Feasibility and Preliminary Effects of a Social Media-Based Peer-Group Mobile Messaging Smoking Cessation Intervention among Chinese Immigrants who Smoke: Pilot Randomized Controlled Trial

Nan Jiang, Ariel Zhao, Erin S. Rogers, Ana Paula Cupertino, Xiaoquan Zhao, Francisco Cartujano-Barrera, Katherine Siu, Scott E. Sherman

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Nan Jiang[1] PhD; Ariel Zhao[1] BS; Erin S. Rogers[1] DrPH, MPH; Ana Paula Cupertino[2] PhD; Xiaoquan Zhao[3] PhD; Francisco Cartujano-Barrera[2] MD; Katherine Siu[1] MS; Scott E. Sherman[1, 4] MD, MPH

[1]Department of Population Health New York University Grossman School of Medicine New York US
[2]Department of Public Health Sciences University of Rochester Medical Center Rochester US
[3]College of Humanities and Social Sciences George Mason University Fairfax US
[4]Department of Medicine VA New York Harbor Healthcare System New York US

Corresponding Author:
Nan Jiang PhD
Department of Population Health
New York University Grossman School of Medicine
17th Fl
180 Madison Ave
New York
US

Abstract

Background: Chinese immigrants experience significant disparities in tobacco use and have limited access to evidence-based tobacco treatments.

Objective: This study assessed the feasibility, acceptability, and preliminary effects of a WeChat-based peer-group mobile messaging smoking cessation intervention among Chinese immigrants who smoke.

Methods: We performed a pilot randomized controlled trial (RCT) and a single-arm pilot test with 60 participants recruited in 2022 in New York City. The first 40 participants were randomized 1:1 to either the intervention (6-week WeChat Quit Coach) or control arm (self-help print material). An additional 20 participants were enrolled in the single-arm pilot test to further assess intervention feasibility and acceptability. All 60 participants were offered a 4-week supply of complimentary nicotine replacement therapy. Surveys were administered at baseline and 6 weeks, with participants in the pilot RCT completing an additional survey at 6 months and biochemical verification of abstinence at both follow-ups.

Results: Of 74 individuals screened, 68 (91.9%) were eligible and 60 (88.2%) enrolled (mean age 42.5 years, 82% male, 70% in pre-contemplation or contemplation stage). On average, participants responded to daily text questions for 25.1 days over the 42-day intervention period, and 23% (9/40) utilized the chat-based instant messaging support. Most participants were satisfied with the intervention (92%) and would recommend it to others (82%). At 6 months, biochemically verified 7-day point prevalence abstinence rates were 25% for intervention participants and 5% for control participants.

Conclusions: WeChat Quit Coach was feasible and well-received by Chinese immigrants who smoke, and produced promising effects on abstinence. Clinical Trial: ClinicalTrials.gov: NCT05130788

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Feasibility and Preliminary Effects of a Social Media-Based Peer-Group Mobile Messaging Smoking Cessation Intervention among Chinese Immigrants who Smoke: Pilot Randomized Controlled Trial

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[1]Department of Population Health, Grossman School of Medicine, New York University, New York, NY
[2]Department of Public Health Sciences, University of Rochester Medical Center, Rochester, NY
[3]Department of Communication, College of Humanities and Social Sciences, George Mason University, Fairfax, VA
[4]Department of Medicine, VA New York Harbor Healthcare System, New York, NY

Corresponding Author:
Nan Jiang, PhD
Department of Population Health
New York University Grossman School of Medicine
180 Madison Avenue, Room #17-54
New York, NY 10016
United States
Tel: +1 (646) 501-3553
Email: Nan.Jiang@nyulangone.org

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Abstract

Background: Chinese immigrants experience significant disparities in tobacco use. Culturally adapted tobacco treatments targeting this population are sparse and the utilization is low. The low use of these treatment programs is attributed to their exclusive focus on individuals who are ready to quit and the wide range of barriers that Chinese immigrants face to accessing these programs. To support Chinese immigrant smokers at all levels of readiness to quit and address their access barriers, we developed the *WeChat Quit Coach*, a culturally and linguistically appropriate WeChat-based peer-group mobile messaging smoking cessation intervention.

Objective: To assess the feasibility, acceptability, and preliminary effects of *WeChat Quit Coach.*

Methods: We enrolled a total of 60 Chinese immigrant smokers in 2022 in New York City for a pilot randomized controlled trial (RCT) and a single-arm pilot test. The first 40 participants were randomized to either the intervention arm (*WeChat Quit Coach*) or the control arm (self-help print material) using 1:1 block randomization stratified by sex. *WeChat Quit Coach* lasted 6 weeks, featuring small peer groups moderated by a coach, daily text messages with text questions, and chat-based instant messaging support from the coach in response to peer questions. The next 20 participants were enrolled in the single-arm pilot test to further assess intervention feasibility and acceptability. All 60 participants were offered a 4-week supply of complimentary nicotine replacement therapy. Surveys were administered at baseline and 6 weeks, with participants in the pilot RCT completing an additional survey at 6 months and biochemical verification of abstinence at both follow-ups.

