

## **Emerging Health Threats Associated with Development: Hmong Highlanders in Thailand<sup>1</sup>**

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### **Introduction: Emerging Health Threats**

Causes of human ailments and their consequences evolve, and health threats “emerge” or “re-emerge” as a result of human cultural evolution and its behavioral, environmental and ecological concomitants. Health threats include objectively measured increases, newly recognized, or newly unacceptable levels or risks of morbidity, mortality, teratogenicity and mutagenicity. Threats associated with “development” may “emerge” in several ways and can be classified into several major groups including those associated with new technologies and those associated with changes in human behavior or beliefs (Chart 1).

### **Development in the Highlands of Northern Thailand**

This paper discusses some of the emerging threats to health associated with rapid economic, social and demographic changes, as indicated by responses to survey questions on risk behavior, and by physical examinations and blood tests among ethnic minority Hmong in northern Thailand. Health conditions or risks considered in this paper include HIV/AIDS, hypertension, obesity, diet changes, malaria, and exposure to pesticides.

Over the past 30 years there have been rapid demographic and socioeconomic changes in the highland ethnic minority populations of northern Thailand. Until the early 1970s, the ethnic Hmong minority, who have a distinct culture and speak a language totally distinct from the Thai-speaking lowland majority, lived in relatively isolated communities and depended on labor-intensive, land-extensive swidden (shifting, slash-and-burn) cultivation of rice and maize as major subsistence crops and opium as a crop for home consumption and sale. Hmong villages broke up and moved when the soil of fields within walking distance became infertile or when fields became choked with weeds. The Hmong population was expanding rapidly into new areas, especially in the mountains of northern and western Thailand. High fertility (TFR 8+) was associated with young age at marriage (median for women ~17) and almost no use of modern contraception. Marriage was near-universal, median age was very young (< 15), infant mortality was low in comparison with other highland minorities, so Hmong population growth was very rapid (annual rate of natural increase ~ 5%).

Starting in the 1970s, and accelerating in the 1980s and 1990s, the Royal Thai Government (RTG) implemented a number of programs that profoundly affected the Hmong and other highland populations, including virtual elimination of opium poppy

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**Chart 1. Some Types of Newly Emerging Threats to Health****Emerging threats associated with new technology**

New methods, speed, volume or distance of transportation: e.g., motor vehicles, aircraft, space flight: bring vectors or agents as “stowaways” into contact with previously unexposed populations.

Newly developed chemicals: e.g., exposure to pesticides, exposure to chemicals used in manufacturing processes; synthetic narcotics (heroin, amphetamines, “ecstasy”).

Iatrogenesis: e.g., thalidomide; unneeded surgical procedures; drug resistant micro-organisms such as multiple drug resistant tuberculosis, drug resistant malaria.

Man-made disturbances of the general, working or living environment: e.g., mining operations that release toxic chemicals such as cyanide or asbestos, black lung associated with coal mining, white lung associated with textile manufacturing.

Legionnaires disease associated with air conditioning, radiation diseases associated with nuclear devices and nuclear waste.

Man-made disturbances of the environment that change patterns of human-vector interaction: e.g., open water jars or abandoned tires, that provide mosquito-breeding sites for vectors of dengue and dengue hemorrhagic fever, global warming associated with spread of vector habitats.

New occupations that involve new risks: e.g., repetitive motion associated with computer operation and carpal tunnel disorders.

New technology that enables detection, diagnosis or differentiation of previously undiagnosed or undiagnosable conditions: e.g., microscope, electron microscope, CAT scan, Human Genome.

**Emerging threats associated with changes in human behavior**

New patterns of travel of infected individuals (e.g., introduction of malaria into areas previously malaria-free by travelers from malarial areas; spread of pathogens to previously uninfected vectors, e.g., West Nile Fever).

New patterns of behavior that bring humans into contact with vectors, organisms or isolated populations to which they were not previously exposed (e.g., Ebola, HIV)

Changes in human behaviors that increase risks of “degenerative” and other diseases (e.g., changes in diet and physical exercise that increase risks of adult onset diabetes and hypertension, changes in consumption of tobacco and narcotics).

Changes in demographic conditions (e.g., population aging) that result in changes in numbers of person years at risk (e.g., for senile dementia, cardiovascular diseases)

Newly dangerous occupations (e.g., journalism in places where freedom of the press is abolished).

Reductions in access to effective health care or public health services associated with changes in laws or resulting from economic decline.

**Emerging threats associated with changes in human beliefs**

Changes in definitions of “illness” by “medicalizing” and raising awareness of conditions not previously considered as health problems, e.g., mental ill health.

Changes in expectations with regard to health status or lifespan (e.g., awareness of newly available life-saving or life-extending or disability-alleviating technology).

Changes in definitions or recognition of risks and their consequences (e.g., domestic violence), associated with other societal changes (e.g., gender equality) Changes in definitions of acceptable risks or acceptable deaths (e.g., capital punishment).

cultivation by about 1990, prohibition on use of Royal Forest for swidden cultivation, and prohibition of migration at the village level. This destroyed the basis of the traditional economy. The responses of Hmong villagers included:

- A change to chemical-intensive (pesticide and fertilizer), machine intensive (tractors, irrigation systems), and capital-intensive, land-intensive farming on permanent fields of cash crops for lowland and international markets
- Widespread recognition that the future of farming in the highlands was limited
- Some purchase or rental of lowland farms
- General acceptance of the idea that children (including girls) would need to be educated in order to get jobs
- Realization that the cost of children was increasing rapidly while their value as household agricultural labor was declining
- Decline in desired family size
- Increased use of modern contraception and increased seasonal or permanent migration to the lowlands, mostly to urban centers for non-farm employment.

