RESEARCH ARTICLE

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A Medical Anthropology Assessment of Community Liver Cancer Risks: Qualitative Comparisons of Communities with Different Risk Profiles in Thailand

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Abstract

Background: Thailand has the highest incidence rate of cholangiocarcinoma (CCA) in the world, and a high rate of hepatocellular carcinoma. Although risk factors for these two types of liver cancer have been identified, gaps persist in models for prevention. This qualitative study examined community awareness of liver cancer risk factors and prevention in rural Thailand. **Methods:** Qualitative interviews were conducted with two groups from two villages in the north of Thailand. Village A (5 participants) has a high prevalence of CCA, while Village B (10 participants) has low prevalence. Open-ended questions were asked about social structures, farming practices, drinking water, diet, health care, and attitudes towards health promotion. Responses were tabulated and common themes were discerned, then stratified by village to examine their similarities and differences. **Results:** In Village A, respondents were ethnic Thai with large families engaged in low-income farming and applying pesticides in unsafe manners. Village B was populated by the Mian ethnic group, where family sizes were smaller and higher incomes were derived from cash crops like coffee. Risky pesticide application practices were commonly reported. Diets were similar, except for intakes of freshwater crabs and crab paste in Village A (absent in Village B). However, the crabs had potentially high contamination of pesticide residues. Village A relied on surface water contaminated with pesticide runoff, in contrast to Village B that was upstream of point-source contamination. Furthermore, Village B emphasized healthy lifestyles and promoted the overall health of the community, supported by a network of social workers. Very few people there had ever experienced cancer. In contrast, Village A suffered from many liver cancer deaths and lacked a social worker network. **Conclusions:** These results inform community-tailored interventions in Thailand to promote safer pesticide practices, healthier diets, safer drinking water, and supportive community health for CCA prevention.

Keywords: pesticides- diet- drinking water- health care- - liver cancer

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Introduction

Thailand has suffered from high incidence and mortality rates of hepatocellular carcinoma (HCC) and cholangiocarcinoma (CCA), also known as bile duct cancer. It has the unfortunate distinction of having the world's highest population rate of CCA. Both types of liver cancer are beset by multiple challenges to their prevention and control. They are the epitome of multifactorial diseases, with prominent risk factors including genetic factors, hepatitis B and C, liver flukes, obesity, diabetes, alcohol and tobacco use, and environmental exposures to pesticides and other chemicals [1-9]. Survival of these patients depends on early diagnosis and access to treatments and therapies, which in turn require multilevel medical systems and equitable access to care. Due to the confluence of all these issues, liver cancers are among the few malignant diseases that continue to increase in worldwide prevalence.

Our team began studying liver cancers in Thailand in 2008, enabled by the formation of the TIGER-LC Consortium (Thailand Initiative for Genomics and Expression Research for Liver Cancer). It deployed a population-based, case-control study design and quantitative surveys to inquire about possible risk factors for HCC and CCA [1, 10-14]. While much progress was made in understanding the molecular underpinnings of the disease, the data from the TIGER-LC large-scale epidemiological study revealed complex co-exposures to multiple factors and synergistic interactions. In particular,

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a cluster of factors emerged that were localized to certain rural areas of the country, especially in the North and Northeast regions where the incidence of CCA is maximal, and also co-occurs geographically with high HCC incidence. Our prior data suggested that farmers in those regions were exposed to high levels of insecticides and herbicides, which were confirmed through chemical analysis of their urine specimens, and were obtaining drinking water from sources that are vulnerable to pesticide runoff, as well as eating foods that exposed them to both pesticide residues and liver flukes: the odds of both HCC and CCA were increased among those who reported such exposures [1].

At the same time, widespread knowledge of apparently "familial" clusters of CCA in these same regions led to public demand for action, and our team was involved in supporting a cancer screening campaign in Nan Province in Northern Thailand [15]. As part of a two-pronged approach (cancer screening and qualitative research), we augmented the CCA screening campaign with visits to high- and low-incidence villages to gather qualitative information on potential cancer causes, ideas for prevention, public knowledge and attitudes, and gaps in knowledge. In this context, we sought to apply a medical anthropology approach to better understand the problem of liver cancer in Thailand.

