



Chickenpox Outbreaks Reported in the East Singhbhum

RK Mahato^{1*}, Sana Irfan¹, AAC Srivastava¹, Piyalee Gupta¹, Rita Chouhan¹, N. Roopa¹, Tarun Kumar Kar¹, Manoj Kumar², Sahir Paul², Md Asad², Sushir Tiwari²

¹Department of Microbiology DHR Viral Diagnostic Research Laboratory, Mahatma Gandhi Memorial College and Hospital, Jamshedpur, India

²Department of Microbiology DHR Viral Diagnostic Research Laboratory, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand

*Corresponding author: RK Mahato, Department of Microbiology DHR Viral Diagnostic Research Laboratory, Jamshedpur, India, E-mail: mgnvrdl@gmail.com

Received: 12-September-2019, Manuscript No. JVA-19-2439;

Editor assigned: 17-September-2019, PreQC No. JVA-19-2439;

Reviewed: 01-October-2019, QC No. JVA-19-2439;

Revised: 03-August-2022, QI No. JVA-19-2439, Manuscript No. JVA-19-2439;

Published: 31-August-2022, DOI: 2324-8955/jva.1000674

Abstract

Introduction: Primary infection with Varicella Zoster Virus (VZV) leads to varicella or chickenpox. The epidemiology of varicella has changed dramatically since the introduction of the varicella vaccine in 1995. The routine childhood immunization in a few countries in the western world like Germany and the United States had reduced the incidence of the disease, associated complications, hospital admissions and deaths related to its complications. However, chickenpox outbreaks are common in naive unvaccinated communities in India.

Materials and methods: We had investigated many outbreaks of chickenpox and reported in different areas of East Singhbhum in Kolhan region of Jharkhand during January 2018 to March 2019. The outbreak was confirmed by the detection of VZV IgM by Enzyme-Linked Immuno Sorbent Assay (ELISA) on serum samples from the patients.

Results: A total of 76 cases occurred in the outbreaks in which 45 number of serum samples showed positive serology for VZV IgM antibodies.

Conclusions: There is an urgent need to identify naive communities and unvaccinated individuals at risk. Also, there is a need for regular training programmes of health workers posted in peripheral centres so that highly contagious communicable diseases can be picked up in time and such outbreaks can be prevented.

Keywords: Jharkhand; Kolhan; East Singhbhum; Varicella; Chickenpox

Introduction

Chicken pox or varicella is an acute infection prevalent in children caused by Varicella-Zoster Virus (VZV), belonging to the *Herpesviridae* family [1]. The disease is usually common in immune compromised children but can be lethal with an attack rate approaching >85% after exposure in adults and immune compromised individuals [2]. Only one serotype of the virus had been recognized till date. Human are the only and primary host of this virus. This disease

is an air borne disease and spreads human to human. The passing on of infection occurs by healthy one respiratory contact with airborne droplets produced during coughing or sneezing of patient or by direct contact or inhalation of aerosols by healthy one from vesicular fluid of skin lesion of acute varicella zoster [3]. The main manifestations of this disease are skin rash, fever, body aches, fatigue, irritability etc. In extreme cases the rash may metastasize to other internal parts of the body [4]. As the disease is highly contagious thus the patient are kept in isolation from the other members of the family. Children should not be allowed to go to school or to any public area attend during the communicability period, i.e. until rash crusts. Usually the infection is acute and self-limited but sometimes can lead to complications such as encephalitis, pneumonia and secondary bacterial infections. Since varicella is a latent infection thus it has long-term consequences of development of herpes zoster due to reactivation [5]. The disease has a incubation period of 14 days-16 days. The infectious period starts 1 day-2 days before the appearance of the exanthema and extends till all the vesicles have crusted, generally within 5 days-7 days.

