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Original Research Article

Seroprevalence of Chikungunya Fever at a Tertiary Care Hospital

Gaurav Chotaliya, Rashmika Parmar, Hiral M Gadhavi*, Hitesh Shingala

Department of Microbiology, Shri M.P. Shah Government Medical College, Jamnagar, India

*Correspondence: Dr Hiral M Gadhavi (hiralgadhavi6@gmail.com)

ABSTRACT

Background
The Chikungunya (CHIK) is a viral infection caused by CHIK virus which is an arbovirus that belongs to the genus alphavirus under the Togaviridae family. CHIK infection is transmitted to humans by the bite of mosquitoes namely Aedes albopictus and Aedes aegypti. Since Chikungunya fever leads to long term residual arthropathy – like complications which causes hampering in routine work of person after recovery, it is still believed that chikungunya fever is a major burden on public health even in post COVID-19 era.

Aims and Objectives
We need to understand and evaluate the seroprevalence of chikungunya with reference to its study period, seasonal tendency, need for hospitalization and age-sex distribution.

Materials and Methods
A retrospective study was done in 305 suspected samples of chikungunya infection with history of Fever along with joint pain, myalgia between January 2020 to December 2023. Separated serum samples suspected to have Chikungunya infection were subjected to IgM capture ELISA for detection of IgM anti-chikungunya antibodies using IgM antibody capture ELISA produced by National Institute of Virology, Pune, India (NIV, Pune, India). Various statistical tests were done to find out statistical significance with p-value < 0.05 kept as statistically significant.

Results
Total 305 samples were tested for Chikungunya IgM antibody detection. 55 out of 305 samples were tested positive for CHIK-IgM antibody (18.03%). Out of total 55 positive samples, 32 (58.18%) were belonged to Males and remaining 23 (41.81%) to females (p-value for gender distribution=0.224). The cases varied significantly by age group (p=0.0328), with the highest number of positives from 41-60 years age-group (38.18%). All positive cases having fever and joint pain as chief complaints (p<0.0001). The post-monsoon period having a greater number of positive samples.

Conclusions
18.03% is the seroprevalence that we found out in our study. As the years progressed from 2020 to 2023, the number of samples and positive cases also increased. This clearly suggest that CHIK fever is still a public health concern and so early diagnosis and prompt treatment required along with need to develop proper strategies to prevent the spread of this vector – borne disease in the community.

Keywords: Seroprevalence, Chikungunya, Joint pain, Arthropathy, Post-COVID Fever, ELISA, IgM

INTRODUCTION

Chikungunya fever is a viral disease which is caused by chikungunya virus. The chikungunya virus belongs to Alphavirus genera which comes under Togaviridae. This virus is a single-stranded RNA virus and the disease is a vector-borne infection to human beings. The infection is transmitted to humans by biting of mosquitoes which are Aedes Albopictus and Aedes Aegypti.

The word Chikungunya fever was described in 1952 after the outbreak on Makonde plateau in Tanzania. [Lumsden; 1955, Robinson; 1955].[1,2] The chikungunya name is historically derived from Makonde word of "KUNGUNYALA" which means to bend up or to get folded with respect to stooped posture developing as a result of arthropathy/joint pain in this illness.[3] Historically, the epidemics of fever and arthropathy were there as far back as 1824, similar to present day CHIK fever. [WHO 2012, Puntasecca et al., 2021].[4,5] For the first time in INDIA in 1963, chikungunya fever was reported and first outbreak occurred from Kolkata, West Bengal. The outbreak was from 1963 to 1973. Then after 32 years, emergence of CHIK virus occurred in Indian ocean islands in 2005 [Lahariya and Pradhan; 2006][6] ,affecting Hyderabad and Ananthapur district of Andhra Pradesh in South India and eventually affected 1.4 million people in 13 states [Schuffenecker et al, 2006].[7] Ahmedabad city of Gujarat and Kerala were the worst affected places [Sudeep & Parashar, 2008].[8] The reemergence of chikungunya in 2005 occurred due to a very important mutation in virus called E1-A226V mutant in which alanine in the 206th position of E1 glycoprotein gene is replaced by valine, also the new vector Aedes albopictus was highlighted.[3,9] Till 2005-06 outbreak, 13 states reported CHIKF cases but in 2009, 15 states and subsequently in 2019, 30 states and union territories reported chikungunya fever cases.[10]

The human transmission of infection is caused by Aedes type of mosquito which bites during the day time, although vertical transmission from mother to baby can occur, it is rarely reported. The mosquito will acquire the virus when it bites the infected person having viremia. The virus replicates in the midgut of mosquito and travels through its body cavity and ultimately reaches the salivary gland of mosquito. So, through the saliva of the mosquito, CHIKV gets secreted by the bite of mosquito, again a new host gets infected and the transmission cycle continues. In the urban transmission cycle, the transmission occurs between human and Aedes aegypti mosquitoes whereas in the sylvatic pathway in African forest, the virus is sustained in monkeys [which serves as reservoir] and other different species of Aedes mosquitoes.[3]

