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A Descriptive Epidemiological Study on Acute Encephalitis Syndrome and Japanese Encephalitis of Sonitpur District of Assam State of India from 2009 to 2016

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Abstract

Introduction: Japanese Encephalitis (JE) commonly affects children and is a major cause of acute childhood encephalopathy. Growth of population, intensified rice farming, pig rearing and lack of surveillance are the key factor for transmission of the disease.

Methods: The present study aimed at determining the Case Fatality Rate, Sample Positivity Rate (SPR) and distribution (Time, Place, and Person) of Acute Encephalitis Syndrome (AES) and JE cases in Sonitpur District of Assam, India. This descriptive study was conducted over 8 years' period (2009-2016), based on surveillance data corresponding to each year. Confirmation of JE was done by IgM ELISA method.

Results: In the present study the CFR was highest for AES in the year 2015 being 11.1% and for JE it was 28% in the year 2015. Overall Sample Positivity Rate for JE was 18.35%. In this 8 years' study (from2009 to 2016), an almost equal sex distribution was observed in case of JE in Sonitpur District. Epi curve of AES cases of Sonitpur District showed two distinct peaks, one in the month of May and another in July. On the other hand, the Epi curve of JE cases showed a clear peak in the month of July in all these 8 years of study.

Conclusion: JE is a predominant infection among children as well as among adult. But less than 6 years' age group was mostly affected. Highest peak has been observed in the month of July and May to August was the period of maximum JE cases and this isthe monsoon season in the district.

Keywords: Acute Encephalitis Syndrome; Japanese Encephalitis; Surveillance Data; Sonitpur

Introduction

Japanese Encephalitis (JE) is among the most common cause of viral encephalitis in human beings and is found worldwide, especially in South-east Asia and less commonly in the Western Pacific regions and Australia [1]. JEV continues to invade other geographical areas and becoming a serious public health problem. JE is caused by JE Virus (JEV), a mosquito-borne flavivirus and belongs to the family Flaviviridae, a single stranded positive-sense RNA virus [2]. JE is primarily a zoonotic disease and vertebrate hosts such as pigs and birds play an important role in the maintenance and amplification of the virus while invertebrate host, mosquitoes are responsible for the transmission of virus [3]. About 1% of human Japanese Encephalitis Virus (JEV) infections result in JE, but 20-30% of these cases are fatal and 30-50% of survivors have significant neurologic or psychiatric squeal [4]. JE is primarily a disease of children however all age groups are affected. It is estimated that approximately 67,900 JE cases have occurred annually in 24 countries, with only 10,426 cases reported in 2011 [4,5]. An important cause of admission, mortality and

permanent neurological sequel in the hospital is viral encephalitis. Hundreds of known arthropods borne viruses (Arbo viruses) cause human diseases and among them the commonest virus is JEV that causes childhood viral encephalitis worldwide. In India, annual incidence of Japanese encephalitis ranged between 1714 and 6594 (NVBDCP). Epidemics are reported from many parts of Assam, Bihar, Haryana, Tamil Nadu, Uttar Pradesh, West Bengal, Manipur, Andhra Pradesh, Karnataka, Madhya Pradesh, Orissa and union territory of Goa and Pondicherry7 and among them Uttar Pradesh and Assam are the major affected state. In Jharkhand, first case was reported in 2010. Japanese encephalitis virus, a small enveloped plus stranded RNA virus is an Arthropod Borne Arbovirus, belonging to the family Flaviviridae and genus Flavivirus. Japanese Encephalitis Virus (JEV) causes inflammation of the brain, which may lead to permanent brain damage, and has a high mortality rate. In India, it was first recognized in 1955 when virus was isolated from *Culex vishnui* from Vellore during the outbreak of encephalitis in Tamil Nadu5. Although, all age groups are affected, cases reported from endemic region are mainly from age groups below 15 years. Growths of population, intensified rice farming, pig rearing etc. are the key factors for transmission of the disease [6].

