
Assessing the Public's Knowledge and Environmental Sanitation Facilities for the Control of Bacillary Dysentery in Jenai Township, Nantou County

Abstract

For the purpose of controlling bacillary dysentery in Jenai Township, the present study was designed to evaluate the knowledge of the residents regarding their personal hygiene and related environmental sanitation facilities such as waste disposals, toilet facilities, fly control, drinking water facilities, and household and public drainage. A semi-structured questionnaire was used to collect above information by interviewing 373 household residents of Chinai, Chunyang, Chingying, Hotsuo, and Nanfeng villages of Jenai Township, Nantou County.

Forty-eight percent of the residents knew about the symptoms of bacillary dysentery, but only 37.3% and 29.5% of them knew of the communicability and routes of transmission of the bacillary dysentery respectively. Though 73.2% of the residents understood hand washing before meal and after toilet, only 57.4% practiced it. Approximately 52.0% of the villagers knew about hand washing with soaps, only 37.5% did so. An estimate of 35.9% of them knew that waste bins must be covered, and only 23.6% performed it. Around 75.0% believed in boiling water for drinking, and 59.8% actually practiced it. About 60.0% of them knew to cover food after eating, though only 45.8% did so.

Wastes in the five villages were disposed primarily by carrying away (83.2%), land filling (6.4%), throwing away (2.9%), and incineration

(1.6%). An estimate of 39.7% and 33.5% of the households had latrines and storage tank toilets respectively, only 20.7% of them had septic tank toilets. There were 2.4% of persons solved their problems in the field, or using community or school toilets (24% and 0.5% respectively). Approximately 37.0% of the households had screened doors and windows against flies. Most of the residents (94.5%) used spring water from ditches or water tanks; only 5.1% of them had tap water. In total, 36.2% of the households had covered drainage around the house, 42.9% of the ditches were not covered. In the communities, 50.9% of the ditches were covered, 27.1% were not.

It is concluded that to intensify health education is needed for promoting the low level of knowledge about and poor health behaviors on the control of bacillary dysentery. Environmental sanitation facilities (waste disposal, toilet in the house, fly control facilities, drinking water facilities, drainage around house and in the community) were inadequate and should be improved.

Introduction

Bacillary dysentery is a highly infectious disease of the intestinal tract. It occurs more often in areas of poor personal hygiene and environmental sanitation. There have been sporadic or endemic outbreaks of bacillary dysentery in Jenai Township of Nantou County for years^(1,2), the number of cases being 36 in 1996, 38 in 1997, 28 in 1998, and 17 by October 1999⁽²⁾. The molecular typing of bacillary dysentery strains also indicates that the same A/A1 strain or its subtypes caused most outbreaks in Jenai Township during 1996 and 1998. The results of analyzing its similarity further indicate that A/A1 could probably originate from Jenai Township⁽³⁾. Epidemiological studies suggest that person-to-person contact is the primary mode of transmission of bacillary dysentery in Jenai Township⁽⁴⁾. Flies around the houses, a culture of sharing of foods, and drinking raw spring water are some of the factors likely to be associated with the transmission of the disease^(5,6). Other studies⁽⁷⁻¹⁸⁾ also indicate that personal hygiene, vector flies, and environmental sanitation facilities are associated with outbreaks of bacillary

dysentery. Therefore, epidemiologists from Field Epidemiology Training Program, staff members of the 3rd Branch Bureau of the Center for Disease Control, and members of the Pingtung County Health Bureau organized an investigation team in November 1999 to assess the personal hygiene, the effects of health education, vector control, and environmental sanitation related facilities of the residents in five villages of Jenai Township. Findings are summarized as follows.

Jenai Township

Jenai is one of the two mountain townships of Nantou County (Hsinyi is another township). The township, with a land area of 1,273.54 square kilometers, is 400 to 3,600 meters above the sea level. Mountains and streams abound in beautiful surroundings. The Township has 33 tribes in 14 villages. Villages are far apart and are often not connected by roads. However, paths are available for villagers to travel to towns. The population is around 15,000, and is primarily aboriginal, 69.1% the Atayals, 18.4% the Bununs, and 12.5% others.

