

## INVESTIGATION THE PREVALANCE AND DEMOGRAPHIC PATTERN OF PLASMODIUM VIVAX IN THE SUSPECTED PATIENT OF DISTRICT KARAK

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### Abstract

Malaria is an infectious disease caused by Plasmodium parasite and mainly transmitted by female Anopheles mosquitoes. While there are 530 species of anopheles mosquitoes, only approximately 68 of them are capable of transmitting the malaria parasite. Infections can also occur through exposure to mosquito bite. Plasmodium encompasses various species, with *Plasmodium vivax* and *Plasmodium falciparum* being prevalent in human population. The aims of current study, is to investigate the prevalence and demographic pattern of *P. vivax* in the suspected patient of district Karak. The current research study was conducted at Professional College of

Medical Sciences Chokara Karak (affiliated with KMU) with collaboration of clinical laboratories of DHQ hospital KDA and Type “C” Hospital Takhti-e-Nasrati, District Karak. A total number of 100 samples were collected from different patients and screen for *Plasmodium vivax* infection. The data collection of patient also involved the use of predesigned questionnaires, which helps in the careful evolution and screening of each and every patient. The blood samples were collected from each individual patient and added in EDTA tube. Further, the samples were screen and analyzed through RDT and staining method.

The result interpretation shows that, the gender wise analysis exhibits that, *P. vivax* is highly frequent in male individual as compared to female. Among the male patients, 32 out of 42 were found positive for *P. vivax*, resulting in a positivity rate of 76.2%, while 10 (23.8%) were negative. In contrast, among the female patients, 40 out of 58 cases were positive, corresponding to a positivity rate of 69.0%, whereas 18 (31.0%) were negative. The overall prevalence of *Plasmodium vivax* infection was 72% among the studied suspected population while the age based data suggested that, the *Plasmodium vivax* is highly prevalent in adult at the age of 11-20 years while the lowest number of cases was observed in individuals above the age of 50 years. Additionally, it was observed that the *Plasmodium vivax* suspected Patient during four months from June 2023 to September 2023.

The month-wise analysis of this study revealed that the prevalence of malaria was notably higher during the months of August to September. Furthermore, it was observed that both urban and rural populations in Karak were affected by malaria, emphasizing the wide geographical distribution of the disease in the region. So we conclude that, the frequency of *Plasmodium vivax* is increases day by day due to different reason such as seasonal change issue, unawareness, No Hygiene, lack of facility and research, political instability and poor funding. We need further research to limits and restrict these challenges. So, the future research tendency will be to check and explore community based vaccine input.

## 1. INTRODUCATON

### 1.1 Background

Malaria is an infectious disease caused by the Plasmodium parasite (1). It is mainly transmitted by infected female Anopheles mosquitoes. Infections can also occur through exposure to contaminated blood (transfusion-associated malaria) and via congenital transmission. Plasmodium encompasses various species, with *Plasmodium vivax* and *Plasmodium falciparum* being prevalent in human disease. Malaria can manifest throughout the year, displaying seasonal fluctuations in its prevalence (2). According WHO (2009), currently malaria is endemic in 109 countries, with 45 of them situated in Africa. Beyond Africa, malaria continues to pose a substantial public health challenge and contributes significantly to global morbidity. Over 90% of malaria related to deaths occur in tropical Africa (2).

Malaria is a significant health concern in Pakistan with *Plasmodium falciparum* and *Plasmodium vivax* being the predominant species. Over the past 10 years, there has been a substantial six-fold increase in *Plasmodium falciparum* associated malaria cases. Currently, *Plasmodium falciparum* accounts for 42% of all malaria cases reported by the National Malaria Control Program (MCP). Resistance to Chloroquine has become widespread across the country (3), making it more challenging to treat malaria effectively. Warmer and autumn seasons favor prolonged transmission of the disease, while there has been a chronic decline in efforts to control the vectors that transmit malaria.

