



Short Communication

A Report on Prevalence of Malaria Infection in General Population of Bajaur Agency, FATA, Pakistan

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ABSTRACT

The present study was conducted from January 2013 to December of the same calendar year to cover all the four seasons. The data of this descriptive study was processed and analyzed to investigate the prevalence of malaria and its specific aetiological agents in suspected patients reported to various laboratories of Agency Head Quarter Hospital Khar, Bajaur Agency. In this study, a total number of 9720 suspected individuals were examined; among which 1273 (13.1%) were found to be positive for malaria infection with different *Plasmodium* species in their blood smears. Male population accounts for higher prevalence rate (14.59%) than female (11.24%). The infection was more prevalent in November (21.4%), December (21.1%) and October (18%) and was lowest in the month of April (6.7%). The highest prevalence was recorded in autumn (36.8%) and summer (30.3%) and the lowest rate of infection was observed in spring (10.1%). Majority of the malarial cases were due to *P. vivax*, which was the most common species; *P. falciparum* was less common species and mix cases of infection due to both *P. vivax* and *P. falciparum* were rare. Majority of the people with age group above 15 years were more infected (14.07%). Such a highest incidence and prevalence of the infection revealed that malaria poses a great public health problem in the area, so Government and Health Authorities should pay attention on preventing and controlling the infection.

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Authors' Contributions

AK performed analysis, interpreted the data and drafting of article. RU helped in samples collection and analysis of data. Both authors edited and revised the article.

Key words

Malaria, Infection, Prevalence, Aetiological agents, *Plasmodium*.

Malaria is a major tropical and sub-tropical public health problem associated with high morbidity and mortality through anemia, cerebral complications and other mechanisms. It is the world's most deadly parasitic disease and is caused by protozoan parasites of the genus *Plasmodium* (Okonko *et al.*, 2009; Onyishi *et al.*, 2018). There are 20 species of *Plasmodium* that are parasite on primates but only 4 species infect humans which are *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae* and *Plasmodium ovale*. These malarial parasites are found in all countries with endemicity in tropical zone (Khalili *et al.*, 2009; Kreier, 1980). Of the four species of human malaria, *P. falciparum* and *P. vivax* account for the immense majority of cases. Malaria is identified as a disease affected by climate change and therefore spread to new areas (Niringiye and Doughlason, 2010; Khan *et al.*, 2006).

Malaria is a serious global health challenge and continues to be a threat in the developing countries (Khan *et al.*, 2006). It is endemic in 106 countries and currently accounts for about 300-500 million clinical cases and

over 1.2-2.7 million deaths worldwide each year, out of which more than 90% occur in Africa (Niringiye and Doughlason, 2010; Okonko *et al.*, 2009). Although the load of malaria and the focus of its control is Africa but still it is a significant public health problem in other tropical countries like India, Indonesia, Papua New Guinea and the Amazon region of Latin America (Khan *et al.*, 2006). In Pakistan, the transmission of malaria remains through out the year but become more intense from July to November as mosquitoes are in majority in these months. The stagnant water after heavy rainfalls provide ideal environment for mosquito breeding. *P. vivax* is responsible for majority of the infection cases and *P. falciparum* causes fewer cases. The transmission of *P. vivax* peaking from June to September and again in April to June and the major transmission period for *P. falciparum* is between August and December (Khatak *et al.*, 2013).

Pakistan is among the countries with a perceived growing risk of malaria infection in view of extensive agriculture practice, irrigation network and monsoon rain; in addition to sizeable population movement and complex political situation in certain border areas. In Pakistan, malaria is the second most frequent clinically suspected disease after acute respiratory infection with 1.5 million cases and 50,000 deaths each year. Pakistan has been placed

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in the group of high burden countries of the WHO Eastern Mediterranean Region along with Somalia, Yemen, Sudan, Afghanistan and Djibouti that collectively report more than 95% of regional burden (Kakar *et al.*, 2010). The prevalence reported in different parts of Pakistan: 6.86% in District Buner (Muhammad and Hussain, 2003) and 38.9% in District Bolan (Baluchistan Province) (Yasinzai and Kakarsulemankhel, 2009). In 2011, 325 cases were reported from Khyber Pakhtunkhwa, followed by Punjab (157) and about one-third to one-half of cases were in the three other sites (Khatak *et al.*, 2013). According to Kakar *et al.* (2010), the malaria highly endemic areas have been reported to be from Balochistan, Federally Administered Tribal Areas (FATA) and Sindh. The present study was planned to determine the prevalence of malaria infection in Bajaur agency of FATA and its correlation with socio-demographic and epidemiological features.

