

Trends, Seasonal variations and meteorological condition in the outbreak of varicella among university students in Tamilnadu, India

Muthunarayanan Logaraj¹, Balaji Ramraj^{2*}

1 Professor, Community Medicine, SRM Medical College Hospital & Research Centre, SRM Institute of Science and Technology, Kattankulathur, Tamilnadu, India

2 Professor, Community Medicine, SRM Medical College Hospital & Research Centre, SRM Institute of Science and Technology, Kattankulathur, Tamilnadu, India

*arbee2002@gmail.com

ABSTRACT

Introduction: The reason for higher susceptibility in younger adult in tropical settings were poorly understood and may related to properties of varicella virus sensitive to heat, climate, population density and risk of exposure. **Objectives:** This study was under taken to assess the Trends, Seasonal variations and meteorological condition in the outbreak of varicella among university students in Tamilnadu. **Methodology:** A retrospective study was conducted with Medical records of 256 cases admitted with chicken pox for period of 4 years. The data on variables such as year of study, month and seasonality of occurrence cases, temperature and humidity were analyzed. **Results:** Number of cases was less during autumn (July to September) in all four years. It was observed that the number of varicella cases increased with the increase in temperature and decrease in humidity. **Conclusion:** The trend in the incidence of varicella cases is definitely influenced by the meteorological conditions.

Key words Varicella, Trends, Meteorological conditions, University students

Introduction

Chickenpox or varicella is an acute highly contagious disease caused by varicella zoster virus. Chickenpox usually occurs among children below the age of 10 years and could be more severe in adult. The extent of the disease and severity in adults in tropical climate is greater compared to temperate climate.^{1,2,3} Over 80% of people have been infected by 10 years of age in the United States, the United Kingdom, and Japan, while many people have been infected by 20 to 30 years of age in China, India, Southeast Asia, and the West Indies. Furthermore, a mortality rate of 2–3 per 100,000 infected persons has been reported. Therefore, chickenpox remains an important public health issue, especially in China, India, Southeast Asia, and the West Indies.⁴ Since the absence of vaccination program and vaccination policy for chickenpox vaccination in India more than 35% of the young adults become susceptible to varicella infection.⁵

In tropical countries like India most number of cases occurs in the coolest and dry seasons during winter and spring.⁶ Outbreaks are periodic and usually occur as epidemic cycle of 2 - 5 years.⁷ The reason for higher susceptibility in younger adult in tropical settings were poorly understood and may related to properties of varicella virus sensitive to heat, climate, population density and risk of exposure.^{8,9} Studies have reported that the differences in temperature and humidity could affect virus transmission.^{10,11} The increasing evidence for rapid global climate change has highlighted the need to examine the relationship between weather variability and infectious diseases incidence. However, the impact of weather fluctuations on varicella is still not well understood and published evidence is inconsistent.¹² This study was under taken to assess the Trends, Seasonal variations and meteorological condition in the outbreak of varicella among university students in Tamilnadu.

Material and Methods

A retrospective study was carried out at SRM Medical College hospital & Research Centre Medical records of 256 cases admitted with history of chicken pox for a period of 4 years

between January 2015 and December 2018 were included in the study. The data on variables such as age, sex, year of study, month and seasonality of occurrence cases, temperature and humidity were analyzed. Temperature and humidity were obtained from the Chennai Meteorological Department. Chi-square statistics was used in finding out the association and making inferences.

Results

A retrospective study was carried out at SRM Medical College Hospital from the hospital notifiable disease register to identify varicella cases admitted during January 2015 to December 2018.

Age and sex distribution

Table 1 depicts a total of 347 cases of varicella were diagnosed at the university hospital. Of these about 283(81.6%) were males, 64(18.4%) were females and 326 (93.9%) were residents in dormitory blocks of a single college. There were 69 cases reported in the year 2015, it was 110 in 2016, it was 77 in 2017 and 91 in the year 2018. More number of cases were reported in younger age group 17-20 years (81.6%) compared to 21-25 years (18.4%) and it was found statistically significant ($p < 0.0001$).

