



RESEARCH PAPER

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Prevalence of malaria and status of *Plasmodium* spp. in Dir Lower, Pakistan

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Abstract

The present study was conducted to evaluate the prevalence of malaria and status of *Plasmodium* species in the residents of Dir Lower, Pakistan. A total of 2395 blood samples were collected from seven Tehsils of District Dir Lower during March to September 2017. The samples were examined to determine the type of *Plasmodium* species with the help of blood smears under microscope. Out of 2395 samples, 292 were found positive for *Plasmodium* spp. Higher frequency of malaria was found in people aged 1-10 years (14.3%) while lowest frequency was found in people aged 61 years and above (7.3%). The maximum number of cases of malaria were detected in August 2017 (17.46%) and minimum number in March 2017 (9.93%). Highest rate of malaria was found in tehsil Timergara (16%) and lowest rate found in tehsil Samarbagh (7.7%). Malaria prevalence was higher in males (56.8%) compared with females (43.2%). Only two species of *Plasmodium* i.e. *Plasmodium vivax* and *Plasmodium falciparum* were detected in the study cohort. Out of the 292 positive samples, *Plasmodium vivax* was detected in 92.8% of the study cohort while *Plasmodium falciparum* was detected in 7.2% of the studied samples. Malaria was more prevalent in males with high frequency in the month of August. *Plasmodium vivax* was the most abundant species followed by *Plasmodium falciparum*.

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Introduction

Malaria is caused by a protozoan parasite belonging to the genus *Plasmodium* (Snow *et al.*, 2005) and transmitted by female *Anopheles* mosquito and through transfusion of infected blood (Trampuz *et al.*, 2003). Each year 300-500 million cases of malaria are recorded worldwide with 1.5 to 2.7 million deaths with a high frequency in developing countries (WHO, 2015). The common symptoms of malaria in human beings are high fever, and chilliness. The vector and parasite population are both affected by temperature (Ceccato *et al.*, 2005). Malaria mostly occurs in Pakistan in the months of July and August (Donnelly *et al.*, 1997; Rahman *et al.*, 2017). There are five species of malarial parasite, *P. malariae*, *P. falciparum*, *P. vivax*, *P. ovale* and *P. knowlesi* which excessively affect human health (WHO, 2012). *Anopheles culicifacies* and *A. stephensi* are the major vectors for *Plasmodium* (Murtaza *et al.*, 2009). In Pakistan, two common species are *P. falciparum* (26%) and *P. vivax* (74%) (WHO, 2009; Kakar *et al.*, 2010). *P. vivax* is cosmopolitan in the tropical, sub-tropical and some are found in temperate regions of the world (Mendis, 2002). *Plasmodium falciparum* is usually present in warm climates, Middle East, South-East Asia, Central America and Northern Australia (Range *et al.*, 1999). *Plasmodium malariae* is found in Africa, India and Ceylon and rarely in the tropics (Range *et al.*, 1999). *P. knowlesi* is specifically found in timbered areas and Southeast Asia. *P. knowlesi* can be shifted from monkeys to humans by the cut of infected mosquitoes (Hellemond, 2009). Malaria was endemic in the 20th century in Europe and North America (Hulden *et al.*, 2013). Transmission of malaria occurred through female *Anopheles* mosquito which was discovered by a military medical doctor Ronald Ross in 1897 (Francis, 2010). About 460 species of *Anopheles* are found worldwide with 80 species involved in the transmission of malaria with 45 species as serious vectors of the disease in humans (Foster and Walker, 2002). Malaria is more harmful in pregnant women and in children five years old (Lamb, 2012). The present study was aimed to evaluate the prevalence of malaria in Dir Lower, Pakistan with focus on the species of *Plasmodium* involved.

