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Prevalence of Human Malaria Infection in District Ziarat and Sanjavi, Pakistan*

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Abstract.- This paper reports the prevalence of malarial parasites in the human population of District Ziarat and Sanjavi. Out of a total of 3765 blood samples 26.8% were found positive for malarial parasite. The incidence of *Plasmodium falciparum* was 69.5% and that of *P. vivax* was 30.2%. The incidence was higher (75.9%) in males. Age wise, the prevalence of the disease was 22.2% in Ziarat and 35.2% in Sanjavi for age group 11-20 and 21 years and above the prevalence was 30.6% in Ziarat and 51.5% in Sanjavi in May and September, respectively. No case of *P. malariae* and *P. ovale* was detected.

Key words: Malaria, slide positivity rate, *Plasmodium vivax, P. falciparum.*

INTRODUCTION

Malaria is one of the most devastating diseases in the World. There were 311 million clinical cases of *Plasmodium falciparum* malaria worldwide in 2002, only about 12% higher than the 273 million estimated by the Global Burden of Diseases GBD program (Snow *et al.,* 2005).

According to the World Health Organization (WHO), Pakistan has been classified as a country with moderate malaria prevalence and relatively well-established control programs. Despite this, the disease is estimated to cause at least 50,000 deaths out of an estimated 500,000 reported malaria cases every year (IRIN=Integrated Regional Information Networks, 2007).

In Nawabshah, out of 435 clinically suspected cases of malaria, 144 patients (33.1%) were confirmed by presence *P. falciparum* (Memon, 1997). Abbasi and Sheikh (1997) studied 380 cases of cerebral malaria at Children Hospital, Chandkia Medical College, Larkana and observed 350 cases (92.1%) with *P. falciparum* and 30 cases (7.8%) due to *P. vivax.* Afridi *et al.* (1998) noted 10.4% incidence rate of malaria out of 2500 suspected cases at Akhunabad, Peshawar. Hozhabri *et al.* (2000) observed slide positivity rate 5.9% with 65% cases of *P. falciparum* and 35% of *P. vivax* in children, at Jhangra, Sindh. Bhalli and Samiullah (2001) presented a review of *falciparum* malaria. Jan and Kiani (2001) observed 7% slide positivity with *P. vivax* 6.3% and *P. falciparum* 0.67% among the Kashmiri refugees settled in Muzaffarabad. Akbar (2002) found high incidence of *falciparum* as compared to *vivax* (65% vs 35%) among 100 positive children for malaria at Baqai Medical University, Karachi. Mohammad and Hussain (2003) observed 70 individuals (6.8%) with positive *Plasmodium* infection out of 1020 blood films among general population of District Buner. There was a high incidence of *P. vivax* as compared to *P. falciparum* (5.7% vs 1.0%). Murtaza *et al.* (2004) studied 3.1% slide positivity with 58% *P. falciparum* and 42% *P. vivax* in Sindh. Jamal *et al.* (2005) found high rate of *P. vivax* (62.5%) than *P. falciparum* (36%) in 200 children at Department of Pediatrics, CMH, Attock. Mahmood (2005) diagnosed 10-15% cases as malaria out of 50 to 70 patients seen on daily basis in Karachi. He also observed *P. vivax* to be two times higher than *P. falciparum.* Jalal-uddin *et al.* (2006) investigated malaria in 160 cases of children in Mansehra and observed 142 confirmed cases suffering from *vivax* (92.2%) and 12 with *falciparum* (7.7%). Mahmood *et al.* (2006) studied 348 patients with fever at Civil Hospital and Ankle Sria Hospital Karachi from August 2003 to December,2005 and observed 35% positivity rate, with *P. falciparum* 88.5% and *P. vivax* 9%. Malaria in NWFP was studied by Saleem *et al.* (2006) and observed that cerebral malaria was

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more common in males (64%) and most vulnerable group was pregnant women. Nizamani *et al.* (2006) studied the data of Provincial Malaria Control Program of Sindh and observed more than 68,000 slides reported positive for malarial parasites with an average slide positivity rate of 2.4%. Average *Plasmodium falciparum* ratio in years 2004 and 2005 was 33% and 37.2% respectively. Annual parasite incidence was unacceptably high and *Plasmodium falciparum* ratio was found increasing in many districts of Sindh. Idrees *et al.* (2007) while studying pattern of malarial infection at Ayub Teaching Hospital Abbottabad found that out of 1994 patients screened 145 (7.2%) were found infected. *P. vivax* was seen in the majority (72.4%). *P. falciparum* was the second common species detected in 24.1% cases. Mixed infection was seen in 3.4% cases.

