



## Prevalence and seasonal variation of malaria in human population of Bajaur Agency Near Pak-Afghan border

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### Abstract

Malaria is one of the major health problems in the developing countries including Pakistan. In Pakistan *P. vivax* is most common (70-95%) while *P. falciparum* (5-25%) accounts for severe malaria leading to lethal malaria. This study aimed to find out the prevalence of malaria infection in human population of Bajaur Agency FATA area located near Pak-Afghan border. Total 13994 suspected febrile patients from different Health Care Centers and Agency Head Quarter Hospital of Bajaur Agency were recruited during January 2016 to December 2016. Blood samples from the subjects were tested using blood smear slides method. Data were analyzed using PHstat2 version 2.5 software. Out of 13994 suspected cases, 1666 (11.90%) were found to be positive for malaria infection. Among the positive cases, 1518 (91.12%) showed *Plasmodium vivax* infection, 145 (8.71%) *P. falciparum* infection and only 3 (0.19%) revealed mixed type infection (both *vivax* and *falciparum*). *P. vivax* was the highest (n=278/2040) in August and lowest (n=24/540) in February. The prevalence was higher [n=1022 (61.34%) in males. Prevalence was 58.10% (n=968) in age group 1-20 years and 29.77% (n=496) in age group of 21-40 years. *Plasmodium vivax* malaria dominated all other types of malaria in the region while *falciparum* malaria has also shown an increased level as compared to other parts of the country. High prevalence of *P. falciparum* here reflects the location of study area near afghan border and human migration across the border where *falciparum* malaria is highly prevalent.

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## Introduction

Malaria is one of the major health problems in tropical and sub tropical regions of the World including Pakistan. Malaria is caused by five species of plasmodium parasites (Hussain *et al.*, 2015). *Plasmodium vivax* (causing 64% of cases) and *Plasmodium falciparum* (causing 36% of cases) are the common malarial species in Pakistan (WHO, 2012). Each year 300-500 million cases are reported worldwide with death rate of 1.5 to 2.7 million people (Majid *et al.*, 2016). Malaria is primarily found in the provinces of Khyber Pakhtunkhwa, Balochistan, Sindh and the Federally Administered Tribal Areas and It has been reported that approximately 37% of cases estimated to occur in regions along the borders with Afghanistan and Iran (Kakar *et al.*, 2010).

Malaria cases have been reduced from 244 million in 2005 to 225 million in 2009 due to malaria control programs performed by different organization, and the decrease of 21% estimated death from 2000 to 2009. *Plasmodium vivax* is an altering threat to almost 40% of the world's population, including 132 to 391 million clinical infections annually (Tareen *et al.*, 2012). Africa is the main region of malaria infection, it is also a health issue in other tropical and sub-tropical countries such as Pakistan, India, Indonesia, Iran, Afghanistan and other countries. The spreading and copiousness of malaria is affected by change in environment, migration of people, drug resistance, agricultural practices and access to health care facilities. The disease is estimated to cause at least 50,000 deaths out of an estimated 500,000 reported malaria cases every year (Yasinzai and Kakarsulemankhel, 2009). The estimated number of annual malaria cases in Pakistan is 1.5 million (Yasinzai and Kakarsulemankhel, 2012).

Khyber Pakhtunkhwa has the most positive cases, followed by Punjab. About 50% of refugee camps are in Federally Administered Tribal Areas (FATA). Bajaur agency is one of the seven agencies in FATA. The movement of Afghan refugees across the border between Pakistan and Afghanistan facilitates the transmission of malaria in the FATA. The poor health

facilities and low economic status facilitate the FATA enzootic to malaria (Hussain *et al.*, 2016). FATA lies on the border of two major climatic systems, the monsoon to the east area and the Mediterranean towards the west area. Bajaur agency lies in the northern region of FATA.

It is the smallest agency of FATA, it has a hilly area. According to the 2017 census, the population was 1093684. Bajaur is about 45 miles (72 km) long by 20 miles (32 km) broad, and lies at a high level to the east of the Kunar Valley; to the south of Bajaur is the wild mountain district of the Mohmand. To the east are the hills of Swat and Dir to the north. Being border area, Bajaur is the hub of diverse malarial plasmodium genotypes. Recently no data has been reported from Bajaur Agency regarding malaria prevalence. The present study is aimed to find out the frequency and distribution of plasmodium species causing malaria in the human population of Bajaur Agency.

## Materials and methods

### *Study area and subjects*

For this cross sectional population based study during the year 2016, Bajaur agency as one of the most neglected tribal areas in FATA of Pakistan was selected with respect to malaria prevalence. Suspected febrile patients visiting Agency Head Quarter Hospital Khaar and different Health Care Centers of Bajaur agency were included in the study and after taking their informed consent their blood samples were collected.

### *Microscopic analysis*

Blood smears were prepared by fixing within methyl alcohol and followed by staining in Giemsa stain for 20-30 min. The slides were screened under microscope for the detection of malarial parasites.

