SERO-EPIDEMIOLOGICAL STUDY OF HEPATITIS A VIRUS INFECTION AMONG HILL-TRIBE YOUTH AND HOUSEHOLD ENVIRONMENTAL SANITATION, A HILL-TRIBE COMMUNITY IN NORTHERN THAILAND

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Abstract. A cross-sectional analytic study of 190 hill-tribe youth in a community in the north of Thailand was conducted to investigate the sero-prevalence of HAV and factors related to positive anti-HAV antibody. The studied youth, whose ages ranged from 15 to 24 years, were interviewed about socio-economic status and personal hygiene. Blood specimens were collected to detect anti-HAV by ELISA commercial kit. Household environmental sanitation conditions were observed and drinking water samples were screened for bacterial contamination using SI_2 medium. Following the anti-HAV assay, the studied youth were divided into two groups: anti-HAV positive, and anti-HAV negative. The studied variables of the two groups were analyzed by χ^2 test to find factors related to anti-HAV positivity. The results revealed that 87% of the studied youth were positive for anti-HAV. There was no statistically significant difference between age group/gender and anti-HAV positivity, p = 0.46 and 0.16, respectively. Approximately 35.79 to 45.79% washed their hands with soap before preparing food, before eating and after using the latrine. About 88% did not improve the potability of their drinking water. The results of screening for bacterial contamination in drinking water samples found that 73.53% were contaminated with coliform bacteria. Factors related to positive anti-HAV antibody included monthly income, number of household members, use of latrine, hand-washing with soap after using latrine, household refuse management and control of insects and rodents; p = 0.04, 0.007, 0.013, 0.008, <0.001 and <0.001, respectively. The findings suggested that appropriate household environmental management should be improved in this community to reduce HAV transmission.

INTRODUCTION

Hepatitis A is an acute, necro-inflammatory infection of the liver caused by the hepatitis A virus (HAV). The disease has been a major public health problem, and a significant cause of morbidity and attendant economic loss in many parts of the world, including Thailand (Hadler, 1991; Poovorawan *et al*, 1997; WHO, 1999). Average direct and indirect costs from hepatitis A ranged from US$ 1,817 to US$ 2,459 per adult case and US$ 433 to US$ 1,492 per pediatric case in the United States (CDC,1996). HAV infection is transmitted from person to person by the fecal-oral route or ingestion of contaminated food or water (Hadler, 1991; WHO, 1999). Improvements in public hygiene and higher socio-economic levels are associated with declining prevalence of infection. In communities that have intermediate rates of hepatitis A, the disease occurs among children, adolescents and young adults, in contrast to communities that have high rates of hepatitis A, in which the majority of cases occur among children less than 15 years of age (Poovorawan *et al*, 1997; Hadler, 1991). In Thailand, HAV infection caused 60-70% of acute hepatitis in children aged less than 15 years (Poovorawan *et al*, 1997). A previous study in 1981 reported that a large number of Thai children have become seropositive for anti-HAV (Burke *et al*, 1981). For the last ten years, the socio-economic situation and sanitary conditions have improved signifi-

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cantly in a newly industrialized countries. Many countries in Southeast Asia have experienced changes in age-specific seroprevalence of anti-HAV antibodies; this infection has been shifting from childhood to adulthood (Jutavijittum *et al*, 2002). Increasingly susceptible adolescents and young adults contribute to sporadic symptomatic hepatitis A, particularly among high school children, communities and factory workers.

In young children, HAV infection may be asymptomatic in about 75% of infected cases. Presumably, many more children have unrecognized infection and can be a source of infection for others (Hadler and McFarland, 1986; Rosenblum *et al*, 1991). The true incidence and prevalence of the infection are still unknown, especially among hill-tribe communities, low socio-economic communities and communities with unsanitary environments. Most hill-tribes found in the northern part of Thailand, and their cultures, attract travelers to visit their communities. Travelers from low- endemic areas may be at risk of acquiring HAV (WHO, 1992). This study attempted to investigate the sero-prevalence of HAV among youth of the Akha hill-tribes. The household environmental sanitation conditions were observed and factors including socio-economic status, personal hygiene and household environmental sanitation related to positive anti-HAV antibody were assessed. The results are valuable for preventing and controlling HAV infection and for improving the personal hygiene and environmental sanitation conditions in this studied community, and may be extended to other hill-tribe communities in the north of Thailand.

