

## ORIGINAL ARTICLE - PUBLIC HEALTH

## CLINICO-EPIDEMIOLOGICAL PROFILE OF INFLUENZA A H1N1 CASES IN TAMIL NADU FROM 2022 TO 2023.

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## Abstract

**INTRODUCTION:** The swine flu or Influenza A H1N1 virus infection was first observed in Mexico and later spread quickly worldwide as a pandemic including India in 2009. It has emerged as a virulent pathogen leading to a considerable burden worldwide. The present study aims to analyze the clinic-epidemiological profile of the cases that tested positive in Tamil Nadu.

**METHODS:** During this retrospective study from 2022 to 2023, 6462 cases tested positive in Tamil Nadu, and the clinical-epidemiological profile was available for 6303 cases. The data was collected after approval from the Director of Public Health and Preventive Medicine of Tamil Nadu and the data was entered in Microsoft Excel and analysed using SPSS software version 21.

**RESULTS:** In Tamil Nadu, the case positivity rate was 11.2% with a case fatality rate of 0.68%. The highest case positivity rate was in children <10 years (20%) followed by adults between 50-60 years of age (15.9%). Highest mortality rate was seen between 51-60 years (41.9%). The incidence was highest in Chennai followed by Coimbatore. The cumulative incidence was highest in September (46.5%) during monsoon. The highest mortality was observed in Category C patients (p-value <0.05) and in those who were initiated on treatment >2 days after the onset of symptoms (p-value <0.05).

**CONCLUSION:** Based on the findings of our study, we can hypothesize that the incidence of the Influenza A H1N1 case has a bimodal distribution with the highest fatality among the elderly. Stringent surveillance and preventive measures are needed during monsoon season and early initiation of treatment is necessary to reduce the mortality and morbidity.

**KEYWORDS:** Influenza A H1N1, Swine flu, Epidemiology, Tamil Nadu, Seasonality.

## INTRODUCTION

The influenza virus, also referred to as the flu virus, is known to primarily attack the respiratory system. It is a member of the Orthomyxoviridae family of RNA viruses, which has three subtypes.<sup>1</sup> They are Influenza A, B, and C, with Influenza A and B being the subtypes that are more frequently circulating. Numerous influenza viruses, including AH1N1, AH3N2, Influenza B, and others, are circulating and can cause seasonal influenza.<sup>2,3</sup> There is a great chance that influenza will frequently spark pandemics and outbreaks. Four of the five worldwide pandemics that occurred in the 20th and 21st centuries have been caused by it.<sup>4</sup>

Swine flu virus Influenza A(H1N1) first appeared in Mexico in March 2009, then moved to the USA and, by May, India. The World Health Organisation (WHO) proclaimed a pandemic in June that persisted in India and claimed the lives of nearly 40% of cases until it was contained in August 2010. The infected cells break down and cytokines are released, causing fever, malaise, damage to the pulmonary parenchyma and respiratory epithelium, and pneumonia. It addition it leads to secondary bacterial infections because of tissue damage and exacerbation of preexisting comorbidities.<sup>2,5</sup>

India witnessed its first swine flu (Influenza A H1N1) outbreak in 2009 which infected 27,236 cases leading to mortality among 981 cases across the country. The outbreak continued until 2010 infecting 20,604 cases and mortality among 1763 cases. The outbreak was contained in 2010 but cases keep reported in all states of India making it endemic in India. In 2015 an outbreak was declared due to a mutant strain of Influenza A H1N1 which infected 10,000 cases leading to mortality in 774 cases. Later in 2017, the virus spread rapidly throughout the country which showed variance in the period of occurrence. The periods of peaks corresponded between January to March and between July to September.<sup>6</sup>

In Tamil Nadu, the incidence of Influenza A H1N1 has been noticed ever since the first outbreak in 2009. The incidence rates have been reduced since 2010 with peaks once in every 3 to 5 years. The peaks in new cases corresponded to the rise and fall in the monsoon rains.<sup>7</sup> There was a drastic fall



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in the number of cases during the COVID-19 pandemic and shown a slight increase in the cases since 2022.<sup>8</sup> This study is planned to elicit the clinical and epidemiological profile of the laboratory-confirmed Influenza A H1N1 cases and the factors that lead to the mortality of the cases.

