Using graphic text-messaging to promote smoking cessation among first-generation Chinese and Korean male immigrants

Xiaoquan Zhao^{1*}, Emily B. Peterson², Kyeong Mi Oh³ and Xiaomei Cai¹

¹Department of Communication, George Mason University, 4400 University Drive, Fairfax, VA 22030, USA, ²National Cancer Institute, 9609 Medical Center Drive, Bethesda, MD 20892-9760, USA and ³School of Nursing, George Mason University, 4400 University Drive, Fairfax, VA 22030, USA

*Correspondence to: X. Zhao. E-mail: xzhao3@gmu.edu

Received on September 14, 2018; editorial decision on January 30, 2019; accepted on February 7, 2019

Abstract

First-generation Chinese and Korean male immigrants in the United States are at high risk for tobacco use. This study pilot-tested a graphic, native-language text-messaging intervention to promote smoking cessation among these groups. First-generation Chinese and Korean male immigrant smokers ($N = 71$) were recruited from the Washington DC area. Participants were randomly assigned to one of four conditions based on a between-subjects 2 (graphic plus text or text-only messages) $\times 2$ (quitline information or quitting tips) design. The text-messaging intervention included 30 text messages in total and lasted one month. Participants completed an expired air carbon monoxide (CO) assessment and self-reported measures at both baseline and follow-up. Results show that, from baseline to follow-up, participants' expired air CO levels decreased significantly ($P = 0.001$). Attitude toward quitting also became more positive ($P = 0.028$). Compared with text-only messages, graphic text messages produced greater positive changes in quitting attitudes ($P = 0.039$) and elicited greater fear response ($P = 0.005$). Compared with quitting tip messages, quitline information resulted in greater regret ($P = 0.016$) and fear ($P = 0.051$). These findings suggest that graphic text-messaging can be an effective method to promote smoking cessation among

first-generation Chinese and Korean male immigrants.

Introduction

Tobacco-related health disparities are a pressing challenge for tobacco control in the United States [1]. Among other populations facing disparities, immigrants are a uniquely vulnerable group whose tobacco use is influenced by a complex and dynamic web of social, cultural, economic and environmental factors [1, 2]. Asian Americans are the fastest growing immigrant group in the United States since 2010, with China ranking second and Korea ninth on the list of top source countries in 2015 [3]. Coincidentally, China and Korea both have strikingly high smoking rates among their male populations. According to the 2010 Global Adult Tobacco Survey, 52.9% of Chinese men aged 15 or older are current smokers, compared with just 2.4% of Chinese women of the same age [4]. WHO statistics show a similar pattern in Korea, with 42% of men and 6.2% of women aged 15 or older estimated as currently smoking in 2015 [5]. By comparison, in the United States, cigarette smoking rate among adults 18 years or older is 17.5% for men and 13.5% for women, respectively, based on data from 2016 [6].

In the United States, national surveillance data have typically shown relatively low levels of

smoking among Asian Americans [7, 8]. But the accuracy of these estimates have been called in question for lack of adequate sample sizes and underrepresentation of non-English-speaking groups [9, 10]. Indeed, studies using community samples and native language instruments have often reported smoking rates much higher than the national average among Chinese and Korean Americans (commonly around or above 30%) [9, 11]. Research further shows that foreign-born Asian Americans tend to smoke at a higher rate than their U.S.-born counterparts [10, 12]. The distinct gender gap in smoking is also observed among Asian American immigrants, with men smoking at a much higher rate than women [9, 11, 13]. Clearly, tobacco smoking is a predominantly male behavior among Chinese and Korean immigrants. Promoting smoking cessation among these immigrant groups can make important contributions to the reduction of tobacco-related health disparities in the United States.

A limited number of smoking cessation interventions have specifically targeted Asian immigrant groups [14, 15]. Existing studies generally show efficacy of community-based and culturally tailored programs, but they have also documented significant challenges in reaching and engaging these populations due to cultural, economic and linguistic barriers [16–18]. For example, cost of nicotine replacement therapy (NRT) is an often-cited barrier to access to this evidence-based treatment [19], an obstacle that is likely to be particularly daunting to immigrant populations. But even when NRT was made freely available in New York, utilization rate among the foreign born, particularly Asian immigrants, was still low. Several dissemination programs were implemented in local community and health care settings. But only one program through culturally and linguistically competent community organizations was able to increase the use of free NTR patches among Chinese Americans [16]. This case study demonstrates the multi-faceted challenges in promoting cessation among Asian immigrant smokers. Building on these prior experiences, this study pilot-tested a new intervention approach using graphic text-messaging to promote smoking cessation among first-generation Chinese and

Korean male immigrant smokers. This intervention approach promises low cost, broad reach, and enhanced learning from graphic risk communication. Its development is informed by several new advances in communication technologies and tobacco control strategies.

First, 95% of Americans own a mobile phone today, including 77% who own smartphones [20]. While digital divides still persist, the majority of racial and ethnic minorities [21] as well as low income groups [22] have gained access to mobile phone technologies. An increasing body of literature suggests that text-messaging is an efficient, effective and low-cost method for promoting smoking cessation [23–26]. To our knowledge, no interventions to date have used text-messaging to target Asian immigrants in the United States. However, a large trial in China has demonstrated success in using text-messages to promote quitting among Chinese smokers [27], lending confidence that a similar approach might also work with Asian immigrants in the United States.

