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A Cluster of Diarrhea in a Tourist Group to Bali, Indonesia, 2010

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Abstract

Diarrhea during travelling has become a common health problem in Taiwan due to increasing international travel. On January 22, 2010, Fever Screening Station at the Taoyuan International Airport found 4 febrile nationals among the 10 members of a tourist group coming back from Bali, Indonesia. Investigation showed that the 10 people all had diarrhea during travelling. Epidemiological investigation showed that all members were fine prior to the trip and started to have symptoms after 4 to 6 days in Indonesia. Laboratory examinations showed that rectal swabs from 3 of the 10 members yielded *S. flexneri* group B and hence confirmed an outbreak of shigellosis. After treatment, the culture-positive cases were negative for the bacteria after two follow-up examinations. Health education and monitoring were done for all members and their close contacts. No secondary outbreaks were seen. The outbreak ended on February 13.

The epidemic curve showed that the outbreak had a single peak suggestive of a common source infection. We suspected that environment encountered during that trip, utensils, foods, or drinking water might be the source of infection. According to the menus during the trip and memory of the members, ice, bottle water or incompletely heated foods might be the risk factors of the cluster. Hence, food hygiene during travels should be emphasized. Disease symptoms should be reported and treated promptly.

Keywords: shigellosis, *Shigella flexneri*, Indonesia, border quarantine

Background

According to the National Immigration Agency, Ministry of the Interior, the numbers of international travelers increase every year. In 2008, a total of 12,297,825 people entered and 12,293,887 exited Taiwan [1]. In 2008, the 5 most popular (first) destinations

INSIDE

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were Hong Kong, Japan, Macao, United States, and Korea; and the 5 most common destinations in Asia were Hong Kong, Japan, Macao, Korea, and Thailand [2]. With the increases in international travelers, health problems of our nationals happened in other countries become common as well. Traveler's diarrhea is one of the common problems. Pathogens of traveler's diarrhea include: *Escherichia coli*, *Campylobacter jejuni*, *Shigella* spp., *Salmonella* spp., norovirus, rotavirus, astrovirus, and *Giardia* [3].

The incidence of traveler's diarrhea is up to 30-70% [3]. Low risk (< 10%) areas include: United States, Canada, Australia, New Zealand, Japan, Singapore, Northern and Western Europe. Areas of moderate risk (10-20%) include: Eastern Europe, South Africa, the Caribbean islands, and Mediterranean countries such as Israel. High risk (> 30%) areas include: Asian countries other than Singapore, Middle East, African countries (other than South Africa), Mexico, Central and South America [3-4].

In 2008, a total of 484 imported cases of acute communicable diseases were found. The 5 most common diseases were: dengue fever (226 cases), amebic dysentery (72 cases), shigellosis (43 cases), acute viral hepatitis A (35 cases) and typhoid (19 cases). The 5 most common source countries of imported communicable diseases were: Indonesia (146 cases), Vietnam (86 cases), China (44 cases), Thailand (40 cases) and the Philippines (39 cases) [5].

Shigella, a Gram-negative bacillus of *Enterobacteriaceae*, is the pathogen of shigellosis. According to biochemical and serological differences, it can be classed into 4 groups as *S. dysenteriae*, *S. flexneri*, *S. boydii* and *S. sonnei* [6]. Shigellosis is highly transmissible, and can be caused by 10-100 *Shigella* bacteria. Common symptoms after infection include nausea, vomiting, fever, abdominal pain, diarrhea, bloody diarrhea, fatigue, and headache.

On January 22, 2010, Fever Screening Station of the Centers for Disease Control (CDC) Second Branch at the Taoyuan International Airport reported a diarrhea cluster of a tourist group. Epidemiological investigation was done by the members of the Field Epidemiology Training Program immediately to understand the extent of the outbreak, possible causes and institute preventive measures.

Methods

A. Subjects

Members of the tourist group and their close contacts (family members, friends, etc.) were subjects of this study.

B. Investigation method

Semi-structured questionnaires were used for telephone interviews to gather basic

