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EPIDEMIOLOGICAL TRENDS OF JAPANESE ENCEPHALITIS IN MADHYA PRADESH FROM 2016 TO 2020

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ABSTRACT **INTRODUCTION:** Many large outbreaks have been recorded in various sections of the nation since 1955. In 1973, a severe epidemic in the Bankura District of West Bengal resulted in a 42.6 percent death rate. Following that, the illness spread to neighboring states, resulting in a series of epidemics across the country. **METHODOLOGY:** It is a retrospective observational study conducted among all lab-confirmed IgM ELISA patients positive for JE in Madhya Pradesh from 2016-2020. The data was collected from IDSP, and it included the number of cases by years, months, districts, and, geographical details were collected from the Department of Land Survey, and the projected population data were collected from the census. **RESULT:** Analysis of data revealed that from 2016 to 2020, a total of 81 Acute encephalitis syndrome cases with 10 deaths were reported in Madhya Pradesh. All these cases were lab-confirmed cases of Japanese Encephalitis. During this period, the average case fatality rate was 12.34%, with a morbidity rate of 0.11 per lakh population. **CONCLUSION:** In all JE-endemic states in India, safe and efficient JE vaccinations are available to prevent the disease and lower the risk of JE and AES; nonetheless, all visitors to JE-endemic areas should take steps to avoid mosquito bites, especially during peak season. Prevention of Japanese encephalitis can be bought about by early diagnosis and apt treatment.

KEYWORDS : Japanese Encephalitis, Madhya Pradesh, Epidemiology, Vaccination

INTRODUCTION

JEV (Japanese encephalitis virus) is a single-stranded RNA virus that belongs to the Flaviviridae family and the genus Flavivirus. The first large outbreak of Japanese encephalitis (JE) was recorded in Japan in 1924, with around 6000 cases reported.[1] Since then, JE has been identified in most East and South-East Asian nations, producing an estimated 67,900 JE cases per year in 24 JE-endemic countries. [(2)] JE is reported to have a 20–30% case fatality rate and to leave neurological or mental sequelae in 30–50% of survivors. [2]

Japanese encephalitis virus is made up of five phylogenetically distinct genotypes (GI–GV) that all belong to the same serotype and share cross-protection. Previously, GIII was the most often isolated genotype. However, genotypes GIV and GV have recently emerged in many endemic regions, but their clinical significance is unknown, with genotype GIV isolated only from one mosquito collection in Indonesia and never from humans, whereas genotype GV has been isolated from mosquitos and pigs mainly, with very few reported human isolates. [3]

The first indication of the Japanese encephalitis virus existence in India was discovered in 1952, and the first human case was reported in Tamil Nadu in 1955.[1] Until 1973, when the first big outbreak erupted in the north-eastern state of West Bengal, the illness was restricted to the southerly areas of India with a low frequency.

Many large outbreaks have been recorded in various sections of the nation since 1955. In 1973, a severe epidemic in the Bankura District of West Bengal resulted in a 42.6 percent death rate.[4] Following that, the illness spread to neighboring states, resulting in a series of epidemics across the country. There were instances recorded from 21 states and union territories in 1978. The first significant JE outbreak in Uttar Pradesh occurred in Gorakhpur in 1978, with 1,002 cases and 297 fatalities. Following the JE epidemic in 1978, Gorakhpur saw a number of outbreaks of different severity and extent. The 2005 outbreak outstripped all prior epidemics in the nation. In that year, Uttar Pradesh saw a devastating outbreak of JE, which was primarily contained to Gorakhpur and resulted in 6,061 cases and 1,500 fatalities; a second outbreak occurred in 2006, with 2,320 cases and 528 deaths. In Uttar Pradesh, JE cases were also on the rise.[5] Japanese encephalitis (JE) is spreading its wings over the State of Madhya Pradesh.

Transmission of JE

The natural enzootic cycle of the Japanese encephalitis virus (JEV) occurs between Culex mosquitoes, most often Culex tritaeniorhynchus, and wading birds, a cycle in which JEV persists in nature despite the absence of amplifying hosts.[6] Pigs are the most common amplifying hosts with lengthy and significant viremia, although, in places where pig population is low, other domestic animals such as cattle, goats, and household birds may, to some extent, substitute pigs as amplifying hosts.[7] However, because these domestic animals have such a short and low degree of viremia, their function in JE transmission is significantly less important.[8]

Changes in climate and environment, notably agricultural changes necessitated by population growth, have a significant influence on JE transmission.[9]

Incidence of Japanese encephalitis

Around 2 billion peoples live in areas where JE poses a considerable

risk to humans and animals, especially in China and India, where at least 700 million children are at risk.[10] Around 50,000 cases and 10,000 fatalities occur each year in Southeast Asia, primarily affecting children under the age of ten [11]. The JE virus has demonstrated a tendency to spread to other geographic locations, posing further hazards to humans.

