

Research Article

Malaria burden in human population of Khanozai, Pakistan

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Abstract

This study was designed to assess and report the frequency of malaria infection in human population of Khanozai, district Pishin a rural area of Balochistan province, Pakistan. The objective of this study was to compare the infection frequency of malarial parasite species causing malaria fever, to detect incidence in different genders and to determine the possible effect of seasonal variation of temperature on malarial incidence. We enrolled total of 958 individuals with clinical symptoms of malaria in this study. Blood samples from these individuals were collected and Rapid immunoassay and microscopic examination was employed to detect malarial infection. Out of 958 blood samples 115 (12.00%) were found positive for malarial parasites. The incidence of *Plasmodium falciparum* was 03 (2.6%) and that of *Plasmodium vivax* 112 (97.3%) while no case of *Plasmodium malariae* and *Plasmodium ovale* was detected. We observed higher incidence of 79 (8.24%) in males as compare to females 36 (3.75%) in relation to total number of samples. This makes 68.69 % infections in male while 31.31 % in females of total positive samples. The incidence of malaria fever increases from colder month of January up to relatively warmer month of June and decreases afterwards. In this study, we observed malarial incidence even in relatively colder Khanozai area. Male were more vulnerable to the malarial incidence probably due to more exposure to malarial vector. While as expected the incidence increase with increase of temperature throughout the year.

Keywords: Immunoassay; Malaria; Pishin; *Plasmodium*

Introduction

Malaria is a life-threatening infectious human diseases caused by parasitic protozoan called *Plasmodium*. It is a serious public health problem with an estimated 219 million cases each year throughout the world and about 660,000 estimated deaths in 2010. The economic burden of controlling malaria is alarming as the annual cost of malaria control programmes for financial assistance of

malaria-endemic countries has been rising from estimated 960 US\$ to 2.5 billion US\$ during 2009–2014 [1].

Malarial is mainly prevailing in tropical and subtropical regions, as temperature and rainfall in these regions are favourable for *Plasmodium* [2]. Pakistan has been categorized by WHO with high malaria burden and transmission in the Eastern Mediterranean region. There is an estimated

annual burden of 1.6 million cases in Pakistan, which make it the second most frequently reported disease after acute respiratory infection (ARI) [3]. According to WHO, the number of confirmed malaria cases reported from 2000 to 2014 in region decreased from 2 million to 1.5 million. However, only two countries Sudan (72 %) and Pakistan (19 %) accounted for 91 % of cases in 2014. Similarly, both the countries Sudan (86 %) and Pakistan (6 %) accounted for more than 90 % deaths due to malaria in 2014 in the region. However, the numbers of deaths from 2000 to 2014 fall from 2166 to 960 [1]. Various factors like uncontrolled migration within country and outside the country (Iran and Afghanistan), urbanization, natural disasters, sudden climatic changes, poor socioeconomic conditions, declining health infrastructure, poor accessibility to preventive as well as curative services and lack of monitoring of drug and insecticides resistance in parasites and vectors respectively has contributed in making malaria a public health problem [4].

Owing to its lethality, the World Health Organization (WHO) in 2007, announced the goal of eradication of malaria in the world [5]. In 2014, 16 countries (Argentina, Armenia, Azerbaijan, Costa Rica, Iraq, Georgia, Kyrgyzstan, Morocco, Oman, Paraguay, Sri Lanka, Tajikistan, Turkey, Turkmenistan, United Arab Emirates and Uzbekistan) were declared to eliminate the malaria [1]. With the efforts of national and international malaria control programmes the number of malaria cases globally decreased by 18%. It demolishes from an estimated 262 million in 2000 to 214 million in 2015. In total, countries with ongoing transmission in 2000 have reduced malaria incidence by >75% in 2015. Similarly, the number of deaths globally due to malaria reduced from an estimated 839000 to 438000 during 2000-2015, which is 48% decline [1]. The transmission of malaria is a seasonal and

mostly occurs in summer after monsoon season.

Among the Plasmodium species *P. falciparum* and *P. vivax* are the most prevalent cause of malaria. *P. falciparum* is the most dangerous parasite with highest rate of mortality [6]. However, *P. vivax* is becoming an increasing risk as it is estimated to have been responsible for 13.8 million malaria cases globally in 2015, and accounted for approximately half the total number of malaria cases outside the Africa [1].

