

Impact of Chinese Respiratory Physicians Participating in Smoking Cessation and Mobile Health: Methodological Assessment and Effectiveness Comparison

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Abstract

Background People who are eager to quit smoking often lack long-term, daily smoking cessation guidance. Besides, advances in mobile communication technology offer promising ways to provide tobacco dependence treatment. However, it is unclear whether doctors-WeChat network can improve the smoking cessation rate of nicotine-dependent patients. **Methods** In this prospective single-blind cohort study, we recruited 250 smokers from April, 2018 to August, 2018. They were randomly divided into two groups with or without doctors' active smoking cessation service and followed-up for 6 months. The smoking cessation rate and the characteristics of successful smoking cessation groups were compared. The reasons for relapse were also analyzed. **Results** After beginning quit for 3 months, the success rate of the group with respiratory physicians actively involved was 65.0% (80/123) ; the success rate of control group was 34.7% (34/98). Quit for 6 months, the success rate of the group with respiratory physicians actively involved was 55.3% (68/123) ; the control group was 11.2% (11/98). There was no difference in weight change between the two groups. Subgroup analysis showed that among men who were younger than 45 years old or unemployment, doctors' participation has a greater impact on the success of smoking cessation. **Conclusions** Doctors in mobile-smoking cessation services plays a very important role to improve quit rates. Our research provides methodological guidance for further clinical trials and provides a template for further real-world application of smoking cessation services.

Background

Since China signed the World Health Organization Framework Convention on Tobacco Control (FCTC) in 2006, the government implemented a series of tobacco cessation policies and spent huge economic investment to promote tobacco control in over ten years. However, in the context of rapid progress in international tobacco control, there has been no significant reduction of smoking rates in China.(1) Adult smoking rate was 27.7% in China compared with the global adult smoking rate of 21% until 2015. Besides, the number of global deaths due to smoking each year is 700 million, of which about 1.1 million are Chinese people.(2) Considering tobacco consuming brings a serious health burden for China, President Xi Jinping proposed Chinese smoking prevalence should be reduced to 20% by 2030 in the national strategy called "Healthy China 2030". Governments of each province are intensively taking measures to encourage people to quit smoking, including implement smoke-free laws, media campaigns to raise public awareness of the harm of smoking, instituted smoking cessation clinics and quitlines.(3)

There are 300 million smokers in China, of which 16.1% said they had a will to quit in the next 12 months. (4) It is suggested that there is a huge demand for smoking cessation services in China. Though most people have a willing to quit, only about one-fifth of these people can successfully quit smoking.(5, 6) Most smokers rely on their own perseverance to quit smoking, often resulting in a higher rate of relapse. Therefore, a scientific and effective guidance throughout the smoking cessation process is very necessary for smokers who want to quit smoking. Respiratory physician of smoking cessation clinics is the medical professionals who are the direct and primary provider of smoking cessation advice for smokers in China. However, based on our special national conditions, it's difficult to get a subsequent visit

at a certain time for outpatients and to participate or intervene in smokers' quit process. The impact of doctors' participation on the rate of smoking cessation still remains unclear.

Our research relies on the WeChat platform to compare the different degree of intervention of doctors on smokers who consulted smoking cessation clinics and evaluate the effect in quit rate. The results of this study confirms the importance of respiratory physician continuous intervention throughout cessation process and establish a methodological possibility for large-scale clinicians to participate in smoking cessation actions.

Methods

Study Design and Setting

This is a prospective single-blind cohort study. Through smoking cessation outpatients and social media campaigns, adult smokers who seek help to quit smoking were recruited from August, 2018 to December, 2018. Participants had to be 18 to 85 years of age, daily smokers over 10 cigarette more than 5 years, WeChat user and had to sign the consent. Once smokers who met one of the following conditions were not included: participate other smoking cessation treatment at the same time; pregnant or lactating women; severe heart, lung, brain, and blood system diseases, including but not limited to 2 weeks after acute myocardial infarction, severe arrhythmia, unstable angina, poorly controlled hypertensive patients; suffering from mental illness and drug use; other diseases or mental states that are unable to meet the research requirements. Carbon monoxide (CO) value was measured using the exhaled gas carbon monoxide analyzer (British BEDFONT Micro+ Smokerlyzer). Greater than or equal to 7 ppm was confirmed as smoker. The study included 250 smokers after initial screening.