Materials and methods

This study was conducted from January 1, 2013 to December 31, 2013 in Bajaur Agency, FATA, Pakistan. Bajaur Agency is a hilly terrain with a population of about 900,000 and is located at an elevation of 972 meters from sea level. The climate of the Agency is extreme having all the four seasons. The temperature in winter ranges from 5-16°C and in summer from 23-36°C. A number of springs and streams flow throughout the Agency that serves as a water source for drinking and irrigation purposes. Different types of crops and vegetables like maize, wheat, rice, tomato, potato, onion, cauliflower etc. are cultivated in the area.

In this study, a total of 9720 malaria suspected individuals of all age groups and both gender having symptoms like high fever, chills, sweating and body aches were examined, who visited various laboratories of Agency Head Quarter Hospital Khar, Bajaur Agency during the study period. Among the suspected individuals, 1961 were reported in age group below 5 years, 2997 in age group of 5-14 years and 4762 in age group of above 14 years. Similarly suspected male individuals were reported to be 5379 and females as 4341. The approval of the study was taken from Research Committee of Department of Zoology, University of Peshawar and the verbal consent was also obtained from all suspected individuals or their parents/guardians and they were assured that the provided information will be kept confidential and will be used for research purposes only.

The blood was collected from them and thick and thin smears were prepared (Awan *et al.*, 2012). The slides were then air dried at room temperature for about 30 min, fixed with methanol for 2-3 min, stained with Giemsa's stain, washed with tap water, dried in air (Sahar *et al.*, 2012) and

examined by a pathologist for any possible *Plasmodium* species under light microscope.

The data was analyzed and processed to investigate the prevalence of malaria as well as prevalence of *P. vivax* and *P. falciparum* in Bajaur Agency in correlation with socio-demographic and epidemiological characteristics.

The Chi-square test was used for determining the association between different age groups and sex of individuals with malaria infection by using the formula:

$$X^2 = \sum (O-E)^2 / E$$

Where, *O* represents the observed frequency and *E* represents the expected frequency under the null hypothesis and is computed by $E = \text{row total} \times \text{column total} / \text{sample size}$. We will compare the value of test statistic to the critical value of $\chi^2\alpha$ with degree of freedom = $(r - 1)(c - 1)$, and reject the null hypothesis if $\chi^2 > \chi^2\alpha$.

Table I.- Total, sex wise and age wise prevalence of malaria infection in Bajaur Agency, FATA, Pakistan.

	Total cases	Positive cases	Percentage
Prevalence			
Total	9720	1273	13.1%
Gender			
Male	5379	785	14.59%
Female	4341	488	11.24%
Age			
< 5	1961	218	11.12%
5-14	2997	385	12.85%
> 14	4762	670	14.07%

Results and discussion

Out of a total of 9720 suspected individuals visiting various laboratories of Agency Head Quarter Hospital Khar from January-December 2013, who were examined for the presence of malarial parasites, 1273 individuals were found positive for malarial parasites in their blood smears, suggesting 13% prevalence in Bajaur Agency during (Table I). A study conducted in Buner District of Khyber Pakhtunkhwa by Muhammad and Hussain (2003), reported 6.86% prevalence rate of malaria. The most likely reason behind the highest prevalence of the disease in Bajaur agency is the low economic level of the people as majority of the people work in rice fields having stagnant water where chances of infective mosquitoes bite are more. Moreover people do not spray insecticides in their residential areas and also they do not use mosquito nets while sleeping in open areas.