High-mountain vegetables, fruit, and tea are the main agricultural products. Unprocessed animal organic fertilizers such as chicken feces are used in farming, attracting flies and contaminating water sources. Agricultural development though has brought about improvement to the Township, and many tall buildings are seen everywhere, infrastructures in environmental sanitation are still inadequate. Tap water is only available in 5% of the Township, 95% of the residents still drink spring water. At times of drought, water is in short supply. In some places, development of the mountain areas has contaminated water sources and become a reservoir of diseases. Sanitary facilities in the house are still insufficient. There are few septic tank toilets, waste bins are not covered, and flies are everywhere. Personal hygiene is poor. People relieve everywhere, dispose wastes at will, drink raw spring water, and share food and drinks. These habits are most instrumental in causing fecal-oral

infectious diseases such as bacillary dysentery.

Outbreaks of Bacillary Dysentery in Jenai Township

In 1995, there were only four confirmed cases of bacillary dysentery in Jenai Township. They were sporadic. There were 36 cases in 1886, 38 in 1997, 28 in 1998, and 17 by October 1999, mostly in Chingying, Chunyang, Chinai, Hotsuo, and Nanfeng villages. Most cases were infected by the strain *Shigella flexneri* serotype 2a. Majority of cases were either younger than ten years or older than 60, and more females than males.

Instruments and Method of Investigation

Investigators used a semi-structured questionnaire to interview residents face-to-face. They were all trained in interviewing in advance. Residents of Chinai, Chunyang, Chingying, Hotsuo, and Nanfeng reported more cases of bacillary dysentery and were selected for interview. The questionnaire included two parts. The first part was used to assess the knowledge of the residents on bacillary dysentery. It contained questions on the knowledge of bacillary dysentery, its mode and route of transmission, hand washing, use of soap in washing hands, covering up waste bins, boiling of drinking water, and covering of foods. The second part was for interviewers to evaluate conditions and facilities of environmental sanitation. It had questions on waste disposal, number of carrying away per week, toilet facilities, fly control facilities (screened doors, windows, table covers), source of drinking water, pipelines and other facilities, and drainage around houses and in the community.

Results

Questionnaire interviews were conducted during daytime. A total of

373 household residents had been visited, 69 in Chinai village, 96 in Chunyang village, 107 in Chingying village, 38 in Hotsou village, and 63 in Nanfeng village. Most of those interviewed were either elderly persons or women.

Effects of Health Education

With the exception of Nanfeng village where 61.9% of the residents knew about bacillary dysentery, more than a half of residents in the rest four villages did not know about bacillary dysentery (Table 1). Again more residents (55.6%) in Nanfeng village knew about the communicability of bacillary dysentery than residents of other villages. More than 40% of the villagers in Nanfeng knew about the routes of transmission of bacillary dysentery, whereas only 20-30% of residents of other villages knew about them. More residents in Nanfeng than in other villages knew about the symptoms, communicability, and routes of transmission, as much as 20 to 30 percentages more. Nanfeng is in the outskirts and is close to Puli. Staff of the health station visits this village more often for health education. In general, knowledge of the residents of the five villages regarding the symptoms, communicability, and routes of transmission of bacillary dysentery was relatively poor. Health education should be intensified.

Many residents of the five villages knew that hand washing before meal and after toilet could prevent the infection of bacillary dysentery (Table 2), though fewer people did so. Although they knew that hand washing was important for the prevention of fecal-oral infectious diseases such as bacillary dysentery, not that many actually practiced it. Fewer people knew to wash hands with soap. An estimate of 66.7% of residents of Chinai village, for instance, knew the importance of hand washing before meal and after toilet. But only 60.9% knew the need of washing hands with soap.

In Chunyang, the rates were 75.0% and 54.2% respectively; in Chingying, they were 74.8% and 54.2%; in Hotsuo, they were 65.8% and 28.9%; and in Nanfeng, they were 79.4% and 50.8%. The discrepancies were probably due to the unavailability of soaps in the houses or that they could not afford soaps. In reality, although 60.9% of the villagers in Chinai, for instance, knew that it was important to wash hands with soap before meal and after toilet, only 43.5% did so. Similar rates in other villages were, 54.2% and 47.9% in Chunyang, 54.2% and 36.4% in Chingying, 28.9% and 13.2% in Hotsuo, and 50.8% and 31.7% in Nanfeng.