The outbreak of CHIK occurs in post monsoon period. It is believed that during this period, more vector density is present. The CHIK infection has incubation period of 2-6 days but may extend up to 10 days followed by a sudden onset of high-grade fever and intense arthralgia. The acute stage of CHIK fever characterized by high fever often poorly responds to antipyretics. Anorexia, nausea, vomiting, myalgia and even confusion in the old age was reported. Back pain, fatigue and headache are less frequently reported symptoms. Bilateral polyarthralgia is noted as a typical symptom affecting mainly small joints like ankle, wrist, phalanges and also large joints like knees and elbows [WHO, 2009].[11] Cutaneous lesions like maculopapular rash are characterized by edematous and itchy skin affecting face and trunk.

Although bleeding because of reduced platelet count, reduced WBC count and retro-orbital pain which are more of dengue related symptoms are less commonly reported here in CHIK infection. In the chronic stage of CHIK infection, the person may develop polyarthralgia of small joints which may last for several years. Mostly this disease is self-limiting and usually resolves within a week.[12] The diagnosis of this viral infection can be achieved by viral isolation technique, antigen detection, antibody IgM/IgG detection and RNA detection by PCR method.[10] The cost effective and widely used method is antibody detection against chikungunya virus in the serum of the affected patient. The marker of acute chikungunya infection is IgM antibody surged in the serum and can be detected by CHIK-IgM capture ELISA by NIV, Pune. IgM starts to rise after the onset of symptoms like fever and is detected up to 5 days in serum sample. Then after, IgG antibody against chikungunya virus starts to rise and can be detected up to 5 to 6 months also, however it may persist in serum for many years.[10]

With respect to Covid-19 pandemic, testing facilities for CHIKV were limited at the most of the places. It is still believed that chikungunya fever is a major burden on public health causing morbidity in form of inflammatory polyarthropathy. That's why we need to understand and evaluate the seroprevalence of chikungunya with reference to its study period, seasonal tendency, need for hospitalization, age-sex distribution, especially after covid-19 pandemic.

MATERIALS AND METHODS

The retrospective type of study was conducted at a tertiary care hospital in the western part of Gujarat over 305 suspected samples of chikungunya fever received from different wards and OPDs of the same tertiary care hospital from January 2020 to December 2023; a 4-year time-period. The collected blood samples of suspected CHIK fever were directed to centrifugation in order to receive clear separated serum. The serum samples were stored until testing was done; in proper sterile aliquots and in deep freezer. Then at the time of testing, the stored samples were taken out in order to achieve the room temperature. We tested the

samples by detection of IgM antibody against chikungunya virus by ELISA technique. This method is widely used in the most of the laboratories because universal and trustworthy supply by National Institute of Virology, Pune (NIV, Pune). The tests were carried out as per the manufacturer's instructions. The ELISA kit used at our facility was IgM antibody capture ELISA test kit is produced by NIV, Pune. The clinical complaints and demographic details of patients whose sample came positive for CHIK fever were also noted.

Statistical Analysis

The data collected to find out chikungunya seroprevalence over the four-year time period from January-2020 to December-2023 was analyzed using appropriate statistical methods. Frequencies and percentages were calculated to summarize the gender-wise, age-group-wise, and clinical manifestation distributions.

To assess the statistical significance of the observed differences in the gender distribution, a two-proportion z-test was performed. The overall p-value for the gender distribution table was calculated using this z-test. For the age group distribution, a chi-square test of independence was employed to determine whether the number of cases varied significantly across the different age groups. The p-value for the age group distribution table was derived from this chi-square test. The clinical manifestations were analyzed using one-sample proportion tests. Separate one-sample proportion tests were conducted for each manifestation, and the corresponding p-values were reported.

All statistical tests were performed at a significance level of 0.05. p-value less than 0.05 were considered statistically significant, indicating that the observed differences or proportions were unlikely to occur by chance alone. The statistical analyses were performed using SPSS software 26 version.

RESULTS

It was found that 55 out of 305 samples were tested positive for CHIK-IgM antibody (18.03%). Among 55 samples tested positive, 32 samples belonged to male patients which denotes 58.18% and the rest 23 samples belonged to female patients (41.81%). The p-value for the entire gender distribution table is 0.2224, indicating that the observed difference between the number of male and female cases is not statistically significant (Table-1).