Also beginning in the 1970s, the RTG began building a road network that eventually reached many highland villages, and provided many services that had become common in the lowlands, including schools, health stations, improved water supplies and eventually electricity and, in some villages, links to the national telephone system via microwave or satellite relay. Urban and rural Northern Thailand became a focus of the HIV/AIDS epidemic in the late 1980s.

### **Methods and Materials**

This paper is based primarily on results of research in 1999-2001 in four Hmong communities selected to represent a range of urban contact.<sup>6</sup> These include several subvillages in the highlands about 85 km west of urban Chiang Mai (Rural Community A), two highland villages 25 – 30 km by road from urban Chiang Mai with differing degrees of urban contact (Rural Communities B and C) and Hmong living or working in urban Chiang Mai (Urban). Characteristics of these communities and their populations are described in Tables 1 – 4. Indices of urban contact include: number of trips to town in the month prior to survey, primary occupation of the study participants, non-traditional religion, and Thai language ability.

Following extensive community preparation we recruited a total of 582 volunteer participants for a health research project including a questionnaire survey of health and health behavior, and a physical examination. Trained Hmong interviewers administered and coded the questionnaires. Doctors, dentists and nurses conducted physical and oral health examinations and collected blood and urine samples. Nurses conducted pre-test counseling in groups and notified study participants of the results of their examinations in individual post-test counseling sessions.

There are statistically significant differences between communities for both males and females:

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<sup>6</sup> Some of the background material was gathered in surveys and case studies in 1986-1989 with support from National Institute of Health grant R01HD22686, and in 1996-97 with support from the University of California Pacific Rim Research Program.

- *Occupation*: Rural A, B and C are predominantly agricultural (84.2% - 97.6% are at least part-time farmers), while only 16.2% of the Urban sample do any farming. The proportion involved at least part-time in non-farm occupations ranges from 19.8% to 29.9% in the Rural communities but is 93.5% in the Urban sample
- *Inter-community differences in major source of household income*: Farming vs. Other  $\pm$  farming was *not* significantly different between Rural communities for either males or females (about 70% derived most of their income from farming in all communities); most of the Urban participants had non-farm occupations.
- *Intercommunity differences in major source of study participant's income*: There is no statistically significant difference for males in the three rural communities in the distribution of Farm vs. Non-farm source of income (most men are farmers) but there are significantly more women with "other" sources of income (e.g., wage labor) in the least remote Rural community (Rural C).
- *Religion*: The highest proportions of non-traditional religions, e.g., Christian, occur in the least remote Rural community

Community	Characteristics	Mean number of trips to town in the previous month
Rural Community A	Relatively remote rural, intensive cultivation of vegetables, fruits and flowers as cash crops + limited subsistence crops	2.15
Rural Community B	Rural, intermediate urban contact, intensive cultivation of fruits and flowers as cash crops + limited subsistence cultivation	4.28
Rural Community C	Rural, extensive urban contact, intensive cultivation of fruits and vegetables as cash crops + very limited subsistence	6.24
Urban	Urban, wage workers, students, merchants, primarily non-agricultural	Live or work in town

Primary Occupation	Community			
	Rural A	Rural B	Rural C	Urban
Farming	80.2	80.7	70.1	6.5
Merchant	2.4		4.5	14.0
Wage or salaried work		1.5	9.0	34.9
Farming + merchant	15.1	8.1	8.2	5.4
Farming + wage work	2.3	7.4	5.2	4.3
Merchant + wage work			2.2	0.5
Farm + merchant + wage work		2.2	0.7	
Student				17.7
Crafts, e.g., sewing				10.8
No occupation outside household				5.9
Total number responding	126	135	134	186

Religion	Community			
	Rural A	Rural B	Rural C	Urban
Animism +/- Buddhism	88.2	61.9	46.3	41.6
Buddhism	3.9	3.0	7.5	23.2
Christianity	7.9	35.1	57.0	35.1
Total number responding	127	134	134	185

Community	Rural A		Rural B		Rural C		Urban	
	M	F	M	F	M	F	M	F
Cannot speak Northern or Central Thai	3.6	12.9	0.0	13.9	0.0	18.2	1.7	4.8
Can speak Northern &/or Central Thai	96.4	8.7	100.0	86.1	100.0	81.8	98.3	95.2
Cannot read or write Thai	35.7	62.9	32.1	62.0	23.4	67.0	1.7	2.4
Can read, not write Thai	3.6	5.7	5.4	8.9	4.2	8.0	11.9	33.3
Can read and write Thai	60.7	31.4	62.5	27.8	70.2	25.0	86.4	64.3
Total N	56	70	56	79	47	88	59	126

- *Hmong* literacy: The proportion is highest in the most remote Rural community
- *Thai language ability and Thai literacy*: The proportion is highest in Urban and least remote Rural community, and is consistently higher for men than for women.
- *Inter-community differences in education*: The differences in proportions who “Did not study” vs. “Less than middle school” vs. “Some middle school or more”) were *not* statistically significant for either male or females.
- *Travel out of the community*: Travel is least frequent in the Relatively Remote Rural community (Rural A) and most frequent in the Least Remote Rural community (Rural C) (male  $p = .066$ , female  $p < .000$ ). Travel is more frequent for Rural men than for Rural women ( $p < .000$ ) and is inversely associated with remoteness of the community.