Malaria is contracted when a mosquito of the Anopheles species, which has become infected after feeding on an individual with the disease, bites another person and injects the malaria parasite into their bloodstream. The completion of the Plasmodium parasite's life cycle necessitates the involvement of both a human host and a mosquito vector. This study primarily investigates the prevalence of malaria caused by *Plasmodium vivax*.

## 1.2 Introduction to *Plasmodium vivax*

*P. vivax* is the predominant malaria parasite in Pakistan. Approximately 2.5 billion people worldwide are currently at risk of *P. vivax* transmission, with around 91% of this population residing in Central and Southeast Asia. In Pakistan, malaria continues to be an endemic disease, imposing a significant healthcare burden with an estimated 1.6 million cases annually, of which 64% are attributed to *P. vivax* (4).

Biological characteristics specific to *P. vivax* set it apart from *P. falciparum* and present unique challenges in its control. Notably, *P. vivax* gametocytes appear at an earlier stage in the progression of a primary infection compared to *P. falciparum* (5), facilitating transmission before diagnosis and treatment. Furthermore, *P. vivax* gametocytes are more easily transmitted by Anopheles mosquito vectors and can be transmitted at lower parasite densities.

One of the most significant epidemiological features of *P. vivax* is its ability to relapse weeks or months after the primary parasitemia due to the formation of liver-stage hypnozoites (6). The presence of hypnozoites and the potential for relapse pose challenges for chemical therapies that primarily target the blood stage of the infection. Currently, the only class of drugs known to effectively target hypnozoites is the 8 aminoquinolines (7).