Month wise occurrence of cases

The analyses of monthly cases of varicella for three years showed total peak number of cases were in the month of March and April for all four years. An unusual increase in the number of cases admitted was notice for the year 2016 in the month of November with 34 cases compared to other three years (Table 2).

Seasonal distribution

Seasonal distribution of the cases of varicella was analyzed for each year showed number of cases was less during autumn (July to September) in all four years. Bimodal cycle of distribution of varicella cases was observed for 2016 with cases of chickenpox reported throughout the year and uni-modal for the years 2015, 2017 and 2018. Zero cases reported in some months in 2015, 2017 and 2018 (Table 3). The average number of cases admitted during spring was 33.3 and the least average was noted for the autumn with 5.8.

Years of study (Half yearly variation)

Half yearly distribution cases of varicella showed 253 (72.9%) cases were reported in the first half of the year compared to second half of the year with 94 (27.1%) of cases. the number of cases reported were higher in the first half of the year compared to second half and it was found statistically significant (Table 4).

Duration of stay in hostel

It was noticed a gradual decrease in the admission rate of students with chicken pox with increase in duration of stay in the campus there is sharp decline in the number of cases following two years of stay in the campus as shown in figure 1.

Temperature and relative humidity

Figure 2 shows the relationship between number of cases of chickenpox and mean monthly temperature and humidity. More number of cases was reported in the month of March and April for all four years. In the year 2016 in the month of November there was unusual 34 cases of chickenpox were reported. We compared with any changes in mean humidity and temperature of other three years showed mean temperature & humidity slightly higher for 2015, 2017 and 2018 (26.13°C, 26.43°C, 26.79°C & 87.90, 84.80 and 74.83) compared to 2016 (26.93°C & 72.0). Figure 3A shows the average yearly temperature, humidity and number of cases of

varicella for all four years. It was observed that the number of varicella cases increased with the increase in temperature and decrease in humidity.

Discussion

Of the 347 cases of chickenpox reported for 4 years put together, nearly two third of them were males and almost all of them were residents in dormitory blocks of the university. Similar finding was reported by Noha Saleh et al¹³, Liese JG et al¹⁴ and Theodoridou M et al¹⁵ with higher percentage male hospitalized with chickenpox compared to females. More number of cases were reported in younger age group 17-20 years (81.6%) compared to 21-25 years (18.4%) and it was found statistically significant ($p < 0.0001$). This could be due to the level of seroprevalence. Several studies had reported the sero-surveillance increases as the age advances. The incidence drastically reduces after the age of 25.^{16,17}

The analyses of seasonal distribution of cases of varicella for four years showed peak number of cases were in the month of March and April for all four years and lowest in the month of July, August and September. Similar picture with the highest seasonal index was during March and April and the lowest was during summer months July and August was reported by Noha Saleh et al¹³. Meyers et al reported peak incidence in November and April; the larger November peak represented a marked variation from the usual seasonal pattern.¹⁸

Katarina Widgren et al¹⁹ reported high numbers of cases during winters to spring. The lowest numbers were seen in August or September of each year. Brisson M et al²⁰ reported the peak incidence of chickenpox was in the late winter to spring. An unusual increase in the number of cases admitted was noticed for the year 2016 in the month of November with 34 cases compared to other three years showing a bimodal cycle of distribution of varicella cases for 2016. Kokaze A et al²¹ had reported two peaks in chickenpox incidence and a close correlation between second peak of epidemic pattern of chickenpox incidence and temperature within a year. Similar incidence of two peaks per year was reported by Banghua Chen et al⁴ one in winter and another in spring. Two peaks of varicella incidence were detected in Jinan, Consistent with other areas of China, the major peak occurred in November–January, and a minor one in April–May. A similar situation was also observed in Korea, located in the same climate zone as Jinan.²² However, in southern Japan, which has a subtropical monsoon climate, the incidence of varicella was highest in August and lowest in winter.²³ These findings further support the role of climate factors in VZV transmission.¹²

It was noticed the mean temperature of the year was higher and humidity was lower for the 2016 compared to 2015, 2017 and 2018. Comparison of the mean temperature and humidity of November month for all the four showed slight decrease of temperature 0.8* Celsius, 0.5* Celsius and 0.14* Celsius for 2015, 2017 and 2018 respectively and humidity was slightly higher 15.9, 12.8 and 2.83 for 2015, 2017 and 2018 respectively compared to 2016.