This study was carried out in Khanozai, Pishin district of Balochistan, Pakistan to identify the prevalence of malarial infection in the area along with socio-economic risk factors. This study may be helpful to plan cost-effective interventions for malaria infection.

Materials and methods

Study population

This study was conducted on 958 clinically suspects during a period of 12 months from January 2012 to December 2012 in Khanozai, Pakistan. The clinically suspect from both sexes with minimal clinical criteria of shaking chills, headache, back ache, high fever, fatigue, dizziness, nausea, vomiting, dry cough, muscle pain, and malaise were enrolled in the study.

Location

Geographically Khanozai is located at Latitude 30° 37' 15.64" N and longitude 67° 20' 20.99" E. It is located at the average height of 6457 ft above sea level.

Collection of sample

The history of all malarial suspects was documented. The blood samples were collected aseptically from suspects of malaria with their written informed consent. The samples were processed without delay for screening malarial parasite using rapid routine serological test [2] and microscopic examination of thick as well as thin blood smears slides.

Malaria diagnosis

Rapid immunoassay

Rapid diagnostic test for detection of malarial parasite was performed according to manufacturer's instructions (Standard diagnostic Inc. Korea). In this chromatographic immunoassay presence of *P. falciparum*, *P. vivax*, *Plasmodium ovale*, and *Plasmodium malariae* in whole blood was detected by identifying their specific antigens [7].

Microscopic examination

Thick and thin blood films were used for the microscopic detection of type and stage of malarial parasite/s respectively. Blood films were prepared on glass slides by fixing and staining with Giemsa stain. Thick films were used to identify malarial species based on microscopic features while thin films were used to categorize the density of malarial parasite in patients [8, 9].

Results

In this study, we observed the prevalence of malarial parasites in the human population of Khanozai, Pakistan. Out of total 958 suspected cases 87.99% (843) were negative for malarial parasite. Whereas in total 12% (115) cases were positive for malarial parasite. We found higher rate of malarial incidence in males (8.24%, n=79) as compared to females (3.75%, n=36) (Figure 1). Comparing the different plasmodium species, we observed higher prevalence of *P. vivax* in the suspects of malaria infection. Among the total positive cases, *P. vivax* prevailed 66.97% in males (n=77) and 34.43% in females (n=35) (Figure 2). However, we did not detect any case of *P. malariae* and *P. ovale* (Figure 2). We also look in the seasonal distribution of malarial incidence and found more prevalence of malaria in June (18.2%, n=170) and least in December (0.0%, n=0) (Figure 3).