The Society for Medical Anthropology [16] describes that field of science as drawing upon "social, cultural, biological, and linguistic anthropology to better understand those factors which influence health and well being, … the experience and distribution of illness, the prevention and treatment of sickness, … and the cultural importance and utilization of medical systems." Broadly, medical anthropologists examine "how the health of individuals, larger social formations, and the environment are affected by interrelationships between humans and other species; [including] cultural norms and social institutions." The approach is well suited to investigate multifactorial diseases, such as cancer, whose myriad risk factors are not easily controlled or prevented singly, but may require more complex, systemwide strategies to improve health. This report, therefore, aims to provide a description of our qualitative methods and the results they yielded, with a focus on informing future cancer prevention and control strategies.

Materials and Methods

Overall, this report follows the guidelines of the Standards for Reporting Qualitative Research [17], including the recommended subheadings below.

Qualitative Approach

This study used qualitative research methods, specifically the ethnographic paradigm advocated by the Society for Medical Anthropology, as quoted above. A narrative approach was used to derive domains and themes from answers that participants gave in qualitative interviews, either by focus group or individual interviews. Overall, we followed a constructivist/ interpretivist paradigm that allows for the subjectivity of individual respondents and the interpretations of data analysts.

Researcher Characteristics

The researchers who conducted this study represent a broad and transdisciplinary range of public health disciplines, including epidemiology, psychology, hepatology, environmental sciences, and cancer sciences. Their deployment of a medical anthropology approach freed them from discipline-specific methods of inquiry, and fostered a broader, holistic approach that addressed individual- and community-level factors, the environment, and health and social systems that impact wellness in general, and cancer specifically.

Context and Sampling Strategy

In January of 2020 we visited two villages in Nan Province, as a follow-up to a major cancer screening campaign that had been conducted there [15]. A team led by the CRI included Thai scientists and medical doctors, and three scientists from the U.S., together with technicians to collect and process drinking water samples. Village A (5 participants) was selected to represent the high prevalence area of Nan province, and Village B (10 participants) represented the low prevalence area of the same province. The 15 participants included 5 patients with CCA (Village A) and 10 key informants (see Village B). The specific village names are not given in this report, to safeguard the anonymity of the interviewed respondents. Participation was voluntary and no incentives were provided.

At each village, the team met with adult residents in focus group interviews. Our visiting team included a medical doctor who was fluent in both Thai, Mian, and English. The answers to our questions were immediately translated verbally to English by CRI personnel at the scene, and recorded on paper.

In Village A, where the vast majority is ethnic Thai, the participants were all those who had been in the screening campaign for CCA [15] and had survived the cancer (5 persons). No other single village in the province had so many CCA survivors, and they were representative of families with multiple affected members. We met with these five persons in two households: two brothers who shared a large, family home, and a woman and her brother and a male cousin, who lived together with their extended family. In addition, this village had no health clinic, providing a contrast to Village B.

In Village B, where the population is ethnic Mian (colloquially known as one of Thailand's "Hill Tribes"), we first met with medical staff at the rural health center in the village. This village was selected because it had no cases of liver cancer, and it was the only village in the area to have a rural clinic within the community. Key informants at that meeting included the medical director, two nurses, and two community outreach workers: these five participants provided general information on how health care is organized and provided to the residents. Then we met with five other adult participants in the same meeting place who had been selected by the village leader as representatives of the community. These included the "headman" of the community (in this case, a woman) and

four other residents.

Ethical Issues

This study was reviewed and designated as exempt by the Institutional Review Board of the Chulabhorn Research Institute. No names of participants were recorded, and no individual identifiers were collected.

Qualitative Data Collection

At both villages, the participants provided answers to our questions about the health status of the community, how health care is delivered, and social structure of the households (see specific questions below). At Village A the meetings were conducted in the two homes described above, and lasted about 30 minutes each. At Village B there was a single group meeting at the rural health clinic described above, which lasted for about one hour. Following these interviews, our team toured the villages and their environs, including the environmental water sources and water treatment facilities.

The questions were developed by the investigators prior to the community visits, as follows, and subsequently classified into domains (see Data Processing and Analysis).

