Research Article

Effects of seasonal variations on the trends of H1N1 cases in a tertiary care hospital of Mumbai

Sujata S Pol, Sneha S Menon, Vijaykumar Singh, Balkrishna Adsul, Seema S Bansode-Gokhe

Department of Community Medicine, Lokmanya Tilak Municipal Medical College and General Hospital, Mumbai, Maharashtra, India

Correspondence to: Sujata S Pol, E-mail: sspol2004@gmail.com

Received: December 17, 2016, **Accepted:** January 30, 2017

ABSTRACT

Background: Recently H1N1 infection has posed a serious public health challenge in India. People belonging to all age groups including children and adolescents have fallen prey to this infection in 2009 and 2015. Interventions focused on climatic factors could play a role in mitigating the public health impact of future H1N1 influenza pandemics.Determinants of H1N1 infection should be studied for getting prepared for control of future epidemics. **Objectives:** To study the trends of the H1N1 infection over the last 5 years in both Mumbai city and the tertiary care hospital in the city (2011-2015) and to study the effect of temperature, rainfall, and humidity on the trends of H1N1 infection. **Materials and Methods:** A retrospective analysis of suspected and confirmed cases of H1N1 influenza infection in a tertiary care hospital in Mumbai from February 2015 to December 2015. Analysis of secondary data of H1N1 cases at Mumbai from January 2011 to December 2015 was also done. **Results:** The H1N1 cases were highest in the year 2015 from 2011 to 2015. Total numbers of 707 respiratory cases reported in the tertiary care hospital were tested for H1N1 in the year 2015. Proportion of positive H1N1 cases was more among female (63.33%) than male (36.67%). A group of 16-30 years age was most affected. The case fatality rate of H1N1 was 6.67% in the year 2015. Cough (67.77%) was the most common symptom. The peak of cases was observed in the month of March followed by August. Data analysis showed no significant correlation between H1N1 cases and climatic factors such as rainfall, temperature, and humidity. **Conclusion:** This study proves the occurrence of an epidemic like situation of H1N1 in 2015 but does not show any relation with environmental factors such as rainfall, temperature, and humidity with occurrence of H1N1 cases.

KEY WORDS: H1N1; Trends; Case Positivity Rate; Case Fatality Rate, Climatic Factors

INTRODUCTION

H1N1 virus has created a great havoc in today's time. Influenza virus spreads faster because of many reasons such as short incubation period, existence of large number of sub-clinical cases, availability of high proportion of susceptible population, short lived immunity and absence of cross immunity. It is one of the most important emerging and re-emerging infectious diseases. Epidemics are known to be associated with excess mortality.[1]

Access this article online

Website: http://www.ijmsph.com

Quick Response code

DOI: 10.5455/ijmsph.2017.1268930012017

The World Health Organization declared an H1N1 pandemic on June 11, 2009, after more than 70 countries reported 30,000 cases of H1N1 infection. In 2015, incidence of swine influenza increased substantially to reach a 5-year high. In India, in 2015, 10,000 cases of swine influenza were reported with 774 deaths.[2] Emergence of the influenza pandemic (H1N1) 2009 (epidemic H1N1) posed new challenges to the public health systems and communities all over the world. Global actions by international agencies and highly vigilant media generated tremendous fear resulting into unprecedented response to the new pandemic by the majority of the nations.

Figure 1 shows the epidemiological triangle for the disease of influenza. Temperature variation leads to increase in aerosol production. Mutation in virus strains also plays an important role in increasing the hosts' susceptibility.[3]

Gerardo Chowell et al. in Chile found a significant association between H1N1 pandemic and minimum temperature and humidity.[3] Liao et al. conducted a study in 2009 to assess the characteristics of influenza-associated morbidity in subtropical Taiwan, corresponding to the seasonal patterns, weather and suggested that seasonality and influenza (sub) types contribute significantly to influenza morbidity. Authors emphasized the importance of using epidemic and climate information to achieve influenza-reduction targets in subtropical regions.[4] Hong et al. at China analyzed the weather conditions associated with influenza A (H1N1) and found that the daily minimum temperature, absolute humidity, and barometric pressure have a strong influence on the development of the epidemic situation.[5] It is thus important to ascertain the effect of local climatic conditions on the outbreak of H1N1 infection.

There are some epidemiological studies done by researchers in India immediately after epidemic of 2009, however, very few have focused on seasonal variations and its effects on H1N1.[6,7] The research on such seasonal variations may certainly help the clinicians to take appropriate preventive measures to avert mortality in these cases. Therefore, the study with objective to learn effect of temperature, rainfall, and humidity on the trends of the H1N1 cases over the last 5 years in both Mumbai city and the tertiary care hospital in the city (2011-2015) has been planned and help the authorities to face the challenge. This will also help in the proper usage of the data available at the tertiary care hospital.

