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Original Research Article

Malaria or typhoid co-infection in a tertiary care hospital of Bareilly, Uttar Pradesh, India

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ABSTRACT

Background: Malaria is a protozoal disease caused by infection with parasite of genus *Plasmodium*. Typhoid is common with malarial infection.
Methods: A cross sectional study was done to find out co-infection of typhoid and malaria. Study was done in central pathological lab of department of pathology, RMCH, Bareilly. Blood samples were collected in EDTA vial and plain vial. Blood smear was examined for malaria parasite within RBCs. Malaria rapid test was done for detection of *Plasmodium* species and Widal test was done for typhoid.
Results: In this study found co-infection of malaria with typhoid was 15.64%. In malarial cases 54.50% were males, while maximum cases (26.92%) were in 21-30 yrs age group. Cases of *P. vivax* was maximum (86.28%) and maximum cases of *P. vivax* (29.42 %) was in 11-20 yrs age group while that of *P. falciparum* (22.22%) was in 11-20, 21-30, 41-50 yrs age group and maximum number (23.60%) of mixed malarial infection was in 31-40 yrs age group, While co-infection of malaria with typhoid was maximum (24.59%) was in 11-20 yrs age group and maximum (53.28%) in females. Maximum (79.51%) cases of typhoid were of *P. vivax.*
Conclusions: Malaria and typhoid co-infection still remain a major public health problem in many developing countries. Concurrent infection with two agents can result in an illness having overlapping symptoms creating a diagnostic dilemma for the treating physician.

Keywords: *Plasmodium vivax, P. falciparum, Salmonella typhi*

INTRODUCTION

Both malaria and typhoid are diseases of epidemiological importance occurring globally. Malaria is a life threatening and mosquito borne illness is caused by Plasmodium genus.[1] As per the World Health Organization report 2015, South East Asian region (SFAR) bears the second largest burden of Malaria (10%), only being next to African region (88%). Malaria caused 214 million infections and 438000 deaths worldwide. Most of them occurred in Africa region (90%) followed by SEAR (7%).[2] Among SEAR India shared two third of burden (66%) followed by Myanmar (18%) and Indonesia (10%).[3] People in endemic areas are at a risk of contracting both infections concurrently.[4]

Malaria and typhoid are common causes of fever. Concurrent infection with two agents can result in an illness having overlapping symptoms creating a diagnostic dilemma for the treating physician.[5] An association between malaria and typhoid fever was first described in the medical literature in the middle of the 19th century and named as typho malarial fever by an

Army Doctor Woodward in 1862 among young soldiers during the American civil war.[6]

Malaria and typhoid usually present similar symptoms particularly at the beginning of typhoid fever.[7] Owing to the fact that it is sometimes very difficult to differentiate clinically the presentation of typhoid fever from that of malaria without laboratory support. Typhoid fever is a systemic infectious disease caused by salmonella serotypes. The species and strains of Salmonella that commonly cause typhoid fever in humans are *Salmonella typhi*, *Salmonella paratyphi* A and *Salmonella paratyphi* B.[8]

It is characterized by an acute illness, the first typical manifestations of are fever, headache, abdominal pain, relative bradycardia, splenomegaly, and leucopoenia.[9] Typhoid is a common worldwide bacterial disease transmitted by the ingestion of food or water contaminated with the faeces of an infected person. Polluted water is the most common source of typhoid transmission. There are about 33 million cases of typhoid annually resulting in 216,000 deaths in endemic areas. The World Health Organization (WHO) identifies typhoid as a serious public health problem with high incidence on children and young adults.[10] Estimated total number of world typhoid fever episode in 2010 was 13.5 million.[11] Typhoid fever also has a very high social and economic impact because of the hospitalization of patients with acute disease and the complications and loss of income during the duration of the clinical illness.[12]

The objective of this study is to determine the prevalence of Malaria, Typhoid fever and their co-infection among febrile patients. Study of prevalence is important to understand and assess magnitude of disease in the community and also to plan better control and prevention strategies.

METHODS

It is a cross sectional study, was done in Central Pathological Lab of Department of Pathology, RMCH, Bareilly and was conducted from September 2018 to December 2018.

Selection criteria

The study included 780 malaria attended in OPD and IPD. Informed consent was taken.

Inclusion criteria

All malaria positive cases were selected during September 2018 to December 2018.