A major outbreak of Japanese Encephalitis was reported from eastern Uttar Pradesh during 2005 resulting in recording of more than 6000 cases and 1500 deaths. This led to a major decision of introduction of vaccine in high endemic areas in 2006. Simultaneously National Vector Borne Disease Control Programme (NVBDCP) developed surveillance and case management guidelines for syndromic reporting of AES including JE [7]. JE in Sonitpur District of Assam is a common cause of outbreak since 2009. The exact burden of JE in Sonitpur District is still not known since no published literature in this regard is currently available. Hence the present study is conducted to estimate the Case Fatality Rate (CFR), Sample Positivity Rate (SPR) and to analyze the distribution of JE cases in terms of time, place and person.

Methods

Study Type

This was an observational descriptive study which is based on surveillance data corresponding to the year 2009 to 2016.

Study Period

Study was based on the data from the year 2009 to 2016.

Study Area

The study was undertaken in the District of Sonitpur of Assam State located in the north-eastern part of India (lies between the Latitude of 26.76760N and the Longitude of Sonitpur is 92.77860E).

The District has an area of 5,324 km^2. According to the 2011 national census, Sonitpur District has a population of 1,924,110 of which male and female were 983,904 and 940,206 respectively. As per 2011 census, 90.96 % population of Sonitpur districts lives in rural areas of villages. Agriculture is the main economic source of this District. The climate is warm and humid for the maximum time of the year. Here summer lasts from April to October. The pre-monsoon arrives by late April and then second flush of monsoon comes by June and lasts up to end of September [8].

Study Population

All cases clinically diagnosed as Acute Encephalitis Syndrome (AES) as per the Case-Definition of Integrated Disease Surveillance Programme (IDSP) as well as tested for JE including those confirmed as JE, as reported to the District Surveillance Unit, Sonitpur, Assam from 2009 to 2016. All the cases are from Sonitpur District.

Study Setting

The District Surveillance Unit, Sonitpur, Aaasam, India.

Study Tools

Secondary Surveillance data reported to District Surveillance Unit from various reporting units of the district. A Questionnaire (Acute encephalitis syndrome/suspected JE case investigation form AESF-4) was used to collect all the data

Study Variables

Case Fatality Rate (CFR), Sample Positivity Rate (SPR), age, sex, address (Person, Place and Time distribution).

Study Technique

Questionnaire: Whenever the District Surveillance Unit is informed of any AES or suspected JE cases, staffs contact that patient and their guardians, and the questionnaire was filled up.

Observation: Symptoms for AES and JE were observed by clinicians and a case specific clinical investigation was carried out.

Laboratory Confirmation

Serum or CSF was collected from the patients who were advised for the laboratory confirmation of JE. For the Detection of IgM antibody against JEV in serum and/or CSF (according to manufacturer's manual), M antibody captured Enzyme-Linked-Immunosorbent-Assay (Mac ELISA, Model:) was performed as standard confirmatory method by the Sentinel Site Laboratory (SSL, Sonitpur). The IgM ELISA method was 100% sensitive and 100% specific.

Sample Size

The sample size from 2009 to 2016 was tabulated below.

Year	JE positive	IR/1 lakh
2009	29	0.69
2010	32	0.77
2011	73	1.76
2012	36	0.86
2013	20	0.48
2014	45	1.08
2015	25	0.6
2016	21	0.5

Table 1: Sample size and Incidence Rate of JE cases in Sonitpur District from 2009-2016.

Data Collection

Data were obtained, as a part of routine JE Surveillance in IDSP, Sonitpur, Assam from all JE screening laboratories of the district viz. Sentinel Site Laboratory (SSL) Sonitpur, Baptist Christian Hospital Mission Chariali Sonitpur, Tezpur Medical College Hospital Tezpur Sonitpur, B.K. Memorial Hospital Tezpur Sonitpur, Kanaklata Civil Hospital Tezpur Sonitpur and JE positive cases of Sonitpur District from the hospitals of other districts also.

Data Analysis

Data were analyzed using MS Excel 2007 and SPSS version 22.0.0.0.