MATERIALS AND METHODS

Study design and study samples

This study was of cross-sectional analytic design, conducted between October 1999 and September 2000. The study involved 190 young people whose ages ranged from 15 to 24 years. The subjects of the study were of both genders, an Akha hill-tribe in Amphoe (district) Mae Suai, Chiang Rai Province, in the north of Thailand. The studied sample size was calculated by the formula $n = Z^2_{\alpha/2} PQ N/[Z^2_{\alpha/2} PQ + d^2(N-1)]$, where n = sample size, N = Akha hill-tribe persons whose ages ranged from 15 to 24 years in the studied community during the study = 375 persons, $Z_{\alpha/2}$ = standard deviation at 95% confidence interval = 1.96, P = estimated proportion of anti-HAV in the low sanitary population from the previous study = 0.4 (Poovorawan *et al*, 1994), Q = 1-P = 0.6, d = the acceptable error set at 0.05. Therefore, the required studied sample size was about 190 persons.

Data collection and laboratory assay

The studied subjects were 190 young Akha hill-tribe individuals who voluntarily participated in the study. They received an explanation of the study and informed consents were signed for participation. All participants with no history of HAV vaccination were interviewed about socio-economic status and personal hygiene by using questionnaires. Blood specimens were collected for anti-HAV detection by an ELISA commercial kit (HEPAVASE A-96, General Biologicals Corp, Taiwan) with approximately 100% sensitivity and specificity. The household environmental sanitation conditions were observed. Studied households' drinking water samples were collected to screen coliform bacteria using sanitation index 2 medium (SI_2 medium) developed by the Thai Ministry of Public Health with 87.64% sensitivity and 88.31% specificity (Luksamijarulkul *et al*, 2001). Following the laboratory assay for HAV antibody, the studied subjects were divided into 2 groups: the first group was anti-HAV-positive subjects and the second was subjects without anti-HAV. The studied variables included socio-economic status, personal hygiene and environmental sanitation conditions of the two groups. These were analyzed to determine some factors related to anti-HAV positivity.

Data analysis

Data from the study were analyzed using descriptive statistics, presented in terms of percentage, mean and standard deviation and using the chi-square test or Fisher's exact test to find factors related to anti-HAV positivity. Statistical significance was expressed as a p-value. A critical level of α equal to 0.05 was used for statistical significance.

RESULTS

General characteristics of studied subjects

and household environmental sanitation of the studied community

The studied community was an Akha hill- tribe at Ban Doi Chang, a cultural travelling community in Amphoe Mae Suai, Chiang Rai Province, Thailand. This community included approximately 250 households, but only 170 households were included in the study (Fig 1). The ages of the 190 studied subjects ranged from 15 to 24 years; 42.63% were 15-19 years old. The mean age was 21.06 years, with a standard deviation of 3.33 years. Regarding the gender and the marital status, 61.58% were male and only 42.11% were married. Based on educational status, almost 50% did not attend school and only 14.21% finished secondary school or higher. Most studied subjects were agriculturists (68.42%), 22.63% laborers and only 8.95% had been studying. About 73% had monthly family incomes less than 5,000 Baht; 48.42% thought that their earnings were not enough. The number of household members ranged from 2 to 20 persons, with mean and standard deviation of 6.43 ± 2.87 persons, respectively.

With respect to household environmental sanitation conditions, only 11.76-17.06% had good housing sanitation. About 55% had a sanitary latrine in their household, 44.71% shared a latrine with a neighbor or went into the forest to defecate. Approximately 5.30-12.94% had sanitary household food conditions. Almost 92% had insects and rodents in their households, but only 62.35% exercised the insect and rodent control. Details are presented in Table 1.

Personal hygiene and screening of bacterial contamination in drinking water

Approximately 35.79 to 45.79% of the subjects washed their hands with soap before preparing food, before eating and after using the latrine. Concerning the habit of eating raw food, 10.53% always ate it and 46.84% occasionally ate it. Mountain pipe water was the main source of drinking water and water for use. About 88% did not improve their drinking water and 46.32% stored their drinking water in an earthen pot. Most of them (73.68%) cleaned the drinking water container about 3 times a week and only 1.58% never cleaned it. Most of them (95.26%) shared their drinking cup with family members. When their