Table 3 shows that 58.7-73.7% of the villagers did not know that waste bins should be covered to avoid breeding of flies, particularly in village such as Hotsuo where wastes were not collected in one place. In fact, very few households had the waste bins covered. The differences between whether knowing that waste bins should be covered and actually covered them were 5.0-15.9%. In addition, many villagers knew that water should be boiled for drinking (63.2-81.0%), but fewer people did so. In Chinai village for instance, 71.0% knew that water should be boiled for drinking, 68.1% actually carried it out. The rates were 79.2% and 64.6% in Chunyang, 75.7% and 59.8% in Chingying, 63.2% and 52.6% in Hotsuo, and 81.0% and 47.6% in Nanfeng. Although many people knew that water should be boiled for drinking, many still drank raw water.

With the exception of Hotsuo village where only 42.1% of villagers knew that foods should be covered to keep flies away, more than a half of villagers in the rest villages (65.2% in Chinai, 57.3% in Chunyang, 57.9% in Chingying, and 71.4% in Nanfeng) knew about it (Table 5). However, fewer people did so, 63.8% in Chinai, 46.9% in Chunyang, 46.7% in Chingying, 28.9% in Hotsuo, and 33.3% in Nanfeng. It could be due to the

fact that fewer villagers had screened covers for foods.

Environmental Sanitation Facilities

Most villages (82.5-97.9%) had their wastes transported away, land filled or discarded. Very few had them incinerated (Table 6). In some places, people had more methods to deal of wastes, such as disposal, transportation and incineration, or incineration and throwing away. Villagers in high mountain areas (Chingying and Hotsuo villages) tended to dispose wastes by land filling, discarding, or incineration for fewer visits of waste trucks or fewer places for garbage collection. Weekly visits of waste trucks by village are shown in Table 7. Trucks visited Chungyang village, close to where the Township Office is, 3-7 times a week. Trucks visited Chinai and Nanfeng further down 2-3 times a week. Trucks visited the furthest Chingying and Hotsuo only 1-3 times a week. Some tribes were relatively isolated; they were less frequently visited by trucks. Hotsuo village for instance had the upper, central and lower tribes. Trucks visited the upper tribe further down only once a week; and the lower tribe was visited three times a week. The less frequent visits of waste trucks for waste collection could probably account for the relatively poor sanitary conditions of aboriginal tribes.

The disposal of human and animal wastes was another important issue. In general, there were more latrines and storage tank toilets than septic tank toilets in the five villages (Table 8). A few people used public toilets, toilets of the neighbors, or the bush. Houses of villages closer to towns such as Chinai, Chunyang, and Nanfeng had more septic tank toilets (20.3%, 30.0% and 27.0% respectively). Houses in the isolated Chingying and Hotsuo villages had fewer septic tank toilets (11.2% and 10.5%), but more latrines (52.3% and 47.4%). Latrines could contaminate the environment. If the effluents were discharged directly into ditches or water sources, the

contaminated ditches or water sources could become breeding places of vectors and pathogens.

Flies abounded in the five villages. As can be seen from Table 9, fewer houses had any preventive measures against flies, 8.7% in Chinai, 44.8% in Chunyang, 45.8% in Chingying, 42.1% in Hotsuo, and 38.1% in Nanfeng. More houses used screened doors or windows against flies, and screened covers for foods the next, 50.0% and 66.7% in Chinai, 97.7% and 81.4% in Chunyang, 95.9% and 71.4% in Chingying, 85.7% and 43.8% in Hotsuo, and 91.7% and 75.0% in Nanfeng.