Second, graphic representation of tobacco-related risks has received increased attention in recent years due to the potential implementation of graphic health warnings as a central tobacco control measure in the United States [28]. While legal battles and public debate continue, the scientific literature has documented clear advantages of adding graphics to convey tobacco risks in comparison to traditional, text-only warning labels [29, 30]. This evidence raises an interesting possibility that adding graphics to traditional text messages may result in similar enhanced effectiveness of a text-messaging-based smoking cessation intervention. Third, health interventions targeting immigrant groups often encounter linguistic and literacy barriers [31, 32]. Among Asian immigrants, lower education is also found to be a risk factor for tobacco use [33, 34]. Using graphics, thus, has the added advantage of overcoming language and literacy obstacles in communicating tobacco risks to Asian immigrant smokers.

The design of this intervention is informed by the extended parallel process model (EPPM) [35, 36]. According to EPPM, health messages that seek to leverage negative emotions such as fear as a source

of motivation should include both a threat component and an efficacy component. The threat component presents a health risk as having severe and personally relevant consequences, motivating people to respond. The efficacy component presents information that gives people assurance and confidence that they can successfully avert the health risk by adopting a course of action that is both effective and feasible. According to EPPM, a health message is likely to work when both components are present and sufficiently strong. When either component is missing or weak, the message may not work or may even backfire.

Based on EPPM and previous research on graphic tobacco risk communication, this intervention study expects graphic plus text messages portraying negative consequences of smoking to be more effective than text-only messages at motivating quitting among Chinese and Korean immigrant smokers. The intervention additionally tests two different types of efficacy information: an Asian language quitline vs. culturally tailored quitting tips. The Asian language quitline has been shown to be useful in promoting abstinence among Asian American smokers [37, 38]. Quitting tips are commonly used in successful text-messaging-based interventions both in the United States. [39, 40] and in China [27]. The goal of the pilot study is thus to assess (i) the relative effectiveness of graphic vs. text-only messages; (ii) the relative effectiveness of providing quitline information vs. specific quitting tips; and (iii) the acceptability and feasibility of the approach to the target populations.

Materials and methods

Study population and recruitment

The study was conducted in the Washington DC metropolitan area, which has a high level of concentration of both Chinese and Korean immigrants. To be eligible for the study, a participant had to be a foreign-born Chinese or Korean man at least 18 years of age, have a cell phone with multimedia capabilities, and be a current smoker (see measures for definition). Recruitment for the study occurred between July 2016 and January 2017. A multi-pronged recruitment

strategy was used, including in-person recruitment at social and religious events, flyers, advertising in local ethnic newspapers and online recruitment through social media popular in the target populations (e.g. WeChat for Chinese, Kakaotalk for Koreans). The study was advertised as a health communication study with immigrant smokers. The goal of smoking cessation was not explicitly stated in recruitment materials and interest in quitting was not an inclusion criterion for participation.

Study procedures

Participants were enrolled into the study on a rolling basis, and the study procedures began immediately after recruitment success to minimize attrition. The study consisted of a baseline survey and biochemical assessment, a one-month text-messaging intervention and a follow-up survey and another biochemical assessment. Data were collected by research assistants with native-language abilities through individual appointments at times and locations of the participants' convenience. Most often, data collection occurred in a public venue (e.g. a public library) or in a work place during down time (e.g. at a restaurant where the participant worked). Surveys were programed in native languages and administered using a tablet computer and a mobile app for Qualtrics, an online research platform. This study was approved by the research team's university IRB.

Participants provided informed consent before participating in the study. At baseline, participants first took a biochemical assessment. They next filled out a survey about their smoking behavior, quitting interest, relevant beliefs and attitudes and other demographic information. Participants received \$30 as a compensation for their time at the completion of the baseline survey. They were also reminded that they would receive additional compensation at the completion of the intervention and the follow-up survey.

The text-messaging intervention began one day after the baseline procedures and lasted 4 weeks. Participants were randomly assigned to one of four conditions, based on a 2 (graphics) $\times$ 2 (efficacy) study design. Randomization was based on order of

entry into the study, regardless of participants' country of origin. Participants received either graphic plus text or text-only health messages depicting the physical and social harms of smoking. They also received either information about an Asian-language Quitline [41] or culturally-tailored tips for quitting adapted from an existing smoking cessation text-messaging program, SmokeFreeTXT [39] and its application in China [42].

Extensive formative research, including multiple rounds of focus groups with members of the target populations, was conducted to inform the development of the messages used in the study. In general, message creation focused on addressing salient concerns about smoking and quitting among the target populations in a culturally appropriate manner. For example, consistent with the general importance of family in East Asian cultures, health effects on children were identified as a particularly salient threat to the target populations in formative research [43]. Multiple messages were thus developed to emphasize risks in this domain. Examples of culturally tailored quitting tips included using sunflower seeds, a popular Asian snack, to fight craving and publicly announcing one's quitting to reduce offers of cigarettes from friends, a common practice in China and Korea. Graphics from a variety of sources were considered in message construction, including pictorial cigarette warnings proposed in the United States and in use in other countries as well as imageries characteristic of East Asian cultures. Professional assistance with graphic design was obtained to ensure that the graphic representation of risk information in the messages was clear, attention-grabbing and capable of evoking strong emotional reactions. Formative research revealed a relatively high level of congruence between Chinese and Korean immigrant smokers in risk perceptions and message preferences. A decision was thus made to use the same set of text messages (albeit in two different languages) for both groups in the intervention. Additional details and findings of the formative research process can be found elsewhere [43].

