

The Pandemonium of Malaria in the Rural Population of District Khairpur During the 2022 Monsoon Flood



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Abstract

Background: The recent monsoon flood in Pakistan triggered a surge in various diseases, particularly affecting Sindh. This study was conducted to assess the prevalence of malaria in the Khairpur district during the flood pandemic.

Methods: A cross-sectional study was carried out in the Khairpur district on the rural population during the flood pandemic of 2022, spanning from August to September. Due to the flood, numerous patients exhibited fever and malaria-related symptoms. Using convenient purposive sampling, all symptomatic patients underwent malaria testing through the ICT (immunochromatographic test) method.

Results: Throughout the study period, 2383 individuals presented with malaria-like symptoms. Among them, 1932 individuals tested positive for malaria, resulting in a prevalence of 81.1%. Among the malaria-positive cases, *Plasmodium vivax* was detected in 1431 (74%) cases, while *Plasmodium falciparum* was identified in 501 (26%) individuals. Notably, 85% of males, 67% of non-pregnant females, 36% of pregnant females, 65% of children up to 8 years old, and 95% of children aged 9-18 were afflicted with malaria.

Conclusion: The prevalence of malaria in flood-affected areas is alarmingly high. While the elevated prevalence of *Plasmodium vivax* poses a substantial health risk, the presence of *Plasmodium falciparum* may lead to severe complications.

Keywords: Malaria, *Plasmodium vivax*, *Plasmodium falciparum*, flood pandemic.

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Introduction

Malaria is the most frequent vector-borne illness in human history, affecting around 200 million individuals annually. Malaria affects pregnant women and young children to the tune of 0.6 million yearly fatalities (1). World Health Organization's Global Technical Strategy (GTS) for Malaria 2016-2030 states that the world will not achieve its targets, which aimed to halve the number of fatalities and hospitalizations caused by Malaria by 2020 (2). Instead, the number of reported cases of Malaria has increased annually from 2015 to 2018. The number of reported malaria cases increased from 214 million in 2015 to 217 million in 2016 and 219 million in 2017. Approximately 3.5 million cases of Malaria are documented annually in Pakistan, according to World Health Organization reports (from 2017 and 2018) (3). Pakistan is one of six nations in the WHO Eastern Mediterranean area with significant malaria transmission and about one hundred percent of the population at risk. Due to climate variances, Malaria's endemicity varies across the country's regions and even within specific towns. Pakistan had an average Annual Parasite Index

(API) of 1.8 in 2017. According to 2017 data, the province of Khyber Pakhtunkhwa had the greatest prevalence (30 percent), followed by Sindh (26.5 percent), the Federally Administered Tribal Area (21.9 percent), Baluchistan (20.5 percent), and Punjab (1.1 percent) (2). Malaria poses the greatest danger to public health, economic growth, and development in many parts of the world (4). Its history shows how helpless we are in fighting against pandemics worldwide. The five *Plasmodium* species i.e., *P. vivax*, *P. falciparum*, *P. ovale*, *P. malaria*, and *P. knowlesi*, all are capable of infecting and causing Malaria (4-5). Despite huge and expensive efforts to combat Malaria over many decades, *Plasmodium vivax* accounts for 81.3% of malaria cases in Pakistan, *Plasmodium falciparum* for 14.7%, and a tie between the two species accounts sodium *ovale* and *malaria* account for the remaining 4.0%. *P. knowlesi* is mainly a zoonotic parasite however its incidence of infecting humans has been reported in some countries (2).

Health system breakdown, medication resistance, population migration, poor sanitation, climate change, and unplanned development activities all contribute to the spread of Malaria in

developing regions like Pakistan and Africa (6-7). Plasmodium falciparum, which causes cerebral Malaria, is responsible for the deaths of an estimated one to two million people per year, most of them being children younger than five and pregnant women. One kid dies from Malaria every 30 seconds, and the illness is often linked to others. A youngster might lose their life to acute Malaria within 24 hours. Infant mortality and low birth weight are increased by a factor of four in malaria-endemic regions. In patients with high-risk severe and complex falciparum malaria, a lack of understanding and use of malaria case management recommendations contributes to an elevated fatality rate (2-3). The high yearly parasite prevalence in the coastal, distant, and dry regions of Sindh and Balochistan may be one reason for the low poverty indices in these provinces (6).

