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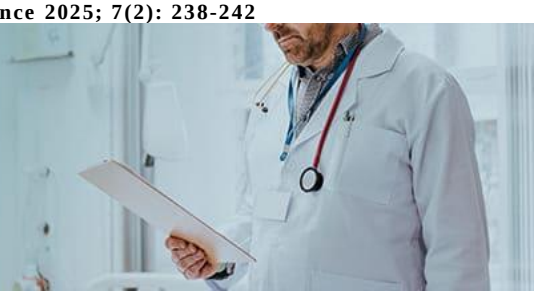

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Chikungunya-A Crippling Concern: A hospital based serological study from Nagpur, Maharashtra, 2024

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Abstract
Background: Chikungunya is arboviral disease caused by chikungunya virus belonging to genus Alphavirus and genus *Togaviridae*. Virus is transmitted by vector like *Aedes aegypti* and *Aedes albopictus*. Chikungunya presents with sudden onset of fever, joint pain and swelling, rash, headache, lower back ache and conjunctivitis. The aim of this study was to study prevalence of chikungunya and post chikungunya arthritis in Nagpur.
Methods: This prospective observational study was carried out at Viral Research Diagnostic Laboratory, Department of Microbiology, Indira Gandhi Government Medical College, Nagpur between May 2025 and July 2025. 4897 serum samples from suspected chikungunya cases from June 2024 to December 2024 were tested in virology lab using chikungunya IgM MAC ELISA kits provided by NIV, Pune. Along with this we called 670 confirm positive cases telephonically till three months to enquire about post arthritis and its duration.
Results: 4897 samples tested, 1462 samples were positive for chikungunya giving attack rate of 29.85%. Knees and ankle were most commonly involved joints. The younger population recovered in 10-15 days while as elderly population showed lingering symptoms even after 3 months of infections.
Conclusions: Chronicity and lingering symptoms were majorly seen in elderly population leading to poor quality of life. Therefore, there is need of long term follow up.

Keywords: Nagpur, Maharashtra, Chikungunya, arthralgia, *Aedes*, crippling concern

Introduction
Chikungunya virus (CHIKV) is arboviral disease re-emerged in many parts of the world causing large-scale outbreaks [1]. It is caused by chikungunya virus belonging to genus *Alphavirus* of family of *Togaviridae* [2]. Chikungunya virus was first reported in Tanzania in 1952 after that virus spread world wide. It was first reported in Calcutta, India in 1963 [1, 2] *Aedes aegypti* and *Aedes albopictus*, main vectors for transmission are day biters [3, 4]. The incubation period is variable from 2 to 12 days [3, 5].
Chikungunya infection causes sudden onset of high fever, polyarthralgia and maculopapular rash. Other symptoms include headache, joint pains and swelling, lower back-pain GI symptoms and conjunctivitis [3]. The most significant characteristic of chikungunya infection is the prolonged joint pain and restricted joint movements, primarily affecting small joint of hands and back with excruciating pain [4, 5]. Although CHIKV infection has low mortality, when progressed to the chronic phase, it may incapacitate the patient for weeks and even for several years, leading to reduced joint movements and poor quality of life [6]. Overlapping symptoms and common vector with dengue and malaria present many challenges for diagnosis and treatment of this disease. Compared to previous outbreaks of chikungunya in this region, the recent outbreak had caused serious and prolonged joint aches which has increased the economic burden on health system.
This study investigated the seroprevalence of chikungunya in this area, causes of outbreak and pattern of clinical manifestations of chikungunya patients.

Methods
This is a prospective observational study and was conducted in Viral Research and Diagnostic Laboratory (VRDL), Department of Microbiology, Indira Gandhi Government Medical College (IGGMC) during the month of May 2025 to July 2025.

Patients presenting with Chikungunya case definition according to WHO: Individual with acute onset of fever (> 38.5 degrees Celcius) and severe arthralgia/arthritis, not explained by any other medical condition, who has resided or visited an area with reported Chikungunya transmission within 15 days prior to symptom onset were included in the study. Related data of patient's personal information, clinical symptoms, epidemiological data and test results were collected from laboratory data excel sheet and VRDL case sheet forms.

Approximately 5 ml of blood was collected from each patient and stored at 4 degrees Celsius. Serum was separated by centrifugation at 6000 rpm for 15 min. Serum of the patients were then tested for Chikungunya virus-specific Immunoglobulin M (IgM) antibodies using the CHIKV MAC capture ELISA kits provided by NIV Pune. Samples were stored at -70 degrees Celsius after testing for further analysis. The record of follow up positive cases were kept.

670 positive cases were contacted telephonically and were followed up for 6 months. Information about relapse of pain symptoms, chronicity of arthritis and joint dysfunction were noted. Results were expressed in frequencies proportions and percentages.

