Increasing Hepatitis B Screening for Hmong Adults: Results from a Randomized Controlled Community-Based Study

Moon S. Chen Jr[1], Dao M. Fang[5], Susan L. Stewart[2], May Ying Ly[6], Serge Lee[7], Julie H.T. Dang[8], Tram T. Nguyen[3], Annette E. Maxwell[9], Christopher L. Bowlus[4], Roshan Bastani[9], and Tung T. Nguyen[10]

Abstract

Background: Hepatitis B-linked liver cancer disproportionately affects Hmong Americans. With an incidence rate of 18.9 per 100,000, Hmong Americans experience liver cancer at a rate that is 6 to 7 times more than that of non-Hispanic Whites. Serologic testing for the hepatitis B virus (HBV) is a principal means to prevent liver cancer-related deaths through earlier identification of those at risk.

Methods: Academic researchers and Hmong leaders collaborated in the design, conduct, and evaluation of a 5-year randomized controlled trial testing a lay health worker (LHW) intervention to promote HBV testing among 260 Hmong adults through in-home education and patient navigation.

Results: Intervention group participants were more likely to report receiving serologic testing for HBV (24% vs. 10%, $P = 0.0056$) and showed a greater mean increase in knowledge score (1.3 vs. 0.3 points, $P = 0.0003$) than control group participants. Multivariable modeling indicated that self-reported test receipt was associated with intervention group assignment [OR 3.5; 95% confidence interval (CI) 1.3–9.2], improvement in knowledge score (OR 1.3 per point; 95% CI 1.02–1.7), female gender (OR 5.3; 95% CI 1.7–16.6), and having seen a doctor in the past year at baseline (OR 4.8; 95% CI 1.3–17.6). The most often cited reason for testing was a doctor's recommendation.

Conclusions: LHWs were effective in bringing about HBV screening. Doctor visits and adherence to doctors' recommendations were pivotal. Participation of health care providers is essential to increase HBV testing.

Impact: LHWs can significantly increase HBV screening rates for Hmong but their doctors' recommendation is highly influential and should be pursued. *Cancer Epidemiol Biomarkers Prev; 22(5); 782–91. ©2013 AACR.*

Introduction

Hepatocellular carcinoma (HCC) is responsible for about two-thirds of all primary liver cancers and is the cancer type most clearly associated with hepatitis B (HBV) and hepatitis C viral infections and cirrhosis (1). The risk of liver cancer is 12 to 300 times greater in individuals chronically infected with HBV than in those who are infection-free. Asian Americans experience not only the highest incidence but also the highest mortality rates for liver cancer (2). Chronic HBV infection is endemic among Asian Americans (3) and is the principal risk factor for liver cancer among this population, responsible for 80% to 85% of cases (4). Of all Asian American groups, the Hmong experience the lowest survival rates due to HCC (5) and are the subject of this article on a community-based randomized controlled trial to increase their HBV screening rates.

According to the 2010 Census, there are 260,076 Hmong living in the United States, a 40% increase since 2000 compared with a 9.7% increase for the overall U.S. population (6). California is home to 91,224 Hmong, the largest of any state (7). This dramatic population increases, the high incidence rates of HBV infection (25.7/100,000 for males and 8.8/100,000 for females; ref. 8), and the sociocultural health concerns it reflects constitute a context for this community-based intervention study to address the HBV-induced liver cancer burden affecting Hmong Americans.

Data and studies on the cancer burden affecting Hmong Americans in California and elsewhere in the United States are limited. The first known published data specifically on the overall Hmong cancer burden in California were reported by Mills and Yang (9–12). On the basis of their data from the California Cancer Registry, using names and other personal identifiers to identify those of

Authors' Affiliations: [1]Division of Hematology and Oncology, Department of Internal Medicine and [2]Department of Public Health Sciences, [3]School of Medicine; [4]Division of Gastroenterology and Hepatology, Department of Internal Medicine, University of California, Davis; [5]University of Phoenix and Health Net, Inc.; [6]Southeast Asian Assistance Center; [7]Division of Social Work, California State University, Sacramento; [8]Administrative Core, "Liver Cancer Control Interventions for Asian Americans", University of California, Davis Comprehensive Cancer Center, Sacramento; [9]Fielding School of Public Health and Jonsson Comprehensive Cancer Center, University of California, Los Angeles, Los Angeles; and [10]Division of General Internal Medicine, Department of Medicine, University of California, San Francisco, San Francisco, California