Materials and methods

Study Area

The present study was carried out at District Dir Lower, Pakistan which is located at 34°, 37' to 35°, 07' North and 71°, 31' to 72°, 14' East. It's altitude from the sea level is approximately 823 m (2700 feet). Area of Dir Lower is 1583 square km. The study was conducted in the seven tehsils of Dir Lower, i.e. Timergarah, Balambat, Lalqila, Adenzai Munda, Khall and Samarbagh.

Sample Collection

Blood samples were collected from March to September 2017. The study cohort consisted upon both genders with age ranging from 01 to 70 years. Sample collection was made from individuals having malaria specific symptoms such as nausea, fever, headache, vomiting etc. at Health Care Centers and Hospitals in the seven Tehsils of District Dir Lower. A proforma was prepared for recording the data which included names, gender, age, locality and socio-economic status of the patients.

Preparation of blood smears

For blood sampling, fingers of the patients were cleaned with 70% alcohol and pricked at the tip with a sterilized lancet. First blood drop from the finger was discarded and the next blood drop was placed on the slide. Fixation of the thin smear was done with methyl alcohol. Staining of blood films were carried out according to Russel *et al.* (1963). Same slide was used for the preparation of thick and thin smears. Screening was done under microscope with 100X oil immersion objective.

Rapid Diagnostic Test (RDT)

The blood samples were applied into RDT strip and was then mixed with buffer solution for checking the bands for the type of *Plasmodium* species present.

Results

In the present study, 2395 blood samples (1217 males and 1178 females) were evaluated for the presence of various species of *Plasmodium*. Positive percentage of malaria in various Tehsils was found as Timergara (16%), Lalqila (15.4%),

Khall (13.1%), Munda (12.6%), Balambat (12.2%), Adenzai (7.9%) and Samarbagh (7.7%). Highest prevalence of malaria was found in Tehsil Timergara and lowest in Tehsil Samarbagh (Fig. 1).

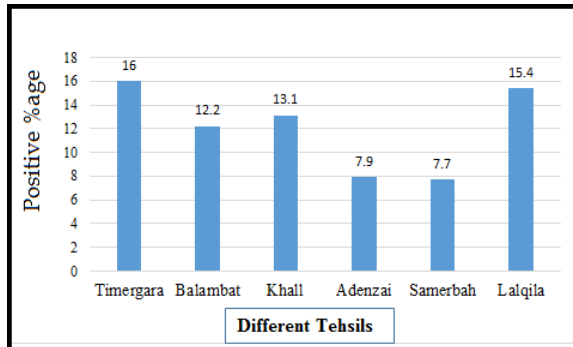


Fig. 1. Tehsil wise prevalence of malaria.

In the studied cohort, 292 (12.1%) were positive for malarial parasites. In males, 166 samples (13.6%) were positive cases while in females, 126 samples (10.6%) were positive for malaria. Tehsil Timergara showed the highest rate of malarial infection of male (18.5%) while in Tehsil Lalqila, malarial infection was higher in females (14.7%). Lowest rate of malarial infection (males (8.5%) and females (6.8%)) was found in Tehsil Samarbagh (Fig. 2).

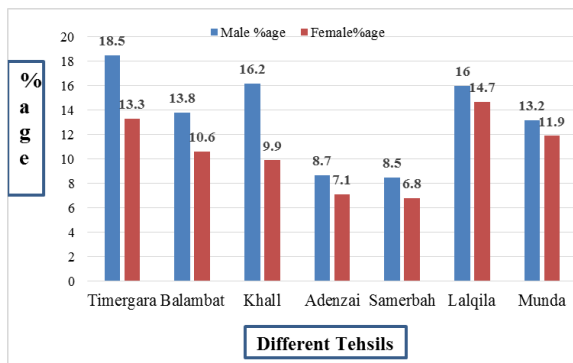


Fig. 2. Gender based prevalence of malaria in different tehsils of Dir Lower, Pakistan.

