Prevalence Of Malarial Parasites *Plasmodium Vivax* And *Plasmodium Falciparum* In Male Population Of Faisalabad, Pakistan

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ABSTRACT
Malaria is the fifth leading cause of death worldwide. Pakistan is considered as a moderate malaria-endemic country but still, 177 million individuals are at risk of malaria. Roughly 60% of Pakistan's population, live in malaria-endemic regions. The present study was undertaken to determine the prevalence of *Plasmodium vivax* and *Plasmodium falciparum* in blood of human males among rural and urban population of Faisalabad. The diagnosis, seasonal variations and age wise distribution of Plasmodium spp. circulating in the study area were also included in the objectives. 250 finger prick blood samples were collected from suspected patients during May to July from rural and urban population of Faisalabad. Prevalence of malarial parasite in male population was 7.29%. Prevalence was higher in the age group 40-50 years. Among positive samples, most of the males were infected with *P. vivax.* All patients showed different sign and symptoms such as chill, fever, vomiting and headache. It was also observed that prevalence of malaria was significantly higher in rural areas and in areas where proper sewerage system was not available. Socio economic status of positive cases was middle or lower class with limited income ranging Pak rupees 10,000-20,000 per month. They were unable to afford to adopt preventive measures like use of mosquito repellents, insecticide treated bed nets etc. Our study reveals that malaria is prevalent in rural areas of Faisalabad and necessary preventive measures are needed.

Key words: *Plasmodium vivax, Plasmodium falciparum*, Malaria, Prevalence, Socio-economic

INTRODUCTION

Malaria is a disease caused by protozoa from five distinct species of Plasmodium and is transmitted by the female Anopheles mosquito (Cox, 2010; Snow et al., 2005). It stands as one of the foremost contributors to illness and mortality worldwide, having significant medical and economic repercussions (WHO, 2015 & 2017). In Pakistan, four species, notably *P. vivax* and *P. falciparum* are known to infect humans and are among the most prevalent and widely dispersed parasites (Qureshi et al., 2019; Qureshi et al., 2021). As per the World Malaria Report of 2021, nearly half of the global population resides in 87 countries and regions where there is a risk of malaria transmission. In 2020, malaria was estimated to result in 241 million clinical cases and approximately 627,000 fatalities (Nankabirwa et al., 2015). Furthermore, it poses a significant public health challenge in humid and subtropical regions (Raghavendra et al., 2011; WHO, 2020). The World Health Organization (WHO) identifies Pakistan as one of the seven nations within the Eastern Mediterranean Region that collectively represent 98% of the region's malaria burden. Currently, about 217 million individuals in Pakistan are considered at moderate risk of contracting malaria, while 63 million are classified as being at high risk. In the year 2020, around 0.47 million malaria cases were documented, resulting in about 800 deaths (Organization, 2021).

Environmental elements such as landscape, precipitation, climate conditions, and socioeconomic factors of the population play a crucial role in the transmission of malaria. Consequently, tropical nations like Ethiopia—characterized by warm temperatures, substantial rainfall, and high humidity—provide optimal breeding grounds for mosquitoes, extending their lifespan and supporting the development of malaria parasites. In Pakistan, malaria is endemic and exhibits an unstable transmission pattern, with seasonal outbreaks. The incidence of malaria tends to peak twice yearly, specifically in September and December, as well as in April and May, aligning with the busy agricultural seasons (Khattak et al., 2013). Clinically, malaria manifests through symptoms such as fever, elevated body temperature, sweating, chills, vomiting, and intense headaches, which are indicative of the disease (Milner, 2018). A variety of diagnostic methods are employed for malaria detection, including microscopy, rapid diagnostic tests, and polymerase chain reaction (PCR) assays. Although microscopy is regarded as the gold standard due to its reliability, it has limitations in sensitivity and requires skilled personnel for accurate interpretation (Nadeem et al., 2021). To combat malaria, the Pakistani government implements strategies such as early

diagnosis, prompt treatment, targeted vector control, and preventive measures against outbreaks. However, Pakistan's susceptibility to climate change exacerbates its vulnerability to malaria, owing to its geographical position, dependence on agriculture and water supplies, and inadequate disaster preparedness infrastructure. Increasingly frequent floods in Pakistan have been linked to a notable surge in malaria cases, attributed primarily to the impacts of climate change, ineffective vector control, and insufficient healthcare resources (Malik et al., 2012). Main objectives of our study was to calculate prevalence of malaria in males living in rural and urban areas of Faisalabad. And to estimate the prevalence of *P. vivax* and *P. falciparum* percentage.