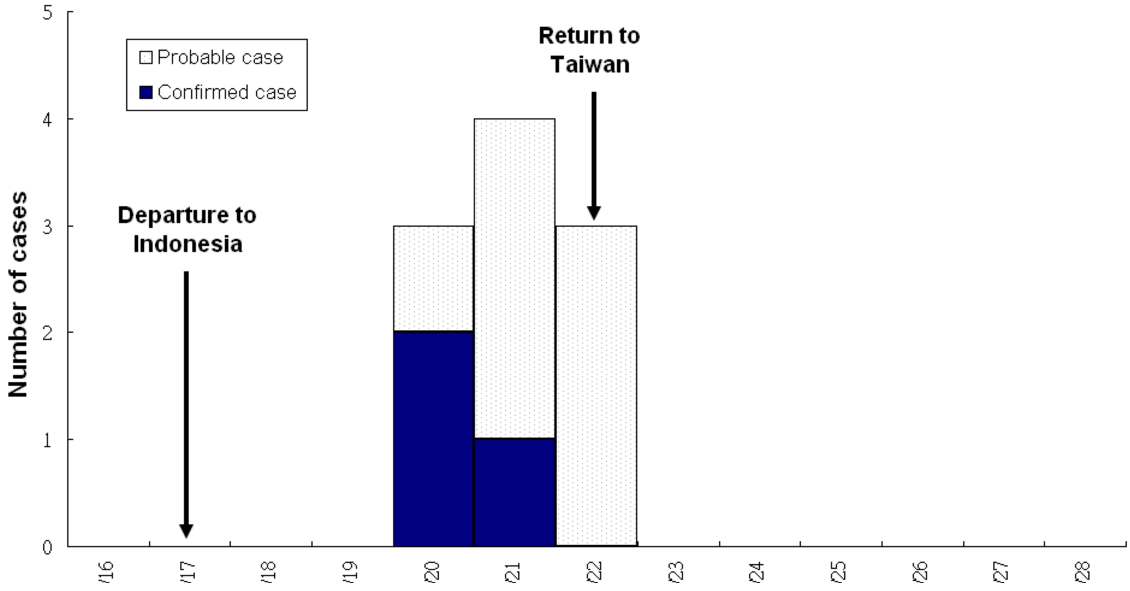

Fig. Number of shigellosis cases by date of onset in a tourist group to Bali, Indonesia, 2010 (n= 10)

profiles, clinical symptoms, dates and time of onset, medical treatments, food history during travelling and histories of activity and contact.

C. Case definition

Definition of probable cases of this diarrhea cluster event: cases having diarrhea during January 17 to 22, 2010 in a tourist group to Bali, Indonesia. Confirmed cases had *S. flexneri* (group B) isolated from their rectal swabs or stool samples.

D. Sample gathering and examination

Rectal swabs and stool samples were gathered from members of the tourist group and their close contacts who might have symptoms. Blood samples were also gathered from febrile cases. Rectal swabs and stool samples were tested for *Shigella* spp, cholera, *Vibrio parahaemolyticus*, and *Salmonella* spp. Blood and serum samples were tested for pathogens including malaria, dengue fever and Chikungunya fever. Once identified, *S. flexneri* strains were sent for pulsed-field gel electrophoresis (PFGE) analysis.

Results

A. Disease investigation

The tourist group to Indonesia had 10 members. Their itinerary was arranged by their agent and the group had no guide from Taiwan. They arrived in Bali, Indonesia on January 17, 2010 and hired a local guide. After the trip, they returned to Taiwan on January 22.

The tourist group had 6 females and 4 males, and their ages were from 26 to 35 years. They were all healthy before the trip, but started to have symptoms after 4 to 6 days (January 20 - 22) in Indonesia (Fig.). All members of the tourist group had diarrhea, 6 had fever, 5 had myalgia, 4 had abdominal pain, 1 had chills, 1 had head discomfort, and 1 had weakness. The first diarrhea case happened on January 20 around 11AM. Diarrhea symptoms lasted as long as 17 days. Four of the 10 members took medication by themselves during the trip, and 9 sought medical treatments after returning to Taiwan.

B. Sample gathering and test results

Rectal swabs from 3 of the 10 members yielded *S. flexneri*. Those members were negative for *S. flexneri* after standard follow-up sampling twice after treatment had been completed. Blood samples from the 4 febrile cases found at the airport were all negative. Close contacts of the above cases were all negative as well. No secondary outbreak was found.

C. Source of infection

The epidemic curve showed a single peak of the dates of onset, showing that this cluster had a point source of transmission. Although one of the members was a vegetarian and another one did not eat salads (but ate fruits), all the members had the symptoms during the trip. The 10 members had at least 17 meals together during the trip (6 days), and almost everybody had eaten all items. Hence, it is difficult to identify the suspected food source. However, according to the incubation period of shigellosis (6 hours to 9 days, and usually less than 3 days) [6], environment, utensils, drinking water or foods (iced or incompletely heated items) on January 18 and 19 might be related to this outbreak [2]. In addition, the members also reported other suspected foods: 1. food they ate in the remote mountainous areas were not fresh; 2. some bottled water had been opened with a straw before being served; 3. water used for fried noodles was turbid.

D. Follow-up and preventive measures

Other than disease surveillance and sample gathering done on those 10 members, CDC branch offices and other health authorities had also tracked and provided health education for their family members and close contacts. They were notified to monitor for symptoms such as diarrhea.

Monitoring of the event had started on January 22 and ended on February 13, longer than 18 days (double the incubation period [6]) since the latest date of onset of symptoms. No new case was reported. Case was closed on February 13.

Discussion

Symptoms of shigellosis are usually self-limiting, and hence travelers might overlook that it is highly contagious. Even though the patients seek medical attention, they may not provide travel history if doctors do not ask for. Hence, for disease prevention, name list, travel and medical history of members of the tourist group should be rapidly available for subsequent preventive measures.

For example, the last member examined on February 8 had incomplete contact information at first and was later tracked via friends in the group. Her diarrhea history was then available through a telephone interview on February 5. It was also found that on February 5, one of her family member also had diarrhea on that day. Health education and sample gathering were later done for those 2 persons. Due to the highly transmissible nature of shigellosis and a long period of transmission (up to 4 weeks), delay in contacting the patients might lead to spreading of the disease.