1.1 Ethical Consideration

Anonymous data were considered for analysis. Confidentiality of the data was maintained throughout the study. The approval of Institutional ethical committee has been obtained for the present study.

Operational definitions

- **Case Fatality Rate**
- Case Fatality Rate (CFR) is the proportion of deaths within a designated population of "cases" (people with a medical condition like JE and AES), over the course of the disease [9]. CFR % = (Number of deaths ÷ Number of cases) X 100
- **Sample Positivity Rate**
- (Number of cases whose sample were found positive for JE) ÷ (Number of cases whose samples were tested for JE) X 100
- **Acute Encephalitis Syndrome (AES)**

Probable Case Definitions [10]

A person of any age with acute onset of fever and any of the following

- Change in mental status (confusion, disorientation, coma, inability to talk).
- New onset of seizures (excluding simple febrile seizures).
- Other clinical findings like an increase in irritability, somnolence or abnormal behavior greater than that seen with usual febrile illness.

Probable Japanese Encephalitis [11]

A suspected case that occurs in close geographic and temporal relationship to a laboratory-confirmed case of JE, in the context of an outbreak.

Confirmed JE [10]

A suspected case of AES with any one of the following markers:

- Demonstration of JE specific IgM antibodies in serum and/or CSF by IgM antibody captures ELISA.
- Nucleic acid detection by PCR
- Four-fold difference in lgG antibody titre in paired sera
- Virus isolation from brain tissue
- Antigen detection by immunofluroscence

Results

Case Fatality Rate

The CFR for JE from the year 2009 to 2016 is given below

Sample Positivity Rate for JE

The Sample Positivity Rate for JE in male and female population of Sonitpur District from the year 2009 to 2016 is given below

Monthly trend of AES and JE in Sonitpur District from 2009-2016

Incidence Mapping of JE cases in Sonitpur District from2009-2016

Sonitpur District has seven Block PHCs (Physical Health Center) viz. Gohpur, Behali, Biswanath Chariali, North Jamuguri, Balipara, Bihaguri and Dhekiajuli. Block PHC wise JE incidences are given below.

Age and sex wise incidence of AES and JE in Sonitpur District from 2009-2016

Discussion

In this study, the role of epidemiological features involved in AES and JE were well documented. The study period is from 2009 to 2016.

Case Fatality Rate

The highest case fatality rate was observed for JE in 2015 being 28% and lowest in 2013 with a CFR of 10% (Table 2). This was may be due to proper and early diagnosis of the patients.

Year	AES cases	JE positive	JE deaths	SPR%	CFR (%)
2009	141	29	5	20.56%	17.2%
2010	200	32	7	15%	23.3%
2011	351	73	8	20.79%	10.9%
2012	184	36	4	19.56%	11.1%
2013	198	20	2	10.10%	10%
2014	198	45	9	22.72%	20%
2015	135	25	7	18.5%	28%
2016	104	21	3	20.19%	14.2%

Table 2: SPR and CFR for JE cases in Sonitpur District from 2009-2016.

Sample Positivity Rate for JE

The highest SPR for JE was observed in 2014 and lowest in 2013.

The average SPR for these 8 years was 18.43; which was corroborative with the findings of the study conducted by Shreshtra et al. at Pediatric ward of Patan hospital. Nepal in their 2 years' study (2006-07) (17.7%) [12]. However, it was quite lower than the findings of studies conducted by Sarkar et al. at ICMR ((Indian Council of Medical Research) Virus Unit of, in their 5 years' study (2005 - 2010) (27.00%) [13]; Taraphdar et al. at ICMR Virus Unit of Kolkata, in their 6 years' study (2005 - 2011) (35.14%) [14]; Anuradha et al. at Paediatric department at VIMS hospital Bellary, Karnataka (23.17%) [15].

On the contrary, the study conducted by Gunasekaran et al. at King Institute of Preventive Medicine & Research (KIPM & R), Chennai and also Bandyopadhyay et al. at Virology laboratory at the Calcutta School of Tropical Medicine, West Bengal in their 2 years' study (2011-12) (12.21%) [16].