MATERIALS AND METHODS

Blood samples of potential or most likely to be patients of malaria belonging to the different areas of Faisalabad. Complete bio-data was collected with the help of questionnaire. These blood samples were categorized using different age groups, weight groups, income groups and family status groups. We collected 250 blood samples of males from Allied hospital Faisalabad. A detailed history and thorough clinical examination was performed and recorded. A structured and pre-tested questionnaire was used to collect information. Blood samples of potential or most likely to be patients of malaria belonging to the different areas of Faisalabad. Finger prick blood samples of all patients were collected on site on glass slide and made thick and thin blood films. Examination was done in the laboratory under microscope for malarial parasite by Geimsa staining. These blood samples were categorized using different age groups, weight groups, income groups and family status groups. And statistical analysis was performed by using Minitab. And chi square applied to find out significant and non-significant relationship.

RESULTS

Seroprevalence of Malaria

Out of 250 samples 17(7.29%) showed positive seroprevalence for *P. falciparum* and *P. vivax*. while 233 (92.71%) were negative for malaria as shown in Fig 1.

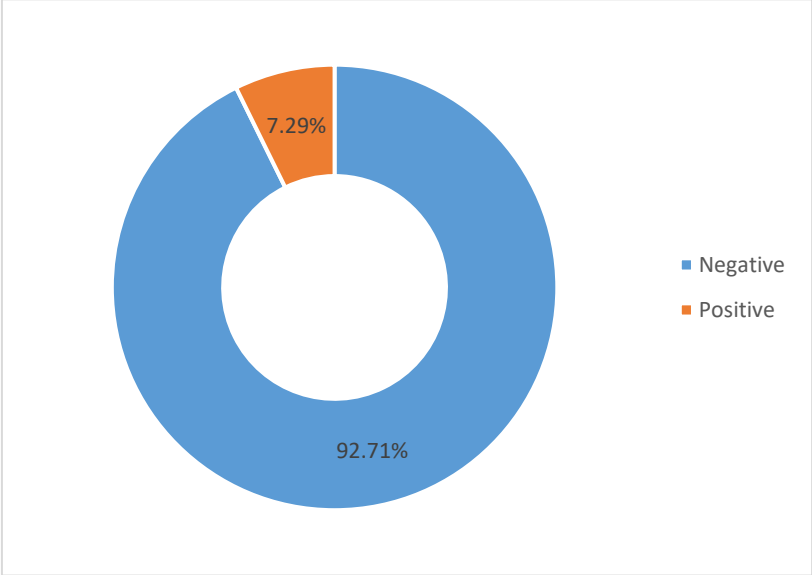

Fig.1. Seroprevalence of malaria in male population

Age groups

Whole samples were divided into four major age groups (18-28, 29-39, and 40-50). Among 17 positive male samples, 10(58.8%) samples of males were of age group of 40-50 years, 2(11.76%) were of the age groups of 18-28 years, and 5(29.4%) were of the group of 29-39. Significant value was obtained by performing chi square test to age groups.

Weight groups

Whole samples were divided into four major weight groups (35-45 kg, 46-56 kg, 57-67 kg, 68-78 kg). Among 17 positive patients 3(17.64%) were of the weight group of 35-45 kg, 5(29.41%) were of the weight group of 51-61 kg, 2(11.76%) were of the weight group of 62-72 kg, and 7(41.17%) were of the weight group of 73-83 kg. By performing chi square test for weight groups non-significant value was obtained.

Blood Pressure

Among 17 male samples 9(52.94%) had normal blood pressure, 5(29.41%) had low blood pressure and 3 (17.64%) had high blood pressure. Significant value was obtained

Occupation and Income

Among 17 male samples 14(82.35%) were employed and 3(17.64%) were unemployed. Income was divided into four major groups (10,000-20,000, 20,000-30,000 and 30,000-40,000 Rs. Among 14 male samples, 9(58.3%) were of income group 0-10,000 Rs, 3 (29.1%) were of income group 10,000-20,000 Rs, 2(8.4%) were of income group 20,000-30,000 Rs, and 1(4.1%) were of income group 30,000-40,000 Rs. For employed or unemployed group non-significant value was obtained and for income group significant value was obtained by applying chi square test.

Residential Areas

Infection of malaria was found more in the inhabitant living in the rural areas of Faisalabad as compared to those who live in urban areas. Among 17 male samples 15(88.23 %) were from rural areas and 2(11.76%) were from urban areas. Non-significant value was obtained by applying chi square test in this data. Out of 17 positive male samples 16 male patients were infected from *P. vivax* and only one patient was infected from *P. falciparum*. Out of total 16 positive *P. vivax* samples 13 patients were from rural areas and remaining 3 patients were from urban areas. And *P. falciparum* patient was from rural area and come from other city.