1.3 Life Cycle of *P. vivax*

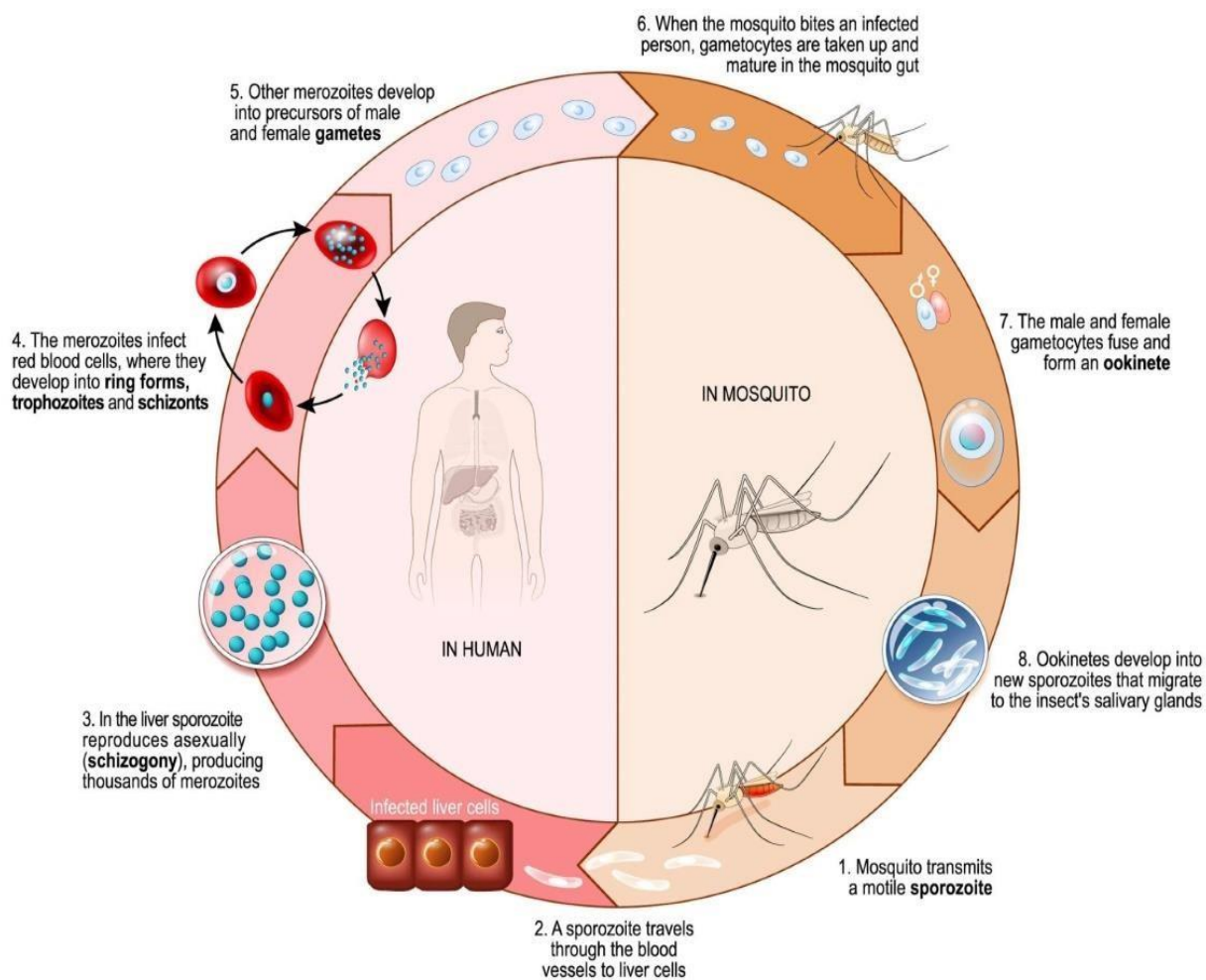


Figure 1: Showing Life Cycle of *P. vivax*

1.4 Clinical Feature

There are following clinical feature of this disease such as

- Fever
- Nausea

- Muscles and Joints Pain
- Chills
- Headache
- Weakness
- Vomiting
- Diarrhea
- Anemia
- Enlargement of the spleen (Splénomegaly)

### 1.5 Age Contribution in the Developing of *P. vivax* Infection

A recent survey was conducted to assess the incidence of malaria infection in the district Karak from September, 2015 to August, 2016. During this period, the malaria blood parasite was identified in 3,849 individuals who were suspected of having malaria, of which 1,491 (38.7%) were confirmed as positive cases. Among these positive cases, 1,302 (87.3%) were attributed to *P. vivax*, while 189 (12.6%) were due to *P. falciparum*.

A monthly analysis revealed that the highest prevalence of malaria parasites occurred during the period from July to October. The infection rate was higher among males, accounting for 79.5% of the cases, compared to females. Age group analysis showed that 168 cases (11.3%) were in the age range of 1-10 years, 619 cases (41.5%) in 11-20 years, and 704 cases (47.2%) were aged 21 and above.

## 2. MATERIALS & METHODS

### 2.1 Area of Study

The current study was conducted at clinical laboratories of District Headquarter Hospital (DHQ) KDA, Karak and Type "C" Hospital Takhti-e-Nasrati, District Karak (Figure-02). The study was approved after formal request by the students of the Department of MLT, Professional College of

Medical Sciences Chokara, Karak. Secondary data were provided with permission from the Head of Department (HOD) for collection and analysis of samples at DHQ Hospital and Type “C” Hospital.



Figure 2: Showing the Area of Study

## 2.2 Collection of Sample

The samples were collected from different patients at the above-mentioned hospitals (Figure-02). Data collection also involved predesigned questionnaires to ensure careful evaluation and screening of each patient. During sample collection, 2 ml of blood was drawn from each individual using a sterile syringe and transferred to EDTA (Ethylenediaminetetraacetic acid) tubes for further screening and testing.

## 2.3 Detection of *P. vivax* Surface Antigen Detection on RDT Test

The detection of *P. vivax* was carried out using the Rapid Diagnostic Test (RDT) method. The RDT test was used for qualitative detection of antigen specific to *P. vivax* available at the testing site. In

the current study, a test strip from HEALGEN SCIENTIFIC LLC (3818 Fuqua Street, Houston, TX 77047, USA, [www.healgen.com](http://www.healgen.com)) was used.

