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Original Research Article

Dengue and Chikungunya co-infection: A dual arbovirus serosurvey in an industrial hub of southern West Bengal

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Abstract

Background: Arthropod-borne fevers, particularly Dengue and Chikungunya, pose significant health challenges across India. While research on these illnesses is extensive in many regions, data on simultaneous infections is scarce, especially in eastern India. This study investigates the occurrence of Dengue and Chikungunya, both individually and in combination, at a major medical centre in Durgapur's industrial zone. Despite numerous reports on the symptoms and effects of these viruses separately, there's a notable gap in understanding their joint presence in eastern Indian populations. This study sheds light on the seroprevalence of Dengue and Chikungunya as individual infections and co-infections in a tertiary healthcare facility in Durgapur, an industrialized city in southern West Bengal.

Materials and Methods: This was a prospective cross-sectional study conducted for a period of 8 months. Serum sample collected from patients subjected to Dengue NS1 antigen & IgM antibody and Chikungunya IgM antibody detection by ELISA.

Result: The study examined 364 samples, revealing 19.78% (72 cases) were dengue-positive, 7.97% (29 cases) were Chikungunya-positive, and 3.85% (14 cases) showed co-infection of both viruses. Individuals aged 25-40 were most susceptible, with women generally more affected, except for Chikungunya, where men predominated. Dengue cases peaked in August, while Chikungunya and co-infections were more prevalent in July. Co-infected patients exhibited symptoms common to both diseases.

Conclusion: Chikungunya incidence is increasing in the region. It emphasises the importance of testing for both viruses in suspected cases, given their co-circulation in endemic areas. This approach ensures that appropriate treatment can be implemented promptly.

Keywords: Dengue, Chikungunya, Co-infection, NS1 antigen, IgM antibody.

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1. Introduction

Dengue and Chikungunya viruses are important arboviruses of public health concern. Over the past few decades, they have been responsible for numerous outbreaks of dengue and Chikungunya in various parts of the world. Several cases of concurrent dengue and Chikungunya infections have been documented.[1] In India, two significant arthropod-transmitted arboviral diseases causing acute fever are Dengue and Chikungunya. The impact of these viral infections, caused by Dengue virus (DENV) and Chikungunya virus (CHIKV), respectively, differs across various parts of the country. While both illnesses are required to be reported to health authorities in India, there's a notable issue of underreporting. This problem is particularly prevalent in private healthcare facilities, which attract a substantial number of patients seeking treatment. As a result, the true extent of these diseases may be underestimated in official records.[2,3] Many concurrent Dengue and Chikungunya viral infections have been reported from various geographical regions, although the actual burden of the co-infection is unknown. The *Aedes aegypti* mosquito, which predominantly inhabits tropical and subtropical regions globally, serves as a crucial vector for both viruses.[4,5] Moreover, *Aedes albopictus* is a secondary dengue vector.[6] Despite their transmission by the same

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mosquito species, these viruses belong to distinct families: DENV is part of the Flaviviridae family, while CHIKV is classified under the Togaviridae family.[7] In the Indian context, the simultaneous presence of DENV and CHIKV has been documented across various states for several decades, with reports dating back to 1964.[8,9] As per the narrative review published in 2018 by Vargas SL el al, the magnitude of coinfection of DENV & CHIKV varies between 0% and 31.9% globally.[10] A hospital-based study done in 2010 reported that there was co-circulation of DENV & CHIKV in different parts of West Bengal with variable morbidity.[11] Another study conducted in Odisha in 2013 reported that 30-40% of cases involved co-infection with both dengue and chikungunya viruses.[12] Both DENV and CHIKV infections typically cause self-limiting fevers that resemble common febrile illnesses, with viral titre generally declining within approximately 10 days. However, these infections can have distinct complications. Some dengue patients may develop severe forms of the disease, potentially progressing to life-threatening conditions such as hemorrhagic fever or shock syndrome. CHIKV infection is uniquely characterised by painful joint inflammation (polyarthralgia), which, although typically lasting only days, can persist for extended periods, ranging from weeks to months, and in some cases, even years. A severe case of chikungunya infection can lead to complications affecting the nervous system and eyes.[13]

Durgapur is a major industrial and Tier-II city and a municipal corporation in the Paschim Bardhaman district in West Bengal, India. Presently, there has been a paucity of data regarding the burden of DENV and CHIKV mono infection as well as co-infection/dual infection (DENV + CHIKV), in this region. This co-circulation of both viruses presents unique challenges for public health initiatives and disease management strategies in the country.