A clinically visible infection usually provides lifelong immunity. The disease impact on human is influenced by various factors like immunity, climate/environment, population density etc. Pregnant women and children are susceptible to this disease. The mothers who contracts varicella in the first 20 weeks of pregnancy has chances of developing congenital varicella syndrome develops among 2% of newborn infants. There is higher risk of developing serious complications and mortality in newborn to that pregnant woman who contracts the infection within 5 days of delivery. The virus has the ability of crossing the placental barrier [6]. Risk of mortality in adults is 15 times higher normal young children are estimated to be >2/100,000 [7]. Normally hospitalization is not required in the patient and can be treated in the home, but if any complication arises then hospitalization is mandatory. There is no specific treatment for chickenpox. Antiviral treatment is generally not recommended in this disease. Immuno compromised patients have greater chance of suffering through complications which is treated accordingly. Secondary infections especially like pneumonia are dealt with antibiotics. Reduction in mortality and morbidity could be achieved by efficient management especially during complication [8]. Though the mortality rate of this infection is not so high but peoples panic since it is highly contagious, lack of awareness, conventional believes etc. Chicken pox can be mail prevented by taking initiatives in increasing health awareness and immunization. Many of the research papers had reported 95% effectiveness of vaccine. In 1974 the vaccine of Oka strain was introduced by Takashi of Japan [9].

There are scanty reports published on data on epidemiology of chicken pox in India since it was not a significant disease till 2005. Later several on outbreaks of chicken pox had been reported in different parts of the world and in India [10]. During the period of 2003 to 2007 large outbreak was reported from Colombia which affected both adults and children population [11]. Few studies had also reported large number of mortality [12]. This indicates that chicken pox is a disease of concern for public health.

The outbreak investigation was done to review and assess the current situation of chicken pox cases in East Singhbhum of Kolhan region, to assess the environmental and sociological factors contributing to the abundance of chicken pox cases, to recommend remedial measures to overcome the current outbreak and to prevent occurrence of outbreaks in future [13,14].

Case Series

Study area

The study was carried out at Department of Health and Research Viral Diagnostic Research Laboratory, Department Of Microbiology, Mahatma Gandhi Memorial Medical College and Hospital Jamshedpur Jharkhand from Jan 2018 to March 2019 in East Singhbhum of Kolhan region. Kolhan division is one of the five divisions in the Indian state of Jharkhand. East Singhbhum district consists of 11 blocks. (Golmuri, Jugsalai, Potka, Patamda, Boram, Ghatshila, Musabani, Dumaria, Gorabandha, Dhalbhumgh, Baharagora, Chakulia).

Study population

Inhabitants of East Singhbhum in Kolhan regions suspected with VZV infection.

Case definition

An illness with acute onset of diffuse (generalized) maculopapulovesicular rash without other apparent cause. In vaccinated persons who develop varicella more than 42 days after vaccination (i.e., breakthrough disease), the rash may be atypical in appearance (maculopapular with few or no vesicles).

Varicella case classification

Probable: A case that meets the clinical case definition is not laboratory confirmed and is not epidemiologically linked to another probable or confirmed case.

Confirmed: A case that is laboratory confirmed or a case that meets the clinical case definition and is epidemiologically linked to a confirmed or a probable case. Note: Two probable cases that are epidemiologically linked are considered confirmed, even in the absence of laboratory confirmation.

Varicella deaths classification

Probable: A probable case of varicella that contributes directly or indirectly to acute medical complications that result in death.

Confirmed: A confirmed case of varicella that contributes directly or indirectly to acute medical complications that result in death.

Ethical issues

The institute ethics committee had granted permission for carrying out this research work.

Data collection

A questionnaire was framed to elicit demographic details of all patients who were suspected with VZV infection.

Sample collection

Blood samples were collected by venepuncture by strict aseptic method taking universal precautions. After proper positioning of the arm of the individual, under adequate illumination, the antecubital

vein was made prominent by tying a tourniquet upstream of the vein and the area was disinfected using a spirit swab in a centrifugal manner. Around 5 ml whole blood was collected from each patient in a relabelled sterile plain vacutainer using a disposable sterile needle and 5 ml syringe.