Approximately 98.4% of households in Nanfeng had their drinking water either from community or household water tanks. Houses in Chinai (65.2%), Chunyang (71.9%), Chingying (64.5%), and Hotsuo (68.4%) had their drinking water from spring water (Table 10). The rest households in these four villages, except the Wanta tribe (27.5%) which had tap water connected from the Wanta Power Plant, had their drinking water either from community or household water tanks. Water was piped either on the surface of the roads, 42.9% in Nanfeng, and around 55.0% in other four villages, or in the ditches, around 15.8-34.9%. If there were pathogens in ditches, they could enter pipelines through leaks and cause fecal-oral infectious diseases.

Table 11 shows that there were more sewers around houses in Chinai, Chunyang, and Nanfeng (87.0%, 94.8%, and 82.5%) than in Chingying and Hotsuo (65.4% and 57.9%). However, only about 22.2-53.1% of them were covered. There were sewers in the Nanfeng communities. About 58.8-86.5% of the rest four villages had community sewers. More community sewers (33.6-73.0%) than household sewers (37.7% in Chinai) were covered.

Discussion

The overall assessment of health education, waste disposal, toilet

facilities, fly control, household and community drainage, and drinking water facilities in five villages in Jenai Township of Nantou County showed that 48.0% of the villagers knew about bacillary dysentery, though only 37.3% and 29.5% of them knew about the communicability and routes of transmission of the disease (Table 1). As many as 73.2% of the residents knew to wash hands before meal and after toilet, but only 57.4% did so. About 52.3% of them knew to wash hands with soaps, only 37.2% performed it (Table 2). An estimate of 35.9% of them knew that waste bins should be covered; only 23.6% did so (Table 3). As many as 75.3% of the residents knew water should be boiled for drinking, and many of them did so (59.8%, Table 4). Approximately 59.8% of them knew that foods should be covered, and 45.8% did so (Table 5). These measures are considered effective in the prevention and control of bacillary dysentery⁽⁸⁻¹⁴⁾. The low rates of knowledge suggested the need for more intensified health education on behavioral changes in particular.

Improvement in environmental sanitation such as waste disposal, disposal of human and animal wastes, fly control, supply of safe drinking water, drainage facilities in households and communities is most important to the control of bacillary dysentery⁽¹⁰⁻¹⁴⁾. In the five villages, wastes were primarily transported away (83.2%, Table 6), followed by land filled (6.4%), discarded (2.9%) and burned (1.6%). Double-deck trucks or waste collecting baskets were used for the collection of wastes. Double-deck trucks could prevent wastes from being messed up by strayed dogs. Residents threw garbage in the waste collecting baskets for trucks to collect later. Strayed dogs often messed up baskets and many flies then gathered around. The number of weekly visits by waste trucks could be associated with cases of bacillary dysentery. Trucks visited less to Hotsuo and

Nanfeng villages; these two villages had more cases of bacillary dysentery.

Ahmed et al.⁽¹⁵⁾ proved in their study that household toilet that discharged human wastes directly into outdoor soil or ditches would significantly increase of risk of bacillary dysentery infection. They, therefore, suggested removing away unsafe household toilets. Many houses in the five villages had either latrines or storage tank toilets (39.7% and 33.5% respectively), and fewer septic tank toilets (20.7%, Table 8). Around 2.4% of the residents even had their problems solved in the fields. Some used public or school toilets (2.4% and 0.5%). Latrine discharge wastes directly into outdoor soil, ditches or water sources to contaminate the environment and water sources. Effluents of storage tank toilets could contaminate soil and ditches. Public toilets in the five villages were often without hand washing facilities and were in poor maintenance. For the prevention and control of fecal-oral infectious diseases such as bacillary dysentery, improvement of household toilet should be one of the most important public health issues.

Flies, after contact with feces of bacillary dysentery patients, collect pathogens on them. They co-exist with people and spread the infection through the foods they contaminate^(14,16). In places where pesticides is used or fly control measures taken, the number of bacillary dysentery cases or number of outpatient visits is significantly lower^(13,14). Farmers in Jenai Township where high mountain vegetables are grown in large quantity, use untreated chicken feces as fertilizers. Flies are then attracted, and chances of flies spreading the infection should not be excluded⁽¹⁴⁾. Table 8 shows that few households (37.0%) in the five villages had screened doors, windows or food covers against flies. These five villages are located at the upstream of water sources. Large-scale use of pesticides to kill flies could

contaminate water sources. Some practicable measures in the control of flies would be by avoiding the use of chicken feces as fertilizers, improving environmental sanitation, subsidizing households to install screened doors and windows, and improving toilet facilities to prevent effluents from contaminating the environment.