Use of Mosquito Repellent

Among 17 positive male samples, only 4(23.52%) were using mosquito repellent and 12(70.58%) were not using mosquito repellent. Significant value was obtained by applying Chi square test to these values.

Proper sewerage Facility

Among 17 patients, 5 (29.41%) were enjoying proper sewerage facility and other 12(70.58%) were not. Non-significant value was obtained by applying Chi square test to these values.

Season

As studies started in May and continue till July. 17 positive samples were obtained in all 250 samples. Among 17 positive male samples, 2(11.7%) samples were obtained in May, 9(52.94%) samples were obtained in June, and 6(35.29%) samples were obtained in the early in July. Significant value was obtained by performing chi square test in this data.

We start research in early in April continuous till July. Most of the cases were appeared in June and July due to change in climate because consistent high temperatures, rainfall, and high humidity, along with stagnant waters in which mosquito larvae readily mature, providing them best environment to breed. So rate of malaria infection will become higher during this whether and malaria cases start to increasing. Trophozoites and gametocytes were the erythrocytic stages of *P. vivax* and *P. falciparum* observed during the study.

DISCUSSION

Malaria causes a huge burden of disease globally, particularly in low middle income countries. A number of environmental factors play an important part in its prevalence, both geographical and environmental. Traditionally malaria is considered a disease of hot and humid weather. The results of this study show that the disease transmission occurs throughout the year with varying severity.

This survey was conducted to provide malaria prevalence in Faisalabad, Pakistan. Because samples were collected from patients presenting with symptoms, one limitation is the potential for regional variation in treatment-seeking behavior and access to treatment centers. Unfortunately, information on treatments taken prior to diagnosis was not collected and could not be included in this analysis. In addition, the timing of sample collection at each site may have coincided with varying levels of species-specific malaria transmission. Our results concluded that in local population of Faisalabad of Pakistan 99% cases were due to *P. vivax* and 1% were due to *P. falciparum* and that patient of *P. falciparum* was not the resident of Faisalabad, he come from Bahawalpur.

Naseem *et al.* (2008) conducted their study in D.I.Khan Pakistan and concluded that rate of malarial infections suffering from *P. falciparum* was greater than rate of malarial infection suffering from *P. vivax.* According to their study in that area 76.75% cases were due to *P. falciparum* and 23.25% were due to *P. vivax*. But in Punjab especially in Lahore *P. vivax* is common and almost all infections occur due to *P. vivax* and *P. falciparum* is very rare or not present in Lahore so our results vary with the results of Naseem *et al.* (2008).

Our findings about age are similar to Chimere et al (2013) who concluded that as age increases causes greatest risk of malaria infection, as well as having the highest parasite densities. And the risk decreases as the age increases. similar findings have been reported by other authors in Gabon and Eastern Sudan where malaria prevalence was observed to decrease as age increased (Marielle *et al*., 2003). Our results also similar to Denish *et al.* (2012) and found that as age increases the risk factor of malaria also increases but female prevalence was maximum in the age group of 18-28 years as most of the females in Pakistan experiences pregnancy in this age group and so they are at greater risk in this age group. And in case of pregnant female's risk of malaria is decreases as the age increases. Anibogu and Olubowale conducted their study in (2002) also observed that malaria causes low blood pressure and dizziness in patients. Severe malaria can lead to low blood pressure and hypotension.

Our results showed that most of the patients are from lower income group and some are from medium income group very few of the patients are from high income group. The patients from lower income group don't have the purchasing power to buy the mosquito nets, repellent lotion and proper medication for each of the family members. And rate of infection was high

(88.23%) in rural areas as compared to Urban areas (11.76%). And in Urban areas this rate is due to the environmental conditions inherent in urban and peri-urban areas, which favor malaria transmission Nduka *et al.* (2006). In rural areas rate of infection is high due to the poor drainage system and lack of other facilities. This survey indicated that the prevalence of malaria is 17% found in Faisalabad. This study also confirmed previous findings that *P. vivax* and *P. falciparum* are the two major *Plasmodium* species found in Pakistan, with *P. vivax* predominating in most regions. A predominance of *Plasmodium vivax* over *Plasmodium falciparum* cases was observed in this study. This may be due to several factors like parasitic load, vector's microenvironment, host parasite interaction or recent introduction of *P. vivax* from nearby areas by means of migration to this area. Malaria can cause significant mortality and morbidity and constitutes a major health hazard in developing countries.

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CONFLICT OF INTEREST
Certified that there is no conflict of interest**.**

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