

Seroprevalence of Various Viral Diseases in Tamil Nadu, India

R. Gopinath, A. L. Meenakshi Sundaram¹, A. Dhanasezhian, M. Arundadhi, G. Sucila Thangam

Department of Microbiology, Government Theni Medical College, ¹Government Theni Medical College, Theni, Tamil Nadu, India

Abstract

Introduction: Virus-borne diseases have recently gained significant public health importance. Viruses infect several hosts, including animal reservoirs, evolve quickly, and recombine emerging and reemerging to pose recurring dangers to humans. The Viral Research and Diagnostic Laboratory (VRDL) located at Government Theni Medical College, Theni, Tamil Nadu, conducts the diagnosis of common virus infections. **Methods:** From January 2018 to December 2022, the VRDL received whole blood sera samples from 84,059 patients suspected of having various viral illnesses. The enzyme-linked immunosorbent assay was used to detect viral infections in all of the samples. **Results:** A total of 84,059 individuals suspected for various viral infections have been tested and out of these 4948 (5.88%) cases have been reported to be positive and among them, the dengue virus is predominantly followed by, hepatitis B virus, chikungunya virus, hepatitis C virus, hepatitis A virus, hepatitis E virus, hepatitis B virus, herpes simplex virus, cytomegalovirus, and rubella virus. **Conclusion:** The issue of emerging and re-emerging infectious illnesses, particularly those caused by viruses, has grown in importance in public health. Timely action combined with proper information and the ability to diagnose infections may save many lives.

Keywords: Chikungunya, dengue, hepatitis, herpes simplex, viral research and diagnostic laboratory

INTRODUCTION

Viruses are known to produce outbreaks and are the largest cause of human sickness and mortality in India, resulting in enormous health-care cost.^[1] Virus-borne diseases have recently gained significant public health importance.^[2] 14 out of the 20 emerging/re-emerging infections worldwide are of viral origin.^[3] In India, 30 distinct outbreaks have been observed in the past 30 years, with 21 of them caused by different viruses.^[4] As a result of these developing viruses, public health principles have undergone a paradigm shift. Aside from health, viruses have had an impact on India's social and economic fabric. Vector-borne viral infections such as dengue (DEN) and chikungunya (CHIK) are a threat to health and development, impacting economically vulnerable populations and accounting for 17% of worldwide infectious disease burden.^[5] The emergence of viral infections can be attributed to genetic exchanges, mutations, and changes in societal patterns such as urbanization, rapid transportation, human or vector movement, and changing lifestyles.^[6] Ecological changes such as deforestation or afforestation, as well as livestock or bird rearing, may all contribute to the introduction of viral infections. To combat these new viral illnesses, a comprehensive approach must be developed. The

epidemiology of viral diseases must be thoroughly examined, which necessitates the establishment of a national viral surveillance system.^[7]

As a result of these developing viruses, public health principles have undergone a paradigm shift. Aside from health, viruses have had an impact on India's social and economic fabric. Due to the lengthy duration of particular antibody reactions, serological diagnosis is not impacted by seasonality. Long-term data collected at regular periods are critical for investigating epidemics and predicting virus outbreaks.^[8] The causal factors are identified through the collaborative efforts of numerous state and federal government research facilities.^[9] The Integrated Disease Surveillance Programme is a nationwide organization that collects data on various diseases using existing laboratory services in medical

Address for correspondence: Dr. G. Sucila Thangam,
Department of Microbiology, Government Theni Medical College, Theni,
Tamil Nadu, India.
E-mail: drgsucilamicro@gmail.com

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colleges and hospitals.^[10] The epidemiology of the deadly viral diseases needs to be studied in depth. There is a paucity of published data on epidemiology of the viral infections in India, particularly in Tamil Nadu. The Viral Research and Diagnostic Laboratory (VRDL) at Government Theni Medical College (GTMC), Theni, conducted the initial diagnosis during the epidemic. The laboratory deals with diagnoses of all common viruses existing in the region DEN, hepatitis B virus, CHIK virus (CHIKV), hepatitis C virus (HCV), hepatitis A virus (HAV), hepatitis E virus (HEV), hepatitis B virus, herpes simplex virus (HSV) 1 and 2, cytomegalovirus (CMV), and rubella virus. The present study was conducted to diagnose the various viral diseases in Theni, Tamil Nadu.

