Patient Education and Counseling 102 (2019) 2263–2269

Contents lists available at ScienceDirect

Patient Education and Counseling

journal homepage: www.elsevier.com/locate/pateducou

Effectiveness of a health belief model intervention using a lay health advisor strategy on mouth self-examination and cancer screening in remote aboriginal communities: A randomized controlled trial

Heng Lee[a,e], Pei-Shan Ho[b], Wen-Chen Wang[a], Chih-Yang Hu[c], Chien-Hung Lee[d], Hsiao-Ling Huang[b,*]

[a] School of Dentistry, College of Dental Medicine, Kaohsiung Medical University, Taiwan. No. 100 Shih-Chuan 1st Road, 80708, Kaohsiung, Taiwan
[b] Department of Oral Hygiene, College of Dental Medicine, Kaohsiung Medical University, Taiwan. No. 100 Shih-Chuan 1st Road, 80708, Kaohsiung, Taiwan
[c] School of Public Health, Health Sciences Center, Louisiana State University, U.S.A. 2020 Gravier Street 3F, New Orleans, LA, USA
[d] Department of Public Health, College of Health Sciences and Research Center for Environmental Medicine, Kaohsiung Medical University, Taiwan. No. 100 Shih-Chuan 1st Road, 80708, Kaohsiung, Taiwan
[e] Department of Oral Hygiene and Healthcare, Cardinal Tien Junior College of Healthcare and Management, Taiwan. No. 112, Minzu Rd., 23143, New Taipei City, Taiwan

ARTICLE INFO

Article history:
Received 2 January 2019
Received in revised form 12 June 2019
Accepted 1 July 2019

Keywords:
Health belief model
Health promotion intervention
Lay health advisor
Oral cancer

ABSTRACT

Objective: Oral cancers caused by chewing betel nuts have a poor prognosis. Using a lay health advisor (LHA) can increase access to health care among underprivileged populations. This study evaluated a health belief model (HBM) intervention using LHAs for oral cancer screening (OCS) and mouth self-examination (MSE) in remote aboriginal communities.

Methods: The participants were randomly assigned to intervention (IG; n = 171) and control groups (CG; n = 176). In the IG, participants received a three-chapter one-on-one teaching course from LHAs, whereas those in the CG received only a leaflet.

Results: The IG participants were 2.04 times more likely to conduct a monthly MSE than those in the CG (95% confidence interval: 1.31–3.17) and showed significantly higher self-efficacy levels toward OSC and MSE (β = 0.53 and 0.44, effect size = 0.33 and 0.25, respectively) and a lower barrier level for OSC (β = −1.81, effect size = −0.24).

Conclusion: The LHA intervention had a significantly positive effect on MSE, strengthening self-efficacy and reducing barriers to OCS among aboriginal populations.

Practice Implications: The effectiveness of the clinical treatment of underprivileged group can be improved through early diagnosis, which can be achieved using LHAs to reduce barriers to OSC.

1. Introduction

In Taiwan, mortality from and the incidence of oral cancer are both higher in the aboriginal population than in the general population. Furthermore, the mortality and incidence of oropharyngeal cancer are both higher among aboriginal communities with high prevalence of betel quid chewing than among those with a low prevalence [1]. The indigenous people who originally lived in Taiwan are referred to as aborigines and comprise 16 independent aboriginal groups, accounting for 2% of the total population of Taiwan [2]. Each aboriginal group has a unique cultural background that renders it unique from other aboriginal groups and the main culture of Taiwan. Areas in which the original culture of aboriginal communities remain are in the remote mountain areas of eastern Taiwan and southern Taiwan [2]. Aboriginal communities that inhabit remote areas in Taiwan traditionally chew betel quid and have a high proportion of betel quid chewers [3]. Studies have shown that aboriginal betel quid chewers often develop severe oral lesions [4] and periodontal alveolar bone loss [5]. A recent study on aboriginal women with betel quid chewing habits found a significant effect of betel quid exposure during pregnancy on birth outcomes [6].

Data from Taiwan's nationwide cancer registration system from 2009 to 2014 showed that oral cancer is the fifth leading cause of all cancer deaths and the fourth leading cause of cancer deaths among

* Corresponding author at: No. 100 Shih-Chuan 1st Road, Kaohsiung, 80708, Taiwan.
E-mail addresses: leeheng@ctcn.edu.tw (H. Lee), psho@kmu.edu.tw (P.-S. Ho), wcwang@kmu.edu.tw (W.-C. Wang), chu@lsuhsc.edu (C.-Y. Hu), Cnhung@kmu.edu.tw (C.-H. Lee), hhuang@kmu.edu.tw (H.-L. Huang).

https://doi.org/10.1016/j.pec.2019.07.001
0738-3991/

men [7,8]. The major risk factors for oral cancer in Taiwan are betel quid chewing with or without tobacco, alcohol consumption, and cigarette smoking [9–11], with the highest incidence among individuals who habitually chew betel quid and smoke cigarettes [12]. Therefore, the Taiwanese government has enforced health education and cessation classes for quitting betel quid chewing and cigarette smoking in high-risk populations. However, 70% of current betel quid users in Taiwan have already developed a betel quid use disorder, and a higher frequency or longer history of betel quid use are key factors correlated with an enhanced risk of an oral potentially malignant disorder [13]. Furthermore, aboriginal betel quid chewers are less likely to quit betel quid chewing because of peer pressure and withdrawal symptoms [3,14].

