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Prevalence of Malaria in District Swat Khyber Pakhtunkhwa, Pakistan

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Abstract

The present study was conducted in year 2016 and 2017 recording all incidences of the infection from May 2016 to April 2017. A detailed description is given below. A cross-sectional survey was conducted from May 2016 to April 2017 in district Swat constituting of seven tehsils. In our study a total of 17,035 suspected cases of malaria were analyzed. Of the total cases 7.83% (1,334) were of *Plasmodium vivax* while 0.0% were of *Plasmodium falciparum*. Mixed infections were not seen in the present study not were any other species observed. Our results show that *Plasmodium vivax* is the dominant malarial parasite and throughout the year it remained prevalent. Seasonal variation was clearly noticed to be one of the factors in effecting the number of incidence, the highest incidence of malarial cases were recorded in the months of August to October i.e., 11.8% (721/6106) due to monsoon rainy season in the area. During the month of January and February the cases were at the lowest i.e., 2.52% (21/833) this can be due to the fact that the temperature is very low and does not provide suitable niche for the vector insect.

Keywords: Malaria; Vectors; *Plasmodium Vivax*; Monsoon; Rainy season; Parasite

Introduction

Despite with the advancement in medical science and technologies, Malaria is still a health problem and a health challenge for whole world and one million death occur annually [1]. Malaria can be transmitted by the bite of female mosquito as well as by the blood transfusion, contaminated syringes and also by placenta [2].

It has been reported that in Pakistan, malaria transmission occur mainly after July-August monsoon [3]. For the control of malaria, anti-malarial drugs are used [4]. A well establish program is working for the control of malaria but still fifty thousand of death occur every year [5]. The use of medicines for treating malaria, the removal of mosquitoes from an area and the prevention from bites are some of the steps used to prevent the malaria. The rate of the infection depends on the density of the population of humans and anopheles mosquitoes in a specific area.

Symptoms of the malaria includes weak health of patients, live in marshy areas, enlargement of spleen fever, chill, sweating, weakness, malaise, nausea, vomiting, diarrhea, headache, backpain, chills cough, pain and fever etc [6]. Symptoms appears right after 8-25 days of bite. The malaria symptoms have similarities with some other diseases like flue, dengue, typhoid, blood poisoning, viral hemorrhagic fever and meningitis due to which it can be confused with these diseases. Sometimes some neurological problems can also be observed like confusion, dizziness, disorientation and comas [7].

The blood infected by malaria parasites leads to anemia, nausea and fever [8]. Anemia or dyserythropoiesis (Defective development of erythrocytes) can occur due to decrease in RBC production and maturation rate and also due to hemolysis cytokine disturbance. Death can occur due to the enlargement of spleen [9]. Paediatric anemia is mainly occurring due to plasmodium infection as the plasmodium infection cause the destruction of RBCs due to which the hemoglobin concentration becomes low. Removal of parasitized and non-parasitized RBCs also leads to lowering the hemoglobin Concentration. Mild anaemia is a condition in which the hemoglobin level becomes less or equal to 11.0 gm/dl [10].

One of the most harmful and common of all parasitic disease in the world is Malaria which is the major cause of morbidity and mortality in developing countries [11]. The incidence, distribution and control of disease depend on the vectors, plasmodium, human host and socio-economic conditions of the area [12]. The vector for the spread of malaria is mosquito [8]. Plasmodium transmits naturally from person to person by the bite of female Anophele mosquito which is known as malarial vector [13]. Transmission of malaria also involve the improper diagnosis and control measures [14].

Malaria is distributed worldwide and it is found in tropical and subtropical areas which include some parts of America, Asia, Africa and pacific Island [15]. Malaria is quiet common in Pakistan and is endemic in 91 districts out of 123 districts of Pakistan [16]. In Pakistan, *Plasmodium vivax* and *Plasmodium Falciparum* are two most common reported parasites responsible for the malaria [4]. Among all the malarial parasites *Plasmodium Falciparum* is dangerous then *Plasmodium vivax* and is found in the whole world. Both *Plasmodium vivax* and *Plasmodium Falciparum* are threatened to life and cause death [17].