A study in Hong Kong²⁴ found no significant association between temperature and varicella incidence, contrary to earlier studies in the West Indies²⁵ that suggested that temperature was inversely correlated with the incidence of varicella. Studies from Mexico²⁶ and Taiwan²⁷ have suggested that temperature is positively associated with varicella incidence. A recent study showed that atmospheric pressure and rainfall were positively associated with varicella incidence.²⁸ Another study also reported the mean temperature and rainfall have significant influence on the incidence of chickenpox and these factors might be important predictor of chicken pox incidence.⁴

Conclusion

The trend in the incidence of varicella cases is definitely influenced by the meteorological conditions, though multi-centric studies in various temperate and tropical regions have to be conducted to provide strong evidence. There is a documented evidence of increase in the cases of varicella among the young adults joining the universities. Varicella vaccination should be strongly recommended among university students at the time of admission and can be brought into policy.

References

1. Hamborsky, J., Kroger, A. & Wolfe, C. (Ed.). (2015). Epidemiology and prevention of vaccine-preventable diseases. 13th ed. Washington: Public Health Foundation [cited 2019 Jul 5].
2. Lokeshwar, M.R., Agrawal, A., Subbarao, S.D., Chakraborty, M.S., Ram Prasad, A.V. & Weil, J. (2000). Age related seroprevalence of antibodies to varicella in India. *Indian Pediatr*; 37:714-9.
3. Sengupta, N. & Breuer, J. (2009). A global perspective of the epidemiology and burden of varicella-zoster virus. *Curr Pediatr Rev*;5:207–28.
4. Chen, B., Sumi, A., Wang, L., Zhou, W. & Kobayashi, N. (2017). Role of meteorological conditions in reported chickenpox cases in Wuhan and Hong Kong, China. *BMC Infectious Diseases*; 17:538.
5. Arunkumar, G., Vandana, K.E. & Sathiakumar, N. (2013). Prevalence of measles, mumps, rubella, and varicella susceptibility among health science students in a university in India. *Am J Ind Med*;56:58–64.
6. Background paper on varicella vaccines- SAGE working group. Available at http://www.who.int/immunization/sage/meetings/2014/apri/presentations_background_docs/en/; accessed on June 2019.
7. CDC NCIRD. “Immunology and Vaccine-Preventable Diseases – Pink Book – Varicella; accessed on June 2019.
8. World health organization. Weekly epidemiological record. (2014 June). Varicella and herpes zoster vaccines: WHO position paper; 25(89): 265–288.
9. Mandal, B.K., Mukherjee, P.P., Murphy, C., Mukherjee, R. & Naik, T. (1998). Adult susceptibility to varicella in the tropics is a rural phenomenon due to the lack of previous exposure. *Journal of Infectious Diseases*; 178: S52–S54.
10. Talukder, Y.S., Kafatos, G., Pinot De Moira, A., Aquilina, J., Parker, S.P. & Crowcroft, N.S. (2007). The seroepidemiology of varicella zoster virus among pregnant Bangladeshi and white British women in the London Borough of Tower Hamlets UK. *Epidemiol Infect*; 135:1344-53.
11. Liyanage, N., Fernando, S., Malavige, G.N., Mallikahewa, R., Sivayogan, S. & Jiffry, M. (2007). Seroprevalence of varicella zoster virus infections in Colombo District, Sri Lanka. *Indian J Med Sci*; 61:128-34.
12. Yang, Y., Geng, X., Liu, X., Wang, W. & Zhang, J. (2016). Association between the incidence of varicella and meteorological conditions in Jinan, Eastern China, 2012–2014. *BMC Infectious Diseases*; 16:179.
13. Saleh, N. & Al Moghazy, B. (2014). Seasonal variation and trend of chicken pox in the southern region of Saudi Arabia (2007–2012). *J Egypt Public Health Assoc*; 89:143–147.

