# Prevalence and co-infection of Malaria and Typhoid in the local population of Faisalabad, Pakistan

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**Abstract**: Malaria and typhoid fever are among the major infectious diseases which impose significant health and socioeconomic burden on affected populations. Further, co-infection and resembling symptomatology in both infections, mostly leads to misdiagnosis and mistreatment. So co-infection of malaria and typhoid fever is becoming a major issue in tropical and subtropical countries. The current study was planned to explore the rate of co-infection of malaria and typhoid fever to show the diagnostic challenges and people health implications in the local population of Faisalabad-Pakistan. For this purpose, 144 samples (n=144) were collected from suspected subjects both male (n=74) and female (n=70) (comprises of three age group ranges viz >01-10, 11-20 and above 20 years old) of typhoid fever and malaria from October to December 2017 at Children Hospital, Faisalabad-Pakistan. Thick smear as a gold standard technique for malaria diagnosis and Widal agglutination technique for typhoid diagnosis were used. Results revealed that the prevalence of co-infection in selected subjects was 6.3% (n=9) with higher prevalence in female subjects (7.1%) as compared to males (5.4%). Further, it was also reported that age groups >01-10 years old, 11-20 years old and 21-above years old have6.6 % (n=75), 5.7 % (n=35) and 5.8% (n=34), coinfection prevalence respectively. In the present study, it could be concluded that although the prevalence of co-infection of malaria and typhoid fever in the studied population was possible but sensitivity of diagnostic tools was limited, so more reliable, specific and sensitive diagnostic tools are required to report confidently more precise correlation of these infectious diseases.

**Keywords**: Malaria, typhoid fever, co-infection, diagnostic tools, correlation.

## INTRODUCTION

Malaria is caused by *Plasmodium* which lives inside the red blood cells (Pradhan, 2011). Malaria is transmitted by biting of female Anopheles' mosquitoes. According to an estimate, 577 species of Anopheles are present all over the world, 24 species of Anopheles are known in Pakistan and only 2 species that are *Anopheles culicifacies* and *Anopheles stephens* act as a vector to cause malaria (Khan, *et al*., 2012). In sub-Saharan Africa most child death causing disease is malaria. For other high-risk infections, malaria is a major risk factor such as bacteremia (Schumacher and Spinelli, 2012). In 2006, 247 million cases of malaria among 3.3 billion populations in which most are children. One hundred and nine countries were endemic for malaria in 2007 (Hall and Fauci, 2009). Two hundred and sixteen million cases of malaria were reported in 2011 and an estimated 655000 deaths in 2010 (Dambhare *et al.,* (2012). Malaria fever is 68% (54.2 million) of the total population of 78 million that are in risk areas. *Plasmodium falciparum* and *Plasmodium vivax* are the most common species of malaria in Ethiopia having 60% and 40% frequencies relatively. The complicated disease is caused by *P. falciparum* in endemic areas and causes death (Birhanie *et al*., 2014). At present 100 countries are considered to be malaria, mostly the African countries. Approximately 90% of malaria deaths all over the world occur in sub-Saharan Africa. Most infections caused by *P. falciparum* that is the most dangerous human malaria parasite, others are *P. vivax*, *P. ovale* and *P. malariae* causing an estimated 1.4-2.6 million deaths per year (McGowan *et al.*, 2009).

Typhoid is a most common disease in children due to unsafe water usage and poor cleaning habits. Malaria is endemic in most developing countries. Typhoid fever is a major public health problem in developing countries that is caused by *Salmonella typhi* (Ochiai *et al*., 2008). *Salmonella enterica* serotype Typhi is isolated to diagnose typhoid fever in patients (Uneke, 2008). In most tropical countries, specific diagnostic investigation of typhoid is the Widal test. Widal test is the most common test is easily available and is cheap that is used in the serological diagnosis of typhoid fever for more than a century. It is based on an antibody present in the serum of an infected patient, against flagellar (H) and somatic (O) antigens of *Salmonella typhi*. Four-fold antibody titer is used; antigens are used to detect antibodies. The IgM Somatic

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O antibody appears first that represent acute typhoid fever, while the IgG Flagella H antibody persists for longer (Olopoenia and King, 2000; Uneke, 2008). An estimate of 16 million typhoid fever illness cases and 600000 deaths annually, this estimate was presented in 1984-1986 (Crump *et al*., 2004). Causative organisms of typhoid and malaria are different; one is caused by gram-negative bacillus while other is caused by a protozoan having different transmission mechanisms. But there are similarities in both the diseases; both diseases are endemic in developing countries (Keong and Sulaiman, 2006).

