

Epidemiology Bulletin

- 93 Investigations of An
Outbreak of Hepatitis A in
Sanmin Township,
Kaohsiung County
- 106 Cases of Notifiable and
Reportable Diseases,
Taiwan-Fukien Area
-

Investigations of An Outbreak of Hepatitis A in Sanmin Township, Kaohsiung County

1. Introduction

On 4 March 1993, the Bureau of Communicable Disease Control of the department of Health (DOH) was informed by the Kaohsiung County Health Bureau that between December 1992 and February 1993, in an aboriginal village of Sanmin Township, Kaohsiung County, there had been around 13 cases of jaundice, all aged between 3 and 9 years. Of these, 5 had developed symptoms such as abdominal pain, vomiting, fever and jaundice and had been hospitalized. The Sanmin Health Station had taken blood samples from the 17 suspects (including 3 hospitalized in the Kaohsiung Medical College Hospital). The blood samples were sent to the National Institute of Preventive Medicine for testing, resulting in 11 suspects being found to be IgM anti-HAV positive. To understand the sources and routes of infection, the Field Epidemiology Training Program (FETP) of the National Institute of Preventive Medicine and the Bureau of Communicable Disease Control, both of DOH, initiated an investigation on 8 March 1993 and an action for effective preventive measures.

2. The Background

Sanmin Township is located in the northeastern corner of Kaohsiung County. In the Township are Mintsu, Minchuan and Minsheng (further subdivided into villages 1 and 2) villages. The distance between Mintsu and Manchuan villages is 5 km, that between Minchuan and Minsheng is 9 km, and that between Minsheng 1 and Minsheng 2 is 900 m. Most of the residents of the Township belong to the aboriginal Bunun tribe. They come in frequent contact with each other. The population of the Township in 1993 is 2,969 (680 in Mintsu, 771 in Minchuan, and 1,518 in Minsheng); of these, 836 persons are 12 years of age and under (194 in Mintsu, 193 in Minchuan, and 449 in Minsheng). The residents are primarily agricultural workers, though many have migrated out for jobs. Excess drinking is still common. The standards of living are the highest in Minchuan, followed by Mintsu, and then Minsheng 1 and 2. Though simple water supply systems have been installed in Mintsu and Minsheng 1 (also

supplying Minsheng 2), but not in Minchuan, (where the residents collect water from springs), spring water is also used by many without boiling. There are 1 to 3 restaurants of fairly good sanitary conditions in each village. Since November 1992, at least one feast for wedding, funeral or other occasions has been held each month in each village. Almost all families in Minchuan have septic tank type toilets, only two-thirds of families in Mintsu and Minsheng have the facilities, and the rest use pit privies or do not have toilets. Feces are, however, not used as fertilizer in farming. In the Township are Mintsu, Minchuan and Minsheng primary schools, and four kindergartens. The sanitary conditions of the primary schools are fair, and those of the kindergartens require improvement. The conditions of the Minsheng 2 kindergarten are the worst, with limited space, no hand-washing and toilet facilities, broken water pipes, no running water, and sharing of cups for drinking.

3. Materials and Methods

1) Detection of Cases

To search for hepatitis A cases, the team visited on 9 March the Kaohsiung Medical College Hospital and three more frequently utilized hospitals in Chishan for any residents of the Township who had been hospitalized for hepatitis A in the last three months. Their medical records were reviewed. The Sanmin Health Station was asked to continue visits to families and schools. In total, 7 hospitalized hepatitis A cases were detected (6 in Minsheng, 1 in Mintsu; 3 hospitalized in the Kaohsiung Medical College Hospital, 1 each in Chungan, Poai, Tsoying Navy, and Kaohsiung Veterans' hospitals). Their SGOT and SGPT were significantly high. They also demonstrated symptoms such as brown urine, abdominal pain, vomiting, loss of appetite, yellowish sclera, and jaundice.

