SURGE OF MALARIA IN MIANWALI DUE TO FLOODS: PERSPECTIVE FROM A SECONDARY CARE HOSPITAL

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ABSTRACT

Objective: To assess the magnitude of flood related rise in the frequency of malaria, diagnosed at a secondary care hospital, during 2007-2011.

Study Design: Cross sectional descriptive study.

Place and Duration of Study: Pakistan Air Force hospital Mianwali, from 1st Jan 2007 to 31st Dec 2011.

Patients and Methods: Monthly records of hospital laboratory patients with peripheral blood smears, positive for malarial parasites, were counted from 1st Jan 2007 to 31st Dec 2011. Frequencies of *vivax* and *falciparum* malarial cases diagnosed each year during 2007-2009 were compared with the corresponding frequencies during the year of floods i.e. 2010, and the following year i.e. 2011.

Results: When compared with the mean of the annual frequencies during 2007-2009, there was a rise in the total number of malaria cases by 1.3 times in 2010; while next year, i.e. during 2011, the rise was 3.0 times. During the period 2007-2011, vivax malaria cases always peaked during the months of September each year while *falciparum* malaria cases had a spike in the months of November.

Conclusion: Massive floods resulted in a rise in the frequency of malaria cases during flood season and as an after math during the next malarial season. Planning for prevention and control should be done accordingly. Spread of falciparum malaria following the floods demands more efforts towards halting its possible rise in Mianwali district.

Keywords: BT malaria, MT Malaria, *P. falciparum* malaria, *P. vivax* malaria.

INTRODUCTION

Malaria is one of the major global health problems, which affects half a billion people and kills around one million people worldwide[1]. In Pakistan too, malaria is a major health concern, being the second most prevalent reported infectious disease[2]. Both, Plasmodium vivax (*P. vivax*) malaria as well as Plasmodium falciparum (*P.falciparum*) malaria, are prevalent in Mianwali. However, like the rest of the Punjab, Mianwali district is considered to have low malaria endemicity[2]. Mianwali district is situated in the north-west region of the Punjab and has an area of 5,840 square kilometers. It is comprised of three tehsils (sub-districts) viz. Mianwali, Esakhel and Piplan. River Indus traverses through the district, dividing it into cis and trans regions. Current population of Mianwali district can be estimated as 14,50,000 if extrapolated from the figures of last census carried out in 1998, which showed a population of 10,56,620 and a population growth rate of 2.32%[3].

Unprecedented rains and massive floods during latter half of 2010 played havoc in Mianwali district. One of the expected consequences was a sharp rise in the number of cases of malaria[4]. Pakistan Air Force (PAF) hospital Mianwali is one of the two major hospitals in Mianwali district and receives patients from all regions of the district. We carried out a study to assess the magnitude of floods related rise in the frequency of malaria cases, diagnosed in our hospital on the basis of slide positivity, during 2010 and 2011 as compared to previous three years, i.e. 2007 to 2009.

MATERIAL AND METHODS

This was a cross sectional descriptive study based on passive case detection, carried out at PAF Hospital Mianwali. All the patients, with

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peripheral blood smear positive for *P. vivax* or *P. falciparum* malarial parasites, were counted month wise, for each year, from 1st January 2007 to 31st December 2011, from the record of our PAF hospital Mianwali's laboratory. The diagnosis of P. vivax or *P. falciparum* malaria had been made on the basis of microscopy carried out on Leishman stained peripheral blood smears. Each slide had been examined by a laboratory technician and the pathologist. For doubtful cases immuno chromatographic method was also used[5]. Relative frequencies of *P. vivax* malaria cases and *P. falciparum* malaria cases for each year were calculated in terms of percentages. BT/MT ratios were calculated for each year as well as overall for five years. Mean of the total number of cases per year, in respect of vivax and *falciparum* malaria, during 2007-2009 were also found out. Rise in frequencies of malaria cases during the years 2010 and 2011 were compared with the mean of annual frequencies of malaria during the preceding three years by means of trend analysis graph. Descriptive statistics were calculated using IBM SPSS Statistics 19.

