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Abstract

Objective: In United States, Asian Americans are 10 times more likely to have hepatitis B virus (HBV) infection than Whites. Asian immigrants with limited English proficiency face extra barriers to HBV screening and many are unaware of the infectious status. This study aimed to evaluate a social media-based intervention to promote HBV screening and liver cancer prevention among Korean Americans (KA) with limited English proficiency.

Methods: Our community-academia partnership developed the “Lets talk about liver cancer” mHealth program by adapting a CDC media campaign. The program consisted of culturally tailored short video clips and pictorial messages and was delivered over 4 weeks to the participants via the popular Korean social media app, Kakao Talk. A total 100 KA living in greater Washington DC metropolitan were recruited via social media networks and completed this pre-post pilot study.

Results: Out of the 100 participants of KA, 56 were female, mean age was 60, and most have lived in the U.S. for more than 20 years, 84% had limited English proficiency, and 21% had a family history of HBV infection or liver cancer. After 4-week intervention, 95% completed the follow-up survey. Participants reported significant improvements in HBV-related knowledge, liver cancer prevention knowledge, perceived benefits of HBV testing, perceived risks of HBV infection, injunctive norms of HBV testing, and self-efficacy of HBV testing.

Conclusions: The Kakao Talk-based liver cancer prevention program for KAs was feasible and effective. We advocate for community-academia partnership to develop and implement culturally appropriate and social media-based interventions for underserved immigrants.

Keywords

HBV, liver cancer, social media, behavioral intervention, asian americans

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Introduction

Hepatitis B virus (HBV) infection continues to be a global health threat and a leading cause of cirrhosis and primary liver cancer, globally affecting nearly 300 million people.¹ In the United States (US), an estimate 850,000~2.2 million people have HBV infection.² The latest report of national prevalence of HBV released in 2020 updated that about 23% Asian Americans had past exposure to HBV compared to only 4.6% of general population; current HBV infection rate among Asian Americans is 3.41%, nearly 10 time that of U.S. general population (0.35%).³ Of those HBV infected Asian Americans, 85%

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are foreign born.³ The high prevalence of HBV infection in Asian Americans has led to higher burden of liver cancer in this group.⁴ Asian American men are 4 times more likely to die from liver cancer caused by chronic HBV compared to their white counterparts (5.6 per 100,000), with Vietnamese men having the highest liver cancer mortality (26.2), followed by Korean men (18.2) and Chinese men (14.5).⁵

The Center for Disease Prevention and Control and Advisory Committee on Immunization Practice recommends HBV screening for high-risk individuals including all foreign-born individuals from regions where hepatitis B prevalence is greater than 2% (endemic regions), such as Asian countries.⁶ However, few healthcare providers screen individuals from HBV endemic regions, and many Asian immigrants face significant barriers to HBV screening.⁷ Literature has documented low rates of HBV screening in Asian immigrants ranging from 7.5% to 35%.⁸ The barriers to screening in this vulnerable population include poor knowledge and misperception about HBV infection and transmission, stigma and fear against HBV testing, limited access to health services due to cultural, linguistic, and financial barriers as well as their immigrant status.^{5,7,8}

Several interventions have been implemented to boost HBV screening in Asian immigrants.^{9–12} However, most of these interventions are community-based and relied on direct in-person contacts by community health workers, thus having limited reach and sustainability. During COVID-19 pandemic, HBV screening effort has been significantly hampered. An urgent need exists for digital or remote delivery of intervention to promote HBV screening in the vulnerable population of Asian immigrants.

More than 95% Asian Americans own a smartphone and mostly use social media apps.¹³ The use of smartphone and social media has significantly accelerated since COVID-19 pandemic. Many Asian immigrants have chosen to use social media apps of their native languages. For example, KakaoTalk, developed in South Korea, are being used by 96% of Korean smartphone owners, including Korean Americans.¹⁴ Similar to WhatsApp and Facebook, Kakao Talk users can send personal or group messages with photos, videos, links, and files; they can take part in group chats with unlimited number of friends; they can also make voice or video chats for free.¹⁴

To address the persistent health disparities of liver cancer mortality and high prevalence of HBV infection in Asian immigrants, this pilot study aims to test a social media-based intervention to promote HBV screening and liver cancer prevention program among Korean Americans. We adapted an existing HBV knowledge media campaign led by CDC and delivered it via the popular social media app of Kakao Talk. The program was evaluated with a pre-post test among 100 Korean Americans.