2) Serum Testings

The 13 jaundice cases aged between 3 and 9 years were kindergarten children. To understand the transmission of this outbreak and also the hepatitis A serum antibody prevalence rate of the Township, 648 blood specimens were taken on 8-11 March from all children of the primary schools and kindergartens, school teachers and cooks of the three primary schools, teachers of the Minsheng 2 kindergarten, and managers of restaurants for testings by the National Institute of Preventive Medicine with the solid phase enzyme-immunoassay HEPAVASE MA and HEPAVASE A (General Biologicals Corporation, ROC) for IgM anti-HAV and total anti-HAV in serum.

3) Testings for Water Quality

The Sanmin Health Station collected 12 water samples on 6 March, among them, 1 from the Minsheng Primary School, 2 from restaurants, 7 from houses of hepatitis A positive cases, and 2 from the simple water supply systems for testings for B. coliform by the Kaohsiung County Health Bureau. The Southern Area Environmental Protection Center of the Taiwan Provincial Department of Environmental Protection also collected 8 water samples on 12 March from Sanmin Township, among them, 2 from springs.

5 from houses of the hepatitis A positive cases, and 1 from the Township office, for testings for total colony and B. coliform.

4) Questionnaires Interview

Based on the findings of the serum testings, the IgM anti-HAV positives were placed in the case group, the both IgM anti-HAV and total anti-HAV negatives were selected on a one-to-one basis matching for village, school grade and age with the case and placed in the control group for case control study. Questionnaire is used to collect information from individuals. The questionnaire contains the individual background information, date of onset, symptoms, medical treatment, contacts before onset of disease, participation in any feast, whether hands washing after going to toilet or before and after meals, any habits of eating raw food and drinking raw water, the source of water supply at home, type of toilet, and whether using feces as fertilizer. In statistical analysis, chi-square test and multiple logistic regression analysis were applied to identify the potential risk factors associated with this outbreak.

4. Findings

1) Serum Testings

(1) Collection Rate of Sample Specimens

Totally, 648 (590 children, 58 contacted adult) serum samples were collected. A total of 590 of 836 (70.57%) children ≤ 12 years of age were tested. The children ≤ 12 years of age blood collection rates in Mintsu, Minchyuan, Minsheng are 82.47%, 66.32%, 67.26% respectively.

(2) The Susceptibles

Of those serum tested, 321 were either IgM anti-HAV positive or anti-HAV negative. This shows that before the hepatitis A outbreak, 49.5% of the population were already susceptible.

i. Persons infected by virus recently

Of those serum tested, 74 (11.4%) were IgM anti-HAV positive, containing 12.54% of children of primary school and under from whom blood specimens were collected. By village, there were 11 in Mintsu (positive rate 6.88%), 1 in Minchuan (positive rate 0.78%), and 62 in Minsheng (positive rate 20.53%). Of the 74 positives, 38 (51.35%) were kindergarten children aged between 3 and 6 years.

ii. Persons not infected by virus yet and without antibody

Of those serum tested, 247 (38.1%) were both IgM anti-HAV and total anti-HAV negative, containing 41.86% of children of primary school and under from whom blood

specimens were collected.

(3) Persons with Antibody

Of those serum tested, 327 (50.5%) were IgM anti-HAV negative and total anti-HAV positive. They have been infected by virus and have immunity. From Figure 1, the antibody positive rate of children aged 8 years and above (2nd grade) is significantly higher than that of children aged 7 years (1st grade) and under. The present outbreak of hepatitis A in Sanmin Township concentrated more in children under 7 years of age

(4) Attack Rate

From Table 1, the total attack rate of hepatitis A for children under primary school in Sanmin Township was 23.5%. By village, they were 13.41% for Mintsu, 1.09% for Minchuan, and 42.18% for Minsheng. The rate was higher among young children in kindergartens and nurseries in Minsheng village, and the highest among children in the Minsheng 2 nursery (82.76%). What made the differences in attack rates between Minsheng 1 and Minsheng 2 nurseries and young children not attending schools, 82.76% for Minsheng 2, and 44.44% for children not attending school, deserves further investigation.