Results: Of 74 individuals screened, 68 (92%) were eligible and 60 (88%) enrolled. The majority of participants, with a mean age of 42.5 (± 13.8) years, were male (49/60, 82%) and not ready to quit, with 70% (42/60) in pre-contemplation or contemplation stage at the time of enrollment. The pilot RCT had follow-up rates of 98% (39/40) at 6 weeks and 93% (37/40) at 6 months, while the single-arm test achieved 100% follow-up at 6 weeks. On average, participants responded to daily text

questions for 25.1 days over the 42-day intervention period, and 23% (9/40) utilized the chat-based instant messaging support. Most participants were satisfied with *WeChat Quit Coach* (36/39, 92%) and would recommend it to others (32/39, 82%). At 6 months, self-reported 7-day point prevalence abstinence rates were 25% (5/20) in the intervention arm and 15% (3/20) in the control arm, with biochemically verified abstinence rates of 25% (5/20) and 5% (1/20) respectively.

Conclusions: *WeChat Quit Coach* was feasible and well-received by Chinese immigrants who smoke, and produced promising effects on abstinence. Large trials are warranted to assess its efficacy in promoting abstinence in this underserved population.

Trial registration: ClinicalTrials.gov NCT05130788; https://clinicaltrials.gov/study/NCT05130788

Keywords: Smoking cessation; Tobacco; mHealth; Social media; Chinese American; Immigrant

Introduction

The prevalence of smoking has declined significantly in the US over the past one-half century [1]. However, smoking rates remain disproportionately high in socioeconomically disadvantaged populations, including Chinese immigrants (foreign-born Chinese Americans). In New York City (NYC), the city with the largest Chinese immigrant population in the US, 28% of Chinese American men smoke compared to 18% of NYC men overall [2]. Chinese immigrants, accounting for 68% of the NYC Chinese American population, are more likely to smoke than US-born Chinese Americans [3].

Culturally adapted tobacco treatments for Chinese immigrants are sparse [4, 5] and the use is low. For example, the national Asian Smokers' Quitline (ASQ) engages only about 2,000 Asian American callers nationwide annually (number of Chinese-speaking callers is unknown) [6]. The low use of tobacco treatment programs is attributed to two major reasons. First, current tobacco treatment programs are designed to offer cessation support to individuals who are ready to quit smoking (meaning they plan to quit within a month). However, only 6-33% of Chinese Americans who smoke are ready to quit [7-9]. This is largely due to the limited knowledge about the harms of smoking, strong attachment to traditional Chinese pro-smoking norms, lack of behavioral capability for quitting, limited social support to facilitate cessation, and low self-efficacy [10-14]. Current tobacco treatment programs often provide no support to move the vast majority of individuals not ready to quit to the stage of being ready to quit. Second, Chinese immigrants have limited access to evidence-based tobacco treatments. Access barriers include limited awareness of treatment resources, skepticism about treatment effects, and time and economic constraints [10-12, 15, 16]. Less than 20% of Chinese American smokers who attempt to quit use pharmacotherapy or behavioral interventions [8, 17]. Research is needed to explore intervention strategies that can engage a broad group of Chinese immigrant smokers, including those not ready to quit, and address the wide range of barriers to cessation.

Over the past decade, social media has been increasingly studied as a tool for tobacco treatment. Social media can reach large populations, allow users to access at their own time of convenience with low or no cost, and may alleviate access barriers to tobacco treatment. Two systematic reviews have provided evidence supporting the feasibility and acceptability of social media-based smoking cessation interventions [18, 19]. Two randomized controlled trials (RCTs) conducted among English-speaking smokers compared social media-based tobacco treatment with other cessation support [20, 21]. Both interventions feature peer-group messaging support, with mixed findings: A Facebook-based intervention resulted in abstinence rates comparable to the control at 3, 6, and 12 months [20], whereas a Twitter-based intervention yielded a higher abstinence rate than the control on day 60 [21].

Three RCTs among Chinese-speaking smokers in Hong Kong [22] and mainland China [23, 24] compared WhatsApp- or WeChat-based interventions with usual cessation care or no tobacco treatment, all utilizing a one-on-one intervention model. A WhatsApp-based intervention led to higher abstinence than the control at 6 months (8% vs. 5% biochemically validated 7-day point prevalence abstinence) [22]. A WeChat-based intervention also produced higher abstinence than the control at 26 weeks (12% vs. 3% biochemically validated continuous abstinence) [24], but the trial only included individuals ready to quit. Another trial of a WeChat-based intervention did not report any abstinence outcomes [23]. Thus far, the impact of using social media to engage and treat smokers, particularly those not ready to quit, is still unclear.

To reduce tobacco use among Chinese immigrants, our multidisciplinary team developed a culturally and linguistically appropriate social media intervention named *WeChat Quit Coach* for Chinese immigrants who smoke, across all levels of readiness to quit. Informed by the Social Cognitive Theory and the Socioecological Model, *WeChat Quit Coach* addresses multilevel barriers to cessation [25]. The intervention features small, private peer-groups moderated by a coach, daily text messages with text questions, and chat-based instant messaging support from the coach

responding to peer questions. By utilizing WeChat, the most widely used social media platform among Chinese with approximately 1.3 billion monthly active users worldwide [26], *WeChat Quit Coach* holds the potential to reach a large population of Chinese immigrants. In our prior study, we found that 94% of Chinese immigrants who smoke in NYC use WeChat, and that WeChat is used more frequently than other platforms, including Facebook, Twitter, WhatsApp, Line, and short messaging [11]. This study sought to assess the feasibility, acceptability, and preliminary effects of *WeChat Quit Coach* among Chinese immigrants who smoke.