Implementation of community-based cancer screening programs has several benefits, including cost-effectiveness and early identification of high-risk populations [15]. However, aboriginal communities in remote areas lack sufficient resources and personnel for health promotion. In addition, each aboriginal community has a unique cultural background [3]; cultural differences and insufficient resources are major barriers to cancer screening.

A lay health advisor (LHA) is a natural helper who communicates health information between a local health department and community residents. Using the LHA strategy helps local health departments to save on staffing costs and to breakdown cross-cultural barriers. In the United States, using LHA interventions has increased the screening rates for several cancers, including colorectal cancer, breast cancer, and cervical cancer [16–21].

The health belief model (HBM) was developed in the 1950s by Hochbaum (1958) and subsequently modified by Rosenstock (1974, 1991) and Hochbaum (1992) as a model for health educators. Use of the HBM has resulted in the development of effective programs in which individuals have undergone changes in beliefs that have led to increases in healthy behaviors. The HBM is based on the concepts of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action [22,23]. Studies have found the HBM valuable in predicting health behaviors and designing intervention programs, especially for cancer screenings, such as screenings for cervical, colorectal, prostate, and breast cancers [24–29].

A 2 year intervention program using the LHA strategy to promote oral cancer screening was conducted in remote aboriginal communities in southern and eastern Taiwan. Therefore, we evaluated the effectiveness of the HBM-based intervention program with LHA strategy on oral cancer screening and self-examination among aboriginal communities in Taiwan.

2. Materials and methods

2.1. Design

A randomized controlled trial (RCT) was conducted in four and two aboriginal communities in remote mountain areas in Taitung in the east of Taiwan and Pingtung in the south of Taiwan, respectively. Participants from the identified communities were randomly assigned to an intervention group (IG) or control group (CG). The randomization process used Microsoft Office Excel to output a random number between 0–1 for each participant; if the number was less than 0.5, the participant was enrolled in the CG, and if the number was more than 0.5, the participant was enrolled in the IG. The randomization process was independently performed in each community.

2.2. Participants and procedure

This study recruited 415 participants who had been recommended by LHAs and local health departments, 347 of whom met the oral cancer screening criteria of age $\geq$ 18 years aboriginal people with betel quid chewing or cigarette smoking experience. The Health Promotion Administration, Ministry of Health and Welfare drafted the oral cancer screening criteria [30]. Betel quid chewing experience was assessed using the following question: "Have you ever chewed betel quid?" The possible responses were "I do not chew betel quid," "I have chewed before but quit over half a year ago," and "I have chewed every day for a half year or more." Participants who reported that they had chewed before but had since quit or chew everyday were defined as having betel quid chewing experience. Smoking experience was assessed using the following question: "As of today, have you smoked every day for over half a year?" The possible responses were "I do not smoke," "I have smoked before but quit over half a year ago," and "I have smoked every day for half a year or more." Participants who reported that they had smoked before but had since quit or smoke everyday were defined as having smoking experience.

An a priori power calculation was conducted based on the repeated measures of two simple *t* test between the groups for analysis. Intervention studies on the promotion of oral cancer screening have reported the effect size of leaflets or one-on-one sessions to be between small and medium [31,32]. Based on a mean estimated Cohen's d effect size of 0.2 for small effects and 0.5 for medium effects (effect size = 0.35, $p < 0.05$, power = 0.8) [32], each group needed to have a minimum sample size of 130. In this experiment, the IG and CG contained 171 and 176 participants, respectively.

The structured questionnaire was developed based on the HBM. All participants completed the questionnaire before and 1 week after the intervention. A face-to-face interview for each participant was conducted by a researcher. The questions in the questionnaire covered the following four domains: (1) individual characteristics (i.e., gender, age, educational level, working conditions, household income, and oral cancer screening experience), (2) oral cancer-related knowledge, (3) perceptions related to HBM constructs (i.e., susceptibility toward oral cancer, seriousness toward oral cancer, benefits toward oral cancer screening, and barriers toward oral cancer screening), (4) self-efficacy toward oral cancer screening and self-examination, and (5) behaviors of oral cancer screening and mouth self-examination (MSE).

2.3. LHA recruitment and training

In total, 51 trainee LHAs were recruited, as recommended by the local health department. All trainee LHAs had betel quid chewing experience, possessed a motorcycle driver's license, and lived in one of the target aboriginal communities. In addition, all trainees underwent 5 consecutive weeks of training, consisting of one 3 h session per week. The training manual was developed to educate the trainee LHAs about basic oral morphology, oral cavity functions, oral cancer-related knowledge, information on oral cancer screening, MSE techniques, and basic communication and teaching techniques. Discussion topics to develop trainee LHAs' attitudes toward oral cancer screening and severity of oral cancer were also included in the training course, such as the impact of oral cancer on individuals and their families, benefits of oral cancer screening, and benefits of maintaining good oral health. A gift certificate of US $30 and stationery were provided to the trainee LHAs who completed all sessions to encourage their attendance and participation. After 5 weeks of training, all 48 trainee LHAs passed the qualification exam and became certified LHAs.

2.4. Interventions

In the IG, a 3 h lesson consisting of three chapters and leaflets was delivered over 3 weeks, with one chapter per hour per week.

Lessons were taught one-on-one by a certified LHA at the participants' homes. The curriculum for each chapter was originally developed on the basis of HBM constructs (see Suppl. Table A) that addressed dental morphology and oral functions, the importance of oral health, oral cancer risk factors, oral cancer-related knowledge, oral cancer screening information, and MSE skills. After each chapter, the LHAs shared their experiences with the participants. The topics of discussion were implications of oral health, oral cancer screening experience, seriousness of oral cancer, and the impact of oral cancer on quality of life. The participants in the CG received only a leaflet on oral cancer-related knowledge.