2) Testing for Water Quality

Findings of the testings for the 12 water samples collected by the Sanmin health Station were: 6 samples collected from homes of IgM anti-HAV positive cases and 1 sample from one restaurant in Minsheng 1 showed B coliform positive (more than 10 MPN); the rest were negative.

Findings of the 8 water samples tested by the Southern District Environmental Protection Center were: 2 spring water samples failed to meet the requirements (one with total colony 550/ml, B coliform 50 MPN/100ml; one with total colony 88/ml, B coliform 17 MPN/100ml); the rest were negative for B coliform.

3) Questionnaire Interview: 148 questionnaires have been collected. The findings are:

(1) Distribution of Hepatitis A Cases

Ages of hepatitis A cases of Sanmin Township ranged from 1 to 11 years, most of them were pre-school children aged 7 years and under, with a median age of 5.41 years. Of these, 15 cases (20.27%) did not show symptoms whereas 59 cases (79.73%) had developed some symptoms. The symptoms were fever (56.76%), loss of appetite (44.59%), tiredness and sleepiness (36.49%), pain of upper abdomen (35.14%), and jaundice and brown urine (16.22-24.32%).

The distribution of cases was characterized significantly by family aggregation and contacts between neighbors. In Minsheng 2 for instance, most cases were from one street; in Minsheng 1, they were in crowded areas with poor sanitation. From

Table 1. Findings of Serum Testings for Hepatitis A by Village and Education, Sanmin Township, Kaohsiung County

Village	Susceptibles					With antibody		Total	
	IgM anti-HAV(+)		IgM anti-HAV(-) anti-HAV(-)	Subtotal		IgM anti-HAV(-) anti-HAV(+)		No.	%
	No	%	No.	No	%	No	%		
Minsheng									
Primary school									
6th grade	0	0	2	2	6.1	31	93.9	33	100
5th grade	1	100	0	1	4.0	24	96.0	25	100
4th grade	0	0	3	3	8.6	32	91.4	35	100
3rd grade	2	50	2	4	11.8	30	88.2	34	100
2nd grade	3	42.86	4	7	24.1	22	75.9	29	100
1st grade	10	33.33	20	30	83.3	6	16.7	36	100
kindergarden	6	46.15	7	13	86.7	2	13.3	15	100
Nursery									
Village 1	7	26.92	19	26	92.9	2	7.1	28	100
Village 2	24	82.76	5	29	90.6	3	9.4	32	100
Not attending school									
Village 1	1	7.14	13	14	82.4	3	17.6	17	100
Village 2	8	44.44	10	18	100	0	0	18	100
School teachers	0	0	0	0	0	7	100	7	100
Restaurant	0	0	0	0	0	7	100	7	100
HAV case family	0	0	0	0	0	11	100	11	100
SUBTOTAL	62	42.18	85	147	45.0	180	55.0	327	100
Minchuan									
Primary school									
6th grade	0	0	1	1	8.3	11	91.7	12	100
5th grade	0	0	4	4	33.3	8	66.7	12	100
4th grade	1	25	3	4	36.4	7	63.6	11	100
3rd grade	0	0	5	5	62.5	3	37.5	8	100
2nd grade	0	0	17	17	85.0	3	15.0	20	100
1st grade	0	0	11	11	91.7	1	8.3	12	100
Nursery	0	0	22	22	88.0	3	12.0	25	100
Not attending school	0	0	28	28	100	0	0	28	100
School teachers	0	0	0	0	0	12	100	12	100
SUBTOTAL	1	1.09	91	92	65.7	48	34.3	140	100
Mintsu									
Primary school									
6th grade	0	0	0	0	0	15	100	15	100
5th grade	0	0	1	1	5.9	16	94.1	17	100
4th grade	0	0	0	0	0	14	100	14	100
3rd grade	0	0	4	4	23.5	13	76.5	17	100
2nd grade	1	12.5	7	8	50.0	8	50.0	16	100
1st grade	1	6.25	15	16	84.2	3	15.8	19	100
Nursery	7	30.43	16	23	79.3	6	20.7	29	100
Not attending school	2	6.67	28	30	90.9	3	9.1	33	100
School teachers	0	0	0	0	0	9	100	9	100
Sanmin health station staff	0	0	0	0	0	12	100	12	100
SUBTOTAL	11	13.41	71	82	45.3	99	54.7	181	100
GRAND TOTAL	74	23.05	247	321	49.5	327	50.5	648	100