In Balochistan Province too, cerebral malaria is a major community problem. Durrani *et al.* (1997) observed 505 (31.2%) cases positive for *P. falciparum*, out of 1620 comatose patients of both sexes aged 1-75 years. in Quetta. Frequency of malaria increased from 22.1% in 1991 to 44.4% in 1995.

Ali *et al.* (1998) studied atypical presentations of *falciparum* at Quetta and observed 109 (74 males and 35 females) cases positive for *P. falciparum* during May 1996 to November, 1997 with ages between 15-75 years in Quetta. Khadim (2002) observed 665 (11.7%) positive cases of malaria out of 5650 patients at CMH, Zhob during 2000-2001. Cases were seen throughout the year with maximum cases of falciparum malaria during the months of July to November. Yasinzai and Kakarsulemankhel (2003, 2004) investigated the incidence of malaria infection in rural and urban areas of Quetta district and reported higher incidence of *P. falciparum* (65.8%, 55.5%) in 2003 and 2004 and slide positivity rate 16.2% and 15.4% respectively. Malaria Control Program Balochistan (M.C.P.B., 2004, 2005, 2006) observed slide positivity rate 5.7, 1.0, 5.3, 1.1, 9.6, 27.2, 13.3, 7.3, and 13.5% in 2004, 4.7, 0.5, 6.6, 1.5, 12.9, 32.4, 10.2, 7.5 and 13.5% in 2005, 5.7, 3.8, 17.5, 2.5, 42.2, 29.5, 7,6.8, and 12.9% in 2006 in the districts of Lasbella, Qilla Abdullah, Mastung, Khuzdar, Kohlu, Zhob, Kharan, Sibi and Turbat, respectively. Sheikh *et al.* (2005) studied endemicity of malaria in Quetta from January 1994 to December, 1998 and observed 34.8% positive smears, with 66.8% *P. vivax* and 30.7% *P. falciparum.* Yasinzai and Kakarsulemankhel (2007a) studied prevalence of malaria infection in Pak-Afghan border area from July, 2004 to June, 2006 and screened blood smears of 3209 suspected cases. 11.4% cases were positive for malaria; out of 3209 suspected cases, 62.2% *P. vivax* and 37.7% were *P. falciparum.* Incidence of malaria infection in central areas of Balochistan Province: Mastung and Khuzdar districts was studied by Yasinzai and Kakarsulemankhel (2007b) from July 2004 to June, 2006, and observed 24.5 and 28.4% slide positivity out of 3644 and 4208 suspected cases of Mastung and Khuzdar respectively. *P. vivax* (52.6, 69.8%) was more prevalent than *P. falciparum* (47.3, 30.1%) in both the districts. Malaria parasites were identified in the blood smears of suspected patients of malaria in the districts of Barkhan and Kohlu, bordering areas of east Balochistan and noted 32.7% positive smears out of 3340 suspected cases, 52.8% and 47.1% were *P. falciparum* and *P. vivax* respectively (Yasinzai and Kakarsulemankhel, 2008a). An investigation of the incidence of malarial infection in 37 localities of district Zhob, Balochistan, was conducted by Yasinzai and Kakarsulemankhel (2008b) in July, 2004 to June, 2006 and observed 41.8% of slide positivity out of 7748 suspected cases with 51.1% *P. vivax* and 48.1% *P. falciparum.* Yasinzai and Kakarsulemankhel (2008c) studied malaria infection in 15 localities of district Kharan, the desert area of Pakistan, in July, 2004 to June, 2006 and noted 43.4% positive smears out of 5598 suspected cases, *P. vivax* (88.6%) was more prevalent than *P. falciparum* (11.3%).