A total of 50 text messages were developed for the intervention, including 15 text-only motivational messages, the same 15 messages plus illustrating

graphics, 15 tips for quitting and 5 Quitline messages. The motivational messages fell in three general categories: health effects on self, health effects on family and children and financial costs of smoking. The quitting tips focused on avoiding triggers, stress management, soliciting social support and building confidence in one's ability to quit. The quitline messages consisted of a quitline number plus simple encouragements to call. Because the quitline information was relatively straightforward, we did not develop 15 different versions as in the other message categories. Instead, participants assigned to the Quitline message condition received each of the five messages three times spread across the duration of the intervention. Figure 1 presents sample text messages used in the study.

We used a paid web-based software, EZTexting, to program and automatically deliver text messages. All text messages were delivered in pairs: a motivational message (graphic plus text or text-only) was sent first, followed 2 min later by an efficacy message (Quitline or tips). The decision to leave a 2-min gap between the pair was to allow the threat to fully register before alleviating it with efficacy information. A total of 15 pairs of messages (30 in total) were sent to each participant over the one-month intervention period. Message order within condition was random. Message frequency was regulated by week, following examples in previous research [39]. In the first week, participants received a daily pair of text messages. Message frequency then decreased to a total of four pairs of messages in the second week, and two pairs each in the third and fourth weeks. At baseline, participants identified a 3-h window in a typical day in which they would prefer to receive study messages. All messages were sent in the participant-designated block of time, but the exact timing of the messages varied randomly within the window throughout the intervention.

At the conclusion of the intervention, another appointment was made with the participant at their earliest convenience for follow-up data collection. The biochemical assessment was again administered before the follow-up survey which included some of the same measures taken at baseline plus additional measures to gauge receptivity to the

Fig. 1. Sample text messages.

Note: Chinese text in (A) reads: ‘Smoking cigarettes causes fatal lung diseases’. Korean text in (B) reads: ‘Smoking causes gangrene’. Chinese text in (C) reads: ‘Quitline offers free services to help you quit. Call 1-800-8917 (Chinese language line) to get help to quit’. Korean text in (D) reads: ‘The next time you have the urge to smoke, try to resist for 5 min. Practice this each day. Then, the urge to smoke will go away’.

intervention program. After the follow-up survey, participants were thanked and given an additional \$30 as a compensation for their time.

Key measures

Self-report measures

At baseline, current smoking was ascertained based on smoking 100+ cigarettes in lifetime and currently smoking every day or some days [6]. Nicotine dependence was assessed using a revised version of the Fagerstrom instrument [44]. Participants reported whether they were interested in quitting cigarettes for good (yes vs. no). Attitude toward quitting was measured with three semantic differential items (harmful/beneficial, wrong/right, useless/useful) [45], each rated on a 9-point scale (e.g. 1 very harmful to 9 very beneficial). Smoking consequences were assessed using a questionnaire adapted from previous research [46] that included 13 negative and positive outcomes of smoking. Sample items included ‘The more I smoke, the more I risk my health’, and ‘I enjoy the taste sensations while smoking’. Agreement with each item was indicated on a 5-point Likert scale (1 strongly disagree to 5

strongly agree). Demographics and text messaging habits were also assessed in the baseline survey.

At follow-up, participants first reported whether they had abstained from smoking in the past 7 days [42]. They were also asked whether they were currently trying to quit (yes vs. no). Those reporting not currently trying to quit were asked whether they had reduced the number of cigarettes smoked in the past month (yes vs. no). All participants then answered the same measures of attitude toward quitting and smoking consequences as in the baseline survey.

To assess experience with and receptivity to the intervention, participants reported the number of messages received in response to an open-ended question, whether they liked the amount (too few, just about right or too many) and timing of the messages (never, rarely, sometimes or often), whether they read the messages received (all, most, some or none of them), and whether they shared the messages with others (yes vs. no). They then evaluated the intervention as a whole using a program quality measure adapted from previous research [47], with items such as ‘The program was helpful’ and ‘The program changed my attitude toward smoking’.

Responses were recorded on a 5-point Likert scale (1 strongly disagree to 5 strongly agree). Participants were also asked about the emotions they experienced, while reading the texts on a scale from 1 (not at all) to 4 (extremely). Three items (frightened, anxious and nervous) tapped into fear, and another two (guilty and regretful) measured regret. Finally, participants evaluated the general persuasiveness of the text messages using items adapted from published measures of perceived message quality [48, 49] (e.g. The messages grabbed my attention; The messages were convincing). Agreement with the evaluation items was indicated on a 5-point Likert scale (1 strongly disagree to 5 strongly agree).

Biochemical assessment

A portable and non-invasive Micro+™ Smokerlyzer® (Bedfont Scientific, UK) was used to measure carbon monoxide (CO) level in the lungs (in parts per million, PPM). Expired air CO is a validated method of biochemical verification of smoking status and 8–10 PPM is a recommended cut-off point between smoking and nonsmoking status [50].

Analysis strategy

Descriptive analysis was used to obtain sample characteristics. Repeated measures ANOVAs were conducted on key continuous outcomes, including CO levels, quitting attitudes and smoking consequence beliefs, with graphics and efficacy conditions as between-subjects factors and pretest-posttest as the within-subjects factor. To further probe condition differences, also to include categorical outcomes in a unified analytical framework, we ran a series of ANCOVAs for pre-post change scores in continuous outcomes and logistic regressions for post-only categorical outcomes. All analyses included country of origin, age, years in the United States and nicotine dependence as covariates. Additional covariates were considered in preliminary analysis but excluded from final analysis due to collinearity issues and small sample size. Finally, participants' general receptivity to the intervention was assessed

through descriptive analysis and condition differences in receptivity were examined using similar ANCOVA and logistic regression analyses. All analyses were conducted using SPSS v.24.