14. Liese, J.G., Grote, V., Rosenfeld, E., Fischer, R., Belohradsky, B.H. & Kries, R. (2008). The burden of varicella complications before the introduction of routine varicella vaccination in Germany. *Pediatr Infect Dis J.*; 27(2):119–24.
15. Theodoridou, M., Laina, I., Hadjichristodoulou, C. & Syriopoulou, V. (2006). Varicella related complications and hospitalisations in a tertiary pediatric medical center before vaccine introduction. *Eur J Pediatr.*; 165(4):273–4.
16. Han, S.B., Kang, K.R., Huh, D.H., Lee, D.H., Kim, J.H. & Kang, J.H. (2015). Seroepidemiology of varicella-zoster virus in Korean adolescents and adults using fluorescent antibody to membrane antigen test. *Epidemiol. Infect.*; 143: 1643–50.
17. Lee, H., Cho, H.K., Kim, K.H. Seroepidemiology of Varicella-Zoster Virus in Korea. (2013). *J Korean Med Sci*; 28: 195-99.
18. Meyers, J., Logaraj, M., Ramraj, B., Narasimhan, P. & MacIntyre, C.R. (2018 Feb). Epidemic Varicella Zoster Virus among University Students, India. *Emerging Infectious Diseases*; 24(2): 366-69.
19. Widgren, K., Giesecke, J., Lindquist, L. & Tegnell, A. (2016). The burden of chickenpox disease in Sweden. *BMC Infectious Diseases*; 16:666.
20. Brisson, M., Edmunds, W.J., Law, B., Gay, N.J., Walld, R. & Brownell, M. (2001). Epidemiology of varicella zoster virus infection in Canada and the United Kingdom. *Epidemiol Infect.*;127(2):305–14.
21. Kokaze, A., Yoshida, M., Sekine, Y. & Ishikawa, M. (2001). The magnitude of variation in temperature within a year has an effect on the seasonal variations of chickenpox incidence in Japan. *Epidemiol Infect.*;126(2):269-77.
22. Cho, S.B., Oh, S.H., Ahn, B.K., Kim, H.S., Park, J.M. & Lee, J.H. (2009). Incidence of chickenpox in young South Korean soldiers and correlation with atopic dermatitis. *Clin Exp Dermatol.*;34(6):668–71.
23. Toyama, N. & Shiraki, K. (2009). Epidemiology of herpes zoster and its relationship to varicella in Japan: a 10-year survey of 48,388 herpes zoster cases in Miyazaki prefecture. *J Med Virol.*; 81(12):2053–8.
24. Chan, J.Y., Tian, L., Kwan, Y., Chan, W. & Leung, C. (2011). Hospitalizations for varicella in children and adolescents in a referral hospital in Hong Kong, 2004 to 2008: a time series study. *BMC Public Health*;11:366.
25. Garnett, G.P., Cox, M.J., Bundy, D.A., Didier, J.M. & St, C.J. (1993). The age of infection with varicella-zoster virus in St Lucia, West Indies. *Epidemiol Infect.*;110(2):361–72.
26. Vergara-Castaneda, A., Escobar-Gutierrez, A., Ruiz-Tovar, K., Sotelo, J., Ordonez, G. & Cruz-Rivera, M.Y. (2012). Epidemiology of varicella in Mexico. *J Clin Virol.*;55(1):51–7.
27. Wu, P.Y., Li, Y.C. & Wu, H.D. (2007). Risk factors for chickenpox incidence in Taiwan from a large-scale computerized database. *Int J Dermatol.*;46(4):362–6.
28. Chan, J.Y., Lin, H.L. & Tian, L.W. (2014). Meteorological factors and El Nino Southern Oscillation are associated with paediatric varicella infections in Hong Kong, 2004–2010. *Epidemiol Infect.*; 142(7):1384–92.

