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Shigellosis Infections in Nantou County: 1995-1999

Abstract

In 1995-1999, there had been in the six counties and cities in central Taiwan 279 cases of Shigellosis: 186 (67%) in Nantou County, and 53 (19%) in Taichung City. Most cases in Nantou County came from Jenai township and the neighboring Puli and Hsinyi townships, 121, 33 and 18 cases respectively. Of the strains isolated, 168 were *Shigella flexneri* (90% of all; 163 strains were of serotype 2a), 17 were *S. sonnei*; and one was *S. boydii*. No *S. dysenteriae* strains had been isolated. The only *S. boydii* strain isolated came from an imported case. In Jenai township in 1995, there were only four sporadic cases. In 1966 in mid-August after two typhoons, there was an outbreak with 35 confirmed cases. Some small-scale sporadic and family-clustering outbreaks continued to occur in villages. The number of cases increased to 38 in 1997 and decreased to 26 in 1998. In 1999 before the September 21 earthquake, there were four cases; there were small-scale outbreaks after the quake, and the number of cases increased to 18. In Puli township, the number of cases increased significantly in early 1997, possibly associated with the outbreaks of Jenai township in 1996. Epedemiologically, cases were sporadic and family-clustering in small-scale outbreaks. The directions of transmission

were associated with the communication conditions between villages. Person-to-person contacts should be the major mode of transmission of Shigellosis in these areas. The many flies found in villages could have been an important medium in the transmission. The lifestyles of the villagers, the lack of safe and stable water supply, and the large number of carriers could have been the reasons for the continual outbreaks of Shigellosis in these areas. Intensive health education, more healthcare infrastructures, and strengthened reporting of cases by medical care institutions are some effective control measures.

Introduction

Shigellosis is a highly infective bacterial disease involving the large and small intestines. Infection can be induced by a mere 10-100 *Shigella* spp.[1] Outbreaks commonly occur in communities of poorer sanitary conditions. Common symptoms are vomiting, fever, and watery diarrhea sometimes with bloody stool[2]. The pathogenic agent, *Shigella*, is comprised of four species or serotypes, *Shigella dysenteriae* (Group A), *S. flexneri* (Group B), *S. boydii* (Group C), and *S. sonnei* (Group D), and further divided into 1 to 18 serotypes[2]. Direct person-to-person contacts are the major mode of transmission. Transmission by direct contacts is often a cause of small-scale outbreaks among family members. Under conditions of crowding, such as in jails, nurseries and primary schools, personal contacts could lead to large-scale outbreaks[3-5]. Contaminated water and food are reported to have also caused large-scale outbreaks of Shigellosis[6-9]. In endemic Shigellosis areas, houseflies are an important vector[10]. Control of flies is one of the important measures in the control of Shigellosis[11].

Since the outbreak of Shigellosis in Jenai township of Nantou County in 1996, there have been more outbreaks. The number of cases reported from Jenai and neighboring townships was the largest among the six counties and cities of central Taiwan. For more effective disease control, Shigellosis infections in Nantou County, and their mode and reasons of transmission are presented.

Bacterial Diagnosis and Collection of Epidemiological Information

Isolation and Assessment of Bacteria: Rectal swabs were collected from suspects and close contacts, placed on Cary-Blair transport agar, and sent in refrigeration to the laboratory of the Third Branch Office of the Center for Disease Control, DOH, for laboratory testing. Specimens of patients cared by the Puli Christian Hospital were collected by the Hospital and isolated strains sent to the Third Branch Office for serotyping. Specimens were first placed in Hektoen enteric agar and Shigella-salmonella agar (Difco Laboratories, Detroit, MI, USA) (xylose lysine deoxycholate agar was used by the Puli Christian Hospital) overnight under 35℃. Strains of suspected non-fermented colonies were placed in triple sugar iron agar (TSI, Eiken Chemical, Tokyo, Japan), sulfite-indole-motility (SIM, Eiken), and lysine iron agar (LIA, Difco) for bio-chemical testing. Strains with reactions of TSI red/yellow, H_2S negative, SIM mobility negative, and LIA lysine fermentation negative were tested for agglutination with the Shigella anti-sera of Denka Seiken (Tokyo, Japan) for assessment and serotyping. Strains were finally verified with API-20E (bioMérieux, Marcy-l'Etoile, France).