Table: Malaria cases diagnosed at PAF Hospital Mianwali from 1st Jan 2007 to 31st Dec 2011 (n=1154).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (%)	BT:MT
2007	BT	6	2	4	9	14	12	20	18	22	19	17	11	154 (96.2%)	25.66
n=160	MT	1	0	0	0	0	0	0	0	1	0	2	2	6 (3.8%)	
2008	BT	3	2	5	7	9	15	18	19	25	20	14	6	143 (96.6%	28.60
n=148	MT	0	0	0	0	0	0	0	0	0	1	3	1	5 (3.4%)	
2009	BT	4	3	7	7	10	12	16	21	26	25	18	9	158 (96.3%)	26.33
n=164	MT	0	0	0	0	0	0	0	0	1	2	2	1	6 (3.7%)	
2010	BT	2	3	3	6	10	15	15	20	48	42	18	10	192 (93.7%)	14.77
n=205	MT	1	0	0	0	0	0	0	0	1	2	4	5	13 (6.3%)	
2011	BT	3	2	4	8	28	38	28	64	108	78	22	18	401 (84.1%)	5.27
n=477	MT	1	0	1	0	1	4	4	3	12	16	18	16	76 (15.9%)	
Total	BT	18	12	23	37	71	92	97	142	229	184	89	54	1048 (90.8%)	9.88
	MT	3	0	1	0	1	4	4	3	15	21	29	25	106 (9.2%)	

BT=Benign tertian or vivax malaria, MT=Malignant tertian or falciparum malaria.

RESULTS

A total of 1154 cases of malaria were diagnosed from 1st January 2007 to 31 December 2011. These included 1048 and 106 cases of *vivax* and *falciparum* malaria respectively. The ratio between vivax and *falciparum* cases varied from the highest of 26.33 in 2009 to the lowest of 5.27 in 2011, with an overall ratio of 9.88 over five years. The results are tabulated in table.

Rise in the frequency of vivax and *falciparum* malaria cases during 2010 and 2011, as compared to the mean of annual frequencies from 2007 to 2009 is shown as trend analysis graph in figure I. Month wise distribution of the sum of all malaria cases from 2007 to 2011 and corresponding distribution patterns for vivax and falciparum malaria cases are shown in fig-2.

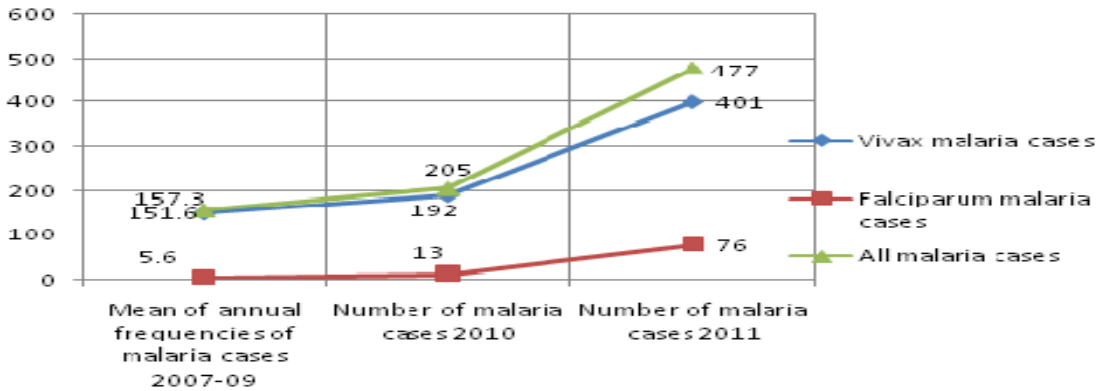
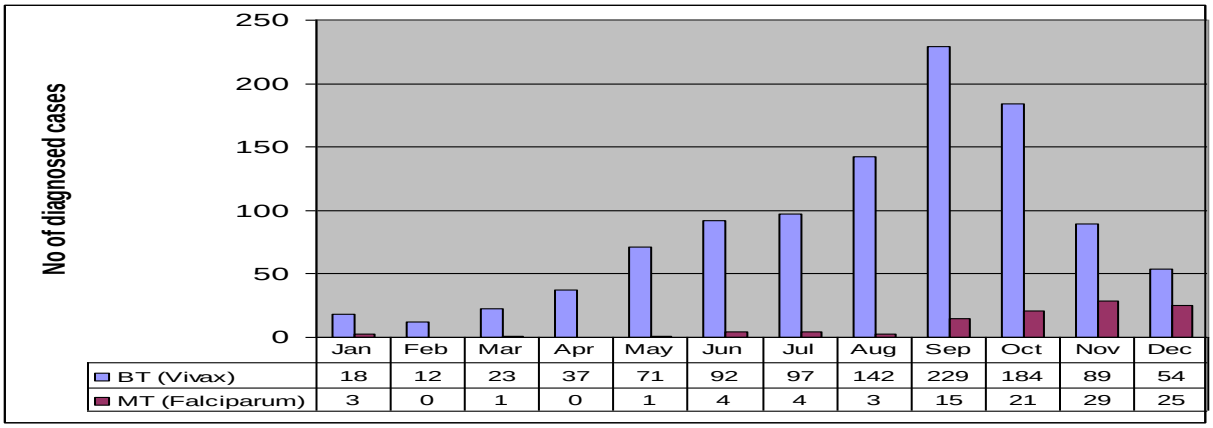


Figure-1: Rise in the frequencies of *vivax*, *falciparum*, and all malaria cases during 2010 and 2011 as compared to the corresponding means of their annual frequencies during 2007-2009.