In males, *P. vivax* was detected in 28 samples while *P. falciparum* was detected in 5 samples. In females, *P. vivax* was detected in 20 samples while *P. falciparum* was detected in 3 samples. Relative prevalence of *P. vivax* and *P. falciparum* is given in Table 2. In children (1-10 years), the prevalence of malaria was high with 14.3% positive percentage and lowest (7.3%) people aged 61 years and above (Fig. 3).

Malarial infection was maximum in August with 51 positive cases (17.46%) and lowest in March with 29 positive cases (9.93%) (Fig. 3).

Table 1. Month wise percentage of *Plasmodium* spp. in Dir Lower, Pakistan.

Month	No. of Positive Slides	Cases	<i>P. vivax</i>	<i>P. falciparum</i>	%age
March	335	29	29	0	9.93
April	339	35	34	1	11.98
May	340	39	37	2	13.4
June	341	40	37	3	13.71
July	348	50	45	5	17.12
August	350	51	44	7	17.46
September	342	48	45	3	16.43
Total	2395	292	271	21	100

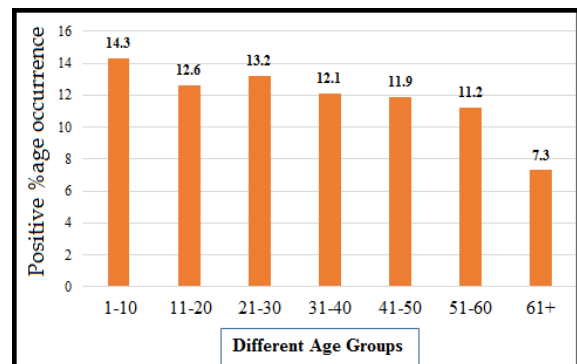


Fig. 3. Prevalence of malaria in different age groups.

Discussion

In the present study, 12.1% of the studied samples were found positive for malaria. Two species of malarial parasite were detected in the present study i.e., *Plasmodium vivax* and *Plasmodium falciparum*. The prevalence of malaria was higher in the present study compared with a previous study carried out in District Bannu, Pakistan (Awan *et al.*, 2012) in District Bannu, Pakistan. The prevalence was however lower compared with a previous study on malaria at Dir Lower where 17.2% of the study cohort was found positive for malaria (Ahmad *et al.* 2013). The differences in the prevalence of the disease are due to the difference in study design, sample size and environmental factors.

In the present study, malaria was found in 56.8% males and 43.2% females. Similar pattern of malaria has also detected by Ahmad *et al.* 2013 in which the intensity of the disease was higher in males (65.24%) and lower in females (34.76%). Irshad *et al.* (2013)

has also reported a higher prevalence of malaria in males (62.12%) and lower in females (37.88%) in District Swat, Pakistan. The higher prevalence in males may be due to the higher rate of exposure of males to mosquito vectors and malarial parasites compared with females.

Prevalence of malaria was highest in August 17.46% of positive cases and lowest in March with 9.93% positive cases (Table 1). *P. vivax* was found as the most prevalent species followed by *P. falciparum* (Table 1). In a previous study, high prevalence was detected in June (23.38%) and lowest in January (8.34%) with *Plasmodium vivax* as the most abundant species followed by *P. falciparum* (Ahmad *et al.* 2013). In Pakistan, most of the studies has shown the presence of two *Plasmodium* species namely *P. vivax* and *P. falciparum*.

High frequency of malarial infection was found below the age of ten-years (14.3%) and lowest frequency of malaria was found in people aged 61-70 years (7.3%) (Fig. 3). Tehsil Timergara showed higher frequency of the disease (16%) and Tehsil Samarbagh with lowest percentage of the disease (7.7%) (Fig. 1).

It has been concluded that *Plasmodium vivax* is the major pathogen of malaria in District Dir Lower, Pakistan. Prevalence of malaria is higher in the month of August. Males are more infected compared with females. Children under 10 years of age are more affected by malaria compared with people aged 61 years and above.

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