All participants orally bupropion hydrochloride sustained release tablets according to conventional standard drug regimen, and were randomly allocated to two groups with regular outpatient follow-up. Each WeChat Group includes two attending respiratory physician and two investigators. The attending respiratory physician in control group (WeChat group) only offer limited help and respond non-periodically only if the investigators were unable to answer the professional question. The physicians in group with respiratory physicians actively involved(WeChat + physicians enrolled group) sent group reminders (taking medicine or messages about encouraging to quit); answered questions daily at regular time; held smoking cessation seminars per week. The allocation was unknown to all investigators. Intervention staff who delivered the intervention did not take outcome measurements. All investigators were kept masked to outcome data.

The study period was from January, 2019 to June, 2019. We followed up the participants for 6 months. 221 participants provided outcome data and included primary analysis at 3 months and 6 months since follow-up. The flowchart shows participants who were screened and participated in the study, how intervention did and follow-up (figure 1).

Participants and Public Involvement

This study was approved by Medical Science Research Ethics Committee of the First Affiliated Hospital of China Medical University. Written informed consent was obtained from all the participants. This study was registered at Chinese Clinical Trial Registry (Trial registration number: ChiCTR1800017231).

Measures

Data Collection

We collected general information including gender, age, education, marital status, income, occupation, living condition, height, weight and smoking characteristics including smoke age (number of year smoking), smoke volume (how much cigarette per day), tobacco dependence diagnostic scale (Tobacco Dependence Assessment Scale, FTND ; Heaviness of Smoking Index, HIS). (7, 8)

Confirmation of Continuous Smoking Cessation

Self-reported continuous abstinence was confirmed. Confirmation of abstinence at months 3 and 6 was determined by outpatients face by face.(9)

Exhaled CO concentration was measured by the exhaled gas carbon monoxide analyzer (British BEDFONT Micro+ Smokerlyzer). Less than or equal to 3ppm regarded as non-smoking. Among 4-6ppm regarded as suspicious smoking. Greater than or equal to 7ppm regarded as smoking.

Assessment of tobacco dependence

Tobacco dependence assessment using the Tobacco Dependence Assessment Scale (FTND, 0~3 scores: mild tobacco dependence; 4~6 scores: moderate tobacco dependence; ≥ 7 scores: severe tobacco dependence) or the Heaviness of Smoking Index (HSI, ≥ 4 scores: severe tobacco dependence) .(10)

Outcome Measures

Concerned outcomes include smoking cessation effect (30-day continuous cessation rate), success rate of smoking cessation (success rate = number of successful cases / total number of cases \times 100%), weight change of participants (Body Mass Index, BMI = weight of kilogram divided by height of meter).

Statistical analysis

Statistical analyses were conducted with SPSS version 16.0 (IBM) and Graphpad Prism 7.0 (<https://www.graphpad.com/>). A total of 27 participants in the control group and 2 participants in the treatment group were lost follow-up. To determine whether randomisation was successful, we compared participant general characteristics and smoking characteristics. None of the eleven comparisons were statistically significant, confirming successful randomisation (all $p > 0.1$).

In order to compare the smoking cessation rate of the two groups and the body weight changes after quitting smoking in different groups, χ^2 tests and t-test respectively were used to test for statistical significance. No adverse reactions were reported by participants, thus it was not included in current study. Multiple logistic regression analysis was performed to examine the influence of the variables on success rate of smoking cessation for three months and six months.

In order to further analyze the influence of physicians participation on the success rate of smoking cessation among the subgroups, and analyze the people who are most suitable to quit smoking with the help of physicians, we conducted a subgroup analysis.(11)

Results

Baseline characteristics

In total, 221 participants were enrolled. General characteristics and smoking characteristics of participants were balanced across study groups (Table 1). Numeric variable data are expressed as median (25th-75th percentile). Participants were predominantly male (91.9%), married (89.1%), non-living alone (94.1%) and have stable job (81.0%). The middle age of enrolled participants was 45 years old. Most of them have received education, thus we divided them into two categories according to whether they had completed university education. The median monthly income was between CNY (Chinese Yuan) 3000 and 6000.