Although no studies have indicated that the bacillary dysentery infection in Jenai Township is associated with the use of spring water, reports^(12,17) are that supply of safe tap water can reduce cases of bacillary dysentery. Table 11 shows that as many as 94.5% of the residents used either spring water or water from community or household water tanks, and that only 5.1% of the households had tap water. Water not filtered and disinfected is likely to transmit bacillary dysentery. About 22.3% of households had the water pipes installed in ditches. Contaminated water could enter pipes through leaks to cause infection. The supply of safe tap water to the villagers is most essential. To pipe water all the way from towns is not economical. A feasible way is the proper management of spring water in the mountain areas by for instance, treatment by chlorides, and by proper maintenance of pipelines. Bacillary dysentery can be effectively controlled by these measures and through intensive health education against the use of untreated spring water.

Rosenberg et al.⁽¹²⁾ showed in their study that the poor drainage facilities in Indian communities were significantly associated with the high incidence of bacillary dysentery. In the five villages of Jenai Township, 36.2% had ditches around their houses covered, 42.9% of the ditches were not covered (Table 11). In communities, 50.9% of the ditches were covered, 27.1% were not. Drainage facilities in the five villages were, in general, inadequate. Effluents of many household toilets were discharged through ditches. As observed, ditches around some houses were filled with

silt, or short and narrow and not connect to the main community ditches. Household and human wastes collected and even overflowed around houses to become breeding places for pathogens. Children playing around the houses could be infected. For poor personal hygiene, chances of infection were high. That many cases of bacillary dysentery in Jenai Township were children could be accounted for⁽¹⁸⁾. For the prevention and control of bacillary dysentery, construction of household ditches and community drainage system and have them properly covered is most essential.

In summary, knowledge of residents of the five villages about the prevention and control of bacillary dysentery was insufficient. Health education should be intensified through communities and schools, to particularly change their attitudes and behaviors. More should be done to improve and strengthen environmental sanitation facilities in waste disposal, household toilet facilities, fly control, drinking water facilities, and household and community drainage systems. Constant maintenance of environmental sanitation by the full participation of all residents should be encouraged.

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References

1. Pan TM, Wang TK, Lai MH, et al. Bacillary dysentery in Taiwan, 1995-1996. *Epidemiology Bulletin* 1997; 13(9): 267-278.
2. Center for Disease Control, Department of Health. Information management system for the reporting of communicable disease cases.
3. Provided by the 3rd Branch Bureau, CDC, DOH.
4. Chiou CS, Hsu WB, Wei HL, et al. Molecular epidemiology of a *Shigella flexneri* outbreak in a mountainous township in Taiwan, Republic of China. *Microbiol* 2001; 39(3): 1048-56.
5. Cohen D, Green M, Block C, et al. Reduction of transmission of shigellosis by control of houseflies (*Musca domestica*). *Lancet* 1991; 337 (8748): 993-997.
6. Epidemiological investigation of a bacillary dysentery outbreak in Kueihui Primary School of Fuhsing Township, Taoyuan County. Unpublished report.
7. Midszi SM, Tshimanga M, Siziya S, et al. An outbreak of dysentery in a rural district of Zimbabwe: the role of personal hygiene at public gatherings. *Centr Afr J Med* 2000; 46 (6): 150-153.
8. Khan MU. Interruption of shigellosis by hand washing. *Trans R Soc Trop Med Hyg* 1982; 76 (2): 164-168.
9. Chin J. *Control of Communicable Diseases*. 17th ed. Am Pub H Assoc 2000; 451-455.
10. Sakdisiwasdi O, Achananuparp S, Limsuwan A, et al. *Salmonella* and