Epidemiological Information: Information of cases came from Reports of Cases (including Suspects) of Communicable Diseases prepared by medical

care institutions and Laboratory Reports of Specimens Tested for Disease Control prepared by local health stations. Information included name and sex of case, date of birth, address, date of onset, date specimen collected, clinical symptoms, treatment, and recent traveling. Some cases were interviewed to determine their epidemiological relationships with other cases.

Definition of Case: A case was defined as one who had been isolated by laboratory procedures of *Shigella* in his/her fecal specimen and had developed clinical symptoms such as diarrhea together with one of the following, abdominal pain, fever, vomiting, or bloody stool. Carriers without symptoms identified by screening of contacts were not counted as cases.

Shigellosis in Six Counties and Cities in Central Taiwan: 1995-1999

In the five-year period between 1995 and 1999 in the six counties and cities of central Taiwan, there had been a total of 279 confirmed Shigellosis cases: 186 (67%) in Nantou County, 53 (19%) in Taichung City, 31 in Taichung County, and 2-4 cases each in Changhua, Yunlin and Miaoli counties (Table 1). In all years, 1997 had the most cases of 109. In the five years, cases had been reported from seven townships of Nantou County: 121 cases from Jenai township (65% of all cases of Nantou County), 33 from the neighboring Puli township, 18 from Hsinyi township, and 14 from other four townships (Table 1). In 1995, there were in Jenai township only four cases of Shigellosis; the number of cases increased to 35 in 1996, 38 in 1997, and decreased to 26 in 1998, and 18 in 1999. It seemed that Shigellosis outbreaks appeared in Jenai township in 1996, and stayed on sporadically in this mountain township for the next three years. Increase in the number of Shigellosis cases in Puli township could be associated with the outbreaks of Jenai township. The number of

cases in Puli increased to 14 in 1997, and stayed around seven and more in 1998 and 1999. Puli is an important stop for Jenai residents en route to somewhere. Many Jenai residents live, go to school, work and conduct trades in Puli. Many cases had also been reported in both Taichung county and city. 45 of the 53 cases reported in Taichung City, however, were cases of an outbreak in a juvenile correction center[5] ; only eight were sporadic cases. The 31 cases in Taichung County were sporadic, geographically and in terms of serotypes. They were not related epidemiologically.

Incidence of Shigellosis by Age and Sex in Jenai Township of Nantou County

In 1995-1999, there had been 121 cases of Shigellosis in Jenai township. The five-year cumulative incidence was 786 cases per 100,000. Incidence for women was twice higher than that of men (the five-year cumulative incidence being 1,106 and 516 respectively). Incidence by age showed a U-shape distribution, the highest in children of 0-9 years (2,288 cases per 100,000), and the elderly of 60 and above (1,387 per 100,000). Incidence was the lowest for adults of 30-39 years (150 per 100,000) (Figure 1).

Shigellosis in Nantou County: 1995-1999

In 1995-1999, cases of Shigellosis in Nantou County had been reported primarily from Jenai, Puli, Hsinyi and Yuchi townships. In 1997, one case was reported in Nantou City; and in 1998, one case in Kuohsing township. In 1998, a dysentery outbreak occurred in Chushan township[12], with seven cases (Table 2). Of the strains isolated, 168 were of Group B *Shigella*, 17 were of

Group D, and one was of Group C. No Group A strains had been isolated. Of the Group B strains, 163 were serotype 2a, and 1, 2 and 2 strains were serotypes 3a, 3 b and y variant respectively. The only one Group C strain was isolated from an imported case. The patient was infected while in Cambodia. Cases were found throughout the year, with more cases in August-October. Monthly distribution of cases varied from year to year (Table 2). Jenai township became a major epidemic area of Shigellosis in 1996; cases had been reported from 13 of the 14 villages of the township. The number of cases in Puli began to increase in 1997. Shigellosis in Nantou County in 1995-1999 is summarized as follows:

1995: Of the eight cases reported in the year, four were from Jenai, three from Hsinyi, and one from Yuchi. The four cases in Jenai occurred in April, August and December. The strains were of *S. flexneri* serotype 2a and y variant (Table 2). Geographically, three cases were from Chingying village, and one from Chungchen village (Figure 2). Cases were sporadic and not related epidemiologically. From the time of onset, place of infection, and serotypes of strains, the three cases in Hsinyi and one in Yuchi were not related. In Puli township, one carrier without symptoms was detected.