Understanding the regional occurrence of these diseases is crucial for guiding diagnostic procedures and treatment strategies. As a result, this study aimed to determine the seroprevalence of Dengue or Chikungunya infections alone, as well as cases where both infections occurred simultaneously, at a major healthcare facility in Durgapur.

2. Materials and Methods

The present study was conducted in a tertiary care medical college in Durgapur, which caters to a large population in this region. Ethical clearance was taken from the Institutional Ethics Committee. In this study, a total of 364 patients who were admitted or visited OPD with symptoms of acute febrile illness (age greater than or equal to 15 years) from May 2019 to December 2019 were included. Children less than 15 years of age, pregnant women and proven cases of malaria (confirmed by peripheral blood smear and antigen) and enteric fever (confirmed by isolation of *Salomonella* sp. from blood culture and/or IgM serology by rapid kit test) were excluded from the study. A thorough clinical examination was done for all the cases. Demographic details, information on the date of onset of fever, rash, and other symptoms were noted. Acute febrile illness was defined as at least 2 consecutive days of fever ≥ 38°C. 2-3 ml of blood sample was collected and tested for Dengue NS1 antigen and IgM antibody by ELISA (using J Mitra & Co pvt ltd, India). To check co-infection with CHIKV, all the samples were subjected to Chikungunya IgM antibody detection by ELISA (using J Mitra & Co Pvt Ltd, India). Patients who were positive for either NS1 antigen or/and IgM antibody were considered as positive for DENV. Data about complete blood count (CBC) and liver function test (LFT) were noted from the hospital information system (HIS).

All the tests were carried out following the manufacturer's instructions.

2.1. Statistical analysis

The result of this study is presented as a proportion. Test of significance of the difference between two independent proportions was performed by Fischer's Exact test. A *p*-value of <0.05 was considered statistically significant. SPSS software version 23 was used for data analysis.

3. Result

The findings from this study revealed that among 364 patients presenting with sudden onset of fever, approximately one-fifth (19.78%, or 72 individuals) tested positive for dengue virus (DENV). Chikungunya virus (CHIKV) was detected in nearly 8% of cases (29 patients). Particularly, a smaller proportion of patients (3.85%, or 14 individuals) showed evidence of simultaneous infection with both DENV and CHIKV, indicating co-infection **Figure 1**).

Table 1 depicts the demographic characteristics of the study population. The most affected age group was 25-40 years (**Figure 2**). In the gender distribution of infected cases, it was observed that females were affected more than males in DENV mono infection (40, 55.55%), but in CHIKV mono infection, males outnumbered females (16, 55.17%). Whereas in coinfection, there was not much difference seen (**Figure 3**). 62 (86.11%) cases of dengue were positive from IPD, followed by 25 (86.21) cases of chikungunya and 12 (85.71%) cases of coinfection. Whereas among the OPD patients, dengue was positive in 10 (13.89%) patients followed by 4 (13.79%) cases of cikungunya and 2 (14.29%) cases of coinfection. It was seen that most cases of dengue and chikungunya infection were in urban residents of Durgapur, 40 (55.55%) and 17 (58.62%), respectively.

A seasonal peak for dengue was seen in August, whereas the majority of the Chikungunya and co-infection occurred in July (**Figure 4**).

Clinical features of DENV infection, CHIKV infection and coinfection were depicted in **Table 2**. An analysis of the patient data revealed that fever was a universal symptom, affecting every individual in the study (100%). Following

fever in prevalence was fatigue. This fatigue was reported by three-quarters of those diagnosed with dengue, representing 54 patients (75.00%). Among those with Chikungunya, roughly two-thirds (19 individuals; 65.52%) experienced this symptom. Notably, in cases where both infections were present simultaneously, fatigue was even more common, affecting nearly 86% of patients, that is, 12 out of 14 co-infected individuals. Myalgia was another common symptom observed amongst the mono infection as well as dual infection. Though DENV cases had experienced more nausea (58.33%) as compared to CHIKV (34.48%) and Coinfection (50.00%). Joint pain and restriction of movement were more prominent in coinfected cases (64.29% each) as compared to the mono infection.

Laboratory parameters were summarized in **Table 3**. Anaemia was more commonly seen in coinfection cases (85.71%), as compared to CHIKV and DENV mono infection. Thrombocytopenia was present in 78.57% of coinfection cases, followed by 72.41% of CHIKV infection and 65.27% of DENV infection cases (**Figure 5**). However, elevated liver enzymes (SGOT, SGPT) were seen among most of the mono infection as well as coinfection cases. Elevated SGPT level was statistically significant (p=.01) among the CHIKV and coinfection cases.