Sample processing

Blood was allowed to clot for 30 minutes followed by centrifugation at 10000 RCF for 15 minutes to separate out serum. Serum was pipette out into properly labelled micro centrifuge tubes.

Sample storage

All serum samples which tested positive for IgM VZV were aliquot into a new labelled cryovial and stored at 4°C for a week while for long term storage at -20°C.

Outbreak investigation

The investigation was carried at 8 different sites of Kolhan region, Jharkhand, India. The investigation team of epidemic surveillance staff was formulated including staff of integrated disease surveillance program and VRDL consisted of doctor's epidemiologist, research scientists and technicians covering field work visited the affected areas. The team was escorted by the local doctors and community members to the houses of the reported cases at times. In addition a door to door survey was conducted to identify any unreported case. In schools the administrators were informed and active case detection was carried out throughout the school and other organisations.

Laboratory testing

The serum sample was tested with NOVATECH VZV ELISA kit at DHR VRDL, Department of Microbiology, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand.

Results



Figure 1: Maculopapular rashes distribution all over the body in VZV suspected cases.



Figure 2: Political map of Jharkhand depicting the affected area.
Note: ● State capital ● District headquarters State boundary.



Figure 3: Affected area in the East Singhbhum with VZV infections. **Note:** ● Affected area in singhbhum □ State boundary
 ■ District boundary ■ C D block/Tehsil boundary.

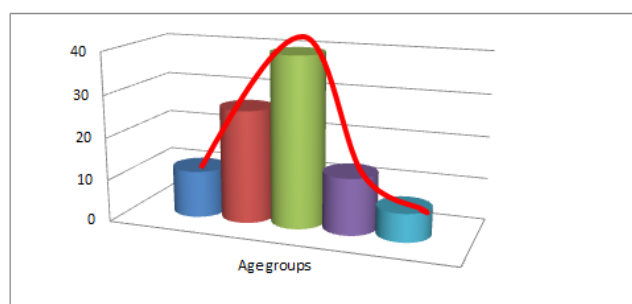


Figure 4: Distribution of VZV infected patients in different age group. **Note:** ■ 0-10 ■ 11-20 ■ 21-30 ■ 31-40 ■ 41-50.

Discussion

The current study reports about the chickenpox outbreak cases in the East Singhbhum of the Kolhan region from January 2018 to March 2019. The study is expected to provide evidence on the factors responsible for chicken pox outbreaks and to plan for appropriate interventions to prevent any future impending disease outbreaks. Many events of outbreak were reported with collection ranging from 5-21 sample numbers in different block area. The first site where the cases were reported was Patamda in June 2018 at Kaoshal Vikas Kendra.

The total population affected was male as it is a male institution. Pradhan Mantri Kaushal Vikas Yojana (PMKVY) is the flagship scheme of the Ministry of Skill Development and Entrepreneurship (MSDE).

Out of total 21 patients 10 was found positive. The total number of students in the institution is 135. The second site where the cases were reported was Golmuri at traffic training institute in June 2018 having 350 students in the institution. Out of total 24 suspected cases 10 cases were positive. This institute is a female institution thus the affected population was female. The third affected site was Gorabandha block in July 2018. It had 137 people in the institution.

It was again a male institution and thus the affected population was male showing positivity in 5 patients out total 10 suspected patients. There were three sites which were institution where outbreak took place in this study. East Singhbhum had also witnessed institutional outbreak in the past. A total of 79 cases satisfying the outbreak case definition were found in KGBV, Chakulia [15].

Similarly many outbreaks had been reported worldwide in institution and schools [16-18]. The 4th, 5th, 6th, 7th and 8th affected site was in the Musabani block in different village and colony. The Roam village supporting the population of 794 people was affected (4/5) in the month of September 2018. The HCL colony of population 500 persons affected (4/4) in January 2019.