MATERIALS AND METHODS

It was a retrospective observational study carried out in a tertiary care hospital in the city of Mumbai. The line listing of all H1N1 cases reported at the tertiary care hospital is updated at the Satellite Disease Surveillance Unit of the tertiary care hospital. All the patients admitted in the tertiary care hospital with respiratory symptoms and who were tested for H1N1 virus by means of a throat swab was included in this study. Secondary data of H1N1 cases for the years 2011-2015 were also obtained from the epidemiological cell at Mumbai to compare the waves of the H1N1 epidemic.

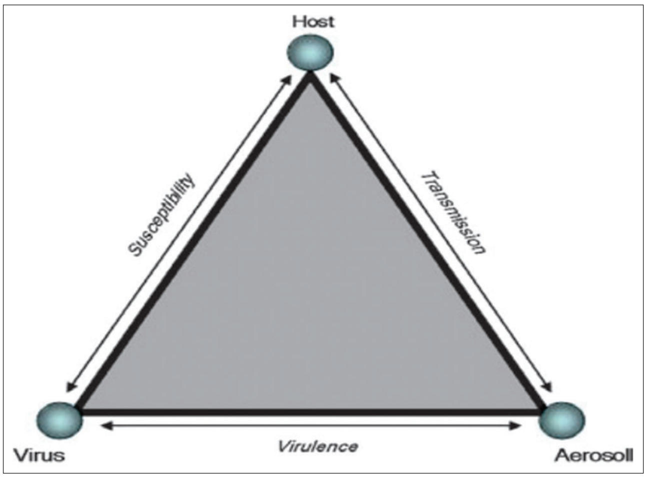

Figure 1: Epidemiological triangle for the disease of influenza

Data of Mumbai city's monthly temperature, rainfall, and humidity for the year 2015 were obtained from the meteorological department website. Data collection was carried out during 1st January 2015 to 31st December 2015. Institutional ethical approval was taken for the study.

Operational Definitions

A suspected case of influenza-like infection (ILI) was a person with acute respiratory illness who had fever or a recent history of fever and sore throat. A suspected case of pandemic H1N1 was a suspected case of ILI who also had an epidemiological link with a confirmed pandemic H1N1 virus infection. A confirmed case of pandemic H1N1 was ILI case with laboratory confirmation of pandemic H1N1 virus by real time reverse transcriptase polymerase chain reaction.

Data Management and Processing

The data on H1N1 case records were entered into excel spread sheet, checked for completeness (patient age, address, test result, date of diagnosis, etc.). Results are summarized using tables and figures. Rates and percentages were calculated appropriately. Test of correlation was applied to the data, as a test of significance.

RESULTS

In 2015, a total of 707 cases that were reported with respiratory complaints were suspected as H1N1 influenza. All these cases were referred for throat swab culture. Of these, 90 cases were found to be confirmed cases of H1N1 indicating case positivity rate as 12.7%.

Table 1 shows an approximately 10-fold increase in the number of H1N1 cases from 2012 to 2015. Maximum number of H1N1 positive cases and deaths was in the year 2015 both in the tertiary care hospital (84.1%) and Mumbai city (86.9%). Mean case fatality due to H1N1 at Mumbai was 1.69% and 7.47% at hospital.

Table 2 depicts the details of H1N1 cases admitted in the tertiary care hospital in 2015. Positive H1N1 cases (n = 90) were more among female (63.33%) than male (36.67%). The age group of 16-30 years was most affected (41.1%). The majority of cases (86.6) were from Mumbai region and very few (13.3) were from outside Mumbai. The case fatality rate due to H1N1 was calculated as 6.66% for the year 2015.

Table 3 shows the usual symptomatic profile among H1N1 cases. Cough (76.67%) was the most common symptom followed by fever (73.3%). Few cases also showed gastrointestinal symptoms such as vomiting (12.2%) and loose stools (6.67%).

Time lag between "date of onset of symptoms" and "date of starting medications against H1N1" for the confirmed cases was 2 days. Time lag between "date of onset of symptoms" and "date of starting medications" against H1N1 for the patients who expired was 3.5 days.