Corresponding Author: Moon Shao-chuang Chen Jr, University of California Davis Comprehensive Cancer Center, 4800 2nd Avenue, Suite 2200, Sacramento, CA 95817. Phone: 916-734-1191; Fax: 916-703-5003; E-mail: moon.chen@ucdmc.ucdavis.edu

Hmong ancestry, they concluded that Hmong disproportionately experience cancers of infectious origin, such as cervical, gastric, nasopharyngeal, and liver, rather than the more common cancers, of chronic origin, such as lung, breast, and colorectal experienced by the general U.S. population. They emphasized the importance of factoring in Hmong-specific sociocultural influences to reduce the burden of cancers of infectious origin and the emerging burden of more chronic forms of cancer due to more westernized lifestyles (9–12). Ross and colleagues (13) using surnames from the Minnesota Cancer Registry data came to similar conclusions about the preponderance of cancers of infectious origin affecting Minnesota Hmong compared with Minnesota residents at large (14).

In California's Central Valley, a prevalence of HBV infection of 16.7% was assessed with a convenience sample of 534 Hmong adults (15) and a 3.41% prevalence among Hmong blood donors compared with 0.06% from donors of all ethnicities (16). Overall, California Hmong are especially affected by liver cancer, with an average annual incidence rate of liver cancer at $18.9/10^5$ compared with $3.4/10^5$ for non-Hispanic Whites (17). The median survival time for Laotian/Hmong HCC cases is only one month, the lowest of all Californian Asians (5).

Thus, for Hmong adults, serologic testing for hepatitis B to determine whether they are chronically infected is the first step toward controlling HBV-induced liver cancer. Serologic testing resulting in detection of chronic HBV infection can also increase the chances of receiving effective treatment with medications, such as IFN-α, entecavir, or tenofovir (18). Findings from a randomized controlled study of HBV-infected individuals in China suggest that surveillance for HCC with ultrasound imaging and serum α-fetoprotein can lead to early detection and improved survival (19).

The overall purpose of this study was to evaluate the effectiveness of a lay health worker (LHW) intervention in a community-based randomized trial to promote serologic testing for HBV and increase knowledge of HBV among Hmong adults. We hypothesized that a significantly greater proportion of Hmong adults, ages 18 to 64 years, enrolled in the intervention arm of this LHW study would report serologic testing at posttest than in the control arm, and that the knowledge gain in HBV would likewise be greater for Hmong enrolled in the intervention arm than for those in the control arm. The study entitled "Community-Based Hepatitis B Interventions for Hmong Adults" was registered on ClinicalTrials.gov as NCT00888407.

Materials and Methods

Research participant consents

The University of California, Davis Institutional Review Board (Sacramento, CA) approved the protocol for participation. Verbal consent for telephone screening was obtained by bilingual interviewers. Bilingual LHWs who made home visits obtained consent from participants in person before enrollment in the control or intervention arms of the study.

Theoretical basis of intervention

The LHW strategy for intervention delivery (described in the next section) and the selection of intervention content and elements were informed by the Health Behavior Framework (HBF), which is a comprehensive conceptual framework that posits that individual health action is influenced by a multiplicity of factors at the individual, health system, and societal levels (20, 21). The model also provides guidance on selecting an intervention strategy that is appropriate for the target audience in question. Thus, we selected a LHW strategy focused primarily on modifying individual HBF factors, such as HBV knowledge, perceived susceptibility to HBV infection, perceived severity of liver cancer, and on reducing barriers and supporting facilitators to action.

LHW intervention strategy

The LHW intervention strategy is an example of the indigenous model (22), which acknowledges the advantages of having individuals who are mature, bilingual, and bicultural from the targeted population as intervention agents. The LHW model recognizes the value of indigenous workers in reaching out and communicating health content and behavioral change to the targeted population. The effectiveness of such a LHW model for Cambodians, Laotians, and Vietnamese in heart health education (23) and in lay-led smoking cessation among Cambodian, Laotian, and Vietnamese men have been documented (24). In our study, Hmong LHWs were experienced case management staff, fluent in Hmong and English, at least 21 years of age, with a driver's license and car, were able to work flexible hours, and were trained by research staff. To reduce potential contamination, LHWs for the intervention arm were only trained on HBV content and LHWs for the control arm were only trained on nutrition and physical activity content. All of the teams who administered the baseline and posttest interviews and conducted educational sessions were composed of a male and a female LHW, respecting the cultural tradition of men working with male participants and women working with female participants. The teams, who were from 2 different Hmong community-based organizations in different counties, each conducted the baseline interviews in their respective county areas before randomization. Then teams from one organization conducted the intervention (HBV screening) educational sessions, and teams from the other organization conducted the control (nutrition and physical activity) educational sessions. After completion of the intervention and control activities, the intervention teams conducted posttest interviews with the control group participants, and the control teams conducted posttest interviews with the intervention group participants. The project manager, a bilingual/bicultural Hmong health professional, maintained fidelity of execution of their respective protocols by accompanying LHWs on 19 percent of their visits.