Results

A total of 86 participants were recruited into the study and 71 (83%) completed both baseline and follow-up surveys plus biomedical assessments. Attrition analysis did not reveal any significant difference between the complete and dropout cases. Characteristics of the final sample are presented in Table I. At baseline, 21 participants (29.6%) returned CO readings below 10 ppm. Because CO has a short half-life (a matter of hours) [50], this is not unequivocal evidence of nonsmoking for these participants. We decided to retain these participants in the sample. Analyses without the low baseline CO subgroup, which showed largely the same pattern of results, are presented in Supplementary Tables for reference.

At follow-up, 10 participants (14.1%) reported abstinence from smoking in the last 7 days. Nine of the 10 returned CO readings at 7 ppm or below and one scored at 10 ppm. Half of the participants ($n=35$, 49.3%) reported currently trying to quit smoking for good. Among those not currently trying to quit, 47.2% ($n=17$) reported reducing the number of cigarettes smoked in the past month.

Condition differences in intervention outcomes

Randomization checks showed no difference among the experimental conditions at baseline (all P 's > 0.05). Repeated measures analyses did not reveal any between-within interactions (all P 's > 0.05); nor was there any significant main effect of graphics or efficacy conditions, or interaction between the two between-subjects factors (all P 's > 0.05). The within-subjects factor (pre-post change) emerged significant for CO levels ($F[1,67] = 12.27$, $P = 0.001$, $\eta_p^2 = 0.155$) and quitting attitude ($F[1,67] = 5.07$, $P = 0.028$, $\eta_p^2 = 0.07$), but not for negative ($P = 0.253$) or positive smoking consequences ($P =$

Table I. Sample characteristics at baseline

	<i>n</i>	Percentages
Country of origin		
China	39	54.9
Korea	32	45.1
Smoking frequency		
Every day	57	80.3
Some days	14	19.7
CO (PPM)		
≤9	21	29.6
10–25	33	46.5
≥26	17	23.9
Nicotine dependence		
0–1	26	36.6
2–3	12	16.9
4–5	15	14.3
6+	18	25.4
Interest in quitting		
Yes	46	64.8
No	25	35.2
Age		
18–24	20	28.2
25–40	17	23.9
41–55	21	29.6
56+	13	18.3
Years in US		
≤1	15	21.1
>1 and ≤10	25	35.2
>10 and ≤20	13	18.3
>20	18	25.4
Employment		
Yes	48	67.6
No	23	32.4
Marital status		
Married	34	47.9
Single	30	42.3
Other	7	9.8
Language preference		
Chinese/Korean	42	59.2
Chinese/Korean and English about equally	26	36.6
English	3	4.2
Number of texts per day		
0–5	35	49.3
6–10	14	19.7
11+	22	31

0.642). As shown in Table II, CO levels among the sample decreased from 17.11 to 13.49 PPM, while quitting attitudes became more positive, increasing from 8.04 to 8.48.

Table II. Changes in CO levels, quitting attitude and smoking consequence beliefs from baseline to follow-up (*N* = 71)

	Baseline M (SE)	Follow-up M (SE)	<i>P</i> -value
CO level (ppm)	17.11 (1.27)	13.49 (1.12)	0.001
Attitude toward quitting	8.04 (0.21)	8.48 (0.12)	0.028
Negative smoking consequences	4.10 (0.08)	4.19 (0.07)	0.253
Positive smoking consequences	3.65 (0.09)	3.60 (0.08)	0.642

Analyses of CO change scores, while controlling for covariates showed similar results. No significant difference was found between the graphic and text-only conditions ($P = 0.295$) or between the tips and quitline conditions ($P = 0.837$). The analysis on quitting attitude change scores, however, showed a significant difference between the graphic and text-only conditions ($F[1,62] = 4.430$, $P = 0.039$, $\eta_p^2 = 0.067$), with the graphic condition producing greater positive change in attitude. No difference was observed between the tips and quitline conditions ($P = 0.743$). Analyses of change scores in smoking consequences data did not reveal any condition differences on either the graphics or efficacy dimension (P 's > 0.241). No interaction between graphics and efficacy conditions was observed in any of these analyses (all P 's > 0.05). Logistic regressions on post-test categorical outcomes also did not reveal any significant condition effects or interactions (all P 's > 0.05). Condition-level descriptive statistics are presented in Table III.

Receptivity to intervention

Participants recalled the number of texts received with great accuracy. The mean estimate was almost the same as the actual number of texts sent ($k = 30$). Three-fourths of the sample (74%) reported receiving 20–40 texts from the intervention. Most participants felt the number of texts received was the right amount (74.6%) and the timing of the texts was never or rarely bad (78.8%). The majority of the participants read all

Table III. *Intervention outcomes by condition^a*

	Graphic (<i>n</i> = 35)	Text (<i>n</i> = 36)		Tips (<i>n</i> = 37)	Quitline (<i>n</i> = 34)	
Categorical outcomes	<i>n</i> (%)	<i>n</i> (%)	<i>P</i> -value	<i>n</i> (%)	<i>n</i> (%)	<i>P</i> -value
Last 7 day abstinence	7 (20%)	3 (8.3%)	0.230	4 (10.8%)	6 (17.6%)	0.273
Currently trying to quit	19 (55.9%)	16 (44.4%)	0.180	18 (50%)	17 (50%)	0.930
Reduced cigarette consumption ^b	8 (50%)	9 (45%)	0.552	12 (63.2%)	5 (29.4%)	0.095
Continuous outcomes	FU-B ^c M (SE)	FU-B ^c M (SE)	<i>P</i> -value	FU-B ^c M (SE)	FU-B ^c M (SE)	<i>P</i> -value
CO level (ppm)	-2.66 (1.25)	-4.53 (1.23)	0.295	-3.78 (1.21)	-3.41 (1.27)	0.837
Attitude toward quitting	0.67 (0.15)	0.22 (0.15)	0.039	0.41 (0.14)	0.48 (0.15)	0.743
Negative smoking consequences	0.11 (0.08)	0.06 (0.08)	0.652	0.13 (0.08)	0.03 (0.08)	0.399
Positive smoking consequences	-0.08 (0.11)	-0.01 (0.11)	0.641	-0.11 (0.11)	-0.01 (0.11)	0.483

^aAll models adjusted for country, age, years in the United States, and nicotine dependence at baseline.