Table 2, of the 45 families with hepatitis A cases, 18 families (40%) had more than two cases; 12 (52%) of the 23 families in Minsheng 2, 3 (23%) of the 13 families in Minsheng 1, and 3 (38%) of the 8 families in Mintsu had more than two cases. The probability (P) of family infection in Minsheng 2 was as high as 0.6522. From Table 3, family aggregation can be noted.

(2) Trend of Infection

Fever was the most common symptom experienced by the hepatitis A patients of Sanmin Township. To avoid any confusion between hepatitis A and common cold, a case was defined as: any IgM anti-HAV positive feeling uncomfortable and with one of the symptoms: yellowish eyes, yellowish skin or brown urine, or with two of these symptoms, fever, tiredness and sleepiness, loss of appetite, weakness, nausea, dizziness, vomiting, abdominal pain, and diarrhea. A total of 44 met the criteria, and their trends of infection are shown in Figures 2 and 4. From the date of onset, the outbreak probably started in November 1992 from the pre-school children of Minsheng 2, later spread to school children, and further to Minsheng 1 and Mintsu in January 1993, and reached a peak in February 1993.

(3) Index Cases and Routes of Transmission

From the trends of infection, the first case of the outbreak with symptoms was a three-year old girl of Minsheng 2 nursery from Minsheng 2 village. Her parents work in Chiahsien and Tainan and she often travelled with them. Though the source of infection could not be identified with certainty, the fact that her grandmother took her to an eating stand in Tainan a month prior to the onset of disease; that her father, being at the terminal stage of liver cirrhosis, has often been in hospital for treatment, and that the spring water collected from her home showed positive for B coliform all indicate that she has a high likelihood of being infected.

The second case is a next-door 3-1/2 year old playmate of the index case. His elder sister, a second-grader of Minsheng Primary School, has also developed symptoms. The third case is a four-year old next-door classmate of the index case at the Minsheng 2 nursery, his four brothers and sisters have all developed symptoms. Three of them are in the Minsheng 2 nursery, and the 1-1/2 year old sister, who has been adopted to Mintsu village, visits them often. She could have been infected.

The first case at Mantsu village is a 5-1/2 year old boy. As the family is related to the one which adopted the young girl of Minsheng 2 village, the children play together. He could have been infected.

The first case at Minsheng 1 is a 6-year old boy of the Minsheng kindergärten. His two younger brothers who attend the Minsheng 1 nursery are also cases with symptoms. The family is poor, living in poor sanitary conditions, the father is disabled and alcoholic, and the mother has to support the family. The children are often placed under the care of their grandmother in Minsheng 2. They could also have been infected through contacts with hepatitis cases.

Figure 1. Prevalence of Hepatitis A serum antibody among children in Sanmin township, Kaohsiung County