There is the existence of genetic variation among *Plasmodium vivax, Plasmodium falciparum* and other species of Plasmodium [18]. There are more than 3,000 mosquito's species out of which 100 species act as a vector for the human diseases [19]. Among these hundred about 25 species of *Anopheles* are found in Pakistan. They are *Anophele sergenti, Anophele pulcherrimus, Anophele subpictus, Anophele dthali, Anophele culicifacies, Anophele pallidus, Anophele turkhudi, Anophele annularis, Anophele fluviatilis, Anophele stephensi, Anophele superpictus, Anophele multicolor, Anophele willmori, Anophele lindesayi, Anophele moghulensis, Anophele theobald,*

Anophele maculates, Anophele claviger, Anophele gigas, Anophele barianensis, Anophele splendidus, Anophele barbirostris, Anophele nigerrimus, Anophele peditaeniatus and Anophele culicifacies [20].

Anophele Culcifacies and *Anophele stephensi* were known to be the first vector species in Pakistan [20-22]. Common vectors of Plasmodium in Khyber pukhtonkhwa are of *Anophele stephensi* and *Anophele culcifacies* [23]. *Anophele stephensi* were found dominant in Punjab province *Anophele culcifacies* appears before the month of September and disappear after September [20-24]. *Anophele stephensi* only found in exclusive regions, it is specific to Pakistan, India and Afghanistan. Most of the malaria is caused by *Plasmodium vivax* in Asia, Central and South America [23]. Round about 60% of Pakistan population live in malaria prevalence regions [25,26]. Children under five years and pregnant women are more prome to the malaria which are the main target population of new malaria control strategy [27].

Malarial parasites are distributed worldwide and can bread in both temporary and permanent water bodies [28]. Certain factors such as elevation, water movement, water condition such as polluted or fresh etc water temperature, vegetation, water sources and many other factors has great effects on the distribution of larva [29]. *Plasmodium vivax* and *Plasmodium falciparum* are more occur in forest areas [30].

Malaria is known to be the second most reported disease according to the public health sector [16]. Malaria affects half billion of people every year living in different countries of Asia, Africa and Latin America [14]. According to a report, in 2013, 3.3 billion people were at risk of malaria, out of which 80% people were affected by malaria and 90% of the infected people were dead due to malaria in Africa [19].

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There are about 109 countries where malaria is endemic where about 3.3 billion people are at risk for malaria [31]. 219 millions of malaria cases and about 6,60,000 deaths have been recorded in 2010 [16]. Out of 5.7 million worldly malarial cases Pakistan had 17% registered cases in whole Eastern Mediterranean Region (EMR) [27]. The prevalence of malaria is high in Balochistan and FATA and have medium rate in Sindh and KPK [16]. Due to floods in last few years the rate of malaria increased in Pakistan due to which more than sixty districts of Pakistan twenty million peoples were affected [5]. In year 2010, 3,00000 cases were reported in Pakistan [32].

Materials and Methods

We designed our experiment in the year 2016 and 2017, recording all incidences of the infection from May 2016 to April 2017. A detailed description is given below. A cross-sectional survey was conducted from May 2016 to April 2017 in district Swat constituting of seven tehsils with the total estimated population of about 2,02,929. The beautiful valley of swat is situated in the north of Khyber Pakhtunkhwa, 35° north latitude and 72° and 30° east longitude.

During the period of Buddhist civilization, Swat was known as "Udyana" which mean gardens or parks. Historians in the time of Alexander the Great identified Swat with Swat River, which was known as Sawastu. The word Sawastu has been derived from the term Swets, which means white, a name well suited to this river as its water is crystal clear. Swat has a diverse variety of plants and animals resources with area about 5,337 square kilometer. Swat is also called the Switzerland of Pakistan. The high mountains, green meadows, and clear lakes attract the tourists from all over the country and the world [33].

