Seasonal variation of chickenpox in Taiwan estimated by NHIR database

Po-yuan Wu [a] , Yu-Chuan Li [a]

[a] graduate institute of medical informatics, Taipei medial university

E-mail Address:skin@url.com.tw

Abstract

In order to determine the seasonal variation of chickenpox in Taiwan, we analyzing data from NHIR database in year 2000. The entire patient suffered from chickenpox in NHI date base are included (N=165719) and divided to northern, center, southern and eastern part of Taiwan by geographic locations. In all geographic locations except off-shore Island, the peak is in January and lowest incidence rate peak in September and July. Chi-Square Test for Equal Proportions show seasonal variation of chickenpox in Taiwan (P <.0001). We also found there are cyclic pattern between total patient numbers and days in all the year 2000, about 7 days a cycle

Keywords: ***chickenpox, seasonal variation, incidence rate, temperature***

Many infection disease especially virus related such as influenza, respiratory syncytial virus[2] behave as cyclical and seasonal pattern. How to identify the seasonal pattern and predictable of virus infection is very important in prevention outbreaks and disease control.

Chickenpox is a highly contagious disease with average 2 weeks incubation periods. The complication of chickenpox is scar in skin, pneumonia, encephalitis. The mortality rate for children with leukemia or immunosuppressed children is 7% to 14%.[3] Infections during pregnancy may cause congenital abnormality[4] and even life threatening to fetus and mother.[5]

The National Health Insurance Plan has accumulated 12 million administrative and claims data, the largest in the world.(http://www.nhri.org.tw/nhird/brief_01.htm). However, it is difficult to study due to there are some traps and often lead to incorrect interpretation in database. First, due to the request of national health insurance, the drugs prescribed by doctor must correlate to ICD numbers. As the result, in some circumstance, incorrect ICD numbers are put into database due to the need of prescription off-label use drugs. Secondary, some diseases are difficult to diagnose without/ either examinations. Temporary ICD numbers are put in this situation. Third, some ICD numbers are the group of the diseases, not specific to the real only one disease. In our study, the disease is easy to diagnose by physicians and no complicated drugs need to prescribe. Further more, chickenpox is needed to report to government, so no intension to put chickenpox ICD number for the sake of other reasons. We also use the daily weather data and demographic data provided by government. The whole data we analysis are very reliable.

Materials and methods

Chickenpox is clinically defined as acute onset of multiple typical skin lesions in the same time (i.e. erythema, papules, vesicles, crusts) and the ICD number of chickenpox are 052.0, 052.1, 052.7, 052.9 respectively. We collect data from Jan 2000 to Dec 2000 in all clinics and hospital in Taiwan which ICD number are described as above by national health insurance research database. By using SQL instructor, we got the data including visiting day, sex, birthday, hospital ID and count once if multiple visits are found . Then we use another hospital basic data in NHI data base to translate hospital ID to real location in Taiwan. Then we divide to Northern, central, southern ,eastern and off-shore Island of Taiwan by hospital locations. The weather data in Taiwan were collect from Central Weather Bureau (http://www.cwb.gov.tw/index-f.htm.). The demographic data is in our government database

(http://www.ris.gov.tw/)

Estimation of incidence rate

Incidence rate is defined by number of new cases divided by total number of person at risk

Evaluation of seasonal variation

We use Lorenz curve[6] and Chi-Square Test for Equal Proportions to evaluation of seasonal variation .First we calculate the incidence rate in every month and rank the incidence rate from lowest to highest cumulative percentage of days in X-axis and cumulative percentage of cases in Y-axis. The more bowed Lorenz curve means more concentrated in particular months.