These differences support the conclusion that the degree of exposure to modernization is inversely and consistently related to remoteness of community. Further analyses examine the extent to which exposure to modernization (at the community level) is associated with risks and consequences of emerging health threats of modernization.

Table 5 shows the age and sex distribution of study participants by community.

	Community									
	Rural A		Rural B		Rural C		Urban		Total All Communities	
Age	M%	F%	M%	F%	M%	F%	M%	F%	M%	F%
15-30	42.9	51.4	28.6	41.6	40.4	42.0	71.7	69.8	46.6	53.4
31-40	32.1	28.6	35.7	27.8	31.9	30.7	15.0	19.8	28.3	25.9
41-50	12.5	14.3	17.9	21.5	14.9	17.0	5.0	4.8	12.3	13.2
≥ 50	12.5	5.7	17.9	8.9	12.6	10.2	8.3	5.6	12.8	7.4
Total N	56	70	56	79	47	88	60	126	219	363

- Proportions of females who volunteered to participate in the study are greater in the less remote Rural and Urban communities, but differences between communities are not statistically significant.
- Age distribution of participants varied in the three communities, so we have made age-specific comparisons with regard to health outcomes.

### **HIV PREVALENCE and HIV RISK BEHAVIOR**

Northern Thailand has the highest rates of the HIV/AIDS epidemic in Thailand. The most common forms of transmission among adults are heterosexual contact with an infected person and sharing of needles for intravenous drug use. The prevalence rate has fallen in recent years, but in the mid-1990s the rate was about 10% of the adult population.

In our study population there only 2 individuals (1 male, 1 female) had confirmed positive HIV tests (HIV Elisa and Western Blot), one from each of the 2 rural communities with the most urban contact (Rural B and C). No one in the Urban sample was HIV+. The overall rate ( $2/582 = 0.34\%$ ) is much lower than in the general population of northern Thailand.

<b>Table 6: HIV/AIDS Risk Behavior (Sexual Activity) by Sex, Age and Community</b>						
Risk Behavior and Current Age	Male			Female		
	Rural A	Rural B	Rural C	Rural A	Rural B	Rural C
Age at first sexual intercourse (median)						
14-29	16	17	17	15	16.5	15
30-39	17	18	18	16.5	16.5	16.5
40 & over	17	16	16	16	16	15
Total number of sexual partners (median)						
14-29	3.5	2	2	1	1	1
30-39	5	2.5	6	1	1	1
40 & over	4.5	5	3	1	1	1
Sexual partners in past 12 months (median)						
14-29	1	1	1	1	1	1
30-39	1	1	1	1	1	1
40 & over	1	1	1	1	1	1
Used condom in past 12 months (%)						
14-29	28.6	20.0	6.7	12.5	15.3	10.3
30-39	31.6	17.6	11.1	5.0	4.5	7.1
40 & over	18.8	10.5	25.0	0.0	4.3	0.0

- Women become sexually active about one year younger than men.
- There is no consistent relationship between age at first sexual activity and community type in the Rural communities.
- There is no consistent pattern of change in age at first sexual activity by age cohort in the Rural communities.
- Rural women consistently report having fewer total number sexual partners than men.
- Both Rural men and women consistently report a median number of only 1 sexual partner in the 12 months prior to survey.
- Rural men report using condoms in higher proportions than do women.
- We are unable to explain the apparent inconsistency between men's and women's reports concerning condom use in relation to their reports of numbers of sexual partners.
- The highest proportions of Rural men and women who report using condoms are found in Community 2 (Relatively Close Rural).
- Use of condom is not consistently associated with age among Rural men, but condom use is consistently negatively associated with age among women.

<b>Table 7: HIV/AIDS Risk Behavior (Use of Narcotics) by Sex, Age and Community</b>						
<b>Risk Behavior And Current Age</b>	<b>Male</b>			<b>Female</b>		
	<b>Rural A</b>	<b>Rural B</b>	<b>Rural C</b>	<b>Rural A</b>	<b>Rural B</b>	<b>Rural C</b>
<b>Ever Use opium (%)</b>						
14-29	<b>5.0</b>	12.5	6.7	<b>3.0</b>	13.3	<b>12.1</b>
30-39	<b>15.0</b>	25.0	21.1	<b>9.1</b>	45.5	<b>30.0</b>
40 & over	<b>37.5</b>	70.0	46.2	<b>26.7</b>	40.7	<b>24.0</b>
<b>Ever Use Amphetamines (%)</b>						
14-29	<b>10.0</b>	6.3	6.7	<b>0.0</b>	0.0	<b>0.0</b>
30-39	<b>5.0</b>	0.0	10.5	<b>0.0</b>	0.0	<b>6.7</b>
40 & over	<b>0.6</b>	5.0	0.0	<b>0.7</b>	3.7	<b>0.0</b>
<b>Ever Use Heroin (%)</b>						
14-29	<b>10.0</b>	18.8	20.0	<b>3.0</b>	0.0	<b>6.1</b>
30-39	<b>0.0</b>	0.0	31.6	<b>4.5</b>	0.0	<b>13.3</b>
40 & over	<b>6.3</b>	5.0	23.1	<b>20.0</b>	0.0	<b>20.0</b>
<b>Ever Inject Narcotics (%)</b>						
14-29	<b>0.0</b>	0.0	0.0	<b>0.0</b>	0.0	<b>0.0</b>
30-39	<b>0.0</b>	0.0	0.0	<b>0.0</b>	0.0	<b>0.0</b>
40 & over	<b>0.0</b>	5.0	0.0	<b>0.0</b>	0.0	<b>0.0</b>
<b>Ever Go for Detoxification (%)</b>						
14-29	<b>5.0</b>	0.0	0.0	<b>0.0</b>	0.0	<b>0.0</b>
30-39	<b>5.0</b>	0.0	0.0	<b>0.0</b>	0.0	<b>3.3</b>
40 & over	<b>6.25</b>	40.0	15.4	<b>6.7</b>	3.7	<b>4.0</b>