Methods

Study setting

The study took place in Washington DC metropolitan area, including Maryland, Northern Virginia, and Washington DC, where Asian Americans account for more than 15% of the total population and continue to grow rapidly.¹⁵ For example, in Fairfax County of Virginia, Asian Americans accounted for 23% of total population in 2020 and are projected to reach 34% in 2040.¹⁶ In Montgomery County of Maryland, Asian Americans accounted for 15.7% total population in 2020 and are projected to reach 28% in 2040.¹⁷ An estimate of 120,000 Korean Americans live in Washington DC metropolitan and a large number of them have limited English proficiency.

Recruitment and data collection procedure

From February to October 2020, during the peak of COVID-19 pandemic, we recruited participants via “social media outreach”.¹⁸ A flyer for study recruitment was distributed via the Kakao Talk accounts of local community leaders, who have a large number of followers. Participation criteria are at least 21 years old, currently live in Washington DC metropolitan, and have a Kakao Talk account. We recruited participants from local communities for the reason that if participants would seek HBV testing as a result of this intervention, we would like to provide information of free or low-cost testing in the area if they are uninsured or underinsured.

Eligible participants first talked to our project staff via phone or video chat on Kakao Talk and completed the informed consent. After that, they were directed to complete an online survey, then participants received the “Lets talk about liver cancer” intervention on their Kakao Talk for 4 weeks. After that, participants were asked to complete a follow-up survey online. The study protocol was approved by the Institutional Review Board of the George Mason University.

Intervention

The 4-week “Lets talk about liver cancer” was adapted from CDC’s “Know Hepatitis B Campaign.”¹⁹ This media campaign consisted of multiple public service announcements delivered through TV, radio, YouTube, and print materials from 2013 to 2015.¹⁹ We used some of the messages and used materials from our prior research on HBV interventions in this population^{11,12,20} and developed the “Lets talk about liver cancer program”. The program consisted of culturally tailored pictorial messages and short video clips and was delivered to participants’ Kakao Talk accounts over 4 weeks. Participants could respond to the information by asking questions via Kakao Talk.

Participants received information 3 times a week with each week focused on a theme. The information conveyed in the multimedia program included HBV transmission and prevalence, liver cancer risks for Asian Americans, benefits and rationale of testing HBV, and resources of testing and vaccination. The intervention was designed to 1) improve knowledge of HBV and liver cancer prevention, 2) analyze benefits versus costs of HBV screening, 3) promote positive social norms, and 4) enhance self-efficacy of screening and vaccination.²⁰

Measures

The main outcomes measured were HBV knowledge (10 items, range 0~10, Cronbach Alpha, or $\alpha=0.79$), liver cancer prevention knowledge (5 items, range 0~5, $\alpha=0.44$), perceived benefits versus cost of HBV screening (4 items, range 4~20, $\alpha=0.61$), injunctive norms of HBV screening (4 items, range 4~20, $\alpha=0.98$), perceived risks of HBV infection, and self-efficacy of HBV screening (4 items, range 4~20, $\alpha=0.92$). All these measures have been validated in previous studies with Korean Americans.^{11,12} We also collected participants' demographic characteristics, family history of HBV infection and liver cancer and acculturation. Acculturation was assessed with 5 items about their English proficiency, proportion of life years living in U.S., cultural identity (Korean or American), and social network composition (mostly Koreans or other racial/ethnic groups). Responses to these 5 items were summarized into an index (range 5~23, $\alpha=0.84$), with a higher score indicating a higher level of acculturation.