Malaria is a climate-sensitive infectious illness spread by mosquitoes. Climate change is an important factor in the development and spread of vector-borne diseases. Long-lasting, heavy rains can lead to flooding, the overflow of surface runoff that drowns cities and farms. Submergence, wet damage, and moisture damage are other names for waterlogging, one of the most catastrophic natural catastrophes, which is often brought on by persistent rain that lacks the ferocity to generate flooding (7).. There have been multiple analyses of how flooding affects Malaria. Standing water from heavy rain or river overflow can both destroy existing mosquito breeding grounds and provide new ones. This flood situation may lead to an increase in vector population and malaria transmission. The post-flood status of Malaria has been characterized in many studies (7-8).

Recent flood has affected all areas of Pakistan and especially Sindh. Many patients are presenting with fever and symptoms of Malaria in flood-affected areas. As various species of Malaria is associated with various mortality rate and few are more resistant than others, the current study was conducted to find the prevalence of Malaria in flood-affected area of district Khairpur, Sindh, Pakistan. Moreover, we aimed to find which species of Malaria is more prevalent so that authorities can take measures and strategies accordingly.

Methodology

This Cross-sectional study was conducted in the district Khair Pur on the rural population during the flood endemic in 2022 from August to September in Khairpur district, Sindh, after getting approval from the institutional ethical review committee. Due to the flood, many patients were suffering from high-grade fever, rigor, and chills. Using a convenient purposive sampling technique, all the symptomatic patients presented at the flood relief medical camp located at khairpur were tested for Malaria using the ICT (immunochromatographic test) method after obtaining informed consent. Detection of malaria-positive cases and types of species were presented in terms of frequencies. The data was computed and entered in SPSS version 25.

Results

During the study period, 2383 individuals presented with malarial symptoms. Among these individuals, 62.7 % were males, 23.75% were females, 2.85% were children having

age amid 2-8years and 10.7% were children of 9-18 years of age. Out of these 2383 individuals, 1932 came out as Malaria positive, yielding a prevalence of 81.1%. Amid the malaria-positive cases, plasmodium vivax was detected in 1431 (74%) cases, and plasmodium falciparum was detected in 501 (26%) individuals, as shown in Table I. Further stratification of data is presented in Table II.

Table 1: Prevalence of Malaria, Plasmodium Vivax, and Plasmodium Falciparum during flood at district Khairpur.

District	Total Test done	Positive Test	Prevalence
Malaria	2383	1932	81.1%
Plasmodium Vivax		1431	74%
Plasmodium Falciparum		501	26%

Table 2: Gender and age categorization of data for the prevalence of Malaria during flood in district Khairpur.

Category	Plasmodium Vivax Positive	Plasmodium Falciparum Positive	Malaria positive (Vivax + Falciparum)	Malaria Negative
Males	1039	231	1270 (85%)	224 (15%)
Non-Pregnant Females	227	136	363 (68.5%)	167 (31.5%)
Pregnant Females	07	06	13 (36.1%)	23 (63.9%)
Children up till 8 years	33	11	44 (64.7%)	24 35.3
Children (9-18 years)	125	117	242 (94.9%)	13 (5.1%)
Total	1431	501	1932 (81.1%)	451 (18.9%)

Discussion

Malaria is a vector-borne illness that becomes endemic in flood-affected regions. Due to the lack of a well-developed healthcare system, prioritization of health-related issues becomes necessary in emergencies like floods. The current study was conducted to determine the prevalence of Malaria and its common variant in flood-affected Khairpur district, Sindh.