In this event, the cases were living in jurisdictions of the 1st, 2nd, 4th, and 5th branches of CDC, and hence collaboration between the aforementioned branches, the 7th branch, and laboratories in each area was required. The event was firstly identified at the airport on January 22, and health education and sample gathering of 6 members were done at the airport. The remaining 4 members were followed by their local branches for disease surveillance, health education, and sample gathering, and later for follow-up and repeated examination. Hence, no new case was found. Cluster of a tourist group are usually followed by the branches at where the index cases are. In this event, index cases were located in areas of 3 different branches, and hence the branch at where the travel agent located led the investigation. Our experience could also be used as reference for future disease investigation of tourist groups.

According to the National Notifiable Disease Surveillance System, 491 cases (430 cases were Taiwanese) were confirmed to be imported cases of shigellosis during 2000 to 2009. Among them, 242 cases were in tourist groups. The most common source countries were Indonesia (84 cases), Cambodia (36 cases), China (35 cases), Thailand (27 cases) and, Vietnam (20 cases), showing that hygiene during travelling in these countries needs to be emphasized.

For example, on December 21, 2002, an outbreak of diarrhea was reported to the CDC. The tourist group had 23 members including the guide. Seven of the members had diarrhea in Indonesia; 6 were treated there. The tourist group returned to Taiwan on December 22, and specimens were gathered at the airport. Seven members were positive for *S. flexneri*. Questionnaire showed that the cluster might be related to a BBQ at the beach and cold drinks in one afternoon [7].

On November 23, 2003, the CDC warned that multiple cases of shigellosis had occurred in tourist groups from Indonesia returning to Taiwan. During November 7 to 22, 2003, at least 40 cases in 15 tourist groups returning from Bali, Indonesia had symptoms including bloody diarrhea, fever and vomiting. Among those cases, 25 were confirmed to be infected by *Shigella*. More than 300 people, including the fever cases and their close contacts, were included in the investigation. Although the infection source could not be identified, a few suspected local restaurants had been identified. Following the outbreaks, the travel agents changed the itinerary to Bali accordingly [8].

A study showed that in northern Jakarta, Indonesia (population 1,435,207 in 2000) among the 16,225 diarrhea cases between 2001 and 2003: 1. The incidence of diarrhea was 50 cases/1,000 persons/year and 2. The incidence of shigellosis was 4 cases/1,000 persons/year. The most common causes were *S. flexneri* (72%), *S. sonnei* (23%), *S. boydii* (3%), and *S. dysenteriae* (2%) [9]. This study shows effect of shigellosis on Indonesia.

Although shigellosis is usually self-limiting and supportive care is the standard management, because it is highly transmissible, antibiotics may be used with caution based on the severity of cases, population density and drug sensitivity in outbreaks. However, drug resistance is a rising issue. An international study showed that drug resistance rate of *Shigella* is very high in Asia. Resistance of *S. flexneri* 2a to ampicillin and cotrimoxazole has reached 94.3% and 80.3%, respectively [10]. Hence, clinically the first line empirical antibiotics have to be more expensive ones such as ciprofloxacin or azithromycin. Accordingly, prevention of shigellosis should be done through public health measures.

Diarrhea is a common disease during travelling, and hence self health monitoring of travelers and the agents should be emphasized. In this event, the responses of the agents were: 1. Complaint has been filed to the travel agent in Indonesia. Whether they will continue the contract depends on improvement by the Indonesian travel agents; 2. Request for improvement to the restaurants had been asked through travel agents in Indonesia; 3. Health education toward the guides and tourists will be emphasized. However, only a limited number of restaurants can handle large group of tourists around popular attractions, so the choices of travel agents are also very limited. Hence, in addition to regular case-reports of public health information to travel agents, communication with the agents should be established by authorities to protect the health of the general public.

In summary, during travelling, local restaurants should be chosen carefully. Raw foods, cold drinks and iced items of unknown origin, and unsealed or opened bottled water should be avoided. Fruits should be peeled by consumers themselves to reduce risks. Symptoms, once happened, should be reported early. Medical attention should be sought as well. Disease prevention and quarantine authorities should collaborate with travel agents to monitor health status and current situation of the travelers in order to control the epidemic.

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Epidemiologic Analysis of Scarlet Fever Reported from Eastern Taiwan during 2000-2006

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Abstract

Scarlet fever is a respiratory disease caused by group A (beta hemolytic) streptococci. The surveillance data shows that the number of confirmed scarlet fever cases appeared to be an increasing trend in recent years in Taiwan. This study conducted an epidemiologic analysis of scarlet fever occurred in eastern Taiwan to understand the characteristics and trend of disease occurrence.

This study extracted data, by using Business Objects (BO) software, from the Communicable Disease Surveillance Database in Taiwan Centers for Disease Control (Taiwan CDC) and the epidemiologic investigation database in Sixth Branch of Taiwan CDC. These data were calculated and mapped by applying the software of Microsoft Excel 2003, SAS9.1 version, and were expressed as number of cases and proportion for various variables, which subsequently were described and analyzed by performing a variety of statistical tests, such as Chi-square for trend test and other relevant test.

A total of 183 cases of scarlet fever were confirmed in eastern Taiwan during 2000-2006, including 50 cases in Haulien County and 133 cases in Taitung County. The secular trend shows that the annual number of scarlet fever cases for both male and female were increasing year by year, and the incidence rate in male has overridden that of female since 2004. Children at the age of 5-6 years old had the highest incidence rate, and May was the peak month of the temporal trend for disease occurrence. Symptom analysis shows that, for cases with only one symptom, fever was the symptom with the highest number of the cases, and, for cases with multiple symptoms, fever combined with skin rash shared the largest part among the cases. The average time interval between

the date of onset and date of diagnosis was 4.02 days. Cases diagnosed within 5 days after the date of onset accounted for 80.9% of total cases.