- Shigella* carrier rates and environmental sanitation in a rural district, Central Thailand. Southeast Asian Trop Med Public Health 1982; 13 (3): 380-384.
11. Faruque AS, Teka T, Fuchs GJ, et al. Shigellosis in children: a clinico-epidemiological comparison between *Shigella dysenteriae* type I and *Shigella flexneri*. Ann Trop Paediatr 1998; 18 (3): 197-201.
 12. Rosenberg T, Kendall O, Blanchard J, et al. Shigellosis on Indian reserves in Manitoba, Canada: its relationship to crowded housing, lack of running water, and inadequate sewage disposal. Am J Pub H 1997; 87 (9): 1547-1555.
 13. Kawata K. Water and other environmental interventions – the minimum investment concept. Am J Clin Nutr 1978; 31 (11): 2114-2123.
 14. Levine OS and Levine MM. Houseflies (*Musca domestica*) as mechanical vectors of shigellosis. Rev Infect Dis 1991; 13 (4): 688-696.
 15. Ahmed F, Clemens JF, Rao MR, et al. Family latrines and pediatric shigellosis in rural Bangladesh: benefit or risk? Int J Epidemiol 1994; 23 (4): 856-862.
 16. Bidawid SP, Edeson JF, Ibrahim J, et al. The role of non-biting flies in the transmission of enteric pathogens (*Salmonella* species and *Shigella* species) in Beirut, Lebanon. Ann Trop Med Parasitol 1978; 72 (2): 117-121.
 17. Tulchinsky TH, Burla E, Clayman M, et al. Safety of community drinking-water and outbreaks of waterborne enteric disease: Israel, 1976-97. Bull WHO 2000; 78 (12): 1466-1473.
 18. Samonis G, Elting L, Skoulika E, et al. An outbreak of diarrheal disease attributed to *Shigella sonnei*. Epidemiol Infect 1994; 112 (2): 235-245.

Table 1. Knowledge of the Communicability and Routes of Transmission of Bacillary Dysentery in Five Village Households, Jenai Township, Nantou County

Variable		Villages					Total
		Chinai yang	Chun- yang	Ching- ying	Hotsuo	Nanfeng	
Knowing symptoms							
Know	Household	28	45	49	18	39	179
	No. %	40.5	46.9	45.8	47.4	61.9	48.0
Don't Know	Household	41	51	58	20	24	194
	No. %	59.5	53.1	54.2	52.6	38.1	52.0
Knowing communicability							
Know	Household	21	31	43	9	35	139
	No. %	30.4	32.3	40.2	23.7	55.6	37.3
Don't Know	Household	48	65	64	29	28	234
	No. %	69.6	67.7	59.8	76.3	44.4	62.7
Knowing routes of transmission							
Know	Household	21	25	29	7	28	110
	No. %	30.4	26.0	27.1	18.4	44.4	29.5
Don't Know	Household	48	71	78	31	35	263
	No. %	69.6	74.0	72.9	81.6	55.6	70.5

Table 2. Knowledge and Practice of Hand-Washing before Meal and after Toilet in Five Village Households, Jenai Township, Nantou County

Variable		Villages					Total
		Chinai	Chun- yang	Ching- ying	Hotsuo	Nanfeng	
Knowledge of hand washing							
Know	Househol	46	72	80	25	50	273
	No. %	66.7	75.0	74.8	65.8	79.4	73.2
Don't Know	Househol	23	24	27	13	13	100
	No. %	33.3	25.0	25.2	34.2	20.6	26.8
Practice of hand washing							
Yes	Househol	42	63	63	17	29	214
	No. %	60.9	65.6	58.9	44.7	46.0	57.4
No	Househol	27	33	44	21	34	159
	No. %	39.1	34.4	41.1	55.3	54.0	42.6
Knowing to use soap							
Know	Househol	42	52	58	11	32	195
	No. %	60.9	54.2	54.2	28.9	50.8	52.3
Don't Know	Househol	27	44	49	27	31	178
	No. %	39.1	45.8	45.8	71.1	49.2	47.7
Practice of using soap							
Yes	Househol	30	46	39	5	20	140
	No. %	43.5	47.9	36.4	13.2	31.7	37.5
No	Househol	39	50	68	33	43	233
	No. %	56.5	52.1	63.6	86.8	68.3	62.5