The samples sent for investigations were much less than the suspected cases. The Kendadih village supported the population of 150 persons and there was 21 suspected cases. The village Gohla had population of around 985 people and there were 12 suspected cases.

The samples of both villages were tested and out of total 10 samples send 7 were tested and all were positive. The three samples were not tested due to inappropriate sample quality and quantity. In village Bhadua total suspected cases were 8 but only 5 samples were collected and tested in which all 5 were positive (Table 1).

Frequency of symptoms	
Symptoms	Frequency
Fever	37 (82.22)
Rash	40 (88.88)
Cough	18 (40)

Coryza	27 (60)
Conjunctivitis	-
Complications	-
Chills and rigour	19 (42.22)
Bodyache	38 (84.44)
Headache	11 (24.44)
No significant symptoms but in close contact to affected patients	5 (11.11)
Severity of disease	No
Mild	Yes
Moderate	Yes
Severe	No
Mortality	No

Table 1: Frequency of symptoms patients in VZV positive patients.

Though the suspected patient number are high but collected sample are less in number because the village people don't support in giving the samples for testing due to their superstitious belief, religious belief and misconceptions. Frequent and greater number of outbreaks was found in Musabani block. Some samples were also collected with not significant symptoms considering as in contact of infected person and may be initially positive but did not developed symptom i.e., very

early acute phase with detectable I_gM antibody (11.11%). No death was reported and most common symptom was maculapapulo-vesicular rash (88.88%) commonly found in almost all patients. Some reported for fever, rash and body ache. Few reported with fever, rash, cough, coryza, bodyache and others with different permutations and combinations. Frequency of symptoms of fever, cough, coryza, chills, rigour, body ache and headache are 82.22%, 40%, 60%, 42.22%, 84.44%, 24.44% and 11.11% (Table 2 and Figure 1).

Sympto-ms	Site 1 (Patamda)	Site 2 (Golmuri)	Site 3 (Gorbandha)	Site 4 (Musabani)	Site 5 (Musabani)	Site 6 (Musabani)	Site 7 (Musabani)	Site 8 (Musa-bani)
Description of site	Kaoshal VikasKendra	Traffic training institute	Kaoshal VikasKendra	Roam village	HCL colony	Kendadih village	Gohla village	Bhadua Village
Month	June 2018	June 2018	July 2018	September 2018	January 2019	February 2019	February 2019	March 2019
Population (persons)	135	350	137	794	500	150	985	367
Number of cases positive/total	10/21	10/24	5/10	4/5	4/4	7/7		5/5
Mean age in years (range)	20	24.5	19.7	33.8	20.75	34		20.4
Male: Female ratio	21:0	0:24	10:0	3:2 (1.5)	2:2 (1:1)	6:1		3:2
Mean age in years of positive patients(range)	19.9	23.3	20.2	32.25	20.75	34		20.4
Male: Female ratio of positive patients	10:0	0:10	5:0	3:1	2:2 (1:1)	6:1		3:2

Table 2: Description of outbreaks.

The history of contact with a case of chickenpox was available in all the patients while none of them gave a history of vaccination

against VZV. The present study also highlights the epidemiological factors contributing to an outbreak of chickenpox. A perfect arrangement for the spread of infection was present such as ambient temperature and people in a community living in close proximity who had never been encountered with the infection, helped in rapid transmission or spread of the virus. The villages were overpopulated with residents living in poorly structured houses. Most of the affected population belonged to low socioeconomic strata, with most of the houses being semi-pucca/ or mud-plastered category, agricultural labour community. Majority was hut with no proper ventilation, affected areas were poor sanitation and no arrangements for proper waste management, also the affected population were illiterate and unaware of the cause of the disease. Studies done in India and Thailand throws light on the fact of community transmission and household crowding are vulnerable to varicella epidemics [19]. Seasonal variation of chicken pox outbreaks had also been observed [20,21]. But in our study the outbreak of chickenpox occurred in approximately all-round the year in every month at different sites. It has been proposed that the transmission potential of the VZV virus might be adversely affected by a combination of high ambient temperatures and humidity in tropical regions [22]. The recorded average annual humidity is 49.25%, clouds 20.91%, rainfall 110.08 mm and temperature range maximum is 19.2°C to 33.4°C [23,24]. History of travel outside the locality was insignificant during the field visit.