In this study, except the events of cluster infections, no other factors that may have led to the increase of annual number of scarlet fever cases in eastern Taiwan during 2000-2006 was observed. Because this study did not have data on molecular epidemiology, it is unknown that the increase of number of scarlet fever cases was associated with the emergence of newly and highly pathogenic strains. In the future, homology analysis of the strains could be included as part of data for the study to identify the exact strains circulated in eastern Taiwan. The factors possibly leading to the increase of number of scarlet fever cases shall be explored.

Keywords: scarlet fever, group A (beta hemolytic) streptococci, Eastern Taiwan

Introduction

Scarlet fever is an ancient disease, which has been documented in the age of Hippocrates. However, the term of 'scarlet fever' was starting to be used only until after the medieval eras, and, only until Eighteen century, it was recognized as an infectious disease caused by bacteria, *Streptococcus pyogenes*, group A (beta hemolytic) streptococci [1].

Scarlet fever most commonly occurred in temperate zone countries, followed by subtropical zone countries, but less frequently occurred in tropical zone countries. The occurrence of scarlet fever presented a seasonal variation, which mainly occurred during seasons between late winter and early spring in countries of both temperate and subtropical zone [2]. The surveillance data collected by Taiwan Centers for Disease Control (Taiwan CDC) shows that the cases of scarlet fever could be identified in every season of the year in Taiwan and reached the peak during March and May [3] . The disease is more likely to be seen among school children [1, 4]. Those under the age of 12 accounts for the most number of cases and those at the ages of 4-6 have the incidence rate higher than any other age groups. Symptoms of scarlet fever include sudden high fever, sore throat, rough skin, nausea and vomiting, headache and fatigue, anorexia, or, in some cases, a typical skin rash, skin desquamation, or strawberry tongue. Most people who get the scarlet fever will recover without treatment, but some may appear severe complications such as rheumatic fever and acute glomerulonephritis [1, 5-6].

The case-fatality rate and morbidity rate of scarlet fever was very high before nineteen century, only after twenty century, when antibiotic was discovered, both of the rates appeared to be an apparently declining trend [7]. However, the number of scarlet fever cases has been presenting in an increasing trend in USA and Taiwan during the last decade [8-12]. Scarlet fever was one of the Category 3 Notifiable Communicable Diseases in Taiwan, for which cases should be notified to health authority within one week. When the Communicable Disease Control Act was revised on October 9, 2007, the Categorization of Communicable Disease and Guideline on Control Measures of Category 4 and Category 5 Communicable Disease was promulgated and enforced and, at the same time, scarlet fever was removed from the list of category 3 communicable diseases, meaning that the requirements on notification and control measures on the Act are no longer applying to scarlet fever. According to the Statistics of Communicable Diseases and Surveillance Report (2006) published by Taiwan CDC, the number of scarlet fever cases caused by group A (beta hemolytic) streptococci was 1,132 in 2005, a 2.2–fold increase, as compared with 511 in 2000. While examining the incidence rate of scarlet fever by year, it was found that the trend has been fluctuating steadily for national population since 2000. However, the incidence rate for eastern Taiwan population was rapidly increased after 2003, which was apparently different from other parts of the country.

Since scarlet fever was no longer one of the mandatory notification diseases required by the Communicable Disease Control Act revised in October 2007, the health authorities may be unable to obtain the data on case number and relevant information as it was before. In order to scientifically document the data of scarlet fever received before it was removed from the mandatory notification list, we retrieved the data stored in the Communicable Disease Surveillance Database established by Taiwan CDC by using the Business Objects (BO) software and the epidemiologic investigation information collected by Sixth Branch of Taiwan CDC to analyze the epidemiologic characteristics of scarlet fever reported from eastern Taiwan during 2000-2006 and to explore the possible factors may affect the fluctuation of trend in disease occurrence.

Materials and Methods

This study analyzed the surveillance data and epidemiologic investigation records of confirmed scarlet fever cases with a date of onset occurred between January 1, 2000 and December 31, 2006 in eastern Taiwan (including Hualien County and Taitung County) based on the data and records stored in the Communicable Disease Surveillance Database established by Taiwan CDC through the Business Objects (BO) software. We retrieved the data on July 20, 2007, including the items of date of birth, sex, age, residence, date of onset, date of diagnosis, date of notification, notifying hospital, and symptoms. The inputs and maintenance of all data for each item were completed by local health workers of the counties where the cases resided. The population data for each township in this analysis was based on Table of Housing and Population by Townships/Cities of Counties/Cities in Taiwan and Fujian Areas and Table of Population by Sex and 5 Year Age Group by County and City (statistics as at December 2006) in the Database for Public Service constructed by Department of Household Registration, Ministry of the Interior. The data for each variable were expressed as number of cases and proportion of the total number of cases and were analyzed by using the software of Microsoft Excel 2003, SAS9.1 version, to form the graphs and process the statistics. In this study we applied the method of log-linear Poisson regression to estimate the annual incidence rate ratio (IRR), used the measure of Chi-square test for trend to explore the annual fluctuation in trend of the number of cases by sex and counties/cities, and performed correlation analysis to test the correlation between time interval to medical service (time interval was defined as number of days between the date of onset and the date of diagnosis) and incidence rate. In addition, Chi-square test and T-test were implemented to examine the difference of incidence rate between different variables. A level of α=0.05 was chose as the power for statistical significance test.

