

## ORIGINAL ARTICLE

## THE QUANTITATIVE EVIDENCE OF MALARIAL TRANSMISSION AND ITS ASSOCIATES IN BAHAWALPUR, PAKISTAN

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**Background:** Malaria transmission is an extremely complex condition that is manifested differently in different parts of the world. In Pakistan, malaria is still endemic in many areas. *Plasmodium vivax* and *Plasmodium falciparum* are identified to be the most prevalent species of malaria in Pakistan. A great deal of work regarding malarial transmission is available at regional level in Pakistan but the evidence of malaria with its associates in Bahawalpur is scarce. The present study was planned to see the pattern of malarial transmission in the city of Bahawalpur, Pakistan. **Methods:** In this cross-sectional study data on 1623 subjects was collected. Giemsa stain thick and thin blood films were used as diagnostic tools for malarial transmission. Bivariate statistical analysis in addition was employed to identify the associates of malarial prevalence. **Results:** Out of 1623 subjects screened, 70 (4.3%) were found infected. *Plasmodium vivax* was seen in the majority 61 (77.2 %). *Plasmodium falciparum* was the second common species identified in 16 (22.8%) cases. As expected place of residence, window screening, malarial knowledge and behaviours of sleeping were seen to be significant associates of malarial transmission in Bahawalpur. **Conclusion:** The findings revealed that Bahawalpur falls in the category of low to moderate level malarial transmission as compared to other regions of Pakistan. *Plasmodium vivax* was the commonest type of malaria diagnosed in Bahawalpur. Geographic location, house safety, malarial knowledge, and behaviour of sleeping are the highly significant associates of malarial transmission in Bahawalpur.

**Keywords:** Bivariate analysis; Malaria; Plasmodium

J Ayub Med Coll Abbottabad 2015;27(1):164-7

### INTRODUCTION

Malaria is one of the most ancient diseases known to us (pre-dynastic in Egypt as early as 3200 B.C).<sup>1,2</sup> Malaria is an infectious disease transmitted by mosquitoes which is acquired from the bite of the female nocturnal-feeding anopheles species of mosquito. Malaria transmission is an extremely complex condition that is manifested differently in different parts of the world. Malarial incidence in 2004 was estimated to be 350-500 million clinical cases, making it one of the most prevalent and fatal infectious diseases.<sup>3</sup>

Malaria infection is caused by minute parasitic protozoa of the genus Plasmodium. Four types of species namely *Plasmodium falciparum* (PF), *Plasmodium vivax* (PV), *Plasmodium ovale* (PO), and *Plasmodium malariae* (PM) are responsible for malarial transmission.<sup>4</sup> Over 90 percent of malarial infections are transmitted by PF in Sub Saharan Africa. More than two-third of the malaria cases are transmitted in South East Asia. Recently, the incidence of PF is reported to be 0.18 per thousand populations in Pakistan.<sup>5</sup> Two species in addition, *Anopheles culicifacies* and *Anopheles stephensi* are the primary malaria vectors in Pakistan; however, *Anopheles culicifacies* is considered to be the most important vector in the rural areas and *Anopheles stephensi* in the urban areas.<sup>6-8</sup>

According to World Health Organization Regional Office for the Eastern Mediterranean (WHO/EMRO) classification, Pakistan falls in countries with moderate to high malaria burden with weak health system. For controlling malaria spread, Pakistan has long history since 1950s. The major activities includes the malaria control eradication campaign (1961), active member of WHO as a part of global Roll Back Malaria (RBM) programme (1999) and a country wide RBM project in 2001.

According to estimates provided by the Ministry of Health in 2003, a total of 3.9 million fever cases were treated as suspected malaria in public sector hospitals of Pakistan.<sup>9</sup> The prevalence of malaria varies depending on the eco systems of the regions or areas. Pakistan is quite heterogeneous having multi-cultural setups, varying seasons with different echoes, and having dissimilar environments which provide suitable conditions for mosquito breeding. However, previously for malarial transmission, studies have been conducted in different regions in Pakistan. For instance, a five year based study conducted in Quetta (from January 1994 to December 1998) showed that 91679 (34.9%) cases have positive smears; out of a total of 263018 subjects. PF was detected in 28166 (30.7%) while PV in 61313 (66.9%); and mixed infection in 2200 (2.3%) subjects.<sup>10</sup>

A great deal of work has been carried out on malaria at regional levels in Pakistan; Abbottabad,

Buner, D.I. Khan, Larkano, Liaquatpur, and Quetta for example.<sup>11-15</sup> The quantitative evidence regarding Malaria in Bahawalpur is strongly scarce in the literature. Therefore, the ultimate objective of this paper is to determine malarial transmission in urban areas of Bahawalpur.