Person Distribution of JE Cases

Most of the AES cases belonged to less than 6 years' age group and in males, only in the year 2009 and 2011; the incidence of AES was low in less than 6 years (Table 3). Accordingly, most of the JE cases also belonged to less than 6 years' age group. In this 8 years' study (from 2009 to 2016), an almost equal sex distribution was observed in case of JE in Sonitpur District (Table 4). Although, JE cases have been observed from all the age groups in the present study, highest numbers of JE positive cases recorded among 0-6 years with a gradual decline towards higher age groups. This finding was in accordance with many previous studies; such as study by Bandyopadhyay et al (48.21% & 61.11% below 20 years of age in 2011&2012, respectively) [11], Sarkar et al., (44.0% belonged to 0 - 10 years age group & 24.0% were in the age group of 11 - 20 years) [12], Taraphdar et al. (59.10% cases were up to 20 years of age) [13], Anuradha et al. (maximum male & female cases were in the age group of 7- 9 years & 1-3 years respectively) [14], Gunasekaran et al. (82% under 12 years of age) [16] and Bista et al. (50% occurred below 15 years of age) [17]. Most of the JE cases were males and other studies also revealed male predominance such as at Calcutta School of Tropical Medicine [11], ICMR, Kolkata [12], ICMR, Virus Unit [13], Bellary [14] and Chennai [16].

- **AES**

Age/Sex	Population	AES 2009 IR/1lakh	AES 2010 IR/1lakh	AES 2011 IR/1lakh	AES 2012 IR/1lakh	AES 2013 IR/1lakh	AES 2014 IR/1lakh	AES 2015 IR/1lakh	AES 2016 IR/1lakh
0-6	277862	5.75	14	12.59	19.43	15.83	18.71	10.4	6.11
>6	2E+06	7.59	7.59	19.19	7.89	9.53	8.99	4.49	5.28
Male	983904	8.74	11.78	19	10.77	11.99	11.68	5.79	6.3
Female	940206	5.84	8.9	17.44	8.2	8.82	9.04	4.89	4.46

Table 3: Age and sex wise incidence of AES in Sonitpur District from 2009-2016.

- **JE**

Age/Sex	Population	JE 2009 IR/1lakh	JE 2010 IR/1lakh	JE 2011 IR/1lakh	JE 2012 IR/1lakh	JE 2013 IR/1lakh	JE2014 IR/1lakh	JE 2015 IR/1lakh	JE 2016 IR/1lakh
0-6	277862	1.43	2.15	1.07	2.15	1.43	1.79	1.43	0.71
>6	2E+06	1.51	1.45	4.25	1.82	0.79	2.42	1.09	1.15
Male	983904	1.52	1.72	4.26	2.43	1.53	3.04	1.42	0.91
Female	940206	1.48	1.38	3.29	1.27	0.21	1.59	1.91	1.27

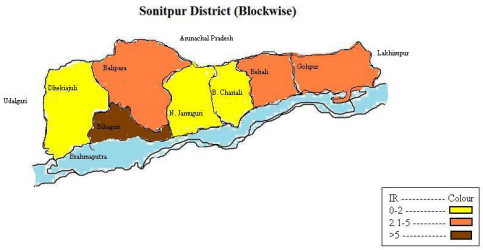
Table 4: Age and sex wise incidence of JE in Sonitpur District from 2009-2016.

Distribution of JE according to place

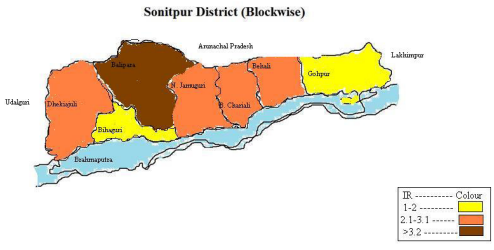
The block wise distribution of positive JE cases during the study period was given in incidence maps.