Participants smoked a median of 20.0 cigarettes per day, with a median smoking age 22.0 years. Tobacco dependence is dominated by moderate to severe dependence, and median CO value before the start of smoking cessation is 9.0.

Table 1 Baseline Characteristics of Smokers

Primary Outcome of Respiratory Physicians Participating in Smoking Cessation

The primary outcome was collected at 3 months and 6 months after beginning quitting smoking. Successful smoking cessation needs to meet self-reported 30-day non-smoking and exhaled gas CO \leq 3ppm.

Characteristics	Total	Control[n(%)]	Physician Enrolled Group[n(%)]	P value
Patients	221	98	123	-
General Characteristics				
Gender (male)	203(91.9)	90(91.8)	113(91.9)	0.993
Age (years)	45(35-53)	43(35.5-53)	43(35-54)	0.656
Education				0.852
Below bachelor degree	94(42.5)	41(41.8)	53(43.1)	
Bachelor degree or above	127(57.5)	57(58.2)	70(56.9)	
Marital Status				0.144
Marriage	197(89.1)	84(85.7)	113(91.9)	
Single/divorced/widowed	24(10.9)	14(14.3)	10(8.1)	
Living Condition				0.505
Living alone	13(5.9)	7(7.1)	6(4.9)	
Living with families or others	208(94.1)	91(92.9)	117(95.1)	
Occupation				0.387
Unemployment/temporary job	42(19.0)	18(18.4)	24(19.5)	
Outdoor stable work	111(50.2)	54(55.1)	57(46.3)	
Indoor stable work	68(30.8)	26(26.5)	42(34.1)	
Income				0.966
<=3000	68(30.8)	31(31.6)	37(30.0)	
=3000-6000	77(34.8)	34(34.7)	43(35.0)	
>=6000	76(34.4)	33(33.7)	43(35.0)	
Smoking Characteristics				
Cigarettes per day	20(15-20)	20(15-25)	20(12-20)	0.972
Number of year smoking	22(14-30)	22(13.5-30)	22(15-30)	0.168
Tobacco dependence				0.215
Mild	63(28.5)	23(23.5)	40(32.5)	
Moderate	82(37.1)	36(36.7)	46(37.4)	
Severe	76(34.4)	39(39.8)	37(30.1)	
CO Value	9(7-12)	9(7-13)	9(7-11)	0.154

After beginning quit for 3 months, the group with respiratory physicians actively involved was successful in 80 cases, the success rate was 65.0% (80/123); the control group was successful in 34 cases, the success rate was 34.7% (34/98). After beginning quit for 6 months, the group with respiratory physicians actively involved was successful in 68 cases, the success rate was 55.3% (68/123); the control group was successful in 11 cases, the success rate was 11.2% (11/98). There was a statistically significant difference between the two groups, that is, the smoking cessation rate of the group with respiratory physicians actively involved was significantly higher than that of the control group (Table 2).

Table 2 The Rate of Quitting for Three Months and Six Months

	Total	Control [n(%)]	Physician Enrolled Group[n(%)]	χ^2	Pvalue
Three Months (Success,%)	114	34 (29.8)	80 (70.2)	20.112	0.000
Six Months (Success,%)	79	11 (13.9)	68 (86.1)	46.100	0.000

The physician enrolled group was successful in 80 cases, the median weight increased by 0.32 kg in three months, the maximum increase of 3.27 kg; the control group succeeded in 34 cases, the median weight increased by 0.33 kg, the maximum increase of 1.73 kg. There was no significant difference in BMI between the two groups before and after smoking cessation. However, in each group, successful smoking cessation has statistically significant effect on weight change.

Factors Affecting the Success Rate of Smoking Cessation and Subgroup Analysis

Univariate analysis of gender, marital status, current living conditions, income, age, smoke years, smoking count (branch/day), expiratory carbon monoxide, and nicotine dependence. When it comes to the successful rate of quitting 3 months, education, exhaled carbon monoxide and whether there is physicians participation are statistical differences (Table 3). Multivariate analysis was performed with a $P < 0.05$ factor. Among them, doctor participation (OR=3.371) and higher education (OR=2.113) contribute to the improvement of the success rate of smoking cessation, but the higher the CO value (OR=0.908), the lower the success rate of smoking cessation.