1996: Of the 39 cases reported Nantou County in the year, 35 were from Jenai township, and three and one from the neighboring Puli and Hsinyi townships respectively. There had not been cases in Jenai township before the end of July. After the two typhoons in late July and early August, a dysentery outbreak occurred in mid-August. Cases were reported one by one in August, September and October. The strains isolated were of *S. flexneri* serotype 2a (Table 2). Cases were reported from ten villages, 13 cases from Chunyang village, and some cases from Chinai, Chingying and Fahsiang villages (Figure

2). The first case appeared in Chunyang village, and subsequently in the neighboring Chingying, Tatung, Fahsiang, Chinai, Nanfeng, Hechuo, Wanfeng, Lihsing, and Huchu villages. With the exception of Huchu village, nine villages are located along highway 14 and its branches (Figure 2). Highway 14 is the primary road for villagers en route to Puli township and farther to other counties and cities. Survey found some epidemiological associations between cases. Some of them are family members, relatives, neighbors, friends or classmates. Cases of different villages are also related in some way. One case in Nanfeng village, for instance, is cousin of one case in Chunyang village, and had visited Chunyang earlier. The case in Huchu was infected while taking care of his grandchild of Chinai village. One case was reported in Puli township in September, and later two more cases in November and December. The increase in the number of cases in Puli in early 1997 was a consequence of the 1996 outbreak. A molecular serotyping study of the strains isolated from Jenai and Puli townships showed that, with the exception of the stains isolated from cases of Tatung village, other strains were closely related. These strains were also highly related to the one strain isolated from Puli township before the outbreak. The strains of the outbreaks were considered to be indigenous, already existing in Jenai and Puli townships even before the outbreaks. The molecular serotyping study also found a major strain. The strain appeared in the villages, starting from Chunyang village to Chingying, Fahsiang, Chinai and other villages along the highway, and finally to Puli township in November. The study suggested that person-to-person contact was the major mode of this long-distance transmission of disease. In the year, two carriers without symptoms, one in Hsinyi township and the other in Chinai village of Jenai township, had also been detected.

1997: Of the 59 confirmed cases in Nantou County in 1997, 38 were from Jenai township, 14 from Puli township, four from Hsinyi township, two from Yuchi township, and one from Nantou City. Cases in Jenai township were not clustered around certain months, they appeared throughout 11 months of the year. Of the strains isolated, 34 were of *S. flexneri* 2a, one of *S. flexneri* 3b, three of *S. sonnei* (Table 2). A six-year old child of Wanfeng village was infected with *S. flexneri* 3b. A four-year old child of Puli township was also infected by 3b strain. Survey found that the four-year old child had visited Wanfeng village with his father. The Wanfeng family ran a breakfast stand. The four-year old child could have been infected while visiting the breakfast stand and later, brought the infection to his own township. Geographically, the ten cases in Jenai township were distributed in ten villages (Figure 2), even in Chungchen and Fachi villages where no cases were reported in 1996. The two villages are connected to Puli township by highway 131. Villagers of Fachi village though can cross the river to Wanfeng village and then to Wushe (Figure 2), river-crossing is rather inconvenient. Though cases of different villages were not found to be in close contact, they were related in some way. The eight cases in Chungchen village for instance, came from three families, with two to three cases in each family. The four cases in Huchu village were either family members or neighboring relatives. The two cases in Tatung village were from the same family. The seven cases in Chingying village, however, were sporadic and not related. Of the 14 cases in Puli township, eight confirmed cases were in January through March (Table 2). Their strains were of *S. flexneri* 2a. The increase in the number of cases in Puli township should be a consequence of the 1996 outbreaks of Jenai township. One case of *S. sonnei* infection was reported from Nantou City, and was considered not

associated with the outbreaks of Jenai township. The gene type of the strains isolated from Kuohsing township was found to be the same as the major strains of Jenai township. In June in Puli township, one imported *S. boydii* case was detected. Two of the four cases in Hsinyi township came from the same family.