Table 1: Year-wise comparison of H1N1 cases and deaths in the tertiary care hospital and in Mumbai

Year	Number of cases (%)		Number of deaths (%)	
	Tertiary care hospital	Mumbai	Tertiary care hospital	Mumbai
2011	0	6 (0.17)	0	0
2012	09 (8.4)	360 (10.3)	02 (25)	5 (8.4)
2013	08 (7.4)	77 (2.21)	0	01 (1.6)
2014	0	11 (0.31)	0	01 (1.6)
2015	90 (84.1)	3029 (86.9)	06 (75)	52 (88.1)
Total	107 (100)	3483 (100)	08 (100)	59 (100)

Table 2: Epidemiological details of cases admitted in tertiary care hospital in 2015 (*n*=90)

Details	Number (%)
Sex wise distribution	
Male	33 (36.67)
Female	57 (63.33)
Age-wise distribution (in years)	
1-15	10 (11.1)
16-30	37 (41.1)
31-45	21 (23.3)
46-60	10 (11.1)
61-75	3 (3.3)
Geographical distribution	
Mumbai	78 (86.67)
Non-Mumbai	12 (13.33)
Outcome of cases	
Cured	84 (92.5)
Died	6 (6.66)

Table 3: Symptoms of H1N1 cases (*n*=90*)

Symptoms	Number (%)
Cough	69 (76.6)
Fever	66 (73.3)
Sore throat	49 (54.1)
Headache	37 (41.1)
Breathlessness	42 (46.6)
Cold	36 (40.0)
Vomiting	11 (12.2)
Loose stools	06 (6.6)

*Multiple responses

Graph in Figure 2 depicts sudden rise of H1N1 cases in 5th week (February and March) preceded by rainfall and drop in temperature. However, for other period of the year, there is no relation seen between cases and rainfall in monsoon season or humidity. Second peak of cases are observed in 31st week (month of August).

Test of correlation was applied to the data of temperature (R = 0.091, P = 0.524), rainfall (R = 0.085, P = 0.554), and humidity (R = −0.018, P = 0.902), however, the R value obtained was not very significant.

DISCUSSION

The data indicated H1N1 epidemic in 2015 at Mumbai. Female and younger age group was most affected due to H1N1 infection. "Cough" as the most common symptom among H1N1 patients suggests that maximum screening might have done for the patients with respiratory complaints. Analysis showed no correlation between climatic factors (temperature, rainfall, and humidity) with H1N1 epidemic.

On yearly data analysis, the peak positivity of influenza A (H1N1) was observed in 2015 followed by 2012. Rewar et al. and Mishra et al. also confirmed similar epidemic of H1N1 in India in same year.[2,8] Other researchers from other states of India also have demonstrated such substantial increase in H1N1 influenza cases in same year.[9,10] Likewise, Itolikar and Nadkar and Bagchi mentioned the H1N1 outbreaks at Maharashtra and Mumbai in 2015.[11,12] Nandhini and Sujatha found similar peaks of H1N1 cases in the year 2015 and 2012.[10] The case positivity rate of H1N1 (12.7%) in this study is comparable with other studies conducted in 2009 by Mukherjee et al. (12.86%), however, it is lower than that found by Choudhry et al. (23.5%) in 2009 and Mehta et al. at Rajasthan (29.26%) for the year 2015.[9,13,14] Females are more affected as per the data in this study whereas Puvanalingam et al. showed greater number of male affected due to H1N1.[15] More proportion of young adults was seen affected by H1N1, which is in congruence with findings of Choudhry et al. and Puvanalingam et al.[13,15] On contrast, study done at West Bengal showed more elderly people (>55 years) were affected.[14] The case fatality rate due to H1N1 in the year 2015 was (6.66%) is analogous to the findings by Mehta et al. (6.29%) and Itolikar (8.41%) but much lower than that observed by Sharma et al. (17.79%).[9,11,16] Studies that were conducted on "H1N1 pandemic in 2009" showed much lower constant rate factor (CFR) 0.026%, 0.86% at Pune and 1.8% in South India in the year 2009.[15,17,18] On the other hand, high CFR due to influenza A (H1N1) was observed by Nandhini and Sujatha (7.6%) and Oliveira et al. (11.2%) at Brazil in 2009.[10,19] Based on experience of epidemic of 2009, hospitals