- The proportion of those in the Rural communities who reported they had ever used opium is consistently positively associated with age among both men and women.
- The proportion of those in the Rural communities who reported they had ever used opium is not consistently related to sex.
- The proportion of those in the Rural communities who reported they had ever used opium is not consistently related to community.
- More men than women in the Rural communities report ever using amphetamines.
- Self-reported use of amphetamines is usually, but not always, associated with younger age of cohort in the Rural communities.
- Self-reported use of heroin is generally higher among men than among women in the Rural communities.
- Self-reported use of heroin is consistently highest in the Least Remote Rural community (Rural C).
- Self-reported use of heroin in the Rural communities is higher among the youngest cohort than among older cohorts of males, but is higher in the oldest cohort women than in the younger cohorts.
- Only one man in the entire study population reported ever injecting narcotic drugs.
- Use of detoxification is highest in the oldest cohorts in the Rural communities.
- Use of detoxification is higher among men than among women.
- Use of detoxification in the Rural communities is not consistently associated with community.



## BLOOD PRESSURE and RISKS FOR HYPERTENSION

Increase in blood pressure and health consequences of hypertension are commonly reported to be associated with modernization, urbanization or economic development in populations making transitions from traditional to modern life styles. In this study we were able to detect increases in blood pressure associated with the differences at the community level in urban contact, as outlined above.

**Table 8: Number and Percent Hypertensive (Systolic BP  $\geq$  140 or Diastolic BP  $\geq$  90) by Sex, Age and Community, Age 40 and Over, by Sex and Community**

Community	Male			Female		
	Hypertensive		Total N Age $\geq$ 40	Hypertensive		Total N Age $\geq$ 40
	N	%		N	%	
Rural A, Relatively Remote	4	25.0	16	0	0.0	15
Rural B, Relatively Close	6	31.6	19	3	11.1	27
Rural C, Least Remote	5	38.5	13	2	8.3	24
Urban	1	12.5	8	4	26.7	15

- The proportion of individuals age 40 and above with hypertension (systolic BP  $\geq$  140 or diastolic BP  $\geq$  90) is associated with community in the predicted direction, with highest in the Less Remote (Rural B) and Least Remote communities (Rural C), but the difference between them and the Most Remote community is not statistically significant.
- The proportion of individuals with hypertension (systolic BP  $\geq$  140 or diastolic BP  $\geq$  90) is highest among Urban study participants in all age groups, as compared with the grouped data from the three Rural communities.
- Proportions with hypertension (systolic blood pressure  $\geq$  140 or diastolic blood pressure  $\geq$  90) increase with age in the Rural communities, but the increase is not completely consistent when analyzed by sex.
- There are higher proportions with hypertension among men than among women at most ages in the Rural communities, but there is a higher proportion of women than men with hypertension among Urban respondents.
- Proportions with hypertension are generally higher in the less remote Rural communities (B and C) than in the most remote community (A).

### Association of Blood Pressure with Risk Factors

We have considered several risk factors in this study generally thought to be associated with hypertension, including Body Mass Index, consumption of alcohol and tobacco, and change in diet.

### Body Mass Index (BMI)

Increased body mass index (BMI) as a measure of overweight or obesity is often associated with increased blood pressure. In this study we were able to detect differences in BMI in the predicted direction associated with the community-level differences in urban contact outlined above.

Location and Age	Normal (BMI 19-24)		Overweight (BMI 25-29)		Obese (BMI 30-39)		Sample Population	
Rural								
19-30	104	70.3	41	27.7	3	2.0	148	39.2
31-40	73	60.3	36	29.8	12	9.9	121	32.0
41-50	49	73.1	16	23.9	2	3.0	67	17.7
≥ 51	34	81.0	6	14.3	2	4.8	42	11.1
Urban								
15-30	103	78.6	25	19.1	3	2.3	131	70.4
31-40	16	47.1	15	44.1	3	8.8	34	18.3
41-50	2	22.2	4	44.4	3	33.3	9	4.8
≥ 51	6	50.0	4	33.3	2	16.7	12	6.5

<sup>1</sup> Source: Thailand data from research supported in part by grant from World AIDS Foundation and University of California Pacific Rim Research Program. 'Normal' BMI among Thailand Rural and Urban Hmong also includes underweight individuals.

- Except for the youngest age group, proportions overweight or obese in each age group are consistently higher among the Urban study participants than among the Rural participants.