^b*n* = 36. Only those reporting not currently trying to quit were asked this question.

^cFU, follow-up; B, baseline.

or most of the texts received (84.5%). Almost half of the participants (45.1%) reported sharing the texts with others.

Participants indicated a fairly high level of satisfaction with the program. The mean score on program quality was 3.80 and the mean rating on text persuasiveness was 3.83 on a 5-point scale, both significantly above the scale mid-point (*P*'s < 0.001). They also reported mild feelings of fear (*M* = 2.10) and regret (*M* = 2.20), while reading the texts. Relevant descriptive statistics are summarized in Table IV.

Condition differences in receptivity

Analyses of the program and text evaluation data did not reveal any condition difference on adequacy of the amount of texting, timing of the texts, text reading, text sharing or ratings of program quality (*P*'s > 0.201). However, those in the graphic condition reported experiencing more fear, while reading the texts (*F*[1,63] = 8.440, *P* = 0.005, $\eta_p = 0.118$) than their counterparts in the text-only condition. They also reported feeling more regret (*F*[1,63] = 3.252, *P* = 0.076, $\eta_p = 0.049$) and judged the texts to be more persuasive (*F*[1,63] = 3.237, *P* = 0.077, $\eta_p = 0.049$) than those in the text-only condition, but these differences did not reach significance.

Table IV. *Receptivity to the intervention for full sample (N = 71)*

Categorical variables	<i>n</i> (%)	
Number of texts is	Just about right	53 (74.6%)
	Too few	6 (8.5%)
	Too many	12 (16.9%)
Bad timing of texts	Never	39 (54.9%)
	Rarely	17 (23.9%)
	Sometimes	14 (19.7%)
	Often	1 (1.4%)
Read texts	All	41 (57.7%)
	Most	19 (26.8%)
	Some	11 (15.5%)
	None	0 (0%)
Shared texts	Yes	32 (45.1%)
	No	39 (54.9%)
Continuous variables	M (SD)	
Number of texts received	30.52 (14.85)	
Program quality	1 to 5; 5 most positive; $\alpha = 0.81$	3.80 (0.65)
Fear	1 to 4; 4 strongest; $\alpha = 0.77$	2.10 (0.77)
Regret	1 to 4; 4 strongest; $\alpha = 0.77$	2.20 (1.13)
Text persuasiveness	1 to 5; 5 most positive; $\alpha = 0.90$	3.83 (0.70)

Table V. *Receptivity to the intervention by condition^a*

		Graphic (<i>n</i> = 35)	Text (<i>n</i> = 36)		Tips (<i>n</i> = 37)	Quitline (<i>n</i> = 34)	
Categorical variables		<i>n</i> (%)	<i>n</i> (%)	<i>P</i> -value	<i>n</i> (%)	<i>n</i> (%)	<i>P</i> -value
Number of texts is				0.397			0.519
	Just about right	27 (77.1%)	26 (72.2%)		26 (70.3%)	27 (79.4%)	
Bad timing of texts	Too few or too many	8 (22.9%)	10 (27.8%)		11 (29.7%)	7 (20.6%)	
				0.628			0.997
Read texts	Never or rarely	27 (77.1%)	29 (80.6%)		29 (78.4%)	27 (79.4%)	
	Sometimes or often	8 (22.9%)	7 (19.4%)		8 (21.6%)	7 (20.6%)	
Shared texts				0.102			0.992
	All or most	32 (91.4%)	28 (77.8%)		31 (83.8%)	29 (85.3%)	
	Some or none	3 (8.6%)	8 (22.2%)		6 (16.2%)	5 (14.7%)	
				0.359			0.332
Yes		18 (51.4%)	14 (38.9%)		14 (37.8%)	18 (52.9%)	
	No	17 (48.6%)	22 (61.1%)		23 (62.2%)	16 (47.1%)	
Continuous variables		M (SE)	M (SE)	<i>P</i> -value	M (SE)	M (SE)	<i>P</i> -value
Number of texts received		30.36 (2.34)	31.03 (2.31)	0.842	27.44 (2.27)	33.95 (2.37)	0.054
Program quality		1 to 5; 5 most positive; $\alpha = 0.81$	3.84 (0.11)	0.419	3.72 (0.11)	3.88 (0.11)	0.318
Fear		1 to 4; 4 strongest; $\alpha = 0.77$	2.36 (0.12)	0.005	1.95 (0.12)	2.28 (0.12)	0.051
Regret		1 to 4; 4 strongest; $\alpha = 0.77$	2.38 (0.13)	0.076	1.99 (0.13)	2.44 (0.13)	0.016
Text persuasiveness		1 to 5; 5 most positive; $\alpha = 0.90$	3.97 (0.11)	0.077	3.83 (0.10)	3.10 (0.63)	0.938

^aAll models adjusted for country, age, years in the United States. and nicotine dependence at baseline.