Exclusion criteria

Those suspected cases who were not malarial positive.

Laboratory investigations

Blood sample was collected by venepuncture technique in EDTA vials for malaria and thin blood film were made by method described by Dacie and Lewis and samples were collected in plain vial for widal test.[13]

Parasitological examination

Blood smear stained with Leishmen stain, and examined microscopically under oil immersion lens for the presence of type of malaria parasite (*P. falciparum* or *P. vivax*) within RBCs.

Malaria rapid diagnostic test (Mal Card by J. Mitra and Company Pvt. Ltd.)

- Antigen Histadine release protein II (HRPII) test, for detection of Plasmodium falciparum
- pLDH for any Plasmodium species (*P. vivax*)

Principles (antigen-antibody reaction)

It is an immunoassay based on the sandwich principle. The conjugate contains colloidal gold conjugated to monoclonal anti-pan specific pLDH (parasite lactate dehydrogenase) antibody. The test uses monoclonal anti-Pf, pLDH antibody.

Widal test

The Widal test is a serological technique used to detect the presence of *Salmonella* antibodies in the patient's serum obtained from 5 ml of the patient's venous blood. One drop of positive control is placed on a reaction circle of a glass slide. A 50 µl of physiological saline was placed on the next reaction circle of the glass slide. One drop of the patient's serum is placed to be tested on each of the reaction circles. A drop of the appropriate Widal antigen suspension is added to the reaction circles containing positive control, physiological saline and patient’s serum. The content of each circle is uniformly mixed over the entire circle with separate mixing sticks.

The slides are gently rocked back and forth and observed for agglutination for one minute. Agglutination is a positive test result which indicates the presence of the corresponding antibody in the patient's serum. The serological testing is done in accordance with manufacturer guidelines (ARKRAY Healthcare Pvt. Ltd.).

Statistical analysis was done by SPSS version 21.

RESULTS

Maximum malarial cases (26.92%) were in 21-30 yrs age group and minimum (0.51%) were in 71-80 yrs age group. Maximum (54.50%) were males.

Table 1: Demographic profile.

Variable	Number	%
Age group (in years)		
0-10	78	10.00
11-20	157	20.13
21-30	210	26.92
31-40	142	18.20
41-50	72	09.23
51-60	74	09.49
61-70	43	05.52
71-80	04	00.51
Total	780	100
Sex		
Male	425	54.50
Female	355	45,50
Total	980	100

Table 2: Correlation of demographic profile with typhoid.

Correlation of age group and sex with typhoid				
Age group (in years)	**Widal positive**	**Widal negative**	**Total**	**Chi-square/p value**
0-10	04 3.28%-5.13%	74 11.25%-94.87%	78 10.00%-100.00%	10.761/0.149
11-20	30 24.59%-19.11%	127 19.30%-80.89%	157 20.13%-100.00%	
21-30	29 23.77%-13.81%	181 27.51%-86.19%	210 26.92%-100.00%	
31-40	25 20.49%-17.61%	117 17.78%-82.39%	142 18.21%-100.00%	
41-50	15 12.29%-20.83%	57 08.66%-79.17%	72 09.23%-100.00%	
51-60	12 09.84%-16.22%	62 09.42%-83.78%	74 09.49%-100.00%	
61-70	6 04.92%-13.95%	37 05.62%-86.05%	43 05.51%-100.00%	
71-80	1 00.82%-25.00%	3 00.46%-75.00%	4 00.51%-100.00%	
Total	122 100.00%-15.64%	658 100.00%-84.36%	780 100.00%-100.00%	
Sex				
Male	57 46.72%-13.41%	368 55.93%-86.59%	425 54.49%-100.00%	3.517/0.61
Female	65 53.28%-18.31%	290 44.07%-81.69%	355 45.51%-100.00%	
Total	122 100.00%-15.64%	658 100.00%-84.36%	780 100.00%-100.00%	

122 (15.64%) malarial cases have correlation with typhoid out of which maximum correlation (23.77%) was in 21-30 yrs age group while minimum (0.82%) was in 71-80 yrs age group. Maximum 53.28% correlation of typhoid with malaria was in females. Maximum (29.42%) *P. vivax* cases were in 21-30 yrs age group while minimum (0.06%) were in 71-80 yrs age group. Maximum *P. falciparum* cases (22.2%) were in 11-20 yrs, 31-40 yrs and 41-50 yrs age group and no cases was found in 71-80 yrs age group. Maximum mixed infection cases were found in 31-40 yrs age group and no cases was found in 71-80 yrs age group.