Methods

Study Design

As shown in Figure 1, we conducted an open-label, two-arm pilot RCT and a single-arm pilot test among 60 participants. The first 40 participants were enrolled in the pilot RCT. To obtain more data on feasibility and acceptability, we enrolled an additional 20 participants in a single-arm pilot test. The study was approved by the Institutional Review Board of New York University Grossman School of Medicine (i20-01959) and preregistered at ClinicalTrials.gov (NCT05130788).

Participants in the pilot RCT were randomized in a 1:1 ratio to the intervention (6-week *WeChat Quit Coach*) or control arm (self-help print material). Both arms received a 4-week supply of nicotine patches and/or lozenges by request. Research staff conducted in-person baseline assessment and follow-up phone assessments at 6 weeks and 6 months post-intervention initiation, and performed biochemical validation through exhaled carbon monoxide (CO) tests at both time points. Participants in the single-arm pilot test received the same treatment as the intervention arm (6-week *WeChat Quit Coach* and nicotine replacement therapy (NRT)), and completed an in-person baseline survey and a phone survey at 6 weeks. Participants received a $20 gift card for each survey completed and an additional $20 for completing each biochemical validation test, irrespective of the test result.

Participants and Recruitment

Participants were recruited from February through December, 2022 primarily in three NYC communities that have high concentrations of Chinese immigrants, including Flushing (Queens), Sunset Park (Brooklyn), and Chinatown (Manhattan). Inclusion criteria were as follows: 1) self-identified as a Chinese immigrant; 2) aged ≥ 18 years; 3) had smoked at least 100 cigarettes in the lifetime; 4) smoked ≥ 3 days per week; 5) used WeChat ≥ 3 days per week; 6) able to read Chinese; 7) lived in NYC; and 8) was somewhat interested in quitting, which was assessed by a question, "Which statement best describes your intention to quit? A) I don't want to quit at all; B) I may quit at some point, but not within the next 6 months; C) I plan to quit within the next 6 months; D) I plan to quit within the next 30 days; E) I am trying to quit." People who chose the answer other than "A" were considered being somewhat interested in quitting. Exclusion criteria included 1) current participation in other tobacco treatment; 2) pregnancy or breastfeeding; and 3) inability to connect with research staff through WeChat.

In collaboration with community-based organizations (CBOs), we disseminated study flyers at community events (e.g., CBOs' workshops, health fairs, and immigrant resource fairs) and posted flyers in CBOs' offices and on their WeChat accounts. The flyer contained information about the study purpose, a study WeChat QR code, and a study phone number. Additionally, CBOs and study participants referred potential participants to the research staff.

Potential participants contacted our research staff by scanning the study WeChat QR code or calling the study number. The research staff conducted eligibility screenings over the phone and arranged an in-person study visit for eligible individuals. At the visit, the research staff administered the written consent process and a paper-and-pencil baseline survey. The first 40 participants were enrolled in the pilot RCT. The subsequent 20 participants were enrolled in the single-arm pilot test.

Randomization

Forty participants were randomized to the intervention or control arm (n = 20 per arm) using block randomization stratified by sex (male/female). A randomization module was created and uploaded into REDCap. The research staff performed the allocation. Participants and research staff were unblinded to assignment.

Intervention Arm

The research staff created a WeChat peer group every other month. Each group comprised participants newly enrolled during the two-month period who were either randomized to the intervention arm or enrolled in the single-arm pilot test (4-10 participants per group), along with a coach (NJ) and a research assistant. During the 6-week intervention period, the coach sent a WeChat text message to the group every day at 9:00 am. The messages aimed to 1) enhance motivation to quit by building awareness about the health effects of smoking, quitting methods (e.g., quitting preparation and relapse prevention) and cognitive/behavioral tips (e.g., coping and refusal strategies), and available Chinese-language tobacco treatment programs (e.g., ASQ and local smoking cessation programs), 2) challenge social norms that perpetuate smoking by denormalizing cigarette sharing culture and highlighting the fact that most Chinese immigrants do not smoke, 3) improve self-efficacy through motivational contents and tips for handling slips, and 4) encourage NRT use by addressing misconceptions. Details about the development process of *WeChat Quit Coach* are available elsewhere [25].

Following the daily WeChat text message, a text question was sent to the WeChat group each day to promote engagement (e.g., “What is the longest period you’ve stayed abstinent in previous quit attempts?”). Participants were encouraged to respond daily and ask their own questions either in the group or directly to the coach, who responded within 24 hours. Figure 2 shows a screenshot of the intervention. If a participant didn’t respond for three consecutive days, a reminder message was

sent to him/her via WeChat by the research assistant. Each participant received up to three reminders during the intervention. Participants could comment on others' responses and withdraw from the intervention anytime. The research assistant moderated peer interactions and monitored engagement.

Control Arm

Participants allocated to the control arm received a leaflet with information about pharmacotherapy and behavioral interventions for smoking cessation, including the ASQ and local Chinese-language tobacco treatment programs.

NRT Supply

All 60 participants were offered a 4-week supply of free nicotine patches and lozenges. Participants could request NRT by texting the study WeChat account or calling the study number, with research staff screening for contraindications over the phone. If no contraindication was reported, participants were recommended a combination of nicotine patches and lozenges with doses as per package instructions. Participants could choose the form (e.g., patch, lozenge, or both) and request a lower dose. NRT medications and an instruction sheet (Chinese version) were then delivered by mail or in person.