2.5. Outcome measures

Each measure was evaluated for scale reliability and internal consistency. Questionnaires were conducted to measure oral cancer-related knowledge, self-efficacy toward oral cancer screening, self-efficacy toward MSE, perceptions related to HMB constructs, and oral cancer screening and self-examination behaviors and were reviewed by a panel of experts to assess content validity. To ensure adequate comprehension of the scales used, the questionnaires were pilottested on 30 aboriginals.

For perceptions related to HBM constructs (see Suppl. Table B), each item was scored on a five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). A Cronbach's α coefficient, which was the index of internal consistency for the questions, was calculated for each scale.

2.5.1. Susceptibility toward oral cancer

Three statements measured susceptibility to oral cancer, including "I think I am at risk for getting oral cancer in my lifetime." Possible scores ranged from 3 to 15; a higher score indicated higher susceptibility toward oral cancer. Cronbach's α was 0.88 for this scale.

2.5.2. Seriousness toward oral cancer

Seven statements measured seriousness toward oral cancer, including "My whole life would change if I had oral cancer." Possible scores ranged from 7 to 35; a higher score indicated higher seriousness toward oral cancer. Cronbach's α was 0.95 for this scale.

2.5.3. Benefits toward oral cancer screening

Four statements measured benefits toward oral cancer screening, including "Receiving screening for oral cancer will decrease my chances of dying from oral cancer." Possible scores ranged from 4 to 20; a higher score indicated higher awareness regarding the benefits toward oral cancer screening. Cronbach's α was 0.93 for this scale.

2.5.4. Barriers toward oral cancer screening

Eleven statements measured barriers toward oral cancer screening, including "Oral cancer screenings are unnecessary" and "Oral cancer screenings will be painful and unpleasant." A Likert scale of summated ratings was used and a numerical value was assigned for each of the five possible answers. Possible scores ranged from 11 to 55; a lower score indicated perceived fewer barriers toward oral cancer screening. Cronbach's α was 0.87 for this scale.

2.5.5. Self-efficacy toward oral cancer screening and self-examination

Two statements were used to evaluate self-efficacy toward MSE and oral cancer screening behaviors. The participants indicated their degrees of agreement with statements related to perceptions of personal ability with respect to MSE and oral cancer screening behaviors. Summated ratings were employed and a numerical value was assigned to the response for each statement. The statements were "I can undergo regular oral cancer screening" and "I can perform oral cancer self-examination correctly" (see Suppl. Table C). Possible scores ranged from 2 to 10; a higher score indicated higher confidence in performing MSE and undergoing oral cancer screening. Cronbach's α was 0.66 for oral cancer screening and 0.73 for oral cancer self-examination.

2.5.6. Oral cancer-related knowledge

Five statements were used to measure oral cancer-related knowledge (see Suppl. Table D), including "Chewing betel quid can improve oral health," and "Long-term chewing of betel nuts will cause difficulty in opening the mouth." Possible responses included *True* (1), *False* (0), and *I do not know* (0), with possible scores ranging from 0 to 5; a higher score indicated a higher degree of oral cancer–related knowledge. The KR-20 coefficient was 0.76 for oral cancer-related knowledge.

2.5.7. Oral cancer screening

After the intervention, the participants' oral cancer screening behaviors were assessed based on their answers to the question, "Did you undergo oral cancer screening after the three lessons?" Possible responses were "Yes, I did" and "No, I did not."

2.5.8. Month mouth self-examination

Month MSE was assessed based on the participants' answers to the question, "Did you perform MSE after the three lessons?" Possible responses were "Yes, I did" and "No, I did not."

2.6. Covariates

Age, gender, educational level, and screening experience were assessed at baseline for each participant in this study. Oral cancer screening experience was assessed based on the participants' preintervention answers to the question, "Did you undergo oral cancer screening in the past 2 years?"

2.7. Statistical analysis

We measured the pairwise mean changes of perceptions related to HBM constructs, self-efficacy, and knowledge between pretest and posttest by using a paired *t*-test. An independent *t*-test was used to measure changes in HBM variables, self-efficacy, and knowledge between the two groups. All effect size (Cohen's *d*) of continuous variables were calculated as the mean difference between baseline and follow-up, and between IG and CG baseline and follow-up mean difference measurement divided by the standard deviation of the sample. An effect of 0.20 is small, 0.50 is moderate, and 0.80 is large [33]. Multivariate linear regression was employed to assess the adjusted effects of the intervention on HBM variables, self-efficacy, and knowledge. Multivariate logistic regression was used to assess the adjusted effects of the intervention on oral cancer screening and MSE behaviors. All intervention effects were adjusted for age, gender, educational level, and screening experience. Significance was set at $p < 0.05$ for all statistical tests. Stata 13.1 (Stata Corp LP, College Station, Texas, USA) was used for statistical analysis.

2.8. Human ethics

The Institutional Review Board of Kaohsiung Medical University Hospital reviewed and approved our protocol (KMUHIRB-20120016). All participants provided informed consent before participation.

3. Results

Table 1 shows no significant differences in individual characteristics between the IG and CG. In the preceding 2 years, 51.5% of the IG and 44.3% of the CG had undergone oral cancer screening. Regarding the type of substance used, 50.9% of the IG and 43.2% of the CG had betel quid chewing experience only, and 30.4% of the IG and 36.4% of the CG had both betel quid chewing and smoking experience.