The most affected age group is 21 years-30 years depicted in the graph is a bell pattern initially starting from 0 yrs-10 yrs and maximizing at 21 yrs-30 yrs and falling at 41 yrs-50 yrs. In India, >30% of persons >15 years of age are susceptible to VZV infection [16]. In the present study the affected sites mean age are approximately ≥ 20 years. Overall mean age of all the cases are 24.75. Study from Japan showed 81.4% chicken pox cases were below 6 years [25]. Also stated in 2010 highest transmission was found in children [26]. Whereas in another study showed maximum affected age groups were adults [27]. The incidence rate of this disease in areas with temperate climate showed 13-16 cases of VZV per 1000 people in each year and maximum of the affected is children below 9 years while in tropical countries like India maximum cases belong to adult groups [28]. The varicella vaccine is not a part of the universal immunisation programme in India; thus outbreaks of chickenpox continue to occur in the naive unvaccinated rural population [29-31]. Due to this, a progressive increase in seroprevalence with age has been found; maximum rates of seroconversion have been found in adolescents and adults [32]. VZV infection has not been completely eradicated and therefore incidence of infection may vary from childhood to young adults which may suffer from serious complications like bacterial infections of the skin, soft tissues and/or bones sepsis, or a bacterial infection of the bloodstream, bleeding problems, dehydration, encephalitis or inflammation of the brain, pneumonia, toxic shock syndrome etc [33]. In our study no clear explanation could be given on the affected sex in the population since institution where outbreak happened was male and female institution. Thus sex ratio is biased in institutions. Outbreak happened in four different sites or villages of Musabani in which affected male population is higher than female in three sites out of four sites. Few studies reflect that men are the main host for VZV [34]. But a clearer picture would have been drawn if all the suspected population at different site would have given their samples for testing.

None of the suspected cases had vaccination history. From the above study we could conclude that the incidence of infection had

shifted to adult age group which due to good fortune had not led to severe complications but studies as mentioned states about complication of chickenpox in adults may lead to higher morbidity and mortality. After primary infection which results in varicella, the virus becomes latent in the cerebral or posterior root ganglia. Because of virus reactivation some of these individuals develop shingles after several decades. It happens due to deterioration of cellular immune response. Cases such as old age, hard work, using of steroids or malignancies contribute to the appearance of shingles [35]. The VZV vaccine was introduced by different countries in their routine immunization. In 1996; Singapore introduced OPR licensed vaccine [36]. It is contraindicated in pregnant women. The vaccine is supposed to be very expensive, but the vaccine had proved to be safe and effective in preventing disease [37]. However, the opinion of the experts is disputed on the necessity of need for a vaccine against chickenpox in the hour. Some consider that there is little need of vaccine since chickenpox is a relatively a mild infection. But it may be disastrous if chickenpox is postponed from childhood, when it is mild to adulthood when it is more severe. One of the major objections to a live vaccine is the capacity of the chickenpox virus to establish a latent infection. This may produce herpes zoster in later years more frequently or in a more severe form, than the natural disease [38].