Table 3. Knowledge and Practice of Covering Waste Bins in Five Village Households, Jenai Township, Nantou County

Variable		Villages					Total
		Chinai	Chun- yang	Ching- ying	Hotsuo	Nanfeng	
Know to cover waste bins							
Know	Household	24	38	36	10	26	134
	No. %	34.8	39.6	33.6	26.3	41.3	35.9
Don't Know	Household	45	58	71	28	37	239
	No. %	65.2	60.4	66.4	73.7	58.7	64.1
Practice to cover waste bins							
Yes	Household	16	27	21	8	16	88
	No. %	23.2	28.1	19.6	21.1	25.4	23.6
No	Household	53	69	86	30	47	285
	No. %	76.8	71.9	80.4	78.9	74.6	76.4

Table 4. Knowledge and Practice of Boiling Water for Drinking in Five Village Households, Jenai Township, Nantou County

Variable		Villages					Total
		Chinai	Chun- yang	Ching- ying	Hotsuo	Nanfeng	
Know to boil water							
Know	Household No.	49	76	81	24	51	281
	%	71.0	79.2	75.7	63.2	81.0	75.3
Don't Know	Household No.	20	20	26	14	12	92
	%	29.0	20.8	24.3	36.8	19.0	24.7
Practice to boil water							
Yes	Household No.	47	62	64	20	30	223
	%	68.1	64.6	59.8	52.6	47.6	59.8
No	Household No.	22	34	43	18	33	150
	%	31.9	35.4	40.2	47.4	52.4	40.2

Table 5. Knowledge and Practice of Shielding Foods with Screen Covers in Five Village Households, Jenai Township, Nantou County

Variable		Villages					Total
		Chinai yang	Chun- yang	Ching- ying	Hotsuo	Nanfeng	
Know to cover foods							
Know	Household No.	45	55	62	16	45	223
	%	65.2	57.3	57.9	42.1	71.4	59.8
Don't Know	Household No.	24	41	45	22	18	150
	%	34.8	42.8	42.1	57.9	28.6	40.2
Practice to cover foods							
Yes	Household No.	44	45	50	11	21	171
	%	63.8	46.9	46.7	28.9	33.3	45.8
No	Household No.	25	51	57	27	42	202
	%	36.2	53.1	53.3	71.1	66.7	54.2

Table 6. Methods of Treating Waste Disposals in Five Village Households, Jenai Township, Nantou County

Methods		Villages					Total
		Chinai yang	Chun- ying	Ching- ying	Hotsuo	Nanfeng	
Transport	Household No.	63	94	68	33	52	310
	%	91.3	97.9	63.7	86.8	82.5	83.2
Incineration	Household No.	1	0	13	1	9	24
	%	1.5	0.0	12.1	2.6	14.3	6.4
Discard	Household No.	2	0	6	2	1	11
	%	2.9	0.0	5.6	5.3	1.6	2.9
Landfill	Household No.	0	0	3	2	1	6
	%	0.0	0.0	2.8	5.3	1.6	1.6
Transport and incineration	Household No.	3	0	13	0	0	16
	%	4.3	0.0	12.1	0.0	0.0	4.3
Transport and landfill	Household No.	0	0	1	0	0	1
	%	0.0	0.0	0.9	0.0	0.0	0.3
Incineration and discard	Household No.	0	2	3	0	0	5
	%	0.0	2.1	2.8	0.0	0.0	1.3

Table 7. Weekly Number of Waste Removals in Five Village Households, Jenai Township, Nantou County

Weekly No. of Waste Removals	Villages					Total
	Chinai	Chun- yang	Ching- ying	Hotsuo	Nanfeng	
1	0	0	3	6	0	9
1-2	0	0	8	6	14	28
2	16	0	26	7	4	53
2-3	0	0	20	8	9	37
3	35	8	13	4	12	72
3-4	0	4	0	2	0	6
4	0	5	0	0	0	5
4-5	0	5	0	0	0	5
5	0	22	2	0	0	24
6	0	4	0	0	0	4
7	0	14	3	0	4	21

Table 8. Types of Family Toilets in Five Village Households, Jenai Township, Nantou County