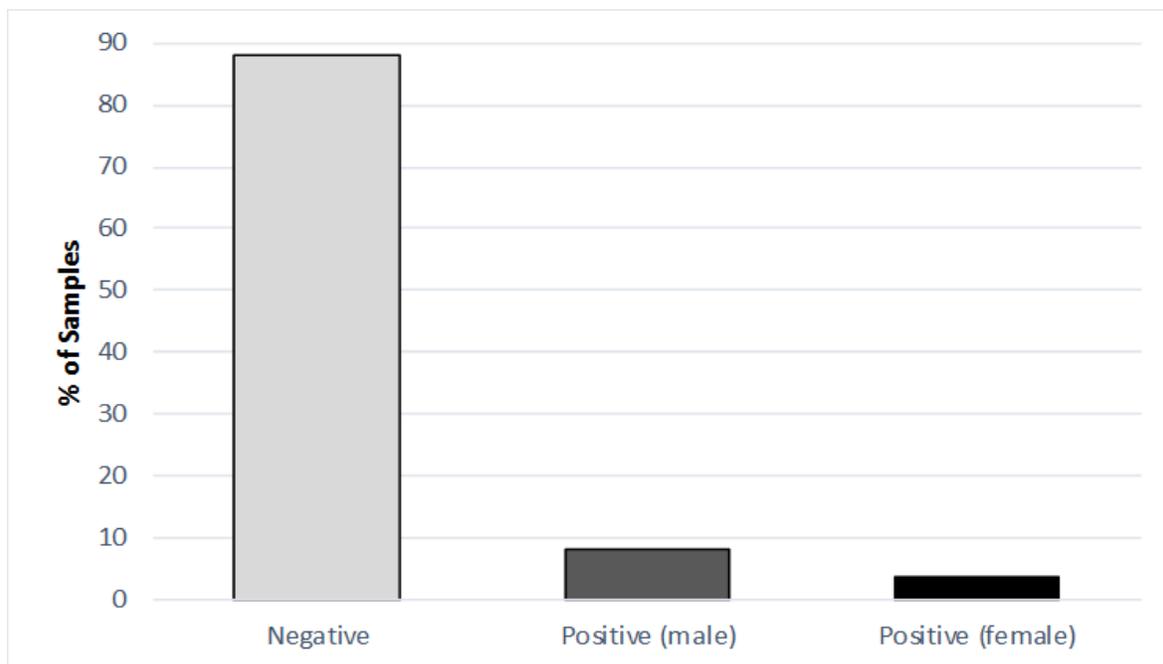


Figure 1. Distribution of malaria incidence among suspected cases

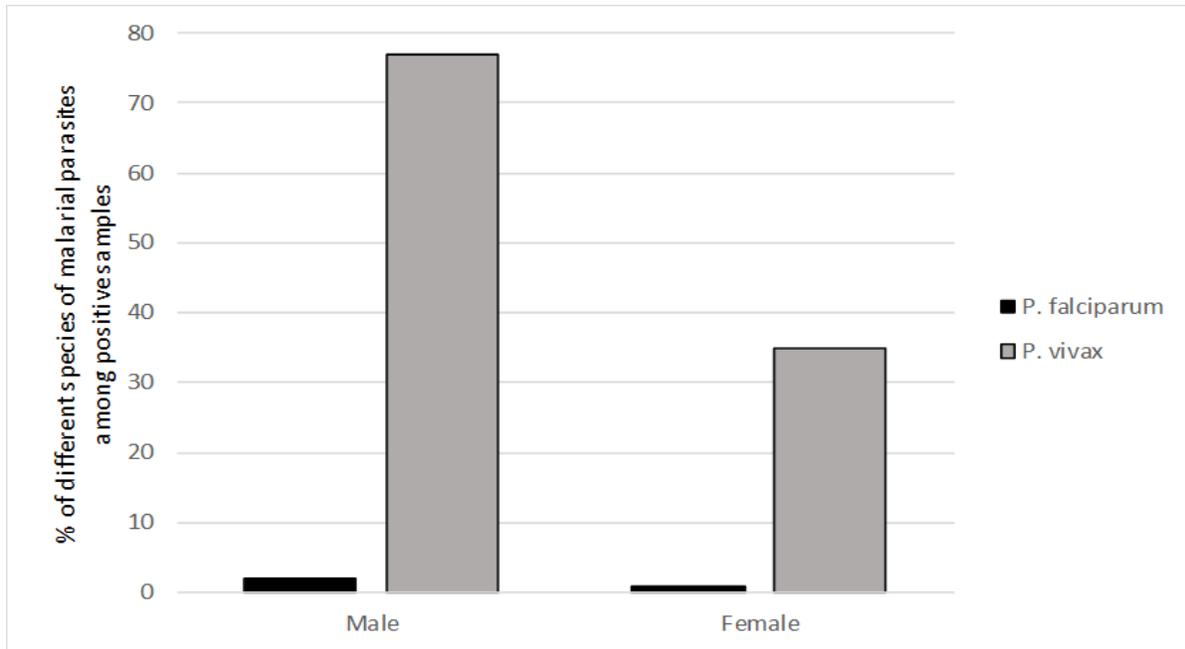


Figure 2. Distribution of malarial species among positive cases

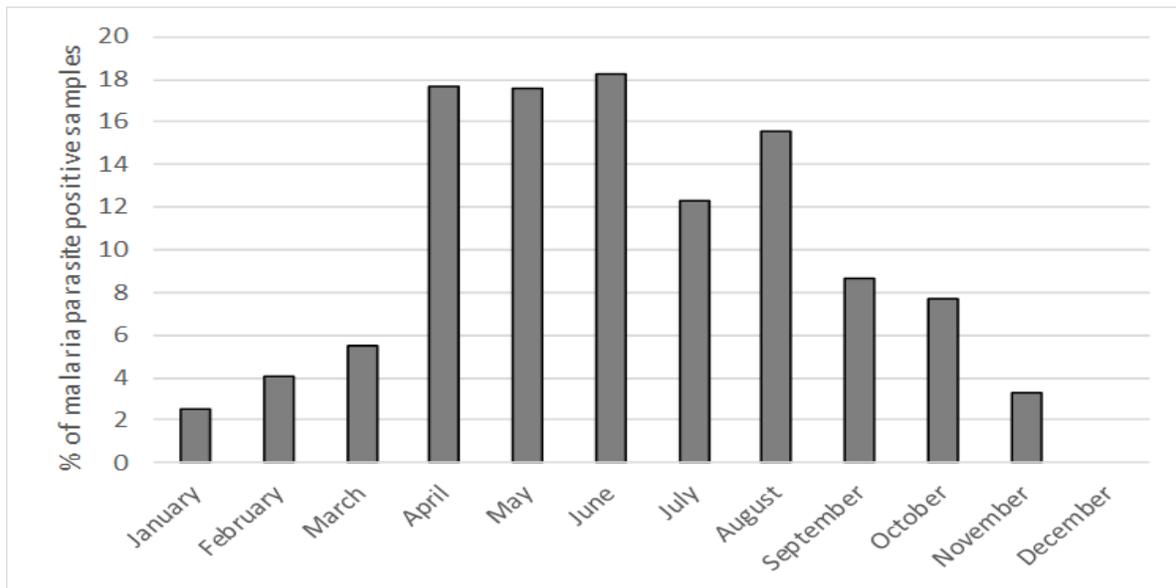


Figure 3. Seasonal distribution of malarial parasite

Discussion

This study was conducted in Khanozai, Pakistan. Our observation of rate of malaria burden in Khanozai is similar as reported by some other studies conducted in Balochistan [2, 10-12]. The trend of higher incidence in males might be due to higher exposures to

malaria vector as compared to females owing to their work at peak biting times or economical migration to high endemic area. Due to sociocultural norms, females in Khanozai have restricted mobility and are well-covered. This might be another factor for less incidence of malaria in females. A

similar trend was also reported by other investigators from Pakistan [2, 13, 14]. A similar trend of high prevalence of malaria in males as compared to females has also been reported by some studies from outside of Pakistan [15, 16].

In our study, the predominant causative specie of malaria was *P. vivax* as compared to *P. falciparum*. Other studies in Pakistan and Eastern Mediterranean region also reported *P. vivax* as predominant specie as compared to *P. falciparum* [14, 15, 17, 18]. Geographically *P. vivax* is more distributed and accounted for approximately half of the total number of malaria cases outside Africa. In fact, it is estimated that more than 80% cases of *P. vivax* malarial infection occur in only three countries (Ethiopia, India and Pakistan) [1]. *P. vivax* is commonly distributed in temperate zones [19] where it has more ability to produce gametocytemia [20]. Therefore, possible explanation for higher incidence of *P. vivax* can be favourable temperature condition as compared to *P. falciparum*. Although, some of the investigators have reported mixed infections of *P. falciparum* and *P. vivax* [17, 21, 22] however, like many of the investigators we did not found mixed infection of any type [15, 23].