Swat lies in temperate zone where the lower areas have moderate summer while the upper areas have refreshing summer. The hottest months are June and July. The winter is relatively severe all over the district during December and January. High rainfall occurs during the winter season. Some rainfall occurs during the months of August and September. We collected the data from various health facilities (2 district hospitals, 4 basic health units and some private clinics).

No personal details were collected in the survey in order to keep the privacy of the contributors. A common laboratory method for blood slide sampling was used and the malarial parasitic species detected were identified using keys developed by Chiodini et al., [34]. Most of the data was collected by the contributing centres if they see the patients with the obvious symptoms of malaria. They have used the passive case detection (PCD) technique.

Results

In our study a total of 17035 suspected cases of malaria analyzed. Of the total cases 7.83% (1,334) were of *Plasmodium vivax* while 0.0% were of *Plasmodium falciparum*. Mixed infections were not seen in the present study not were any other species observed (Table 1). Our result shows that *Plasmodium vivax* was the dominant malaria parasite and throughout the year it remained prevalent in (Figures 1 and 2).

Name of Month	Passive Case Detection (PCD)			Percentage	
	Slides	*Plasmodium vivax (PV)*	*Plasmodium falciparum (PF)*	Slide Positivity Rate (SPR)	Annual Parasite Incidence (API)
May	1639	98	-	5.97%	0.048%
June	1547	106	-	6.58%	0.052%
July	1294	123	-	9.50%	0.060%
August	2326	270	-	11.60%	0.133%
September	1905	242	-	12.70%	0.119%
October	1875	209	-	11.14%	0.102%
November	1836	114	-	6.20%	0.056%
December	986	42	-	4.25%	0.020%
January	690	22	-	3.18%	0.01%
February	833	21	-	2.52%	0.00%
March	919	31	-	3.37%	0.01%
April	1158	56	-	4.72%	0.02%
Grand total	17035	1334	-	92.1%	6.5%

Table 1: Overall prevalence.

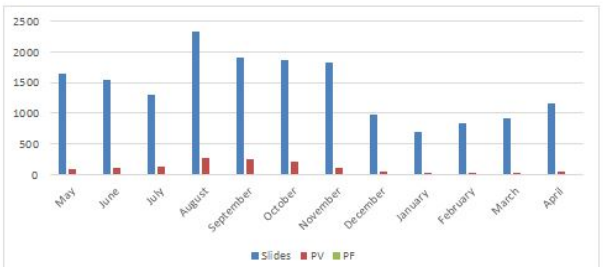

Figure 1: Overall prevalence rate of district Swat.

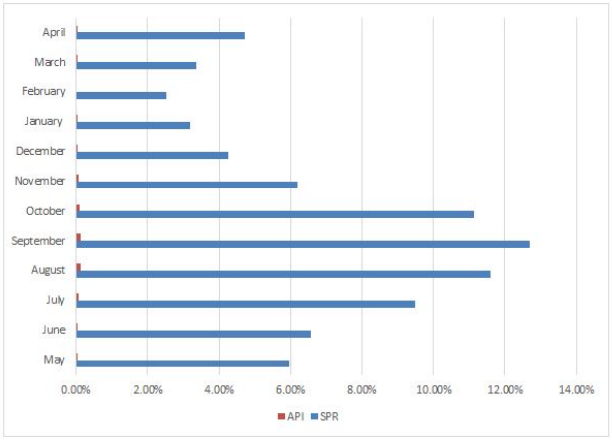

Figure 2: Annual parasitic incidence and slide positivity rate.