Table 2 shows the mean differences in oral cancer-related knowledge, self-efficacy, and HBM variables between the two groups. All variables were not significantly different between IG and CG at baseline. The levels of oral cancer-related knowledge, self-efficacy toward oral cancer screening, and self-efficacy toward MSE after the intervention were higher than those before the intervention for the IG and CG (all $p < 0.001$). In the IG, the levels of susceptibility toward oral cancer, seriousness toward oral cancer, and benefits toward oral cancer screening were significantly higher and barriers toward oral cancer screening were significantly fewer after the intervention than before the intervention ($p < 0.05$). In the CG, the levels of seriousness toward oral cancer and benefits toward oral cancer screening were significantly higher and barriers toward oral cancer screening were significantly fewer after the intervention than before the intervention ($p < 0.05$). However, the level of susceptibility toward oral cancer showed no significant change after the intervention in the CG.

As shown in Table 2, self-efficacy toward oral cancer screening, self-efficacy toward MSE, and the effect of barriers toward oral cancer screening were significantly higher in the IG than in the CG ($p = 0.001$, $p = 0.021$, and $p = 0.027$, respectively). In regard to effect size, all variables in the IG were larger than in the CG. No significant differences were observed between the two groups with respect to the effect of oral cancer-related knowledge, susceptibility toward oral cancer, or benefits of oral cancer screening before and after the intervention.

Table 3 shows the mean differences estimated of oral cancer-related knowledge, self-efficacy, and HBM variables in a multivariate linear regression analysis. All mean differences estimated were adjusted for age, gender, educational level, and screening experience. The mean differences estimated of self-efficacy toward oral cancer screening and MSE were significantly more efficient in the IG than in the CG [mean difference of 0.53 and 0.44, 95% confidence intervals (CIs): 0.23–0.83 and 0.11–0.77; effect size: 0.33 and 0.25, respectively]. The mean difference estimated for barriers toward oral cancer screening was −1.82, which was significantly different between IG and CG (95% CI: −3.21 to −0.43; effect size: −0.24). The mean differences estimated of oral cancer-related knowledge, susceptibility toward oral cancer, seriousness about oral cancer, and benefits toward oral cancer screening were not significantly different between the two groups.

Table 4 shows the results for MSE and oral cancer screening for both groups after the intervention. The percentage of participants who underwent oral cancer screening after the intervention was higher in the IG (36.8%) than in the CG (28.4%); however, the

Table 1
Distribution of individual characteristics arranged by two groups.

Variables	Intervention Group (n = 171)		Control Group (n = 176)		*P*
	N	%	N	%	
Age (M ± SD)[a]	49.76	±11.99	51.06	±13.27	0.338
Gender					0.639
Men	83	48.5	81	46.0	
Women	88	51.5	95	54.0	
Education level					0.175
Less than high school	131	74.4	116	67.8	
High school and up	45	25.6	55	32.2	
Household income (NTD)					0.345
Low (<20,000)	127	72.2	132	74.6	
High (>20,000)	49	27.8	39	25.4	
Work status					0.547
Unemployed	89	50.6	92	53.8	
Employment	57	49.4	79	46.2	
Oral cancer screening experience					0.183
No	83	48.5	98	55.7	
Yes	88	51.5	78	44.3	
Type of substance used					0.508
Ever betel nut chewing or smoking	22	12.9	23	13.1	
Betel nut chewing only	87	50.9	76	43.2	
Smoking only	10	5.8	13	7.4	
Betel nut chewing and smoking	52	30.4	64	36.4	

[a] Used a two sample *t*-test; the others used a chi-square test.

Table 2
Mean differences of oral cancer knowledge, self-efficacy and variables of health belief model between the two groups.

Variables	Intervention Group (n = 171)	Control group (n = 176) aaa	P^b
	M ± SD	M ± SD	
Oral cancer–related knowledge (0-5)			
Pre-test	3.59 ± 1.53	3.44 ± 1.67	0.393
Post-test	4.46 ± 1.01	4.19 ± 1.38	0.036
P^a	<0.001	<0.001	
Effect size	0.57	0.45	
Diff.	0.87 ± 1.49	0.75 ± 1.98	0.502
Self-efficacy toward oral cancer screening (2-10)			
Pre-test	6.38 ± 1.53	6.87 ± 1.41	0.807
Post-test	7.70 ± 1.32	7.25 ± 1.32	0.001
P^a	<0.001	<0.001	
Effect size	0.86	0.27	
Diff.	0.86 ± 1.52	0.37 ± 1.36	0.001
Self-efficacy toward mouth self-examination (2–10)			
Pre-test	6.59 ± 1.57	6.54 ± 1.42	0.751
Post-test	7.61 ± 1.36	7.17 ± 1.39	0.003
P^a	<0.001	<0.001	
Effect size	0.65	0.44	
Diff.	1.01 ± 1.66	0.62 ± 1.49	0.021
Health belief model			
Susceptibility toward oral cancer (3–15)			
Pre-test	8.46 ± 2.32	8.36 ± 2.19	0.685
Post-test	8.88 ± 2.51	8.55 ± 2.20	0.183
P^a	0.009	0.217	
Effect size	0.19	0.09	
Diff.	0.42 ± 2.13	0.18 ± 2.00	0.282
Seriousness toward oral cancer (7–35)			
Pre-test	27.94 ± 4.63	28.00 ± 4.56	0.905
Post-test	29.35 ± 4.00	28.63 ± 3.69	0.082
P^a	<0.001	0.028	
Effect size	0.30	0.14	
Diff.	1.40 ± 4.10	0.63 ± 3.77	0.066
Benefits toward oral cancer screening (4–20)			
Pre-test	16.04 ± 2.35	15.76 ± 2.42	0.287
Post-test	16.77 ± 2.18	16.29 ± 2.01	0.035
P^a	<0.001	0.004	
Effect size	0.31	0.22	
Diff.	0.73 ± 2.08	0.52 ± 2.40	0.402
Barriers toward oral cancer screening (11–55)			
Pre-test	29.36 ± 6.97	30.65 ± 6.71	0.081
Post-test	26.57 ± 6.86	29.44 ± 6.76	<0.001
P^a	<0.001	0.011	
Effect size	0.40	0.18	
Diff.	−2.79 ± 7.06	−1.20 ± 6.26	0.027