Participants in the quitline condition reported more regret than those in the tips condition ($F[1,63] = 6.083$, $P = 0.016$, $\eta_p = 0.088$). They also reported feeling more fear than the latter group, and the difference bordered on significance ($F[1,63] = 3.953$, $P = 0.051$, $\eta_p = 0.059$). The tips and quitline conditions did not differ on text persuasiveness ($P = 0.938$). No significant interaction between graphics and efficacy conditions emerged in any of these analyses. Descriptive statistics for each condition are presented in Table V.

Discussion

First-generation Chinese and Korean male immigrants are high-risk populations for tobacco use [9, 11]. Yet programs to promote smoking cessation among these populations are limited and often

hindered by cultural, economic and linguistic barriers [14, 15]. In this study, we pilot tested a text-messaging-based intervention that takes advantage of the increasing popularity of smart phones and cell phones with MMS technology among immigrant populations [20–22]. It also seeks to utilize the well-documented ability of graphics to attract attention and enhance comprehension of tobacco risk information among audiences challenged by limited linguistic and health literacy [29, 30].

The results of the study are overall encouraging. In particular, pre- and post-intervention comparisons showed significant reduction in expired air CO levels in the sample, as well as positive shifts in self-reported attitudes toward quitting. Consistent with these findings, about one in seven participants reported past 7-day abstinence from smoking at follow-up that was largely confirmed by biochemical verification; and about half of those not

currently abstaining reported reducing the number of cigarettes smoked in the past month. These results suggest that this intervention approach as a whole is able to generate meaningful positive shifts in smoking behavior and quitting-related cognitions among Chinese and Korean male immigrant smokers. The fact that the current evidence was obtained in just one month with a relatively small sample makes a compelling case for the potential of this intervention approach.

In this pilot study, we compared text-only and graphic-plus-text messages as two different methods to convey risk information and motivate quitting. We additionally tested specific quitting tips vs. Asian language quitline information as two different types of efficacy-enhancing message content. The data did not reveal any differences in self-report or biochemical indicators of smoking behavior across the conditions. However, those receiving the graphic text messages did show greater positive change in quitting attitudes and report stronger negative emotions, compared with those receiving the text-only version. These results, while limited, do seem to suggest that using graphics may enhance the effectiveness of text-only messages with the Chinese and Korean male immigrant populations. This pattern of findings is also consistent with the broader conclusions in the tobacco control literature that graphic tobacco risk communication is more effective than text-only information [29, 30].

The two efficacy conditions also showed a few differences. Those in the quitline condition reported greater regret and fear than those in the quitting tips condition. This could indicate stronger emotional response to the quitline texts, but the source of this emotionality is not clear as the content of the quitline messages is purely informational. Another, perhaps more likely, possibility is that the difference in fear and regret was a result of quitting tips effectively mitigating the negative affect induced by the preceding threatening text messages. Indeed, in EPPM, a key functionality of the efficacy information is to help audience manage fear [35, 36]. Recent empirical research shows that emotional response to fear appeal messages tends to rise and fall as threat and efficacy information is sequentially encountered in

message processing [51]. While this latter explanation is consistent with the tenets of EPPM, the lack of corroborative evidence on smoking behavior, quitting attitudes and other evaluation measures compels caution in inferring superiority of quitting tips over quitline information on the basis of the current data. Until more definitive evidence is available, future smoking cessation interventions targeting Chinese and Korean immigrants may wish to include both types of efficacy messaging to increase the likelihood of favorable behavior change in response to threatening tobacco risk information.

Immigrants are often difficult to reach and resistant to broad stroke intervention methods designed for the general population [1, 14]. Indeed, recruitment proved challenging in this study and lasted longer than expected. In the end, in-person recruitment through social networks and assistance from a local community organization proved most productive. Nevertheless, those participating in this study showed a relatively high level of receptivity to the text-messaging intervention. They recalled the total number of messages received with accuracy, deemed the amount and timing of messaging appropriate, and reported reading most or all of the messages received and sharing about half of them with others. They also rated the program and the messages favorably, recognizing the help received through the program and the positive impact it had on their thoughts and behaviors related to smoking. All of this feedback suggests that the intervention was well received and did not generate any counterproductive effects.

As a pilot test, this study has its limitations. First, the sample of the study was relatively small. A larger sample would have afforded greater power and clarity in the results. The small sample also precluded separate examination of Chinese vs. Korean participants. Second, the small sample size also made it unfeasible to include a true control condition in the study. Although the pre-post design of the study allowed for the assessment of intervention effects, having a control group with no intervention could provide additional opportunities to ascertain intervention outcomes. Third, due to limited resources, the intervention program did not tap into

the full capabilities of mobile messaging. In particular, the current program did not allow for texting back or other interactive forms of communication with study participants. The message library, although carefully constructed, was also relatively small and thus unable to sustain a longer-term intervention. These issues have restricted the scope and potential of the current intervention. Fourth, this study only included a one-month follow-up. Additional follow-ups over a longer time period would provide evidence on the longevity of the effects observed in this study and other potential changes over time.

Despite the limitations, this study has generated encouraging evidence for the potential of graphic text-messaging as an efficient and low-cost method to promote smoking cessation among first-generation Chinese and Korean male immigrants. Further testing of this intervention approach on a larger scale with enhanced technological capabilities and an extended longitudinal design is warranted.

Supplementary data

Supplementary data are available at *HEAL* online

Acknowledgements

The authors gratefully acknowledge Joonwoo Moon, Jiayi Liu and Liuyi Wang for their assistance with data collection and Prof. Shanshan Cui for assistance with graphic design during message development.

Funding

This work was supported by a Multidisciplinary Research Seed Grant from George Mason University.

Conflict of interest statement

None declared.