**METHODOLOGY**

This is a retrospective cross-sectional study that was conducted in Tamil Nadu. Data of all the laboratory-confirmed Influenza A H1N1 cases in Tamil Nadu between the period January 2022 to December 2023 from both private and government institutions in Tamil Nadu were used for the study. The epidemiological factors of the cases like demographic characteristics, clinical profile, and outcome was represented and compared. Official permission to conduct the study was obtained from the Director of Public Health and Preventive Medicine, Tamil Nadu. All the suspected and confirmed Influenza A H1N1 cases were categorized into either of the three categories A, B or C based on the guidelines issued by the National Centre for Disease Control (NCDC) of the Ministry of Health and Family Welfare (MoHFW) India. The patients' treatment protocol and procedure were as per the categorization of cases from the MoHFW. Patients in Category-A included those with a low fever, cough, or sore throat, along with headache, diarrhoea, vomiting, and/or body aches. Patients in category B included individuals with high-grade fever, sore throat, and other high-risk conditions in addition to those exhibiting the signs and symptoms of category A. In addition to the signs and symptoms of Categories A and B, individuals in Category C also had bluish discoloration of the nails, sputum mixed with blood, sleepiness, chest pain, and dyspnea.<sup>9</sup> Influenza A H1N1 screening is done in both private and government institutions in Tamil Nadu. There are 60 laboratories throughout the state of Tamil Nadu where screening is done with 13 institutions from the Government sector and 47 institutions from the Private sector. It is mandatory to report the total number of samples screened and the total screened samples resulted in positive.<sup>10</sup> During the study period, 57,764 samples were screened in Tamil Nadu with 24,333 samples in 2022 and 33,431 in 2023. A total of 6462 cases (Year 2022- 2852 cases, Year 2023 - 3510 cases) were reported in Tamil Nadu during the study period. Among them, complete details were not available for 59 cases. Hence the final study population was 6303 (Year 2022- 2851 cases, Year 2023 - 3452 cases).

The line list contained the details of patients' demographic profiles like age, gender, and place. Clinical profile like date of onset of symptoms, date of sampling,

date of result published, and the outcome of the disease. The secondary data was entered in the Microsoft Excel software and the data was checked for duplication and any typing errors. The final data was analysed using IBM-SPSS software version 21.0. Categorical variables were represented as frequency and proportion and significance was tested using the Chi-square test. Continuous variables were represented as mean and standard deviation and significance was tested using the t-test.

**RESULTS**

Figure 1 describes the distribution of Influenza A H1N1 cases in Tamil Nadu during the study period. Among the 6303 cases reported positive, 6269 cases were natives of Tamil Nadu, and 34 cases were from different states. Half of the cases from other states were from Andhra Pradesh (n=18). Within Tamil Nadu, the major proportion of cases was from Chennai (n=1936, 30.7%) followed by Coimbatore (n=1480, 23.5%). A total of 43 deaths occurred in Tamil Nadu among the cases during the study period with a case fatality rate of 0.68%.

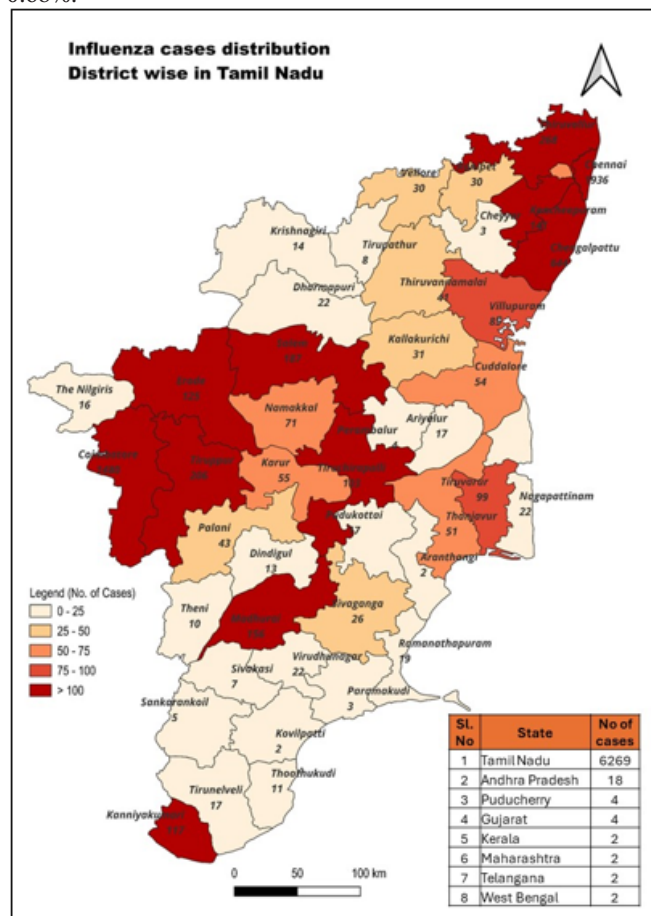


Figure 1 : District-wise distribution of Influenza A H1N1 cases in Tamil Nadu from 2022 to December 2023.