P^a used paired *t*-test at pre- and post-test within group.
P^b used independent *t*-test between groups.
Diff. is mean difference between pre- and post-test.
Effect size are Cohen *d*, from mean difference between pre- and post-test; 0.20 is small, 0.50 is moderate, and 0.80 is large.

Table 3
The regression-estimated mean differences of participant's oral cancer knowledge, self-efficacy, and HBM variables between groups.

Effect	Mean diff.	(95% CI)	Effect size	(95% CI)
Oral cancer knowledge	0.18	(−0.18,0.55)	0.07	(−0.28,0.13)
Self-efficacy toward oral cancer screening	0.53	(0.23,0.83)	0.33	(0.12,0.55)
Self-efficacy toward mouth self-examination	0.44	(0.11,0.77)	0.25	(0.03,0.45)
Health believe model variables				
Susceptibility toward oral cancer	0.27	(−0.16,0.70)	0.12	(−0.32,0.09)
Seriousness toward oral cancer	0.82	(−0.01,1.66)	0.19	(−0.40,0.01)
Benefit toward oral cancer screening	0.22	(−0.25,0.70)	0.09	(−0.30,0.12)
Barrier toward oral cancer screening	−1.82	(−3.21, −0.43)	−0.24	(−0.44, −0.02)

95% CI = 95% confidence interval.
Mean differences estimated adjusted by age, gender, education level, and screening experience.
Effect sizes are Cohen *d*; an effect size of 0.20 is small, 0.50 is moderate, and 0.80 is large.

Table 4
Oral cancer self-exam and screening between the two groups after intervention.

Variables	Intervention group (N = 171)		Control group (N = 176)		aOR	(95% CI)
	N	%	N	%		
Oral cancer self-exam monthly					2.04	(1.31, 3.07)
Yes	115	67.3	86	48.9		
No	56	32.7	90	51.1		
Oral cancer screening					1.24	(0.70, 2.20)
Yes	63	36.8	50	28.4		
No	108	63.2	126	71.6		

95% CI = 95% confidence interval.
aOR (adjusted odds ratio) adjusted for age, gender, education level, and screening experience.

difference between the two groups was not significant (adjusted odds ratio = 1.24, 95% CI: 0.70–2.20). The percentage of participants who performed MSE after the intervention was higher in the IG (67.3%) than in the CG (48.9%). The IG were 2.04 times more likely than the CG to perform a self-examination once monthly (95% CI: 1.31–3.17).

4. Discussion and conclusion

4.1. Discussion

This study was the first to conduct an LHA intervention for promoting oral cancer screening among aboriginal betel quid chewers or cigarette smokers. This study provided evidence of the effectiveness of an HBM-based intervention using the LHA strategy in aboriginal communities. After the LHA intervention, the IG participants were more than twice as likely as CG participants to perform MSE. Moreover, the 1 month LHA intervention with one-on-one lessons and experience sharing and discussion proved more effective than reading leaflets alone for reducing barriers to oral cancer screening and increasing self-efficacy toward oral cancer self-examination.

Our study demonstrated that the LHA approach can effectively enhance on MSE, strengthening self-efficacy and reducing barriers to OCS among aboriginal populations. A previous study that conducted a smoking cessation RCT intervention for pregnant urban-dwelling indigenous women implemented case management, incentivized and supported smoking cessation, and encouraged culturally based art activities; these activities achieved positive results—nearly 100% of the women and their significant others made positive changes in their smoking habits [34]. Another RCT study examined the effects of cultural respect programs that use cultural mentors to support indigenous patients in general practice and determined that the program did not increase the rate of indigenous health checks or improve cultural respect scores in general practice [35].

In our study, 36.8% of the IG underwent oral cancer screening after the 3 week LHA intervention. In cervical cancer screening intervention studies, 31.8% participants underwent screening after only an LHA visit following an intervention [18], 62.6% participants underwent screening after an LHA visit and a subsequent reminder from an LHA [17], and 67.3% participants underwent screening after LHA lessons in small groups and a subsequent media promotion [15]. In colorectal cancer screening intervention studies, 11.2% of participants underwent screening after only an LHA visit following an intervention [19], whereas 52.7% participants underwent screening after an LHA visit and a subsequent reminder from an LHA [20]. In another previous intervention study, 50.6% of participants underwent mammography cancer screening after an LHA visit and a subsequent reminder from an LHA [16]. Considering LHA visits only, our study had the highest percentage of people who underwent screening compared with related studies. However, considering LHA visits and subsequent reminders from LHAs, other screening studies obtained higher percentages of participants undergoing screening than did our study. To increase the oral cancer screening receipt percentage, reminders from LHAs after intervention should be considered.