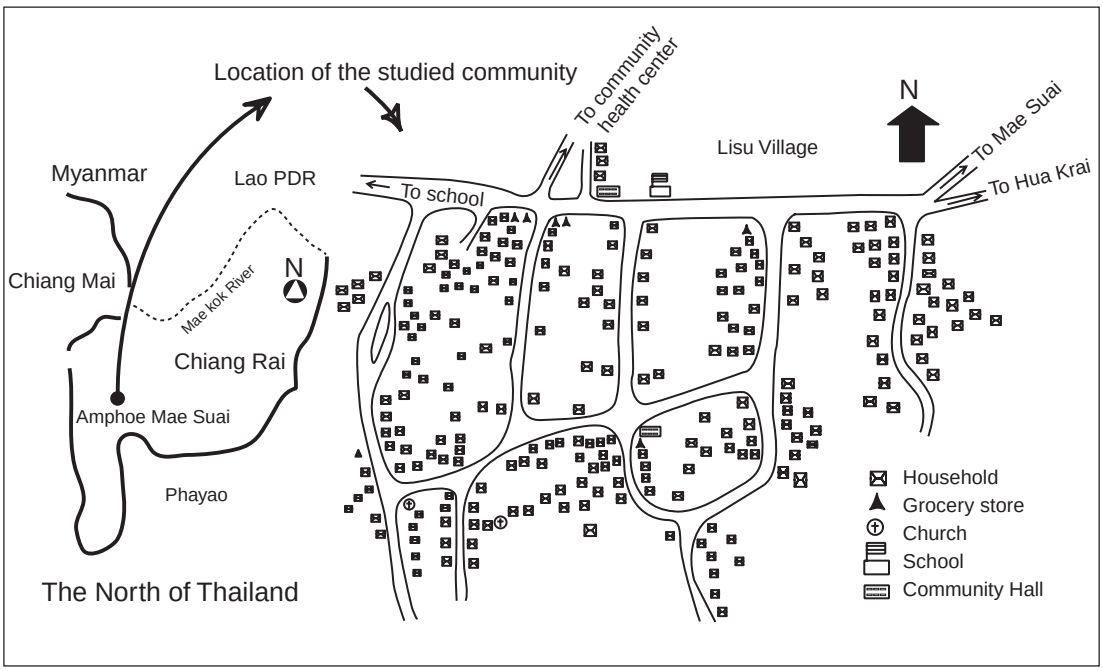

Fig 1–Map of the studied Akha hill-tribe community, amphoe Mae Suai, Chiang Rai Province, Thailand.

Table 1
Household environmental sanitation of the studied community (N=170).

Household environmental sanitation		Number	%
Housing sanitation			
1. House cleanliness	: Good	20	11.76
	Fair	87	51.18
	Poor	63	37.06
2. Indoor lighting and ventilation	: Good lighting and fresh air flow	29	17.06
	Fair lighting but no air flow	24	14.12
	Poor lighting and no air flow with musty smell	117	68.82
Sanitary latrine available in the household	: Yes	94	55.29
	No	76	44.71
Household food sanitation			
1. Food storage	: Sanitary cabinet or shield	22	12.94
	Unsanitary cabinet or shield	7	4.12
	No food storage cabinet or shield	141	82.94
2. Kitchen cleanliness	: Clean and tidy	13	7.65
	Clean but untidy	69	40.59
	Unclean and untidy	88	51.76
3. Dining place	: Clean	9	5.30
	Fair	140	82.35
	Dirty	21	12.35
4. Utensil cleanliness and good keeping	: Clean and well kept	13	7.65
	Clean but not well kept	110	64.70
	Dirty	47	27.65
Insect and rodent control in the household	: Yes	106	62.35
	No	64	37.65
Residential surrounding environment			
1. Cleanliness of residential surroundings	: Clean	26	15.29
	Fair	127	74.71
	Dirty	17	10.00
2. Place to keep domestic animal	: in premises	122	71.76
	in the house but no odor nuisance	22	12.95
	in the house and with odor nuisance	26	15.29
Waste-water around residence	: No waste-water remaining	92	54.12
	Waste-water remaining	78	45.84
Refuse disposal			
1. Refuse disposal container in the house	: Sanitary container	1	0.59
	Unsanitary container	169	99.41
2. Frequency of refuse disposal	: Always	27	15.88
	Occasionally	82	48.24
	Never	61	35.88

drinking water samples were screened for bacterial contamination, it was found that 73.53% were contaminated with coliform bacteria (Table 2).