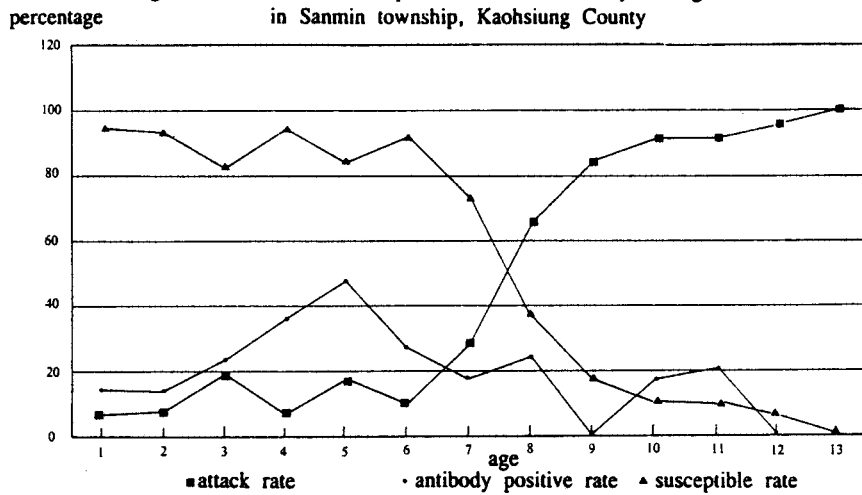


Figure 2. Epicurve of HAV outbreak of preschool children in Sanmin township

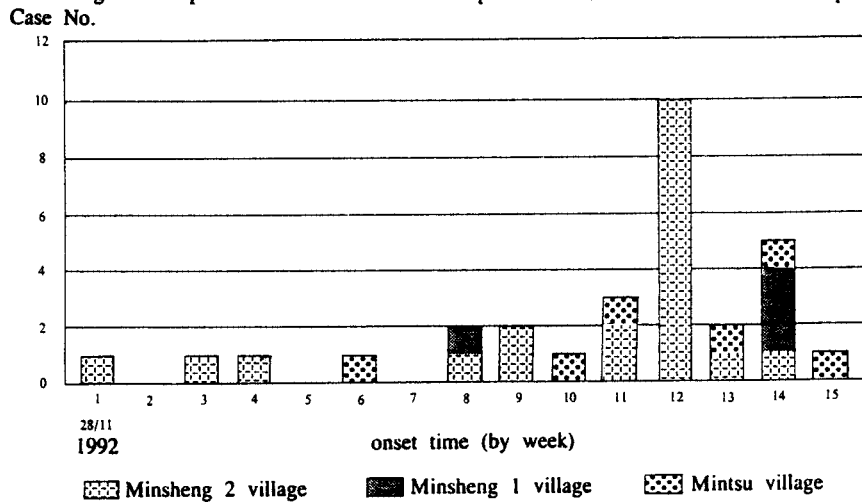
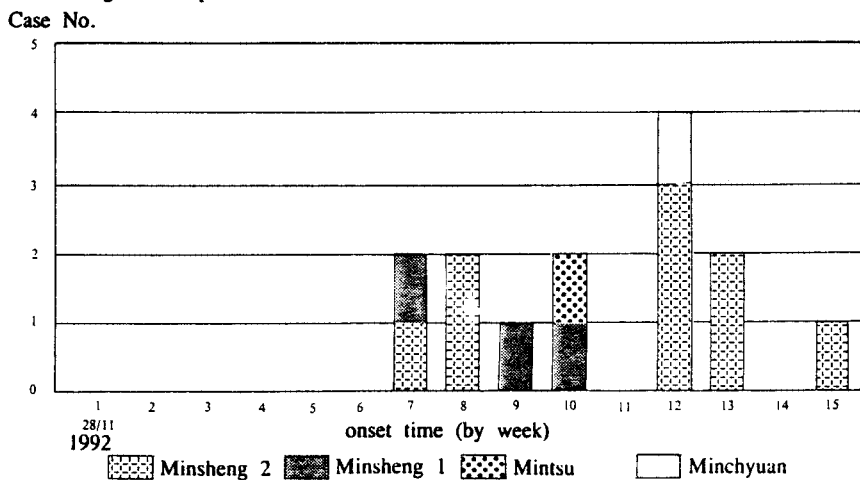


Figure 3. Epicurve of HAV outbreak of school children in Sanmin township



(4) Risk Factors

Epi-Info and SAS/PC are further applied to identify potential risk factors involved.

i. Uni-variable analysis: from Table 4, the onset of disease is statistically significantly related ($p < 0.05$) to such risk factors as whether attending school, whether being in school every day, and whether coming in contact with infected cases, but not to other factors ($p > 0.05$).

ii. Multi-variable analysis: using IgM anti-HAV of Sanmin as dependent variable, and the statistically significant risk factors identified in the uni-variable analysis as independent variables, a multiple logistic regression analysis was made. The findings are: the onset of disease is only statistically significantly related to the contacts with cases, and the speculation, thus, is that the present hepatitis A outbreak is primarily attributable to contacts with cases. The best logistic regression model is: $\text{Logit}(P) = 1.9111 + 2.7461 (\text{contact with case})$, and the Odd Ratio is 15.58.