In this method, 7 µl of blood sample was added to the strip. After that, 3 drops of buffer were added to the strip and mixed with the blood sample. The RDT strip was placed for 5 minutes. The interpretation of results was based on the presence or absence of specific lines on the test strip. If only the control line “C” was present and there was no appearance of color lines, it indicated a negative result for *P. vivax* infection. A positive result for *P. vivax* infection was indicated by the presence of both the “T” band (test band) and the control line “C.” Additionally, the appearance of a single line designated as “PV” further confirmed the positive result.

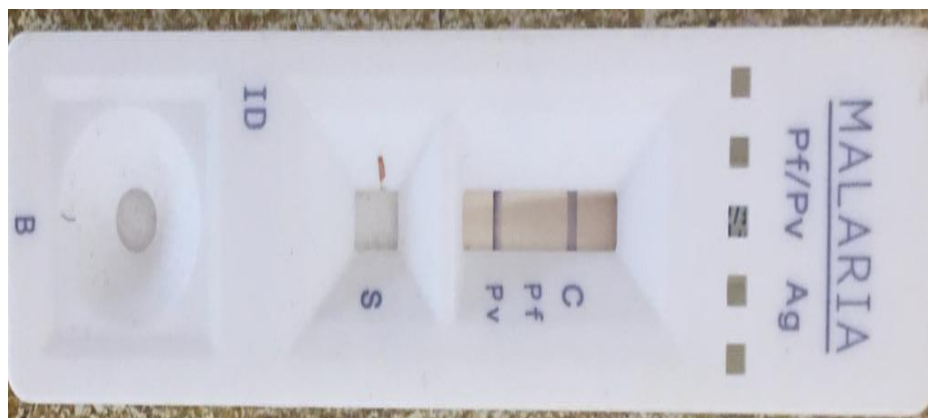


Figure 3: Showing RDT Strip for Malaria Diagnosis

#### 2.4 Identification of *P. vivax* Based on Slide Method (Giemsa Staining Technique)

The detection of *Plasmodium vivax* was performed using the slide method, and the staining technique employed was Giemsa staining. Giemsa stain is well-known for its histological application in staining blood smears. It is utilized for both thin and thick blood smears to identify *P. vivax* infections and is classified as a Romanowsky stain. The staining process was conducted following the provided guidelines and recommended procedures for Giemsa staining.

In this method, a sterilized glass slide was used, and one drop of blood was placed to prepare thin and thick blood smears. The smear was flooded with Giesmsa stain for 5 minutes, then washed with tap water and dried. The prepared slide was observed under a microscope at 100X

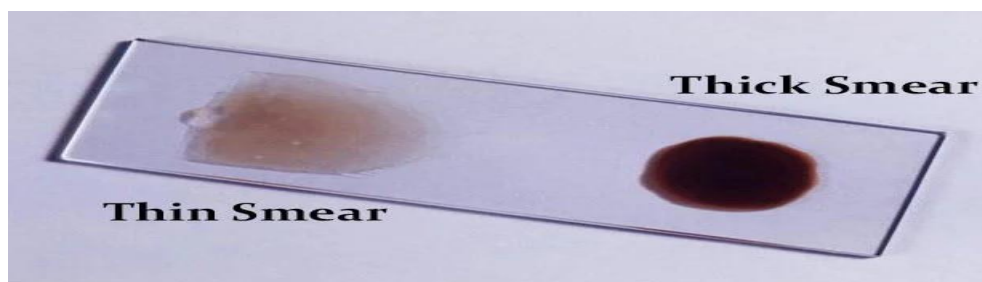


Figure 4: Showing Thin and Thick Blood Smear for *P. vivax* Identification

### 3. RESULTS

#### 3.1 Sample Collection

A total number of 100 samples were collected from different patients of DHQ and THQ Hospital. Among these, 65 samples were collected from DHQ hospital while 35 samples from THQ hospital.