Data analysis

First, the demographic characteristics and baseline health outcomes of the participants were presented as total and by comparing if they ever had HBV testing. Students' *t* test and Fisher exact test were used to compare the mean (continuous variables) and frequency (categorical variables) between participants with or without an HBV testing. Second, the baseline and follow-up health outcomes were compared for all the patients using paired *t* test. Third, we used multivariable linear regression models to analyze the association between the intervention effects and key demographic variables. The changes in health outcomes (follow-up – baseline) were used as outcome variables. Age, gender, type of insurance, regular source of care, history of HBV in family members and acculturation were used as the independent variables. The effects of the independent variables on health outcomes were measured by the estimated value of the corresponding regression coefficient and its 95% confidence intervals. The regression diagnostics were investigated to validate the assumed linear

model and presence of potential outliers. The analyses were conducted using R environment (version 4.0.0).

Results

The participants' demographic characteristics, health outcomes, and their relationships with ever having HBV test are depicted in Table 1. Their mean age was 60 years (SD = 12), 56% were female; 43% had household income less than \$40k; 41% were unemployed; 70% reported excellent to good health; about 84% had limited English proficiency; and on average they have lived in U.S. for 24 years. About 21% participants had a family history of liver cancer, 13% had a family member with HBV infection, and only 18% reported that their doctors ever recommended HBV testing. HBV testing was associated with younger age, insurance coverage, having a regular source of care in western doctor's office, having a family member with HBV infection, better HBV knowledge, perceived higher benefits of HBV testing, and better self-efficacy of HBV testing.

Table 2 illustrates the health outcomes before and after the intervention. HBV knowledge increased from 5.89 to 9.75; liver cancer prevention knowledge increased from 2.44 to 4.90; perceived benefits vs. costs of HBV testing decreased 8.69 to 8.49; injunctive norms of HBV testing increased from 15.99 to 16.42, perceived risks of HBV infection increased from 5.70 to 6.53; and self-efficacy of HBV testing increased from 15.70 to 15.92. All these health outcomes had significant changes after the intervention.

Table 3 presents how the intervention effects, as measured by the change in health outcomes varied by key demographic characteristics while adjusting for potential covariates. The increase in HBV knowledge was significantly higher for older and male participants compared to their counterparts. The participants without family history of HBV showed a significantly higher increase in HBV knowledge than participants with family history of HBV. Younger participants reported higher levels of changes in perceived risks of HBV infection after the intervention. The changes in injunctive norm of HBV testing were higher in participants with insurance coverage than those without, and higher in participants without a regular source of care than those who used western doctor for care.

Discussion

This study reports one of the first social media-based HBV screening promotion and liver cancer prevention interventions for Asian Americans. We adapted an existing HBV knowledge media campaign for digital delivery via a social media app. The intervention had a high follow-up rate of 95%, and it led to significant changes in health outcomes, including knowledge of HBV and liver cancer, and

Table 1. Sample characteristics comparing HBV testing (baseline) .

Variable	Total (n = 100)	Had HBV testing (n = 70)	No or don't know (n = 30)	p-value
Age (mean, SD)	60.13 (12.24)	61.54 (11.54)	56.79 (13.39)	0.10
Age group				0.09
<45	11 (11%)	6 (8.57%)	5 (16.67%)	
45~60	24 (24%)	14 (20%)	10 (33.33%)	
>60	63 (63%)	49 (70%)	14 (46.67%)	
Gender				< 0.01
Male	43 (43%)	23 (32.86%)	20 (66.67%)	
Female	56 (56%)	46 (65.71%)	10 (33.33%)	
Household income				0.59
≤ \$39,999	43 (43%)	32 (45.71%)	11 (36.67%)	
\$40,000 – \$74,999	33 (33%)	21 (30%)	12 (40%)	
≥ \$75,000	22 (22%)	15 (21.43%)	7 (23.33%)	
Employment status				0.13
Employed	64 (64%)	41 (58.57%)	23 (76.67%)	
Unemployed	36 (36%)	29 (41.43%)	7 (23.33%)	
Marital status				0.36
Married	86 (86%)	62 (88.57%)	24 (80%)	
Unmarried	14 (14%)	8 (11.43%)	6 (20%)	
Living arrangement				0.52
Living alone	2 (2%)	1 (1.43%)	1 (3.33%)	
Living with spouse or family	97 (97%)	69 (97.14%)	29 (96.67%)	
Health status				0.92
Excellent to good	71 (71%)	49 (70%)	22 (73.33%)	
Fair or poor	29 (29%)	21 (30%)	9 (26.67%)	
English speaking				0.55
Fluent or well	16 (16%)	10 (14.29%)	6 (20%)	
So-so, very limited, to not at all	84 (84%)	60 (85.71%)	24 (80%)	

(continued)

Table 1. Continued.