While looking on incidence of malaria throughout the year we observed gradual increase in the rate of malarial incidence with warmer month and vice versa (Figure 3). Malaria is climate sensitive diseases [19] and gradual increase in temperature increases the growth and number of malarial vector and Plasmodium [24-26]. Therefore, gradual increase in malarial incidence up to June, one of the warmest month of the year, and subsequent decrease might be due to increased temperature.

In conclusion, this study shows the incidence of malaria even in relatively colder area of Khanozai. Based on the results, male should adopt more precautionary measure to avoid

malarial infection, such as wearing protective clothing and using insect repellent. Although the predominantly prevailing plasmodium type is in accordance with other parts of the country, timely diagnosis will greatly decrease the severity of the disease by timely intervention. Especial care is needed in the warmer months of the year to minimize the risk of malarial infection.

Conclusions

The findings of this study will be helpful to develop prevention strategies, in future, to in the local population. The study location is a remote resource less area. Our finding of malaria in this area urge the need of develop more rapid and economical diagnostic methods for detection of malaria in future studies.

Authors' contributions

Conceived and designed the experiments: FU Rehman, Performed the experiments: M Noor & K Khan, Analyzed the data: K Khan & H Wali, Contributed materials/ analysis/ tools: M Ayub & FU Rehman, Wrote the paper: K Khan.

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