However, at 6 months, doctor participation in the promotion of smoking cessation rate is significantly more important than other factors (OR=9.320). As a recognized indicator of the degree of smoking, CO value (OR=0.927) is still instructive for the success or failure of smoking cessation rate (Table 3).

Since doctors' participation in smoking cessation for three months does not have such a significant effect in improving the success rate of smoking cessation like smoking cessation for six months, we would like to know further whether doctor participation in different subgroups will affect the success rate of smoking cessation, so we conducted a subgroup analysis (figure 2A).

The results showed that among men who were younger than 45 years old or unemployment, doctors' participation has a greater impact on the success of smoking cessation. Among the heavy smokers, the participation of doctors is more convince than light smokers during smoking quitting.

Table 3 Univariate and Multivariate analyses of various parameters in successful quitting smokers after three months

	Univariate analyses			Multivariate analyses		
	<i>P</i>	Odd Ratio	95% confidence interval	<i>P</i>	Odd Ratio	95% confidence interval
Successful quitting after three months						
Gender	0.888	1.071	0.409-2.810			
Age	0.453	0.991	0.968-1.015			
Education	0.021	1.885	1.098-3.234	0.012	2.113	1.184-3.770
Marital Status	0.869	1.074	0.460-2.506			
Living Condition	0.866	0.908	0.295-2.794			
Occupation	0.280	1.234	0.843-1.806			
Income	0.140	1.282	0.922-1.783			
Cigarettes per day	0.453	0.991	0.967-1.015			
Number of year smoking	0.008	0.963	0.937-0.990			
Tobacco dependence	0.424	0.872	0.624-1.219			
CO Value	0.004	0.893	0.826-0.965	0.017	0.908	0.836-0.985
Physician Participation	0.000	3.502	2.006-6.113	0.000	3.371	1.891-6.010
Successful quitting after six months						
Gender	0.772	0.864	0.321-2.325			
Age	0.928	1.001	0.977-1.026			
Education	0.113	1.582	0.897-2.788			
Marital Status	0.250	1.766	0.671-4.650			
Living Condition	0.333	1.919	0.512-7.189			
Occupation	0.343	1.213	0.814-1.806			
Income	0.471	1.134	0.805-1.597			
Cigarettes per day	0.909	1.001	0.977-1.027			
Number of year smoking	0.119	0.978	0.950-1.006			
Tobacco dependence	0.518	0.892	0.630-1.263			
CO Value	0.022	0.905	0.831-0.986	0.117	0.927	0.844-1.019
Physician Enrolled or Not	0.000	9.779	4.755-20.108	0.000	9.320	4.516-19.235

Cause Analysis of Relapse

We found that relapse is a major obstacle to the success rate during smoking quitting, we thus analysis participants who succeeded quitting smoking at 3 months and relapsed at 6 months in each group. Among all participants who had relapse, 23 patients in the control group (figure 2B) had relapse, the relapse rate was 67.6% (23/34), and 12 patients in the physician enrolled group (figure 2C) had relapse, the relapse rate was 15% (12/80). Therefore, doctor participation is also crucial to reduce the relapse rate. Further, we investigated the reasons for relapse. We found that smoking addiction is the main cause of relapse. Social pressure, the surrounding environment and stress work also have a certain impact on the existence of relapse.