Balipara and Bihaguri BPHCs remained to be the two major contributors of JE cases in almost all the years of the study period. Apart from them, Behali showed maximum number of JE cases in 2015 (Figure 3g), N. Jamuguri in 2016 and Gohpur in 2013 (Figure 3h). In the present study, the BPHCs like Balipara, Bihaguri and N. Jamuguri showed constant presence of JE cases in almost all the years (2009-2016) (Figure 3a-3h). This may be because these areas are mainly rural and have wide spread cultivation area. Constant water logging was observed during monsoons providing a favourable place for mosquito breeding. Bihaguri and Balipara BPHC have a large number of tribal populations and pig rearing is one of the main practices in them. These two areas have large piggeries. All these may contribute to incidence of JE in the said areas.

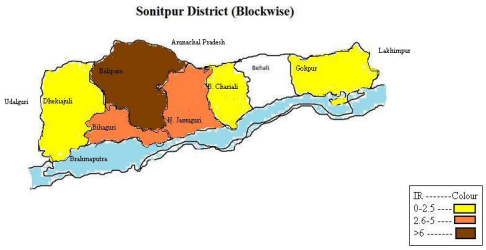
Block PHC wise Incidence Map of JE from the year 2009 to 2016



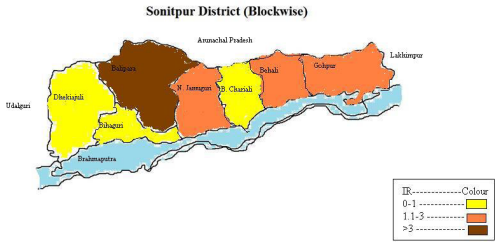
3(a) For the year 2009



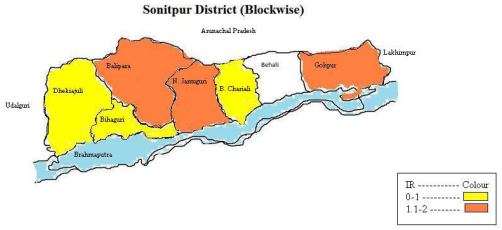
3(b) For the year 2010



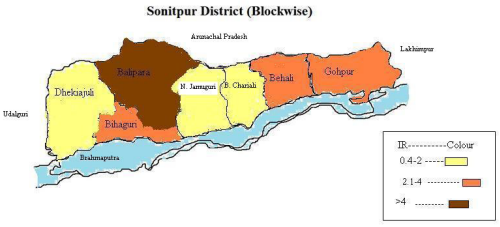
3(c) For the year 2011



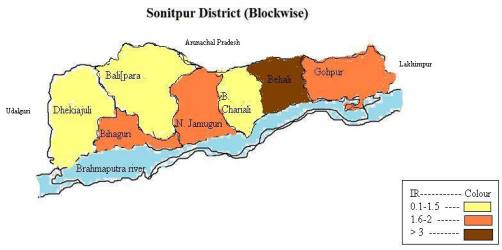
3(d) For the year 2012



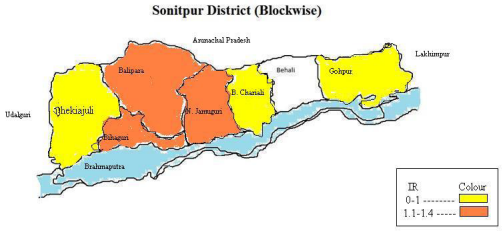
3(e) For the year 2013



3(f) For the year 2014



3(g) For the year 2015



3(h) For the year 2016

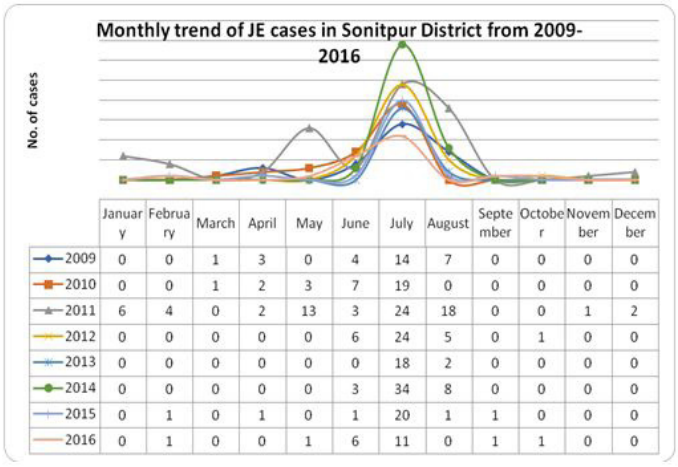
Figure 3(a-h): Incidence map for JE in Sonitpur District from the year 2009 to 2016.