Social settings

Please describe your household and family. Where do they work and what do they do for a living? What are incomes like in this village?

Agriculture

Please tell us about the crops you raise, when and how you plant and harvest them, any pests you have to contend with (including weeds, insects, rodents, and other creatures), and any pesticides you use and how you apply them.

Water and Food

What are the sources of drinking water in your house? Where does that water come from, and is the water treated in any way before it comes to the house? What kinds of food do you regularly consume? Are there any special foods that you prepare, especially from local products, and how do you prepare them?

Health and disease prevention questions

How are you doing now? Has anyone else in your household had cancer recently? What other health problems do you and others in your community have? Do people drink alcohol commonly, or smoke cigarettes? Where do you get your health care? Is it meeting your needs? What do you think caused your cancer? What future actions are you thinking about to stop cancer?

Data Collection Instruments and Technologies

No data collection instruments were used (i.e. questionnaires), nor were audio recordings created. Participant answers were written down on paper by the investigators.

Data Processing and Analysis

The English language transcripts were first examined by one of the investigators (C.L.) and the responses of participants were categorized into the six major domains shown below. Common themes were then developed. A second investigator (J.W.) checked the initial domain-fitting and themes, and made note of any responses that needed reassignment: all such differences were resolved by discussion and consensus. The resulting thematic analysis was stratified by village for the purpose of comparing and contrasting the findings in relation to high- versus low-prevalence of liver cancer (i.e. high in Village A and low in Village B). We include direct quotes from the interviewees below (shown in italics).

Techniques to Enhance Trustworthiness

The trustworthiness and credibility of the data analysis were enhanced by having two independent researchers deriving themes from the participant answers, and resolving differences by discussion and consensus.

Results

Table 1 shows the broad contrasts between the two villages across the six domains of our inquiry. Several points of contrast in the themes are apparent in every domain.

Domain 1

Social structures

Regarding social structures, we observed that nuclear family sizes were large in Village A, in contrast to Village B, where married couples typically had two children. Grandparents and extended families in the home were common to both sites. Farming was the dominant occupation across the sites, but in Village A the staple crops of rice and corn typically yield small profits, in contrast to the higher income derived from coffee and tropical fruits grown in village B. Many people in the latter village supplement their income by selling local handicrafts, particularly textiles and weavings. And the mountains are increasingly popular with tourists, who come to enjoy hiking, meditation, and health spas, providing additional sources of income to the villagers.

Domain 2

Farming practices

In addition to the differences in the predominant agricultural products produced in each site, the two villages also differed with regard to farming-related practices. In Village A, farmers plant and harvest several successive crops of rice and corn per year. In turn, this pattern requires multiple applications of pesticides during each growing season. Before the seeds are planted in the ground, the fields are sprayed with the herbicides glyphosate and paraquat to kill the weeds. Insecticides and rodenticides are also sprayed multiple times during the growing season, and the respondents mentioned using cypermethrin and zinc phosphide, respectively. Participants reported several unsafe pesticide practices, including not following the instruction on the label, using excessive amounts of the chemicals, mixing two or more types of chemicals into one spray bottle, adding grain

Table 1. Comparisons between Two Rural Villages in Nan Province, Thailand, January 2020, Regarding Health and Social and Environmental Characteristics