Maximum *P. vivax* (53.94%) cases were in males while equal percentage (50.00%) of *P. falciparum* cases was found in both sexes.

Maximum mixed infection cases (59.55%) were found in males. Maximum correlation of malaria parasite with typhoid (79.51%) was found in *P. vivax* while minimum correlation (4.92%) was found in *P. falciparum.*

Table 3: Correlation of demographic profile with type of malaria parasite.

Correlation of age group and sex with type of malaria parasite					
Age group (in years)	***P. vivax***	***P. falciparum***	**Mixed**	**Total**	**Chi-square/p value**
0-10	67 09.96%-85.90%	01 00.06%-1.28%	10 11.24%-12.82%	78 10.00%-100.00%	0.051/23.625
11-20	134 19.91%-85.35%	04 22.22%-2.55%	19 21.35%-12.10%	157 20.13%-100.00%	
21-30	198 29.42%-94.29%	03 16.67%-01.43%	09 10.11%-04.29%	210 26.92%-100.00%	
31-40	117 17.38%-82.39%	04 22.22%-2.82%	21 23.60%-14.79%	142 18.21%-100.00%	
41-50	58 08.62%-80.56%	04 22.22%-5.56%	10 11.24%-13.89%	72 09.23-100.00	
51-60	62 09.21%-83.78%	01 05.56%-01.35%	11 12.36%-14.86%	74 09.49%-100.00%	
61-70	33 04.90%-76.74%	01 05.56%-02.33%	09 10.11%-20.93%	43 05.51%-100.00%	
71-80	04 00.06%-100.00%	00 00.00-00.00	00 00.00-00.00	04 00.51%-100.00%	
Total	673 100.00%-86.28%	18 100.00%-2.31%	89 100.00%-11.41%	780 100.00%-100.00%	
Sex					
Male	363 53.94%-85.41%	09 50.00%-02.12%	53 59.55%-12.47%	425 54.49%-100.00%	0.563/1.148
Female	310 46.06%-87.32%	09 50.00%-02.54%	36 40.450%-10.14%	355 45.51%-100.00%	
Total	673 100.00%-86.28%	18 100.00%-02.31%	89 100.00%-11.41%	780 100.00%-100.00%	

Table 4: Correlation of type of malaria parasite with typhoid.

Type of malaria	Widal positive	Widal negative	Total	Chi-square/p value
P. vivax	97 79.51%-14.41%	576 87.54%-85.59%	673 86.28%-100.00%	7.236/0.027
P. falciparum	06 04.92%-33.33%	12 01.82%-66.67%	18 02.31%-100.00%	
Mixed	19 15.57%-21.35%	70 10.64%-78.65%	89 11.41%-100.00%	
Total	122 100.00%-15.64%	658 100.00%-84.36%	780 100.00%-100.00%	

DISCUSSION

In this study authors found maximum 26.92% malarial cases were in age group 21-30 year age group, followed by (20.13%) 11-20 year age group, (18.20 %) 31-40 year and least (00.51%) in 71-80 year age group. Similar findings were observed by Ukaegbu et al highest malarial cases (18.33%) 20-29 age group and lowest (1%) among ≥60 years. Archibong et al found highest malaria cases (35.15%)31-45 year age group and lowest (02.48%) 61-75 age group. Gupta et al (56%) 15-40 year age group, (38%) 18-30 year age group. Jairajpuri et al reported (38.20 %) 21-30 year age group, (20.00%) 31-40 year age group, (2.6%) 61-80 year age group.[14-17] Khuraiya et al found (34.61%) 21-30 years age group while Gill et al found maximum (43.33%) were under the age of 20 years.[18-19]

Age distribution of typhoid cases

Out of total 780 malarial cases we found 122 (15.64%) correlation with typhoid and maximum (24.99%) 11-20 years group followed by (23.77%)21-30 years age group and least (00.82%) 71-80 years age group. Similar finding was observed by Odikamnoro et al (24.86%) 10-19 years age group followed by (17.92%) 20-29 years age group.[20]