Results

A total of 346 cases of scarlet fever were reported from eastern Taiwan from January 2000 to December 2006. Among these cases, 183 (52.8%) were confirmed to be positive for scarlet fever, 89 were negative, and 74 were undetermined, with an accumulated incidence rate of 4.92 cases per 100000 population per year. The incidence rate increased year by year, which a 24-fold increase (IRR=24.73, 95 ％ confidence interval [CI]：7.79 to 78.49) was found for year of 2006, as compared with year of 2000, and 1.67-fold increase (IRR=1.67, 95％ CI：0.4 to 6.99) for 2001, 2.34 (IRR=2.34, 95 ％ CI：0.6 to 9.07) for 2002, 4.03 (IRR=4.03,95％ CI：1.14 to 14.29) for 2003, 12.87 (IRR=12.87, 95％ CI：3.97 to 41.69) for 2004, and 15.67 (IRR=15.67, 95 ％ CI：4.87 to 50.37) for 2005. Trend analysis between the number of annual confirmed scarlet fever cases and the total population of eastern Taiwan during 2000 – 2006 also found that the number of newly confirmed cases certainly increased yearly (Chi-square for trend=143.4, p＜0.001) over the study period. The comparison of disease occurrence between Hualien County and Taitung County shows that the accumulated incidence rate of 7.81 cases per 100000 population per year (133 cases) for Taitung County was far higher than 2.04 (50 cases) for Hualien County.

When Taitung and Hualien counties were compared separately with national occurrence (Figure 1), it was found that the pattern of variability of the incidence rate for Hualien County was similar to that of national incidence rate after 2003 and the incidence rate of Hualien County was always lower than national incidence rate. In contrast, the incidence rate of Taitung County became higher than

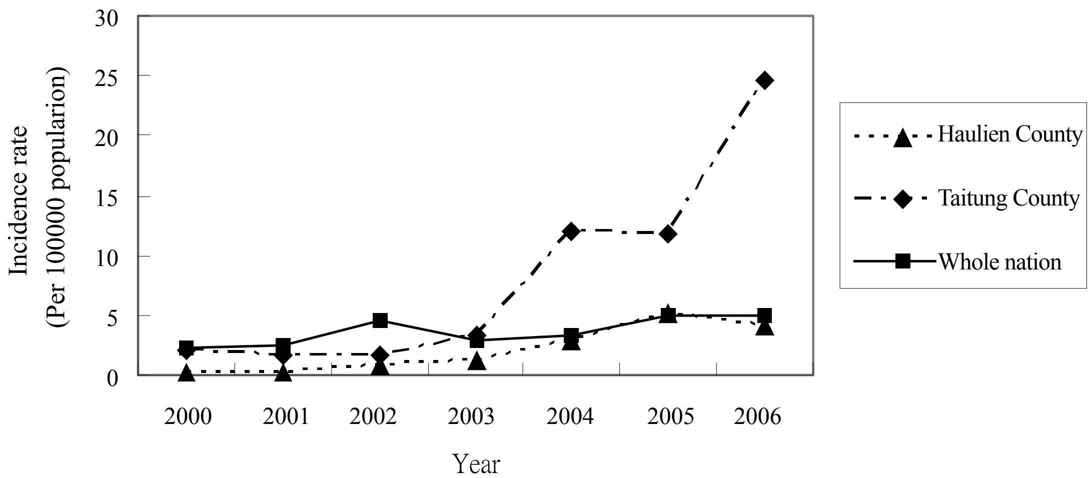

Figure 1. Trend of incidence rates of scarlet fever for Haulien County, Taitung County, and whole nation of Taiwan, 2000-2006

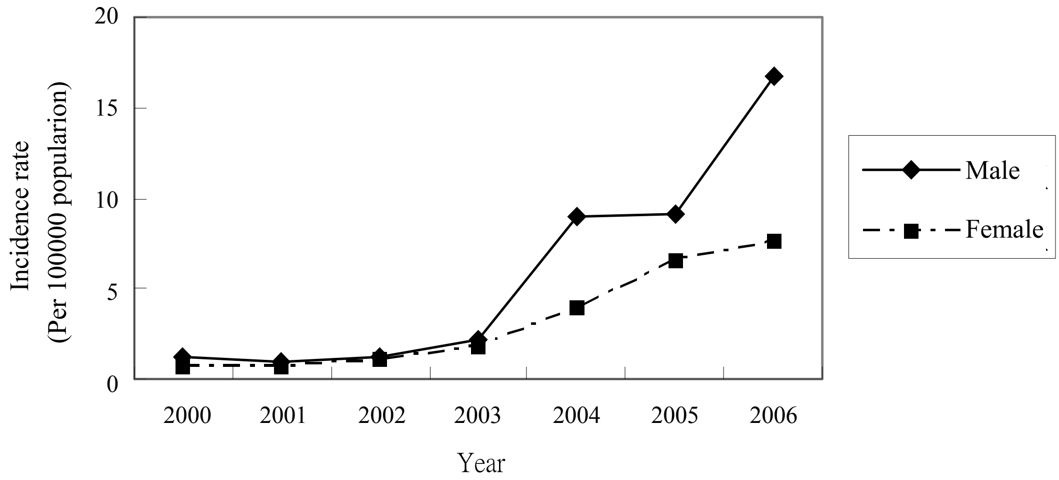

Figure 2. Trend of incidence rates of scarlet fever for male and female in eastern Taiwan, 2000-2006