Funding support: No funding has been received from external resources

Conflict of Interest: Nil

Table 1: Age sex distribution of the students

Age group	Male	Female	Total	X ² , df & p value
17-20 Years	263(86.8%)	40(13.2%)	303(87.3%)	X ² =43.66,df=1, P<0.0001
21-25 years	20(45.5%)	24(54.5%)	44(12.7%)	
Total	283(81.6%)	64(18.4%)	347(100%)	

Table 2 . Monthly distribution of students with varicella admitted to hospital

Months	2015	2016	2017	2018	Total
Jan	10(47.6%)	6(28.6%)	4(19.0%)	1(4.8%)	21(6.1%)
Feb	9(20.9%)	10(23.3.0%)	18(41.9%)	6(13.9%)	43(12.4%)
Mar	19(27.5%)	14(20.3%)	14(20.3%)	22(31.9%)	69(19.9%)
Apr	22(22.0%)	13(14.8%)	17(19.3%)	36(40.9%)	88(25.4%)
May	2(7.1%)	9(32.1%)	12(42.9%)	5(17.9%)	28(8.1%)
Jun	1(25%)	2(50%)	1(25%)	0(0.0%)	4(1.5%)
Jul	0(0%)	3(42.9%)	1(25%)	3(42.9%)	7(1.5%)
Aug	3(30.0%)	3(30.0%)	0(0%)	4(40.0%)	10(2.9%)
Sep	1(16.7%)	4(66.6%)	1(16.7%)	0(0.0%)	6(1.7%)
Oct	0(0%)	8(42.1%)	2(10.5%)	9(47.4%)	19(5.5%)
Nov	0(0%)	34(75.6%)	6(13.3%)	5(11.1%)	45(12.9%)
Dec	2(28.6%)	4(57.1%)	1(14.3%)	0(0.0%)	7(1.5%)
Total	69(19.9%)	110(44.5%)	77(22.1%)	91(26.2%)	347(100%)

Table 3A: Seasonal Distribution Students with Varicella Reported To Hospital

Year	Spring (Jan-Mar)	Summer (Apr- Jun)	Autumn (Jul- Sep)	Winter (Oct- Dec)	X ² , df & p value
2015	38	25	4	2	X ² = 61.6 df = 9 p = 0.000
2016	30	24	10	46	
2017	36	30	2	9	
2018	29	41	7	14	
Mean	33.3	30.0	5.8	17.8	
Total	133	120	23	71	

Table 3B. Half yearly distribution of cases of varicella

Year	Spring & Summer (Jan-Jun)	Autumn (Jul- Dec)	X ² , df & p value
2015	63	6	X ² = 50.6 df= 3 p = 0.000
2016	54	56	
2017	66	11	
2018	70	21	
Total	253(72.9%)	94(27.1%)	

Figure 1 .Number of varicella cases admitted in the hospital by year of study

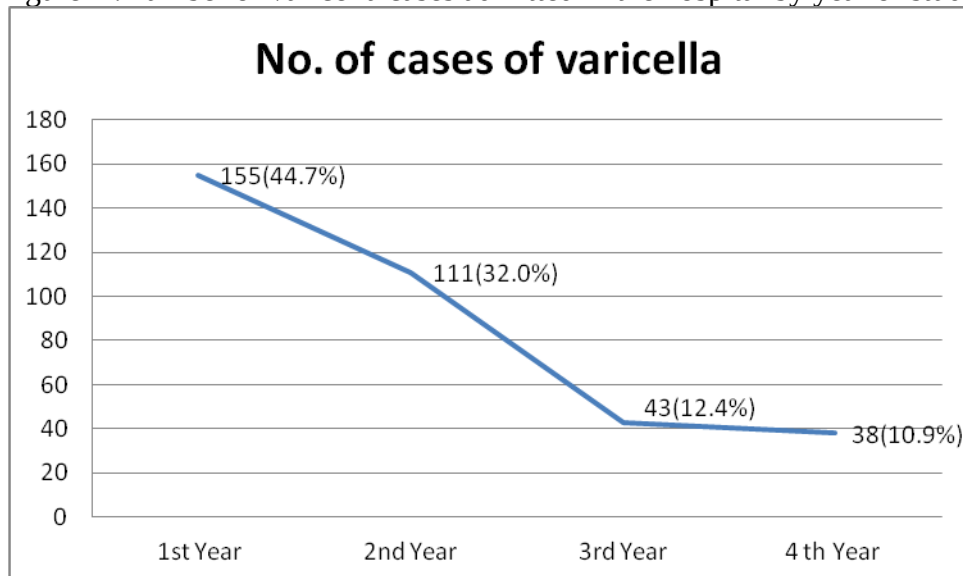


Figure 2 month wise comparison of varicella cases with mean monthly temperature and humidity