5. Discussion

The present hepatitis outbreak in Sanmin Township of Kaoshiung County is considered to be an infection of hepatitis A virus, judging from the IgM anti-HAV positive findings of the serum testings. Those infected were children aged 1 to 11 years, with most of them being 7 years and under. Likely reasons are:

(1) Before the outbreak, the hepatitis A virus antibody positive rate of children under 7 years of age was less than 27.7%, giving a susceptibility ratio of more than 72.3%. The antibody positive rate of children aged 8 years and above went up to more than 64.4%, giving a susceptibility ratio of less than 35.6%. Studies⁽¹⁻⁶⁾ show that the hepatitis A antibody positive rate of children increases with age after one year of age. Since younger ones have higher susceptibility, their chances of being infected by hepatitis A virus are higher.

(2) The sanitary facilities of the four nurseries in Sanmin, with the exception of the Mintsu nursery, are poor, with limited space and water supply, no hand-washing or toilet facilities, and children sharing water cups and one hand-washing water bucket. The sanitary conditions are the worst in the Minsheng 2 nursery. Studies^(7,8) show that nurseries with poor sanitary conditions are more prone to hepatitis A infection. Most cases of the outbreak (38 cases, 51.35%) were children of nurseries. The attack rate of the Minsheng 2 nursery was as high as 82.76%.

(3) Students of the three primary schools were on winter vacation between 20 January and 17 February 1993, thus limiting their contact in school. The outbreak was therefore primarily the result of contacts between neighbors and among family members. Among primary school children the infection was sporadic, and only a few cases were noted.

The total attack rate of hepatitis A on children of primary school age and below

was 23.5%; and by village, they were: 42.18% in Minsheng, 13.41% in Mintsu, and 1.09% in Minchuan. The study of Szmuness et al.⁽⁹⁾ shows that the proportion of hepatitis A infection is higher among people in areas of poorer sanitary conditions and of lower socioeconomic status. The standards of living in Sanmin Township are the highest in Minchuan, to be followed by Mintsu, Minsheng 1 and Minsheng 2. The attack rates of hepatitis A are negatively related to living standards and sanitary conditions. In Minsheng village, the infection rate was higher among children of the Minsheng 2 nursery and children not attending school (32 cases, 43.24%). This is considered to be associated with the living standard of the village and the sanitary conditions of the nursery. Why there are the differences in the attack rates at the nurseries of Minsheng 1 and Minsheng 2 (29.17% in Minsheng 1 and 82.76% in Minsheng 2) so large? Further investigation reveals that the space at the Minsheng 1 nursery is larger, attendance of children is not regular, and though sanitary facilities there are poor, the sanitary facilities (with simple water supply system and septic tank type toilet) of the church next door are at their disposal, so the chances of being infected by hepatitis A are much reduced. On the other hand, the Minsheng 2 nursery is crowded, with more children attending nursery regularly, and in poor sanitary condition. Hepatitis A is easily spread once a child becomes sick. Stephen et al.⁽⁷⁾ in their study of risk factors for hepatitis A infection in day-care centers in 1977-1979 found that hepatitis A is closely associated with the size of enrolment, the age of children, and the duration of time that the day-care centers are open every day. Day-care centers that enrol more children under two years of age and are open for longer duration everyday, have higher chances of hepatitis A infection. The high attack rate of the Minsheng 2 nursery is considered to be associated positively with the poor sanitary conditions and the higher attendance rate of children.