The incidence rate of malaria infection increased from June to December and then decreased from January to May (Fig. 1A). The highest incidence was reported in November (21.4%) with 129 positive cases out of 602 suspected cases, followed by December (21.1%) with 114

cases and October (18%) with 181 positive cases. The infection rate was lowest (6.7%) in the month of April with only 5 positive cases. The highest prevalence was recorded in autumn (36.8%) and summer (30.3%) and the lowest rate of infection (10.1%) was observed in spring (Fig. 1B).

Table II shows the species wise prevalence of malaria in different months. It is obvious that malaria cases were mostly due to *P. vivax* that occurs throughout the year, cases due to *P. falciparum* were less common and were rarely due to mix species (*P. vivax* + *P. falciparum*). Not a single case was reported to have infection due to *P. malariae* or *P. ovale*. The frequency of *P. vivax* was maximum in the months of June (96.6%), April (96.4%) and August (95.8%); while that of *P. falciparum* was maximum in the months of October (42%), November (41.9%) and

December (30.7%). A previous study (Muhammad and Hussain, 2003) conducted in Buner also showed more or less similar results. The reasons of maximum cases of the disease in these months and seasons are most likely to be due to high rainfall, presence of stagnant water, high temperature, more cultivation of rice crops, sleeping in open places and less use of mosquito nets. In the study area, there occurs a high rainfall in the months of September, October and November and usually the Summer season is dry and Autumn is rainy due to which to which high population of mosquitoes is likely to occur in these months and seasons that can transmit the *Plasmodium* parasite from infected individuals to healthy people and thus the incidence of infection is increased.