Key Measures

Primary outcomes included feasibility, engagement, and acceptability. Feasibility was measured by eligibility rate (defined as the proportion of individuals screened who were eligible), enrollment rate (the proportion of eligible individuals who enrolled), follow-up rate (the proportion of participants who completed follow-up assessment at each time point), and the number of withdrawals. Engagement and acceptability were assessed at 6 weeks among participants from the intervention arm and the single-arm pilot test. Engagement was defined as the number of days participants

responded to text questions and the number of participants who post their own questions for instant messaging support. Acceptability was assessed via Likert scale questions regarding participant perceptions about the intervention (e.g., timing of text messages and length of the intervention), helpfulness of intervention components (i.e., text messages, text questions, and chat-based instant messaging support), overall satisfaction, and willingness to recommend it to others.

Secondary outcomes, assessed at 6 weeks and 6 months in the pilot RCT, included self-reported and biochemically verified 7-day point prevalence abstinence (Yes/No). Participants reporting abstinence in the past 7 days were invited to participate in an exhaled CO test administered by research staff. A CO concentration of ≤ 6 parts per million indicated biochemically verified abstinence [27]. Additional outcomes encompassed quit attempts (Yes/No; defined as no smoking for at least 24 hours because of trying to quit), change in smoking knowledge score, progression to a more advanced stage of change (Yes/No), NRT use (Yes/No), and use of other tobacco treatment (Yes/No). Smoking knowledge was assessed using a 5-item measure adapted from the Global Adult Tobacco Survey [28], “Based on what you know, does smoking cigarettes cause 1) respiratory diseases, 2) lung cancer, 3) coronary heart disease, 4) stroke, 5) diabetes?” (0 = “No” / “Not sure”; 1 = “Yes”). The score of smoking knowledge was the sum of the points (range: 0 – 5). The stage of change was assessed by a question “Which statement best describes your plan about quitting?” with answer options of 1 = “I am not interested in quitting at all” [pre-contemplation], 2 = “I may quit in the future, but not in the next 6 months” [pre-contemplation], 3 = “I plan to quit within the next 6 months” [contemplation], 4 = “I plan to quit within the next 30 days” [preparation], and 5 = “I am trying to quit now” [action]. Participants reporting a more advanced stage of change at follow-up, compared to baseline, were deemed to have transitioned to a more advanced stage.

Other measures included sociodemographic characteristics (e.g., age, gender, education, birth country, years of residence in the US, marital and employment status, and household income level), smoking behaviors (e.g., age of smoking initiation, number of smoking days per week, cigarette

consumption per day, time to first cigarette in the morning, and current use of other tobacco products), quitting experience (e.g., quit attempts in the past 12 months, reasons for past quit attempts, and quitting methods ever used), and smoke-free home rule ("Which statement best describes the rule about smoking inside your home? A) Smoking is not allowed anywhere in my home [complete rule]; B) Smoking is allowed in some places or at some times in my home [partial rule]; C) Smoking is allowed anywhere in my home [no rule]; D) There are no rules about smoking in my home [no rule]" [29]).

Statistical Analysis

We performed descriptive statistics to summarize the variables of interest. Secondary outcomes were assessed utilizing an intention-to-treat approach, with missing data treated as no change compared to baseline. To compare the differences between intervention and control arms, effect size estimates were computed, including odds ratios for categorical variables (e.g., self-reported and biochemically validated abstinence) and Hedges' g for the continuous variable (i.e., smoking knowledge score) and their 95% confidence intervals (CIs). For variables containing zero count cells, odds ratios and 95% CIs were not reported. All data analyses were performed using Stata 17.

Results

Feasibility

Of 74 potential participants screened, 68 (92%) were eligible, and 60 (88%) enrolled, with no withdrawals. For the pilot RCT, follow-up rates were 98% (39 out of 40 participants) at 6 weeks and 93% (37/40) at 6 months. The single-arm test achieved 100% follow-up at 6 weeks.

Sample Characteristics

On average, participants were 42.5 (± 13.8) years old and had resided in the US for 13.1 (± 7.7) years (Table 1). Most were male (49/60, 82%), born in mainland China (58/60, 97%), and employed full-time (41/60, 68%). Fifteen out of 60 participants (25%) had a middle school education (comparable to US 9th grade) or lower, and 28 participants (47%) reported an annual household income of $55,000 or less.

Forty-seven out of 60 participants (78%) reported daily smoking. On average, participants started smoking at 17.9 (± 5.9) years old, smoked 12.0 (± 8.0) cigarettes per day, and had a smoking knowledge score of 2.1 (± 1.6). Participants were predominantly not ready to quit (42/60, 70% in pre-contemplation or contemplation stage). While 23 out of 60 participants (38%) reported current e-cigarette use, no participants reported current use of hookah, cigars or smokeless tobacco (data not shown). Thirty-two out of 60 participants (53%) reported having a complete smoke-free home rule. Twenty-three participants (38%) reported past 12-month quit attempts, and 11 participants (18%) had used evidence-based tobacco treatment, including 10 participants (17%) used NRT, one participant (2%) consulted a doctor, and one participant (2%) sought help from a smoking cessation program. None reported ever calling a quitline.

