Feasibility and acceptability of using Wi-Fi access points to provide smoking cessation help at 17 airports and 38 railway stations across China

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Abstract

Background: The use of mobile phone significantly improved the outcomes of tobacco cessation. However, its feasibility and acceptability were unclear in the Chinese population. This study was to explore the feasibility of using Wi-Fi access points (APs) as a platform to provide smoking cessation help at 17 airports and 38 railway stations across China.

Methods: This study was divided into two stages: platform development and population survey. In the first stage, a survey platform was developed and incorporated into Wi-Fi service at airports and railway stations, which could provide survey content as a pop-up window when participants tried to access the Wi-Fi service. In the second stage, a population survey was conducted to explore the intention to receive tobacco cessation support.

Results: A total of 20,199 users participated and 13,628 users submitted the survey, with a response rate of 67.47%. The smoking rate was 30.9%. A total of 86.58% of smoking participants and 2.44% of non-smoking participants wished to receive tobacco cessation support, respectively. The multivariate analysis showed intention to receive support did not differ in age, gender, and heaviness of smoking ($P > 0.05$).

Conclusion: Providing tobacco cessation support via Wi-Fi APs is feasible and efficient, and smokers have high intention to receive tobacco cessation support. It is suggested hospitals, academia, information technology industries, and government agencies must work together to provide tobacco cessation support via mHealth.

Keywords: Tobacco smoking; Tobacco cessation; WiFi access points; Survey; Mobile health (mHealth)

Introduction

Tobacco use is a significant threat to human health and social development, which is estimated to cause approximately 7 million global deaths each year.[1] It is one of the main risk factors driving the growing epidemic of noncommunicable diseases. Currently, a staggering 44% of the world's cigarettes are consumed in China,[2] and 1 million people die of tobacco-related diseases each year.[3]

Smoking cessation can significantly reduce the harm of tobacco use. Pharmacotherapy medication, physician counseling, hotline intervention,[4] and acupuncture[5] increase the likelihood of successful quitting. Moreover, considering the very high mobile technology penetration in China,[6] there is a strong opportunity to use mobile Health (mHealth) to support and facilitate tobacco smoking.

mHealth could reach large population at low cost, and has already been successfully used in different fields of health.[7] Among various mHealth techniques, mobile phone is a flexible, accessible, and cost-effective method for delivering tobacco cessation, and a growing body of evidence[8-10] indicated the use of mobile phone significantly improved the clinical outcomes of tobacco cessation. Besides, tobacco cessation via mobile phone is much cheaper than traditional hospital visits.[11] However, one study indicated that unmotivated smokers were less likely to visit health-related websites (on their computer or handheld device) than motivated smokers.[12] Therefore,

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these unmotivated smokers need to be reached proactively through other mHealth channels.

Fortunately, ubiquitously available Wi-Fi access points (APs) can be used as a solution for this challenge. Wi-Fi APs could generate a coverage area where any mobile device (laptops, mobile phones, tablets, etc) equipped with Wi-Fi technology can connect. For example, it is very common for tourists and travelers to have a free Wi-Fi service to check email or access to social networks at airports and railway stations. It would be beneficial if we present the danger of smoking and redirect them to our website and mobile phone applications to provide cessation support. However, the feasibility and acceptability of using Wi-Fi APs to recruit populations remained clear.

To address this gap, we developed a survey platform and incorporated it into Wi-Fi service at 17 airports and 38 railway stations across China, which could provide survey content as a pop-up window when travelers tried to access the Wi-Fi service. Then we conducted a population survey to verify the feasibility and acceptability of this method and to explore travelers' intention to receive tobacco cessation support.

Methods

Ethics approval and consent to participate

The study was approved by the Review Board of China-Japan Friendship Hospital, and all participants provided electronic informed consent before the survey.

Study protocol

This study was divided into two stages: survey platform development and population survey. This study was approved by the Review Board of China-Japan Friendship Hospital, and all participants provided electronic informed consent before the survey.

Stage one: development of survey platform based on Wi-Fi APs

The survey platform was developed by OPSMART Technology Company (Chaoyang District, Beijing, China). Several recommendations and findings[13-15] for designing survey were followed. In brief, this survey platform was programmed in PL/SQL on an Oracle 8 database server and specifically developed for mobile phones. HTML5 was chosen as the basis for the displays. SQL Server 2005 was used for storing participants' data. The file size was 15 kb to minimize the download time. The total length of the program was 1363 lines. The whole programming, testing and verification took approximately 40 h.