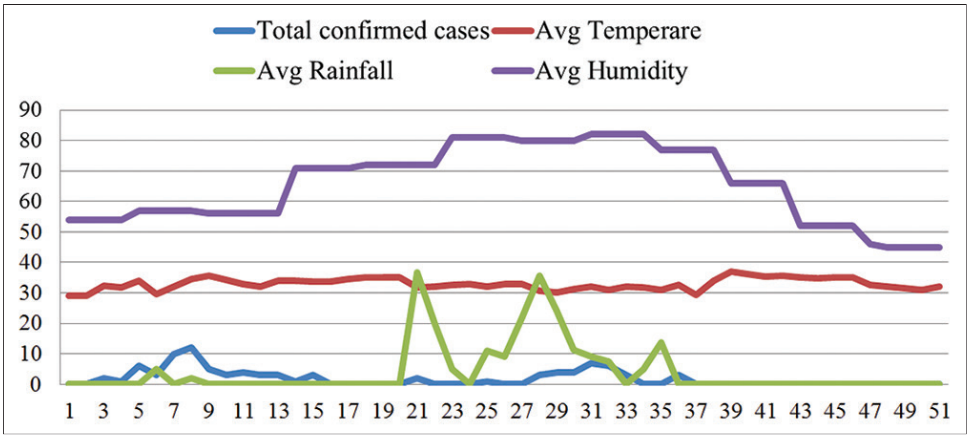

Figure 2: Week-wise distribution of H1N1 cases along with temperature, rainfall, and humidity in the year 2015

might have adopted more preparedness in terms of availability of drugs for treatment of H1N1 influenza and this might have contributed to low CFR. The most common clinical feature observed in this study was "Cough" unlike other studies that have reported "Fever" as the most prominent and common symptom by H1N1 cases.[13,15,20] Itolikar made a mention of 30% mortality among patients with H1N1 who reported for treatment with a delay of 3 days.[11] Time lag between date of onset of symptoms and date of starting medications against H1N1 for the patients who expired was found to be 3.5 days. Each year influenza-like illness and influenza virus activity coincided with period of high rainfall and low temperature except in the 1st half of 2012.[10] Usually, an upsurge in H1N1 cases is expected in the months of winter, but the present study brings about striking results. More number of H1N1 cases occurred in the month of March (when there was untimely rainfall) followed by August in 2015. The studies done at West Bengal India found similar two peaks of H1N1, one in summer and one in winter.[14] In India, the monsoon ends by September and October, which is followed by start of winter from November. The atmospheric temperature remains lowest in December. It continues in January and the winter comes to an end by February; the number of reported positive cases also shows a fall. Rao in 1980 had proved the association of H1N1 outbreaks with the rainy season.[7] In the year 2015, the rainfall was below the standard annual average. Thus, there was an increase in humidity, stimulating aerosol production, which led to a favorable environment for virus growth. However, analysis showed no correlation between factors such as temperature, rainfall, and humidity. Similarly, Silva et al. at Brazil and Chaudhary et al. at India established no pattern of seasonality or expected climatic conditions for H1N1 epidemic.[6,21]

Strengths and Limitations

Research on trends of H1N1 definitely adds to the knowledge of H1N1 magnitude in the city and in-turn would help the health sectors for preparedness of the epidemic. Public health experts working in collaboration with the clinicians at the tertiary care hospital could help in creating increased awareness and future epidemic preparedness. This vulnerable population of adolescents and younger people can be taught respiratory etiquettes with help of International Education Centre banners at colleges and offices. The study proposes a health-care system based research to find out the determinants of low case fatality rate. The details on history of contact with H1N1 case and presence of metabolic disorder could not be elicited as it was retrieved from the line list. A similar H1N1 epidemic was seen in the year 2009 as well, but data of H1N1 cases for that year could not be traced.

CONCLUSION

Mumbai city faced the outbreak of H1N1 in the year 2015 but the tertiary care hospitals managed to keep case fatality rate low. Monthly maximum, minimum temperature and relative humidity showed no effect on occurrence of influenza A (H1N1) cases.

ACKNOWLEDGMENT

We extend our heartfelt gratitude to Dr. Padmaja Keskar, EHO, Dr. Mini Khetrapal, DEHO, Epidemiological Cell, MCGM, for permitting the use the Epidemiology Cell Database. We also thank Dr. Sheela Jagtap, AHO and Dr. Nitin Mahajan, AMO from Epidemiology Cell for offering their help in data management. The authors are thankful to Dr. Deepika, Asst. Prof. GMC, Nagpur, for offering her statistical help.