Domain	Question	Village A Themes (ethnicity: Thai)	Village B Themes (ethnicity: Mian)
Social Structure	Household size	Large family sizes	Small family sizes
	Occupations	Farming by the older people; younger people are working in the cities	Everyone works in farming
	Income	Typically low	Typically higher
Farming Practices	Types of crops	Corn, rice	Coffee, fruit trees
	Crop management	Several seasons of planting and harvesting per year in the flat, open fields; farmers do all the work themselves	One harvest per year; trees live for many years and require limited but regular upkeep; farm owners hire immigrants for the work
	Use of pesticides	Multiple applications of herbicides to clear the fields after harvest; multiple applications of insecticides and rodenticides during the growing season. Many unsafe pesticide practices were noted.	Multiple applications of herbicides to keep the ground weed-free under the trees; limited use of other chemicals. Fewer unsafe practices.
Drinking Water	Water sources	Surface water that passes through the fields before reaching the village intake pipes; some use of shallow wells	Surface water from springs located in high terrain is piped to the village
	Water treatment	Water filtration facility was poorly maintained	Water filtration system in good working order
Diet	Types of food	Typical rural Thai diet of rice and some meats and fish	Typical rural Thai diet but with more vegetables and some local variations; fish is not eaten
	Local specialties	Crab paste, home brewed alcohol	Tropical fruits, locally grown coffee, soy milk, home-brewed alcohol
	Endemic food preparation practices	Freshwater crabs are purchased at the market and also caught in nets as they float to the surface after being poisoned with insecticides, and then processed at home	Nothing specific was reported
Health	Current health status	Cancer survivors are doing well and have resumed normal activities	Cancer is rare and no one has had liver cancer
	Community health	Major concerns about the vulnerability of family and friends to cancer	Major concerns about diabetes, infections, and care for the elderly
	Substance use	Alcohol drinking and cigarette smoking are common	Alcohol and tobacco habits are common in men, less so in women
	Access to care	Medical centers are close by, and a health volunteer from the village is a liaison to the district hospital, but medical providers don't come to the village	Rural health clinic is in the village; there is no nearby medical center; home health visits are made annually by peer social workers
Prevention Attitudes	Causes of cancer	Some think their cancer was caused by pesticides; others attribute inherent weakness of their constitution	Cancer is very rare and there is little attention to its causes
	Preventive actions	Some plan to cut down on pesticide use and others deny this is an issue for them; some plan to inform family and neighbors of the benefits of cancer screening	Current healthy lifestyles are emphasized as promoting overall health, but no specific cancer preventive actions are contemplated

alcohol "to strengthen the mix," and not using personal protective equipment such as masks. All of the mixing and spraying activities are done by the farmers themselves.

At Village B, the participants reported using glyphosate and paraquat to control weeds growing under the coffee and fruit trees, but their use of insecticides and rodenticides appeared to be more limited than in Village A (i.e. once or twice a year in Village B compared to all year round in Village A). As they are growing trees and not annual crops, there is no need for annual cycles of planting, and there is typically one harvest per year. It was reported that the farmers do little of the spraying, tree maintenance, and harvesting themselves; instead, they employ low wage immigrant laborers from Burma to do the work.

Domain 3

Drinking water sources

Drinking water at the two villages was obtained from the same major source, namely the Nan River, which is a tributary of the Chao Phraya River that flows south towards Bangkok, but there were notable differences in water quality based on the specific intake sites and water treatment. In Village A, which is in the valley, the river flows through the agricultural fields and receives pesticide and fertilizer runoff and animal waste before it reaches the intake pipe at the village. From there, the water is pumped to a filtration station and then piped into people's houses. We observed that the filters at the station were clogged and had not been changed in a long time. Some shallow wells are also available next to some but not all of the

houses. Interestingly, three of the five respondents from Village A, despite the numerous and obvious sources of potential contamination of their drinking water (including cattle standing in the water when we were given a tour to the river banks), claimed that it was "good water" and that "it comes down from the mountain, where it is pure." Despite these claims, we noted that all of the houses we visited had stacks of bottled water, and people reported drinking bottled water much of the time.

At Village B, which is in the highlands, all respondents explained that the water intake pipe for the village is located at the top of the mountain at the river's source of natural springs, and from there it is piped downhill to the village's water treatment facility before reaching the indoor taps in each house. The water source is located within a protected nature preserve, where there is no agricultural runoff. We observed that the water treatment station was in spotless working order, including clean filter meshes. The participants were proud of the "pure, sweet water" they had access to, and we saw no obvious signs that people were using bottled water.