Data from Microsoft Excel sheet was analysed. Categorical variable such as age, sex, and clinical symptoms was summarised as frequencies and percentages, which were displayed in tabular form and visualised using bar diagrams. The attack rate was calculated to determine the proportion of new cases occurring during the outbreak period. Line charts were used to show the seasonal trends.

Results

A total of 4897 suspected cases were included in this study. The CHIKV test was positive in 1462 cases and the attack rate was 29.85%. Of 4897 suspected cases, 2405 (49.11%) were males and 2492 (51.89%) were females. Male to female ratio is 0.97. The positivity in males was 692/2405 (28.77%) while as in females it was 770/2492 (30.89%).

Table 1: Age wise distribution of Chikungunya cases (N=4897)

Age	Suspected cases	Positive cases	Positive percentage (%)
< 1 year	54	17	0.34
1-12 years	792	190	3.87
13-25 years	1767	597	12.19
26-40 years	1032	344	5.59
41-55 years	956	274	5.98
> 55 years	296	172	1.85
Total	4897	1462	29.85

Table 2: Pattern of joint involvement among positive cases of Chikungunya

Involved joint	No of cases	Percentage (%)
Knee	1111	75.99
Ankle	818	55.95
Elbow	790	54.03
Small joint of hands	933	63.81
Shoulder	526	35.97

Table 3: Recovery period of arthralgia among positive cases of chikungunya (N=670)

Recovery period	No of cases (%)	Age group affected mainly
10-15 days	297(44.32)	< 25 years of age
1-2 months	193(28.80)	26-50 years of age
More than 3 months	121(18.05)	>50 years
Recurrent arthralgia	59(8.80)	>60 years
Total	670(100)	

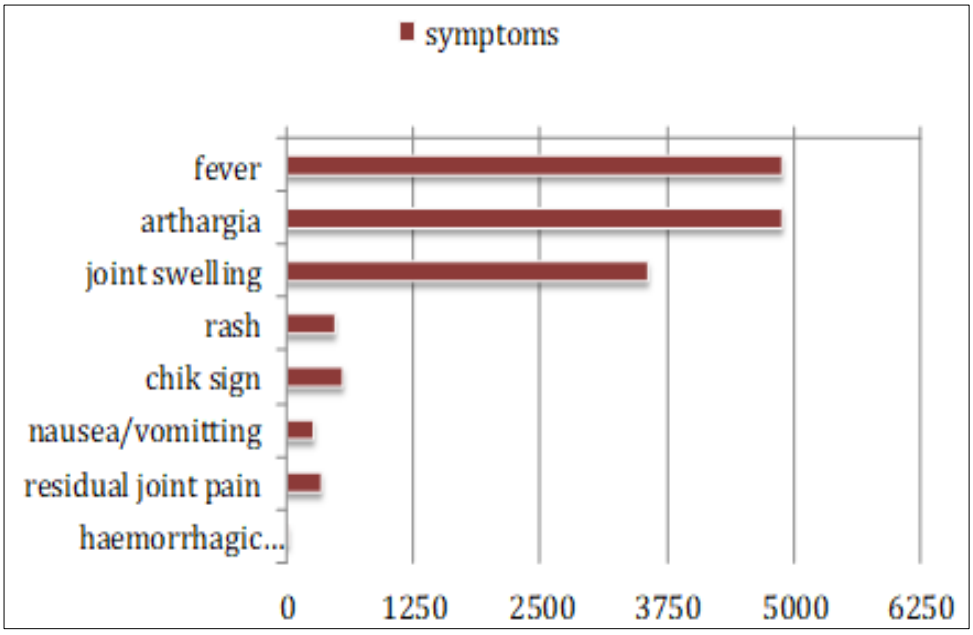

Fig 1: Clinical symptoms of suspected cases of CHIKV

To observe long term effects, of Chikungunya and recovery of joint pain, 670 confirmed positive cases were contacted telephonically. Younger population recovered in 10-15 days without any lingering symptoms, while as elderly population moved towards chronicity with recurrent and severe joint aches.

Geographical distribution of suspected cases revealed that 76% of positive cases resided in urban slums while as only 24% lived in rural areas.