Evaluation the relationship between climate and incidence of chickenpox

We use daily temperature, daily temperature difference in Taipei as independent variable, number of patients 14 days latter in northern part of Taiwan (due to mean incubation period are 14 days) as dependent variable. Regression analysis are performed

Result

Total number of patients in our study is 165719, female is 80448 and male is 84312, 959 are unknown. Average annular incidence of Taiwan is 0.007439. The highest incidence rates in four areas are January and lowest rate is September in three areas, July in center area of Taiwan. (Fig1)However, in off-shore islands there are different pattern from Taiwan Island. (Fig2)Detail distribution in four part of Taiwan in Table1 .Lorenz curve shown in Fig3. Chi-Square Test for Equal Proportions shows Chi-Square is 16957.377 (Pr <.0001) . The Estimation of highest Incidence rate in Taipei city , Taichung city, Kaohsiung city are: 0.000543, 0.000737,0.000999 respectively.(Fig4)

We also found there are cyclic pattern between total patient numbers and days in all the year 2000(Fig.5) as example). If we closely observe in one month (Fig.6), we can find about 7 days a cycle (peak in 10/2, 10/9, 10/16, 10/23, 10/30 respectively.

The equations for transforming from temperature to number of patients as follows:
patient numbers= -3.189X TEMP +254.222 ($P< 0.001$, $r=0.237$).

There is no statistical significance about regression equations for daily temperature differences and patient numbers. ($P=0.718$)

Discussion

The major determinants of the incidence of disease include the age of people, the season of the years, climate geographic locations and the degrees of contact with individuals.[7]As the result, we can fully explain the lowest incidence rate in July, September due to summer vacation which loss closely contact among child. The highest incidence rate in July in Kingmen showed local endemic with poorly disease control. In addition to above, more elevation in temperature may be decrease viral activity.

The compositions of climate include temperature, moisture, pressure, rainy days, sunny hours[8] and the amount of rain. In our study, we try to use daily temperature and temperature differences to find out the relationship between climate and incidence of chickenpox. Although the r value (0.237) is not so high to explain strong relationship between temperature and incidence of chickenpox, but we can predict the number of victim 14 days later by statistical significance regression formula. It may be due to complicated viral transmission pattern that climate influence only one of the decision factors. On the other hand, there are no statistical significance regression formula between temperature differences and incidence of chickenpox.

We use two methods to determine the season variation of chickenpox or not. First, we use the Lorenz curve and second we use statistic methods --Chi-Square Test for

Equal Proportions. If the monthly incidence are equal the curve may follow the diagonal line throughout (0,0) to (1,1). No area between the Lorenz curve and diagonal lines due to they are the same lines. When the variation increase, the Lorenz curve are more bowed, the area between curve and diagonal lines indicate the variations. The Chi-Square Test for Equal Proportions show significance variation ($P<0.0001$)

In three main city of Taiwan, the incidence rate increase from north to south. However, they are lower than rural area in Taiwan, although more hospital and clinics in city area. The factors that influence the difference incidence rate between city and rural area may be due to fewer siblings in city family.

We also found the cyclic pattern in daily patient numbers in Taiwan. The truly medical meaning still unknown. It need further evaluations and explanations.

Control disease center develop report system by sentinel general practitioner for infection disease surveillance [1] . Compare with data from CDC, we can find the trend is similar between sentinel general practitioner and NHI data. However only from NHI data, the true incidence rate and cyclic pattern are found ..

It is difficult to compare data in other country due to little papers published in journal[9,10]. The epidemiologic data may be very difficult to get and incorrect in other country due to poorly report system and no electronic data base. (only 5861 cases report in Taiwan, report rate=3.53%). However due to the era of SARS, study the relationship between virus and its cyclic pattern[11,12], the climate factor that influence the virulence of virus will be important for us to understand them , control them and eradication them. We hope more further investigation and analysis to determine the actual significance of each of the individual risk factor[13]