Study sites

Our study was conducted in the Greater Sacramento, California area (Sacramento County and its 4 contiguous counties). Our community collaborators gathered the names, addresses, and telephone numbers of Hmong residents using the 18 distinctive Hmong surnames (10) to identify Hmong from local telephone directories in addition to their lists of clients and attendees at outreach activities. Over 3,408 Hmong households constituted our database, which was greater than any extant listing. To minimize contamination, as many Hmong live in the same apartment complex, we only selected households that were separated by at least half a mile from currently participating households.

Study design

Our study design was jointly discussed and developed in concert with our Hmong community collaborators and consisted of: (i) telephoning Hmong households and randomly selecting one respondent ages 18 to 64 years to estimate the prevalence of serologic testing for HBV; (ii) screening age-eligible members until an individual not previously tested for HBV was identified and invited to participate in the study; (iii) collecting baseline data from each consenting participant; (iv) randomly assigning participants to either the intervention or control arm; (v) implementing intervention and control activities; and (vi) administering postintervention assessments.

Research questions

Our research questions were as follows: (i) How common is serologic testing for HBV among Hmong adults (ages 18–64 years)? (ii) How effective is a LHW intervention in promoting serologic testing for HBV among Hmong adults? (iii) How effective is a LHW intervention in increasing knowledge of HBV among Hmong adults not previously tested for HBV? (iv) What factors facilitate or impede serologic testing for HBV among Hmong adults?

Sample selection

To enroll new participants, we randomly selected a batch of households from our database, examined the address of each household in the order selected, and rejected any whose address was within half a mile of a current participant or another household in the same batch. We then attempted to contact and screen each household by telephone. If we reached an adult Hmong individual, we conducted a screening interview with each consenting household member aged 18 to 64, selected in random order, until we identified a person who had not been tested for hepatitis B; we then invited that individual to participate in the intervention trial. Although all household members were welcome to attend the educational sessions, only one individual per household was enrolled in the study.

Home visits by LHWs

LHWs visited homes 3 times. The first visit was to administer the baseline instrument before the participant was assigned to the intervention or control condition. A maximum of 2 weeks elapsed between the first visit and the second visit for an educational session approximately 45 minutes long. LHWs used a colored flip chart on HBV (intervention) or nutrition (control) where the key points were presented in a standardized manner in Hmong or in English. The third visit was to administer posttests, which were conducted approximately 6 months after the first visit.

The intervention LHWs provided information in Hmong or English (respondent's preference) in a culturally appropriate and comprehensible way on the value of serologic testing for HBV to the eligible respondent. LHWs made phone calls one week after the education session to offer navigation to a serologic testing site. The LHWs provided additional case management to individuals who tested positive, including scheduling follow-up care appointments, transportation, and interpretation, applying for health insurance, and emotional support. The control condition LHWs also communicated in Hmong or English (respondent's preference) in a culturally appropriate and comprehensible way but instead provided education about healthy nutrition and physical activity. At the end of the educational session, the LHWs offered navigation services, including linking participants to nutrition programs, such as women, infants, and children and local food banks, and taking them to grocery stores.

During the third session, intervention and control group LHWs administered the posttests to the control and intervention group participants, respectively. To assess the dependent variable, self-reported serologic testing for HBV during the study period, respondents were asked, "Have you ever had a blood test to check for hepatitis B?" Those answering "yes" who reported being tested at a time between the screening interview and the posttest were considered "self-reported tested", and all others were considered "self-reported not tested." Participants received a 25 lb bag of rice for doing each survey (pretest and posttest).

Sample size and power

Our study had 80% power to detect a difference of 20 percentage points between the study arms at the 0.05 level, (2-sided) based on an assumption that 5% to 20% of the control group participants would report being serologically tested, with a sample size of 100 per arm at posttest. In the study, we enrolled 260 participants who had never been tested for HBV, with equal numbers randomized to the intervention group ($n = 130$) and to the control group ($n = 130$). Two hundred seventeen participants completed the posttest: 105 in the intervention group and 112 in the control group.

Questionnaire

The baseline and follow-up questionnaires were based on the HBF (20, 21). The baseline questionnaire assessed demographic information, access to care, HBV knowledge

(11 items), screening history, HBV-related attitudes and beliefs, nutrition, physical activity, acculturation, and other measures relating to the HBF (20, 21). The postintervention questionnaire also included items on whether, when, where, and why the participant received serologic testing, as well as questions about the education and kind of services received from the LHW. See Table 1.