As indicated by our results, the IG participants were more than twice as likely as the CG participants to perform MSE. Thus, the LHA intervention for MSE was more effective and had a higher effect size than reading leaflets alone for MSE. Other studies have shown that MSE skills taught by an instructor are more effective than reading leaflets [31]. MSE may be an effective tool for improving oral cancer awareness and early detection of lesions [36,37]. One study evaluating the effectiveness of reading brochures and MSE instruction from trained health workers showed 80% overall awareness of oral cancer and its risk factors after introduction of the MSE program; however, compliance with seeking treatment remains low (32%) [36].

In the present study, both an LHA intervention and leaflet reading were found to reduce barriers to oral cancer screening; however, LHA intervention resulted in significantly fewer barriers toward oral cancer screening and a higher effect size than did leaflet reading only. Furthermore, even if nearly half of the participants had cancer screening in the past 2 years at baseline, this barrier can be considered significantly reduced after LHA

intervention. Barriers are a central part of many theories of health behavior; perceived barriers can explain engagement (or lack of engagement) in health-promoting behavior [38]. Previous studies have shown that perceived barriers are associated factors for undergoing cancer screening in Japan and Taiwan [26,39]. An oral cancer screening study showed that leaflet reading and one-on-one instruction led to more accurate oral cancer-related knowledge, decreased anticipated delay, and increased understanding of oral cancer screening [32]. By learning about the oral cancer screening process, psychological barriers to oral cancer screening weaken.

LHA intervention increases people's self-efficacy toward oral cancer screening and MSE. In the present study, regarding self-efficacy toward oral cancer screening, after learning about the oral cancer screening process through LHA, the participants were more likely to undergo oral cancer screening at local health departments. Regarding MSE, the participants were more confident about self-examining after learning MSE skills through one-on-one teaching conducted by LHAs. Thus, the LHA intervention increased self-efficacy scores to a greater degree than did leaflet reading.

All effect size between pre- and post-test of the IG were higher than the CG. In the IG, self-efficacy toward oral cancer screening had a large effect size, a medium effect size for self-efficacy toward mouth self-examination and oral cancer-related knowledge, and a small effect size for barriers toward oral cancer screening, benefits toward oral cancer screening, seriousness toward oral cancer, and susceptibility toward oral cancer. All variables in the CG had a small effect size. These findings differ from a previous study [32] that showed that the effect size of one to one teaching with a leaflet was not clearly higher than reading a leaflet only; however, our study showed a larger effect size in the IG than CG. Lay health advisors for the IG who had the same cultural background as the participants may have contributed to the larger effects in our study.

No significant differences were observed between the IG and CG in terms of seriousness toward oral cancer, benefits toward screening, and oral cancer-related knowledge. In a previous study, a well-designed leaflet was shown to reduce individual anxiety regarding screening and increase the intention toward undergo oral cancer screening [40]. In our study, a leaflet was developed to provide information regarding oral cancer and screening for the CG and as a supplementary material for LHA teaching. The difference in outcomes between the IG and CG may have been diluted in our study, possibly because of the significant mean differences before and after the intervention in the CG. Moreover, no significant difference was observed in susceptibility toward oral cancer between the two groups; health education about oral cancer implemented by the local health department for many years may be the reason for this.

This study had some limitations. First, because of social desirability concerns, the IG might have provided answers perceived to be preferable rather than those reflecting their actual conditions, particularly regarding oral cancer screening. Second, the LHA intervention program was time bound, and this study was unable to evaluate long-term effects such as those of cancer screening. Third, because the participants were living in aboriginal communities, information leakage during the intervention period cannot be ruled out. Finally, maturation bias may have occurred as the LHAs' teaching skills improved; the participants who received lessons later may have received better teaching. Bias could be avoided in future research by employing well-trained certified LHAs.

4.2. Conclusion

The community-level HBM-based intervention using an LHA strategy had a significantly positive effect on monthly mouth self-examination, self-efficacy toward oral cancer screening and self-examination, and reducing barriers to oral cancer screening among aboriginals living in remote areas of Taiwan.

4.3. Practice implications

The LHA intervention strategy significantly increased MSE, self-efficacy toward oral cancer screening and MSE, and strongly decreased barriers toward oral cancer screening. These results suggest that, in an aboriginal community that is lacking public health workers, the health department can perform an oral cancer outreach program to train LHAs to assist in the promotion of oral cancer screening rate. The clinical stage at which oral cancer is discovered affects the survival rate and prognosis of patients. This study further suggests that patients who live in remote areas can receive more effective clinical treatment if they can be screened and their oral cancer is diagnosed earlier, which can be achieved using the LHA strategy to strengthen self-efficacy and reduce barriers to OSC.

Acknowledgements

This work was supported by the Ministry of Health and Welfare, Executive Yuan, ROC (Taiwan) [grant numbers DOH102-TD-M-113-122001, MOHW103-NAHC-M-114-122005].

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.pec.2019.07.001.