DISCUSSION

Epidemic of malaria in the wake of flooding is a well known phenomenon[6]. Upsurge in Malaria cases was also expected during and following the massive floods of 2010 in Mianwali[4]. During floods of 2010, the number of vivax malaria cases doubled in the month of September as compared to August, similarly an upsurge was seen in falciparum cases and number of patients of falciparum malaria doubled during the last quarter of 2010 as compared to the corresponding period of 2009.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
BT (Vivax)	18	12	23	37	71	92	97	142	229	184	89	54
MT (Falciparum)	3	0	1	0	1	4	4	3	15	21	29	25

Figure-2: Month wise distribution of the sum of all *vivax* malaria and *falciparum* malaria cases occurring during each month from 2007 to 2011.

The major surge was however seen in the next malaria season, during the year 2011, especially in the latter half. The number of *vivax* malaria cases during 2011 increased by about 2.6 times and the falciparum malaria cases by about 13.6 times as compared to the corresponding annual frequencies seen in pre-flood years.

The reasons for the rise in malaria in 2011 were persisting large areas of inundated land, marshes, pools and puddles along the river Indus even one year after the floods, which served as huge breeding places for the Anopheles mosquito, in the favourable monsoon and post monsoon weather. Displacement of people to camps, poverty and malnutrition were other contributing factors. Absence of electricity for long hours meant no running fans, which also left the affected population more exposed to mosquitoes. Relief activities including medical camps and distribution of anti-malarial medicines also waned off over time after the floods, resulting in tilting of balance in favour of malaria.

Many studies have reported the association of surge in malaria cases during and after the floods. Floods in Costa Rica during 1991 and in Dominican Republic during 2004 led to outbreaks of malaria[6]. In India there have been heavy monsoon rains and floods related epidemics of malaria in Barmer and Gargaon districts in 1990 and 1996 respectively[7-8]. Mozambique floods of 2000 increased the number of malaria cases by factor of 1.5-2 as compared to 1999[9-10]. This study has also highlighted the rise in the incidence of malaria by four to five times after the floods were over, as noted in our study too. In Pakistan, flood waters inundated large areas of Karachi in 2006 after torrential rains, which were followed by a sharp rise in malaria cases[11].

During 2010 and 2011, maximum cases of vivax malaria were seen in the months of September, which was consistent with the pattern seen during the previous three years and over all pattern of the month wise distribution of *vivax* malaria in Pakistan[12]. In case of falciparum malaria, most of the cases were recorded in the months of September to December with a peak in November. The occurrence of falciparum peak after the vivax peak could be due to a longer interval seen in falciparum, between the appearance of gametocytes in the primary case and the appearance of disease in the secondary case, as compared to *vivax*[12]. Moreover the emerging

immunity in the population against vivax causes its peak to plateau before the *falciparum* cases peak[12].

The ratio between *vivax* and *falciparum* malaria was 25.66, 28.60 and 26.33 during 2007, 2008 and 2009 respectively. It decreased to 14.77 in 2010 and 5.27 in 2012. This was due to relatively higher rise in the number of falciparum cases as compared to *vivax* during 2010 and 2011.

Over all *vivax/falciparum* ratio is around 2.3 in Pakistan[2]. Studies have shown *P. falciparum* malaria to be more common in some areas of Balochistan province such as Duki, Harnai and Quetta, but in the rest of the country vivax malaria is more predominant[13,14]. Other studies have reported occurrences of *P. falciparum* malaria epidemics and a rise in the prevalence of *P. falciparum* malaria over the past few years in Khyber Pakhtunkhwa (KPK) province and Federally Administered Tribal Areas (FATA)[12-15, 16].

Cases of falciparum malaria in this study came from Kalabagh (Tehsil Esakhel of Mianwali district) and surrounding areas, which share border with KPK. These areas are also frequented by tribes of nomads from Afghanistan, FATA, and KPK, where *P. falciparum* malaria is quite common. Studies have shown that movement of people, especially those of refugees, affects the epidemiology of malaria in an area[17]. Therefore the areas of Mianwali district bordering with KPK appear to be at risk of facing a rise in the prevalence of falciparum malaria in future.

CONCLUSION

The study shows that massive floods, such as seen in 2010, can result in the upsurge of *vivax* and *falciparum* malaria, not only during that season but also during the next season due to persisting breeding places and warrant planning for the control of malaria accordingly. Since *falciparum* malaria is potentially more dangerous, its spread following the floods demands more focused and committed efforts by the district health authorities in collaboration with national "Rollback Malaria programme", for halting a possible future rise in its prevalence in Mianwali district.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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