Statistical methods

We assessed the history of HBV testing for a randomly selected 18- to 64-year-old member of households screened for eligibility to participate in the randomized trial and computed the proportion reporting being tested, along with its 95% confidence interval (CI). We compared participants in the 2 study arms with respect to baseline demographic characteristics, access to care, and HBV knowledge to assess balance between the study arms. χ^2 tests were used for categorical variables and Student t tests for continuous variables.

Evaluation

To evaluate the intervention, we used a χ^2 test to assess the difference between the intervention and control arms with respect to the postintervention proportion reporting serologic testing during the study period. We also conducted an analogous intent-to-treat analysis in which study dropouts were considered not serologically tested.

We used a χ^2 test to compare the intervention and control arms with respect to the postintervention proportion answering each knowledge item correctly. Within each study arm, the change from pre- to post-test in the proportion answering each item correctly was assessed using McNemar's test, and the difference between the study arms (difference-in-difference score) was assessed using a z-test that accounted for correlation between an individual's responses over time. The knowledge score was defined as the number of knowledge items answered correctly and the differences between pretest and posttest knowledge scores were computed for each participant. We used a Student t test to assess the difference between the intervention and control arms with respect to the change between baseline and postintervention in mean knowledge score.

Regression analyses

We developed a logistic regression model for the self-reported receipt of serologic testing during the study period (yes or no) as a function of factors potentially associated with testing according to the HBF. The model included a term for study arm (intervention vs. control) representing the intervention effect. Independent variables included demographic and health-related variables (age, gender, educational level, marital status, length of U.S. residency, English language fluency, household income, employment status, regular place of medical care, had seen a doctor in the past 12 months at baseline, had seen a traditional healer in the past 12

months at baseline, self-perception of health). Baseline HBV knowledge scores and change in knowledge scores from pretest to posttest (i.e., posttest score minus baseline score) were also included in the model to assess the association of test receipt with increased knowledge controlling for baseline knowledge level. Statistical significance was assessed at the 0.05 level (2-sided) for all analyses.

Results

Of the 1,860 households selected, we were able to contact 869; the remainder had no phone ($n = 48$), a disconnected phone number ($n = 551$), or did not answer ($n = 392$). Within those contacted households, we identified 552 potential respondents. Of these, 490 were screened for eligibility, 59 refused the screener, and 3 could not be contacted. Of those screened, 260 consented and were randomized equally to intervention and control conditions. The remaining individuals were ineligible ($n = 107$) or refused to participate in the trial ($n = 123$; ref. see Fig. 1).

Sociodemographic characteristics of the 260 Hmong randomized trial participants with comparisons between control and intervention groups at baseline are presented in Table 1. The overall high proportion of female respondents, those with no formal education, foreign nativity (Laos and Thailand), unemployment, low annual household income, but high proportion with health insurance, and overwhelming use of the Hmong language to answer the survey is noteworthy. These characteristics affirm that our study engaged among the most underserved Hmong and hence our findings should be framed within that context. No statistically significant differences in sociodemographic characteristics were detected between control and intervention participants. At baseline, no differences in HBV-related knowledge were detected for 8 of 11 items. Control participants were more likely to answer correctly: "can get HBV by sharing needles" (86% vs. 72%, $P = 0.0039$); "can get HBV at childbirth" (74% vs. 59%, $P = 0.013$); and "HBV causes liver cancer" (66% vs. 52%, $P = 0.017$); control group participants also had higher mean knowledge scores at baseline (5.1 vs. 4.2, $P = 0.042$).

Answers to research questions

Baseline prevalence of HBV test receipt. Altogether 18% of Hmong individuals ages 18 to 64 (78/433) who were initially selected from each household reported having been serologically tested for hepatitis B (95% CI 14%–22%).