Sex and Community	Age Group					
	14 – 29		30 – 39		40 & over	
Male	N	%	N	%	N	%
Rural A, Relatively Remote	15	11.8	14	28.3	16	12.5
Rural B, Relatively Close	15	0.0	14	33.3	20	20.0
Rural C, Least Remote	12	20.0	10	47.4	13	7.7
Urban	5	11.6	6	66.7	4	50.0
Female						
Rural A, Relatively Remote	33	27.3	22	40.9	15	6.7
Rural B, Relatively Close	31	35.5	22	36.4	27	29.6
Rural C, Least Remote	33	30.3	31	51.6	24	50.0
Urban	21	25.3	14	46.4	10	66.7

- Comparison of Body Mass Index (BMI) shows that overweight and obesity are significantly more common in the less remote Rural communities B and C.
- Overweight is highest among Urban males age 30 – 39 and \$0 and over, and among Urban females age 40 and over.
- BMI  $\geq$  25 (Overweight and obese) is relatively common in all communities, but is greatest, when all ages are combined, in the Least Remote Rural Community C.
- BMI  $\geq$  25 is higher among women than among men in both the Rural and Urban communities.
- BMI  $\geq$  25 is highest among women age 30-39 in all Rural communities.
- BMI  $\geq$  25 is especially common among women in the Relatively Close and Least Remote Rural communities (B and C).
- Because overweight is an important risk factor for hypertension and diabetes this suggests the possibility of an increase in these conditions in these Rural and Urban populations, especially among women age  $\geq$  40, in the foreseeable future.

### Alcohol and Tobacco

Consumption of tobacco and excess consumption of alcohol are generally considered to be risk factors for hypertension, and often increase in amount, while age of onset of consumption decreases with modernization or urban contact.

<b>Table 11A: Hypertension Risk Behavior (Alcohol) by Sex, Age and Community</b>						
<b>Risk behavior</b> Current Age	<b>Male</b>			<b>Female</b>		
	<b>1 Relatively Remote Rural</b>	<b>2 Relatively Close Rural</b>	<b>3 Least Remote Rural</b>	<b>1 Relatively Remote Rural</b>	<b>2 Relatively Close Rural</b>	<b>3 Least Remote Rural</b>
<b>Ever Drink Alcohol</b>						
14-29	<b>95.0</b>	81.3	100.0	<b>48.5</b>	<b>63.3</b>	<b>72.7</b>
30-39	<b>80.0</b>	100.0	94.7	<b>45.5</b>	<b>40.9</b>	<b>73.3</b>
40 & over	<b>87.5</b>	95.0	69.2	<b>40.0</b>	<b>48.1</b>	<b>48.0</b>
<b>Table 11B: Hypertension Risk Behavior (Alcohol) by Sex, Age and Community, cont.</b>						
<b>Risk behavior</b> Current Age	<b>Male</b>			<b>Female</b>		
	<b>1 Relatively Remote Rural</b>	<b>2 Relatively Close Rural</b>	<b>3 Least Remote Rural</b>	<b>1 Relatively Remote Rural</b>	<b>2 Relatively Close Rural</b>	<b>3 Least Remote Rural</b>
<b>Age First Drank Alcohol (Median of those who drank)</b>						
14-29	<b>15</b>	15	<b>15</b>	<b>15.5</b>	16.5	<b>16.5</b>
30-39	<b>18</b>	17	<b>15</b>	<b>17</b>	20	<b>25</b>
40 & over	<b>16</b>	18	<b>16</b>	<b>17</b>	22	<b>30</b>
<b>Times Drink Alcohol in Past Month (Median)</b>						
14-29	<b>2</b>	2	<b>1.5</b>	<b>0</b>	0	<b>0</b>
30-39	<b>2.5</b>	1	<b>2</b>	<b>1</b>	0	<b>0</b>
40 & over	<b>1</b>	1	<b>2</b>	<b>1</b>	0	<b>0</b>

- Ever use of alcohol is consistently about twice as common among men (close to 100%) as among women.
- Ever use of alcohol in Rural communities is not consistently associated with age among women, but is generally higher among the youngest cohort of women than in older cohorts.
- Ever use of alcohol is high among men and women in all Rural communities.
- Median age at first consumption of alcohol is younger among men than among women in Rural communities.
- Median age at first consumption of alcohol is younger in the youngest cohort of women than in older cohorts in Rural communities, but is not consistently associated with age cohort among men.
- Median age at first consumption of alcohol is not associated with age cohort among men, but is higher in Rural communities B and C than in community A.
- Median number of times alcohol was drunk within the month prior to survey is consistently higher for men than for women in Rural communities.
- Median number of times alcohol was drunk within the month prior to survey is not consistently associated in Rural communities with age cohort or community.

**Table 12: Hypertension Risk Behavior (Tobacco) by Sex, Age and Community**

Risk behavior and current age	Male			Female		
	Rural A	Rural B	Rural C	Rural A	Rural B	Rural C
Ever Smoke Tobacco (%)						
14-29	10.0	18.8	26.7	0.0	0.0	0.0
30-39	10.0	20.2	21.1	0.0	4.5 <sup>1</sup>	0.0
40 & over	25.0	55.0	0.0	0.0	3.7 <sup>1</sup>	0.0
Median Age First Smoked (of those who smoked)						
14-29	20 years	16 years	14.5 yrs	-	-	-
30-39	20 years	26 years	25.5 yrs	-	8 years <sup>1</sup>	-
40 & over	26 years	27 years	-	-	30 years <sup>1</sup>	-

<sup>1</sup> Represents only 1 person

- About 20% of Rural men report ever smoking tobacco, but only 2 women Rural community B report ever having smoked.
- Proportion of Rural men who have smoked increases with age in the relatively remote (A) and relatively close (B) Rural communities, but declines with age among men in the least remote rural community (Rural C).
- Association of smoking tobacco with age, cohort and community is inconsistent in Rural communities.
- Median age at first smoking of tobacco is younger in the youngest cohorts than in the older cohorts, suggesting that it has been declining in recent years.