**MATERIAL AND METHODS**

This study utilizes data on 1623 subjects systematically selected. This cross sectional study was conducted between January and June 2008 at 18 union councils in Bahawalpur City. Every 10th subject for screening after getting the suggestive symptomology of malaria from subjects was included. In the clinical examination process, blood samples using thick slide procedure were collected. Thick smear was stained by Giemsa’s stain. Slide was studied under microscope and in addition the status of malarial parasite was noted as positive or negative. During this diagnosis procedure the parasites or species identifications using thin slides were further quantified in two categories namely: PF and PV. In addition, through a structured questionnaire, the subject’s demographic (age, gender), geographic location (residence: urban, slums), socioeconomic (monthly income, type of house), environmental (information regarding stagnant water near house), house safety (window, door and house screening status; information regarding insecticides spray), knowledge of malaria (awareness, mosquito bite, source of prevention) and behavioural (net use, habit of sleeping at night, use of repellents and smoke) characteristics were collected.

For quantitative evidence about malarial transmission and its associates, bivariate statistical analysis in connection with Chi-square test of independence was employed. Odds ratios (OR) with 95 percent confidence intervals (CI) were also reported in results. SPSS version 20 was used for analysis.

**RESULTS**

A total of 1623 cases were screened. A comparative distribution of malarial transmission in Bahawalpur and other regions of Pakistan are shown in table-1. In terms of malarial infection statistics, the regions are shown in ascending order of malarial transmission (Table-1). Seventy subjects (4.3%) were found infected in Bahawalpur (Table-1).

Regarding malarial species, the percentage distribution according to species and region is shown in table-2. The infection of PV (77.2%) was found to be high as compared to PF infection (22.8%) in Bahawalpur. Notably, the PV infection in Bahawalpur was found to be high as compared to other regions of Pakistan shown in table-2.

The association between selected demographic, geographic, socioeconomic, environmental, house safety, malaria protection

behaviour and transmission of malaria are shown in Table-3. Probability values (*p*-values) for significant association with degrees of freedom (df) are given with in parenthesis against each variable in table-3. Malarial transmission with gender is found to have no statistical association (*p*-value: 0.064). It can be concluded that malarial transmission is not gender-specific in Bahawalpur. As expected, spread of malaria has a significant association with the residential location. More explicitly, malaria transmission is twice (OR: 1.95; CI: 1.16–3.28) more in areas of substandard housing as compared to those who living in good areas. Alternatively, by looking at the individual cases of malarial transmission, this significance is confirmed: malarial transmission cases in slums (49 cases) are more than double as compared to malaria diagnosed in good housing urban locality. Malaria transmission is not bound to poor and construction pattern of the houses (see *p*-values). Alternatively, it can be said that income is a must for every human related phenomenon and income is directly or indirectly related to human daily life. But in one to one association of malarial transmission among Bahawalpur residents income turn out to be insignificant. As expected, house safety including windows, door screening and insecticides spray were significantly associated with malarial transmission in Bahawalpur (see *p*-values). Finally, the attitudes of sleeping including use of bed net, repellents, smoke and place of sleeping are significantly associated with malarial transmission in Bahawalpur.

**Table-1: Distribution of malarial transmission in Bahawalpur and other regions from multiple sources, Pakistan**

Region	Total	Negative	Positive	Infection (%)
LiaquatPur*	183028	182266	762	0.4
Larkano	87617	86143	1474	1.7
Bahawalpur	1623	1553	70	4.3
Buner	1020	950	70	6.9
Abbottabad	1994	1849	145	7.3
D.I.Khan	490	392	98	20.0
Quetta**	263018	171339	91679	34.9
Overall	538790	444492	94298	17.5

\*estimates are based on four year screening (2001–2004),

\*\*estimates were based on five years screening (1994-1998)

**Table-2: Percentage distribution of malarial species in Bahawalpur and other regions from multiple sources, Pakistan**

Region	Total	PF (%)	PV (%)
LiaquatPur*	762	15.1	84.9
Larkano	1474	52.8	47.2
Bahawalpur	70	22.8	77.2
Buner	70	84.3	15.7
Abbottabad	145	24.1	72.4
D.I.Khan	98	58.2	40.8
Quetta**	91679	66.9	30.7

PF: *Plasmodium Falciparum*, PV: *Plasmodium Vivax*, \*estimates are based on four year screening (2001-2004)

\*\*estimates were based on five years screening (1994–1998)