Rather than being presented as a single and unattractive internet webpage, the survey platform was divided into three pages. The first page was the introduction page, which introduced the danger of smoking and significant benefit of becoming an ex-smoker to enhance positive and proper value regarding tobacco cessation; the electronic informed consent was also provided. The second page was the main survey page. The questions of survey were displayed in bold. List boxes, radio buttons, and check boxes were designed to ensure the consistency of layout for different types of mobile phones; in addition, the top of the screen displayed banner with a small picture which emphasized the title of the survey, and the bottom displayed the contact and address of our tobacco cessation clinic and quitline 4008085531, in case the participants would like to reach us for cessation support. The third page was the reward page. When the participants submitted the survey successfully, they entered their mobile phone number and received reward of data roaming package [Figure 1].

When the survey platform was developed, we collaborated with IT Ministry of Transport to incorporate this survey platform into Wi-Fi service at 17 airports and 38 railway stations. The geographical distribution of 17 airports and 38 railway stations were shown in Table 1.

Stage two: population survey

The survey introduction, questionnaire, informed consent, and other detailed information were uploaded into the platform. With the ceremony of 2016 World No-Tobacco Day, we launched our study. When the participants tried to access the Wi-Fi service at 17 airports and 38 railway stations across China via mobile phones, they could read our survey introduction as a pop-up window and were invited to participate. Participants were sampled by a convenient sampling method. Inclusion criteria for all participants included (1) voluntarily participating in this survey, (2) being able to read Chinese, and (3) aged 18 years or older. The participants were informed of the study introduction and invited to participate when they tried to access the Wi-Fi service at airports and railway stations. Before starting the survey, all participants were guaranteed anonymity and confidentiality of their answers, and were ensured that their contact information will be kept and treated separately from the rest of survey data. After submitting the questionnaire successfully, participants were compensated with free package of data roaming, each worth 20 US dollar. All participants provided electronic informed consent before filling the survey.

A six-question questionnaire with a multiple-choice format was developed based on available guidelines and references. The six questions collected demographic information of age and gender, background of tobacco smoking, and their intention to receive tobacco cessation support. A list of all questions and answers was outlined in the Supplementary Figure 1, http://links.lww.com/CM9/A37. A pilot survey was conducted among study staff to evaluate the content, wording, and completion time. The survey took approximately 3 to 5 min to complete.

Statistical analysis

SPSS 19.0 statistical software (SPSS Inc., Chicago, IL, USA) was used for statistical analyses. Descriptive statistical