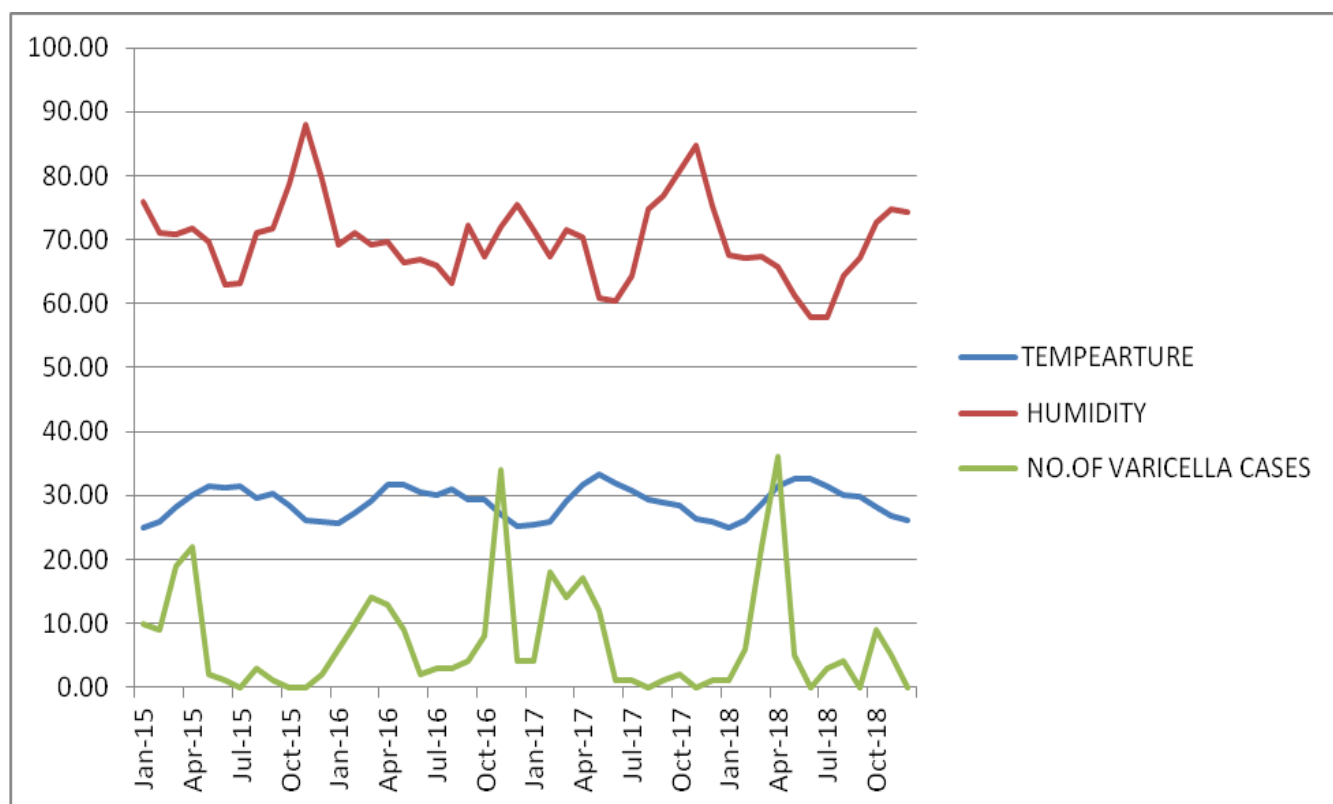


Figure 3: Year wise comparison of mean temperature, humidity and number of cases of Varicella