Although most human infections are mild or asymptomatic, roughly half who acquire encephalitis develop persistent brain abnormalities, and a third of those who develop encephalitis die as a result of the condition[12]. In West Bengal's Bankura and Burdwan districts, the first JE outbreak was noted in 1973, with a total of 700 cases and 300 case fatalities.[13]

Since 1973, JE outbreaks have occurred in Tamil Nadu, West Bengal, Assam, Bihar, Uttar Pradesh, Karnataka, and Andhra Pradesh [14]. Every year, occasional JE cases are documented in these states, indicating that it is endemic.[15]

Immunization against Japanese encephalitis

In India, JE immunization began in 2006, following big outbreaks of the disease in various regions of Eastern Uttar Pradesh and Bihar. In 2006, large vaccination programs were conducted in 11 of the country's most at-risk districts, followed by 27 districts in 2007, 22 districts in 2008, and 30 districts in 2009. A single dose of Chinese live attenuated SA-14-14-2 JE vaccination was administered to children aged one to fifteen years.[16]

In the 181 endemic areas of India, the live attenuated SA-14-14-2 vaccine against Japanese encephalitis (JE) was introduced into regular vaccination under the Universal Immunization Program. In endemic locations, the Indian government has approved the introduction of a single dosage of JE vaccination for adults.[17]

Geographical distribution

With instances recorded from Japan, China, India, the Philippines, and Pakistan, the virus is now known to be endemic throughout a vast area of Asia. (Fig-1 & 2) In Africa, Europe, and the Americas, there have been no autochthonous instances of JEV. JEV is the most common cause of human encephalitis in eastern and southern Asia, and there are now several genotypic variants in Asia. [18]

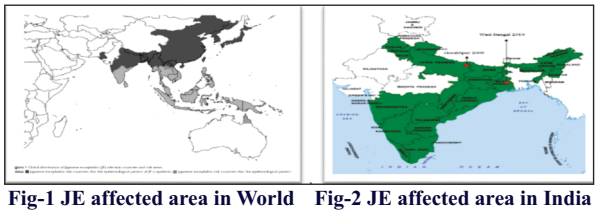


Fig-1 JE affected area in World **Fig-2 JE affected area in India**

The virus has been identified as active in practically every section of India, with outbreaks occurring on a regular basis. Assam, Andhra Pradesh, Haryana, Bihar, Maharashtra, Karnataka, Kerala, Tamil Nadu, Manipur, West Bengal, Orissa, and Uttar Pradesh, are the states most impacted. Epidemics have also been recorded in the union territories of Goa and Pondicherry. [19]

METHODOLOGY

Study area

Madhya Pradesh, which literally means "Central Province," is located in the geographic center of India, between 21.6°N and 26.30°N and 74°9'E and 82°48'E. The state is divided by the Narmada River, which flows east-west between the Vindhya and Satpura mountains; these ranges, together with the Narmada, constitute the traditional northern and southern boundaries of India. Gujarat borders the state on the west, Rajasthan on the northwest, Uttar Pradesh on the northeast, Chhattisgarh on the east, and Maharashtra on the south. Summer, Monsoon, and Winter are the three primary seasons of Madhya Pradesh.

Study Population

The cases of Japanese Encephalitis in Madhya Pradesh were recorded between 2016 and 2020. Instances with clinical diagnoses of acute encephalitis syndrome (AES) were sent to the Virology laboratory for etiological diagnosis of Japanese encephalitis, all cases were reported positive via Elisa from Virology lab NIV Pune, AIIMS Bhopal, and NIRTH Jabalpur. An individual of any age with an immediate onset of fever and a change in mental state (including symptoms such as confusion, disorientation, coma, or inability to speak) and / or a new beginning of seizures was considered to have AES (excluding simple febrile seizures). Patient's age, sex, and residential address were collected.

The data was collected from IDSP, and it included the number of cases by years, months, districts, and, geographical details were collected from the Department of Land Survey, and the projected population data were collected from the census.

Data Analysis

Microsoft Excel was used to conduct a retrospective descriptive data analysis. To better understand the burden of JE in humans, the morbidity rate (number of JE cases per 100,000 population per year) and case fatality rate (number of deaths/number of cases diagnosed per year) was calculated. Graphs were used to depict the seasonal and yearly patterns of JE cases. To calculate yearly-specific incidence for each district, the reported JE cases were combined with projected population data. The occurrence of JE was plotted on the chart.