References

1. 行政院衛生署疾病管制局.(2002.3).臺灣地區傳染病統計暨監視年報(中華民國八十九年).
2. van der Sande MA, Goetghebuer T, Sanneh M, Whittle HC, Weber MW(2004), "Seasonal variation in respiratory syncytial virus epidemics in the Gambia, West Africa" , Pediatr Infect Dis J. Jan;23(1):73-4.
3. Feldman S, Hughes WT , Daniel CB(1975), "Varicella in children with cancer . seventy-seven cases, "Pediatrics 56:388-397
4. Wheller TH(1983), "Varicella and herpes zoster: changing concepts of the natural history , control and importance of a not-so-benign virus, " N Engl J Med 309:1434
5. Pastuszak Al, Levy M(1994), "Outcome after maternal varicella infection in the first 20 weeks of pregnancy" N Engl J Med 330:901-905
6. Lee WC(1996), "Analysis of seasonal data using the Lorenz curve and the associated Gini index. " Int J Epidemiol 25:426-34
7. Nelson WE, Behrman RE, Kliegman RM, Arvin AM (1996)Textbook of Pediatrics,15th ed , Philadelphia: WB saunders: 750-751
8. Zak-Prelich M, Borkowski JL, Alexander F, Norval M.(2002), "The role of solar ultraviolet irradiation in zoster , " Epidemiol Infect. Dec;129(3):593-7.
9. Liu SC, Wang JD, Lee CY, Chou MC(1998), "Seasonal variation of chickenpox, mumps and rubella in Taiwanese children estimated by pediatric clinics,"J Microbiol Immunol Infect. Dec;31(4):217-24 .
10. Kokaze A, Yoshida M, Sekine Y, Ishikawa M, Kurokochi T, Uchida Y, Matsunaga N, Takashima Y.(2001),"The magnitude of variation in temperature within a year has an effect on the seasonal variations of chickenpox incidence in Japan.Epidemiol Infect," Apr;126(2):269-77.
11. Noah ND(1989),"Cyclical patterns and predictability in infection," Epidemiol Infect.102:175-90
12. Wagner S, Jung H, Nau F, Schmitt HJ(1993), "Relevance of infectious diseases in a pediatric practice," Clin Padiatr.205:14-7
13. Sumi A (1998), "Time series analysis of surveillance data of infectious diseases in Japan,"Hokkaido Igaku Zasshi. Jul;73(4):343-63.

Count

area			FUNC_month												Total
			JAN 2000	FEB 2000	MAR 2000	APR 2000	MAY 2000	JUN 2000	JUL 2000	AUG 2000	SEP 2000	OCT 2000	NOV 2000	DEC 2000	
center	ID_SEX	F	2724	2360	2244	2235	2199	1980	815	1309	1134	1266	1223	1299	20788
		M	2709	2597	2312	2297	2383	2146	917	1344	1232	1316	1271	1323	21847
		U	18	20	22	15	19	11	5	19	17	13	20	8	187
	Total		5451	4977	4578	4547	4601	4137	1737	2672	2383	2595	2514	2630	42822
eastern	ID_SEX	U		1	1	2	3	2	3	3	2	1	6	2	26
		F	762	649	485	469	413	332	304	200	109	195	249	281	4448
		M	772	635	502	493	419	331	302	210	136	218	283	290	4591
	Total		1534	1285	988	964	835	665	609	413	247	414	538	573	9065
northern	ID_SEX	U	72	91	57	51	58	35	37	35	44	36	36	52	604
		F	4453	3314	2632	2313	2462	2420	2039	1828	1865	2467	2450	2387	30630
		M	4621	3545	2831	2440	2504	2544	2154	1985	1826	2488	2544	2498	31980
	Total		9146	6950	5520	4804	5024	4999	4230	3848	3735	4991	5030	4937	63214
off-shore island	ID_SEX	U	1	1										1	3
		F	18	26	55	66	72	62	69	39	21	28	50	47	553
		M	20	28	58	57	65	87	85	48	29	28	40	46	591
	Total		39	55	113	123	137	149	154	87	50	56	90	94	1147
southern	ID_SEX	U	20	13	18	17	13	19	7	5	6	3	10	8	139
		F	3384	3096	2759	2777	2620	2100	1433	1317	1105	1136	1134	1168	24029
		M	3616	3331	2967	2878	2668	2128	1504	1319	1147	1217	1223	1305	25303
	Total		7020	6440	5744	5672	5301	4247	2944	2641	2258	2356	2367	2481	49471

Table 1. Detail patient numbers distribution in five part of Taiwan.