1998: Of the 48 cases in Nantou County in the year, 26 confirmed cases were from Jenai township, nine from Puli township, seven from Chushan, three from Hsinyi, two from Yuchi, and one from Kuohsin townships. The 26 cases of Jenai township were distributed in nine months, more in August and September. Cases were distributed in 11 villages (Figure 2). Cases were relatively sporadic in terms of time and space, though their strains were of the same *S. flexneri* 2a serotype. Some epidemiological relationships were found among cases. Cases were either family members or relatives. The two cases in Hechuo village for instance, were neighbors. The three cases in Nanfeng village were neighbors and relatives. The three cases in Chingying village were family members. Seven strains isolated from the nine cases in Puli township were of *S. flexneri* 2a, and two were of *S. sonnei*. In Chushan township, there were seven *S. sonnei* infections. They were collective infections of a small-scale outbreak[(12)]. Cases of the outbreak came from three families. Two of them were neighbors, and one case was classmate of the index case. In the year, two carriers without symptoms were detected in Chinai village.

1999: Of the 32 cases in Nantou County in the year, 18 were from Jenai township, and seven each from Puli and Hsinyi townships. Before the end of August, only four cases were reported in July in Chunyang, Chingying and Hechou villages of Jenai township (Table 2). As compared with the 21 cases

Jenai township in January through July of 1997, and eight cases in 1998, the number of cases had significantly declined. However, soon after the September 21 earthquake on 28 September, a case was reported in Nanfeng village to cause a small-scale outbreak. Cases soon appeared in Chingying, Fahsiang, Hechou and Chungyang villages. There had been a total of 14 cases and two carriers without symptoms in Jenai township after the quake. Four of the five cases in Nanfeng village were either neighbors or relatives; and the three cases in Chingying village were family members. Two of the seven cases in Puli township that became sick in July and August were family members.

Mode of Transmission of Shigellosis in Jenai Township

Direct person-to-person contact and transmission through contaminated food, that is, person-food-person, should be the major modes of transmission of Shigellosis in Jenai township. The mechanical transmission by flies could have also played an important role. With the exception of a clustered outbreak in Chungyang village in August and September 1996, Shigellosis in Jenai township occurred sporadically and in family clustering small outbreaks. Typically, a case would appear in a village, several cases would then follow; they were often family members, close relatives, friends, neighbors, or classmates. A molecular serotyping study on the strains isolated in 1996 showed that the outbreak of the year started with Chungyang village to spread to other villages along with the common highway, and eventually to Puli township in November. Villages of Jenai township are fairly isolated under poor transportation conditions; transmission of diseases is highly associated with the convenience of transportation. The Shigellosis outbreaks in Jenai township in 1996 through 1999 was primarily transmitted by personal contacts, not much so by contaminated water. Shigellosis is a highly infectious disease,

a mere 10-100 pathogenic agents[1] would be enough to induce infection, it is more likely to be transmitted by personal contacts. The mechanical transmission by flies could be another important risk factor. The township has witnessed a high agricultural development in recent years. Many hills have been developed for high-value crops such as vegetables, tea, and fruits, and for better farming effects, organic fertilizers such as chicken feces have been used in great amount, particularly in springtime. Chicken feces attract flies, and flies are a major vector of Shigellosis[10]. The person-human waste-flies-food-person mode involves the participation of flies. In the 1996 outbreaks for instance, no epidemiological associations of personal contacts were found in some patients of the same villages infected with strains of the same serotype, flies could have played some role in their infections.

Reasons for the Shigellosis Outbreaks in Jenai Township

Shigellosis in Nantou County concentrated around Jenai and Puli townships. The outbreaks in the two townships were consequence of the outbreaks in Jenai township in 1996. That the outbreaks would continue for two to three more years was associated possibly with the poor sanitary conditions of the area, the unavailability of safe and stable water supply, and the lifestyles of the people. The lack of safe and stable water supply should be an important factor. Outbreaks of Shigellosis occurred soon after the two typhoons in July and August of 1996, and again after the September 21 earthquake when in both cases, water supply was severely damaged. The lack of water supply kept people from hand washing, and carriers already existing in the communities became active again.