Table 1: Showing Total Sample Distribution

Hospital name	DHQ Hospital KDA Karak	THQ Hospital Takhti-e-Nasarati
Total No of Samples	65	35

### Total Sample Distribution

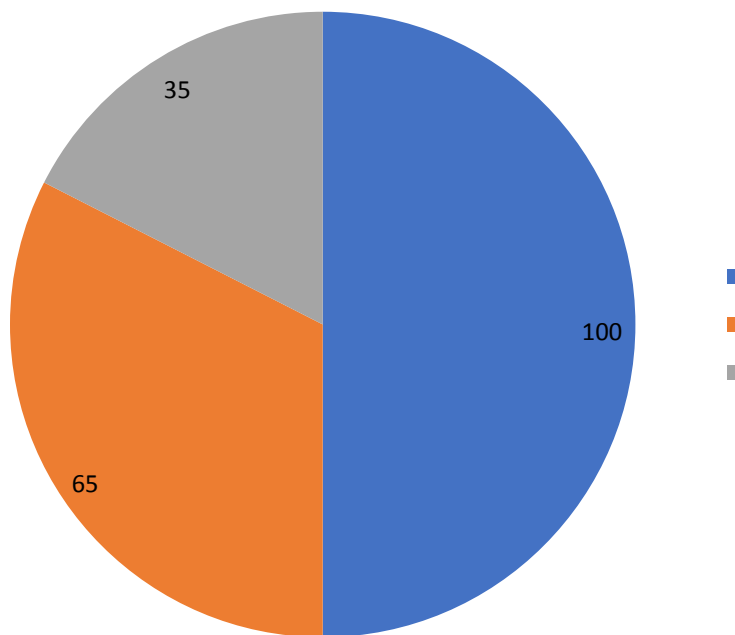


Figure 5: Showing Total sample Distribution Collected in Hospital

Total No, of Sample

DHQ Hospital KDA Karak

THQ Hospital Takhti-e-Nasrati

### 3.2 Gender Wise Distribution of sample

The sample distribution was based on gender. A total of 100 samples were collected, of which 42 were from male patients and 58 were from female patients, as shown in Table-02.