METHODS

The present study was a prospective study done on the blood samples from a total of 84,059 patients suspected of various viral diseases received at VRDL located at tertiary care hospital, Theni, from January 2018 to December 2022. Viral diseases to be tested on the samples received included DEN, hepatitis B virus, CHIKV, HCV, HAV, HEV, HSV, CMV, and rubella virus. The samples were tested for immunoglobulin M (IgM) antibodies of CHIK, HAV, and HEV, IgM antibodies and NS1 antigen of DEN virus (DenV), antiHCV antibodies of HCV, surface antigen of hepatitis B virus, and IgG and IgM antibodies for CMV, herpes simplex, and rubella virus. All the tests were carried out following the kit manufacturer's instructions.

Statistical analysis

Every variable's percentage and proportion were computed. The data were statistically examined using Chi-square tests. A $P < 0.05$ was considered statistically significant.

RESULTS

In the present study, a total of 84,059 samples were tested over the 5-year from January 2018 to December 2022 [Figure 1]. The test was done on samples suspected for DEN, hepatitis B virus, CHIKV, HCV, HAV, HEV, HSV 1 and 2, CMV, and rubella virus. Out of the 84,059, about 4948 cases have been reported to be positive for one or more of these viral infections [Table 1 and Figure 2]. It is significant that DEN is predominant in the districts studied with a total of 10,553/2945 (27.9%) individuals positive for anti-DEN IgM antibodies and the specific difference is statistically significant ($P = 0.001$). This is followed by hepatitis B virus 44,368/879 (1.9%), CHIKV 3860/392 (10.1%), DEN NS-1 1383/286 (20.6%), HCV 22,304/268 (1.2%), and HAV 571/126 (22.0%), followed by CMV 290/15 (5.1%), HEV 104/15 (14.4%), HSV/1 and 2 339/14 (4.1%), and rubella 287/8 (2.7%).

The male group had a higher prevalence of almost all the studied viruses such as higher positivity for DenV 1644 (55.8%), hepatitis B virus 502 (57.1%), CHIKV 215 (54.8%), HCV 169 (63.0%), followed by CMV 9 (60.0%), HEV 8 (53.3%), HSV 1 and 2 7 (50.0%), and rubella 5 (62.5%), as compared to their female counterparts, except DEN NS-1 142 (49.6%),

HAV 58 (46.0%), and HSV 1 and 2 7 (50.0%). The specific difference between the gender group was statistically significant ($P = 0.0001$) [Table 2]. Higher cases of positive results were shown for DEN IgM test, especially in the age group of 21–40 years, and the least were seen in cases above 60 years of age. In the case of DEN NS-1, higher cases were seen in the age group of 21–40 years and no cases in above 60 years of group. For CHIK IgM, higher cases were seen in the age group of 21–40 years and the least number of cases in above 60 years of group. Higher cases of HEV IgM were seen in the age group of 0–20 years and no cases in above 40 years of group. In the case of HAV IgM, higher cases were seen in the age group of 21–40 years and no cases in above 60 years of group. For rubella IgM, higher cases were seen in the age group of 0–20 years and no cases in above 40 years of group. CMV IgM showed that higher cases were seen in the age group

Table 1: Total number of serologically tested positive cases out of the total suspected individuals

Name of virus for which investigation was done	Total	Positive, n (%)
Dengue IgM	10,553	2945 (27.9)
Dengue NS-1	1383	286 (20.6)
CHIK IgM	3860	392 (10.1)
HEV IgM	104	15 (14.4)
HAV IgM	571	126 (22.0)
Rubella IgM	287	8 (2.7)
CMV IgM	290	15 (5.1)
HSV 1 and 2 IgM	339	14 (4.1)
HBsAg ELISA	44,368	879 (1.9)
HCV ELISA	22,304	268 (1.2)
Total	84,059	4948

IgM: Immunoglobulin M, HAV: Hepatitis A virus, HEV: Hepatitis E virus, HSV: Herpes simplex viruses, HCV: Hepatitis C virus, ELISA: Enzyme-linked immunosorbent assay, CMV: Cytomegalovirus, HBsAg: Hepatitis B surface antigen