Flood has affected more than 33 million people in Pakistan (9). local rescue workers and public health specialists depicted that there would be an increase in the prevalence of several diseases, including Malaria (10). Flooding in Pakistan began in July and has affected 116 of

the country's 154 districts. The flooding was caused by strong monsoon rainfall. Over 1162 individuals have perished thus far. The World Health Organization also stated that access to "health facilities, healthcare professionals, and key medications and medical supplies" are the primary issues faced by the healthcare system (11).

In our current study, the prevalence of Malaria is about 81.1% which is way higher than the previously reported prevalence of approximately 26.5% in Sindh province (2). This increase in prevalence can be linked to multiple factors, flood being top of all. The impacts of flooding on malaria infections were documented in several studies previously (12). Fifty percent of the studies found a strong positive correlation between flood and Malaria. Malaria and other vector-borne illnesses are a major public health concern, and climate change significantly influences their prevalence (13). Between 1990 and 2019, the prevalence of Malaria increased in five African countries: Ethiopia, Kenya, Somalia, Sudan, and Tanzania, due to the increasing frequency and severity of floods (14). After devastating floods in western Uganda, Boyce et al. found that malaria test positive rose by 30% and hospitalizations attributable to the disease rose by 40% (15). According to a study conducted by Yeka et al., Malaria is responsible for more than 95% of post-flood illnesses (16). Mboera and colleagues reveal that malaria cases double on land with irrigation compared to land without irrigation (17-18). As district Khairpur is irrigated land, this may be the factor that leads to an increase in the prevalence of malaria prevalence.

Plasmodium Falciparum was found in 26% of all the cases, which is more than the prevalence of *Plasmodium falciparum* found in studies, i.e. 14.7% (2). Literature reveals that Malaria caused by *P. falciparum*, unlike that caused by *P. vivax*, rose in tandem with August-September temperatures. Flood in this favorable time added to our area's prevalence of *Plasmodium falciparum*. Moreover, irrational use of chloroquine is associated with a rise in *P. falciparum* infection (19). Due to the lack of proper health care services, the irrational use of chloroquine can not be overlooked.

One-third of Pakistan has been affected by floods (20). In the flooded areas of the southern Sindh province, a significant number of basic health units and rural health centers were submerged. To reach flood victims, many medical teams have had to swim (12). Malaria transmission patterns were studied, along with their correlation to flood area (in km²) and flood discharge (in mm³/month). The extent of a flood is the total area inundated, expressed in square kilometers. A flood discharge is an amount of water, expressed in milliliters, that flows through a given location in a specific time period. The strongest correlation between flood extent and the occurrence of clinical Malaria was seen at a lag of six months (Pearson's = 0.467, p 0.05) (21). The correlation between flood discharge and the occurrence of clinical Malaria was strongest when the lag time was adjusted to zero months (= 0.396, p 0.05). According to Chirebvu and coworkers (2016), this finding suggests that malaria transmission patterns follow the ebb and flow of floodwaters. Studies showed that children under five were the most severely impacted (21-23).

During the past several years, Pakistan suffered from a massive epidemic of COVID-19, putting a strain on the

country's healthcare system. Now, weeks of monster floods which brought water and vector-borne diseases, have further destabilized the country (24).

With all these factors in mind, it's clear that we need to take immediate action to implement preventative measures, repair broken healthcare infrastructure, and educate the public about the impending malarial crisis. Volunteers, government agencies, and NGOs are preparing medical camps in case an epidemic breaks out, but it's possible that they won't be enough to contain the situation for very long. It may be possible to achieve this goal by developing tiny camp dispensaries with medications on hand at all hours and by proper awareness.

Conclusion

The risk of contracting Malaria in regions ravaged by flooding is relatively high. *Plasmodium falciparum* may potentially cause severe consequences of cerebral malaria and *Plasmodium vivax*, which substantially threatens public health due to its high prevalence rate. A large number of human cases of Malaria should be a cause for alarm for higher authorities, and swift action is required at this point.

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