Variable	Total (n = 100)	Had HBV testing (n = 70)	No or don't know (n = 30)	p-value
Language spoken at home				1.00
Korean only or mostly Korean	97 (97%)	68 (97.14%)	29 (96.67%)	
English	3 (3%)	2 (2.86%)	1 (3.33%)	
Years living in US	24.07 (7.18)	24.09 (6.87)	24.03 (7.97)	0.97
Type of insurance				0.10
No insurance	12 (12%)	8 (11.43%)	4 (13.33%)	
Private insurance	47 (47%)	29 (41.43%)	18 (60%)	
Public (Medicaid Medicare etc)	35 (35%)	29 (41.43%)	6 (20%)	
Regular source of care				0.02
None/ Oriental clinic	11 (11%)	4 (5.72%)	7 (23.33%)	
Western doctor's office	88 (88%)	65 (92.86%)	23 (76.67%)	
Doctor recommended HBV testing	18 (18%)	14 (20.29%)	4 (15.38%)	0.77
Have a family history of liver cancer	21 (21%)	16 (22.86%)	5 (16.67%)	0.60
Have a family member of HBV	13 (13%)	12 (17.14%)	1 (3.33%)	0.10
Acculturation score (mean, SD)	9.42 (2.59)	9.25 (2.51)	9.79 (2.77)	0.37

Table 2. HBV-related health outcomes pre- and post-intervention comparison .

Domain	Baseline	Follow-up	Change	p-value
HBV knowledge (range 0~10)	5.89 (2.55)	9.75 (0.56)	3.86 (2.58)	<0.001
Liver cancer prevention knowledge (range 0~5)	2.44 (1.01)	4.90 (0.42)	2.45 (1.10)	<0.001
Perceived benefits vs costs of HBV testing (range 4~20)	8.69 (1.77)	8.48 (1.69)	-0.26 (0.89)	0.01
Injunctive norms of HBV testing (range 4~20)	15.99 (2.42)	16.42 (1.87)	0.44 (2.19)	0.05
Perceived risks of HBV infection (range 1~10)	5.70 (1.75)	6.53 (1.73)	0.84 (0.58)	<0.001
Self-efficacy of HBV testing (range 4~20)	15.70 (2.02)	15.92 (1.92)	0.26 (0.99)	0.01

perceived benefits, perceived risks, injunctive norms, and self-efficacy of HBV testing.

The success of this pilot study suggested that it was feasible and effective to deliver HBV screening promotion and liver cancer prevention intervention in underserved Korean immigrants via the popular social media app used by the

group. Our results were comparable to the existing community-based HBV promotion intervention that required in-person contact.⁹⁻¹²

The high prevalence of HBV infection and disproportional burden of liver cancer caused by chronic HBV in Asian Americans highlights the urgent need for more targeted

Table 3. Changes in HBV-related health outcomes by key demographics.