Is the present outbreak a common source epidemic or a propagated epidemic? The outbreak had lasted through two incubation periods for four months, the trends of infection between November 1992 and January 1993 showed a pattern of person-to-person transmission. However, the 13 children of Minsheng 2 (10 of the Minsheng 2 nursery, and 3 of the Minsheng Primary School) became sick at the peak of infection in February 1993, an outbreak due not to the person-to-person type of propagated infection but to a common source of infection was more likely. The possible routes of infection of the current outbreak are:

(1) Sources of Water Supply

With the exception of Minchuan, the residents of which still use spring water, simple water supply systems have been installed in Mintsu and Minsheng, though spring water is used at the same time, and without boiling. Though findings of the water quality testings conducted by the Kaohsiung County Health Bureau and the Southern District Environmental Protection Center show that the 8 samples collected from homes of hepatitis A positive cases were positive to B. coliform (polluted by feces), 35 persons who used water from simple water supply systems (negative to B. coliform) became sick, and 51 persons who used spring water alone did not become sick. From Table 4, the two factors, whether using spring water and whether drinking raw water, are found to be not significantly related to the onset of disease. The sources of water supply

possibly are not the major reason of the outbreak. However, the water pipes for spring water connected by the residents are often in such poor condition that the water, during the process of delivery, could be contaminated by feces and thereby becomes a source of infection.

(2) Foods

Since November 1992, each village has held at least one feast every month. From statistical studies, it was found that eating at a feast recently is not significantly related to the onset of disease. There are no eating places around schools, the restaurants of the villages are in fair sanitary condition, and people of the villages in general are not in the habit of eating raw foods, as foods cannot be considered as a source of infection.

(3) Types of Toilet

All families in Minchuan have installed the septic tank type toilets. Two-thirds of families in both Mintsu and Minsheng have installed the septic tank type toilets, and the rest are either using pit privies or have no toilet facilities. From Table 4, the factor of using a pit privy is not significantly related to the onset of disease. Feces are not used as fertilizer in farming, therefore, the different types of toilet are not considered as a source of infection in this outbreak.

(4) Person-to-Person Transmission

Of all likely risk factors, by uni-variable analysis, factors such as whether attending school, whether being in school regularly, and whether coming in contact with infected cases are found to be significantly related ($p < 0.05$); and by multiple logistic regression analysis, contacts with cases are found to be the only factor significantly related ($p < 0.05$), with an Odd Ratio of as high as 15.58. Thus, it is considered that contact with infected cases was the major cause of the outbreak. Aboriginal children do not often wash hands after toilet or before and after meals, sanitary facilities of nurseries are rather poor, and school children and playmates come in close contact. These are considered to be some of the risk factors of this outbreak.

To control the transmission of hepatitis A, the Department of Health, through the Sanmin Health Station, offered immune-globulins to all children through primary school and to adults likely to come in contact with infected cases; the National Quarantine Service of the Department also disinfected the water and toilets of the Township on 18-19 March 1993. However, the effect of immune-globulins is of short duration, so it is not realistic to use them to prevent infection in a highly-infected area. Its main purpose is to suppress the spread of the infection. Therefore, the control of hepatitis A in the aboriginal areas, like elsewhere in Taiwan, depends primarily on the improvement of environmental sanitation and personal hygiene.

6. Conclusion

The present outbreak is the fourth reported hepatitis A outbreak in the aboriginal areas. The primary risk group attacked was children under 7 years of age, and person-to-person contact was the major route of transmission. Hepatitis A, though causing a mild infection in young children, could produce significant symptoms among older children and adults. With the improvement of environmental sanitation, sanitary facilities and personal hygiene, the immunity against hepatitis A among people of Taiwan, and particularly among young children and pre-school children who have not yet been exposed to the viruses and are active, has declined accordingly, so outbreaks can occur any time. Serum investigation of Hsu HY et al. in 1984 of children aged 6 months to 14 years in Taipei City shows an hepatitis A antibody positive rate of lower than 20%⁽¹⁰⁾, thus the chances of hepatitis A outbreaks are relatively high. Strengthening the surveillance system for hepatitis A, improving management of kindergartens and nurseries, and promoting health education programs are some of the ways to prevent and control hepatitis A.