References

[1] P.S. Ho, Y.H. Yang, T.Y. Shieh, C.H. Chen, C.C. Tsai, Y.C. Ko, Ethnic differences in the occurrence of oropharyngeal cancer in Taiwan, Public Health 121 (10) (2007) 765–773.
[2] Council of Indigenous Peoples. [Internet]. Executive Yuan. [updated 2019/6/2]. residence of indigenous peoples. Available from: https://www.apc.gov.tw/portal/docList.html?CID=200161A7D09A7FEC.
[3] C.C. Lin, I. Tami-Maury, W.F. Ma, C. Lam, M.H. Tsai, M.T. Lin, C.I. Li, C.S. Liu, T.C. Li, C.F. Chiu, I.Y. Lu, E.R. Gritz, Social and cultural context of betel quid consumption in Taiwan and implications for prevention and cessation interventions, Subst. Use Misuse 52 (5) (2017) 646–655.
[4] Y.H. Yang, C.H. Chen, J.S. Chang, C.C. Lin, T.C. Cheng, T.Y. Shieh, Incidence rates of oral cancer and oral pre-cancerous lesions in a 6-year follow-up study of a Taiwanese aboriginal community, J. Oral Pathol. Med. 34 (10) (2005) 596–601.
[5] C.N. Hsiao, C.C. Ting, T.Y. Shieh, E.C. Ko, Relationship between betel quid chewing and radiographic alveolar bone loss among Taiwanese aboriginals: a retrospective study, BMC Oral Health 14 (2014) 133.
[6] M.S. Yang, C.H. Lee, S.J. Chang, T.C. Chung, E.M. Tsai, A.M. Ko, Y.C. Ko, The effect of maternal betel quid exposure during pregnancy on adverse birth outcomes among aborigines in Taiwan, Drug Alcohol Depend. 95 (1-2) (2008) 134–139.
[7] C.J. Chiang, S.L. You, C.J. Chen, Y.W. Yang, W.C. Lo, M.S. Lai, Quality assessment and improvement of nationwide cancer registration system in Taiwan: a review, Jpn. J. Clin. Oncol. 45 (3) (2015) 291–296.
[8] R.C. Shelton, S.K. Dunston, N. Leoce, L. Jandorf, H.S. Thompson, D.O. Erwin, Advancing understanding of the characteristics and capacity of african american women who serve as lay health advisors in community-based settings, Health Educ. Behav. 44 (1) (2017) 153–164.
[9] Y.C. Ko, Y.L. Huang, C.H. Lee, M.J. Chen, L.M. Lin, C.C. Tsai, Betel quid chewing, cigarette smoking and alcohol consumption related to oral cancer in Taiwan, J. Oral Pathol. Med. 24 (10) (1995) 450–453.
[10] C.H. Lee, Y.C. Ko, H.L. Huang, Y.Y. Chao, C.C. Tsai, T.Y. Shieh, L.M. Lin, The precancer risk of betel quid chewing, tobacco use and alcohol consumption in oral leukoplakia and oral submucous fibrosis in southern Taiwan, Br. J. Cancer 88 (3) (2003) 366–372.
[11] K.W. Lee, W.R. Kuo, S.M. Tsai, D.C. Wu, W.M. Wang, F.M. Fang, F.Y. Chiang, K.Y. Ho, L.F. Wang, C.F. Tai, E.L. Kao, S.H. Chou, C.H. Lee, C.Y. Chai, Y.C. Ko, Different impact from betel quid, alcohol and cigarette: risk factors for pharyngeal and laryngeal cancer, Int. J. Cancer 117 (5) (2005) 831–836.
[12] C.P. Wen, M.K. Tsai, W.S. Chung, H.L. Hsu, Y.C. Chang, H.T. Chan, P.H. Chiang, T.Y. Cheng, S.P. Tsai, Cancer risks from betel quid chewing beyond oral cancer: a multiple-site carcinogen when acting with smoking, Cancer Causes Control 21 (9) (2010) 1427–1435.
[13] C.H. Lee, A.M. Ko, F.M. Yang, C.C. Hung, S. Warnakulasuriya, S.O. Ibrahim, R.B. Zain, Y.C. Ko, Association of DSM-5 betel-quid use disorder with oral