### *Data analysis*

For the management and statistical analysis of the data we used PHstat2 version 2.5, to apply Chi-square Test. The P-value below 0.05 was considered as significant.

## Results

In our study a total of 13994 suspected cases of malaria were analyzed where 1666 (11.90%) cases were found positive in which male subjects were 1022

(61.34%) and females were 644 (38.65%). Among the positive cases 1518 (91.12%) were due to *P. vivax* in which males were 956 (62.89%) and females were 564 (37.10%).

**Table 1.** Gender-wise distribution of malaria cases in Bajaur Agency.

Month	Suspected cases	Positive cases	<i>P. vivax</i>	Male	Female	<i>P. falciparum</i>	Male	Female
January	522	27	21	12	9	06	04	02
February	540	24	24	14	10	00	00	00
March	539	38	37	26	11	01	01	00
April	864	84	84	53	31	00	00	00
May	1416	147	147	96	51	00	00	00
June	1355	163	163	107	56	00	00	00
July	1223	196	196	128	68	00	00	00
August	2040	278	272	147	125	06	03	03
September	1485	185	173	113	60	12	08	04
October	1595	258	204	132	72	54	25	29
November	1430	190	134	80	54	56	23	33
December	985	76	65	48	17	11	04	07
Total	13994	1666 (11.90%)	1520 (91.23%)	956 (62.89%)	564 (37.10%)	145 (8.70%)	67 (46.20%)	78 (53.79%)

The *P. falciparum* positive cases were 145 (8.71%) including 42 (28.96%) male subjects and 49 (33.79%) female subjects while 3 cases were found as mixed

infection of both *vivax* and *falciparum*(Table 1).The high rate of *P. vivax* proved to be the most dominant malarial parasite in this region.

**Table 2.** Age-wise distribution of malaria cases in Bajaur Agency.

Age (years)	Positive Cases	Percentage	P value
0-20	968	58.10%	2.6E-145
21-40	496	29.77%	
41-60	184	11.04%	
61-Above	09	0.54%	

The age wise prevalence of the malaria revealed the highest number 968 (58.10%) in the age group of 0-20 years, followed by 496 (29.77%) in age group of 21-40 years, 184 (11.04%) in 41-60 years and 09 (0.58%) in the age group of 60 years and above (Table 2). Month wise prevalence of the disease showed the highest frequency in the month of August as 278 (16.68%) followed by October as 258 (15.48%) while the lowest was observed in the month of February as 24 (1.44%) and in January as 27 (1.62%) (Table 3).

## Discussion

Malaria is one of the major infectious diseases in

human caused by parasites. In the current study the overall prevalence of malaria was observed as 11.90% as it was lower than the prevalence in many previous studies conducted in other parts of the country like Yaseen and Ali, (2015) at Tertiary Hospital Karachi Pakistan reported 18% malaria cases and Hussain *et al.* (2016) reported 29% prevalence from FATA. Similarly Ahmad *et al.* (2013); Khan *et al.* (2013) and Tareen *et al.* (2012) have reported 17.32%, 17.35% and 18.45% respectively, from Dir, Bannu and Quetta. Conversely our prevalence rate was somewhat higher than some studies conducted by various investigators including Majid *et al.* (2016) and Hussain *et al.*

(2015) reported 6.8% and 10.29% prevalence of malaria. In our study the infection rate was higher in male i.e. 1022 (61.34%) than female population i.e.

644(38.65%) as compared to Ansar *et al.* (2010), who reported 58% male and 42% females cases in Gadap region of Pakistan.

**Table 3.** Month-wise distribution of Malaria infections in study population during 2016.

Months	Total	Positive	Male	Female	<i>P. vivax</i>	<i>P. falciparum</i>	Mixed species
January	522	27	16	11	21	5	1
February	540	24	14	10	24	0	-
March	539	38	27	11	37	1	-
April	864	84	50	34	84	0	-
May	1416	147	96	51	147	0	-
June	1355	163	107	56	163	0	-
July	1223	196	128	68	196	0	-
August	2040	278	150	128	272	6	-
September	1485	185	121	64	173	12	-
October	1595	258	158	100	202	54	2
November	1430	190	103	87	134	56	-
December	985	76	52	24	65	11	-
Total	13994	1666 (11.90%)	1022 (61.34%)	644(38.65%)	1518 (91.12%)	145 (8.71%)	03(0.19%)

In another study by Junejo *et al.* (2012), the rate of prevalence was dominant in males as 117(58.5%) on females as 83(41.5%) cases. Species-wise prevalence rate in current study remained almost similar to the previous studies (Ansar *et al.*, 2010; Junejo *et al.*, 2012; Majid *et al.*, 2016; Hussain *et al.*, 2015) across the country and in asian countries. Prevalence of vivax and plasmodium was recorded as 91.23% and 8.70%, respectively, while no case of *plasmodium malariae* and *plasmodium ovale* was detected in our study. Mohammad and Hussain (2003) observed the highest rate of *plasmodium vivax* as 94.16% while Yasinzai and Kakarsulemankhel (2012) and Hailemariam and Gebre (2015) reported lower rate of infection by *plasmodium vivax* as 86.2% and 74%, respectively than our study.