Frequency of various malaria infections in hottest area of Central Balochistan Province: Duki, Harnai, and Sibi was investigated by Yasinzai and Kakarsulemankhel (2008d) in July, 2004 to June, 2006, and observed 34.2% slide positivity out of 6730 suspected cases with 57.1% *P. falciparum* and 42.8% *P. vivax*. Farooq *et al.* (2008) studied 505 suspected malaria patients from district Khuzdar at C.M.H. Khuzdar, from August, 2003 to December, 2004, and observed higher prevalence of *P. falciparum* (69%) than of *P. vivax* (24%) and 7%

mixed infection. Yasinzai and Kakarsulemankhel (2008e) while investigating frequency of malaria infection in Qallat and Qilla Saifullah districts, in July, 2004 to June, 2006, observed slide positivity rate 14.6, 29.7% out of 3670 and 3396 suspected cases in Qallat and Qilla Saifullah respectively. *P. vivax* was seen in the majority (57.9, 84.2%) in Qallat and Qilla Saifullah districts respectively. However, *P. falciparum* infection was significantly higher in Qallat (42%) than Qilla Saifullah (15.7%). Malaria infection in central and capital area of Balochistan: Pishin and Quetta was investigated by Yasinzai and Kakarsulemankhel (2008f) in July, 2004 to June, 2006 and noted 41.1 and 15.3% positive smear in district of Pishin and Quetta respectively. *P. vivax* was more prevalent (76.5%) in Pishin whereas *P. falciparum* (64.9%) in Quetta district. Malaria infection in bordering areas of east Balochistan Province, adjoining with Punjab: Loralai and Musakhel districts, was investigated by Yasinzai and Kakarsulemankhel (2009) in July 2004 to June 2006 and found 28.8% positive smear out of 7899 suspected cases with 71.8% *P. falciparum* and 28.2% *P. vivax.* Malaria infection in the district Dera Murad Jamali was studied by Yasinzai and Kakarsulemankhel (2008g) in July, 2004 to June, 2006, and observed 40.4% slide positivity out of 6757 suspected cases of malaria. There was high incidence of *P. vivax* as compared to *P. falciparum* (71.7% vs 28%). Malaria infection in central Balochistan, district Bolan, was investigated by Yasinzai and Kakarsulemankhel (2008h) in July, 2004 to June, 2006. They observed 38.9% slide positivity out of 3709 suspected cases. *P. vivax* was more prevalent (86.2%) than *P. falciparum* (13.7%).

Since, prior to the present study, no comprehensive research work on the frequency of human malaria infection among the patients attending the Government Hospitals and Private Clinics of Ziarat and Sanjavi areas or residing there was ever published, therefore, to fill this gap of knowledge the present investigation on the above mentioned topic was carried out from July 2004 to June, 2006.

PATIENTS AND METHODS

This study was conducted during July, 2004 to June, 2006 by adopting ACD (Active case detection) and PCD (Passive case detection) techniques (Paniker, 2002) in the areas of District Ziarat and Sanjavi to detect malaria cases from amongst those subjects who were suspected to be malaria patients. PCD technique was applied on the patients presenting themselves to a health station with symptoms of shivering and fever or a history suggestive to malaria (Ziarat, 1520; Sanjavi, 1607 subjects). ACD technique was applied by door to door visits on monthly basis with the help of Malik / Head to the persons with sign or symptoms of malaria (Ziarat, 291; Sanjavi, 347) and both thin and thick blood films were prepared. Blood slides were taken back to the laboratory where they were stained in Giemsa's stain following the techniques described by Manson-Bahr and Bell (1987). Identification of species of malarial parasites was made from the keys furnished by Chiodini *et al.* (2001) and Paniker (2002).

RESULTS AND DISCUSSION

Both Passive Case Detection (PCD) and Active Case Detection (ACD) methods were used for detection of malaria cases. In PCD 8 health facilities (1 District Hospital Ziarat, 3 Basic Health Unit and 4 Private clinics) have collaborated. For ACD, 24 visits were conducted during two year study.

A total of 3765 blood smears were prepared from the age groups ranging from 1 year to 21 years and above residing in 4 different localities of Ziarat *viz.* Harnai city, Babian, Nakus, Shahrag (PCD:1520;236+ve: *Plasmodium vivax* 129, *P. falciparum* 107), (ACD: 291; 122+ve: *P. vivax* 79, *P. falciparum* 43) and nine different localities of Sanjavi *viz.* Sanjavi city, Pasra, Torwaam, Old Sanjavi, Regura, Baghao, Shinlaize, Pithao and Kharsang (PCD:1607:479+ve; 29.8%: *P. vivax* 76, *P. falciparum* 401, and 2 mixed infection), (ACD: 347: 173+ve; 49.9%: *P. vivax* 22, *P. falciparum* 151). However, variations were observed among different localities having different environment and hygienic conditions.