Jenai Township: Jenai township is one of the two mountain townships (the other one being Hsinyi township) of Nantou County. The township neighbors

Hualien County to the east, Hsinyi township to the south, Puli and Yuchi townships to the west, Kuohsing township to the east-west, and Taichung County to the north (Figure 2). The township is 400-3,600 meters above sea level, with a land area of 1,273 m^2. The township is mountainous and beautiful with many tourist attractions. The population of the township is about 15,000, primarily of Atayal (69.1%), Bunun (18.4%), and other aboriginal tribes (12.5%). They are happy people; eat, dance and drink on festivals. Most of them are Protestant and Catholic. The township has 33 fairly isolated tribes in 14 villages of relatively poor transportation conditions. They travel on motorcycles and trucks through paths to highway 14 to Wushe and eventually to Puli. On high hills, crops of high economic value such as vegetables and tea are grown. Chicken feces are collected and used as fertilizers. They attract flies and contaminate water sources. Agricultural development has brought about more incomes to the villages; it has also brought about problems of environmental sanitation and health.

Water Supply in Villages: Only 8% of the population use tap water. Most people collect spring water with pipes. In some areas, water is often in short supply. Pipes are often installed along and in ditches and are in poor conditions (conditions have improved recently). Water comes from mountains, and mountains often are contaminated by chicken feces, particularly so in Chungyang village which is located in the middle of the mountains. Surveys have shown that human and chicken wastes have contaminated water of many villages. Chungyang village is close to Wushe, the administration center, and tap water could be made available if people so wish. Many, however, cannot afford tap water (spring water is free), and are objectionable to the chlorine smell. The village people should collectively resolve the problem of water supply. In some villages, water towers have been built. The maintenance of

water tower is another issue.

Health Facilities: Most houses are installed with bath and toilet, though in some places, they are shared. Water, primarily spring water, is piped into houses, and at times, water is in short supply. Toilet though is flushed, for lack of septic tanks; water goes directly into ditches. Flies gather in ditches. Ditches were not covered some years ago. For hepatitis A and later Shigellosis outbreaks, the government installed new ditches and covered them up. Ditches in Chungyang village have made great improvement. In general, disposal of wastewater in Jenai township and in many other places of Taiwan as well, is not satisfactory yet.

Community Involvement of Villagers: Local politics is complex, and villagers are often indifferent to public affairs. In many villages for instance, water towers are not built. Villagers collect spring water through pipes. Pipes are laid irregularly here and there. The maintenance of water towers is often neglected. For instance, water towers in a community had been damaged by the September 21 earthquake. They had not been repaired even a month later. In some villages, however, villagers join together to build a public water supply system, and the environment is in better conditions. Involvement of villagers is most important in the maintenance of environmental sanitation. A poorly maintained water supply system would be hazardous to the scenery and the environment of the community.

Carriers without Symptoms: There are without doubt, carriers in Jenai township. A screening of 216 specimens conducted in Hsunglin tribe of Chinai village, Jenai township, in February 1998 with the financial support of the Center for Disease Control, DOH, detected a three-year old carrier. His

grandfather was also found carrier later. Subsequent follow-up showed that pathogenic agents had stayed in the feces of the boy for as long as one month. In the outbreaks of 1995-1999, carriers without symptoms, altogether seven, had also been detected. Carriers without symptoms can discharge bacteria for a long period. One report showed a carrier discharging bacteria for 17 moths[13]. In the follow-up of patients of the Taichung City juvenile correction center in 1997, some patients were found to continue to discharge bacteria for two months after recovery. Bacteria were found on and off upon cultures, indicating changes in the amount of bacteria in the body. Pathogenic agents could incubate in human body for some time and breed in large amount again to become sources of infection[5]. A large number of people, after the disappearance of symptoms of Shigellosis infection, are found to continue to discharge bacteria[5]. There should be a large number of carriers in Jenai township after the outbreaks of 1996 through 1998. Though many patients in Jenai township are young children and the elderly, young people are more active and in closer contact with others, they are more likely to bring into families the pathogenic agents.