Table 2: Showing Gender Wise Distribution of Sample

Total No, of Sample	Male	Female
100	42	58

Gender Wise Distribution of Sample

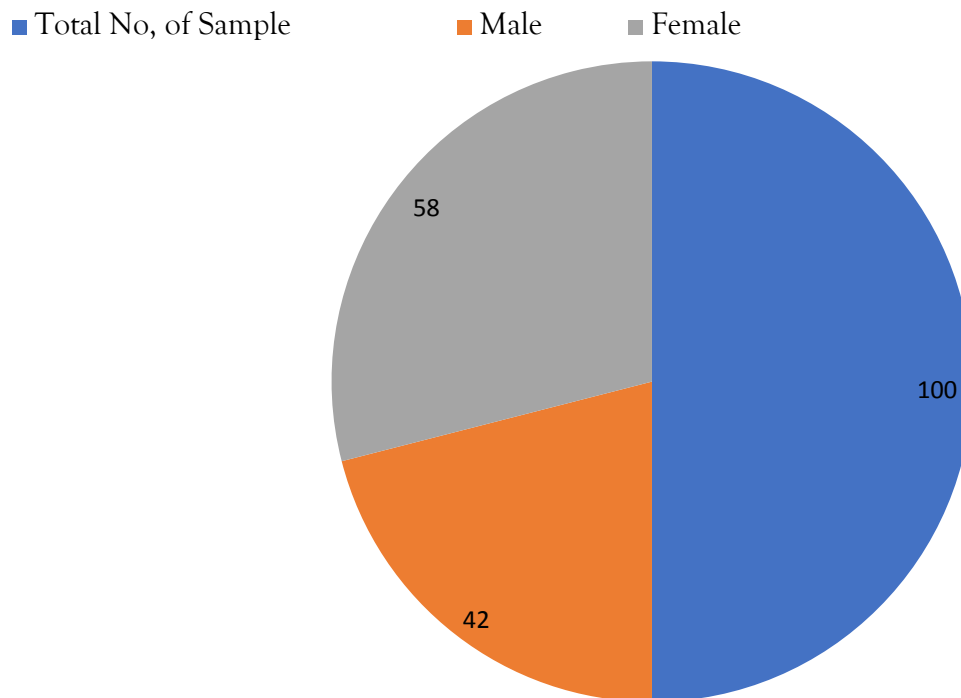


Figure 6: Showing Gender Wise Distribution of Sample

3.3 Gender Wise Distribution of Positive and Negative Cases

The gender-wise positive and negative cases revealed that among 42 samples collected from males, 32 cases were positive for *P. vivax*, while 10 samples were negative. In the case of females, 40 samples were positive, and 18 cases were *P. vivax* negative, as shown in Table-03.

Table 3: Showing Gender Wise Distribution of Positive and Negative Case

Gender	No, of Sample	Positive Cases	Negative Cases
Male	42	32	10
Female	58	40	18

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### Gender Wise Distribution of Positive and Negative cases of *P. vivax*