Sero-epidemiological study of HAV

Among the 190 youths studied, 87% were positive for anti-HAV antibody. There was no statistically significant difference between age groups (15-19 years and 20-24 years) / gender and being positive for anti-HAV, p=0.46 and 0.16, respectively (Table 3). Antibody prevalence to HAV by age and gender is shown in Fig 2.

Table 2
Personal hygiene behaviors of 190 studied subjects and results of bacterial contamination screening of 170 drinking water samples.

Studied factors		Number	%
Personal hygiene behaviors (N = 190)			
Hand-washing before preparing food	: Yes, with soap	68	35.79
	Yes, with only water	119	62.63
	No	3	1.58
Hand-washing before eating food	: Yes, with soap	73	38.42
	Yes, with only water	116	61.05
	No	1	0.53
Hand-washing after using latrine	: Yes, with soap	87	45.79
	Yes, with only water	101	53.16
	No	2	1.05
Raw food eating behavior	: Always	20	10.53
	Occasionally	89	46.84
	Never	81	42.63
Improving household drinking water	: Yes, by boiling	21	11.05
	Yes, by filtration	1	0.53
	Not done	168	88.42
Drinking water container	: Earthen pot	88	46.32
	Bottle	52	27.37
	Jug and others	50	26.32
Frequency of cleaning drinking water container (times/week)	: 2-3 times	107	73.68
	1 time	47	24.74
	Not done	3	1.58
Use of drinking cup or class	: Yes, but shared with others	181	95.26
	No, or use separate cup	9	4.74
Screening coliform bacteria contamination of drinking water (N = 170)			
Positive (unsanitary)		125	73.53
Negative (sanitary)		45	26.47

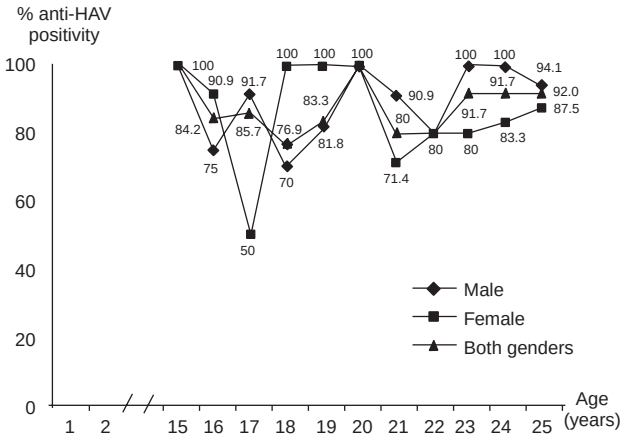

Fig 2–Age- and gender-specific prevalence of anti-HAV in the studied youth.

Table 3
Prevalence of anti-HAV among studied youth by age group and gender.

Variables		No. tested	Anti-HAV-positive	
			No.	%
Age group	: 15-19 years	81	71	87.65[a]
	20-24 years	109	96	88.07[a]
Gender	: Male	117	105	89.74[b]
	Female	73	62	84.93[b]
Total		190	167	87.89

[a]No statistically significant difference by proportional Z test, p = 0.46.
[b]No statistically significant difference by proportional Z test, p = 0.16.

Table 4
Socio-economic factors, some personal hygiene factors and some household environmental sanitation factors related to positive anti-HAV antibody among the studied youth.

Studied factors			Anti-HAV positive group	Anti-HAV negative group	p-value from χ^2 test or Fisher's exact test
Socio-economic factors					
Age (years)	:	15-19	71	10	0.930
		20-24	96	13	
Gender	:	Male	105	12	0.323
		Female	62	11	
Education	:	≤ Primary level	145	18	0.279
		≥ Secondary level	22	5	
Occupation	:	Agriculturist	117	13	0.116
		Others	53	10	
Monthly family income (Baht)	:	< 5,000	127	14	0.040[a]
		≥ 5,000	40	9	
Number of household members	:	< 6 persons	96	13	0.007[a]
		7-11 persons	66	6	
		>11 persons	5	4	
Some personal hygiene factors					
Drinking boiled water	:	Yes	19	2	0.517
		No	148	21	
Hand-washing after using latrine	:	Yes, with soap	71	16	0.013[a]
		No	96	7	
Hand-washing before preparing food	:	Yes, with soap	59	9	0.721
		No	108	14	
Hand-washing before eating	:	Yes, with soap	62	11	0.323
		No	105	12	
Raw food eating behavior	:	Yes	94	15	0.611
		No	73	8	
Some household environmental sanitation					
Use of latrine	:	Always or often	106	21	0.008[a]
		Occasional use and never	61	2	
Waste water management	:	Drained to canal	19	1	0.268
		Others	148	22	
Household refuse management	:	Leave on the ground	137	10	<0.001[a]
		Leave in a pit	30	13	
Presence of insects and rodents in the household	:	Yes	154	22	0.407
		No	13	1	
Insect and rodent control (n=176)	:	Yes	74	21	<0.001[a]
		No	80	2	