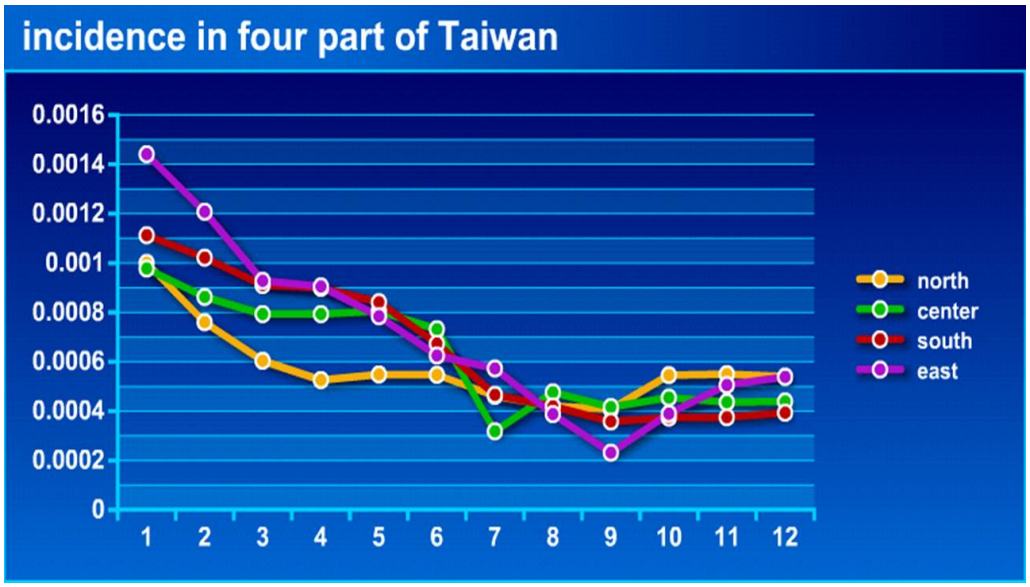

Fig.1 Incidence in four part of Taiwan

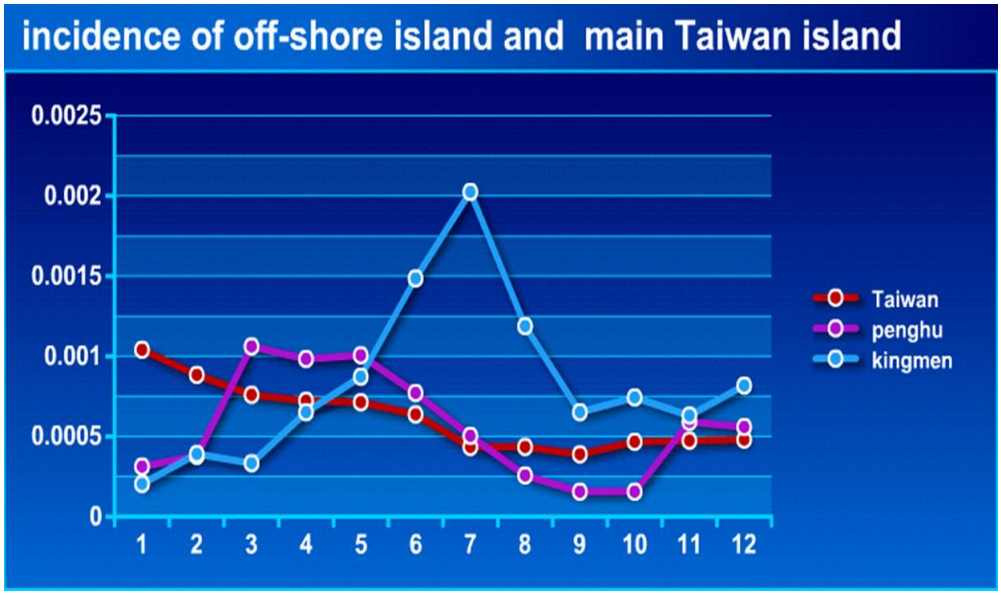

Fig2. Incidence of off-shore island and main Taiwan island

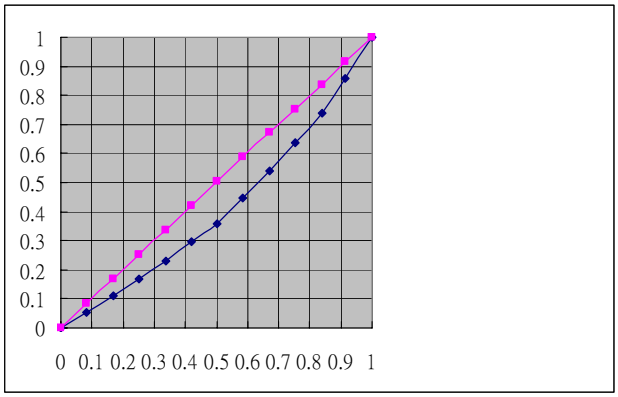

Fig3. Lorenz cure of chickenpox in Taiwan, where x-axis shows cumulative percentage of days and y-axis shows cumulative percentage of incidences