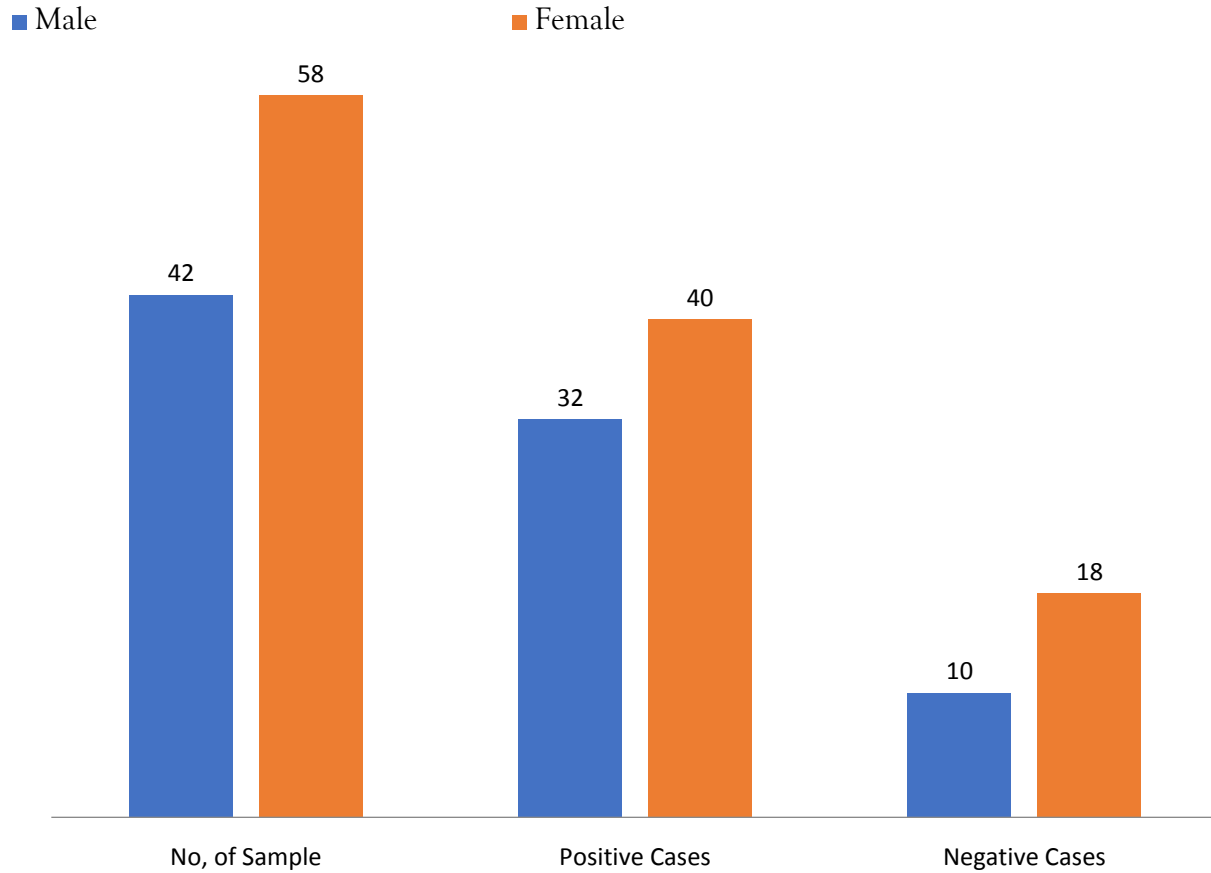


Figure 7: Gender Wise Distribution of Positive and Negative Cases

### 3.4 Age Wise Distribution

The age-wise data shows that *P. vivax* was highly prevalent in the age group of 11-20 years in both males and females and the lowest number of cases was observed in individuals above the age of 50 years as shown in Table-04

Table 4: Showing Age Wise Distribution of Sample (*P. vivax*)

Age \ Gender	No of Sample	1-10 Years	11-20 Years	21-30 Years	31-40 Years	41-50 Years	Above 50 Years	Positive	Negative
Male	42	06	11	04	04	05	02	32	10
Female	58	09	16	07	02	05	01	40	18

Age Wise Distribution of Samples

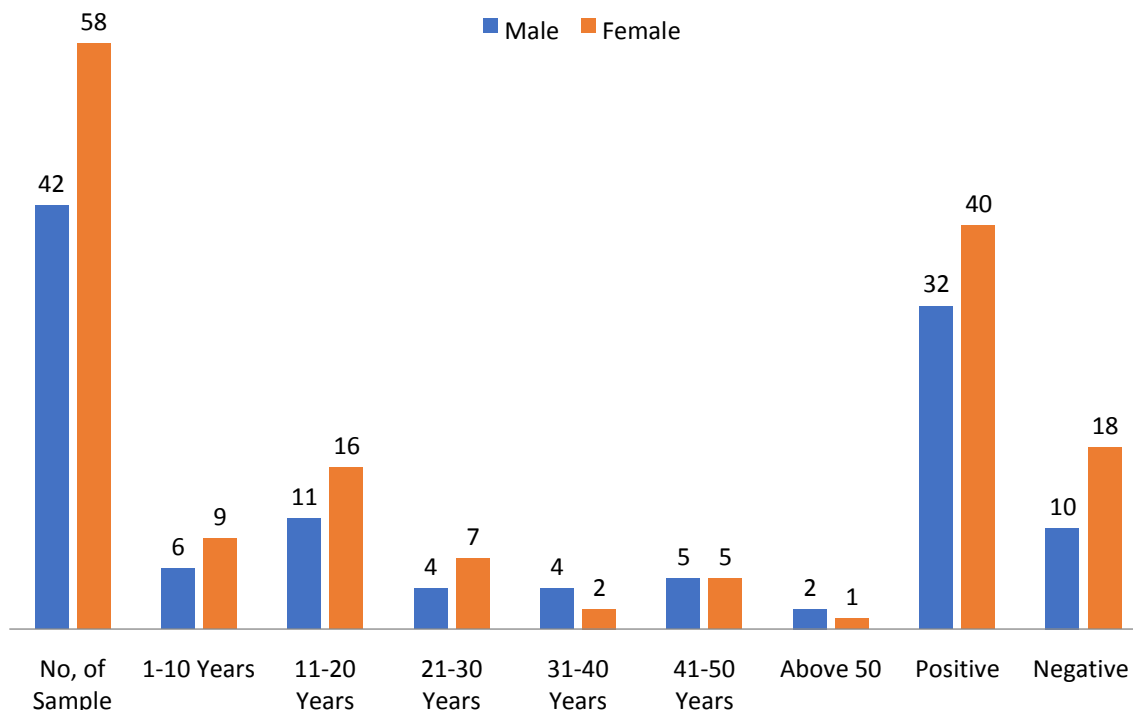


Figure 8 : Showing Age Wise Distribution of Samples (*P. vivax*)