[a]Statistical significance at $\alpha = 0.05$.

Socio-economic status, personal hygiene and environmental sanitation conditions related to anti-HAV positivity

Following the anti-HAV antibody results, the studied youth were divided into two groups: individuals with, and without, anti-HAV. The studied variables of the two groups were analyzed to find factors related to anti-HAV positivity. It was found that two socio-economic factors (monthly income and number of household members) and two personal hygiene factors (hand-washing with soap after using the latrine and use of latrine) were related

to anti-HAV positivity; p=0.04, 0.007, 0.013 and 0.008, respectively. Another significant factor related to anti-HAV positivity was household environmental sanitation conditions, including household refuse management and control of insects and rodents, p <0.001. Details are shown in Table 4.

DISCUSSION

The results of this cross-sectional study demonstrated a high prevalence of anti-HAV (87.89%) among Akha hill-tribe youth in Ban Doi Chang, Amphoe Mae Suai, Chiang Rai Province, Thailand. The high prevalence might be due to the living style of the subjects in unsatisfactory sanitation conditions (Schenzle *et al*, 1979). This finding demonstrated a higher anti-HAV prevalence than a previous study in the rural eastern part of Thailand (67.9% anti-HAV-positive) and a study of Bangkok students (12.7%; Poovorawan *et al*, 1997). Poovorawan *et al* (1993, 1997) concluded that HAV infection in urban areas of Thailand has changed from hyperendemic to intermediate endemic status.

This study revealed no statistical difference in anti-HAV prevalence between the age groups 15-19 years and 20-24 years, which may be due to the infection occurring in the early age-group. Gender and education were not associated with anti-HAV, which supported a study in the Swedish population (Bottiger *et al*, 1997). There were associations between family income, number of family members and anti-HAV positivity (p=0.04, and p = 0.007) which was consistent with the previous studies (Schenzle *et al*, 1979; Moschen *et al*, 1997).

HAV can survive for prolonged periods in the environment (Sobsey *et al*, 1986; Mbithi *et al*, 1992). Therefore, food, water and shellfish are major vehicles of exposure implicated in the transmission of HAV infection, resulting in common sources of several outbreaks (Mahoney *et al*, 1992; Poonawagul *et al*, 1995). However, we did not find an association between anti-HAV positivity and drinking water improvement, kind of drinking water container, method and frequency of cleaning drinking water container, sharing cup or utensil used for drawing drinking water from drinking water container. This may be due to the use of the same source of water (mountain pipe water) for daily use and consumption. The studied subjects might be infected with HAV in childhood, causing the high anti-HAV positivity in this study (87.89%).

Hand-washing after using the latrine and use of a latrine were associated with anti-HAV positivity (p = 0.013 and 0.008), which supported the findings of other studies (Mbithi *et al*, 1992; 1993; Luksamijarulkul *et al*, 1994). Young children and infants may carry HAV to susceptible hosts, usually caretakers. Secondary infections are recognized when adult contacts become ill (Smith *et al*, 1997). The spread of HAV infection occurs when caretakers change and handle dirty diapers (Rosenblum *et al*, 1991).

It was found that unsanitary household refuse management and not controlling insects and rodents were associated with anti-HAV positivity (p < 0.001). Garbage may be a source of infections such as cholera, parasitic helminthes, typhoid and other diseases. Moreover, it may provide breeding places for flies, cockroaches and rats. Food may be contaminated with feces carried by domestic flies, cockroaches and rats. Therefore, appropriate refuse disposal can reduce the transmission of food-borne and water-borne diseases. However, most households in this community were infested with insects and other vehicles of disease. It is likely that they may play a part in HAV contamination. Appropriate environmental management should be emphasized in this community to reduce HAV transmission.

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