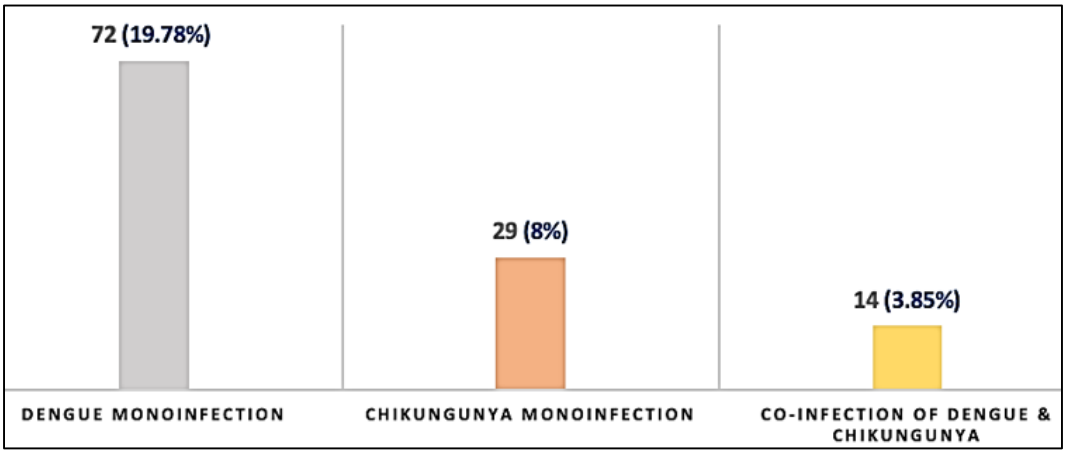

Figure 1: Infection in seropositive cases (n=364)