References

1. NCI. *A Socioecological Approach to Addressing Tobacco-Related Health Disparities*. Washington, DC: National Cancer Institute, 2017. Available at: https://cancercontrol.cancer.gov/brp/tcrb/monographs/22/docs/m22_complete.pdf. Accessed: 17 September 2017.
2. Reiss K, Lehnhardt J, Razum O. Factors associated with smoking in immigrants from non-western to western countries—what role does acculturation play? A systematic review. *Tob Induc Dis* 2015; **13**: 11.
3. López G, Bialik K. *Key Findings About U.S. Immigrants*. Pew Research Center, 2017. Available at: <http://www.pewresearch.org/fact-tank/2017/05/03/key-findings-about-u-s-immigrants/>. Accessed: 10 October 2017.
4. GATS China Workgroup. *Global Adult Tobacco Survey (GATS) China 2010 Country Report*. Chinese Center for Disease Control and Prevention, 2010. Available at: http://www.who.int/tobacco/surveillance/survey/gats/en_gats_china_report.pdf. Accessed: 11 April 2018.
5. WHO. *WHO Report on the Global Tobacco Epidemic, 2017*. World Health Organization, 2017. Available at: <http://apps.who.int/iris/bitstream/handle/10665/258503/WHO-NMH-PND-17.4-eng.pdf?sequence=1>. Accessed 25 April 2018.
6. Jamal A, Phillips E, Gentzke AS *et al.* Current cigarette smoking among adults—United States, 2016. *MMWR Morb Mortal Wkly Rep* 2018; **67**: 53–9.
7. Martell BN, Garrett BE, Caraballo RS. Disparities in adult cigarette smoking—United States, 2002–2005 and 2010–2013. *MMWR Morb Mortal Wkly Rep* 2016; **65**: 753–8.
8. Jamal A, Homa DM, O'Connor E *et al.* Current cigarette smoking among adults—United States, 2005–2014. *MMWR Morb Mortal Wkly Rep* 2015; **64**: 1233–40.
9. Lew R, Tanjasiri SP. Slowing the epidemic of tobacco use among Asian Americans and Pacific Islanders. *Am J Public Health* 2003; **93**: 764–8.
10. Chae DH, Gavin AR, Takeuchi DT. Smoking prevalence among Asian Americans: findings from the National Latino and Asian American Study (NLAAS). *Public Health Rep* 2006; **121**: 755–63.
11. Kim S, Ziedonis D, Chen K. Tobacco use and dependence in Asian Americans: a review of the literature. *Nicotine Tob Res* 2007; **9**: 169–84.
12. Maxwell AE, Bornaards CA, McCarthy WJ. Smoking prevalence and correlates among Chinese- and Filipino-American adults: findings from the 2001 California Health Interview Survey. *Prev Med* 2005; **41**: 693–9.
13. Gorman BK, Lariscy JT, Kaushik C. Gender, acculturation, and smoking behavior among U.S. Asian and Latino immigrants. *Soc Sci Med* 2014; **106**: 110–8.
14. Liu JJ, Wabnitz C, Davidson E *et al.* Smoking cessation interventions for ethnic minority groups—a systematic review of adapted interventions. *Prev Med* 2013; **57**: 765–75.
15. Cox LS, Okuyemi K, Choi WS, Ahluwalia JS. A review of tobacco use treatments in U.S. ethnic minority populations. *Am J Health Promot* 2011; **25**(Suppl. 5): S11–30.
16. Shelley D, Nguyen N, Peng C-H *et al.* Increasing access to evidence-based smoking cessation treatment: effectiveness