Table 2: Gender-wise distribution of serologically tested positive cases

Name of virus for which investigation was done	Number of positive	Male, n (%)	Female, n (%)
Dengue IgM	2945	1644 (55.8)	1301 (44.1)
Dengue NS-1	286	142 (49.6)	144 (50.3)
CHIK IgM	392	215 (54.8)	177 (45.1)
HEV IgM	15	8 (53.3)	7 (46.6)
HAV IgM	126	58 (46.0)	68 (53.9)
Rubella IgM	8	5 (62.5)	3 (37.5)
CMV IgM	15	9 (60.0)	6 (40.0)
HSV 1 and 2 IgM	14	7 (50.0)	7 (50.0)
HBsAg ELISA	879	502 (57.1)	377 (42.8)
HCV ELISA	268	169 (63.0)	99 (36.9)
Total	4948	2759	2189

IgM: Immunoglobulin M, HAV: Hepatitis A virus, HEV: Hepatitis E virus, HSV: Herpes simplex viruses, HCV: Hepatitis C virus, CHIK: Chikungunya, ELISA: Enzyme-linked immunosorbent assay, CMV: Cytomegalovirus, HBsAg: Hepatitis B surface antigen

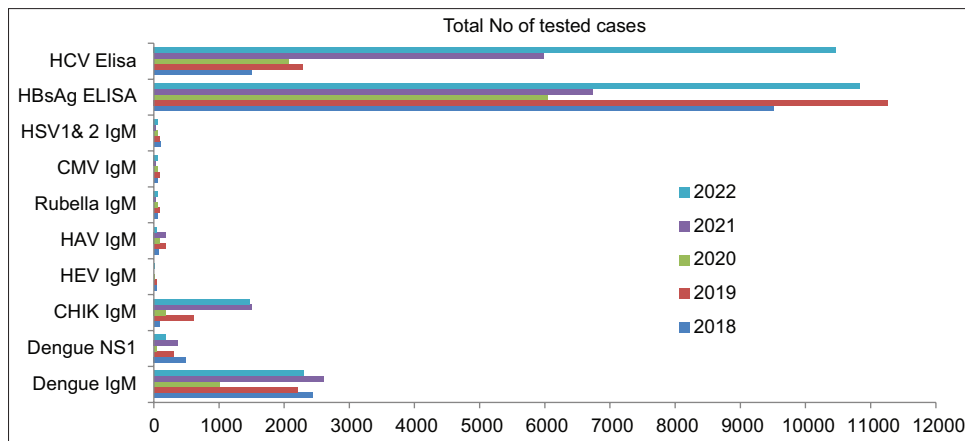


Figure 1: Distribution of serologically tested suspected samples. IgM: Immunoglobulin M, HAV: Hepatitis A virus, HEV: Hepatitis E virus, HSV: Herpes simplex viruses, HCV: Hepatitis C virus, ELISA: Enzyme-linked immunosorbent assay, CMV: Cytomegalovirus, HBsAg: Hepatitis B surface antigen

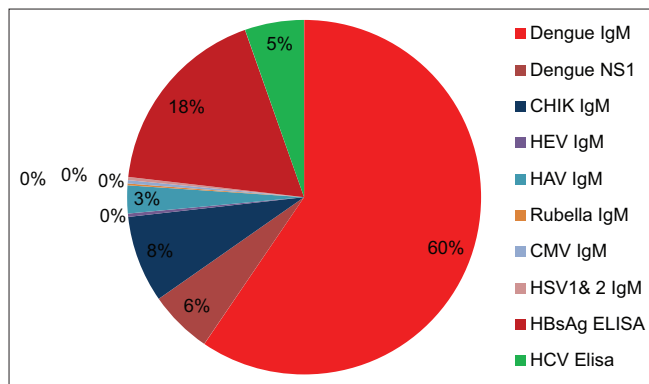


Figure 2: Percentage of cases tested positive for each of the studied viral Infection. IgM: Immunoglobulin M, HAV: Hepatitis A virus, HEV: Hepatitis E virus, HSV: Herpes simplex viruses, HCV: Hepatitis C virus, ELISA: Enzyme-linked immunosorbent assay, CMV: Cytomegalovirus, HBsAg: Hepatitis B surface antigen

of 21–40 years and no cases in above 60 years of group. In the case of HSV IgM, higher cases were seen in the age group of 0–21 years and no cases in above 60 years group. Hepatitis B surface antigen (HBsAg) ELISA/rapid showed higher cases were seen in the age group of 21–40 years and no cases in 0–21 years of age group. In the case of HCV Rapid/ELISA, higher cases were seen in the age group of 21–40 years and no cases in the age group of 0–21 years [Table 3].