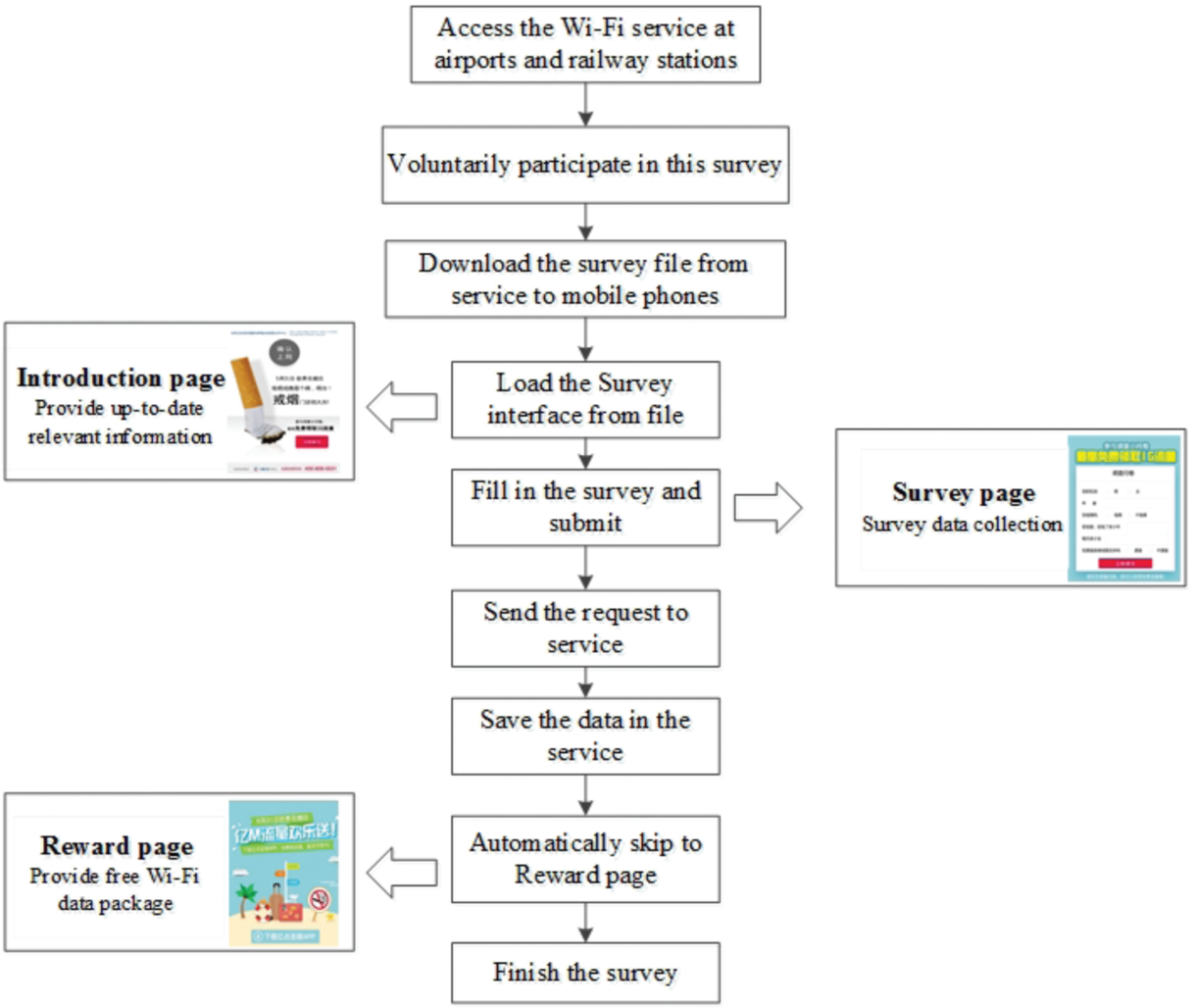

Figure 1: Flow chart of the study.

analyses were performed on all variables. The continuous variables were represented with mean ± standard deviation. The *t* test was used for comparison which met Gaussian distribution and homogeneity of variance, while the non-parametric test was used for comparison which did not meet homogeneity of variance. Chi-square test was used for categorical variables. Logistic regression analysis was performed to estimate the effect of possible factors on participants' intention to receive tobacco cessation support, represented as odds ratio (OR) value and 95% confidence interval (CI). *P* value of less than 0.05 was taken as statistical significance.

The authors had no access to information that could identify individual participants during or after data collection.

Results

Characteristics of participants

From May 26 to May 31, 2016, a total of 20,199 users participated and 13,021 users submitted the survey. The response rate was 64.46%. Among the submitters, 5341 users (41.02%) submitted in airport and 7680 users (58.98%) in train station, respectively.

The characteristics of study participants by smoking were presented in Table 2. The majority of participants were male, with an average age of (33.83 ± 11.42) years; the smoking rate was 30.9%. A total of 86.58% of smoking participants and 2.44% of non-smoking participants wished to receive tobacco cessation support, respectively. Moreover, it was noted that the age ($\chi^2 = 326.0$, $P < 0.05$), gender ($\chi^2 = 61.9$, $P < 0.05$), and duration of smoking ($\chi^2 = 399.4$, $P < 0.05$) were significantly different between light smokers and heavy smokers, but their intention to receive tobacco cessation support was similar ($\chi^2 = 1.9$, $P > 0.05$).

According to the intention to receive the support of tobacco cessation, all smoking participants were further divided into an intention to receive support (ITRS) group and a non-intention to receive the support (NITRS) group, and their characteristics was shown in Figure 2. The majority of participants were male (97.0% in NITRS group and 95.3% in ITRS group), with an average age of (36.17 ± 11.16) years in NITRS group

and (34.36 ± 10.85) years in ITRS group; the number of cigarettes smoked per day was (13.82 ± 9.46) in NITRS group and (13.62 ± 9.26) in ITRS group; the duration of smoking was (13.32 ± 10.20) years in NITRS group and (12.08 ± 9.21) years in ITRS group. No significant differences of gender ($\chi^2 = 3.1$, $P > 0.05$), age ($\chi^2 = 24.6$, $P > 0.05$), cigarettes smoked per day ($\chi^2 = 0.6$, $P > 0.05$), and duration of smoking ($\chi^2 = 11.9$, $P > 0.05$) were observed between ITRS group and NITRS group.