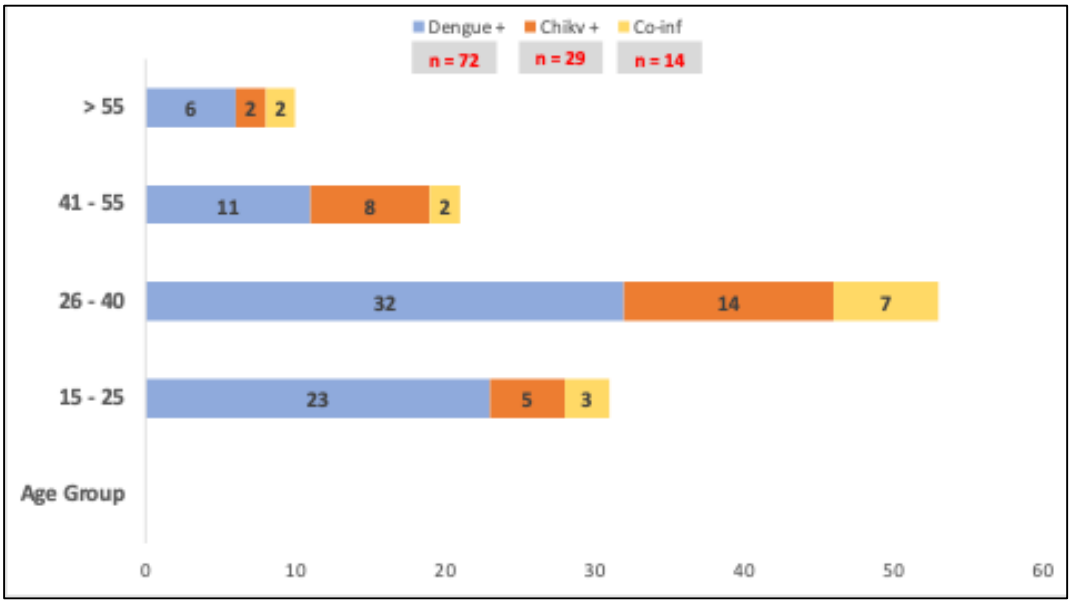

Figure 2: Age-wise distribution of seropositive cases

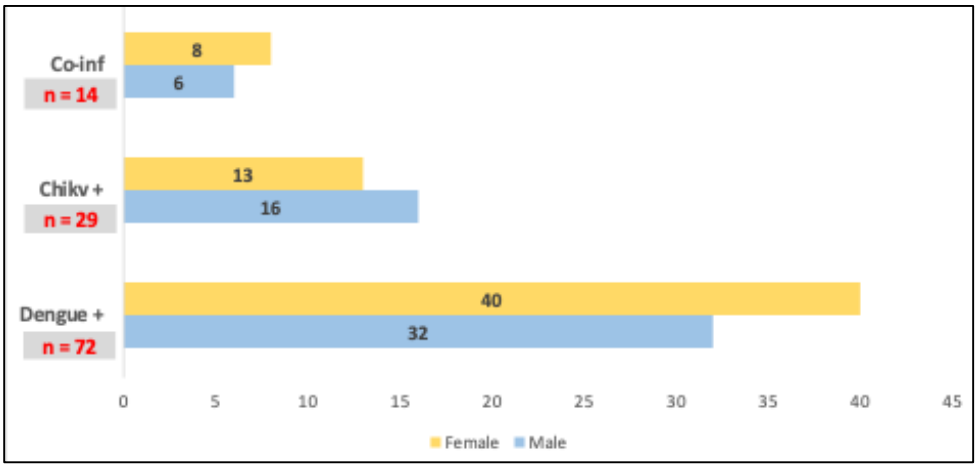

Figure 3: Gender-wise distribution of seropositive cases

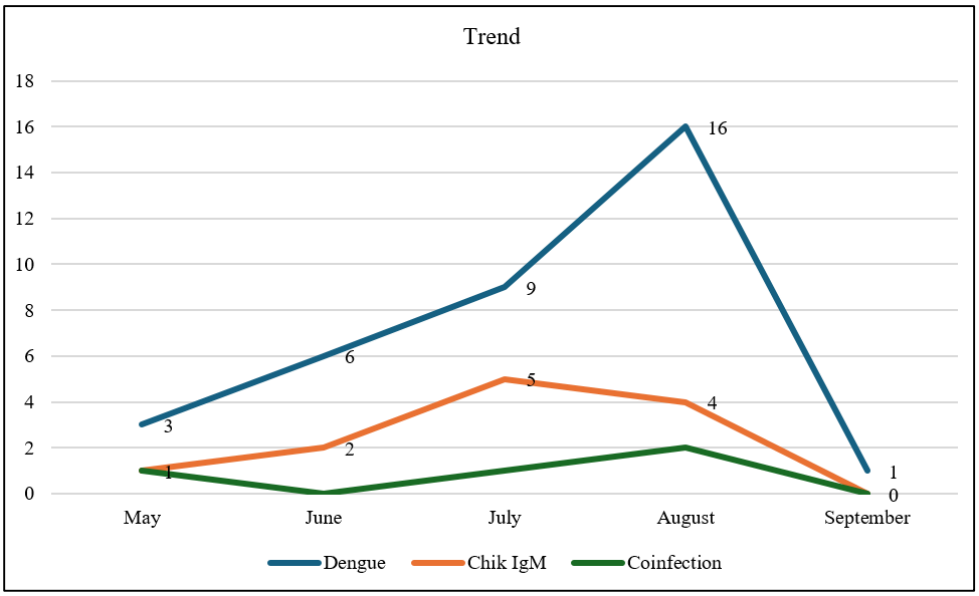

Figure 4: Line chart showing trends of DENV and CHIKV infection

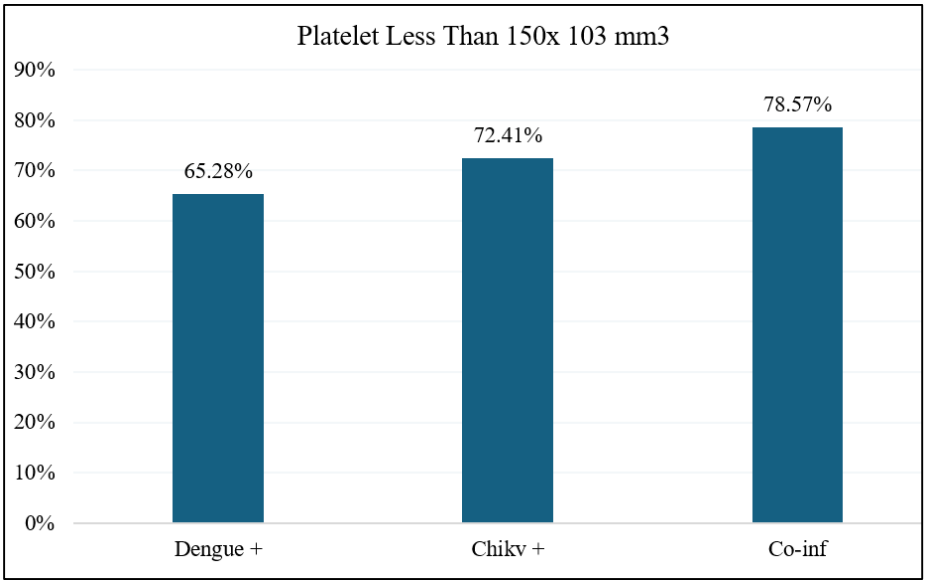

Figure 5: Bar diagram showing Thrombocytopenia/low platelet in different serogroups