DISCUSSION

India constantly confronts the risk of newly emerging and reemerging viral infections that are significant for public health because of the country’s vast geographic and climatic variety. Our nation’s disease surveillance system has to be improved, with a greater emphasis placed on epidemiology and illness burden. In addition, there is a continuing need to learn more about the biology of disease vectors and the environmental factors that affect how viral infections originate. 14 of the 20 new or reemerging infections worldwide are viral in nature.^[11] These novel viruses have resulted in a paradigm shift in how

Table 3: Age-wise distribution of serologically tested positive cases

Virus name	0–20 years	21–40 years	41–60 years	>60 years
Dengue IgM	754	1520	610	61
Dengue NS-1	101	108	77	0
CHIK IgM	128	146	93	25
HEV IgM	13	2	0	0
HAV IgM	42	63	21	0
Rubella IgM	5	3	0	0
CMV IgM	5	8	2	0
HSV1 IgM	7	6	1	0
HBsAg ELISA/rapid	0	515	322	42
HCV rapid/ELISA	0	158	95	15
Total	1055	2529	1221	143

CHIK: Chikungunya, IgM: Immunoglobulin M, HAV: Hepatitis A virus, HEV: Hepatitis E virus, HSV: Herpes simplex viruses, HCV: Hepatitis C virus, ELISA: Enzyme-linked immunosorbent assay, CMV: Cytomegalovirus, HBsAg: Hepatitis B surface antigen

we think about public health. On the seroprevalence of viral illnesses, which requires further study, there is a dearth of information.

The current study details the number of patients who visited the hospital between January 2018 and December 2022 with suspected viral infections such as DEN, hepatitis B, CHIK, hepatitis C, hepatitis A, hepatitis E, herpes simplex 1 and 2, CMV, and rubella. The most prevalent viral infection caused by mosquitoes, DEN fever is spreading quickly around the globe. Very few DEN virus infections from Northern India have been reported in the past 20 years,^[12] probably owing to a shortage of diagnostic resources. According to the current findings, the overall seropositivity of DEN suspected cases is 5.88% (84,059/4948). According to Murhekar *et al.*, the total seroprevalence of DenV infection in India is 48.7%.^[13] Another study conducted by Ukey *et al.* found 31.3% of Central Indian patients to be serologically positive for DEN infection, whereas a Tamil Nadu-based study found 32.1% seropositivity.^[4] Increased seropositivity in our study could be