Slide positivity rate (SPR), month wise

In Ziarat area (Table I) high SPR of 27.6%

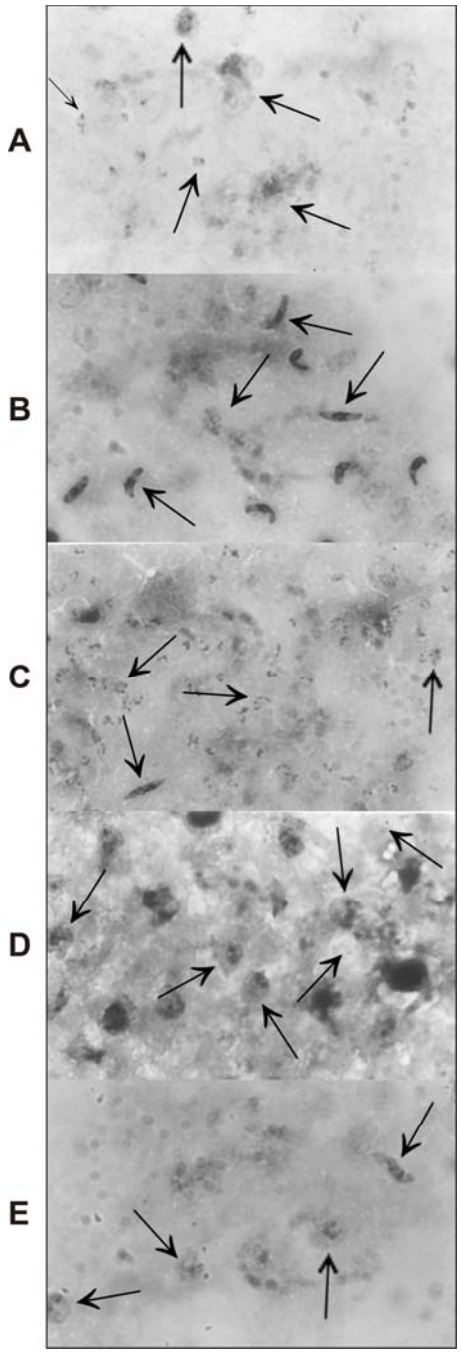

Fig. 1. Gametocyte and ring stage of *Plasmodium vivax* (A) and *Plasmodium falciparum* (B) in blood smear (1000x) of malaria patient of Ziarat and of *Plasmodium falciparum* (C) and *Plasmodium vivax* (D) of malaria patient of Sanjavi. E, gametocytes and ring stages of mixed infection of *P. viax* and *P. falciparum* in blood smear of malaria patient of Sanjavi.

(PCD) and 65.2% (ACD) was observed in June and May whereas in Sanjavi area (Table II) high SPR of 52.4% (PCD) and 78.7% (ACD) was observed in the month of August and April, respectively.

SPR in Sanjavi area (Table II) was 29.8% (479/1607) (PCD) and 49.8% (173/347) (ACD), wherein *P.f.* (Fig.3) was observed to be higher (83.7% PCD), 87.2% (ACD) as compared with that of *P. v.* (Fig.4) 15.8% (PCD) and 12.7% (ACD). Among SPR, children (1-10 years) 34.1% (PCD), 37.9% (ACD), in the age group of 11-20 years 26.7% (PCD), 43.7% (ACD) and in the age group of 21 years and above 30.3% (PCD) and 68.2% (ACD). However, mixed infection (0.1%) of *P. v.* and *P. f.* (Fig.5) was also observed in the present study, as mixed infection of 2.3% (2/86) was observed in Multan district (Yar *et al.*, 1998). High SPR of *P. f.* was also observed in remaining parts of the Province *viz.* Barkhan (60.8%), Duki (78.5%) and Harnai (77.1%), Quetta (64.9%), Loralai (75.7%) and Musakhel (55.1%) by Yasinzai and Kakarsulemankhel (2008a, d, f, 2009) respectively.