In contrast Ukaegbu et al found highest frequency (32.35%) 20-29 years age group, Archibong et al found (41.03%) 31-45 years age group.[14,15]

Sex distribution

Out of 780 malarial patients 54.50% were males while 45.50% were females. Ahmad et al reported 52% males and 48% females, Gill et al found 63.33% males and 36.66% females, Gupta et al found 65.22% males and 34.78% females, Aundhakar et al in their study found 67% males and 33% females, Jairajpuri et al reported 69% males and 31% females, Kalavathi et al found 77.15% males and 22.85% females.[16,17,19,21-23] The males thought to be at a higher risk due to more outdoor activity and less protection from mosquito bites. In contrast Ukaegbu et al found more malarial cases in female 56.17% than in males 43.83%, Odikamnoro et al also found more malarial cases in males (56.84%) than in females (43.16%). Archibong et al found 51.98% in females and 48.02% in males.[14,15,20]

Sex distribution of typhoid cases

Authors found among typhoid cases 56.72% males while 43.28% females. Similar finding by Odikamnoro et al 54.34% males and 45.66% while Ukaegbu et al found higher among males (61.76%) and 38.24% in females.[14,20] Archibong et al also found higher prevalence of typhoid fever among males than females. Vats et al also found higher prevalence of typhoid in males as compared to females.[15,24]

Type of malaria

Out of 780 cases of malaria we found 86.28% cases of *P. vivax*, 02.31% cases of 1 and 11.41% mixed infection. Similar finding by Jairajpuri et al *P. vivax* (87.74%), *P. falciparum* (03.77%) and mixed infection (08.49%). In contrast *P. vivax* 57.14%, 56.51%, 51.69%, 41%, 40% and 28.7%, *P. falciparum* 37.14%, 39.13%, 01.12, 59%,50% and 70.6% and mixed infection 5.72%, 4.34%, 47.19%, 00.90% and 10% by Kalavathi et al, Gupta et al Faseela et al, Patel et al, Kashikunti et al and Agravat et al, respectively.[16,17,23,25-28]

Table 5: Types of malaria

	Present study	Jairajpuri et al[17]	Kalavathi et al[23]	Gupta et al[16]	Faseela et al[25]	Patel et al[26]	Kashikunti et al[27]	Agravat et al[28]	Ahmad et al[21]	Faseela et al[25]
P vivax	86.28%	87.74%	57.14%	56.51%	51.69%	41%	40%	28.7%	11%	51.69%
P. falciparum	02.31%	03.77%	37.14%	39.13%	01.12%	59%	50%	70.6	57%	01.12%
Mixed infection	11.41%	08.49%	05.72%	04.34%	47.19%	00.90%	10%	-	32%	47.19%

Incidence of co-infection of typhoid with type of malaria

In this study we found 15.64% malarial cases were having Widal positive. Similar findings (15.38%), (14.9%) were reported by Samal et al and Abd Elseed et al respectively.[29,30] Higher rate of co-infection (42.42%) was noted by Dennis et al.[31] In this study we found typhoid with *P. vivax* 79.51% cases, 04.92% with *P. falaciparum* and 15.57% with mixed infection. Due to paucity of data we have not found any study which shows correlation of type of malaria with typhoid.

CONCLUSION

Authors found maximum (26.92%) malarial cases in the 21-30 years age group and least cases (00.51%) in 71-80 years age group, 54.50% in males and 45.50% in females, co-infection with typhoid were found in15.64% malarial cases with maximum 24.59% in 11-20 years age group and least 00.82% in 71-80 years age group, while 56.72% in males. Maximum *P. vivax* cases 19.91% were in 21-30 years age group, 22.22% *P. falciparum* cases were in 11-20, 31-40 and 41-50 years age group and again maximum 23.60% mixed malarial infection in 31-40 years age group. while maximum malarial cases of *P. vivax*, *P. falciparum* and mixed infection are in males 53.94%, 50.00% and 59.55% respectively. Correlation of malaria with typhoid again found maximum (79.51%) in *P. vivax* because typhoidal salmonella antibodies are known to cross-react with other antigen including those from non-typhoidal Salmonella and malaria antigens, the use of Widal test as a diagnostic tool in patients with malaria leads to misleading results, cross reaction can occur as a consequence of latent and post infectious diseases prevalent in the tropics.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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