ORIGINAL ARTICLE

CHIKUNGUNYA FEVER SURVEILLANCE, OUTBREAK INVESTIGATION, RESPONSE AND ITS DETERMINANTS FACTORS IN PESHAWAR, PAKISTAN: A DESCRIPTIVE AND UNMATCHED CASE-CONTROL STUDY

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Background: Chikungunya is a viral disease transmitted by Aedes aegypti and Aedes albopictus mosquitoes. It is characterized by fever, joint pain, and rash. The first officially confirmed outbreak in Peshawar, Pakistan, was identified in Shamshatoo Camp, which is an Afghan refugee settlement, in 2024. The objective of this study was to identify the determinants of the outbreak, access the magnitude of the outbreak, and implement control measures. **Methods:** The study design was a descriptive study followed by an unmatched case-control study (1:1 ratio) conducted between October 10 and November 26, 2024. Data were collected by administering structured questionnaires, active case search, and review of health facility records. In all, 154 cases were recruited and an equal number of controls. Univariate and multivariable logistic regression were computed to determine the relationship between the outcome and associated factors. Mosquito breeding sites were noted in the environmental survey, and later, laboratory testing confirmed 14 positive chikungunya cases out of 43 samples. **Results:** During the outbreak a total of 416 cases were reported with the peak on November 1, 2024 (32 cases). Females constituted 55% of the total cases and the most affected group belonged to the age group 10–19 years. Other significant risk factors were the presence of mosquito larvae in households (OR 3.2; 95% CI 2.0–5.2), open storage containers for water (OR 3.0; 95% CI 2.0–4.9), and less use of mosquito protection measures (OR 3.4; 95% CI 1.7–6.8). Precaution measures on awareness against vector-borne diseases showed protective effects (OR 0.03; 95% CI 0.01–0.14). **Conclusion:** The outbreak was driven by inadequate mosquito control, favourable climatic conditions (20–30 °C), and community laxity in eliminating breeding sites. Targeted interventions, including vector control, health education, and distribution of insecticide-treated nets, contributed to the decline in cases. However, the absence of a dedicated health facility and poor health-seeking behaviour remain challenges. Comprehensive surveillance and community engagement are essential to prevent future outbreaks.

Keywords: Chikungunya; Aedes aegypti; Aedes albopictus; Afghan refugee; Health education

Citation: Roghani I, Ashfaq M, Sharif MJH, Khan Q, Taj N. Chikungunya fever surveillance, outbreak investigation, response and its determinants factors in Peshawar, Pakistan: A descriptive and unmatched case-control study. J Ayub Med Coll Abbottabad 2024;36(4 Suppl 1):890–5.

DOI: 10.55519/JAMC-S4-12932

INTRODUCTION

Chikungunya is a viral disease caused by the Chikungunya virus (CHIKV), predominantly transmitted by Aedes aegypti and Aedes albopictus mosquitoes.[1] Since its identification in 1952 in Tanzania, the virus has caused intermittent outbreaks across Africa, Asia, Europe, and the Americas. Its global spread has been facilitated by international travel, urbanization, and climate change. Regions in tropical and subtropical zones are particularly susceptible, with recurring epidemics in Southeast Asia, the Indian subcontinent, the Caribbean, and parts of South America. Global reports in November, 2024 highlighted approximately 480,000 chikungunya cases worldwide with more than 200 associated deaths.[2,3]

In South Asia, particularly in countries like India, Bangladesh, and Pakistan, Chikungunya has emerged as a significant public health concern. Outbreaks are typically seasonal, coinciding with monsoon rains that increase mosquito breeding sites. Dense population areas and lack of effective vector control measures exacerbate its transmission.[4–6]

In Pakistan, the first documented outbreak occurred in Karachi in 2016, affecting thousands of individuals. Since then, sporadic cases and localized outbreaks have been reported in various cities,

particularly in Sindh and Punjab provinces. The country's tropical climate and rapid urbanization have contributed to the growing threat of Chikungunya.[7,8]

Peshawar, the capital of Khyber Pakhtunkhwa, has faced outbreaks of mosquito-borne diseases, including Chikungunya. In recent years, the region experienced outbreaks marked by febrile illnesses with symptoms overlapping with dengue fever.