Engagement and Acceptability

On average, participants responded to WeChat text questions on 25.1 (± 11.0) days out of 42 days (median: 26.5 days; interquartile range: 19-33 days). Nine out of 40 participants (23%) sent their own questions to receive chat-based instant messaging support from the coach. Three out of 40 participants (8%) interacted with peers: one participant made a comment on other's responses to a text question, while two participants each posted a message to communicate with the entire peer group.

Of the 39 participants who completed the 6-week follow-up assessment, 36 participants (92%) were satisfied or very satisfied with the intervention (Table 2). Participants predominantly

agreed that *WeChat Quit Coach* enhanced their motivation to quit (35/39, 90%), increased awareness about how to quit (34/39, 87%), and promoted confidence in quitting (32/39, 82%). Most (32/39, 82%) would recommend the intervention to others, while 8 out of 39 participants (21%) indicated the intervention duration was too short. When asked about perceptions about the intervention, 34 out of 39 participants (87%) agreed that text messages were helpful, 33 participants (85%) indicated that text questions were helpful, and 25 participants (64%) found it enjoyable to answer text questions. Of the nine who sent their own questions for instant messaging support, 7 participants (78%) reported such support was helpful.

Cessation Outcomes

At 6 weeks, 20% (4/20) of intervention participants reported 7-day point prevalence abstinence and were validated biochemically (Table 3). None of the control participants reported abstinence. At 6 months, 25% (5/20) of intervention participants reported abstinence and were validated, while 15% (3/20) of control participants reported abstinence and only 5% (1/20) were validated.

Compared to baseline, intervention participants showed an average increase of 1.6 (± 1.6) points in smoking knowledge at 6 weeks, while the score remained unchanged (-0.3 ± 1.0) for control participants. At both follow-up time points, more intervention participants reported quit attempts and progressed to a more advanced stage of change, while more control participants requested NRT during the study period than intervention participants (17/20, 85% vs. 16/20, 80%; data not shown in tables) and reported NRT use at both follow-ups (14/20, 70% vs. 11/20, 55%).

Discussion

This is the first study of a social media-based smoking cessation intervention targeting Chinese immigrants. The sociodemographic characteristics of our participants correspond to the overall population traits of Chinese immigrants in NYC, including low income and low education [30]. The

study demonstrates the feasibility and acceptability of a WeChat-based smoking cessation intervention and shows promising early efficacy on biochemically verified abstinence at 6 months.

Seventy percent of participants were in the pre-contemplation or contemplation stage at enrollment. It suggests that the intervention is attractive to participants, including those not determined to quit in the near term. *WeChat Quit Coach* targets individuals at all levels of readiness to quit and is implemented through a platform deeply integrated into the daily lives of Chinese immigrants. The intervention has the potential to extend the reach of tobacco treatment within this population.

WeChat Quit Coach created favorable user experiences, as indicated by high levels of acceptability and engagement. Participants were overwhelmingly satisfied with the intervention. The interactive feature (daily text questions) was deemed enjoyable and helpful overall, resulting in a high engagement level compared to other social media peer-group cessation interventions [21, 31]. It is encouraging that participants post their own questions to receive instant messaging support, resulting in a usage rate (23%) comparable to that of a WhatsApp-based one-on-one cessation intervention for smokers in Hong Kong, which also features instant messaging support (17%) [22]. The results suggest that our intervention generally aligns with needs of Chinese immigrant smokers. Eight participants (21%) reported the intervention was too short, highlighting opportunities for further refinement.

WeChat Quit Coach appears to be promising in promoting abstinence, with a biochemically verified abstinence rate of 25% at 6 months, which is higher than those reported in prior trials of social media interventions for Chinese-speaking smokers in Hong Kong (8% vs. 5% biochemically validated 7-day point prevalence abstinence at 6 months [22]) and China (12% vs. 3% biochemically validated continuous abstinence at 26 weeks [24]). Other outcomes, including quit attempts and smoking knowledge, were also higher in the intervention arm than control. Larger trials are needed to evaluate the impact of such intervention on abstinence among Chinese immigrants.

A noteworthy finding is that 55% of intervention participants and 70% of control participants reported NRT use. The high utilization of NRT could be attributed to the availability of complimentary NRT and the convenient process to request NRT. Chinese immigrants have limited awareness and hold widespread misconceptions about NRT despite its over-the-counter availability [11, 15]. Moreover, Chinese immigrants have a high poverty rate compared to immigrants overall in the US [32]. These factors contribute to the underutilization of NRT. Our study indicates that Chinese immigrant smokers are receptive to using NRT when access barriers (e.g., cost) are minimized. Our intervention might be more successful in promoting NRT use if cues to try NRT were added to our message library.

This study has several strengths. It is the first to explore a social media-based smoking cessation intervention for Chinese immigrants, a disadvantaged population with high smoking rates. It tests an innovative intervention using a culturally appropriate platform. The study fills gaps in research on tobacco-related disparities and application of mobile technology for tobacco treatment. It also benefits from an inclusion of both individuals who are ready to quit and those not ready to quit, high follow-up rates, biochemically validated abstinence, and provision of NRT. This study has several limitations. First, as a pilot study aiming to test the feasibility, acceptability, and preliminary effects of our intervention, it was not adequately powered to assess treatment efficacy on abstinence. Second, participants were recruited from NYC, thus limiting the generalizability of our findings to other geographic regions.

Conclusions

This study supports the feasibility of a WeChat-based smoking cessation intervention for recruiting Chinese immigrant smokers across different levels of readiness to quit. The high levels of engagement, acceptability, and promising abstinence outcomes suggest that the intervention may be viable for this population. Larger trials are warranted to determine its efficacy.