According to the multivariate regression analysis [Table 3], except for the age group of 41 to 50 (OR = 0.60, 95% CI: 0.40–0.91), none of the characteristics were significantly associated with intention to receive the support of tobacco cessation (all $P > 0.05$), which indicated that the smokers aged 41 to 50 years might be more interested in receiving the support of tobacco cessation with this method.

Table 1: The geographical distribution of 17 airports and 38 railway stations.

Type	Location	No. of study site	Number (%) of participants
Railway stations			
	Jiangsu Province	12	2930 (22.5)
	Anhui Province	11	1488 (11.4)
	Shanghai	2	1447 (11.1)
	Zhejiang	10	1412 (10.8)
	Beijing	2	386 (3.0)
	Xizang	1	17 (0.1)
Airports			
	Beijing	1	1253 (9.6)
	Chongqing	1	884 (6.8)
	Sichuan Province	1	753 (5.8)
	Shandong Province	2	633 (4.9)
	Henan Province	1	448 (3.4)
	Xinjiang Province	1	356 (2.7)
	Hainan Province	2	195 (1.5)
	Neimengu Province	1	196 (1.5)
	Ningxia Province	1	182 (1.4)
	Shanxi Province	1	148 (1.1)
	Guangdong Province	2	107 (0.8)
	Yunnan Province	1	109 (0.8)
	Qinghai Province	1	56 (0.4)
	Jilin Province	1	21 (0.2)
Total		55	13,021 (100.0)

Discussion

To our knowledge, this is a rare study to explore the feasibility and acceptability of using Wi-Fi APs to provide smoking cessation help in China. The results show that this method is feasible and efficient, and smokers have high intention to receive tobacco cessation support. Therefore, future studies should focus on the methodology of this technique and verify the efficacy via clinical trials.

Strengths of this study were novel approach of Wi-Fi APs, high recruitment population and a wide variety of 55 study sites. More importantly, compared with short-message service and smartphone applications, the cost of our survey was low but the results were solid and reliable.

The findings had practical implications. Wi-Fi provides unprecedented connectivity to citizens and visitors, but it was mostly applied for business. We used Wi-Fi APs to recruit a particularly large number of participants, and could be a good example for future study. More importantly, this study could not be completed only by

Table 2: Characteristics of the study participants by smoking.

Characteristic	Total ($n = 13,021$)	Non-smoking group ($n = 9004$)	Smoking group		
			Total ($n = 4017$)	Light smoking group ($n = 2648$)	Heavy smoking group ($n = 1369$)
Gender					
Male	9708 (74.6)	5869 (65.2)	3839 (95.6)	2482 (93.7)	1357 (99.1)
Female	3313 (25.4)	3135 (34.8)	178 (4.4)	166 (6.3)	12 (0.9)
Age					
18–30 years	6401 (49.2)	4577 (50.8)	1842 (45.4)	1441 (54.4)	383 (28.0)
31–40 years	3209 (24.6)	2152 (23.9)	1057 (23.3)	659 (24.9)	398 (29.1)
41–50 years	2212 (17.0)	1460 (16.2)	752 (18.7)	399 (15.1)	353 (25.8)
51 years and older	1199 (9.2)	815 (9.1)	384 (9.6)	149 (5.6)	235 (17.2)
Duration of smoking					
Less than 10 years	NA	NA	2361 (58.8)	1835 (69.3)	526 (38.4)
11–20 years	NA	NA	1058 (26.3)	581 (21.9)	477 (34.8)
21–30 years	NA	NA	456 (11.4)	175 (6.6)	281 (20.5)
31 years and more	NA	NA	142 (3.5)	57 (2.2)	85 (6.2)
Intention to receive smoking cessation support					
Yes	3698 (28.4)	220 (2.4)	3478 (86.6)	2307 (87.1)	1171 (85.5)
No	9323 (71.6)	8784 (97.6)	539 (13.4)	341 (12.9)	198 (14.5)

All data were shown as *n* (%). Light smoking was defined as smoking less than 20 cigarettes per day. Heavy smoking was defined as smoking 20 cigarettes or more per day. NA: Not available.