Seasonal wise occurrence of malarial parasites

Seasonal variation was clearly noticed to be one of the factors in effecting the number of incidence, the highest incidence of malarial cases were recorded in the months of August to October due to monsoon and rainy season in the area. During the month of January and February, the cases were at the lowest i.e., 2.52% (21/833) this can be due to the fact that the temperature is very low and does not provide suitable niche for the vector insect (Table 2).

Name of Month	Passive Case Detection (PCD)			Percentage	
	Slides	PV	PF	PV	PF
May-July	4480	327	-	7.29%	-
August-October	6106	721	-	11.8%	-
November-January	3512	178	-	5.06%	-
February-April	2910	108	-	3.71%	-
PV-*Plasmodium vivax*, PF-*Plasmodium falciparum*					

Table 2: Seasonal wise occurrence of malarial parasites.

A seasonal variation was also noted with highest incidence in months of August-October of the cases of *Plasmodium vivax* recorded during these months and the lowest in February-April (Figure 3).

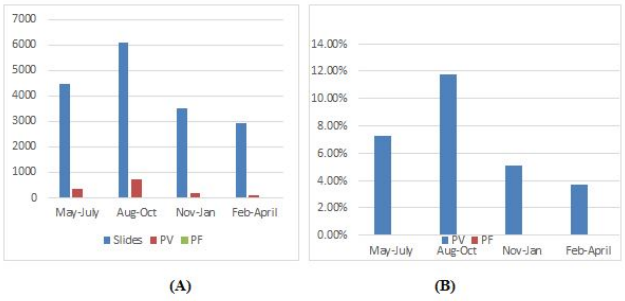

Figure 3: A and B show the seasonal wise occurrence of Malarial parasites.

Month wise prevalence

Month wise Distribution of total suspected cases, positive cases and species wise of malaria Parasites in Swat Khyber Pakhtunkhwa Pakistan during May 2016 to April 2017 (Table 3). Prevalence of malaria cases was highest in the months of August, September and October and lowest in the moths of January and February (Figure 4).

Month	Total no. of cases	Positive cases	Negative cases	*P. vivax*	*P. falciparum*	Mix Species
May	1639	98 (5.97%)	1541 (94.04%)	98 (100%)	-	-
June	1547	106 (6.85%)	1441 (93.14%)	106 (100%)	-	-
July	1294	123 (9.50%)	1171 (90.49%)	123 (100%)	-	-
August	2326	270 (10.29%)	2056 (88.39%)	270 (100%)	-	-
September	1905	242 (20.70%)	1663 (87.29%)	242 (100%)	-	-
October	1875	209 (11.14%)	1666 (88.85%)	209 (100%)	-	-
November	1836	114 (6.20%)	1722 (93.79%)	114 (100%)	-	-
December	986	42 (4.25%)	944 (95.74%)	42 (100%)	-	-
January	690	22 (3.18%)	668 (96.81%)	22 (100%)	-	-
February	833	21 (2.52%)	812 (97.24%)	21 (100%)	-	-
March	919	31	888	31	-	-

		(3.37%)	(96.62%)	(100%)		
April	1185	56 (4.72%)	1129 (95.275)	56 (100%)	-	-
Total cases	17035	1334 (7.83%)	15701 (92.16%)	1334 (100%)	-	-

Table 3: Month wise prevalence.

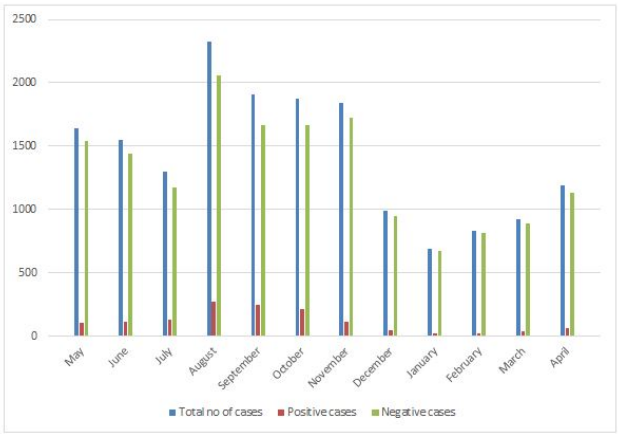

Figure 4: Graph showing the month wise prevalence of the parasites.