Domain 4
Diet

There were many similarities in the diets of the people in the two villages, corresponding to the typical Thai dietary pattern of rice, vegetables and some meats. In the lowland Village A, fish is also consumed, but respondents in the highlands said "we don't eat fish here, people don't grow up with it and don't like it." We asked if there are any local specialties that people cook at home. Several people in Village A mentioned making their own crab paste that is used to flavor different dishes. When asked how they catch these freshwater crustaceans, one respondent said: "We used to catch them in small nets, but it was hard. Nowadays we pour insecticide [cypermethrin combined with paraquat] into the water [in the rice paddy] and the dead crabs float to the top. Then we wade in [in bare feet] and just scoop them up. It is much easier." The crabs are taken home, ground up, mixed with spices and hot chilis, and formed into a paste that is packed into jars for later use as a flavoring in a variety of dishes they prepare for the family. And some jars are sold to outsiders. Crab paste is not used by the hill tribes. From responses to our inquiry, people in Village B eat more vegetables compared to residents of Village A, but many foods of the typical Thai diet (rice, in particular) were commonly consumed in both localities.

Domain 5
Health

In Village A, where we talked with people who had survived CCA, all of them said that they were doing well, were in good health, and had resumed activities of daily life. But several respondents remarked that they were worried about family members and other members of the community who might get cancer. Several of them volunteered that they thought their cancer was caused by pesticides in the environment and through their personal use of pesticides, in the case of farmers. No one mentioned liver flukes. One of the male cancer survivors in that village, a farmer, when asked what he thought had caused his bile duct cancer, said "I don't believe that pesticides caused it. I got it because my cells were weak." When asked where they got their usual medical care, respondents identified the rural health clinics and regional medical center, which are close by the village, but medical providers don't come into the village on any routine basis.

In contrast, residents of Village B had access to a rural health clinic for primary care that is right in the village, but there are no large medical centers nearby, and people have to travel a considerable distance to access specialty services. On the other hand, home health visits are made annually by peer social workers from the community who check up on household members and refer them to the rural clinic for diagnosis and treatment of any problems. Despite having approximately the same population size as Village A (a few hundred persons), this community has practically no incidence of cancers of any type, and no one has been diagnosed with CCA. Diabetes, infectious diseases (e.g. Dengue fever), and the health care needs of elderly family members were the major health concerns expressed by respondents. They were also concerned about the long-term consequences of alcohol drinking and tobacco smoking, which were highly prevalent behaviors mentioned in both of the villages.

Domain 6
Cancer prevention practices

As noted above, the cancer survivors in Village A attributed the causes of cancer largely to pesticides, although one of the farmers vehemently denied this and thought that his inherently weak constitution was to blame. With his exception, the others wanted to reduce their use of pesticides and to urge others in the community to do the same. And as a result of their participation in the CCA screening campaign that saved their lives, they had become advocates to inform family and neighbors of the benefits of cancer screening. In addition, a community nurse informed us that stool samples from villagers recently tested negative for Opisthorchis viverrini, a prominent cause of CCA, possibly due to the success of a prior health education campaign to prevent parasitic infection and raise awareness of available treatment. In Village B, where cancer is very rare, there is little attention to its causes. Respondents talked about "healthy lifestyles" (not further defined) as promoting overall health, and indeed the region has become a tourist destination for people seeking holistic health retreats, but no specific cancer preventive actions were contemplated.

Discussion

Results from our ethnographic analysis suggested that the two villages displayed striking differences in such domains as social structure, agricultural practices, water sources and diet, while they were similar in the use of herbicides. These differences could plausibly contribute to CCA risk [9], and would account for the differences in the prevalence of liver cancer between the two villages. Specifically, different family structure and occupations

were observed between the two villages. In Village A, large family size with more older people working in the farming may have led to overall low household income compared to Village B. Education levels were low in both villages. Low income and low educational attainment were risk factors of CCA in the TIGER-LC study [1].

Farming in the two villages involves the use of pesticides, which could be detrimental to the liver and subsequently increases famers' risk for developing cancer. The low-income farming of corn and rice often require multiple applications per year of pesticides. People in Village A reported unsafe use of pesticides, heightening their risk for developing cancer [1]. In contrast, people in Village B are involved in farming coffee, tropical fruits, and other cash crops, which yield higher prices compared to staple crops, and do not require multiple applications of pesticides each year. Respondents in Village B expressed more limited use of pesticides.