Effect of intervention on test receipt. In an intention-to-treat analysis in which study dropouts were classified as not screened, statistically significant results were achieved (19% vs. 8%, $P = 0.0119$). The proportion of Hmong adults, ages 18–64 years, reporting serologic testing for HBV during the study period at posttest was also significantly greater in the intervention group than the control group (24% vs. 10%, $P = 0.0056$). The absolute

Table 1. Baseline characteristics of Hmong American participants (Greater Sacramento, CA Region) 2007–2011: comparisons between control and intervention group

	Total % n = 260	Control % n = 130	Intervention % n = 130	P
Age group (y)				
18–29	28.1	26.2	30.0	0.7164
30–49	44.6	46.9	42.3	
50–64	27.3	26.9	27.7	
Gender				
Male	40.4	39.2	41.5	0.7046
Female	59.6	60.8	58.5	
Marital status				
Married or has partner	71.9	75.4	68.5	0.4409
Widowed or divorced	13.5	12.3	14.6	
Single	14.6	12.3	16.9	
Education				
No formal education/DK	63.9	65.4	62.3	0.6056
Some formal education	36.2	34.6	37.7	
Years in the United States				
≤10	37.9	35.7	40.2	0.4665
>10	62.1	64.3	59.8	
Country of birth				
Laos	73.1	74.6	71.5	0.8311
Thailand	21.5	20.0	23.1	
USA	5.4	5.4	5.4	
Employment				
Employed	31.9	35.4	28.5	0.3104
Not employed	68.1	64.6	71.7	
Annual household income				
<$20,000/DK	63.5	66.9	60.0	0.2464
>$20,000	36.5	33.1	40.0	
Health insurance status				
Yes	90.8	92.3	89.2	0.3914
No/DK	9.2	7.7	10.8	
Seen a traditional healer in past 12 months				
Yes	34.2	35.4	33.1	0.6950
No/DK	65.8	64.6	66.9	
Regular place of health care				
Yes	78.0	76.9	79.1	0.6767
No/DK	22.0	23.1	20.9	
Seen a doctor in past 12 months				
Yes	62.3	59.2	65.4	0.3059
No/DK	37.7	40.8	34.6	
Language of survey				
Hmong	91.0	93.0	89.1	0.2745
English/both	9.0	7.0	10.9	
English fluency				
Fluently/well	15.8	15.4	16.2	0.8649
So-so/poorly/not at all/DK	84.2	84.6	83.9	
General health				
Good	65.8	64.6	66.9	0.6950
Fair/poor/DK	34.2	35.4	33.1	

Abbreviation: DK, don't know.

Figure 1. CONSORT flow diagram, HBV screening intervention.
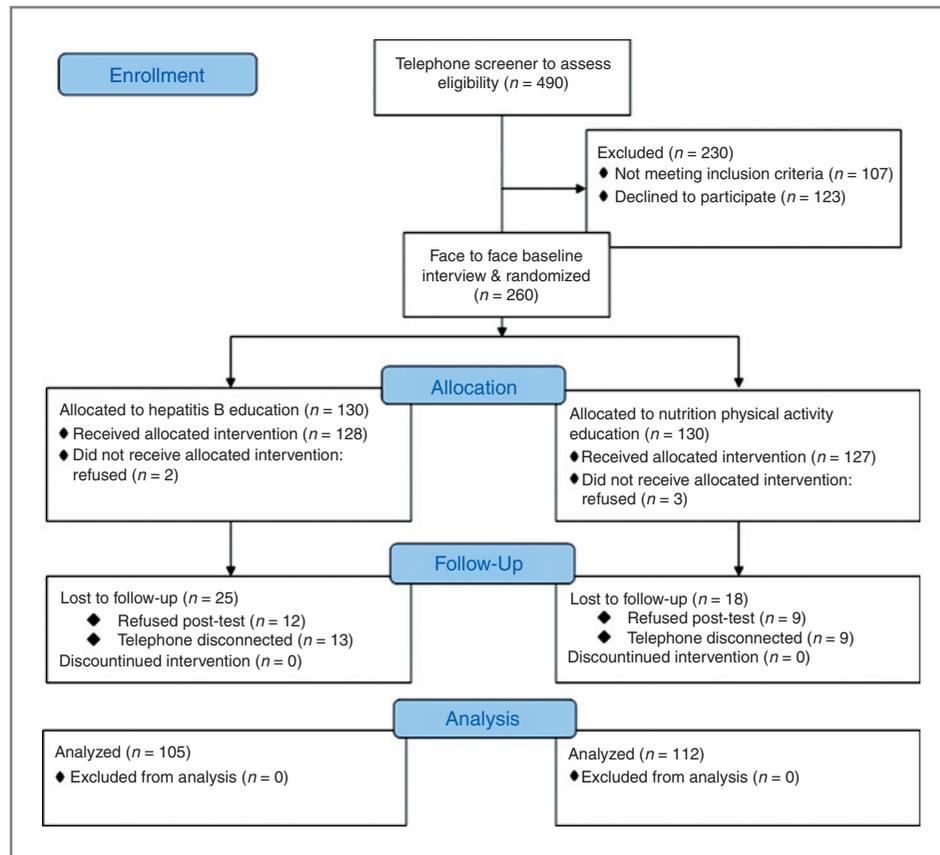
numbers of individuals being serologically tested were 25 in the intervention group and 11 in the control group. Adhering to a doctor's recommendation for testing was given as a reason for being tested by 13 of the 25 tested in the intervention group and 9 of the 11 tested in the control group. Thus, as with Cambodians (25), Chinese (26), Koreans (27), and Vietnamese (28), the pivotal influence of a doctor's recommendation in being tested for HBV was