Table 1: Demographic characteristics of seropositive cases

Demographic Details	DENV (n=72)	CHIKV (n=29)	DENV+CHIKV (n=14)
Age group (years)			
15-25	23 (31.94%)	5 (17.24%)	3 (21.43%)
25-40	32 (44.44%)	14 (48.28%)	7 (50.00%)
41-55	11 (25.71%)	8 (27.59%)	2 (14.29%)
>55	6 (17.14%)	2 (6.90%)	2 (14.29%)
Sex			
Male	32 (44.44%)	16 (55.17%)	6 (42.86%)
Female	40 (55.55%)	13 (44.83%)	8 (57.14%)
OPD	10 (13.89%)	4 (13.79%)	2 (14.29%)
IPD	62 (86.11%)	25 (86.21%)	12 (85.71%)
Residence			
Rural	32 (44.44%)	12 (41.38%)	8 (57.14%)
Urban	40 (55.55%)	17 (58.62%)	6 (42.86%)

n: number of participants, %: percentage of participants

Table 2: Clinical manifestation of seropositive cases

Clinical features	DENV n= 72		CHIKV n= 29		DENV+CHIKV n= 14	
Fever (no of days)	72	100.00%	29	100.00%	14	100.00%
Fatigue	54	75.00%	19	65.52%	12	85.71%
Nausea	42	58.33%	10	34.48%	7	50.00%
Vomiting	23	31.94%	5	17.24%	4	28.57%
Joint Pain	22	30.56%	12	41.38%	9	64.29%
Myalgia	48	66.67%	18	62.07%	9	64.29%
Skin rash	11	15.28%	5	17.24%	3	21.43%
Retroorbital pain	0	0.00%	0	0.00%	0	0.00%
Restriction of movement	16	22.22%	10	34.48%	9	64.29%
Headache	15	20.83%	4	13.79%	4	28.57%

n: number of participants, %: percentage of participants

Table 3: Distribution of lab parameters in different serogroup

Parameters with normal range	DENV (I), n= 72	CHIKV (II), n=29	DENV+CHIKV (III), n=14	p-Value (I & II)	p-Value (I & III)
Anaemia (11-16 g/dl)	35 (48.61%)	16 (55.17%)	12 (85.71%)	0.66	0.02
Leukopenia (4-11 x 10^3 mm^3	4 (5.55%)	2(6.89%)	0 (0.00%)	1	1
Thrombocytopenia (150-400 x 10^3 mm^3)	47 (65.27%)	21 (72.41%)	11 (78.57%)	0.64	0.53
↑SGOT (15-37 IU/ml)	58 (80.55%)	26 (89.65%)	13 (92.85%)	0.38	0.45
↑SGPT (14-59 IU/ml)	48 (66.66%)	27 (93.10%)	14 (100.00%)	0.01	0.01

n: number of participants, %: percentage of participants, co-inf : coinfection

4. Discussion

The first outbreak of CHIKV was recorded from 1963 to 1965 in Kolkata, West Bengal, along with the outbreak of DENV.[14] After 1965, CHIKV disappeared from this region and remained dormant for almost three decades.[15] Re-emergence of CHIKV was again reported from many states of India, including West Bengal, during 2005-2006.[16] Thereafter, it has been repeatedly reported from 13 different states of India and has resulted in 1.4−6.5 million estimated cases across the country.[17]

West Bengal faces a significant challenge with the dengue virus, experiencing numerous outbreaks.[18] The similarity in symptoms between dengue and chikungunya fever often leads to underreporting of chikungunya infections in the region. Both viruses share common vectors - *Aedes aegypti* and *Aedes albopictus* mosquitoes - which can lead to their simultaneous circulation and transmission.[19] This situation may result in co-infections in humans, presenting a

complex mix of symptoms from both viruses. Such cases can be particularly difficult to diagnose accurately. Proper identification of these infections is crucial for timely and appropriate treatment, as well as for effectively managing potential complications associated with both dengue and chikungunya viruses.