Among 55 seropositive chikungunya samples, 21 samples were from age group 41-60 years (38.18%) which denotes that it is the most vulnerable age group. 16 samples out of 55 were from 21-40 age group (29.09%). 12 positive samples came from 0-20 age group (21.81%). 6 samples were from 61-80 age group (10.90%) which is the least affected age group. The p-value for the entire age group distribution table is 0.0328, suggesting that the observed differences in the number of cases across age groups are statistically significant (Table-2).

Table-1: Gender-wise distribution of CHIK-seropositive cases

Gender	Year 2020	Year 2021	Year 2022	Year 2023	Total positive	p-value
Males	03	07	09	13	32 (58.18%)	0.224
Females	02	06	06	09	23 (41.81%)	
Total seropositive cases over four years period					55	

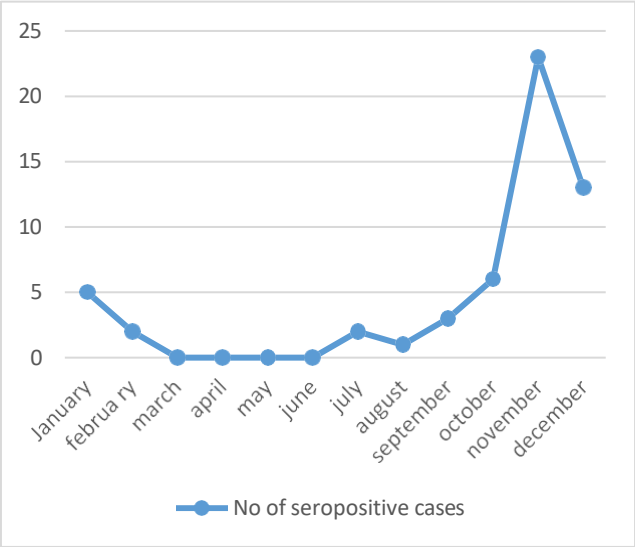
Table-2: Age-wise distribution of CHIK-seropositive cases

Age group (years)	Year 2020	Year 2021	Year 2022	Year 2023	Total positive	p-value
0-20	2	3	5	2	12 (21.81%)	0.0328
21-40	1	6	2	7	16 (29.09%)	
41-60	1	3	6	11	21 (38.18%)	
61-80	1	1	2	2	06 (10.90%)	
Total	5	14	15	22	55	

It was found out that out of 55 positive samples, 39 (70.90%) belonged to indoor wards and 16 (29.09%) belonged to OPD patients.

The seasonal distribution assessed as maximum number of positive samples came from November and December months; 41.81% and 23.63% respectively. This is the post monsoon period. No positive samples were detected in March, April, May & June months (Figure-1).

Figure-1: Seasonal distribution of seropositive cases



The number of total and positive samples received and tested increased successively from year 2020 to 2023 (Figure-2).

Figure-2: A four-year seropositivity rate of Chikungunya infection

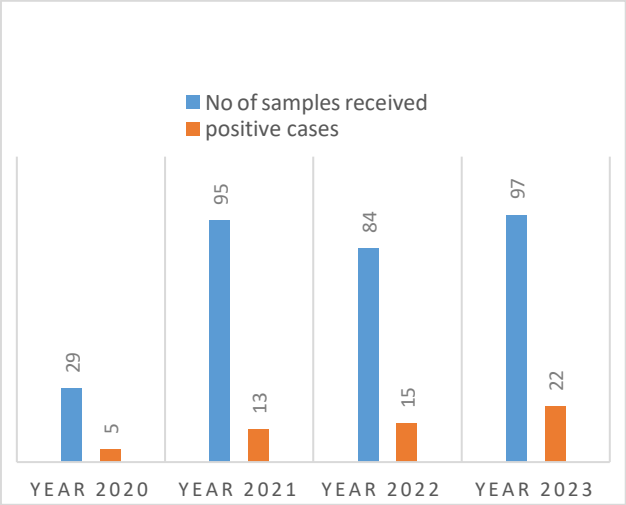


Table-3 shows clinical manifestations of CHIK IgM positive and negative samples. All 55 (100%) positive cases exhibited fever and joint pain (arthralgia), with p-values less than 0.001, indicating that the presence of these symptoms is highly statistically significant. Additionally, 46 (83.63%) cases presented with myalgia (p-value < 0.001), and 15 (27.27%) cases showed a rash (p-value = 0.0004), both of which are statistically significant observations.

Out of 55 seropositive for CHIK, 41 (74.54%) belonged to peripheral urban areas in the district whereas 9 out of 55 (16.36%) belonged to rural part of the district and only 5 out of 55 (9.09%) from urban areas.