The mean age of the cases was  $42.47 \pm 25.45$  years ranging from less than 1 to 97 years. Table 1 explains the age distribution of cases and mortality rates in each age group.

All the cases were stratified into 10 groups with a 10-year class interval. The majority of positive cases occurred in children less than 10 years of age ( $n=1261$ , 20%) followed by 51-60 years ( $n=1019$ , 16.2%). The case fatality rate was highest in adults between the ages 51 to 60 years with 1.77% and least with nil deaths above 80 years of age.

Table 1 : Morbidity and Mortality due to Influenza A H1N1 cases in Tamil Nadu from 2022 to December 2023 among various age groups ( $n=6303$ ).

Age group in years	No. of cases	Percentage of cases	No of deaths	Percentage of deaths	Case fatality rate
< 10 years	1261	20	1	2.3	0.08
11 - 20 years	316	5	1	2.3	0.32
21 - 30 years	460	7.3	2	4.7	0.43
31 - 40 years	686	10.9	2	4.7	0.29
41 - 50 years	701	11.1	4	9.3	0.57
51 - 60 years	1019	16.2	18	41.9	1.77
61 - 70 years	978	15.5	9	20.9	0.92
71 - 80 years	648	10.3	6	14.0	0.93
81 - 90 years	214	3.4	0	0.0	0.00
> 90 years	20	0.3	0	0.0	0.00
Total	6303	100	43	100.0	0.68

Figure 2 depicts the comparison trend of Influenza cases in Tamil Nadu from 2022 to 2023. There has been a surge in cases in August, September and October and November in 2022 and 2023 but the number of cases was lesser in 2023 compared to 2022 and the fall in cases occurred at the end of November.

Figure 2 : Comparison between the trend of Influenza A H1N1 cases in Tamil Nadu from 2022 to December 2023 ( $n=6303$ ).

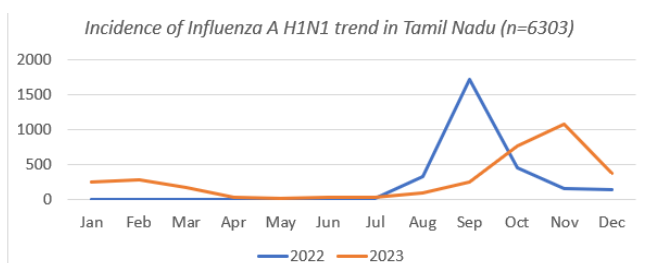


Table 2 describes the month-wise distribution of cases and mortality rates in Tamil Nadu. Maximum number of cases were reported in September ( $n=1966$ , 31.2%) followed by November ( $n=1255$ , 19.9%) and October ( $n=1233$ , 19.6%). The case fatality rates were higher in August (2.6%) followed by July (1.5%) and September (1.0%).

Table 2: Month-wise Morbidity and Mortality due to Influenza A H1N1 cases in Tamil Nadu from 2022 to December 2023 ( $n=6303$ ).

Month	No. of cases	Percentage of cases	No of deaths	Percentage of deaths	Case fatality rate
Jan	255	4.00%	1	2.30%	0.39
Feb	285	4.50%	1	2.30%	0.35
Mar	178	2.80%	0	0.00%	0.00
Apr	37	0.60%	0	0.00%	0.00
May	29	0.50%	0	0.00%	0.00
Jun	45	0.70%	0	0.00%	0.00
Jul	65	1.00%	1	2.30%	1.54
Aug	422	6.70%	11	25.60%	2.61
Sep	1966	31.20%	20	46.50%	1.02
Oct	1233	19.60%	0	0.00%	0.00
Nov	1255	19.90%	6	14.00%	0.48
Dec	533	8.50%	3	7.00%	0.56
Total	6303	100.00%	43	100.00%	0.68

Table 3 describes the distribution of cases and mortality rates with various influencing factors. For comparison of susceptibility of age with case fatality rate and to find association of age leading to mortality, the age was classified as  $\leq 41$  years and  $> 41$  years based on the mean age of the cases. Factors like the age of the patients more than 42 years (Case fatality rate-1.02%), those admitted in government institutions (Case fatality rate-1.26%), and those patients in Category C (Case fatality rate-1.14%) had higher case fatality rates. The higher case fatality rates in the above findings were statistically significant with  $p$ -value  $< 0.05$ . The case fatality rates were higher in those who were treated as inpatients (Case fatality rate-0.71%), but the finding was not statistically significant. The number of cases and case fatality rate was higher in males which was not statistically significant. There wasn't much difference between gender of the cases and the year diagnosed positive with the deaths among cases.