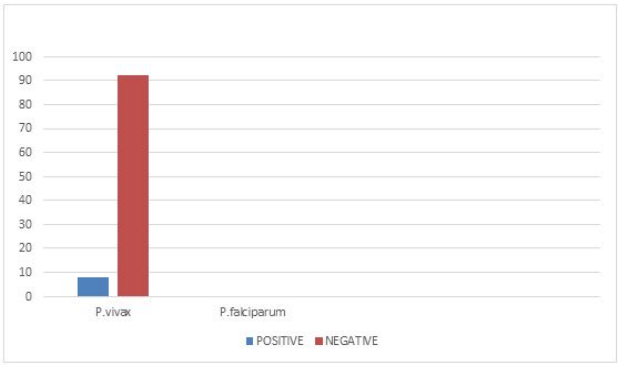

Figure 5: Graph showing specie wise distribution of malarial parasites.

Species	Positive	Negative
P. vivax	7.83%	92.16%
P. falciparum	0.0%	0.0%

Table 4: Species wise distribution.

Species wise distribution

A total of 17,035 blood samples were tested during the present study period of which 1,334 were found infected with malaria parasites. All the total 1,334 positive cases were infected with *Plasmodium vivax* (Table 4). Mixed infection of both species was not found in any blood sample (Figure 5).

Discussion and Conclusion

Malarial infection is one of the serious health issues in Pakistan. Literature suggests that in 2000, 5.9% SPR with 65% cases of *Plasmodium falciparum* and 35% of *Plasmodium vivax* in children across Sindh were observed [35]. These statistics are in agreement with our results where the same species is the dominant agent in causing the disease [36]. Reviews published also corroborate with our results where higher incidence of *Plasmodium vivax* was recorded in comparison to *Plasmodium falciparum*. Not just form the northern areas of Pakistan, but from Karachi various studies have suggested the same [37]. Nizamani et al., [38] studied the data of the Sindh Malaria Control Programme and observed more than 68,000 positive slides for malarial parasites with an average SPR of 2.4%. Some studies suggest that the incidence ratio of *Plasmodium falciparum* is on the rise as recorded in year 2004 and 2005 the rise was from 33% and 37.2% respectively. Annual parasite incidence was unacceptably high and *Plasmodium falciparum* ratio was found to be increasing in many districts of Sindh and in southern Punjab, 41% were found to be infected by the same species.

During the present study, no case of *Plasmodium malariae* and *Plasmodium ovale* was observed. The same was the case in a study done in Multan and other studies has a higher incidence rate of *Plasmodium vivax* (60.5%) was also observed in Kashmiri refugees settled in Muzaffarabad. In the current study the data was collected during May 2016 to April 2017. The month wise distribution of malaria shows that the prevalence rate was higher in the month of September (20.70%), followed by October (11.145) and lower in January (3.18%) and February (2.52%). The similar highly prevalence rate was reported previously, which was 41% in August, 23% in July and 22% in June.

The high number of cases was recorded in the month of September while the low numbers of cases were reported in the month of March. Pakistan is a tropical country where the most of peoples have agriculture profession. In rainfall season the water accumulates and provides better condition for the mosquito breeding. The rate of malaria infection was high in the monsoon season from July to November. The results of our study is comparable with the results of others studies.

In the current study the most common species reported of malaria was *Plasmodium vivax*. Many studies have shown the same results [16,39,40].

According to Hussain et al., [40] reported high cases of malaria in the months of November 68%, December 51%, October 48% and September 35%. The low prevalence rate was recorded in the month of March 3%. Proper treatment, diagnosis, awareness regarding the disease is needed to control and eliminate the malaria infection.

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