Lifestyles: The local people are hospitable. They share food with others, with hands. Handling of food with hands gives *Shigella* a good opportunity of transmission. Though villages are isolated, friends and relatives get together or work together quite often. Shigellosis is transmitted through this close personal contact.

Methods of Control

Strengthening health education and improving environmental sanitation are some effective ways of controlling Shigellosis[2]. Surveillance and

reporting of disease are also important in the prevention and control of Shigellosis. Health education and disease surveillance are responsibilities of healthcare authorities, they can be implemented without delay. Improvement of environmental sanitation, construction of infrastructures, and protection of water sources, however, are under the jurisdiction of the Ministry of the Interior, the Environmental Protection Administration, the Council of Agriculture, and the Council of Aboriginal Affairs. Their cooperation is necessary.

Strengthening of Health Education: People should be educated to wash hands before meals and after toilet. Water should be boiled for drinking. Drinking of raw water should be avoided. While sharing food, public chopsticks and spoons should be used. Wastes should be classified for recycling. Garbage should not be disposed of or incinerated anywhere. One should learn to establish good health behaviors early in life. Nurses of the health rooms in the villages know about the people. They can be good health educators of the local people.

Improvement of Environmental Sanitation: People should be encouraged to install septic tanks, window screens, and food covers to keep away flies. Garbage bins (particularly the ones in toilet) should be covered. Processed organic fertilizers should be used instead of raw chicken feces to avoid the breeding of flies. Installing of septic tanks in old houses could be difficult. Subsidies should be made available to new houses under construction to install septic tanks. Public toilets are in poor conditions and require improvement. Some simple garbage collection sites should be set up to help dispose of wastes. Many villages are located around water sources, their wastewater should be properly disposed of. Ditches should be covered up. Some simple

wastewater disposal facilities should be established.

Protection of Water Sources: Jenai township used to be a beautiful place. The plantation of high economic value crops and the development of hills in recent years have seriously contaminated water sources, and damaged water conservation. Government should take measures to protect water sources from further contamination by pesticides and organic fertilizers used in large amount for agricultural development. Development will have to continue, or the incomes of farmers will suffer. New development, however, should be reviewed carefully. The excess use of hills in the recent years has resulted in the shortage of water supply, disasters such as landslides, and silting of dams to shorten their life spans, and in the long run, less availability of water to the people. Economic losses are, in the end, greater than gains from agricultural development.

Establishment of Water Supply Facilities: Water is essential to good health. Water though is not the direct cause of Shigellosis in Jenai township, it is a relevant factor. The two typhoons and the September 21 earthquake had seriously damaged water supply systems. The lack of water was a major cause of the subsequent outbreaks of Shigellosis. Government should set up water towers at water sources, lay public pipes to villages to be shared by villagers. Water sources of Chungyang village could have been contaminated, and water is in short supply during winter. Villagers should be encouraged and subsidized to build a water supply system. Construction of water supply facilities should be the joint effort and commitment of the entire village people to guarantee the proper maintenance of the facilities in the future. Villages with resolution and commitment should be given priority assistance.

Strengthening of Reporting by Medical Care Institutions: Studies have shown that the Shigellosis outbreaks in Jenai township in 1996-1999 were primarily caused by the same strain circulating in communities. Strengthening of disease reporting for earlier detection and treatment is essential to disease control. Interviews of cases revealed that most cases visited a certain local clinic for treatment. The clinic in question, however, did not report cases. The Nantou County Health Bureau should once again strongly ask the medical care institutions under its jurisdiction to promptly report cases.

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References

1. DuPont HL, Levine MM, Hornick RB, et al. Inoculum size in Shigellosis and implications for expected mode or transmission. J Infect Dis 1989; 159: 1126-1128.
2. Benenson AS. Control of Communicable Diseases Manual. 16th ed., American Public Health Association, Washington, DC, 1995; 421-425.
3. Caldwell GG, Fiegel D, Bryant L, et al. *Shigella* in Tulsa County, 1993: epidemiology, day care center association, and control. J Okla State Med Assoc 1995; 88: 198-204.

4. Maguire HC, Seng C, Chambers S, et al. *Shigella* outbreak in a school associated with eating canteen food and person to person spread. Commun Dis Public Health 1998; 1: 279-280.