SPR (Slide Positivity Rate) by age

In Ziarat area (Table II), the overall incidence SPR was 15.5% (236/1520:15.5%) (PCD) and 41.9% (122/291: 41.9%) (ACD), wherein *Plasmodium vivax* (*P.v.*) (Fig.1) positivity was observed to be higher 54.6% PCD, 64.7% ACD as compared with that of *P. falciparum* (*P.f.*) (Fig.2) 45.3% PCD and 35.2% ACD. Among SPR, children (1-10 years) 9.3% (PCD), 37.5% (ACD), in the age group of 11-20 years 15.8% (PCD), 52.2% (ACD) and in the age group of 21 years and above 18.1% (PCD) and 33.9% (ACD). It is pertinent to be mentioned here that Ziarat is itself a very coldest and snow falling area in winter and thus have practically no malaria, but its majority population in winter used to go for work to the adjoining hottest areas of the province *viz.*, Harnai, Shahrag and Sibi and settles there up to the start of the hottest season and again came back to Ziarat in summer. Therefore, the population gets malarial infection while living in the hottest areas and brings it to Ziarat when they came back. During present study, no case of *P. malariae* or *P. ovale* infection was observed, as the same was also not observed in Multan (Yar *et al.*, 1998). Highest rate of *P. v.*

(60.5%) was also observed by them and highest *P.v.* (90.4%) was also observed in Kashmiri refugees settled in Muzaffarabad (Jan and Kiani, 2001). M.C.P.B. (2004) observed high SPR 88.5% *of P.v.* in Ziarat. High SPR of *P.v.* was also observed in other parts of Balochistan *viz.* Qilla Abdullah and Chaman (62.2%), Mastung (52.6%) and Khuzdar (69.8%), Kohlu (58.9%), Zhob (51.8%), Kharan (88.6%), Sibi (72.3%), Qallat (57.9%) and Qilla Saifullah (84.2%), Pishin (76.5%), Dera Murad Jamali (71.7%), Bolan (86.2%) by Yasinzai and Kakarsulemankhel (2007a,b, 2008a,b,c,d,e,f,g) respectively.

SPR in Sanjavi area (Table II) was 29.8% (479/1607) (PCD) and 49.8% (173/347) (ACD), wherein *P.f.* (Fig.3) was observed to be higher (83.7% PCD), 87.2% (ACD) as compared with that of *P. v.* (Fig.4) 15.8% (PCD) and 12.7% (ACD). Among SPR, children (1-10 years) 34.1% (PCD), 37.9% (ACD), In the age group of 11-20 years, 26.7% (PCD), 43.7% (ACD) and in the age group of 21 years and above 30.3% (PCD) and 68.2% (ACD). However, mixed infection (0.1%) of *P. v.* and *P. f.* (Fig. 5) was also observed in the present study, as mixed infection of 2.3% (2/86) was observed in Multan district (Yar *et al.*, 1998). High SPR of *P. f.* was also observed in remaining parts of the Province *viz.* Barkhan (60.8%), Duki (78.5%) and Harnai (77.1%), Quetta (64.9%), Loralai (75.7%) and Musakhel (55.1%) by Yasinzai and Kakarsulemankhel (2008a,d, f, 2009).

SPR by sex

High SPR of 15.5% (PCD) and 41.9% (ACD) in Ziarat area was observed wherein 72.4% PCD and 76.2% ACD in male and 27.5% PCD and 23.7% ACD in female. In Sanjavi area, high SPR of 29.8% (PCD) and 49.8% (ACD) was noted wherein 71.1% PCD and 75.7% ACD in male and 28.8% PCD and 42.2 ACD in female (Table III).

In conclusion, it is revealed from results that infection with *P. v.* was found to be more prevalent in Ziarat while infection with *P.f.* was observed to be more common in Sanjavi.

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Table I.- Month wise SPR (Slides Positivity Rate) of malaria infection in Ziarat and Sanjavi.