There have been reports of coinfection across India, and a similar trend has been noticed among the previous studies.[20,21] Previous research has documented varying rates of coinfection using serological methods, such as Taraphdar D *et al*. reported 12.4% in West Bengal,[11] Deshkar S *et al*. reported 2.97% in Nagpur, Bula A *et al.* reported 13.3% in Andhra Pradesh[22] and Prakash S et al. reported 25.3% in Uttar Pradesh.[5] Our current investigation found a coinfection rate of 3.85%, which falls within the lower end of these previously observed rates. In a study conducted in North India, the seroprevalence rate was found to be 6.72%. In this study male gender was predominant, and in the age group of 20-30 years maximum cases were seen.[19]

The majority of the DENV and CHIKV infected cases belonged to the 25-40 years age group. The reason is that this age group is more occupationally active and outdoor going. Naturally, there is an increased chance of being exposed to arthropod-borne viruses. A comparable trend was also reported in the earlier studies done in India.[23,24]

The research findings indicated a marginally higher occurrence of DENV in women (55.55%) compared to men (45.45%). This observation aligns with the results reported by Chattopadhay and colleagues but diverges from the trends noted in Kaur et al.'s work.[24,25] Conversely, CHIKV positivity was more prevalent among males (55.17%) than females (44.83%), a pattern that resembles the findings of Dinkara and associates.[19] In cases of coinfection, the gender distribution was approximately equal.

These infections are generally seen during the monsoon and post-monsoon periods. Due to the climate change during these months, the arthropod vector breeding is favoured, thereby increasing the number of mosquitoes. Hence, there is an increased number of DENV and CHIKV infections. In the present study, the peak incidence of dengue was observed in August, whereas chikungunya and coinfection were more prevalent during July.

In this study, it has been observed that joint pain and restriction of movement were more pronounced in coinfection (64.49%) as compared to CHIKV (34.48%) and DENV (22.22%) mono infection. A previous study done by Londhey et al.[26] showed that reduced joint mobility was 100% in co-infection and CHIKV infected cases as compared to DENV mono infection, which was 13%. These features may help in clinically differentiating DENV from DENV + CHIKV co-infection cases. Fever, myalgia and fatigue were seen among many DENV and CHIKV mono-infected as well as coinfection cases. Clearly, it shows that there is an overlapping of symptoms in dengue and chikungunya infection.

Thrombocytopenia was observed in all the groups. However, in contrast to the study done in Mumbai, present study's results did not reveal any significant reduction of platelets in patients with coinfection.[26] In our study population, none of the dengue patients developed hemorrhagic shock syndrome. Additionally, we observed zero mortality among all participants in the study. Liver enzymes were raised among the majority of the mono infection as well as dual infection cases. In contrast, a study done by Kaur et al.[25] stated that elevated Serum Glutamic-Pyruvic Transaminase (SGPT) occurred in 66.67% and elevated Serum Glutamic-Oxaloacetic Transaminase (SGOT) in 86.27% of dengue cases. Dengue and chikungunya infections both impact liver function. When acute liver dysfunction develops early in the disease progression, it serves as an important warning sign that the patient may develop a severe form of the illness.[27]

5. Conclusion

This study demonstrates the simultaneous presence of Chikungunya virus and Dengue virus in the same area. The symptoms of these infections are largely similar, with few distinctive indicators to differentiate between them. Given this overlap, it's recommended that medical professionals test for both viruses when examining patients with suspected dengue or chikungunya fever in regions where these diseases are endemic. This approach could lead to more prompt and effective patient care. Additionally, public health officials should implement robust monitoring systems to track the spread of these dangerous mosquito-borne viruses, enabling timely interventions to control outbreaks.

6. Limitations

Our investigation was constrained by the limited number of participants and the short duration of the study. Additional techniques, such as Dengue serotyping and RT-PCR for gene detection, could have yielded more comprehensive insights into the coinfection patterns observed. Due to resource limitations, these tests were not performed. Future research would benefit from an expanded participant pool and extended study time frame to generate more conclusive findings that could better inform healthcare providers and improve patient outcomes.

7. Source of Funding

None.

8. Conflict of Interest

None.

9. Ethical Committee Approval

Approved by the Institutional ethics committee, IQ City Medical college, Durgapur, West Bengal with the proposal no: IQMC/IEC/Project/13(01)/19.

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