Diets overall were similar in the two villages, except for the consumption of freshwater crabs and crab paste in Village A (absent in Village B), that appeared to have a high potential for contamination with pesticide residues. Drinking water had a similar disparity, with village A relying on surface water with a high potential for pesticide runoff, in contrast to Village B that was upstream of point-source contamination. To the extent that any of the above factors are contributing to the high CCA risk in the region, they would all be amenable to preventive interventions, including community education outreach, as further described below.

Regarding community strengths and preventive factors, Village B was notable for having a history of engaging in healthy lifestyles and promoting the overall health of the community, supported by a network of social workers affiliated with the local rural health clinic. Very few people there had ever experienced cancer of any type, and there were no known cases of CCA. In contrast, Village A had CCA survivors living in the community. Surprisingly, few if any people mentioned their awareness of liver flukes as a cause of CCA.

Our observations from these two communities are consistent with prior research in Thailand. Numerous anthropological studies have been conducted among the Hill Tribes communities in Northern Thailand, documenting the recent and rapidly evolving transitions from their traditional to mainstream practices in diet, health, and agriculture [18]. Consistent with our observations about drinking water quality in the two villages, access to clean drinking water is an ongoing issue for both groups, as recent studies estimate that 43 million people in Thailand are drinking water that is contaminated with industrial and agricultural runoff [19]. This is because many communities, including members of the Hill Tribes such as those in Village B, rely on groundwater and surface water that is particularly vulnerable to contamination [20]. Pesticides, such as atrazine and organochlorine compounds, and coliform bacteria from animal and human waste are routinely detected in drinking water samples [21].

Regarding the use of and access to health services, it has been noted that many Hill Tribe communities face barriers to health care access, unlike our respondents in Village B, and tend to utilize healthcare at much lower levels compared to ethnic Thais. For example, a study on children's health noted that factors such as distance, socioeconomic disadvantages, lack of cultural sensitivity of providers, language barriers, and traditional belief systems (including preferences for traditional medicines) contribute to health inequities faced by Hill Tribe children [22]. On the other hand, successful community-based interventions have been shown to improve measures of community health among members of Hill Tribes [23-24]. In the latter study, the importance of training social workers from within these communities was noted as the most important factor that facilitated health behavioral changes. In our study, Hill Tribe respondents from Village B reported fewer health problems compared to ethnic Thais in Village A, perhaps as a result of having better medical care than typical Hill Tribe communities, and having access to trained social workers.

Several strengths and limitations should be noted. Our study benefitted from the use of a medical anthropology approach, which freed the team of investigators from discipline-specific methods of inquiry, and fostered a broader, holistic approach that addressed individual- and community-level factors, the environment, and health and social systems that impact wellness in general, and cancer specifically. The study was confined to a single province in Thailand, with interviews of a small number of residents in just two villages, which restricts generalization of the results.

In conclusions, future strategies for CCA prevention and control in this region would benefit from considering the patterns we have noted here. Tailored interventions should be devised separately for ethnic Thais and Hill Tribes. First, interventions to educate communities about the benefits of cancer screening are warranted, especially in the high-incidence regions exemplified by Village A where both HCC and CCA are commonly diagnosed. Second, we noted multiple reports of highly unsafe behaviors involving agricultural pesticides in both of the villages we visited. Regardless of the evidence of carcinogenicity of these chemicals, there are many other harmful effects from high exposures resulting from unsafe practices, including both human and environmental. However, glyphosate has been designated by the International Agency for Research on Cancer as a class 2a human carcinogen [25], and was commonly reported as an exposure by nearly all of our respondents. Therefore, interventions to teach safe handling practices of pesticides have the potential to result in multiple benefits to individuals and communities, including reducing run-off that contaminates community drink water supplies. Third, the positive impacts of the social worker system in Village B could well be used as a model to develop such networks in Village A and similar areas. Emphasizing health promotion and healthy lifestyle would yield many benefits in terms of reducing cancer risks overall, and specifically for CCA. Such interventions would be consistent with the National Cancer Control Program of Thailand's National Cancer Institute, which has called for primary cancer prevention through improved

awareness of risk factors and the promotion of healthy lifestyle behaviors [26]. And finally, all preventive interventions will require careful tailoring to address the low levels of education that we observed across the region

Author Contribution Statement

All authors contributed equally in this study.

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