Table 2. Baseline and posttest Hepatitis B-related knowledge among Hmong American respondents in Greater Sacramento Region, 2007–2011

Item	Control (n = 112)				Intervention (n = 105)				I-C Diff	I-C Diff
	Pre	Post	Diff	*P*	Pre	Post	Diff	*P*	Diff	*P*
Cannot get Hep B by smoking	0.17	0.17	0.00	1.000	0.08	0.18	0.10	0.016	0.10	0.079
Can get Hep B by sharing a toothbrush	0.63	0.77	0.13	0.014	0.54	0.68	0.13	0.035	0.00	0.994
Cannot get Hep B by sharing food/eating utensils	0.22	0.27	0.04	0.317	0.21	0.42	0.21	0.001	0.16	0.027
Cannot get Hep B by being near a person who sneezes	0.14	0.13	−0.02	0.655	0.13	0.22	0.09	0.061	0.10	0.085
Can get Hep B by sharing needles	0.84	0.84	0.00	1.000	0.69	0.83	0.14	0.003	0.14	0.018
Cannot get Hep B by shaking hands with a person	0.63	0.65	0.03	0.532	0.55	0.70	0.14	0.007	0.12	0.082
Can get Hep B by sexual intercourse	0.58	0.63	0.04	0.398	0.50	0.60	0.10	0.105	0.05	0.518
Can get Hep B at childbirth	0.74	0.72	−0.02	0.705	0.59	0.68	0.09	0.095	0.10	0.135
Can get Hep B from people who look and feel healthy	0.38	0.37	−0.02	0.724	0.30	0.37	0.08	0.194	0.09	0.222
Hep B causes liver cancer	0.64	0.71	0.06	0.274	0.48	0.56	0.09	0.106	0.02	0.764
Hmong more likely than white Americans to be infected with Hep B	0.09	0.08	−0.01	0.763	0.11	0.22	0.10	0.012	0.11	0.023

Abbreviations: C, control; I, intervention; pre, assessed at baseline; post, assessed at posttest; diff, difference.

Table 3. Factors associated with self-reported serologic testing for Hepatitis B in the study period, Hmong adults, ages 18 to 64 years, Greater Sacramento Region, 2007 to 2011 ($n = 210$)

Effect	OR[a] (95% CI)
Study arm	
Intervention	3.51 (1.33–9.24)
Control	1.00
Age, y	
18–29	0.47 (0.09–2.30)
30–49	0.39 (0.14–1.11)
50–64	1.00
Gender	
Female	5.27 (1.68–16.6)
Male	1.00
Marital status	
Married/living together	3.02 (0.92–9.93)
Widowed/divorced/single	1.00
Years of U.S. residence	
More than 10	1.48 (0.57–3.85)
10 or fewer	1.00
Employment status	
Employed	0.80 (0.24–2.69)
Not employed	1.00
Educational level	
Some formal education	0.69 (0.20–2.33)
No formal education	1.00
Speaks english	
Fluently/well	0.36 (0.03–4.61)
So-so/poorly/not at all/don't know	1.00
Annual household income	
$20,000 or more	0.48 (0.18–1.32)
Less than $20,000/don't know	1.00
Regular place of health care[b]	0.43 (0.11–1.74)
Seen doctor in past 12 months[b]	4.83 (1.32–17.6)
Seen traditional healer in past 12 months[b]	2.10 (0.86–5.08)
Self-perceived health status	
Good	1.78 (0.69–4.61)
Fair/poor/don't know	1.00
Baseline knowledge (per unit)	1.26 (0.98–1.62)
Change in knowledge (per unit)	1.32 (1.02–1.71)

NOTE: All independent variables assessed at baseline except change in knowledge.

[a]Adjusted for all variables tabulated.

[b]Yes versus No/don't know.

affirmed in Hmong as well. It should be noted that participants gave multiple reasons for being tested; in fact, 15 of 25 (60%) of intervention group participants and 2 of 11 (18%) of control group participants cited Kashia Health (the name of the project) as a reason for being tested, indicating that participants viewed the lay health worker intervention as an important motivator and facilitator.