Table 3: Morbidity and Mortality due to Influenza A H1N1 cases with influencing factors in Tamil Nadu from 2022 to December 2023 among various age groups ( $n=6303$ ).

Factors	No. of cases	% of cases	No of deaths	% of deaths	Case fatality rate	p value	
Gender	Male	3415	54.20	25	58.10	0.73	0.601
	Female	2888	45.80	18	41.90	0.62	
Age	$\leq 41$ years	2777	44.10	7	16.30	0.25	$< 0.001^*$
	$> 42$ years	3526	55.90	36	83.70	1.02	
Year	2022	2851	45.20	25	58.10	0.87	0.121
	2023	3452	54.80	18	41.90	0.52	
Type of Institution	Government	553	8.80	7	16.30	1.26	0.081
	Private	5750	91.20	36	83.70	0.62	
Patient testing condition	In-patient	6022	95.50	43	100.00	0.71	N/A
	Out-patient	281	4.50	0	0.00	0.00	
Category of Patient	A	901	14.30	1	2.30	0.11	0.001*
	B	2774	44.00	12	27.90	0.43	
	C	2628	41.70	30	69.80	1.14	

A H1N1 cases and the factors leading to mortality including duration for symptoms, RT-PCR testing and treatment initiation. The factors were converted to categorical variables for analysis. The case fatality rate was higher when the sampling was done after 2 days of onset of symptoms (Case fatality rate -0.91%), when the samples were tested more than 24 hours later (Case fatality rate -1.39%) and when the treatment was initiated more than 2 days after onset of symptoms (Case fatality rate -0.95%). This difference was statistically significant only when the initiation of treatment was more than 2 days following onset of symptoms with a p value <0.05.

*Table 4: Morbidity and Mortality due to Influenza A H1N1 cases due to clinical and laboratory diagnosis to initiation of treatment in Tamil Nadu from 2022 to December 2023 among various age groups (n=4064).*

Factors	No. of cases	% of cases	No of deaths	% of deaths	Case fatality rate	p value
Onset of Symptoms to sampling	≤2 days	4121	65.40	23	53.50	0.100
	>2 days	2182	34.60	20	46.50	
Onset of Symptom to Treatment	≤2 days	3257	51.70	14	32.60	0.012*
	>2 days	3046	48.30	29	67.40	
Publication of results to Treatment	≤24 hours	6144	97.50	42	97.70	0.934
	>24 hours	159	2.50	1	2.30	

## DISCUSSION

Influenza A H1N1 cases clinical and epidemiological factors may exhibit a wide variety of presentations in relation to geographical distribution. Several studies have mentioned that the incidence and positivity rates of Influenza A H1N1 cases are high in temperate zones compared to tropical zones.<sup>11,12</sup> The distribution of cases in Tamil Nadu varied widely, and maximum clustering of cases was seen in Chennai, Coimbatore, and the districts surrounding Chennai. The varied distribution of cases probably could be due to the high volume of migration between people in those industrialized districts with higher cases. Similar findings were observed in the study by Pandita AK et al, and Singhal et al, where urban areas had the maximum burden of cases.<sup>13,14</sup> Tamil Nadu is a state of India with a wide diversity like the sub-continent and the findings of this study can be compared with studies from other Indian states. During the study period in Tamil Nadu, the case positivity rate of Influenza A H1N1 was 11.19% and the case fatality rate was 0.68%. A similar case positivity rate and fatality rate was observed in the study by Kiruba R et al in Chennai which could reflect the influence of geographical location.<sup>15</sup> Whereas the findings from other studies in India were not similar. In studies by Pandita AK et al in Uttarakhand, Singhal YK et al in Rajasthan, Siddharth V et al in Chandigarh, and Gaikwad LL et al in Solapur, the