#### 4. DISSCUSSION

Malaria is a significant health issue in Pakistan, with nationwide cases reaching around 2.6 million in 2008 and an estimated annual total death rate of approximately fifty thousand (8). The causative agent of malaria, Plasmodium, is an intracellular parasite that can be transmitted from one person

to another via mosquito bites. Plasmodium comprises various species, with *P. falciparum* being one of the most concerning. Globally, it is estimated that between three to five hundred million people are affected by malaria each year, resulting in approximately 1,520,000 annual fatalities (9).

In 2007, the Malaria Case Management Desk Guide (MCMDG) reported that the majority of malaria cases in Pakistan were concentrated in Baluchistan and Sindh, followed by FATA and Khyber Pakhtunkhwa (KPK), while Punjab had the lowest number of malaria cases (10). A recent study on malaria cases was conducted from September 2015 to August 2016, with a particular focus on the incidence of *P. vivax* in various local populations in District Karak. In 2015, a total of 1,491 slides were examined for malaria, with 90.01% of cases attributed to *P. vivax* and 9.90% to *P. falciparum*. Similar high incidence rates were also reported in District Okara, Punjab (11).

In District Karak, the number of *P. vivax* cases is higher than that of *P. falciparum*, indicating a greater prevalence rate of *P. vivax* malaria in the region. This observation aligns with findings that emphasize the significant burden of *P. vivax* malaria in District Karak. Age-wise analysis showed the highest proportion of cases in the male age group >14 years (27.9%), followed by the male age group 5-14 years (23.6%), while the lowest rate was observed in the male age group <5 years (9.1%). Among females, the >14 years age group showed a relatively lower frequency (9.2%), followed by the 5-14 years age group (16.7%), and the lowest frequency was in the <5 years age group (5%). Similar patterns were observed in previous studies, including those conducted in Mitha Khel, District Karak (12).

The present study was conducted at DHQ and Type "C" Hospital with the collaboration of Professional College of Medical Sciences (PCMS) Chokara, Karak, affiliated with Khyber Medical University, Peshawar. A total of 100 samples were collected and screened for *P. vivax*. Approximately 100 random samples of patients suspected to have *P. vivax* were collected over four months, from June 2023 to September 2023 (complete results mentioned in the above tables and figures). The positive cases of *P. vivax* were highly reported in male patients compared to females. The reasons

behind this higher prevalence in males may include increased outdoor activities, occupational exposure, and differences in health-seeking behavior

## 5. Conclusion

The month-wise analysis of this study revealed that the prevalence of malaria was notably higher during the months of August to September. This observation suggests a seasonal pattern of increased malaria cases during these specific months. Furthermore, the study's findings led to the conclusion that males exhibited a higher rate of malaria infection as compared to females. Additionally, it was observed that both urban and rural populations in Karak were affected by malaria, emphasizing the wide geographical distribution of the disease in the region. Regarding age groups, the highest numbers of malaria cases were reported among individuals aged 11-20 years. Conversely, the lowest number of cases was observed in individuals above the age of 50 years. Among the two hospitals included in the study, *P. vivax* was found to be more prevalent as compared to *P. falciparum*. To effectively control malaria infection, there is a crucial need for awareness sessions and knowledge dissemination about the disease. Additionally, early diagnosis of malaria infections, prompt treatment, and preventive measures are essential components of malaria control strategies.

## 6. Recommendations

Future research study will be needed to find out novel and more fruitful information regarding *P. vivax*. So, the future improvement and scientific research tendency will be,

- To strictly check out the in/out of the population to the concerned community
- To check and explore community based vaccine level input.
- Awareness Seminar About the prevalence of Malarial parasite it will be helpful.
- To study drug resistance patterns and assess alternative therapeutic options.

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