Time distribution of JE cases

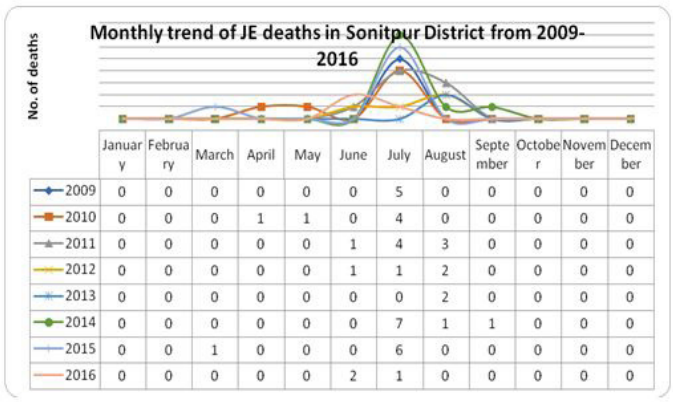
Line diagram of time distribution of AES cases of Sonitpur District showed two distinct peaks, one in the month of May and another big peak in the month of July i.e. at monsoons. AES cases starts in the District from late April and lasts up to October. However, JE cases show their highest peak in the month of July. May to August is the period when JE cases are found in maximum number. In the present study, Epi curve of AES cases of Sonitpur District showed two distinct peaks, one in the month of May and another in July (Figure 2). On the other hand, the Epi curve of JE cases showed a clear peak in the month of July in all these 8 years of study (Figure 1). Nepal study [17] revealed an upsurge of cases after the rainy season where cases start to appear in the month of April - May and reached its peak during late August to early September and start to decline from October. Strangely, as per Chennai study [16] also, majority of the cases were reported soon after monsoon, i.e. peak during late August to early September and start to decline from October. These two studies are showing similar seasonal pattern for JE as the present study. If we compare our study with neighboring state of West Bengal, studies [11,13] demonstrated that large number of JE cases occurred during rainy and post rainy season (June to November). According to the study of Arindam Sarkar et al. [12], in West Bengal, JE cases reaches peak in September, followed by October and November. As per study at Bellary, Karnataka, the cases started from July, reached peak in November (rainy season followed by winter season) and then decline; no cases seen from January to June [14]. Considering the peak in Epi curve in July & August for cases of

Sonitpur District it can be stated that vector breeding started from April and June i.e. around one to one and half months before the peak. Hence a temperature favorable for breeding of culex in these regions probably explains the time pattern of JE cases in Sonitpur District.

- **Monthly trend of JE cases and deaths in Sonitpur District from 2009-2016**



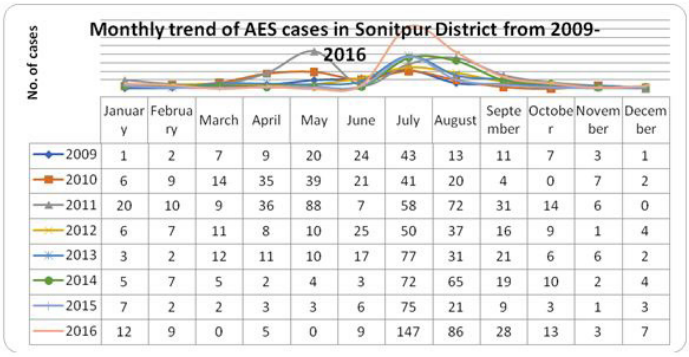
	January	February	March	April	May	June	July	August	September	October	November	December
2009	0	0	1	3	0	4	14	7	0	0	0	0
2010	0	0	1	2	3	7	19	0	0	0	0	0
2011	6	4	0	2	13	3	24	18	0	0	1	2
2012	0	0	0	0	0	6	24	5	0	1	0	0
2013	0	0	0	0	0	0	18	2	0	0	0	0
2014	0	0	0	0	0	3	34	8	0	0	0	0
2015	0	1	0	1	0	1	20	1	1	0	0	0
2016	0	1	0	0	1	6	11	0	1	1	0	0