Prepared by: S.F. Hsieh¹, K.T. Chen¹, H.M. Hsu², S.K. Yu¹, Y.H. Chi²
1. FETP, National Institute of Preventive Medicine, DOH.
2. Bureau of Communicable Disease Control, DOH.

Reported by: FETP; Serology Section; National Institute of Preventive Medicine, Bureau of Communicable Disease Control, DOH; Kaohsiung County Health Bureau; Sanmin Health Station.

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Table 2. Family Aggregation of Hepatitis A cases, Sanmin Township, Kaohsiung County

No of children per household	Mintsu					Minchyuan					Minsheng 1							
	1 case	above 2 cases				sub-total	1 case	above 2 cases				sub-total	1 case	above 2 cases				sub-total
		2	3	4	sub-total			2	3	4	sub-total			2	3	4	sub-total	
6 children														1			1	1
5 children														1				1
4 children		2			2	2							1	2			2	3
3 children	1				1	1	1				1		2					2
2 children	2	1			1	3							4					4
1 child	2				2								2					2
Total	5	3			3	8	1					1	10	2	1		3	13

Table 2. (Continued)

No of children per household	Minsheng 2					Sanmin Township						
	1 case	above 2 cases				sub-total	1 case	above 2 cases				sub-total
		2	3	4	sub-total			2	3	4	sub-total	
6 children								1		1	1	
5 children	1			1	1	2	2		1	1	3	
4 children		2		3	5	5	1	6	3	9	10	
3 children	2	3	2		5	7	6	3	2	5	11	
2 children	5	1			1	6	11	2		2	13	
1 child	3				3	7					7	
Total	11	6	2	4	12	23	27	11	3	4	18	45

Table 3. Actual Distribution and Expected Value of Families Infected with Hepatitis A, Sanmin Township, Kaohsiung County (Infection rate P = 0.6522)

No of Case	Actual No of Families	Expected No. of Families	O-E	(O-E) ²	(O-E) ² /E
0	10	0.48	9.52	90.6304	188.81
1	11	3.62	7.38	54.4644	15.05
2	6	10.19	-4.19	17.5561	1.72
3	2	12.74	-10.74	115.3476	9.05
4	4	5.97	-1.97	3.8809	0.65
Total	33	33.00	0		215.28

df = (5-1)×(2-1) = 4, $\chi^2 = 215.28$, p < 0.01

Table 4. Risk Factors for Hepatitis A transmission in Sanmin Township, Kaohsiung County

Risk Factors	Cases			Controls			OR	OR 95% CI	P value
	Yes	No	%	Yes	No	%			
Being to school	65	9	87.84	53	21	71.62	2.86	1.13-7.42	< 0.05
Being to school everyday	53	21	71.62	39	35	52.70	2.26	1.09-4.85	< 0.05
Contact with case	73	1	98.65	30	44	40.54	107.07	14.69-2184.5	< 0.001
Drinking spring water	39	35	52.70	51	23	68.92	0.50	0.24-1.04	ns*
Drinking raw water	57	17	77.03	51	23	68.92	1.51	0.68-3.35	ns*
Eating raw food	21	53	28.33	15	59	20.27	1.56	0.68-3.57	ns*
Washing hands after toilet	9	65	12.16	4	70	5.41	2.42	0.64-9.89	ns*
Washing hands before and after meal	6	68	8.11	4	70	5.41	1.54	0.36-6.87	ns*
Using septic tank type toilet	46	28	62.16	52	22	70.27	0.70	0.33-1.46	ns*
Family members being to other places for job or visit	26	48	35.14	22	52	29.73	1.28	0.61-2.71	ns*
Being to feast recently	39	35	52.70	28	46	37.84	1.83	0.90-3.72	ns*

* chi-square test not significantly associated (p > 0.05)

OR: Odd Ratio

CI: Confidence Interval