potentially malignant disorder in 6 betel-quid endemic asian populations, JAMA Psychiatry 75 (3) (2018) 261–269.
[14] S.F. Yap, P.S. Ho, H.C. Kuo, Y.H. Yang, Comparing factors affecting commencement and cessation of betel quid chewing behavior in Taiwanese adults, BMC Public Health 8 (2008) 199.
[15] Y.H. Yang, P.S. Ho, H.M. Lu, I.Y. Huang, C.H. Chen, Comparing dose-response measurements of oral habits on oral leukoplakia and oral submucous fibrosis from a community screening program, J. Oral Pathol. Med. 39 (4) (2010) 306–312.
[16] J. Mock, S.J. McPhee, T. Nguyen, C. Wong, H. Doan, K.Q. Lai, K.H. Nguyen, T.T. Nguyen, N. Bui-Tong, Effective lay health worker outreach and media-based education for promoting cervical cancer screening among Vietnamese American women, Am. J. Public Health 97 (9) (2007) 1693–1700.
[17] K.M. Russell, V.L. Champion, P.O. Monahan, S. Millon-Underwood, Q. Zhao, N. Spacey, N.L. Rush, E.D. Paskett, Randomized trial of a lay health advisor and computer intervention to increase mammography screening in African American women, Cancer Epidemiol. Biomarkers Prev. 19 (1) (2010) 201–210.
[18] E.D. Paskett, J.M. McLaughlin, A.M. Lehman, M.L. Katz, C.M. Tatum, J.M. Oliveri, Evaluating the efficacy of lay health advisors for increasing risk-appropriate Pap test screening: a randomized controlled trial among Ohio Appalachian women, Cancer Epidemiol. Biomarkers Prev. 20 (5) (2011) 835–843.
[19] C.R. Studts, Y.N. Tarasenko, N.E. Schoenberg, B.J. Shelton, J. Hatcher-Keller, M.B. Dignan, A community-based randomized trial of a faith-placed intervention to reduce cervical cancer burden in Appalachia, Prev. Med. 54 (6) (2012) 408–414.
[20] C.L. Holt, M.S. Litaker, I.C. Scarinci, K.J. Debnam, C. McDavid, S.F. McNeal, M.A. Eloubeidi, M. Crowther, J. Bolland, M.Y. Martin, Spiritually based intervention to increase colorectal cancer screening among African Americans: screening and theory-based outcomes from a randomized trial, Health Educ. Behav. 40 (4) (2013) 458–468.
[21] A.E. Maxwell, L.L. Danao, R.T. Cayetano, C.M. Crespi, R. Bastani, Implementation of an evidence-based intervention to promote colorectal cancer screening in community organizations: a cluster randomized trial, Transl. Behav. Med. 6 (2) (2016) 295–305.
[22] I.M. Rosenstock, Why people use health services, Milbank Mem. Fund Q. 44 (Suppl (3)) (1966) 94–127.
[23] I.M. Rosenstock, V.J. Strecher, M.H. Becker, Social learning theory and the health belief model, Health Educ. Q. 15 (2) (1988) 175–183.
[24] S.H. Javadzade, M. Reisi, F. Mostafavi, A. Hasanzade, H. Shahnazi, G. Sharifirad, Factors associated with the fecal occult blood testing for colorectal cancer screening based on health belief model structures in moderate risk individuals, Isfahan, 2011, J. Educ. Health Promot. 1 (2012) 18.
[25] G.X. Ma, W. Gao, C.Y. Fang, Y. Tan, Z. Feng, S. Ge, J.A. Nguyen, Health beliefs associated with cervical cancer screening among Vietnamese Americans, J. Womens Health (Larchmt) 22 (3) (2013) 276–288.
[26] M. Tsunematsu, H. Kawasaki, Y. Masuoka, M. Kakehashi, Factors affecting breast cancer screening behavior in Japan–assessment using the health belief model and conjoint analysis, Asian Pac. J. Cancer Prev. 14 (10) (2013) 6041–6048.
[27] N. Bae, S. Park, S. Lim, Factors associated with adherence to fecal occult blood testing for colorectal cancer screening among adults in the Republic of Korea, Eur. J. Oncol. Nurs. 18 (1) (2014) 72–77.
[28] F. Ghodsbin, M. Zare, I. Jahanbin, A. Ariafar, S. Keshavarzi, A survey of the knowledge and beliefs of retired men about prostate Cancer screening based on health belief model, Int. J. Community Based Nurs. Midwifery 2 (4) (2014) 279–285.
[29] H.Y. Lee, M.J. Stange, J.S. Ahluwalia, Breast cancer screening behaviors among Korean American immigrant women: findings from the Health Belief Model, J. Transcult. Nurs. 26 (5) (2015) 450–457.
[30] Health Promotion Administration. [Internet]. Taiwan: Ministry of Health and Welfare; 2015/2/24 [updated 2017/12/13]. Oral cancer screening (oral mucosal examination) criteria. Available from: https://www.hpa.gov.tw/Pages/List.aspx?nodeid=191.
[31] G. Boundouki, G. Humphris, A. Field, Knowledge of oral cancer, distress and screening intentions: longer term effects of a patient information leaflet, Patient Educ. Couns. 53 (1) (2004) 71–77.
[32] S.E. Scott, M. Khwaja, E.L. Low, J. Weinman, E.A. Grunfeld, A randomised controlled trial of a pilot intervention to encourage early presentation of oral cancer in high risk groups, Patient Educ. Couns. 88 (2) (2012) 241–248.
[33] J.W. Kotrlik, H.A. Williams, The Incorporation of Effect Size in The Incorporation of Effect Size in Information Technology, Learning, Information Technology, Learning, and Performance Research and Performance Research, (2003) .
[34] D.A. Askew, J. Guy, V. Lyall, S. Egert, L. Rogers, L.A. Pokino, P. Manton-Williams, P.J. Schluter, A mixed methods exploratory study tackling smoking during pregnancy in an urban Aboriginal and Torres Strait Islander primary health care service, BMC Public Health 19 (1) (2019) 343.
[35] S.T. Liaw, V. Wade, J.S. Furler, I. Hasan, P. Lau, M. Kelaher, W. Xuan, M.F. Harris, Cultural respect in general practice: a cluster randomised controlled trial, Med. J. Aust. 210 (6) (2019) 263–268.
[36] K.J. Elango, N. Anandkrishnan, A. Suresh, S.K. Iyer, S.K. Ramaiyer, M.A. Kuriakose, Mouth self-examination to improve oral cancer awareness and early detection in a high-risk population, Oral Oncol. 47 (7) (2011) 620–624.
[37] P.L. Jornet, F.J. Garcia, M.L. Berdugo, F.P. Perez, A.P. Lopez, Mouth self-examination in a population at risk of oral cancer, Aust. Dent. J. 60 (1) (2015) 59–64.
[38] K. Glanz, B.K. Rimer, K. Viswanath, Health Behavior and Health Education: Theory, Research, and Practice, Wiley, 2008.
[39] S.Y. Cheng, M.C. Li, S.L. Chia, K.C. Huang, T.Y. Chiu, D.C. Chan, H.M. Chiu, Factors affecting compliance with confirmatory colonoscopy after a positive fecal immunochemical test in a national colorectal screening program, Cancer 124 (5) (2018) 907–915.
[40] G.M. Humphris, R.S. Ireland, E.A. Field, Randomised trial of the psychological effect of information about oral cancer in primary care settings, Oral Oncol. 37 (7) (2001) 548–552.