### CHANGES IN DIET

Change in diet, especially increase in salt, sugar, fat and total calories, is frequently associated with modernization. Road transport improved markedly within the past 10 years, especially in the most remote community, and increased the availability of modern foodstuffs. Combined with a decline in physical activity, these dietary changes are often considered to be a risk factor for hypertension. In this study we have considered changes in foods high in salt or sodium content foods, high sugar content and fat (in the form of meat), as well as changes in consumption of fruits and vegetables that are generally considered to be “heart healthy”.

**Table 13: Change in Consumption of Packaged Noodles (High Sodium) by Sex, Age and Community (Percent)**

Change in Consumption of Packaged Noodles in the Past 10 Years	Rural Community							
	Most Remote		Less Remote		Least Remote		Total	
Male	N	%	N	%	N	%	N	%
Don't eat packaged noodles	0	0.0	6	10.7	2	4.3	8	5.0
Ate more packaged noodles	17	30.4	8	14.3	3	6.4	28	17.6
Ate less packaged noodles	3	5.4	9	16.1	6	12.8	18	11.3
No change in packaged noodles	36	64.3	33	58.9	36	76.6	105	66.0
Female								
Don't eat packaged noodles	1	1.4	4	5.1	12	13.6	17	7.2
Ate more packaged noodles	41	58.6	19	24.1	18	20.5	78	32.9
Ate less packaged noodles	2	2.9	15	19.0	17	19.3	34	14.3
No change in packaged noodles	26	37.1	41	51.9	41	46.6	108	45.6

**Table 14. Changes in Diet in the 10 Years Before Survey (All Rural Communities Combined)**

Change in Food Consumption	Pork		Vegetables		Fruit		Packaged Noodles		Sweets, Candy	
	M	F	M	F	M	F	M	F	M	F
Increase	41.5	34.6	19.5	11.8	25.2	33.8	17.6	32.9	8.2	22.8
Decrease	11.9	19.8	1.3	2.1	8.8	13.5	11.3	14.3	8.2	13.5
No change	46.5	44.3	78.6	85.7	62.9	48.1	66.0	45.6	55.3	40.1
I never eat this food	0.0	11.3	0.6	0.4	3.1	4.6	5.0	7.2	28.3	23.6

Food or Condiment	Community with highest consumption	Mean percent for three rural communities			Chi square	df	p
		None	1-14	15-90			
Rice	No difference	0.3	0.8	99.0	2.1	4	.723
Vegetables	No difference	1.1	2.8	96.1	4.1	4	.394
Pork	Least, Most Remote	8.2	58.0	33.8	14.8	4	.005
Chicken	Less & Least Remote	7.3	71.1	21.6	19.9	4	.001
Beef	Least Remote	61.9	36.8	1.4	13.6	4	.009
Fruit	Less & Least Remote	34.7	42.7	22.6	9.8	4	.045
Salt, cooking	No difference	0.3	1.6	98.1	2.0	4	.742
Salt, eating	Least, Less Remote	68.9	18.2	13.0	22.7	4	.000
Fresh fish	Most Remote	33.1	59.5	7.3	4.6	4	.331
Dried fish	Less & Least Remote	62.3	34.2	3.8	23.4	4	.000
Salted fish	Less Remote	59.0	37.7	3.3	13.0	4	.011
Fish sauce (C)	Less & Least Remote	69.7	11.9	18.3	5.8	4	.211
Fish sauce (E)	Less & Most Remote	85.8	8.4	5.7	11.8	4	.019
Pkg. noodles	Most & Less Remote	18.0	61.6	20.4	13.0	4	.011
MSG (Cook)	Less & Most Remote	14.3	12.0	73.7	28.6	4	.000
MSG (Eating)	Most & Less Remote	84.6	8.4	7.0	12.0	4	.017
Sugar (Cook)	Least & Most Remote	69.6	21.3	9.1	14.5	4	.006
Sugar (Eat)	No difference	89.3	7.0	3.7	1.9	4	.754
Sweets, candy	Least & Less Remote	42.6	39.7	17.7	21.5	4	.000

<sup>1</sup>Condiments are used either "In Cooking" (C) or "When Eating" (E).

Change in Condiment Consumption	Salt		Fish Sauce		Monosodium Glutamate		Sugar	
	M	F	M	F	M	F	M	F
Increase	3.8	2.1	8.8	12.7	6.9	19.4	8.8	14.8
Decrease	0.6	0.4	10.7	13.5	7.5	8.9	7.5	12.7
No change	95.6	97.5	50.9	23.2	78.6	59.5	54.1	37.6
I never eat this condiment	0.0	0.0	29.6	50.6	6.9	11.8	29.6	35.0

- All Rural communities are undergoing “food transitions” by adding manufactured foods (packaged noodles, candy and sweets) and condiments (fish sauce, MSG, sugar), while retaining or increasing consumption of traditional foods (pork, vegetables, salt). Consumption of fruit (both a traditional food and a new cash crop in these communities) has also increased.
- Increased consumption of pork and vegetables is more frequent among males; increases in other foods and condiments (fruit, noodles, fish sauce, MSG, sugar, sweets or candy) are more frequent among females.
- Increased consumption of “modern” foods is most frequent in Rural A (the Most Remote community), where the road was greatly improved in the 1990s.