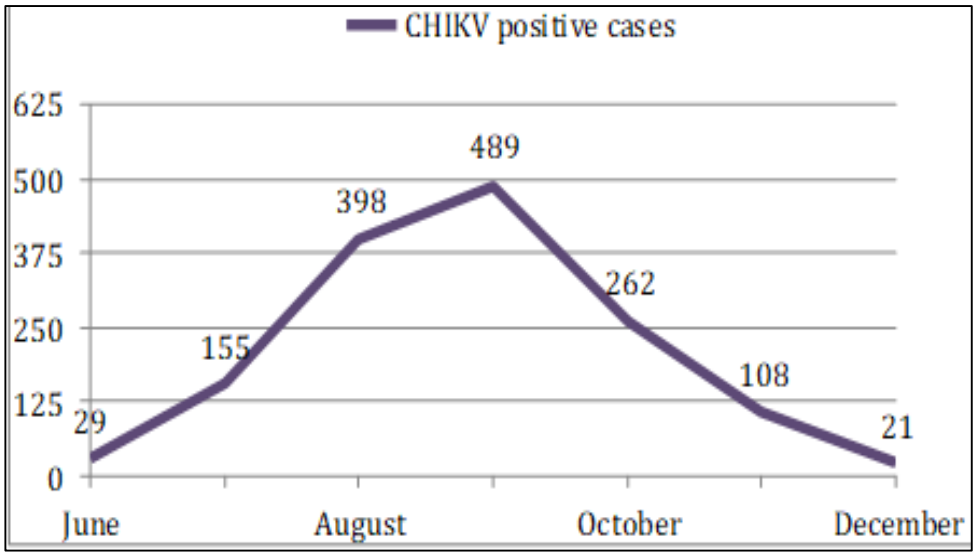

Fig 2: Month wise distribution of positive CHIKV cases

Discussion

A total of 4897 serum samples were tested for CHIKV by IgM ELISA between June 2024 to December 2024 of which 1462 samples were positive. The attack rate was calculated as 29.85%. 4897 samples tested in this study, 2405(49.11%) were males and 2492(50.88%) were females. Of total 2405 males included in this study 692(14.13%) were positive and 770(15.72%) of 2492 females were positive by chikungunya IgM ELISA.

The attack rate in study by Dumpala *et al.* and Jain SK. *et al.* was 19% and 2.57%, which was much less compared to our study [3, 7]. On other hand, Suneel Kumar *et al.* reported high seroprevalence of chikungunya as 76.7 % in central India [8].

The maximum number of cases of belonged to age group 21-30 years of age group followed by 31-40 years. Rajderkar *et al.* also reported maximum cases in young adult age group of 25-40 years [1]. Similar findings were reported by Dumpala *et al.* and Jain SK. *et al.* [3, 7] This can be attributed to risk involved in daily activities and occupation by this age group, also being immunologically naive. While as Suneel Kumar *et al.* and Chundawat *et al*. reported most common age group affected was 40-50 years [8, 9]. Our study also observed that as age increases, more number of females were infected by chikungunya. This can be attributed to women spending more time indoors are at high risk as these mosquitoes dwell in houses and in domestic areas. *Aedes* mosquito being lazy mosquito, bite members in same family in day time. Similar results were seen in study carried by Chundawat *et al.* where females were infected more than males [9]. Other study by Suneel Kumar *et al.* observed more male preponderance [8].

After inoculation from mosquito bite CHIKV replicates first in skin fibroblast as only skin fibroblast and osteoblasts are susceptible to CHIKV [10, 11]. After replication it spreads to liver, muscle tissue, lymph nodes and brain through blood stream. CHIKV replicates in "muscle satellite cells" and not in muscle fibers, joint fibroblast or synovial tissue. Muscle satellite cells are stem cells crucial for skeletal muscle growth, repair and regeneration [10]. These are mono-nucleated cells residing in quiescent state in between sarcolemma and basal lamina. These cells are activated in response to injury, exercise or physical stress. CHIKV replication in satellite cells leads to cytopathic effect causing damage and dysfunction. These cells also serve as reservoir of the virus contributing to chronic myalgia and long-term effects of chikungunya infection [12]. Muscle biopsy from patient during relapse of pain in chronic chikungunya patient showed presence of CHIKV antigen in muscle satellite cells [11].

In acute phase of chikungunya infection, intense viremia associated with activation of host type1 interferon and IL-6.[13] Infected osteoblasts increase the recruitment of monocyte into the joints resulting in arthritis [11]. Other cytokines, chemokine and soluble factors (IL-4, IL-7, macrophage inhibiting factor, CCL4, CCL2, CXCL10) are activated. These leads to clearing of virus by macrophages, CD8+T cells and NK cells within 7-10 days [13]. IL-6 activates muscle metabolism to increase body temperature. It is pleiotropic cytokine and has destructive role responsible for pain and inflammation [10]. High level of IL-6, IL-1, RANTES, monocyte chemoattractant protein, monokine induced by gamma interferon are associated with disease severity [11]. Increased levels of C-reactive protein (CRP) is associated with lymphopenia, high viral load and persistent arthralgia [10].