Due to similarities of clinical features of malaria and typhoid fever cause wrong diagnosis and treatment of a patient having a fever (Hassan *et al*., 2011). Malaria and typhoid co-infection is the most common problem in developing countries. Mostly in Africa due to contaminated water supply and especially the antiviral drug's resistance of malaria of *Plasmodium.* In Widal agglutination test antibodies and cross-react that cause false positive results. Blood culture bone marrow culture is reliable for the diagnosis of typhoid fever (Mbuh *et al*., 2003).

## MATERIALS AND METHODS

***Study area***

This study was conducted in the Pathology Department, Children Hospital, Faisalabad, Pakistan.

***Data collection***

Data collection was based on sex, age and area. For this purpose, 144 samples (n=144) were collected from suspected subjects of malaria and typhoid from both male (n= 74) and female (n=70) comprises of three age group ranges viz >01-10 (n=75), 11-20 (n=35) and above 20 (n=34) years old during 02$^{nd}$, October to 15$^{th}$, December 2017 at Department of Pathology, Children Hospital, Faisalabad-Pakistan.

***Consent***

Prior to the study written consents were obtained from all the patients before enrollment to the study and only those were enrolled for the study who gave their consents voluntarily.

***Ethical approval***

The study protocol was also approved by the Ethics Committee. Overall confidentiality was maintained and the data was used only for the research purpose.

***Inclusion and exclusion criteria***

The only those patients who were presenting undifferentiated fever of more than 05 days with clinical suspicion of malaria or typhoid having age ≥1 years onwards were included in this study. While all those patients with the history of taking antimalarial medicine, or any other antibiotics were excluded from this study.

***Detection tests***

Malaria was determined by microscopic examination in the thick and thin blood film. After fixation of slides, Giemsa stain was used to stain. Both slides were observed under a microscope. On the bases of physical features of parasites and appearance of red blood cells malaria was identified. For the diagnosis of typhoid fever, the Widal test was used. The Widal test antigen H and O were added to patient serum to detect the antibodies. Agglutination showed that the Widal test is positive while no agglutination showed that the test is negative (Elseed, 2015).

## RESULTS

It was reported that the prevalence of malaria and typhoid fever was 6.3% (n=09) in all age groups. Further, results revealed that the highest prevalence was observed in females 7.1% (n=5) while in males the prevalence of co-infection was 5.4 % (n=4) (table 1). Moreover, the highest prevalence of co-infection among three groups of males was found in the age group above 20 years old 10.5% (n=2), the age group 1-10 years old has 5.9% (n=2) while in the age group of 11-20 years old prevalence was zero (table1). Among three age groups of females, results revealed that age group 11-20 years old (n=14) have the highest co-infection prevalence 14.3 % (n=2) while 7.3% (n=2) was reported in the age group 11-20 years old (n=41) and no single co-infected positive case was reported in the age group above 20 years old (table 1).

## DISCUSSION

The current study of the prevalence of co-infection of typhoid 6.7% compared with the Sajid *et al*. (2017) that reported the prevalence of co-infection that was 7%. They reported the high prevalence in males while in current study females are more affected by co-infection of malaria and typhoid. Birhanie at al., (2014) reported the co-infection of malaria and typhoid that was 6.5% and the high-risk group was 2-5 years old can be compared with present study that showed that the prevalence of co-infection of malaria and typhoid fever is 6.7% while the high prevalence age group was 21 and above of females. High prevalence can be due to poor hand washing. The present study of the prevalence of malaria and typhoid fever can be compared with the previous study of Mbuh *et al*., (2003) published that the correlation that was 10.1 % using Widal test while 0.5% when using culture method, the present study showed the correlation 6.7%. This may be due to the cross-reaction of malarial and typhoidal antigens. Tasawer at al., (2003) said that Prevalence is more in males (5.55%) as compared to females (3.17%) while the current study showed that co-infection is more