Effect of intervention on knowledge. The mean knowledge score gain between pretests and posttests was significantly higher in the intervention compared with the control group (1.3 vs. 0.3 correct items, $P = 0.0003$). Statistically significant differences were detected in 6 of 11 HBV-related knowledge items for the intervention group compared with only one for the control group. At posttest, intervention group participants were more likely than control participants to know that one cannot get hepatitis B by sharing food or eating utensils (42% vs. 27%, $P = 0.0163$) and that Hmong are more likely than white Americans to be infected with HBV (22% vs. 8%, $P = 0.0040$), as well as showing greater increases in the proportion correct for both items, but remained less likely to know that HBV causes liver cancer (56% vs. 71%, $P = 0.0282$). (See Table 2).

Factors affecting serologic testing. Multivariable modeling indicated that self-reported test receipt was associated with intervention group assignment (OR = 3.5, 95% CI 1.3–9.2), pretest to posttest change in knowledge score (OR = 1.3 per point; 95% CI 1.02–1.7), female gender (OR = 5.3; 95% CI 1.7–16.6), and having seen a doctor in the past year at baseline (OR = 4.8, 95% CI 1.3–17.6). (See Table 3).

Participants' impressions

When asked what they learned from the LHWs, HBV education was cited by 63% of intervention group members and 35% of control group members, whereas healthy eating was cited by 76% of the control group and 39% of the intervention group (multiple responses were given). Thus, despite our attempts to eliminate any contamination, some spillover of content between the 2 groups occurred but the spillover occurred more or less equally to both groups. We surmise that the content of our questionnaires focusing on HBV, nutrition, and physical activity, may explain the inclusion of topics considered by Hmong participants and subsequently discussed with LHWs. The quality of the education was rated as "good" or "excellent" by 90% of intervention and 91% of control group participants. The LHW services most often mentioned by intervention group members were case management (49%), interpretation (46%), health access (36%), education (21%), and transportation (19%); those most often mentioned by control group members were education (34%), interpretation (26%), case management (21%), and health access (21%). The quality of the services provided by LHWs was rated as "good" or "excellent" by 96% of intervention and 95% of control group participants.

Discussion

This study is the first randomized, controlled, longitudinal study of a theoretically informed, nationally peer-reviewed intervention to promote serologic testing for HBV among Hmong Americans. To conduct this study, we assembled a team of research and community

collaborators including bilingual/bicultural Hmong scientists and community leaders as well as academic experts in biostatistics, cancer control, epidemiology, methodology, theory, and medicine. Academic research rigor, community expertise, and cultural competency perspectives were blended together resulting in innovative methodologies. For instance, to create a sampling frame for this randomized, controlled study, our Hmong collaborators compiled the names and addresses of more than 3,400 households in our catchment area. No such listing of Hmong residents existed before this "census" and an enduring legacy of this study is the continued updating of this database for use by Hmong community leaders.

From this study, we determined that only 18% of the Hmong adults had reported being serologically tested for HBV. Preintervention testing rates were greater for Cambodians (45%, male; 54%, female; ref. 25); Chinese (48%; ref. 26); Koreans (56%; ref. 27); and Vietnamese (62%; ref. 28). In comparison to these other Asian American groups, the Hmong had the lowest baseline prevalence rate of HBV test receipt and, on average, the lowest baseline knowledge of HBV transmission, formal education, annual household incomes, English fluency, and awareness of HBV (29).

As a result of our randomized, controlled, LHW intervention, the proportion who reported getting a HBV test during the study period was significantly greater in the intervention group than in the control group. However, the actual number of intervention participants who reported being tested ($n = 25$) versus control participants ($n = 11$) was low relative to the effort expended, and fell far short of the CDC recommendations that those who originate from defined endemic regions should be tested for HBV (30). Although the knowledge gains for the intervention group significantly exceeded the control group, intervention group members on average had significantly lower knowledge levels than controls at baseline. Regression results indicated that increased knowledge was associated with being tested, controlling for baseline knowledge; however, the intervention effect remained substantial indicating that testing was mainly due to other aspects of the intervention, for example, navigation.

In our multivariable model, having visited a doctor within the past 12 months was a strong independent predictor of being tested (OR = 4.8), and a doctor's recommendation was also one of the most common reasons for getting tested, regardless of group assignment. Results from the study therefore support the importance of interaction with health care providers as a determinant of being tested. Future interventions that are health care system-based and directly influence health care provider behaviors, such as through electronic messaging would seem to be more effective (31), and greater emphasis on influencing provider behavior in community clinic settings is warranted. Our incremental progress in increasing screening was achieved with considerable capacity build-ing (i.e., training bilingual/bicultural Hmong educators, development of educational materials, translation, home visits, etc.). This capacity building represents an investment in the infrastructure of the 2 Hmong community-based organizations with whom we worked, and the skills and products that were developed are part of the legacy of this study, enabling the potential of future community-centered participatory efforts.