national rate after 2004 and reached the peak in 2006. Three cluster infections were identified in 2006 in Taitung County, two of them were recognized as household infections (in Guanshan Township and Taitung City) and the other happened in a kindergarten in Peinan Township.

For sex variable, among the 183 confirmed scarlet fever cases in eastern Taiwan, 122 cases (66.7%) are male and 61 cases (33.3%) are female. The secular trend showed that the incidence rate of scarlet fever for both male and female were increasing year by year, and the incidence rate in male has overridden that in female since 2004 (Figure 2). The trend analysis of the number of confirmed scarlet fever between male and female during the studied period was not statistically significant (Chi-square for trend=0.55, p＝0.46).

This means that the probability of scarlet fever infections was evenly stable for male and female over the studied period, and the increase of number of cases did not specifically aggregate at one of the sexes. In Hualien County, the accumulated confirmed cases of scarlet fever for male and female were 30 and 20 cases, respectively, during 2000 – 2006, with an accumulated incidence rate of 2.36 and 1.72 cases per 100,000 population for male and female, respectively. In Taitung County, the accumulated confirmed cases for male and female were 92 and 41 cases, respectively, with an accumulated incidence rate of 10.38 and 5.23 cases per 100,000 population for male and female, respectively.

For age variable, the age range of the confirmed scarlet fever cases was 7 months to 56 years of age, with a mean age of 6.48 years and median age of 5.58 years. When the studied populations were divided into nine age groups, the accumulated incidence rate of scarlet fever per 100,000 population for each age group was 2.56 cases for group younger than 1 year of age, 13.86 for group aged 1-2 years, 59.09 for 3-4 years, 64.58 for 5-6 years, 27.47 for 7-8 years, 10.62 for 9-10 years, 2.65 for 11-12 years, 1.79 for 13-14 years, and 0.09 for group aged more than 15 years, respectively. The group aged 5-6 years ranked the highest rate, followed by the group aged 3-4 years. While these age groups were stratified by sex, the highest incidence rate fell in the group aged

5-6 years and then 3-4 years for female, and the group aged 3-4 years and then 5-6 years for male (Figure 3). In addition, the age of all female cases belonged to the range of 7 months to 10 years of age, no female cases aged older than 11 years. However, an age range wider than female was found for male cases, which some male cases were older than 11 years of age. The trend analysis between the occurrence of scarlet fever cases and the populations younger than 15 years of age in the two counties of eastern Taiwan, Hualien and Taitung, during 2000 – 2006 reveals that the number of newly diagnosed scarlet fever cases in each year increased year by year in both Hualien and Taitung Counties. (Hualien: Chi-square for trend =40.54，p＜0.001, Taitung: Chi-square for trend =116.25，p＜0.001)

In Hualien County, the highest accumulated incidence rate occurred in Joushi Township (57.78 cases per 100,000 population) and then Fonglin Township (44.34 cases per 100,000 population), and the highest number of confirmed cases appeared in Hualien City (12 cases) and then Jian Township (10 cases), but no cases were found in Shiuolin Township. In Taitung County, the highest accumulated incidence rate occurred in Guanshan Township (111.91 cases per 100,000 population) and then Taimali Township (98.56 cases per 100,000 population), and the highest number of confirmed cases appeared in Taitung City (79 cases) and then Taimali Township (13 cases), but four townships (including Chenggung, Dunghe, Liudau, and Jinfeng) did not occur any scarlet fever cases during the studied seven-year period. The accumulated incidence rates for each township are shown in Table.

This study shows that the scarlet fever cases could occur in each of the four seasons in eastern Taiwan area. The greatest number of scarlet fever cases, 28 cases, occurred in May in eastern area, consistent to the nationwide epidemic curve that the peak occurred during March - May. In contrast, the lowest number of scarlet fever cases, only 5 cases, occurred in February in this area. Afterwards, the number of cases gradually ascended until it reached the peak again in May, and then appeared fluctuating around the average and descended gradually until it touched the bottom of the curve in next February. The epidemic curve of scarlet fever was similar between Taitung and Haulien Counties during January – May, which reached the peak in May in both of the counties. However, it was different during the second half of the year between the two counties. In Haulien County, another peak appeared in November and the lowest number, two cases each, occurred in the months of August and December. But in Taitung County, the epidemic curve presented another peak in October and immediately descended in November (Figure 4).