According to Yasinzai and Kakarsulemankhel (2012) and Jan and Kiani (2001), 88.93% and 74% of cases higher than current rate (29%) were observed in people of age 21 years and above. In our study the rate of infection was comparatively very high in the age group of 0-20 58.10%. On the basis of seasonal distribution in our study high number of positive cases was noted in the month of August-November confirming the season of malaria transmission in the

region.

### Conclusion

*Plasmodium vivax* is the most prevalent species in Bajaur Agency followed by *P. falciparum*. *P. vivax* is more dominant in male than female population as compared to *P. falciparum* malaria. Malaria infection is very high in the age group of 0-20 years.

The risk of disease is considerably high during the period from the month of July to November.

### Authors' contribution

SGA designed the study. AS, IU and R carried out the sample collection and research work. MS, MM and MSJ wrote the manuscript and helped in data analysis. SGA and MS reviewed the manuscript.

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### Conflict of interest

The authors declared no conflict of interests regarding the publication of this article.

**References**

- Ahmad T, Hussain A, Ahmad S.** 2013. Epidemiology of Malaria in Lal Qilla. International Journal of Science and Technological Research **2**, 199-202.
- Ansar MM, Nusrat Z, Nadir A, Aminah MM, Rubina K.** 2010. Hematological findings and endemicity of malaria in Gadap region. Journal of College of Physicians and Surgeons Pakistan **20**, 112-116.
- Hailemariam M, Gebre S.** 2015. Trend analysis of malaria prevalence in ArsiNegelle health center, Southern Ethiopia. Journal of Infectious Diseases and Immunology **7**, 1-6.  
<http://dx.doi.org/10.5897/JIDI2014.0147>.
- Holdich, Hungerford T.** 1911. Bajour. In Chisholm, Hugh. Encyclopædia Britannica. 3 (11th ed.). Cambridge University Press. p 226.
- Hussain A, Ahmad T, Jamal SG, Inamullah J.** 2015. Prevalence of Human Malaria Infection in Lal Qilla Pakistan. American Journal of Biomedical Sciences **4**, 9-14.  
<http://dx.doi.org/10.5099/aj150100009>
- Hussain I, Qureshi NA, Afzal M, Shaheen N.** 2016. Prevalence and distribution of human Plasmodium infection in Federally Administrative Tribal Areas of Pakistan. Acta Parasitologica **61**, 537-543.  
<http://dx.doi.org/10.1515/ap-2016-0071>.
- Jan AH, Kiani TA.** 2001. Haematozoan parasites in Kashmiri refugees. Pakistan Journal of Medical Research **40**, 10-20.
- Junejo AA, Abbasi KA, Chand H, Abbasi S.** 2012. Malaria in children at children hospital chandka medical college larkana. Medical Channel **18**, 55-57.
- Kakar Q, Khan MA, Bile KM.** 2010. Malaria control in Pakistan: new tools at hand but challenging epidemiological realities. Eastern Mediterranean Health Journal **16**, S54-S60.
- Khan IU, Shah AH, Awan Z.** 2013. Epidemiology of Malaria in Urban and Rural Areas of Bannu District Khyber Pakhtunkhwa, Pakistan. International Journal of Modern Biology and Medicines **4**, 30-39.
- Majid A, Rehman MU, Ahmad T, Ali A, Ali S.** 2016. Prevalence of Malaria in Human Population of District Mardan, Pakistan. World Journal of Zoology **11**, 63-66.  
<http://dx.doi.org/10.5829/idosi.wjz.2016.11.1.102147>
- Mohammad N, Hussain A.** 2003. Prevalence of malaria in general population of district Buner. Journal of Postgraduate Medical Institute **17**, 75-80.
- Tareen AM, Rafique M, Wadood A, Qasim M, Rahman H, Shah SH, Khan K, Pirkani GS.** 2012. Malaria burden in human population of Quetta, Pakistan. European Journal of Microbiology and Immunology **2**, 201-204.  
<http://dx.doi.org/10.1556/EuJMI.2.2012.3.5>.
- World Health Organization.** 2012. World malaria report 2012. Geneva; 2012.
- Yaseen M, Ali NH.** 2015. Frequency and Seasonal Distribution of *Plasmodium falciparum* and *Plasmodium vivax* Children in Tertiary hospital Karachi – Pakistan. International Journal of Endorsing Health Science and Research **3**, 23-25.
- Yasinzai MI, Kakarsulemankhel JK.** 2012. Frequency of human malaria infection in south-eastern areas of Balochistan. Pakistan Journal of Medical Sciences **28**, 167-170.
- Yasinzai MI, Kakarsulemankhel JK.** 2009. Prevalence of human malaria infection in district Ziarat and Sanjavi, Pakistan. Pakistan Journal of Zoology **41**, 475-482.