On November 24, 2024, a concerning spike in febrile cases presenting with arthralgia and body aches was reported to the Public Health and Disease Surveillance Response Unit (PDSRU) in District Peshawar. Initial investigations indicated the outbreak of a viral infection. In response to this report, the PDSRU deployed a multidisciplinary team to assess and address the situation in Shamshatoo Camp, Union Council Urmar Bala, Tehsil Saddar, Peshawar to verify the information provided while investigating the cause of disease. Laboratory testing confirmed six cases of chikungunya virus among symptomatic individuals. This outbreak marked the first confirmed chikungunya epidemic in Peshawar.

UC Urmar Bala in Tehsil Saddar of District Peshawar has the local population of approximately 112,884, with 11,134 houses, including 5,013 within Afghan refugee camps having around 8,035 individuals. The area covers 43 square kilometers and consists of 630 Mohalla's and 56 main villages.

Map of the area

Chikungunya fever is a mosquito-borne viral disease caused by the chikungunya virus (CHIKV), a member of the Alphavirus genus in the Togaviridae family. The virus is primarily transmitted to humans through the bites of infected Aedes aegypti and Aedes albopictus mosquitoes, which are also vectors for dengue and Zika viruses. The disease does not spread through human-to-human contact.[9]

The symptoms of chikungunya fever typically manifest 3 to 7 days after a mosquito bite. These include:

Sudden onset of high fever, severe joint pain, predominantly in the hands, feet, knees, and wrists, muscle pain, headache, fatigue, rash and nausea and vomiting. While chikungunya fever is rarely fatal, the joint pain associated with the disease can be debilitating and may persist for weeks, months, or even years in some cases.

While symptoms are debilitating, fatalities are rare. Joint pain can persist for weeks or months. Severe complications, though uncommon, may include neurological manifestations such as encephalitis, cardiovascular complications, chronic arthritis, particularly in patients with pre-existing joint disorders

Rarely, multi-organ failure in vulnerable populations like the elderly or immunocompromised individuals. Currently, there is no specific antiviral treatment for chikungunya fever. Management focuses on relieving symptoms through analgesics, antipyretics, and adequate hydration. Preventive measures include eliminating mosquito breeding sites, using insect repellents and

protective clothing and employing mosquito nets and window screens. Preventive measures include the use of DEET-based repellents, protective clothing, and elimination of mosquito breeding sites.[10–12]

MATERIAL AND METHODS

The study employed a two-phase design, initially with a descriptive study followed by an unmatched case control study in a 1:1 ratio.[13] The study was conducted from October 10 to November 26, 2024, focusing on the residents of Shamshatoo Camp. A total sample size of 154 cases and 154 controls was selected for the case-control phase. Data was collected using structured questionnaire, active searches and healthcare facilities records. The questionnaire included information on demographic profiles and sanitation practices and was administered to all cases and controls. Statistical analysis was conducted using MS Excel and Epi 7.2, employing both univariate and multivariate analysis to evaluate the data.

Case Definition

Operational case definitions were constructed:

Suspected Case: Any resident of AR camp Shamshatoo who developed an illness with acute onset of fever, arthralgia, body aches with or without rash after 10th Oct 2024 not explained by other medical conditions.

Confirmed Case: "A case that meets the clinical case definition and is laboratory confirmed or is epidemiologically linked to a confirmed or a suspected case." OR "Two suspected cases that are epidemiologically linked are considered confirmed, even in the absence of laboratory confirmation."

An unmatched case control study at a ratio of 1:1 was conducted to test our hypothesis that the outbreak was associated with presence of larvae in the surrounding and limited use of insecticides bed nets /repellants by the community.