**Table 1**: Sex and age wise prevalence of malaria, typhoid and their co-infection both in males and females

| Age group (Years) | Examined n (%) | | Malarial infected n (%) | | Typhoid infected n (%) | | Co-infection n (%) | |
|---|---|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female | Male | Female |
| All age groups | 144 | | 11 (7.7) | | 86 (59.7) | | 9 (6.3) | |
| 1-10 | 34 (23.6) | 41 (28.5) | 2 (5.9) | 3 (8.6) | 23 (67.6) | 25 (61.0) | 2 (5.9) | 3 (7.3) |
| 11-20 | 21 (14.5) | 14 (9.7) | 1 (2.9) | 2 (14.3) | 11 (52.3) | 10 (71.4) | 0 (0) | 2 (14.3) |
| > 20 | 19 (13.2) | 15 (10.4) | 2 (5.9) | 1 (6.7) | 09 (47.3) | 08 (60) | 2 (10.5) | 0 (0) |
| Total | 74 (51.3) | 70 (48.7) | 5 (6.7) | 6 (8.6) | 43 (58.9) | 43 (61.4) | 4 (5.4) | 5 (7.1) |

prevalent in females (7.1%) than the males (5.4%) this may be due to the working in open area of males. They should use bed nets. Pradhan *et al.* (2011) examined that the co-infection of malaria and typhoid caused by misleading widal tests. Because typhoidal salmonella antibodies are known to cross-react with other antigens including those from non-typhoidal salmonella and malaria antigen, the use of Widal test as a diagnostic tool in patients with malaria may lead to misleading result can be compared to the present report that showed the co-infection that was 6.7%. Prevalence of malaria and typhoid that was 50.4% were positive for malaria parasite, 12 (4.7%) were positive for Widal test and 31 (12%) were positive for both typhoid and malaria. This previous study can be compared with a present study that showed that 86 (59.7%) were positive for typhoid, 11 (7.6%) were positive for malaria while malaria and typhoid co-infected patients were 9 (6.3%). There is no specific correlation between malaria; high prevalence is due to poor hand washing (Igbeneghu *et al*., 2009). In a previous study, Ekesiobi *et al*. (2017) published that the prevalence of typhoid and malaria that was 13 (6, 64%) can be compared with present study showed that the correlation is 6.7%. Results showed that there is no specific correlation between malaria and typhoid but there may be a misleading diagnosis of typhoid in malarial patients. Ammah *et al*. (1999) reported a 17% correlation between malaria and typhoid that is 10 times higher than the present study. Pam *et al*. (2015) reported the correlation between malaria and typhoid that was 4.5% while the current study had 6.7%. Afoakwah *et al*. (2011) reported the correlation (3.9%) that is less than the present study. Orok *et al*. (2016) reported that the co-infection in patients was 28% by using the Widal test method that is 20 times greater than the present study. Snehanshu *et al*. (2014) reported that the correlation between malaria and typhoid in patients was 8.50% while using the Widal test as a diagnostic tool for patients. Results showed that there is no specific correlation between malaria and typhoid. This may lead to the misdiagnosis because malarial antibodies can cross-react with typhoidal antigens and may lead to false positive results. When using the Widal agglutination method, the prevalence of malaria and typhoid co-infection is high while using the culture technique there is a low correlation. The high rate of typhoid fever and malaria in the tropics, co-infections are common (Uneke, 2008)

## CONCLUSION

Malaria and typhoid fever are among the major infectious diseases which impose significant health and socioeconomic burden on affected populations. Further, co-infection and resembling symptomatology in both infections, mostly leads to misdiagnosis and mistreatment. So co-infection of malaria and typhoid fever is becoming a major issue in tropical and subtropical countries. In the present study, it could be concluded that although the prevalence of co-infection of malaria and typhoid fever in the studied population was possible and non-significant but sensitivity of diagnostic tools was limited, so more reliable, specific and sensitive diagnostic tools are required to report confidently more precise correlation of these infectious diseases. The study suggests adopting some more reliable diagnostic modalities as compared to the discussed methods for the differential diagnosis of patients presented with fever.

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