Due to all these limitations, many of the public health experts do not consider the need for the vaccine. IAP has recommended varicella vaccine to children only after one to one discussion with parent. Passive immunization is recommended as post prophylaxis for immune compromised children, pregnant women and newborn exposed to maternal varicella. Close contact between a highly susceptible patient and a patient with herpes zoster is an indication of passive immunization as a prophylaxis. In previously immunized children, asymptomatic infection with mild type of virus may occur. When a child develops rash after 42 days of chickenpox vaccination it is due to the mild type of varicella-zoster virus, is known as breakthrough varicella. This breakthrough varicella should be isolated, since they are infectious and some experts think we need more epidemiological data on case fatality and complications and sequelae due to varicella in our country for formulation of proper guidelines. The Indian Academy of paediatrics suggests that vaccine can be given to (a) adolescents who have not had varicella in childhood, (b) household contacts of immune compromised children, (c) children attending crèches and day care centers and (d) susceptible adolescents and adults if they are working in the institutional set up, eg. School teachers, day care center workers, military personnel, health care professionals, etc.

Conclusion

Vaccination, health awareness, proper nutrition etc. may control or prevent the outbreak. For which all have to work together including government, NGOs, different unions and village's active people. Hence, it is important to improve our surveillance system for early and true detection so that control measure could be taken to prevent the probable outbreak with collaboration of all governments and non-governments agencies.