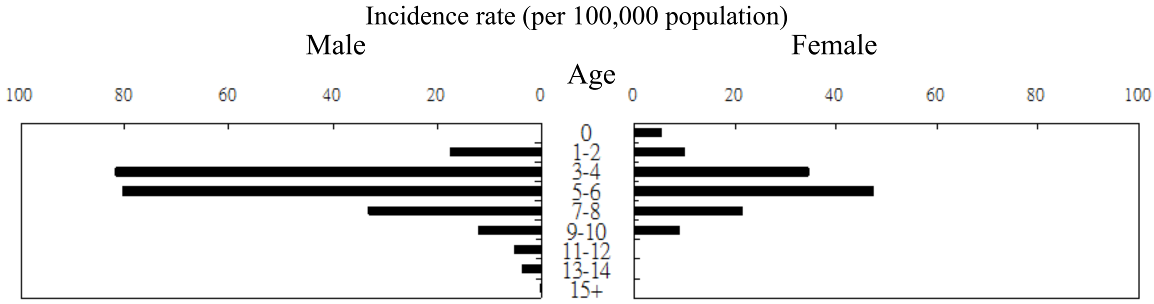

Figure 3. Age-specific incidence rates of scarlet fever for male and female in eastern Taiwan, 2000-2006

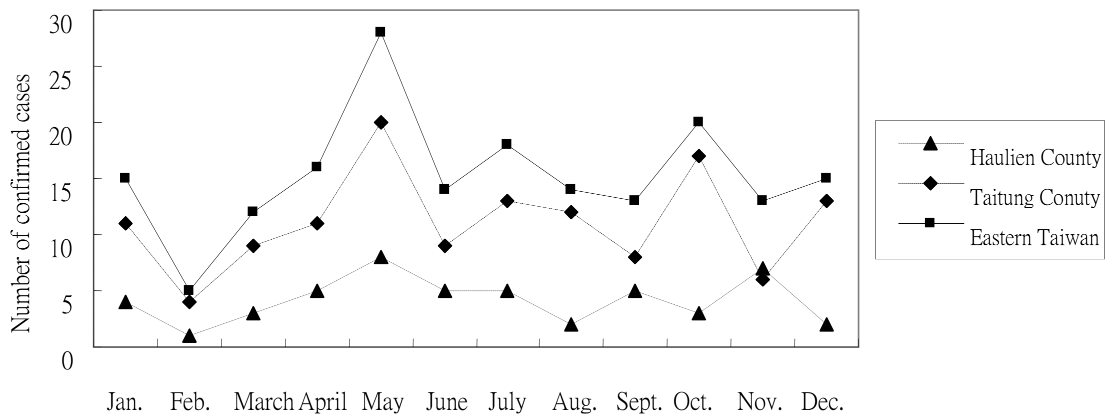

Figure 4. Trend of monthly number of scarlet fever cases in eastern Taiwan, 2000-2006

Table. Number of cases and incidence rate of scarlet fever by township and sex in eastern Taiwan, 2000-2006

Township/City in Haulien and Taitung County	Number of cases and incidence rate					
	Male	Accumulated incidence rate (per100000 population)	Female	Accumulated incidence rate (per100000 population)	Male & female	Accumulated incidence rate (per100000 population)
HaulienCounty						
Haulien City	6	11.03	6	11.23	12	11.13
Fonglin T.S.	4	54.98	2	31.97	6	44.34
Yuli T.S.	2	11.62	3	21.83	5	16.15
Shincheng T.S.	4	35.88	0	—	4	18.96
Jian T.S.	5	12.31	5	13.32	10	12.79
Shoufeng T.S.	2	17.91	0	—	2	9.82
Guangfu T.S.	1	11.58	0	—	1	6.26
Fengbin T.S.	2	59.67	0	—	2	33.12
Rueisuei T.S.	1	12.60	0	—	1	6.87
Fuli T.S.	1	13.56	0	—	1	7.51
Shiuolin T.S.	0	—	0	—	0	—
Wanrung T.S.	1	24.80	1	28.81	2	26.65
Joushi T.S.	1	25.86	3	98.18	4	57.78
Taitung County						
Taitung City	56	97.44	23	43.04	79	71.23
Chenggung T.S.	0	—	0	—	0	—
Guanshan T.S.	7	122.27	5	100.05	12	111.91
Peinan T.S.	6	54.36	4	45.72	10	50.54
Dawu T.S.	3	74.84	0	—	3	39.89
Taimali T.S.	11	154.25	2	33.01	13	98.56
Dunghe T.S.	0	—	0	—	0	—
Changbin T.S.	1	17.86	0	—	1	10.13
Luye T.S.	3	57.51	2	45.14	5	51.83
Chrshang T.S.	0	—	2	42.07	2	19.44
Liudau T.S.	0	—	0	—	0	—
Yanping T.S.	3	141.68	0	—	3	80.42
Haiduan T.S.	1	38.66	1	46.94	2	42.40
Daren T.S.	0	—	1	54.59	1	24.43
Jinfeng T.S.	0	—	0	—	0	—
Lanyu T.S.	1	52.11	1	63.23	2	57.13

Symptom analysis of 183 cases of scarlet fever shows that 41 cases (22.4%) presented only one symptom (skin rash, fever, strawberry tongue, abdominal pain, sore throat, or tonsillitis), 126 cases (68.9%) had multiple symptoms, and 16 cases (8.7%) had no available symptom record . For the cases with only one symptom, fever was the symptom with the highest number of cases (18 cases or 43.9%), and then skin rash (13 cases or 31.7%). For the 72 cases with two symptoms, fever combined with skin rash (37 cases or 51.4%) shared the largest part among them, and followed by symptoms of fever combined with sore throat or tonsillitis (16 cases or 22.2%).