Table-3: Clinical manifestations of CHIK-IgM positive cases

Clinical manifestations	Present/ Absent	Number of CHIK-IgM Positive cases	p-value
Fever	Present	55 (100 %)	< 0.001
	Absent	-	
Joint Pain (arthralgia)	Present	55 (100 %)	< 0.001
	Absent	-	
Myalgia	Present	46 (83.63 %)	< 0.001
	Absent	09 (16.36 %)	
Rash	Present	15 (27.27 %)	0.0004
	Absent	40 (72.72 %)	

DISCUSSION

The total of 305 samples were tested in our study, out of which 55 (18.03%) were found to be reactive for chikungunya IgM antibodies. The seroprevalence found in other different studies are shown in Table-4.

Study	Year	Prevalence rate of CHIK fever	Gender	Common age group
Present Study	2023	18.03 %	M > F	41-60
Sinha R et al[14]	2019	31.85 %	M > F	20-40
Mahesh S. et al[19]	2018	23.06 %	F > M	21-30
Wadekar MD. et al[13]	2017	8.17 %	M > F	18-45

In our study, we found that males (56.36%) were more affected than females which is also found in the studies of Wadekar MD. et al 2017[13] and Sinha R et al,2019.[14] Even though there were no statistically significant association (p=0.224) between gender and Chikungunya seropositivity, the reason behind males being frequently affected maybe due to the fact that more exposure of them in outside environment and travelling. These gender differences can be due to community specific habits, behaviors, customs and religions (Sissoko et al 2008 and Azami et al 2013).[15,16]

Seroprevalence of chikungunya infection in different age group was also assessed and revealed that 41–60-year age group is the most commonly affected age group which clearly suggests that adults are being more exposed to outdoor works, travel to places and specially in daytime working hours and corresponds to the fact of daytime biting habit of the Aedes mosquito.

Though the most common age group affected was 41-60, we found an interesting fact that males of 51-60 years age group were more affected particularly in our study. Also, the samples belonging to the indoor patients were more (70.90%) compared to OPD based patients (29.09%) which leads to the fact that this age group (51-60) which was mostly affected necessitates hospitalization in the facility because of high grade fever and joint pain. Long term morbidity like polyarthropathy after recovery of CHIK infection was found to be high in this age group. The least commonly affected age groups were extremes of age groups that are 0-20 years and 61-80 years. The observed difference was statistically significant with p=0.0328.

November and December months had a greater number of positivity rate which directs that post-monsoon period and early winter period have more vector density. Similar type of result was also assessed in study of Sinha R. et al 2019.[14] No positive cases were recorded in months of March, April, May and June; the summer months.

All positive samples had history of fever and joint pain. Myalgia was found in approx. 83% of study population and rash was less frequently recorded symptoms. This finding is statistically significant and consistent with many different studies of Wadekar MD et al, 2017[13], Sinha R et al, 2019[14], Kayalvili K et al, 2021.[17] The study showed that the majority of population affected by CHIK Fever belonged to peripheral urban areas followed by rural and least from highly urbanized areas in the district. This also points toward the community behaviors, cleanliness of household water storages, awareness in public which is more in urban and less consistent with peripheral urban slums and rural areas. The previous outbreak in INDIA in 2005, also was from most of peripheral urban zones and this can be attributed to Aedes Aegypti being the dominant CHIK vector having more tendency for semi-urban environments [Kumar NP et al 2008].[18]

In 2020, number of samples received were less due to the scene of COVID-19 Pandemic. As the time advanced and reduced COVID effect, more numbers of suspected samples came and tested post 2020. This clearly suggest that NO LOCKDOWNS, increased outdoor activities, more travelling has an impact on transmission cycle of CHIK fever.

CONCLUSIONS

Since chikungunya fever is one of the commonest arboviral infections known to humankind causing long term arthropathy even after getting treated, the study conducted and revealed the seroprevalence of 18.03% with more frequency in post monsoon months affecting males slightly more compared to females. The peripheral urban parts of the district have emerged as the cluster zones of the vectors. Also, the most commonly affected population was 51-60 years age group which required hospitalization and suffered morbidity. Especially in the post covid-19 phase from 2020 to 2023; the study duration of our study; as the time advanced a greater number of suspected samples came to the facility and tested positive also in successive years which suggests that CHIK fever is still a significant burden on public health.

So, to prevent the spread of this vector –borne disease, more screening is required by authorities specially in semi-urban, rural areas in the district. Cleaning of the mosquito breeding places and house-hold water storage sites, construction sites is required to prevent spread. We cannot underestimate the other mosquito related arboviral disease like Dengue fever; that's why clinician and practitioners have to be vigilant enough to screen the patient based on clinical symptoms and signs to according infection and confirm the diagnosis by microbiology laboratory. Also, the personal protective wears, generating awareness in community and giving them knowledge about this kind of vector-borne disease should be included in the strategy.

Though CHIK fever is a self-limiting illness which resolves in a week, early diagnosis and prompt treatment is required along with mass education to community because of long term joint pain complications and stiffness causing tendency.

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