**Table-3: Responses on malarial transmission by background characteristics, Bahawalpur, 2008-09, (n = 1623)**

Characteristics	Total	Malarial transmission		OR (95% CI)	p-value
		Negative	Positive		
<b>Demographic factors</b>					
Male (ref)	868	823	45	0.62 (0.38-1.03)	0.064
Female	755	730	25		
<b>Geographic factors</b>					
Urban (ref)	728	707	21	-	
Slum	895	846	49	1.95 (1.16-3.28)	0.011
<b>Socioeconomic factors (Income PKRs 000 &amp; Type of house)</b>					
<10	1090	1036	54		0.178
10-20	424	412	12		
20+	109	105	04		
Kacha (ref)	541	511	30		
Pacca	1082	1042	40	0.65 (0.40-1.06)	0.084
<b>Environmental factor (fresh stagnant water near house)</b>					
No (ref)	1429	1367	62		
Yes	194	186	08	0.95 (0.45-2.01)	0.89
<b>House safety factors (screening &amp; spray)</b>					
Door screening: No (ref)	1379	1321	58		
Yes	244	232	12	1.17 (0.62-2.23)	0.26
Windows screening: No (ref)	838	792	46		
Yes	785	761	24	0.54 (0.33-0.90)	0.016
Overall house: Yes (ref)	177	169	08		
No	1446	1384	62	0.95 (0.45-2.01)	0.021
Insecticides spray: Yes	242	238	04	0.34 (0.12-0.93)	0.027
No (ref)	1381	1315	66		
<b>Malaria knowledge (awareness, bite &amp; source of prevention (sp))</b>					
Awareness: No*	133	120	13		
Yes	1490	1433	57	0.37 (0.2-0.69)	0.01
Mosquito bite: No (ref)	133	121	12		
Yes	1490	1432	58	0.41 (0.21-0.78)	0.005
Sp: No	874	850	24		
Yes (ref)	749	703	46	2.31 (1.41-3.83)	0.001
<b>Behavioural factors (net use, body covering, place of sleeping, use of repellents &amp; use of smoke)</b>					
Net use: No (ref)	183	167	16		
Yes	1440	1386	54	0.41 (0.23-0.73)	0.02
Body: No (ref)	188	180	08		
Yes	1435	1373	62	1.02 (0.48-2.16)	0.002
Sleeping: outdoor ref)	321	275	46		
Indoor	1302	1278	24	0.11 (0.07-0.19)	0.000
Repellents: No*	1201	1139	62		
Yes	422	414	08	0.36 (0.17-0.75)	0.004
Smoke: No (ref)	1023	966	57		
Yes	600	587	13	0.38 (0.2-0.69)	0.001

OR: odds ratio; CI: confidence interval; \*: reference category (ref)

## DISCUSSION

Epidemiological data from different regions of Pakistan is still scarce to exactly estimate the incidence of malarial transmission. The present study contributes to update the regional epidemiology of malarial infection in Pakistan. Bahawalpur has been taken as the case for disease epidemiology by keeping in view the climate of Bahawalpur which is characterized by a long hot dry summer (March-October) with very little rains. The present investigation in Bahawalpur adds to the credibility of the previously conducted studies in other regions of Pakistan.

Comparing our results with other studies conducted in different regions, Bahawalpur ranks third in terms of malarial transmission as compared to LiaquatPur<sup>15</sup>, Larkano<sup>14</sup>, Buner<sup>11</sup>, Abbotabad<sup>12</sup>, D.I.Khan<sup>13</sup> and Quetta<sup>10</sup>. Diagnosis of the species of malaria is acute for its effective and curative treatment as resistance to chloroquine and drugs<sup>16</sup>. Regarding malarial parasites, PV and PF were detected to be the commonest type of malarial species in Bahawalpur; mixed infection in addition was also detected in this study but it is negligible. These findings are quite consistent with other regions, Abbottabad for example.<sup>12,14</sup>

Malarial infection is not gender specific; it can affect both males and females. Malaria transmission is also not bound to affect the poor and the construction pattern of the houses but it has effect on the safety measure of houses in Bahawalpur. The no protective behaviour in response to malarial infection results in severe disease.<sup>16</sup> The protective behaviour including use of bed net or repellents were found to be strong associates of malarial transmission in Bahawalpur.

## CONCLUSION

Malaria is a public health issue in Pakistan. The overall malarial transmission is less than five percent in Bahawalpur. This concludes that Bahawalpur has a low to moderate level of malarial infection. The *Plasmodium vivax* is the predominant species responsible for malarial infection in Bahawalpur. For malarial associations a total of seven determinants including various characteristics namely: demographic, geographic, socioeconomic, environmental, house safety, malarial knowledge and behaviour were statistically examined. The investigation suggests that four out of seven determinants: geographic, window safety, malarial knowledge and behaviour of sleeping are the strong associates of malarial transmission in Bahawalpur.

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