REFERENCES

1. Fang LQ, Wang LP, de Vlas SJ, Liang S, Tong SL, Li YL, et al. Distribution and risk factors of 2009 pandemic influenza A (H1N1) in mainland China. Am J Epidemiol. 2012;175(9):890-7.
2. Rewar S, Mirdha D, Rewar P. Treatment and prevention of pandemic H1N1 influenza. Ann Glob Health. 2015;81(5):645-53.
3. Chowell G, Towers S, Viboud C, Fuentes R, Sotomayor V, Simonsen L, et al. The influence of climatic conditions on

the transmission dynamics of the 2009 A/H1N1 influenza pandemic in Chile. BMC Infect Dis. 2012;12:298.
4. Liao CM, Chang SY, Chen SC, Chio CP. Influenza-associated morbidity in subtropical Taiwan. Int J Infect Dis. 2009;13(5):589-99.
5. Hong X, Huaiyu T, Xiaoling LI, Lidong GA, Xiangyu DA, Xixing Z, et al. Influence of extreme weather and meteorological anomalies on outbreaks of influenza A (H1N1). Chin Sci Bull. 2013;58(7):741-9.
6. Chaudhary AK, Khandhedia S, Mazumdar V. A study of correlation between the environmental factors and occurrence of influenza an H1N1cases in Baroda district. Sch J Appl Med Sci. 2015;3(6C):2361-4.
7. Rao BL, Kadam SS, Pavri KM, Kothavale VS. Epidemiological, clinical, and virological features of influenza outbreaks in Pune, India, 1980. Bull World Health Organ. 1982;60(4):639-42.
8. Mishra B. 2015 resurgence of influenza A (H1N1) 09: Smoldering pandemic in India? J Glob Infect Dis. 2015;7(2):56-9.
9. Mehta S, Sharma R, Harshvardhan L, Singh R. Preparedness of India's largest state in combating influenza a (H1N1) outbreak of 2015. J Assoc Physicians India. 2015;63(6):94.
10. Nandhini G, Sujatha S. Epidemiology of influenza viruses from 2009 to 2013 - A sentinel surveillance report from Union territory of Puducherry, India. Asian Pac J Trop Med. 2015;8(9):718-23.
11. Itolikar S, Nadkar MY. H1N1 revisited after six years: Then and now. J Assoc Physicians India. 2015;63(4):41-3.
12. Bagchi S. India tackles H1N1 influenza outbreak. Lancet. 2015;385(9972):e21.
13. Choudhry A, Singh S, Khare S, Rai A, Rawat DS, Aggarwal RK, et al. Emergence of pandemic 2009 influenza A H1N1, India. Indian J Med Res. 2012;135(4):534-7.
14. Mukherjee A, Roy T, Agrawal AS, Sarkar M, Lal R, Chakrabarti S, et al. Prevalence and epidemiology of pandemic H1N1 strains in hospitals of Eastern India. J Public Health Epidemiol. 2010;2(7):171-4.
15. Puvanalingam A, Rajendiran C, Sivasubramanian K, Ragunanthanan S, Suresh S, Gopalakrishnan S. Case series study of the clinical profile of H1N1 swine flu influenza. J Assoc Physicians India. 2011;59:14-6, 18.
16. Sharma R, Agarwal S, Mehta S, Nawal CL, Bhandari S, Rathore M, et al. Profiling the mortality due to influenza a (H1N1) pdm09 at a tertiary care hospital in Jaipur during the current season - January & February 2015. J Assoc Physicians India. 2015;63(4):36-9.
17. Donaldson LJ, Rutter PD, Ellis BM, Greaves FE, Mytton OT, Pebody RG, et al. Mortality from pandemic A/H1N1 2009 influenza in England: Public health surveillance study. BMJ. 2009;339:b5213.
18. Mishra AC, Chadha MS, Choudhary ML, Potdar VA. Pandemic influenza (H1N1) 2009 is associated with severe disease in India. PLoS One. 2010;5(5):e10540.
19. Oliveira W, Carmo E, Penna G, Kuchenbecker R, Santos H, Araujo W, et al. Pandemic H1N1 influenza in Brazil: Analysis of the first 34,506 notified cases of influenza-like illness with severe acute respiratory infection (SARI). Euro Surveill. 2009;14(42). pii:19362.
20. Sharma V, Verma PK, Gupta S, Sharma A. Mortality from influenza A/H1N1 in a tertiary care teaching institution in North India. J Infect Dev Ctries. 2010;4(8):468-71.
21. Silva Rde C, Siqueira MA, Netto EM, Bastos JS, Nascimento-Carvalho CM, Vilas-Boas AL, et al. Epidemiological aspects of influenza A related to climatic conditions during and after a pandemic period in the city of Salvador, Northeastern Brazil. Mem Inst Oswaldo Cruz. 2014;109(2):229-35.

How to cite this article: Pol SS, Menon SS, Singh V, Adsul B, Bansode-Gokhe SS. Effects of seasonal variations on the trends of H1N1 cases in a tertiary hospital of Mumbai. Int J Med Sci Public Health 2017;6(6):1008-1012.

Source of Support: Nil, **Conflict of Interest:** None declared.