Months	No. of slides examined		Total number of positive		*P. vivax*		*P. falciparum*		Mix Inf.
	PCD*	ACD	PCD	ACD	PCD	ACD	PCD	ACD	PCD
Ziarat									
July, 2004 – 05	160	23	23 (14.3%)	12 (52.1%)	11	8	12	4	
August	168	37	35 (20.8%)	14 (37.8%)	21	6	14	8	
September	156	41	13 (8.3%)	25 (60.9%)	5	19	8	6	
October	141	24	10 (7.0%)	9 (37.5%)	7	5	3	4	
November	123	19	6 (4.8%)	7 (36.8%)	3	6	3	1	
December	76	17	3 (3.9%)	6 (35.2%)	2	4	1	2	
January 05 – 06	59	9	5 (8.4%)	2 (22.4%)	3	2	2	0	
February	75	14	7 (9.3%)	8 (57.1%)	5	6	2	2	
March	94	20	17 (18.0%)	4 (20.0%)	12	3	5	1	
April	120	28	24 (20.0%)	9 (32.1%)	15	5	9	4	
May	153	23	39 (25.4%)	15 (65.2%)	21	10	18	5	
June 05 – 06	195	36	54 (27.6%)	11 (30.5%)	24	5	30	6	
Total	1520	291	236 (15.5%)	122 (41.9%)	129 (54.6%)	79 (64.7%)	107 (45.3%)	43 (35.2%)	
Sanjavi									
July, 2004 – 05	168	29	63 (37.5%)	16 (55.1%)	9	3	54	13	
August	225	40	118 (52.4%)	18 (45.0%)	16	2	101	16	1
September	193	38	93 (48.1%)	26 (68.4%)	9	5	84	21	
October	131	36	27 (20.6%)	11 (30.5%)	10	2	16	9	1
November	58	25	7 (12.0%)	4 (16.0%)	5	1	2	3	
December	75	16	7 (9.3%)	7 (43.7%)	3	0	4	7	
January 05 – 06	58	21	2 (3.4%)	3 (14.2%)	1	0	1	3	
February	71	19	4 (5.6%)	6 (31.5%)	0	2	4	4	
March	123	25	23 (18.6%)	13 (52.0%)	3	2	20	11	
April	156	33	30 (19.2%)	26 (78.7%)	4	3	26	23	
May	184	39	63 (34.2%)	23 (58.9%)	10	1	53	22	
June 05 – 06	165	26	42 (25.4%)	20 (76.9%)	6	1	36	19	
Total	1607	347	479 (29.8%)	173 (49.8%)	76 (15.8%)	22 (12.7%)	401 (83.7%)	151 (87.2%)	2 (0.4%)

*ACD, active case detection; PCD, passive case detection.

Table II. Age wise SPR (Slides Positivity Rate) in Ziarat and Sanjavi.

Sr. No.	Age (Years)	No. of slides examined		Total number of positive		*P. vivax*		*P. falciparum*		Mix infection	
		PCD	ACD	PCD	ACD	PCD	ACD	PCD	ACD	PCD	ACD
Ziarat											
1	1 – 10	320	72	30 (9.3%)	27 (37.5%)	17	20	13	7		
2	11 – 20	524	113	83 (15.8%)	59 (52.2%)	43	37	40	22		
3	21-above	676	106	123 (18.1%)	36 (33.9%)	69	22	54	14		
Total		1520	291	236 (15.5%)	122 (41.9%)	129 (54.6%)	79 (64.7%)	107 (45.3%)	43 (35.2%)		
Sanjavi											
1.	1 – 10	316	87	108 (34.1%)	33 (37.9%)	17	5	91	28	0	0
2.	11 – 20	576	153	154 (26.7%)	67 (43.7%)	20	11	133	56	1	0
3.	21-above	715	107	217 (30.3%)	73 (68.2%)	39	6	177	67	1	0
Total		1607	347	479 (29.8%)	173 (49.8%)	76 (15.8%)	22 (12.7%)	401 (83.7%)	151 (87.2%)	2 (0.4%)	0

Table III.- Sex wise SPR (Slides Positivity Rate) in Ziarat and Sanjavi.

District	No. of slides		Total number of +ve		No. of male +ve							No. of female +ve				
						PCD				ACD			PCD			ACD	
	PCD	ACD	PCD	ACD	Positive	*P. v.*	*P. f.*	Mix. Inf.	Positive	*P. v.*	*P. f.*	Positive	*P. v.*	*P. f.*	Positive	*P.v.*	*P. f.*
Ziarat	1520	291	236 (15.5%)	122 (41.9%)	171 (72.4%)	93	78	0	93 (76.2%)	57	36	65 (27.5%)	36	29	29 (23.7%)	22	7
Sanjavi	1607	347	479 (29.8%)	173 (49.8%)	341 (71.1%)	47	292	2	131 (75.7%)	14	117	138 (28.8%)	29	109	42 (24.2%)	8	34

P.v., *Plasmodium vivax*; *P.f.*, *Plasmodium falciparum.* For other abbreviations see Table I.