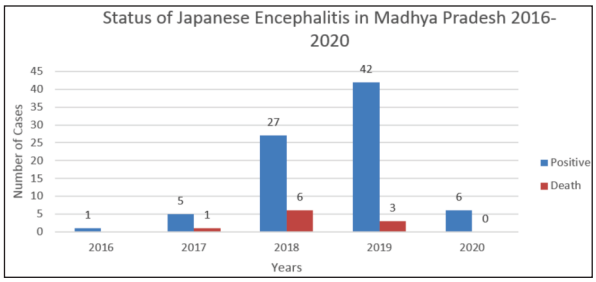
RESULT

Analysis of data revealed that from 2016 to 2020, a total of 81 Acute encephalitis syndrome cases with 10 deaths were reported in Madhya Pradesh.

All these cases were lab-confirmed cases of Japanese Encephalitis. During this period, the average case fatality rate was 12.34%, with a morbidity rate of 0.11 per lakh population.

Status of Japanese Encephalitis in Madhya Pradesh

The first case was reported from the Indore district in the year 2016. 5 cases were reported from three districts Bhopal, Chhatarpur, and Vidisha in the year 2017, and 27 cases were reported from nine districts Ashoknagar, Bhopal, Harda, Hoshangabad, Katni, Raisen, Sagar, Sehore, Vidisha in the year 2018. Similarly, 42 cases were reported from 15 districts Ashoknagar, Betul, Bhopal, Guna, Harda, Hoshangabad, Narsingpur, Neemuch, Raisen, Rewa, Sagar, Sehore, Tikamgarh, Vidisha, Chhindwara in the year 2019, and 6 cases were reported from four district Rewa, Sidhi, Shahdol, Satna in the year 2020. Deaths from Japanese Encephalitis were reported in the year 2017, 2018, and 2019 and a total of 10 deaths has been reported. (Graph-1)



Graph-1: Cases of Japanese Encephalitis in Madhya Pradesh

It was observed that these aforementioned districts mainly represented the central part of Madhya Pradesh. As evident from the print map of the state, it is very clearly seen that Japanese Encephalitis is most prevalent in Bhopal division and surrounding districts of central Madhya Pradesh. The state capital and nearby districts were found to be consecutively affected with JE for multiple years. (Fig-2)

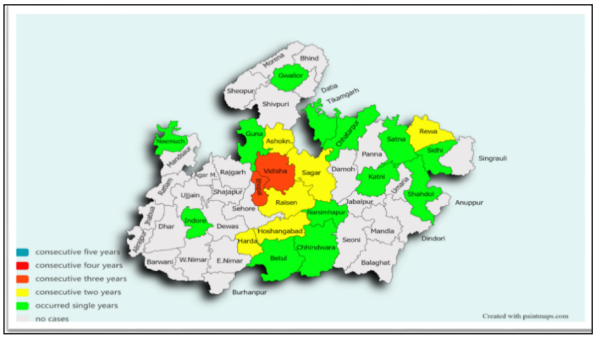
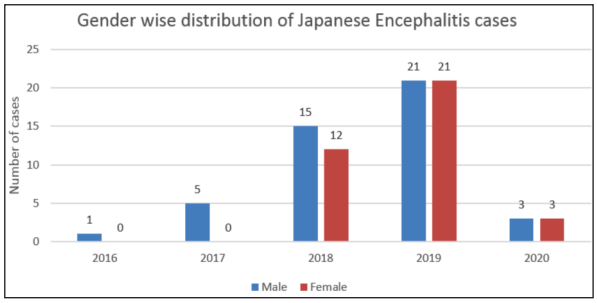


Fig-3: Spot map of Madhya Pradesh showing Japanese Encephalitis cases

Gender distribution

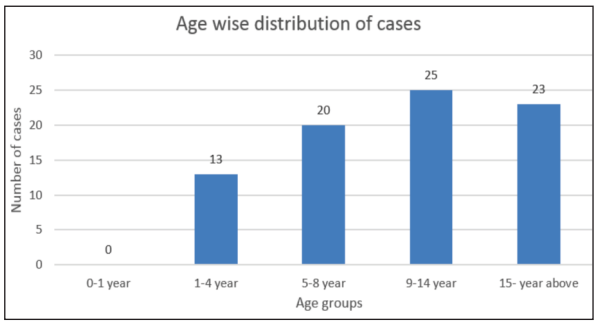
Gender- based distribution of Japanese encephalitis cases in 2016 reported a single male patient, whereas 5 male patients were reported in the year 2017. Subsequently, 15 (55.55%) males, 12 (44.44%) females were reported in the year 2018, whereas 21(50%) males, 21(50%) females in the year 2019 and 3 (50%) males, 3 (50%) females in the year 2020 were reported. Overall out of 81 participants, 45 were male (55.5%) and 36(44.44%) were female. (Graph-2)