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Conflicts of Interest
The authors declared no conflict of interest.

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Authorship Contributions
NJ: Conceptualization, Data curation, Formal analysis, Methodology, Funding acquisition, Investigation, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **AZ:** Investigation, Data curation, Writing – original draft, Writing – review & editing. **ESR:** Writing – review & editing. **APC:** Conceptualization, Writing – review & editing. **XZ:** Writing – review & editing. **FC:** Writing – review & editing. **KS:** Formal analysis, Writing – review & editing. **SES:** Conceptualization, Methodology, Supervision, Writing – review & editing.

Data Availability
Data will be made available on request.

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Abbreviations

ASQ: Asian Smokers' Quitline
CBO: community-based organization
CO: carbon monoxide
NRT: nicotine replacement therapy
NYC: New York City
RCT: randomized controlled trial

Figure 1. Study schema

Figure 2. A screenshot of the *WeChat Quit Coach* intervention

Table 1. Characteristics of study participants at baseline (N = 60)

	Pilot RCT		Single-arm pilot test (n = 20)	Total (N = 60)
	Intervention (n = 20)	Control (n = 20)		
	n (%)	n (%)	n (%)	n (%)
Age, mean (± SD)	45.5 (± 13.5)	42.5 (± 14.8)	39.6 (± 13.2)	42.5 (± 13.8)
Male	14 (70)	15 (75)	20 (100)	49 (82)
Years of residence in the US, mean (± SD)	13.5 (± 7.7)	12.5 (± 5.1)	13.3 (± 9.9)	13.1 (± 7.7)
Place of birth				
Mainland China	19 (95)	20 (100)	19 (95)	58 (97)
Other	1 (5)	0 (0)	1 (5)	2 (3)
Education				
Middle school or less	5 (25)	5 (25)	5 (25)	15 (25)
High school or vocational high school	5 (25)	7 (35)	8 (40)	20 (33)
Some college, no degree or associate degree	4 (20)	2 (10)	2 (10)	8 (13)
Bachelor's or advanced degree	6 (30)	6 (30)	5 (25)	17 (28)
Marital status				
Single, never married	5 (25)	2 (10)	9 (45)	16 (27)
Married, living with a spouse	9 (45)	13 (65)	11 (55)	33 (55)
Married, living apart with spouse	1 (5)	2 (10)	0 (0)	3 (5)
Divorced	5 (25)	3 (15)	0 (0)	8 (13)
Employment status				
Full-time employed	14 (70)	11 (55)	16 (80)	41 (68)
Part-time employed	1 (5)	5 (25)	2 (10)	8 (13)
Other	5 (25)	4 (20)	2 (10)	11 (18)
Annual household income level				
Less than $25,000	6 (30)	5 (25)	2 (10)	13 (22)
$25,000 – $55,000	5 (25)	5 (25)	5 (25)	15 (25)
More than $55,000	6 (30)	5 (25)	2 (10)	13 (22)
Not reported/Not sure	3 (15)	5 (25)	11 (55)	19 (32)
Age of smoking initiation, mean (± SD)	19.4 (± 8.4)	17.2 (± 4.1)	17.0 (± 4.3)	17.9 (± 5.9)
Current smoking status				
Daily smoker	16 (80)	15 (75)	16 (80)	47 (78)
Non-daily smoker	4 (20)	5 (25)	4 (20)	13 (22)
Cigarette consumption per day, mean (± SD)	15.5 (± 10.0)	9.4 (± 6.4)	11.2 (± 6.0)	12.0 (± 8.0)
Time to first cigarette in the morning				
≤ 5 minutes	9 (45)	2 (10)	3 (15)	14 (23)
6-30 minutes	2 (10)	6 (30)	6 (30)	14 (23)
31-60 minutes	2 (10)	1 (5)	4 (20)	7 (12)
> 60 minutes	6 (30)	5 (25)	5 (25)	16 (27)
No pattern / Not sure	1 (5)	6 (30)	2 (20)	9 (15)
Current e-cigarette use	5 (25)	8 (40)	10 (50)	23 (38)
Smoke-free home rule				
Complete rule	9 (45)	10 (50)	13 (65)	32 (53)
Partial rule	3 (15)	6 (30)	2 (10)	11 (18)
No rule	8 (40)	4 (20)	5 (25)	17 (28)
Smoking knowledge score, mean (± SD)	2.1 (± 1.6)	1.9 (± 1.3)	2.3 (± 1.8)	2.1 (± 1.6)
Quit attempts in the past 12 months	10 (50)	5 (25)	8 (40)	23 (38)
Ever use of evidence-based tobacco treatment[b]	3 (15)	3 (15)	5 (25)	11 (18)
Used tobacco treatment clinics/programs	0 (0)	0 (0)	1 (5)	1 (2)
Consulted s family doctor	0 (0)	1 (5)	0 (0)	1 (2)
Nicotine replacement therapy	3 (15)	3 (15)	4 (20)	10 (17)
Other smoking cessation medications	0 (0)	0 (0)	0 (0)	0 (0)
Called a quitline	0 (0)	0 (0)	0 (0)	0 (0)
Reasons for past quit attempts[a]				
Concern for my health	14 (70)	13 (65)	13 (65)	40 (67)
Concern for other's health	4 (20)	2 (10)	4 (20)	10 (17)
Family/roommate against smoking	5 (25)	1 (5)	4 (20)	10 (17)
Smoking is not allowed in my home	1 (5)	0 (0)	1 (5)	2 (3)