5. Chiu CS and Lee TF. An investigation of a Shigellosis outbreak at a juvenile correction center. Epidemiological Bulletin, 1997; 13: 371-385.

6. Dunn RA, Hall WN, Altamirano JV, et al. Outbreak of *Shigella flexneri* linked to salad prepared at a central commissary in Michigan. Public Health Report 1995; 110: 580-586.

7. Swaddiwudhipong W, Karintraratana S, and Kavinum S. A common-source outbreak of Shigellosis involving a piped public water supply in northern Thai communities. J Trop Med Hyg 1995; 98: 145-150.

8. Chiu JP, Wei HF, Chen KT, et al. A preliminary investigation of a dysentery outbreak at a primary school in Taichung City. Epidemiological Bulletin 1994; 10: 75-88.

9. Lu KL, Chiang TH, Pan TM, et al. A Shigellosis outbreak at a primary school in Quanhsi Township, Hsinchu County. Epidemiological Bulletin 1998; 14: 147-157.

10. Khin New Oo, Sebastian AA, and Aye T. Carriage of enteric bacterial pathogens by house flies in Yangon, Myanmar. J Diarrahoeal Dis Res 1989; 7: 81-84.

11. Cohen D, Green M, Block C, et al. Reduction of transmission of Shigellosis by control of houseflies. Lancet 1991; 337: 993-997.

12. Chiu CS, Chang TH, Lai HK, et al. Shigellosis outbreaks in Chushan Township, Nantou County. Epidemiological Bulletin 1999; 15: 291-301.

13. Levine MM, DuPont HL, Khodabandelou M, et al. Long-term *Shigella*-carrier state. New Eng J Med 1973; 288: 1169-1171.

Figure 1. Five-Year Cumulative No. of Cases and Cumulative Incidences of Shigellosis in Jenai Township, Nantou County, 1995-1999

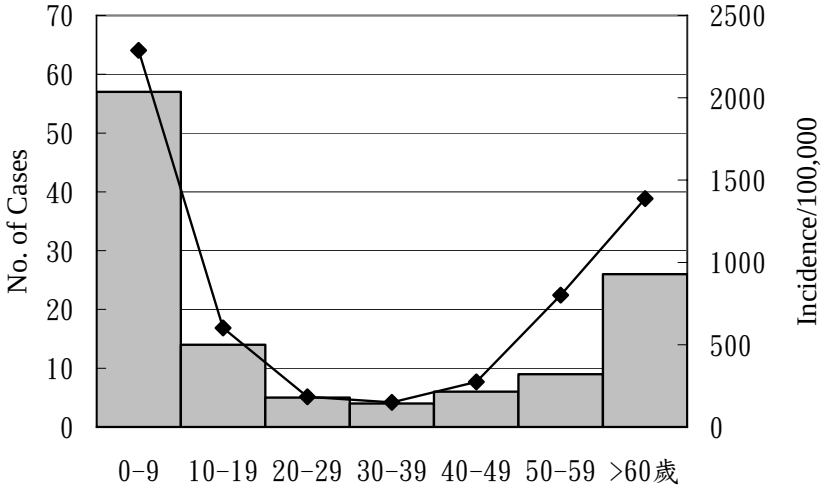

Table 1. Distribution of Shigellosis Cases in Six Counties and Cities of Central Taiwan, 1995-1999

	1995	1996	1997	1998	1999	總計
Nantou County						
Jenai township	4	35	38	26	18	121
Puli township	0	3	14	9	7	33
Hsinyi township	3	1	4	3	7	18
Chushan township	0	0	0	7[b]	0	7
Yuchi township	1	0	2	2	0	5
Nantou city	0	0	1	0	0	1
Kuohsing township	0	0	0	1	0	1
Subtotal	8	39	59	48	32	186
Taichung City	1	2	45[a]	3	2	53
Taichung County	6	6	3	9	7	31
Changhua County	1	0	2	1	0	4
Yunlin County	0	2	0	0	0	2
Miaoli County	0	0	0	1	2	3
Total	16	49	109	62	43	279

45[a] cases of an outbreak at a juvenile correction center[5]

7[b] cases of an outbreak in Chushan township[12]