Graph-2: Gender wise distribution of Japanese Encephalitis

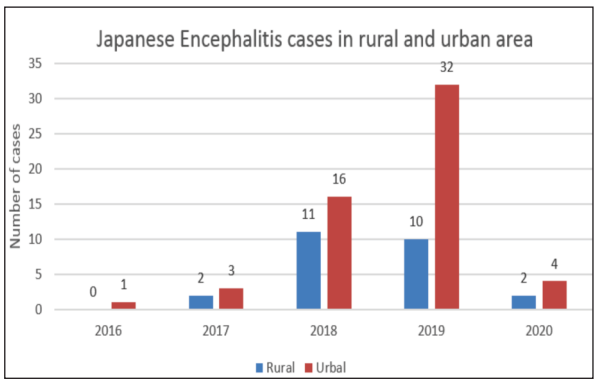
Age-wise distribution of Japanese Encephalitis

20% of JE cases were found in the 1-4years age group, 60% cases in the 9-14years age group, and 20% cases in above 15 years age group in the year 2017. 18% cases in 1-4 years age group, 30% cases in 5-8 years age group, 26% cases in 9-14 years age group, 26% cases in above 15 years age group were reported in the year 2018. In the year 2019, 14% cases in 1-4 years age group, 26% cases in 5-8 years age group, 31% cases in 9-14 years age group, and 29% cases in above 15 years age group were reported. Similarly, in the year 2020, 18% cases in the 1-4years age group, 30% cases in the 5-8 years age group, 26% cases in the 9-14 years age group, and 26% cases in above 15 years age group were reported. (Graph-3)

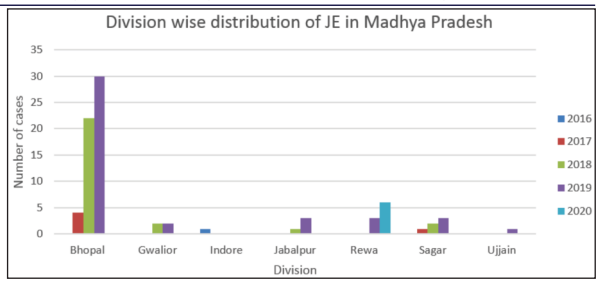


Graph-3: Locality wise distribution of Japanese Encephalitis in Madhya Pradesh

According to the available data, 1 case has been reported from an urban area in the year 2016, 2 (40%) rural, 3 (60%) urban areas cases reported in the year 2017, whereas 11 (40.74%) rural, 16 (59.25%) urban areas cases reported in the year 2018. In the year 2019, 10 (23.80%) rural, 32 (76.19%) urban and 2 (33.33%) rural, 4 (66.66%) urban cases were reported in the year 2020. Cumulatively, during 2016-2020, 25 (30.86%) cases were from the rural region and 56 (69.13%) were from the urban region. (Graph-4)



Graph-4: Locality wise distribution of study participants

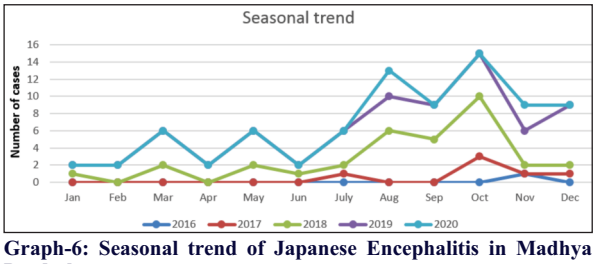


Graph-5: Division-wise distribution of Japanese Encephalitis in Madhya Pradesh

The cases of Japanese Encephalitis were most prevalent in the Bhopal division, that consists of 8 districts. From this division, Bhopal and Vidisha districts reported JE cases for consecutive three years, whereas the districts of Harda, Hoshangabad, and Raisen reported cases for consecutive two years and the Betul district reported only once in the year 2019. Rajgarh is the only district from Bhopal division where no case has been reported till now (Graph-5).