#### **Potentially Beneficial Changes in Diet:**

- The proportion increasing the amount of *vegetables* eaten is highest in Rural A (the most remote village) for both males ( $p = .668$ ) and females ( $p = .001$ ).
- The proportion increasing the amount of *fruit* eaten is highest in Rural A (the most remote village) for both males ( $p = .616$ ) and females ( $p = .000$ ).

#### **Potentially Risky Changes in Diet:**

- No change was reported in amounts of salt added when cooking or added when eating in any of the villages
- Amounts of high sodium and high sugar foods changed.
- The proportion increasing the amount of *packaged noodles* is highest in the most remote village (Rural A) for both males ( $p = .003$ ) and females ( $p = .000$ )
- The proportion increasing the amount of *fish sauce* eaten is greatest in the most remote village (Rural A) for males ( $p = .244$ ) and females ( $p = .000$ ).
- The proportion increasing the amount of *MSG* is greatest in the most remote village (Rural A) for males ( $p = .001$ ) and females ( $p = .000$ ).
- The proportion increasing the amount of *sugar* is greatest in Rural A (the most remote village) for males ( $p = .061$ ) and females ( $p = .012$ ).
- The proportion increasing the amount of *sweets or candy* is greatest in Rural A (the most remote village) for males ( $p = .662$ ) and for females ( $p = .000$ ).
- The most remote community (Rural A) consistently shows increases in consumption of both in beneficial and potentially risky foods in the past 10 years. Females have many more significant changes than males.

### **PESTICIDE EXPOSURE**

The first widespread use of pesticides in Thailand was in the very successful campaign to control malaria, which began in the lowlands in the 1950s and was eventually extended to highland villages. By the early 1960s malaria had been virtually eliminated in all urban areas and in almost all rural villages except those near uncontrolled borders with Burma and Cambodia.<sup>7</sup>

The conversion in recent years from land- and labor-intensive shifting cultivation for subsistence to land-intensive fixed-field farming of cash crops has been accomplished

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<sup>7</sup> Hmong felt that malaria was a major hazard to travel to the lowlands. Control of malaria in the lowlands is one explanation Hmong give for increased travel to the lowlands. Malaria was reintroduced to at least one Hmong village in 2000, after an absence of almost 40 years, by forest workers from Burma.

with the extensive use of a great variety of agricultural chemicals, including fertilizers, herbicides, insecticides, fungicides, hormones and adherents, many of which are toxic to humans. Screening for exposure to organophosphate and carbamate exposure was accomplished by means of a test for cholinesterase inhibition.<sup>8</sup> The test results represent 4 levels of cholinesterase inhibition, labeled from low to high level as “Normal”, “Safe”, “Risky” and “Dangerous”. The rate of risky and dangerous exposure ranged from 20.5% in the most remote rural community to 68.9% in the least remote rural community, and was 56.5% among urban study participants, as shown in the following table.

Percent with Risky or Unsafe Level	Rural Village A	Rural Village B	Rural Village C	Urban
Male	24.5	38.9	68.1	61.7
Female	16.4	22.5	69.3	54.0
Total	20.5	28.9	68.9	56.5
N	122	135	135	186

- The level of risky or dangerous cholinesterase inhibition (an indication of exposure to organophosphate or carbamate pesticides) is strongly and significantly associated with type of community.
- The Relatively Close Rural Community (B) has consistently higher proportions of high or dangerous exposure levels than the Relatively Remote Rural Community (A), and the Least Remote Rural Community (C) has consistently higher levels of exposure than Community B.
- The highest proportion of risky and dangerous levels of exposure (13/15 = 86.7%) is among males age 15-29 in the Least Remote Rural Community C, but 69.3% of *all* of those measured in Community C have risky or dangerous levels of exposure.
- Most of the individuals, both male and female, who have risky or dangerous levels of exposure are in the ages of reproduction.
- Other studies conducted in Rural Community 3 (the rural community with the greatest amount of urban contact), using other methods, indicate dangerous levels of exposure to organochloride pesticides (DDT) residues in this population with an estimated dose for infants who are breastfed between 2.8 and 5.4 times the WHO acceptable level of daily intake.<sup>9</sup> Sources or routes of exposure to this chemical are unknown.
- Thus the high rates of exposure may pose a risk for children, especially breastfeeding infants, as well as for adults.

<sup>8</sup> Tovivich, S. Testing of poisoning from pesticide exposure using reactive paper. *Bulletin of the Government Pharmaceutical Organisation*, 20 (3):35-44, 1994. (In Thai.)

<sup>9</sup> Steutz, W. 1999. Toxicological assessment of pesticide residues among a rural population living in the mountains of northern Thailand. *Environmental and Nutritional Problems in Watersheds of Northern Thailand: Research Report*. Chiang Mai University – University of Hohenheim – Kasetsart University Stuttgart-Hohenheim, p. 46, also published in *Science of the Total Environment* 273(1-3):53-60, May 2001.



- No research to date has screened for exposure to pyrethrins, another widely used class of pesticides.