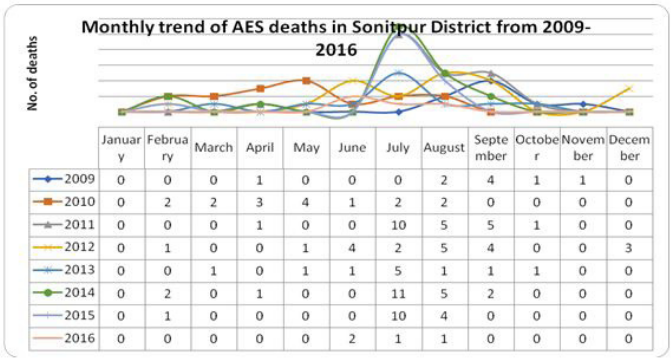
	January	February	March	April	May	June	July	August	September	October	November	December
2009	0	0	0	0	0	0	5	0	0	0	0	0
2010	0	0	0	1	1	0	4	0	0	0	0	0
2011	0	0	0	0	0	1	4	3	0	0	0	0
2012	0	0	0	0	0	1	1	2	0	0	0	0
2013	0	0	0	0	0	0	0	2	0	0	0	0
2014	0	0	0	0	0	0	7	1	1	0	0	0
2015	0	0	1	0	0	0	6	0	0	0	0	0
2016	0	0	0	0	0	2	1	0	0	0	0	0

Figure 1: Monthly trend of Japanese Encephalitis cases and deaths in Sonitpur District from 2009-2016.

- **Monthly trend of AES cases and deaths in Sonitpur District from 2009-2016**



	January	February	March	April	May	June	July	August	September	October	November	December
2009	1	2	7	9	20	24	43	13	11	7	3	1
2010	6	9	14	35	39	21	41	20	4	0	7	2
2011	20	10	9	36	88	7	58	72	31	14	6	0
2012	6	7	11	8	10	25	50	37	16	9	1	4
2013	3	2	12	11	10	17	77	31	21	6	6	2
2014	5	7	5	2	4	3	72	65	19	10	2	4
2015	7	2	2	3	3	6	75	21	9	3	1	3
2016	12	9	0	5	0	9	147	86	28	13	3	7



	January	February	March	April	May	June	July	August	September	October	November	December
2009	0	0	0	1	0	0	0	2	4	1	1	0
2010	0	2	2	3	4	1	2	2	0	0	0	0
2011	0	0	0	1	0	0	10	5	5	1	0	0
2012	0	1	0	0	1	4	2	5	4	0	0	3
2013	0	0	1	0	1	1	5	1	1	1	0	0
2014	0	2	0	1	0	0	11	5	2	0	0	0
2015	0	1	0	0	0	0	10	4	0	0	0	0
2016	0	0	0	0	0	2	1	1	0	0	0	0

Figure 2: Monthly trend of Acute Encephalitic Syndrome cases and deaths in Sonitpur District from 2009-2016.

Limitations

We did not take into consideration some important socio-demographic variables like location of the residence, type of house, educational status, economic status etc.

Conclusion

The present study added the followings, over and above the previous knowledge:

- JE is a predominant infection among children as well as among adult. But less than 6 years' age group is mostly affected.
- Highest peak has been observed in the month of July and May to August is the period of maximum JE cases and this is the monsoon season in the district.

- JE cases have been found in the BPHCs of Balipara, Bihaguri and N. Jamuguri consistently in all the years. This may result in the endemicity of JE in these areas in near future.

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