Seasonal trend of Japanese Encephalitis in Madhya Pradesh

The available data from the year 2016 to 2021 showed that the JE cases have occurred occasionally throughout the year, though peaking during the months of September-October, and declining subsequently. Seasonal maxima of JE cases have been seen in the state from August to October. Statistics showed that the majority of cases occurred from July to October, corresponding with the rainy and post-rainy seasons. With the arrival of winter season, the number of cases of JE dropped dramatically. (Graph-6)



Graph-6: Seasonal trend of Japanese Encephalitis in Madhya Pradesh

DISCUSSION

In Madhya Pradesh there are a total of 52 districts, out of which 21 districts are affected with Japanese Encephalitis. Districts of the Bhopal division were most commonly affected. It is very clearly seen that Japanese Encephalitis is most prevalent in central Madhya Pradesh, the cases of Japanese Encephalitis were most prevalent in the Bhopal division, Bhopal division consists of 8 districts, one district didn't register any case of Japanese Encephalitis, two districts confirm the cases for consecutive three years, whereas the cases from three districts were reported for consecutive two years.

In our study, 60% of cases were in the 9-14 years age group, which is the most common age group to be affected. Analysis of age distribution of JE cases from Gorakhpur division in outbreaks in 1985, 1988, 2005, and 2009 show that children were more susceptible than adults. The highest number of cases occurred in children aged between 0 and 10 years.[2] A study conducted to see the trend of Japanese Encephalitis in Uttar Pradesh by **P. Jain** found that 30% of the patients affected with JE were adults.[30]

From the analysis of our data for gender-based distribution, we found that in 2016, a single male patient was reported, whereas 5 male patients were reported in the year 2017 for JE. In the year 2018, 15 (55.55%) males, 12 (44.44%) females were reported, whereas 21(50%) males, 21(50%) females in the year 2019 and 3 (50%) males, 3 (50%) females in the year 2020 were reported. Overall out of 81 participants, 45 were male (55.5%) and 36(44.44%) were female, so there is not much difference in gender of the affected patients in our study. The 2005 Japanese Encephalitis outbreak in Uttar Pradesh reported a case breakdown of 61% males and 39% females, the male to female ratio during the year 2016-2020 is 1.25:1.[2]

According to the available data from our study, 25 (30.86%) cases were from the rural region and 56 (69.13%) were from the urban

region. A study conducted by **S. Bhattacharya** found that the prevalence of JE and peri-urban areas are more prevalent as compared to a rural area, the reason proposed was that, in the urban and suburban fringe, urbanization and accompanying land-use changes offer optimal conditions for the transmission and maintenance of JEV. [21]

In our study, the average CFR was 12.34% during the year 2016-2020, However, according to **Kakkar et al.,** research from Uttar Pradesh that looked at two years of data from a tertiary care center indicated that the CFR for AES ranged from 18% to 19.8%. [22]However, in another study CFR was 31.5% in 1978 during an epidemic, 34.5% in 1985, 31.5% in 1988, and 24.9% in 2005, according to research that analyzed CFR at different eras. [2]

Monthly reports of JE cases in our study showed that occasional incidences occurred throughout the year, subsequently peaking in September-October, and finally declining in November-December. Seasonal maxima of JE cases have been seen in the State from August to October, a similar seasonal trend is found in the different regions. AES and JE cases in Nepal were found to begin a bit earlier, in April–May, peaking in late August and early September, and subsequently dropping. [23] **Saxena et al**. looked at the AES case trend and found that JE was on the rise in northern India, which might lead to greater outbreaks in the future.[24] Karnataka, like the rest of India, has been known to experience two epidemics each year, one with increased severity from April to July and the less severe one from September to December.[25]

Limitation

Data on factors that may impact JEV dispersion, such as personal health practice, awareness vaccination status, education level antibody positivity in the population, and mosquito population dynamics in districts, are either unavailable or inappropriate.

CONCLUSION

In Asia, particularly in India, the Japanese Encephalitis virus is the most common cause of viral encephalitis. The most typically afflicted age group is 9-14 years, with October being the month for highest incidence. In all JE-endemic states in India, safe and efficient JE vaccinations are available to prevent the disease and lower the risk of JE and AES; nonetheless, all visitors to JE-endemic areas should take steps to avoid mosquito bites, especially during peak season.

Prevention of Japanese encephalitis can be bought about by early diagnosis and apt treatment which can be achieved by timely implementation of adequate health policies, establishment of new labs at districts level and strengthening vaccination against JE in the afflicted regions. Government awareness activities such as the "Dastak" campaign and intersectoral preventive activities still need to be bolstered.

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