Limitations

A major limitation of these findings is the reliance on self-reported serologic testing rates by Hmong participants. Our rationale for powering our study based on self-reported screening receipt was that in community trials like this one in which participants are not all recruited from the same health system, it can be impractical and cost-prohibitive to collect medical record information from the numerous separate providers. In addition, in community trials focusing on low resource populations, many participants do not have a usual source of care so it is difficult to determine where to obtain validation data for participants who do not report receipt of screening. On the basis of results of other intervention studies that verified self-reported tests in provider records (32–34), it is likely that the actual proportion tested in each study arm was lower than indicated by self-report.

We acknowledge that we had to select a large number of households to reach our planned sample size. In particular, we do not know how many unreachable households contained individuals in our target population (Hmong ages 18 to 64 not tested for hepatitis B), and whether such individuals differed systematically from the study participants. Nevertheless, 490 of 552 individuals in contacted households (89%) agreed to be screened for eligibility, and 260 of 383 eligible persons (68%) agreed to participate in the randomized trial, indicating that contacted households were well represented.

This study also has considerable strengths. We partnered with 2 Hmong community-based organizations, the Hmong Women's Heritage Association for the intervention group, and the Hmong Cultural Council of Butte County. These community-based organizations have a history of service and had already earned the community's trust. We could not have conducted this study without the full support of the Hmong community and its leaders. Our ideas (research design, instrument, conduct of the study, etc.) were thoroughly vetted with Hmong community leaders before implementation. The Hmong project manager supervised the LHWs and the data collection, assured the fidelity of the study with respect to research rigor, and contributed extensively to the interpretation of the data. The value of already having earned community trust was immeasurable to the success of this study as it facilitated immediate access to the Hmong community throughout the Greater Sacramento region. Our study embodied many of the characteristics that Lee and colleagues (35) recommended to reduce barriers to cancer screening in Hmong Americans. All of

our LHWs were bilingual, bicultural professionals who were well trained and well supervised to assure fidelity to protocols. Regular meetings and extensive documentation allowed us to assure adherence to research rigor. If unanticipated situations arose, the project manager conscientiously brought them to the attention of other members of the research team for joint resolution, data analyses, and interpretation of the data. Furthermore, we benefited from our colleagues who were conducting parallel studies among Korean Americans and Vietnamese Americans.

Conclusions

A LHW intervention focused on Hmong adults achieved a statistically significant effect on self-reported serologic testing for HBV, the principal risk factor for HCC, and perhaps the most important cancer health disparity affecting Asian Americans (36). This LHW intervention also resulted in significantly greater increases in knowledge about HBV compared with the control condition. Nevertheless, it seemed that even greater effectiveness would be achieved by having more physicians recommend HBV testing.

Disclosure of Potential Conflicts of Interest

C.L. Bowlus has commercial research grant from Gilead, Bristol Myers Squibb, and Intercept; has honoraria from speakers' bureau of Gilead and Bristol Myers Squibb; and is a consultant/advisory board member of Gilead. No potential conflicts of interest were disclosed by the other authors.

Authors' Contributions

Conception and design: M.S. Chen Jr, D.M. Fang, S.L. Stewart, M.Y. Ly, S. Lee, R. Bastani, T.T. Nguyen
Development of methodology: M.S. Chen Jr, D.M. Fang, S.L. Stewart, M.Y. Ly, S. Lee, A.E. Maxwell, R. Bastani, T.T. Nguyen
Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): M.S. Chen Jr, D.M. Fang, M.Y. Ly, S. Lee, T.T. Nguyen
Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): M.S. Chen Jr, D.M. Fang, S.L. Stewart, M.Y. Ly, S. Lee, T.T. Nguyen, C.L. Bowlus, T.T. Nguyen
Writing, review, and/or revision of the manuscript: M.S. Chen Jr, D.M. Fang, S.L. Stewart, M.Y. Ly, S. Lee, J.H.T. Dang, T.T. Nguyen, A.E. Maxwell, C.L. Bowlus, R. Bastani, T.T. Nguyen
Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): M.S. Chen Jr, D.M. Fang, S.L. Stewart, M.Y. Ly, J.H.T. Dang, T.T. Nguyen
Study supervision: M.S. Chen Jr, D.M. Fang, S.L. Stewart, M.Y. Ly, S. Lee

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