sex.

| Blood group | Males | Affected % | Females | Affected % |
|---|---|---|---|---|
| O+ | $21^{f}$ | 18.10 | $18^{c}$ | 18.94 |
| O- | $1^{abc}$ | 0.86 | 0 | 0.00 |
| B+ | $55^{h}$ | 47.41 | $44^{e}$ | 46.31 |
| B- | $1^{ab}$ | 0.86 | 0 | 0.00 |
| A+ | $30^{g}$ | 25.86 | $22^{d}$ | 23.15 |
| A- | $3^{d}$ | 2.58 | 0 | 0.00 |
| AB+ | $4^{e}$ | 3.44 | $9^{b}$ | 9.47 |
| AB- | $1^{a}$ | 0.86 | $2^{a}$ | 2.10 |
| Total | 116 [350] | | 95 [350] | |

The number in the parentheses is the total no. of individuals tested; Controls are the unaffected individuals from respective sample size; Values are means [n=6] that do not share common superscript differ significantly at $p<0.05$.

## DISCUSSION

The important role that host genetics plays in determining the susceptibility to infectious pathogens in humans has been less known. The ABO blood group system is part of the innate immune system and it has been shown that the individuals with different ABO blood groups differ in their susceptibility or resistance to viral and bacterial infections and diseases[6].

The O gene is amorphic and does not transform the H substance; therefore O is not antigenic. The A, B and H antigens are present on most body cells[10]. The differences in susceptibility and severity of *P. falciparum* malaria infection among the "ABO" blood groups have been attributed to rosetting of parasitized erythrocytes and cytoadherence, perhaps more in the $B^+/A^+$ blood groups as is observed in the study[11].

The pathogenesis of malaria is best understood for *P. falciparum* infection. Several factors contribute to the severity of the clinical disease. High parasite burdens combined with the unique ability of infected erythrocytes to adhere to host endothelium contributes to microvascular occlusion, metabolic derangement and acidosis, which lead to the manifestations of severe malaria (acute respiratory distress syndrome, renal insufficiency and cerebral malaria) [12]. Manifestations of the disease may also be related to intravascular hemolysis and parasite consumption of glucose. Host factors such as sickle cell disease and glucose-6-phosphate dehydrogenase deficiency can modify the severity of the disease[13].

The dynamics of age shifts also depend on the slow build-up of natural immunity under parasitological challenges[13]. An important feature of this is an increase in the force of infection with age for the first few yearsof life as is evident from the present study i.e. age group 1-10 years. One of the most serious complications is cerebral malaria, manifested by an altered level of consciousness, focal neurologic findings and seizures. Mortality is high (15% to 25%) and survivors may have residual neurologic deficits[14,15]. But same dynamics of age shifts are also observed in the age group 51-70 years for the reasons better understood in terms of immunity.

Available evidence supports the suggestions that males are more vulnerable to malaria infection than females in most endemic areas. Although semi-immune people and those living in endemic regions tend not to experience severe malaria, they may still experience complications from recurrent infections[16]. Limited financial resources pose considerable barriers to malaria prevention and control efforts in endemic areas. Vector control has met with limited success. Insecticide-treated bed nets (ITNs) offer effective protection against malaria[17].

Molecular manipulation of mosquito genomes to create mosquitoes that are incapable of becoming infected by and transmitting malaria (transgenic mosquitoes) is an interesting avenue for the prevention of malaria but has not yet been realized.

## CONFLICTS OF INTEREST

None

## AUTHORS CONTRIBUTION

Concepts, Design, Literature search, Data analysis, Statistical analysis, Manuscript preparation, Manuscript editing, Manuscript review – Nagabhushan Reddy, M. Clinical studies, Experimental studies, Data acquisition – Oliva Grace, R. & Kumara Swamy, M.

## REFERENCES


1. World Health Organization. (2018). World Malaria Report, Geneva, WHO, Press:1–238.
2. 2nd International Conference on Science. (2018). In: Proceedings of Journal of Physics, Conference series, 979.
3. Anthony, M. (2002). Rapid Antigen Detection Tests for Malaria Parasites. Clin. Microbiol. Rev., 15(1):66-78.
4. Ajay, R.B., Scott, L.L., Kailash P.P., & Joseph, M.V. (2009). Malaria Diagnosis by a Polymerase Chain Reaction – Based Assay using a pooling strategy. Am. J. Trop. Med. Hyg., 81(5):754-757.
5. Skripal, I.G. (1996). ABO system of blood groups in people and their resistance to certain infectious diseases (prognosis). Mikrobiol. Z., 58:102-8.
6. Greenwell, P. (1997). Blood group antigens: Molecules seeking a function? Glycoconj. J., 14:159-73.
7. Valiathan, R., Ashman, M. & Asthana, D. (2016). Effects of ageing on the immune system: Infants to elderly. Scand. J. Immunol., 83(4):255-66.
8. Payne, D. (1988). Use and limitations of light microscopy for diagnosing malaria at the primary health care level. Bull. W.H.O., 66:621-626.
9. Kalayanarooj, S., Vaughn, D.W., Nimmannitya, S., Green, S., Suntayakorn, S. & Kunentrasai, N. (1997). Early clinical and laboratory indicators of acute dengue illness. J. Infect. Dis., 176:313-21.
10. Chrispal, A., Boorugu, H., Gopinath, K.G., Chandy, S. & Prakash, J.A. (2010). Acute undifferentiated febrile illness in adult hospitalized patients: the disease spectrum and diagnostic predictors - an experience from a tertiary care hospital in South India. Trop. Doct., 40:230–234.

11. Pathirana, S.L., Alles, H.K. & Bandara, S. (2005). "ABO-blood-group types and protection against severe, Plasmodium falciparum malaria", Ann. Trop. Med. Parasitol., 99(2):119-124.
12. Abdallah, T.M., Abdeen, M.T., Ahmed, I.S., Hamdan, H.Z. & Magzoub, M. (2013). Severe *Plasmodium falciparum* and *Plasmodium vivax* malaria among adults at Kassala Hospital, eastern Sudan. Malar. J., 12:148.
13. Felger, I., Maire, M., Bretscher, M.T., Falk, N., Tiaden, A. & Sama, W. (2012). The dynamics of natural *Plasmodium falciparum* infections. PLOS One, 7(9):e45542.
14. Shah, I. & Katira, B. (2007). Clinical and laboratory profile of dengue, leptospirosis and malaria in children: a study from Mumbai. Arch. Dis. Child., 92:561.
15. Reuben, R. (1993). Women and Malaria - Special Risks and Appropriate Control Strategy. Soc. Sci. Med., 37(4):473-480.
16. Krause, G. & Sauerborn, R. (2000). Comprehensive community effectiveness of health care: A study of malaria treatment in childrenand adults in rural Burkina Faso. Ann. Trop. Paedtr.,20:273-282.
17. Rashed, S. (1999). Determinants of the Permethrin Impregnated Bed nets (PIB) in the Republic of Benin: the role of women in the acquisition and utilization of PIBs. Soc. Sci. Med., 49:993-1005.

**CITATION OF THIS ARTICLE**

Nagabhushan Reddy, M., Oliva Grace, R. & Kumara Swamy, M.. Susceptibility of Human Population to Malaria Concerning Blood Groups, Age and Sex.Bull. Env.Pharmacol. Life Sci., Vol 11[2] January 2022 : 147-150