case positivity ranged from 25.4% to 63%, which is much higher than the finding in our study.<sup>13,14,16,17</sup> This difference in positivity could be influenced by the socio-demographic profile of the study area. Despite the lesser case positivity rate in our study and studies conducted in Tamil Nadu compared to other studies in different parts of India like Uttarakhand, Rajasthan, Chandigarh, and Solapur the case fatality rate is similar.<sup>13,14,16,17</sup> This probably could be due to the spontaneous recovery due to the innate immunity and herd immunity following exposure to Influenza A H1N1 over the years and also the advancement in the healthcare system with early diagnostic techniques and treatment modalities compared to the scenario a decade back. The age of the cases varied from less than a year to 97 years and the majority of the positive cases were from the age group lesser than 10 years followed by those from the age group 51-60 years and above with high case fatality rates in those from the age group 51-60 years and above. The findings of the bimodal distribution of case positivity were identical to the findings from Abdulkader R et al where higher rates were seen in cases lesser than 20 years and above 50 years.<sup>12</sup> However, the case fatality rate increased with increasing age and more among those ages >42 years. The higher case positivity with mortality, similar to our study was noted in ages above 50 years in the study by Sidhu SK et al in Amritsar.<sup>6</sup> The finding of higher positivity in less than 10 years and above 50 years highlights the fact that children and the elderly are more susceptible and hence categorized as B cases as they are more vulnerable.<sup>5,18-20</sup> Monsoon has a higher influence in the case positivity and fatality ratio. In our study there was a high positivity rate in September followed by August, October, and November. Similar to our study findings were observed in the study by Siddharth V et al in Chandigarh, Gaikwad LL et al in Maharashtra, and Kiruba R et al in Tamil Nadu where higher cases were reported from August to December.<sup>15-17</sup> In studies at Telangana by Sujatha K et al, Uttarakhand by Pandita AK et al, and in Amritsar by Sidhu et al the incidence of cases varied from December to April.<sup>6,14,21</sup> In a systemic review by Ratre YK et al, the incidence of Influenza A H1N1 cases varied from each country depending on the monsoon. Likewise, the case fatality rate had a drastic increase when compared to the case positivity rate by July which could be due to the number of suspected cases tested was less before the mortality increased due to influenza. This brings strong evidence of the influence of monsoons on the incidence of Influenza A H1N1 cases.<sup>20</sup>

The onset of symptoms to the initiation of treatment influenced the outcome of the patient in our study. The earlier the initiation of treatment with Oseltamivir following

the onset of symptoms reduced the mortality and early recovery of the patients. However, the duration between the onset of symptoms with time of testing, publication of result, and publication of result to initiation of treatment did not influence the mortality and outcome of the patients. Similar to our study findings were found in the studies by Fjellveit EP et al, Lee BY et al, and Deshpande A et al, where the outcome was better with earlier initiation of treatment following the onset of symptoms.<sup>8,22,23</sup> Hence earlier initiation of treatment is better to achieve a better outcome. The findings from our study shows that majority of the cases were tested positive in private hospitals compared to government hospitals. Similarly, another finding from our study showed that there was nil mortality among those who tested positive as outpatient sampling for Influenza A. But studies on these findings were not available as most studies were institution-based study where the cases were admitted and on treatment. The possibilities of these findings could be due to the fact that the mortality rates are higher among those in Category C. As per the NCDC guidelines sampling is required for only those who are hospitalised and category C which is strictly followed by Government institutions which could be the reason for the variations in the findings.<sup>9,10</sup>

## CONCLUSION

Our study involved cases from the entire state of Tamil Nadu. Epidemiological information of Influenza A H1N1 was provided in our study. The positivity rate following testing the symptomatic patients was lesser in Tamil Nadu and the Case fatality rate was also lesser than that of other states in India. Based on the findings of our study, it was hypothesized that the incidence of H1N1 cases was higher during the winter and monsoon season starting from August to December affecting Children less than 10 years of age and between 51 to 70 years with bimodal distribution. Highest mortality was seen between ages 50 to 70 years. Our study also highlighted the fact that early initiation of treatment following the onset of symptoms is essential to mitigate mortality and morbidity among the cases. Timely initiation of treatment can reduce mortality and morbidity of cases of Influenza A H1N1. Hence treatment with Oseltamivir can be initiated in symptomatic patients even before testing and availability of test results during winter and monsoon seasons to achieve a better outcome.

## RECOMMENDATION

Based on the findings from our study it can be recommended that children aged less than 10 years and

adults more than 50 years of age has to be more cautious during monsoon and winter season with appropriate respiratory etiquette like wearing masks and avoiding social gatherings. Symptomatic patients can be initiated with tablet Oseltamivir prior to the availability of the laboratory reports as it significantly decreases the mortality due to Influenza A H1N1 and adequate stocks to be kept available in private and public sectors. Vaccination against Influenza can be initiated before monsoon and should be advised for elderly and children less than 10 years of age which should be promoted in private and public institutions.

## LIMITATIONS

This is a secondary data analysis of the laboratory confirmed cases. There was no control group available to compare the findings. Presenting signs and symptoms of the cases were not available and could not be used for the analysis. However the details that were available are consistent with the findings from other studies.

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**CONFLICTS OF INTEREST:** There are no conflicts of interest.

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