The time interval, days between the date of onset and date of diagnosis, was, on average, 4.02 days. The analysis shows that the time interval of 3 days had the highest number of cases (38 cases or 20.8％), followed by the time interval of 1 day (26 cases or 14.2％). Cases diagnosed within 5 days after the date of onset accounted for 80.9% of total cases. The statistical analysis shows no correlation （r=0.29, p=0.52） was found between the annual average time interval and the annual incidence rate in eastern area. When this analysis was stratified by county and sex, the results also shows no correlation between the length of time interval and the level of incidence rate in Hauling (r=0.45, p=0.31) and Tatung (r=0.06, p=0.9) counties, and for male (r=0.27, p=0.55) and female (r=-0.13, p=0.78).

Figure 1 shows that the incidence rate of scarlet fever has sharply increased since 2003. Therefore, we divided the cases of scarlet fever into two groups by the year of onset (A group: 2000-2003, B group: 2004-2006) and conducted analysis to examine the difference between the two groups by county, sex, and age. The number of cases for Group A and Group B were 27 and 156 cases, respectively. The analysis (Chi-square test) reveals that there were no significant difference between the two groups in county (p=0.77) and sex (p=0.37). The average age for Group A and Group B was 7.78 and 5.64 years, respectively. The analysis (t-test) shows that the difference of the average age between the two groups was also not significant (p=0.35).

Discussions and Conclusions

The annual number of newly diagnosed cases of scarlet fever has increased and almost doubled since 2000 in eastern Taiwan. The number of cases was almost no change during 2004-2005, it increased dramatically in 2006. The trend analysis also found that the number of newly confirmed cases have increased annually. The only factor which caused an increase in number of cases may be coming from the cluster infection. In order to identify other factors possibly having led to the increase of case number, analysis by comparing the subgroup of years (2000-2003) with low incidence rate and the years (2004-2006) with high incidence rate was carried out. But, no significant results were obtained.

The incidence rate of scarlet fever among male and female in both Haulien and Taitung County appeared to be an increasing trend year by year since 2000. The analysis for age variable among male and female cases showed that the range of age for male was wider than female, and the number of male cases was higher than that of female. This supported that male was more likely to become a case of scarlet fever, as compared with female. The strikingly increased incidence rate in Taitung County in 2006 was partly caused by the event of cluster infections. Fortunately, these cluster infections was under control immediately after taking a series of control measures. However, no cluster infections have been observed in Haulien County.

Chiou et al. has investigated the reasons why the number of scarlet fever cases has increased dramatically in central Taiwan in recent years [13]. In this investigation, they speculated that the possible factors may be the mergence of disease control institutes, the limitation of the national policy on antibiotic use, and emergence of newly and highly pathogenic strains.

In the aspect of mergence of disease control institutes, Chiou et al. hypothesized that Taiwan CDC, established by reorganizing several institutes related to disease control in 1999, has set up effective disease reporting system and, therefore, enhanced the notification rate, leading to the striking increase in number of scarlet fever cases. However, they concluded that no significant relationship existed between them. Since the data period (2000-2006) in this study occurred after the establishment of Taiwan CDC, and the case definition of scarlet fever for notification was not changed after 2000, we excluded the possibilities that the integration of various disease control institutes led to the elevation in number of scarlet fever cases in eastern Taiwan.

Regarding the inference that the limitation of national policy on antibiotic use might have caused the increase of disease occurrence, Chieu et al. thought that this policy could easily affect the time delay to treatment in scarlet fever cases and result in a more serious conditions in patients. This in turn may maximize the opportunities for the spread of pathogenic agent. Since no clinical data of the cases were collected, this study could only examine whether the time delay (the number of days between the date of onset and the date of diagnosis) for treatment has caused any spread of the disease. However, the results showsd that no association existed between the length of time interval for diagnosis and the level of incidence rate.

The hypothesis as to whether a new and highly pathogenic strain has appeared and caused the rise of case number needs to be further studied. The previous studies showed that the emm type of scarlet fever strains isolated from northern, central, and southern Taiwan was slightly different. In northern Taiwan, the most common emm type was emm1 (29.2%), followed by emm4 (24.1%); in central Taiwan, emm4 (45%) and emm12 (36%), respectively; and in southern Taiwan, emm1 (72.7%) and emm4 (26%), respectively [8-10]. Because this study did not have data on molecular epidemiology, we were unable to conduct the comparison of emm type of scarlet fever strains in eastern Taiwan with that in three other areas of Taiwan [9-11]. Perhaps, in the future the molecular epidemiology can be used as a method to survey the relationships between the emergence of highly pathogenic agent and the occurrence of the disease and to determine the homology of the strains isolated from different cases, promptly recognizing the association or possible infection sources among the cases.

Because only 183 cases of scarlet fever were identified in eastern Taiwan during 2000-2006, analysis was not statistically strong enough to support the relationships between variables and disease occurrence in this study. Theoretically, a larger sample size is necessary to obtain more powerful evidence for these relationships. Hopefully, in the future, homology analysis will be used to clarify the strains circulated in eastern Taiwan and to explore the factors for an increasing trend of scarlet fever in recent years.

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