References

1. Arvin AM (1996) Varicella-zoster virus. *Clin Microbiol Rev* 9: 361-381.

2. Preblud SR (1981) Age-specific risks of varicella complications. *Pediatr* 68: 14-17.
3. Tunbridge AJ, Breuer J, Jeffery KJ (2008) Chickenpox in adults-clinical management. *J Infect* 57: 95-102.
4. Nagel MA, Gilden D (2013) Complications of varicella zoster virus reactivation. *Curr Treat Options Neurol* 15: 439-453.
5. Enders G, Bolley I, Miller E, Cradock-Watson J, Ridehalgh M (1994) Consequences of varicella and herpes zoster in pregnancy: Prospective study of 1739 cases. *Lancet* 343: 1548-1551.
6. Bennett JE, Dolin R, Blaser MJ (2019) *Mandell, Douglas and Bennett's principles and practice of infectious diseases* E-book. Elsevier Health Sciences.
7. Bres PL (1986) *Public health action in emergencies caused by epidemics: A practical guide*. WHO.
8. Pace D Review of varicella zoster virus: From epidemiology to prevention.
9. Idrovo AJ, Albavera-Hernández C, Rodríguez-Hernández JM (2011) Social epidemiology of a large outbreak of chickenpox in the colombian sugar cane producer region: A set theory-based analysis. *Cad Saude Publica* 27: 1393-1402.
10. Singh MP, Singh G, Kumar A, Singh A, Ratho RK (2011) Epidemiologic lessons: Chickenpox outbreak investigation in a rural community around Chandigarh, North India. *Indian J Pathol Microbiol* 54: 772.
11. Rawson H, Crampin A, Noah N (2001) Deaths from chickenpox in England and Wales 1995-1997: Analysis of routine mortality data. *Br Med J* 323: 1091-1093.
12. Brisson M, Edmunds WJ (2003) Epidemiology of varicella-zoster virus in England and Wales. *J Med Virol* 70: 9-14.
13. Pall S, Kumar D (2018) Outbreak investigation of viral exanthem in Jharkhand, India: An eye opener for surveillance managers and vaccine policy makers. *Int J Community Med Public Health* 5: 4756.
14. Meyers J, Logaraj M, Ramraj B, Narasimhan P, MacIntyre CR (2018) Epidemic varicella zoster virus among university students, India. *Emerg Infect Dis* 24: 366.
15. Tugwell BD, Lee LE, Gillette H, Lorber EM, Hedberg K, et al. (2004) Chickenpox outbreak in a highly vaccinated school population. *Pediatrics* 113: 455-459.
16. Danish Khan I, Chatteraj A, Nimonkar R, Rajmohan KS, Mohan Gupta R, et al. (2018) Outbreaks of varicella zoster in a military nursing institute: Infection control in hospital and institutional environments. *J Arch Mil Med* 6.
17. Meyers J, Logaraj M, Ramraj B, Narasimhan P, MacIntyre CR (2018) Epidemic varicella zoster virus among university students, India. *Emerg Infect Dis* 24: 366.
18. Greenaway C, Boivin JF, Cnossen S, Rossi C, Tapiero B, et al. (2014) Risk factors for susceptibility to varicella in newly arrived adult migrants in Canada. *Epidemiol Infect* 142: 1695-1707.
19. Bakker KM, Martinez-Bakker ME, Helm B, Stevenson TJ (2016) Digital epidemiology reveals global childhood disease seasonality and the effects of immunization. *Proc Natl Acad Sci* 113: 6689-6694.
20. London WP, Yorke JA (1973) Recurrent outbreaks of measles, chickenpox and mumps: Seasonal variation in contact rates. *Am J Epidemiol* 98: 453-468.
21. Garnett GP, Cox MJ, Bundy DA, Didier JM, Catharine JS (1993) The age of infection with varicella-zoster virus in St Lucia, West Indies. *Epidemiol Infect* 110: 361-372.
22. Bechtel KA, Mehta PN, Lichenstein R, Chatterjee A (2016) *Pediatric chickenpox*. Medscape.
23. Socan M, Berginc N, Lajovic J (2010) Varicella susceptibility and transmission dynamics in Slovenia. *Public Health* 10: 1-6.
24. Kole AK, Roy R, Kole DC (2013) An observational study of complications in chickenpox with special reference to unusual complications in an apex infectious disease hospital, Kolkata, India. *J Postgrad Med* 59: 93.
25. Singh MP, Singh G, Kumar A, Singh A, Ratho RK (2011) Epidemiologic lessons: Chickenpox outbreak investigation in a rural community around Chandigarh, North India. *Indian J Pathol Microbiol* 54: 772.
26. Verma R, Bairwa M, Chawla S, Prinja S, Rajput M (2007) Should the chickenpox vaccine be included in the national immunization schedule in India? *Hum Vaccin* 7: 874-877.
27. Sinha DP (1976) Chickenpox-a disease predominantly affecting adults in rural West Bengal, India. *Int J Epidemiol* 5: 367-374.
28. Balraj VI, John TJ (1994) An epidemic of varicella in rural southern India. *J Trop Med Hyg* 97: 113-116.
29. Lee BW (1998) Review of varicella zoster seroepidemiology in India and Southeast Asia. *Trop Med Int Health* 3: 886-890.
30. Doerr HW (2013) Progress in VZV vaccination? Some concerns. *Med Microbiol Immunol* 257-258.
31. Arvin AM (1996) Varicella-zoster virus. *Clin Microbiol Rev* 9: 361-381.
32. Tunbridge AJ, Breuer J, Jeffery KJ (2008) Chickenpox in adults-clinical management. *J Infect* 57: 95-102.
33. Fatha N, Ang LW, Goh KT (2014) Changing seroprevalence of varicella zoster virus infection in a tropical city state, Singapore. *Int J Infect Dis* 22: 73-77.
34. Takahashi M, Otsuka T, Okuno Y, Asano Y, Yazaki T, et al. (1974) Live vaccine used to prevent the spread of varicella in children in hospital. *Lancet* 304: 1288-90.
35. Brunell PA (1978) Varicella-zoster virus vaccine. *J Am Med Assoc* 239: 1034-1035.
36. Drwal-Klein LA, O'Donovan CA (1993) Varicella in pediatric patients. *Ann Pharmacol* 27: 938-949.
37. Kliegman RM, Behrman RE, Jenson HB, Stanton BM (2007) *Nelson textbook of pediatrics* e-book. Elsevier Health Sciences.
38. Singh S (2004) Update on immunization policies, guidelines and recommendations. *Indian Pediatr*.