All the suspected cases presented with fever and arthralgia initially. Most common joints involved were knees, ankles, wrists and elbows. The joint pain with joint swelling was bilateral and, in many cases, presented with limited movement of joints due to excruciating pain. Our study mainly involved large joints of body. This finding was different from the reported in 2007 outbreak, where smaller joints of wrists were most commonly involved [2]. Other common symptoms were headache and lower back ache. Our findings were similar to Reshma *et al.* [2] Maculo-papular rash was seen all over body in initial days in 484/4896 (9.88%) of suspected cases while as chic sign was seen in 547/4896 (11.17%) of suspected cases. Gastrointestinal and hemorrhagic symptoms were least common.

On telephonic conversation with 670 positive patients after at least 3 months of infection, 121 positive patients had recurrent joint pains and swelling. Most common affected joints were knees and ankles making them walk with difficulty. Worst affected was elderly population above 50

years of age where Chikungunya infection progressed chronically. Some patients complained of joint pains even after 6 months of infection. The severity and duration of disease was less in younger patients as compared to elderly population. Pain symptoms were relieved in 10-15 days in younger population while as symptoms persisted even after 3 months in elderly population. Elderly succumb to chronic Chikungunya and its lingering symptoms due to low immunity and pre-existing co-morbid conditions. Reshma *et al.* 25.7% of affected people had recurrence of symptoms after one week whereas in 2007 outbreak, 88.5% of affected people had persistent arthralgia after one week of infection [2].

Young people tend to have robust innate immune response for CHIKV, leading to rapid viral clearance from body and less severe disease than elderly. This is due to higher levels of immune mediators (pro-inflammatory cytokines and chemokine) in young population. Immune response begins diminishing with age due to decreased number of circulating Dendritic cells (DCs) in older adults. DCs in elderly also have impaired chemotactic ability. NK cells from elderly also show decreased cytotoxicity and IFN gamma and granzyme B production. Macrophages also have lower phagocytic activity and declines nitric oxide production [14, 15]. Gerardin *et al*. identified age > 45 years, severe rheumatic involvement at time of presentation and CHIKV-specific IgG titers as the main risk factors for relapsing or lingering rheumatic manifestations [16]. Chang *et al*. reported chronic cases were associated with higher education, initial symptoms of headache or knee pain, and more aggressive acute disease (missed work, normal activities affected, more than 3 days of initial symptoms, and more than 3 weeks of initial joint pain) [17]. According to Santiago *et al.* rheumatic lesions in the chronic phase of the CHIKF is result from the virus ′ability to reproduce, its ability to damage joint tissue and immune response of the infected individual [6]. Koen Bartholomeeusen *et al.* said that affected individuals demonstrate faulty immune responses. Persons with chronic arthralgia had higher levels of IL-6 than those who had recovered from initial infection, which suggests an ongoing distorted ratio of RANKL to OPG leading to persistent bony erosions. Also, levels of IL-17 and another cytokine responsible for bone breakdown and resorption, were higher among patients with persistent arthralgia [18].

Most of the chikungunya cases belonged to urban slums. Overcrowded living conditions, poor residential plans, no treatment of sewage water, ongoing metro construction work, poor water storage practices and low literacy rates are reasons for high breeding places in slums.

The outbreak started in hot month of June and peaked in month of September coinciding with heavy rainfalls. After that cases started steadily declining. Similar scenario was seen in study by Jain SK. *et al*. [3] Environmental conditions like high temperature, rainfall and humidity is a major factor for the distribution of the vectors in particular geographical areas**.** Vector survives best between the temperature of 16 °C and 30 °C and humidity of 60-80% [19].

Until commercial vaccines are available, prevention the best way to combat infection. Personal protective measures and eliminating mosquito breeding sites is key measures to prevent further outbreaks. People in this area used personal protecting measures like mosquito repellants, but mostly during night time. This did not provide any protection as *Aedes* mosquito is day biter. Full light colored clothing to reduces skin exposure to day-biting vector was recommended for protection.

4. Conclusion

Being a tropical country with moderate rainfall and high temperatures, Nagpur is best breeding sites for *Aedes* mosquitoes. Expanding urbanization, poor water storage practices, low literacy rates and unawareness were major contributing factors. Present study indicates high female preponderance with increasing age. Chikungunya is a silent threat in shadows of dengue. Screening of dengue with chikungunya should be done because of overlapping symptoms and chikungunya diagnosis is often missed. Chronicity and lingering symptoms were majorly seen in elderly population leading to poor quality of life. Therefore there is need for long-term patient follow-up. Chronic chikungunya cases poses major threat but is underestimated burden in this area. It is not just debilitating polyarthralgia, but also adds to burden on health care system. This outbreak highlights the urgent need of community support and participation for prevention of further outbreaks

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