attributed to climate change, globalization, travel, and trade, all of which are more prevalent in Theni, Tamil Nadu. The male group in this study had a higher prevalence of DenV (55.8%) than the female group (44.1%). Males outweighed females in DenV positive in the majority of prior DEN outbreak studies. In the current investigation, the 21–40-year-old appears to be the most susceptible to DenV, accounting for 1520 of the 2945 positive cases. Bhat *et al.* and Sood found similar results in their studies.^[14,15] In our study, HBV was shown to be responsible for 1.9% of cases of clinically suspected viral hepatitis. The prevalence of HBsAg in India is reported to be 3%–4.2%,^[16] which is significantly lower than that described in our study, which could be owing to the testing being done on patients clinically suspected of having acute viral hepatitis rather than as a screening test. This study's findings are consistent with previous research that shows a greater prevalence of HBV in the male population.^[17] The current study found that HBV prevalence was highest in adults aged 21–40 years. This is comparable to some other Indian research.^[18] Another major vector-borne disease, the Indian subcontinent, is no stranger to CHIK. Since its first isolation in Kolkata in 1963, CHIKV has recently returned to India, impacting an estimated 1.3 million people over 150 districts in eight Indian states.^[19] CHIK IgM positivity was determined to be only 10.1% in the current study, compared to other studies reported from other parts of the country.^[20,21] According to the current findings, the overall seropositivity of DEN NS-1 suspected patients is 20.6% (286 out of 1383). The relationship between NS-1 and IgM is said to be directly proportional, whereas the relationship between IgG and NS-1 is considered to be inversely proportional.^[22] The study also revealed similar features. Our results were identical to those reported by Lakshmi *et al.*^[23] and Madan *et al.*^[24] Few studies reported a higher incidence of secondary infection as seen through the data reported by Garg *et al.*^[25] and Anandan *et al.*^[26] In India, the overall prevalence of HCV is 0.5%–1%, with around 15 million HCV carriers.^[27] Anti-HCV prevalence in blood donors ranges from 0.4% to 2% in developed nations. In the current investigation, HCV seroprevalence was found in 1.2% of the total suspected cases who visited the hospital. The male group has a higher prevalence of HCV (63.0%) than the female group (36.9%), and the gender difference is statistically significant ($P = 0.0001$). Several more investigations found similar findings.^[28,29] A difference in seroprevalence between sexes could be attributable to differences in risk behaviors. It has also been discovered that HCV infection is more common in persons aged 21–60 years. The seroprevalence of HAV in the current study is 22.0% (126 out of 571 probable cases). Previous HAV seroprevalence investigations in India found anti-HAV antibodies in 70% of the 0–20 and 21–40 years of age groups.^[30] According to the current statistics, the prevalence of anti-HAV antibodies is highest (96%) in children aged 0–20 years.

HEV seroprevalence is relatively high, having been reported in 14.4% (15 of 104 probable cases). HAV and

HEV infections are common in personnel living in crowded locations and in areas with low socioeconomic development. HEV is responsible for 50%–70% of all instances of acute viral hepatitis in India, as well as significant outbreaks, with the primary source of infection being contaminated water supplies.^[31] The current investigation indicates a high endemicity of HEV infection (86.66%) in adults (0–20 years) and a significantly reduced seroprevalence in the age groups of 21 and >40 years. Other researchers observed similar findings.^[31] HSVs are among the most common cause of human viral illnesses. 90% of people worldwide have one or both viruses. HSV-1 is the most common virus, with 65% of people in the United States possessing antibodies against it.^[32] HSV-2 infections are far less common than HSV-1 infections, infecting 15%–80% of people in varied populations.^[33] HSV was found in 14 of 339 (41.5%) of the probable cases in the current investigation. The presence of HSV-1 seropositivity in both males (50%) and females (50%) in this study is most likely attributable to the small sample size. Due to their sexually active lifestyles, HSV seropositivity is highest among the young age groups of 0–20 years and 21–40 years.^[34] Rubella virus was found in 8 of 287 probable cases (2.7%) in the current investigation. This study painted a picture of the most common viruses found in the area. CMV is one of the most common opportunistic viral infections in immunocompromised people. Primary CMV infections are typically asymptomatic; however, the frequency and severity of disease in immunocompromised individuals establish this virus as a significant human pathogen.^[35] The seropositive rate for CMV-specific IgM antibodies in this study was 5.1% (15 out of 290). Overall, this study presented a picture of the most common viruses found in the region. Individuals infected with viruses suffer from a variety of comorbidities. The high prevalence of infectious disease suggests that more research into any potential biologic connections between these frequent viral diseases is warranted.

CONCLUSION

Disease emergence and reemergence have been a long-standing phenomenon in humans. Given the current state of viral infections in Theni, increased surveillance is advised to precisely monitor the trends of various viral diseases prevalent in the region and to identify undiagnosed viral infections. VRDL, which was established in GTMC, Theni, has proven to be useful in detecting new and reemerging viral infections. Timely action combined with proper information and the ability to diagnose viruses has the potential to save many lives.

Research quality and ethics statement

This study was approved by the Institutional Ethics Committee (GTMCH/IEC/2023). This work only requires analysis of openly available information and does not require patients or patient samples. The authors followed applicable EQUATOR Network (<https://www.equator-network.org/>) guidelines during the conduct of this research project.

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Conflicts of interest

There are no conflicts of interest.

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