Environmental Investigation: An environmental investigation was carried out by observing water and sanitation practices and identifying potential mosquito breeding sites within Shamshatoo Camp, located in Union Council Urmar Bala, Tehsil Saddar, Peshawar. After reviewing patient records, a hotspot area within the camp, consisting of over 150 houses, was selected to calculate the House Index, which represents the percentage of houses infested with mosquito larvae or pupae. Larva identified in multiple houses and containers were sent to determine the infectivity rate. Laboratory Investigation: Human serum samples were collected and sent to Public Health Reference Laboratory, Khyber Medical University, Peshawar for laboratory confirmation of chikungunya through PCR method.

RESULTS

During the outbreak period, 416 cases were reported with first case identified on 10 October 2024. Maximum cases 32 in total were reported on 1 November 2024 (Figure 1). Majority of cases 227 (55%) were reported in females' patients. Age-wise distribution of cases revealed the 10-19 years age group were highest (n=128) among all affected groups. More than half cases (n=238) were reported in street 4 and 5 with an overall attack rate of 5% (population 8035).

The bar graph presents the percentage of Chikungunya cases who experienced fever, joint pain, and rash during the outbreak period. Fever was the most common symptom, reported in approximately 100% of the cases. Joint pain was also highly prevalent, affecting around 100% of the cases. Rash was less common, with approximately 60% of cases reporting this symptom (Figure 2).

Larva present in the home/surrounding was associated with increased risk of getting ill [odds ratio: 3.2 (95% CI2. 0–5.2 *p*-0.000) and not covering water storage drums also showed significant association with getting ill [odds ratio: 3.0 (95% CI 0-4.9 *p*-(0.000)) limited use of mosquito protection by community 3.4 (95% CI 1.7 -6.8) respectively, while preventive awareness about Vector diseases of community showed protective effect odds ratio: 0.03 (95% confidence interval 0.01-0.14).

Out of 43 blood samples sent for test to Public Health Reference Laboratory Khyber Medical University 14 were found positive for Chikungunya virus on PCR Testing. Larvae identified in multiple households confirmed the presence of Aedes mosquitoes.

To address the situation, several measures were implemented. Entomologists and their teams were deployed to eliminate mosquito larvae in the affected area, while long-lasting insecticide-treated nets (LLINs) were distributed to patients within the community. Advisories were issued to nearby health facility in-charges for the establishment of isolation wards. Teams were mobilized alongside Town Municipal Administrations (TMAs) to conduct indoor and outdoor residual spraying (IRS) and protective fogging. The district health team organized health education and treatment camps, emphasizing awareness and prevention. Local community elders, schoolteachers, and clerics were sensitized to disseminate information on acute watery diarrhoea (AWD) prevention and control measures. Health promotion messages were displayed at the treatment facility, and women were educated on

proper water handling during storage to reduce contamination risks.

EPI CURVE:

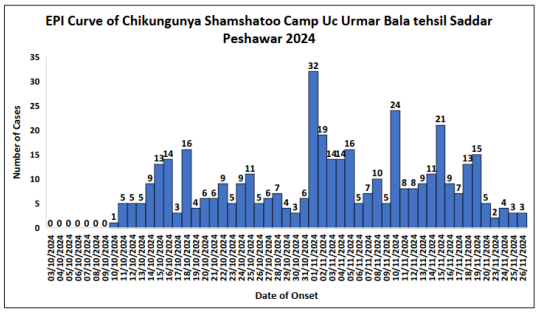

Figure 1: Epi Curve of Chikungunya cases of Shamshatoo Camp Uc Urmar Bala tehsil Saddar Peshawar 2024 from 10th Oct 2024 to 26th Nov 2024. (n=416)

ATTACK RATES

Name of Area	Total Population	Population at Risk	Total Cases	Attack Rates per 10
Shamshatoo Camp	8,035	8,035	126	5 per 100 population

Table 1: Chikungunya attack rate in of Shamshatoo Camp

Age Group	Population in age group	Total Cases	Attack Rates Per 100
0-9Years	2522	69	3 per 100 population
10-19 Years	1888	128	7 per 100 population
30-39 Years	883	63	7 per 100 population

Table 2: Shows Age-Related Chikungunya attack rates in of Shamshatoo Camp

SYMPTOMS FREQUENCY:

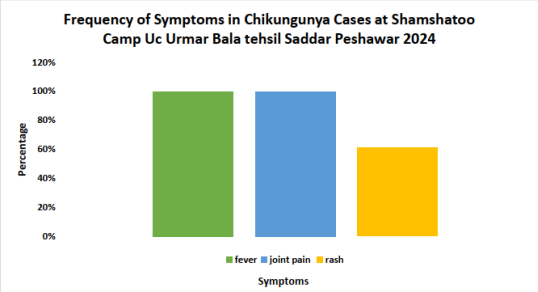

Figure 5: **Chikungunya cases of Shamshatoo Camp Uc Urmar Bala tehsil Saddar Peshawar 2024 from 10th Oct 2024 to 26th Nov 2024. (n=416)**

CASES DISTRIBUTION SELECTED EXPOSURE VARIABLES:

Exposure variables	Cases	Controls	Odds ratio	95% Confidence Interval
larva Present home/surrounding	106	51	3.2	2.0-5.2 P (0.000)
Use of Mosquito Nets/ repellents	117 (not using)	142 not using	3.4	1.7-6.8 P (0.000)
Covering water source	112 not covering	72 not covering	3.0	2.0-4.9 P (0.000)
Preventive awareness about vector diseases	83	69	0.6	0.4 - 1.0 P (0.05)

DISCUSSION

The chikungunya outbreak in Shamshatoo Camp, Peshawar, was the first confirmed occurrence in the area, affecting a highly vulnerable refugee population. The outbreak was confirmed through laboratory detection of the chikungunya virus in 14 of 43 blood samples. Epidemiological and environmental investigations identified key factors contributing to the outbreak. Larvae were detected in multiple houses and containers, with entomological evidence pointing to inadequate vector control and sanitation practices as primary contributors.

The outbreak exhibited a clear temporal pattern with a peak in cases on November 1st. This temporal pattern can be further analyzed to identify potential factors influencing the transmission dynamics, such as seasonal variations in vector abundance, changes in human behaviour, or environmental factors. The higher proportion of cases among females warrants further investigation. Possible explanations could include differences in occupational exposure, outdoor activities, or clothing choices that may influence mosquito bites. The highest number of cases in the 10–19 years age group is noteworthy. This could be due to increased outdoor activities, school attendance, and social interactions among this age group, potentially leading to higher exposure to infected mosquitoes. The concentration of cases in streets 4 and 5 suggests potential hotspots for transmission. Factors such as mosquito breeding sites, population density, and socio-economic conditions in these areas should be explored to understand the spatial distribution of the outbreak. The high prevalence of fever and joint pain in Chikungunya cases is consistent with the typical clinical presentation of the disease. This information can be used to raise awareness among healthcare providers and the public regarding the common symptoms of Chikungunya and facilitate early diagnosis and management.

The findings highlight the need for targeted vector control measures, particularly in areas with high case densities like streets 4 and 5. Continued surveillance is essential to monitor the outbreak and assess the effectiveness of control measures. This should include active case finding, laboratory testing, and data analysis to track the temporal and spatial trends of the outbreak.

The findings of this case-control study provide valuable insights into the risk factors associated with Chikungunya infection in the study population. These findings underscore the importance of multi-pronged approach to Chikungunya prevention and control, including vector control, community engagement, and access to protective measures. Extended weather conditions with temperatures ranging from 20–30°C provided an ideal environment for Aedes aegypti breeding, similar to outbreaks in other tropical regions.[14] Community laxity in eliminating standing water and ineffective surveillance further exacerbated the outbreak, as evidenced by the high attack rate of 7 per 100 in the most affected age groups.

Although no fatalities were reported, the significant morbidity underscores the public health burden of chikungunya. Joint pain and other debilitating symptoms may lead to long-term socio-economic impacts, particularly in resource-limited settings like Shamshatoo Camp. Efforts to control the outbreak included targeted vector elimination campaigns, distribution of insecticide-treated nets, health education, and community sensitization. These measures contributed to the decline in active cases, demonstrating the effectiveness of integrated outbreak response strategies. However, the lack of a dedicated health facility, informal healthcare practices, and poor health-seeking behaviour remain significant barriers to effective outbreak management.