- of a free nicotine patch program among Chinese immigrants. *J Immigr Minor Health* 2010; **12**: 198–205.
17. Kim SS. A Culturally adapted smoking cessation intervention for Korean Americans: preliminary findings. *J Transcult Nurs* 2017; **28**: 24–31.
 18. Tsoh JY, Burke NJ, Gildengorin G *et al*. A social network family-focused intervention to promote smoking cessation in Chinese and Vietnamese American male smokers: a feasibility study. *Nicotine Tob Res* 2015; **17**: 1029–38.
 19. Bansal M, Cummings KM, Hyland A, Giovino G. Stop-smoking medications: who uses them, who misuses them, and who is misinformed about them? *Nicotine Tob Res* 2004; **6**: 303–10.
 20. Pew Research Center. *Mobile Fact Sheet*. Pew Research Center: Internet, Science & Tech, 2018. Available at: <http://www.pewinternet.org/fact-sheet/mobile/>. Accessed: 25 April 2018.
 21. Perrin A. *Smartphones Help Blacks, Hispanics Bridge Some—But Not All—Digital Gaps with Whites*. Pew Research Center, 2017. Available at: <http://www.pewresearch.org/fact-tank/2017/08/31/smartphones-help-blacks-hispanics-bridge-some-but-not-all-digital-gaps-with-whites/>. Accessed: 25 April 2018.
 22. Anderson M. *Digital Divide Persists Even as Lower-Income Americans Make Gains in Tech Adoption*. Pew Research Center, 2017. Available at: <http://www.pewresearch.org/fact-tank/2017/03/22/digital-divide-persists-even-as-lower-income-americans-make-gains-in-tech-adoption/>. Accessed: 25 April 2018.
 23. DHHS. *Using Health Text Messages to Improve Consumer Health Knowledge, Behaviors, and Outcomes: An Environmental Scan*. Rockville, MD: U.S. Department of Health and Human Services. Health Resources and Services Administration, 2014. Available at: <http://www.hrsa.gov/healthit/txt4tots/environmentalscan.pdf>. Accessed: 22 May 2015.
 24. Whittaker R, McRobbie H, Bullen C *et al*. Mobile phone-based interventions for smoking cessation. *Cochrane Database Syst Rev* 2016; CD006611. doi:10.1002/14651858.CD006611.pub4
 25. Spohr SA, Nandy R, Gandhiraj D *et al*. Efficacy of SMS text message interventions for smoking cessation: a meta-analysis. *J Subst Abuse Treat* 2015; **56**: 1–10.
 26. Head KJ, Noar SM, Iannarino NT, Grant Harrington N. Efficacy of text messaging-based interventions for health promotion: a meta-analysis. *Soc Sci Med* 2013; **97**: 41–8.
 27. Augustson E, Engalgau MM, Zhang S *et al*. Text to quit China: an mHealth Smoking Cessation Trial. *Am J Health Promot* 2017; **31**: 217–25.
 28. Husten CG, Deyton LR. Understanding the Tobacco Control Act: efforts by the US Food and Drug Administration to make tobacco-related morbidity and mortality part of the USA's past, not its future. *Lancet* 2013; **381**: 1570–80.
 29. Hammond D. Health warning messages on tobacco products: a review. *Tob Control* 2011; **20**: 327–37.
 30. Noar SM, Hall MG, Francis DB *et al*. Pictorial cigarette pack warnings: a meta-analysis of experimental studies. *Tob Control* 2016; **25**: 341–54.
 31. Kreps GL, Sparks L. Meeting the health literacy needs of immigrant populations. *Patient Educ Couns* 2008; **71**: 328–32.
 32. Pitkin Derosé K, Bahney BW, Lurie N, Escarce JJ. Review: immigrants and health care access, quality, and cost. *Med Care Res Rev* 2009; **66**: 355–408.
 33. Zhang J, Wang Z. Factors associated with smoking in Asian American adults: a systematic review. *Nicotine Tob Res* 2008; **10**: 791–801.
 34. Yu ES, Chen EH, Kim KK, Abdulrahim S. Smoking among Chinese Americans: behavior, knowledge, and beliefs. *Am J Public Health* 2002; **92**: 1007–13.
 35. Witte K. Putting the fear back into fear appeals: the extended parallel process model. *Commun Monogr* 1992; **59**: 329–49.
 36. Witte K. Fear control and danger control: a test of the extended parallel process model (EPPM). *Commun Monogr* 1994; **61**: 113–34.
 37. Zhu S-H, Cummins SE, Wong S *et al*. The effects of a multilingual telephone quitline for asian smokers: a randomized controlled trial. *J Natl Cancer Inst* 2012; **104**: 299–310.
 38. Cummins SE, Wong S, Bonnevill E *et al*. A multistate Asian-language tobacco quitline: addressing a disparity in access to care. *Am J Public Health* 2015; **105**: 2150–5.
 39. Abroms LC, Boal AL, Simmens SJ *et al*. A randomized trial of Text2Quit: a text messaging program for smoking cessation. *Am J Prev Med* 2014; **47**: 242–50.
 40. Abroms LC, Chiang S, Macherelli L *et al*. Assessing the National Cancer Institute's SmokefreeMOM text-messaging program for pregnant smokers: pilot randomized trial. *J Med Internet Res* 2017; **19**: e333.
 41. Zhu S-H, Wong S, Stevens C *et al*. Use of a smokers' quitline by Asian language speakers: results from 15 years of operation in California. *Am J Public Health* 2010; **100**: 846.
 42. Augustson E, Engalgau MM, Zhang S *et al*. Text to Quit China: an mHealth smoking cessation trial. *Am J Health Promot* 2016; **31**: 217–25. doi: 10.4278/ajhp.140812-QUAN-399.
 43. Peterson EB, Zhao X, Cai X, Oh KM. Developing a graphic text messaging intervention for smoking cessation targeting first-generation chinese immigrant men: insights from focus group interviews. *Studies in Media and Communications* 2018; **15**: 241–64. doi:10.1108/S2050-206020180000015005
 44. Heatherton TF, Kozlowski LT, Frecker RC, Fagerstrom K-O. The fagerstrom test for nicotine dependence: a revision of the fagerstrom tolerance questionnaire. *Addiction* 1991; **86**: 1119–27.
 45. Fishbein M, Triandis HC, Kanfer FH *et al*. Factors influencing behavior and behavior change. In: Baum A, Revenson TA, Singer JE (eds). *Handbook of Health Psychology*. Mahwah, NJ: Lawrence Erlbaum Associates, 2001, 3–17.
 46. Myers MG, MacPherson L, McCarthy DM, Brown SA. Constructing a short form of the Smoking Consequences Questionnaire with adolescents and young adults. *Psychol Assess* 2003; **15**: 163–72.

47. Haug S, Meyer C, Schorr G *et al.* Continuous individual support of smoking cessation using text messaging: a pilot experimental study. *Nicotine Tob Res* 2009; **11**: 915–23.
48. Zhao X, Strasser A, Cappella JN *et al.* A measure of perceived argument strength: reliability and validity. *Commun Methods Meas* 2011; **5**: 48–75.
49. Davis KC, Nonnemaker J, Duke J, Farrelly MC. Perceived effectiveness of cessation advertisements: the importance of audience reactions and practical implications for media campaign planning. *Health Commun* 2013; **28**: 461–72.
50. SRNT Subcommittee on Biochemical Verification, Iii PJ, Ahijevych K *et al.* Biochemical verification of tobacco use and cessation. *Nicotine Tob Res* 2002; **4**: 149–59.
51. Dillard JP, Li R, Huang Y. Threat appeals: the fear–persuasion relationship is linear and curvilinear. *Health Commun* 2017; **32**: 1358–67.