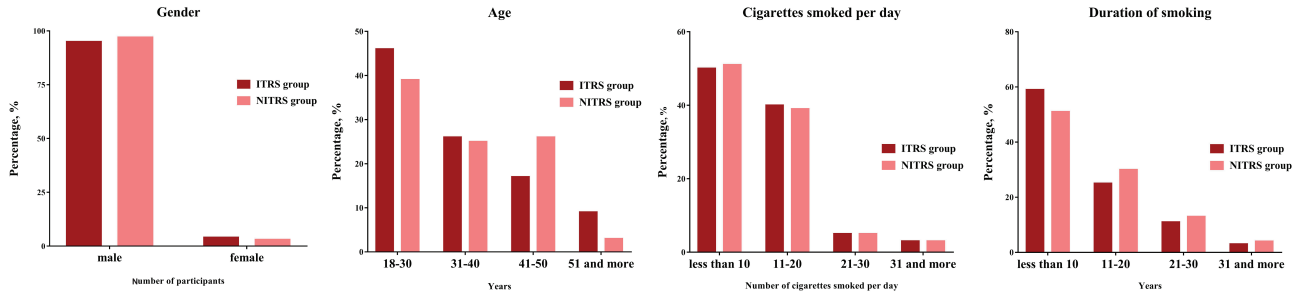

Figure 2: The intention to receive the support of tobacco cessation between ITRS group and NITRS group. ITRS: Intention to receive support group; NITRS: Non-intention to receive the support.

Table 3: The regression analysis of intention to receive the support of tobacco cessation in smoking participants.

Characteristic	OR (95% CI)	*P*
Gender		
Male	Reference	
Female	1.51 (0.89–2.56)	0.13
Age		
18–30 years	0.96 (0.61–1.52)	0.86
31–40 years	0.94 (0.60–1.47)	0.78
41–50 years	0.60 (0.40–0.91)	0.02
51 years and more	Reference	
Cigarettes smoked per day		
Less than 10	0.84 (0.51–1.41)	0.52
11–20	1.05 (0.63–1.74)	0.86
21–30	1.00 (0.54–1.84)	0.99
31 and more	Reference	
Duration of smoking		
Less than 10 years	1.47 (0.79–2.71)	0.22
11–20 years	1.17 (0.65–2.12)	0.61
21–30 years	1.28 (0.72–2.29)	0.40
31 years and more	Reference	

ORs and 95% CIs were obtained from the logistic model. 95% CI: 95% Confidence interval; OR: Odds ratio.

doctors, but the collaboration of stakeholders from diverse fields, including medical professionals, government officers, telecom operators, and IT professionals. Given there were 315 million smokers in China,[16] this study may have a positive influence to reduce smoking prevalence in China and worldwide.

Previous studies[17,18] reported predictors for intentions to quit smoking varied with culture, but commonly include gender, age, nicotine dependence, motivational factors, health concerns, self-efficacy, and previous quit attempts. Because we only developed a six-question questionnaire, this current study failed to identify predictors significantly associated with the intention to receive tobacco cessation support, and how to provide targeted and individual recruitment based on predictors should be a priority in the future.

The limitations of this study must be acknowledged. First, although we recruited sufficient participants, the respond rate was moderate in this study. Second, the compensation of free package of data roaming (worth 20 US dollar) might overestimate the effects of our survey-based study as it would occur in real-world practice. Third, as the survey was conducted at airports and high-speed railway stations, there may be a selection bias. Lastly, as the majority of people using mobile phones or internet terminals are young and middle-aged people, this study may lead to bias in the selection of research objects and may omit some people.

Overall, the mHealth for tobacco cessation was still in the exploratory stage in China, and many problems remained to be solved, such as the incorporation of traditional treatment into mHealth, surveillance and quality control,[19] possible medical disputes, and long-term return on investment. Therefore, as indicated above, hospitals, academia, IT industries, and government agencies must work together to provide tobacco cessation support via mHealth.

Our study found providing tobacco cessation support via Wi-Fi APs among smokers is feasible, efficient and acceptable, and the intention to receive is high. Based on this observation, we kindly suggest that future studies should focus on the methodology of this technique and verify the efficacy via clinical trials.

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Conflicts of interest

None.

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