The strong association between the presence of mosquito larvae in or around the home and increased risk of Chikungunya infection underscores the critical role of vector control measures. This finding is in agreement with previous studies conducted in Pakistan and India.[15-17] This finding emphasizes the need for targeted interventions to eliminate mosquito breeding sites, such as stagnant water in containers, gutters, and other potential sources. The significant association between not covering water storage drums and increased risk highlights the importance of proper water storage practices. Covering water containers can significantly reduce mosquito breeding and thus lower the risk of transmission.[18-19] The finding that limited use of mosquito protection measures (e.g., mosquito nets, repellents) was associated with increased risk emphasizes the need for promoting and facilitating access to these protective measures among the community as evident from the study of. [20,21]

The protective effect of community awareness about vector-borne diseases suggests that public health education campaigns can be effective in reducing the risk of Chikungunya infection.[22] These campaigns should focus on promoting knowledge about mosquito-borne diseases, their transmission, and preventive measures. The findings strongly support the implementation of comprehensive vector control strategies, including: Targeting mosquito breeding sites through larvicides, using insecticides to kill adult mosquitoes and, eliminating or modifying potential mosquito breeding sites, such as stagnant water containers.[23,24]

Engaging with the community is crucial for successful outbreak control. Conducting community awareness campaigns is the primary step to educate the public about Chikungunya prevention and control measures. In addition, community members should be mobilized to participate in vector control activities and adopt preventive behaviours.

CONCLUSION

The chikungunya outbreak in Peshawar was driven by inadequate mosquito control, extended favourable weather conditions (20–30 °C), and community laxity in vector management. The outbreak peaked in mid-November and is now declining, with no reported fatalities. The most affected age group in the outbreak was 10–19 years, with 128 cases reported. The highest number of cases occurred on November 1, 2024, with 32 cases reported that day. The chikungunya outbreak was attributed to inadequate mosquito control and surveillance measures, coupled with a lack of community awareness about vector control strategies. Extended weather conditions with temperatures ranging from 20 to 30°C created a favourable environment for the breeding of Aedes mosquito larvae, which facilitated the outbreak. Additionally, community negligence in eliminating water sources that serve as mosquito breeding grounds further contributed to the spread of the disease.

Recommendations:

To effectively manage the outbreak and prevent future occurrences, several key actions are recommended. A dedicated health facility should be established in the area to provide targeted care. Extensive and intensive vector control measures, including the elimination of mosquitoes and larvae, must be prioritized, coupled with regular indoor and outdoor surveillance activities. Supervisory visits by the entomologist and the Deputy District Health Officer should ensure the effectiveness of vector elimination campaigns. Provision of POL (Petrol, Oil, and Lubricants) to Public Health Coordinators and other supervisory staff is essential to facilitate field activities. Coordination with the Afghan Consulate should be strengthened to mobilize support for the community through international and local NGOs. Additionally, a separate focal person should be nominated to oversee health initiatives in Shamshatoo Camp. Lady Health Workers (LHWs) and Lady Health Supervisors (LHS) should organize health education sessions in the most affected areas to raise awareness about chikungunya prevention and control.

Limitations:

The area faces several challenges that hinder effective healthcare delivery and disease control. There is a lack of a dedicated health facility, leaving residents with limited access to formal medical care. The presence of informal healthcare providers further complicates the situation, as they do not maintain proper patient records, making it difficult to track and manage health conditions. Additionally, the community exhibits poor health-seeking behaviour, often delaying or avoiding

medical consultation, which exacerbates the spread and impact of diseases.

AUTHORS' CONTRIBUTION

IR, MA: Concept, Literature search, write-up, proof reading. MJHS, QK, SM, NT: Data collection, data analysis, data interpretation.

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Submitted: November 29, 2024	*Revised: December 9,2024*	*Accepted: December 9, 2024*

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