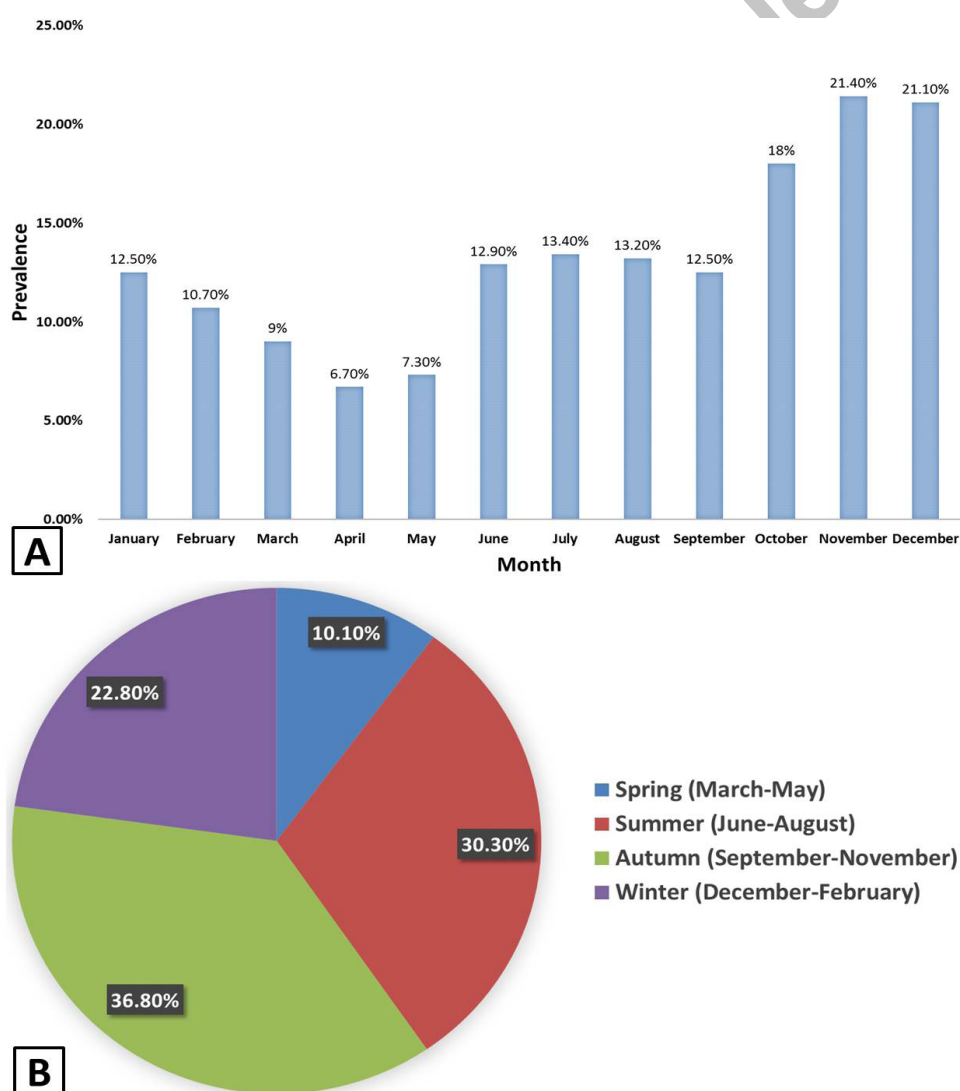


Fig. 1. Month wise (A) and season wise (B) prevalence of malaria in Bajaur Agency during 2013.

Table II.- Mosquito species wise prevalence of malaria in Bajaur Agency, FATA, Pakistan during different months of 2013.

Month	Positive cases	<i>P. vivax</i> (%)	<i>P. falciparum</i> (%)	Mix species (%)
January	112	99 (88.4%)	10 (8.9%)	3 (2.7%)
February	64	60 (93.8%)	4 (6.2%)	0 (0%)
March	5	4 (80%)	1 (20%)	0 (0%)
April	55	53 (96.4%)	1 (1.8%)	1 (1.8%)
May	69	64 (92.8%)	5 (7.2%)	0 (0%)
June	118	114 (96.6%)	4 (3.4%)	0 (0%)
July	126	113 (89.7%)	13 (10.3%)	0 (0%)
August	142	136 (95.8%)	6 (4.2%)	0 (0%)
September	158	132 (83.5%)	26 (16.4%)	0 (0%)
October	181	105 (58%)	76 (42%)	0 (0%)
November	129	72 (55.8%)	54 (41.9%)	3 (2.3%)
December	114	77 (67.5%)	35 (30.7%)	2 (1.8%)
Total	1273	1029 (80.8%)	235 (18.5%)	9 (0.7%)

Table II shows sex-wise and age wise prevalence of malaria. The prevalence rate was higher in male (14.59%) than female (11.24%). Our report is in line with previous studies (Muhammad and Hussain, 2003; Reza and Taghi, 2011). This is due to the fact that male work or sleep in open places without using mosquito nets so are more exposed to the bite of infected mosquitoes; while comparatively female are mostly well covered due to local and Pakhtoon culture. The infection was more prevalent (14.07%) in people with age group above 14 years, followed by the age group of 5-14 years (12.85%) and was less prevalent (11.12%) in children with age below 5 years. It appears that there is some association between sex and age of the patient and malaria infection at a 5% level of significance. A previous study (Sahar et al., 2012) conducted in Muzaffargarh also reported higher malaria cases in age group of 16-30 years. In another study (Yasinzaï and Kakarsulemankhel, 2009) conducted from 2004 to 2006, the maximum prevalence was reported in the age group 11-20 years. The reason for such a highest prevalence in the people of age above 14 years is the low economic level of the people of the area as majority of them are farmers and cultivated rice crops, vegetables etc. which need continuous supply of water that provide habitat for mosquito breeding. Moreover these people don't take proper care of protecting themselves from the bite of mosquitoes and mostly sleep in open places without using mosquito nets, so these factors contributed to the spread of malaria infection in the area. On the other hand, children are restricted to homes and young individuals below 14 years are busy in schooling so comparatively they are less exposed to the bite of mosquitoes.

Conclusion

It is concluded that malaria poses an important public health problem in Bajaur agency, FATA, Pakistan with majority of the cases in the months of November and December due to favourable environmental conditions for the growth of Plasmodium in these months and is higher in males than females. The aetiologic agent of the infection was reported to be *P. vivax* and people with age group of above 15 were found to be more infected who have great exposure to the bite of mosquitoes. The authorities are needed to pay attention on controlling and preventing the disease in the area.

Statement of conflict of interest

Authors have declared no conflict of interest.

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