	HBV knowledge β (95% CI)	Liver cancer knowledge β (95% CI)	perceived benefits of HBV testing β (95% CI)	injunctive norms of HBV testing β (95% CI)	perceived risks of HBV infection β (95% CI)	self-efficacy of HBV testing β (95% CI)
Age	0.07 (0.02, 0.13)	0.01 (-0.01, 0.04)	0.02 (-0.00, 0.05)	0.04 (-0.02, 0.09)	-0.02 (-0.03, -0.01)	-0.00 (-0.03, 0.02)
Gender: Male vs. Female	1.72 (0.76, 2.68)	0.08 (-0.41, 0.57)	0.11 (-0.31, 0.52)	1.09 (0.11, 2.07)	0.03 (-0.23, 0.28)	0.16 (-0.31, 0.63)
Type of insurance (no insurance as reference)						
Public insurance	-0.33 (-2.03, 1.38)	-0.89 (-1.77, -0.02)	0.31 (-0.46, 1.09)	1.58 (-0.31, 3.48)	-0.21 (-0.66, 0.24)	-0.12 (-0.96, 0.72)
Private insurance	0.40 (-1.27, 2.07)	-0.08 (-0.94, 0.78)	0.71 (-0.05, 1.47)	2.52 (0.60, 4.43)	-0.17 (-0.61, 0.28)	-0.11 (-0.94, 0.73)
Regular source of care (use eastern clinic or no regular source of care as reference)						
Western clinic	-1.19 (-0.48, 2.86)	0.15 (-1.01, 0.71)	-0.46 (-0.37, 1.29)	-2.93 (-4.87, -0.99)	0.45 (0.00, 0.89)	-0.24 (-1.11, 0.63)
Have a family member w. HBV vs. not	-3.26 (-4.60, -1.93)	0.67 (-0.01, 1.36)	0.39 (-0.19, 0.97)	-0.12 (-1.51, 1.27)	0.07 (-0.28, 0.43)	-0.54 (-1.20, 0.11)
Acculturation level	-0.03 (-0.28, 0.22)	-0.05 (-0.18, 0.08)	0.02 (-0.09, 0.13)	-0.02 (-0.28, 0.25)	-0.03 (-0.10, 0.03)	-0.00 (-0.12, 0.12)

interventions in this vulnerable population. For decades, interventions to promote HBV screening and vaccination in this population were limited to community-based in-person outreach; thus, the reach, impact, sustainability, and scalability of these interventions were limited. The advent of social media has brought with it new opportunities for public health interventions.²¹ However, most of the social media-based public health campaigns were delivered via Facebook or Twitter for “mainstream” audiences, few have been designed for minority populations, especially immigrants with limited English proficiency.²² As noted by Jorgenson and colleagues about the barriers to promote HBV screening and vaccination in Asian Americans, “to add to the challenge of low knowledge levels, prior research highlighted the linguistic isolation faced by many Asian Americans. The linguistic isolation supported the use of in-language media outlets, as many Asian Americans cannot be reached through mainstream English language media.”¹⁹ Developing culturally relevant and linguistic appropriate program like “Lets talk about liver cancer” was a direct response to this urgent public health need.

Cultural and linguistic appropriate content alone is not sufficient for intervention effectiveness, the right intervention channel is also critical for its adoption and scalability. For example, the CDC-led HBV knowledge campaign from which the current intervention was adapted, was available in multiple Asian languages. It was delivered as a mass media campaign via TV, radio, and print media. It costed more than \$2.2 million and lots of donated time from TV and radio stations. The program outcomes or effectiveness were never reported.¹⁹ Such a mass media campaign is expensive and might not effectively reach the target population. Delivering culturally tailored public health campaign via social media apps used by the target groups not only saves costs but also increases adoption, sustainability, and scalability. Such a targeted approach represents the future of public health campaigns in underserved communities.

This study has the following limitations. First, the intervention was delivered during the peak of COVID-19 pandemic, so we were not able to assess whether participants actually went for HBV testing; instead, proxies of behavioral outcomes such as self-efficacy of HBV testing were measured. Future studies need to include clinically validated outcomes in program evaluation. Second, this pilot study did not include a comparison group, the intervention effect we observed in this pre-post cohort design and might have potential biases or testing effects. For example, 70% participants reported they have had HBV testing, this might affect the intervention effects on self-efficacy of HBV testing or injunctive norms of testing. Third, the study was conducted in Washington DC metropolitan, the findings might not be generalizable to other Korean Americans in the country, let alone other Asian American groups.

To conclude, this study represents one of the first social media-based interventions for HBV screening promotion and liver cancer prevention in Asian Americans. It also

represents the growing trend of using minority social media platforms to serve minority populations.²² We advocate for more research and practice to deliver culturally tailored public health programs for underserved populations via social media apps used by the target groups.

Declarations

Conflicting interests: All authors declare no conflicts of interest

Ethical approval: The study protocol was approved by the Institutional Review Board of George Mason University #1637328-1.

Guarantor: YAH.

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Author Contributions: YAH and SY conceptualized and designed the study, SY obtained funding, YAH gained ethical approval, SY led participant recruitment, intervention delivery, data collection and entry, PB analyzed the data, YAH wrote the first draft of the manuscript, HSU, DL and SKK edited the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

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