Smoking is not allowed in my workplace	3 (15)	1 (5)	2 (10)	6 (10)
To set a good example for my child(ren)	3 (15)	3 (15)	1 (5)	7 (12)
To save money	1 (5)	1 (5)	1 (5)	3 (5)
Other reasons	0 (0)	1 (5)	3 (15)	4 (7)
Stage of change				
Pre-contemplation	11 (55)	9 (45)	4 (20)	24 (40)
Contemplation	4 (20)	5 (25)	9 (45)	18 (30)
Preparation	3 (15)	2 (10)	5 (25)	10 (17)
Action	2 (10)	4 (20)	2 (20)	8 (13)

Notes. RCT: Randomized controlled trial
[a]Multiple responses, do not add up to 100%.

Table 2. Acceptability of *WeChat Quit Coach* among participants (n = 39)

	n	(%)
Daily text messages		
Timing of text messages		
Too early	5	(13)
Too late	0	(0)
Just right	21	(54)
Doesn't matter	13	(33)
Length of text messages		
Appropriate	29	(74)
Too long	5	(13)
Other	5	(13)
"Do you find text messages helpful?"		
Helpful or very helpful	34	(87)
Neither helpful nor unhelpful	4	(10)
Unhelpful or very unhelpful	1	(3)
"In general, the messages are easy to understand."		
Agree or strongly agree	36	(92)
Neither agree nor disagree	3	(8)
Disagree or strongly disagree	0	(0)
Ever showed or sent text messages to others	10	(26)
Daily text questions		
"Do you enjoy responding to the text questions?"		
Enjoy or very much enjoy	25	(64)
Neutral	11	(28)
Do not enjoy	3	(8)
"Do you find text questions helpful?"		
Helpful or very helpful	33	(85)
Neither helpful nor unhelpful	4	(10)
Unhelpful or very unhelpful	2	(5)
Chat-based instant messaging support[a]		
"Do you find the instant messaging support helpful?"		
Helpful or very helpful	7	(78)
Neither helpful nor unhelpful	2	(22)
Unhelpful or very unhelpful	0	(0)
Overall intervention		
Satisfaction with the intervention		
Satisfied or very satisfied	36	(92)
Neither satisfied nor dissatisfied	3	(78)
Dissatisfied or very dissatisfied	0	(0)
Agree or strongly agree with the statements		
"It makes me want to quit smoking."	35	(90)
"It is helpful for quitting smoking."	32	(82)
"It makes me feel more confident that I can quit."	32	(82)
"It makes me feel I knew how to quit."	34	(87)
"It makes me want to try again if a quit attempt is unsuccessful."	30	(77)
Length of the intervention (6 weeks)		
Appropriate	30	(77)
Too short	8	(21)
Too long	1	(2)
Would recommend the intervention to others		
Definitely yes	13	(33)
Probably yes	19	(49)
Probably no	5	(13)
Definitely no	2	(5)

Note.

[a]Among participants who sent in their own questions to receive chat-based instant messaging support (n = 9)

Table 3. Intention-to-treat analyses of preliminary effects of *WeChat Quit Coach* (n = 40)

	6 weeks			6 months		
	Intervention arm	Control arm	Effect size estimates[a]	Intervention arm	Control arm	Effect size estimates[a]
	n (%)	n (%)	Odds ratio OR Hedges' g [95% CI]	n (%)	n (%)	Odds ratio OR Hedges' g [95% CI]
Self-reported 7-day point prevalence abstinence	4 (20)	0 (0)	--	5 (25)	3 (15)	1.89 [0.38, 9.27]
Biochemically verified 7-day point prevalence abstinence	4 (20)	0 (0)	--	5 (25)	1 (5)	6.33 [0.67, 60.16]
Quit attempts	11 (55)	7 (35)	2.27 [0.54, 9.82]	15 (75)	13 (65)	0.62 [0.16, 2.43]
Change in smoking knowledge score, mean (± SD)	1.6 (± 1.6)	-0.3 (± 1.0)	1.10 [0.45, 1.79]	-- --	-- --	--
Transition to a more advanced stage of change[b]	8 (40)	0 (0)	--	7 (35)	5 (25)	1.62 [0.41, 6.34]
Use of NRT	11 (55)	14 (70)	0.52 [0.12, 2.30]	11 (55)	14 (70)	0.52 [0.12, 2.30]
Use of other tobacco treatment programs	0 (0)	0 (0)	--	0 (0)	0 (0)	--

Notes. NRT: nicotine replacement therapy; CI: confidence interval
[a]For categorical variables, we computed the odds ratio and its 95% CI; for the continuous variable, we computed the Hedges' g and its 95% CI.
[b]Compared to baseline