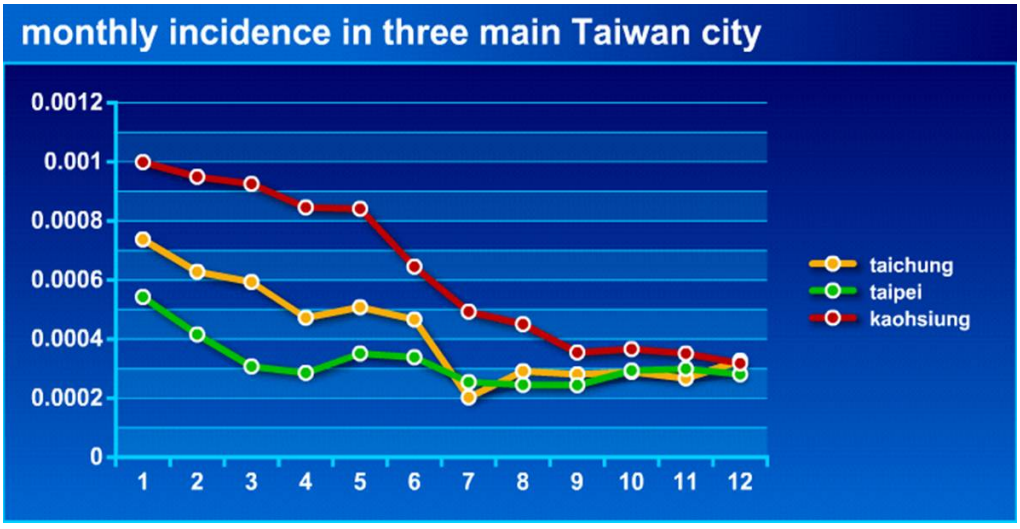

Fig 4.comparisome of incidences in three main Taiwan cities

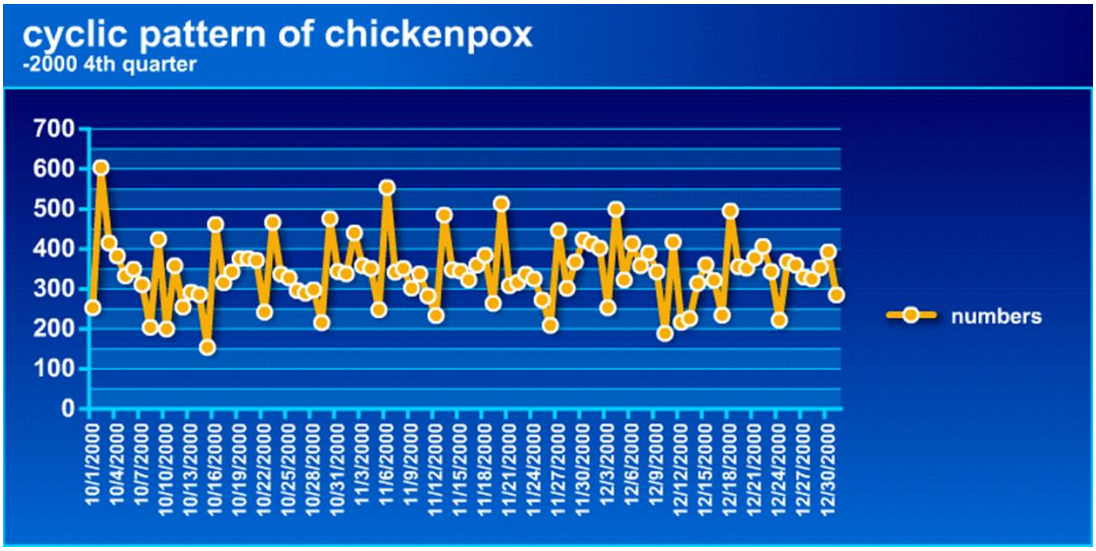