Types		Villages					Total
		Chinai	Chun- yang	Ching- ying	Hotsuo	Nanfeng	
Latrine	Household	28	33	56	18	13	148
	No. %	40.6	35.0	52.3	47.4	20.6	39.7
Storage tank	Household	24	29	28	12	32	125
	No. %	34.8	31.0	26.2	31.6	50.8	33.5
Septic tank	Household	14	30	12	4	17	77
	No. %	20.3	30.0	11.2	10.5	27.0	20.7
To the bush	Household	2	2	4	1	0	9
	No. %	2.9	2.0	3.7	2.6	0.0	2.4
Public toilet	Household	0	2	3	3	1	9
	No. %	0.0	2.0	2.8	7.9	1.9	2.4
School toilet	Household	0	0	2	0	0	2
	No. %	0.0	0.0	1.9	0.0	0.0	0.5
Neighbor's toilet	Household	1	0	2	0	0	3
	No. %	1.4	0.0	1.9	0.0	0.0	0.8

Notes: Latrines are ditches that discharge wastes directly outdoors. Storage tanks are containers. Effluents may overflow. Septic tanks come in four tanks. Wastes are discharged into sewers.

Table 9. Fly Control Measures in Five Village Households, Jenai Township, Nantou County

Variable		Villages					Total
		Chinai yang	Chun-yang	Ching-ying	Hotsuo	Nanfeng	
Control measures							
Yes	Household No.	6	43	49	16	24	138
	%	8.7	44.8	45.8	42.1	38.1	37.0
No	Household No.	63	53	58	22	39	237
	%	91.3	55.2	54.2	57.9	61.9	63.0
Screened windows/doors							
Yes	Household No.	3	42	47	14	22	128
	%	50.0	97.7	95.9	87.5	91.7	92.8
No	Household No.	3	1	2	2	2	10
	%	50.0	2.3	4.1	2.5	8.3	7.2
Food cover							
Yes	Household No.	4	35	35	7	18	99
	%	66.7	81.4	71.4	43.8	75.0	71.7
No	Household No.	2	8	14	9	6	39
	%	33.3	18.6	28.6	56.2	25.0	28.3

Table 10. Water Supply and Pipelines in Five Village Households, Jenai Township, Nantou County

Variable		Villages					Total
		Chinai yang	Chun- yang	Ching- ying	Hotsuo	Nanfeng	
Sources of water supply							
Tap water	Household No.	19	0	0	0	0	19
	%	27.5	0.0	0.0	0.0	0.0	5.1
Spring water	Household No.	45	69	69	26	1	210
	%	65.2	71.9	64.5	68.4	1.6	56.3
Water tanks	Household No.	5	27	38	12	62	144
	%	7.2	28.1	35.5	31.6	98.4	38.6
Pipelines							
On roads	Household No.	41	56	60	22	27	206
	%	59.4	58.4	56.1	57.9	42.9	55.2
In ditches	Household No.	14	20	21	6	22	83
	%	20.3	20.8	19.6	15.8	34.9	22.3
Don't know	Household No.	14	20	26	10	14	84
	%	20.3	20.8	24.3	26.3	22.2	22.5

Table 11. Ditches around Houses and in the Community in Five Village Households, Jenai Township, Nantou County

Variable		Villages					Total
		Chinai yang	Chun- yang	Ching- ying	Hotsuo	Nanfeng	
Ditches around houses							
Covered	Household No.	28	51	34	8	14	135
	%	40.6	53.1	31.8	21.1	22.2	36.2
Not covered	Household No.	32	40	36	14	38	160
	%	46.4	41.7	33.6	36.8	60.3	42.9
No ditches	Household No.	9	5	37	16	11	78
	%	13.0	5.2	34.6	42.1	17.5	20.9
Ditches in communities							
Covered	Household No.	26	57	36	25	46	190
	%	37.7	59.4	33.6	65.8	73.0	50.9
Not covered	Household No.	23	26	27	8	17	101
	%	33.3	27.1	25.2	21.1	27.0	27.1
No ditches	Household No.	20	13	44	5	0	82
	%	29.0	13.5	41.2	13.1	0.0	22.0