Supplementary Files

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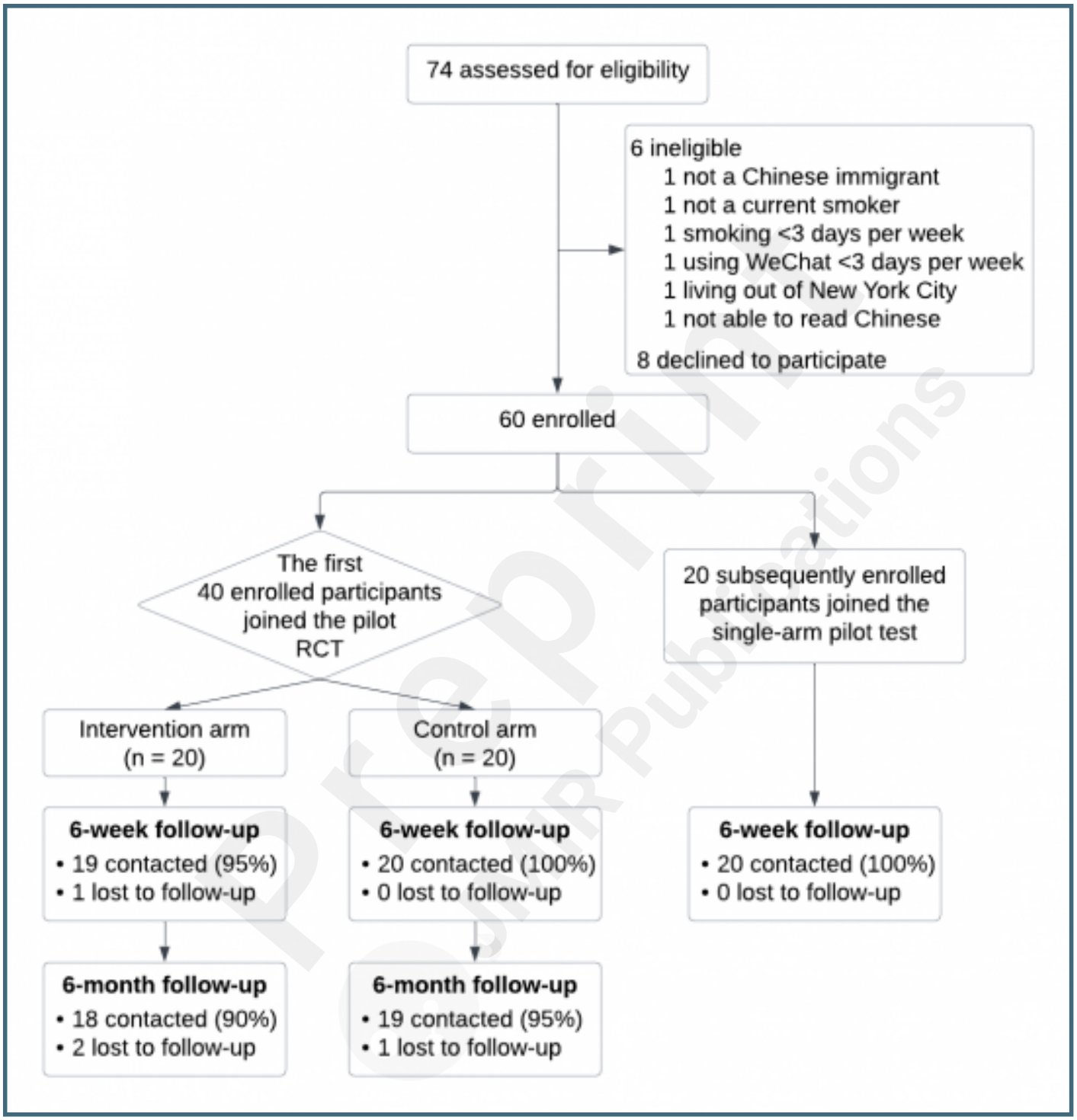
Figures

Study schema.



A screenshot of the WeChat Quit Coach intervention.

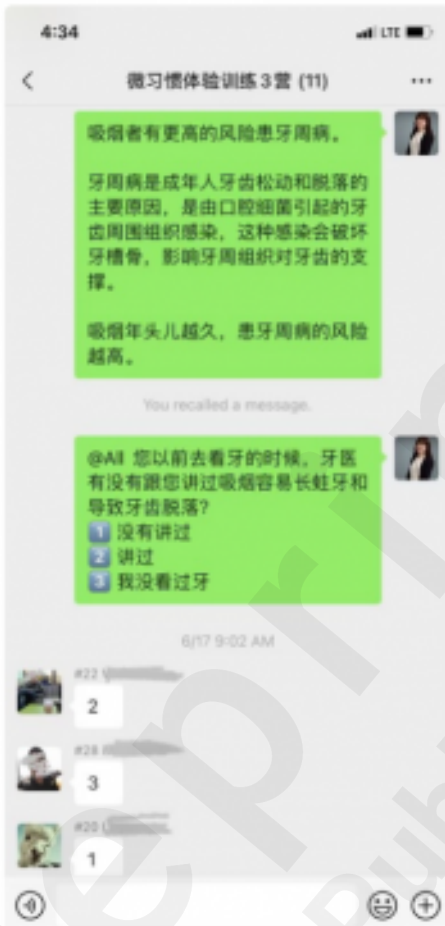


Figure 2. A screenshot of the *WeChat Quit Coach* Intervention

Smokers have higher risks of developing gum diseases compared to nonsmokers.

Gum diseases, infections in the gums that affect the bone structure supporting teeth, are the primary cause of tooth loss among adults.

The longer one smoke, the greater the risk of developing gum diseases.

Question: Have you ever been told by a dentist that smoking increases the risk of tooth decay or loss?

1. No
2. Yes
3. Never visited a dentist