Fig 5.cyclic pattern of chickenpox in 2000/10-2000/12

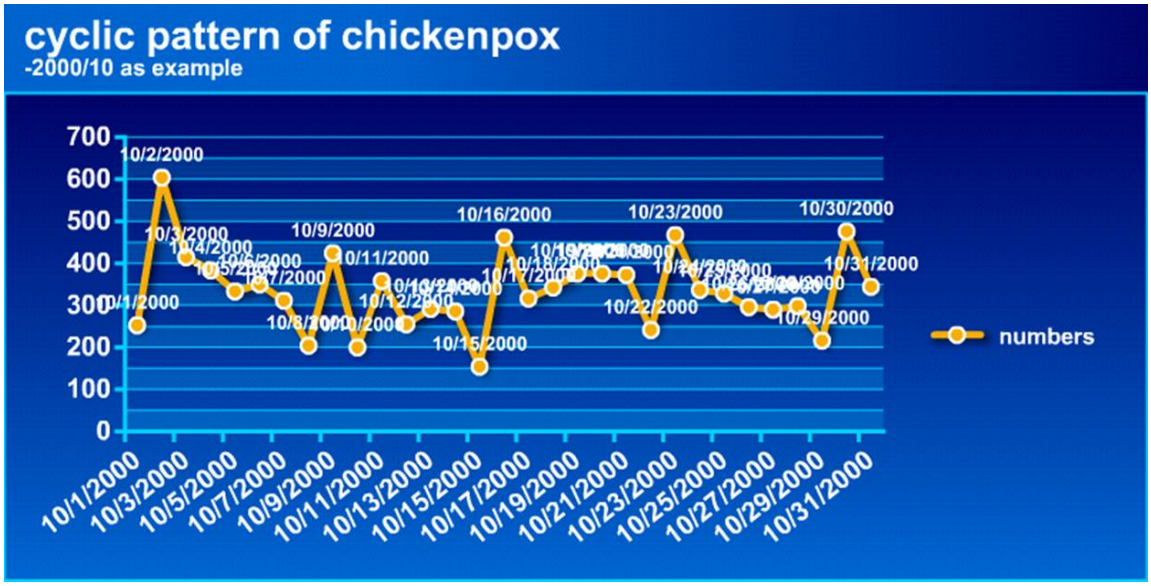

Fig 6.cyclic pattern of chickenpox in 2000/10