Protective clothing that would reduce exposure while applying pesticides was used inconsistently, as shown in the following table.

Type of Protective Clothing	Sex	Frequency of Use of Protective Clothing									
		Always		Usually		Sometimes		Never		Total	
		N	%	N	%	N	%	N	%	N	%
Long sleeve shirt	M	127	77.4	18	11.0	4	2.4	15	9.1	164	100.0
	F	<b>177</b>	<b>65.8</b>	<b>25</b>	<b>9.3</b>	<b>18</b>	<b>6.7</b>	<b>49</b>	<b>18.2</b>	<b>269</b>	<b>100.0</b>
Boots	M	119	72.5	17	10.4	8	4.9	20	12.2	164	100.0
	F	<b>171</b>	<b>63.6</b>	<b>25</b>	<b>9.3</b>	<b>21</b>	<b>7.8</b>	<b>52</b>	<b>19.3</b>	<b>269</b>	<b>100.0</b>
Cloth over mouth and nose	M	77	47.0	22	13.4	36	22.0	29	17.7	164	100.0
	F	<b>82</b>	<b>30.6</b>	<b>24</b>	<b>9.0</b>	<b>47</b>	<b>17.5</b>	<b>115</b>	<b>42.9</b>	<b>268</b>	<b>100.0</b>
Gloves	M	63	38.4	19	11.6	30	18.3	52	31.7	164	100.0
	F	<b>57</b>	<b>21.2</b>	<b>25</b>	<b>9.3</b>	<b>41</b>	<b>15.2</b>	<b>146</b>	<b>54.3</b>	<b>269</b>	<b>100.0</b>

<sup>1</sup> Includes both rural and Urban respondents. Does not include individuals who said they do not use chemicals or responses that did not specify frequency.

- Lack of protective clothing increases the chances of exposure through skin and eye contact, and by respiration.
- Women were less likely to use protective clothing than men.

Comparisons of results of screening pesticide applicators and non-applicators, and farmers and non-farmers suggest pesticides are widespread in the environment, and that exposure to pesticides must take place by routes other than direct contact during application.

Rural (3 communities)			Urban		
Apply pesticides	N	%	Do any farming	N	%
Yes	140	48.1	Yes	13	43.3
No	16	48.5	No	92	59.0

We also noted that some of the people in the urban sample were exposed to other classes of dangerous chemicals in their jobs as owner or hired labor, with manufacturing figurines for local sale and export. Their children, who lived, ate, and played in close proximity to the work site, were also at risk of exposure.<sup>10</sup>

<sup>10</sup> This manufacturing process involves use of solvents resins, solvents, making of rubber molds, and painting the figurines with dyes to color them. As with pesticides, labels and health and safety warnings for some of these (e.g., Wacker Silicone Catalyst T40, containing methyl ethyl ketone peroxide 36% in dimethyl phthalate) are in European languages but not in Thai or Hmong language. Other lowland

## CONCLUSIONS

The Hmong population of northern Thailand, the bulk of which was relatively remote from centers of technological modernization had little direct contact with non-Hmong lowland populations 30 years ago. In the past three decades Hmong highlanders have become integrated into lowland Thai and international markets, and now make use of modern technology for farming and transportation, and have begun to enter the lowland labor force. These changes are associated with a series of emerging health problems.

- Modernization and its associated technological changes can be measured by occupation, religion, Thai language ability and distance and frequency of travel to the urban center. These indices are associated with rapid changes in health status and health risks at the community level and individual levels.
- Despite proximity to a population with high rates of HIV/AIDS, the study population has a relatively low rate of HIV+. This may be due to the maintenance of traditional social controls on sexual behavior despite increased geographic mobility.<sup>11</sup>
- The association of hypertension and BMI, and diet changes with level of urban contact and comparison with data from Hmong refugees in the US imply future hypertension and diabetes problems among Thailand Hmong.
- The high rate of cholinesterase inhibition, an index of exposure to organophosphate or carbamate pesticides, in all of the studied communities, especially in the less remote Rural and Urban communities is a cause for concern.
- Although many of those who apply pesticides, especially women, do not wear protective clothing, the analysis of data by occupation indicates clearly that pesticides are widespread in the environment.
- Entry into the lowland labor force has resulted in exposure of Hmong to other dangerous toxic chemicals.
- Hmong are also exposed to modern synthetic narcotics (e.g., amphetamines) as “recreational” drugs, that have replaced opium that was traditionally used largely for medical purposes.
- There are very few population-based studies that enable measurement of health consequences of changed behavior (e.g., blood pressure screening) or detection of exposure to toxic substances, such as pesticides, that are likely to be widespread in modernizing societies. The results of this imply the existence of widespread health problems of which people are not yet aware, but that are soon to emerge in populations that are undergoing rapid development.

## LIMITATIONS OF THIS STUDY

- This is a cross-sectional study, thus the association of changes in health and risks with modernization is inferred rather than directly demonstrated.
- Even though the study populations are large, they consist of volunteers, not a random sample.

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occupation bring Hmong workers in contact with lead and petroleum distillates known to be harmful to health (e.g., in soldering or automobile repair).

<sup>11</sup> The low rate in our sample might also be due to self-selection of study participants. Self-exclusion out of fear of learning of HIV infection seems unlikely since the two individuals who were HIV+ already suspected they were infected, and since we were able to include large numbers of individuals in the “high risk” age groups, including many men who reported having multiple sexual partners.

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