Discussion

With the development of technology and the popularity of mobile phones, instant messaging tools are gradually commercialized and become the tool for improving work efficiency. In the past, there have been

many reports that using mobile phone text messages or specialized developed mobile phone applications to help increase the rate of smoking cessation.(12-14) However, both SMS and mobile phone applications are unilaterally output by investigators. As the trial time increases, almost half of smokers enrolled in these programs drop out.(15) Therefore, in our study, we chose to integrate the participation of doctors into smokers' daily activities. In the regular communication tools that they are in contact, the relationship between doctors and participants are strengthened. In addition, face-to-face communication (regular follow-up and smoking cessation seminar) is set up so that doctors can continue to play a role in the whole process of quitting smoking. Our results and the methods we established show significantly improved smoking cessation rates in long-term quitting. (3 months OR=3.371 versus 6 months OR=9.320)

Doctors have an essential role in the prevention and control of smoking.(16) About 70% of smokers will visit doctors each year, which provides doctors with a great deal of opportunity to influence the behavior of smokers and provide them with guidance and help to quit smoking.(17) Tobacco use is the main cause of the disease burden, and about one-third of the world's tobacco is produced and consumed in China. However, compared with countries that have been relatively successful in quitting smoking.(18) China's smoking cessation lacks full-time medical staff, and non-smoking doctors seldom actively advise patients to quit smoking. Besides, the level of smoking cessation guidance is different. As for why doctors don't have enough passion to participate in smoking cessation, there are two mainly reasons. Firstly, the doctor is too busy to have enough time to strengthen the patient's awareness of tobacco control. Secondly, doctor's professional ability is not enough to provide smoking cessation services. Most specialists lack formal, systematic smoking cessation service related training.(19) In addition, doctors do not have enough motivation to fully participate in the whole process of smoking cessation. They have no idea about how to take better measurements to increase the rate of smoking cessation. In this study, 4 attending doctors participated in the study. Since their major is respiratory, the training of smoking cessation service has certain relevance to their professional knowledge they have already mastered. Only short-term training was conducted before the trial. Although actively enrolled in quitting industry did take up some of their personal time, they were very willing to do the job because of additional income.

There are also some limitations in this trial, however. Both groups of participants were treated with bupropion hydrochloride orally as an adjuvant therapy. However, if the existing scheme are promoted, not all medical institutions can provide smoking cessation drug because of the price. Only the psychological treatment method may not such a higher rate of smoking cessation. Secondly, although WeChat group can be supervised by starting smoking cessation at the same time, it is impossible to refine individualized treatment and individualized psychological guidance. The latest research shows that smokers are more likely to accept encouraging language rather than health warning, and reminders according to personal habits and individualized concerns are more likely to prevent relapse.(20) Therefore, it is undoubtedly the most effective way for smokers to quit smoking is one smoker-on-one doctor, but it will also greatly increase the doctor's time and expense cost. We will improve our scheme by detailing the grouping in future clinical trials to complete treatment as accurate as possible. In addition, we will expand the scope of participating professional physicians to other fields, especially gastroenterology, surgery,

cardiovascular, oncology, etc. Smoking has a crucial effect on the progress of many diseases (21-24) and all doctors are encouraged to participate in smoking cessation, which plays an important role in improving the quality of life of patients and reducing the burden of diseases.

Conclusions

Overall, our study found the intervention of doctors by the instant messaging tools throughout smoking cessation process could effectively improve the success rate of smoking cessation. Besides, doctors' involvement can reduce the possibility of relapse due to the surrounding environment and social activity. Our research provides methodological guidance for further clinical trials and provides a template for further real-world application of smoking cessation services.

Abbreviations

CO, Carbon monoxide

FTND, Tobacco Dependence Assessment Scale

HIS, Heaviness of Smoking Index

BMI, Body Mass Index

CNY, Chinese Yuan

OR, Odd Ratio

SMS, Short Messaging Service

Declarations

Ethics approval and consent to participate

This study was carried out in accordance with the Declaration of Helsinki. This study was approved by Medical Science Research Ethics Committee of the First Affiliated Hospital of China Medical University. Written informed consent was obtained from all the participants. This study was registered at Chinese Clinical Trial Registry (Trial registration number: ChiCTR1800017231).

Consent for publication

Not applicable.

Availability of data and materials

The datasets analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' Contributions

All authors participated in the study design, revised and approved the final draft of manuscript. WXN, LR and ZL contributed to data collection and execution of the trial. WYZ and WXN performed the analyses and wrote the manuscript. KJ, XD and HXJ were responsible for financial support and the integrity of the data and the accuracy of the data analysis. WXN and WYZ give a comprehensive arrangement of this work and, as such, had full access to all the data in the study. All authors read and approved the final document.

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Figures

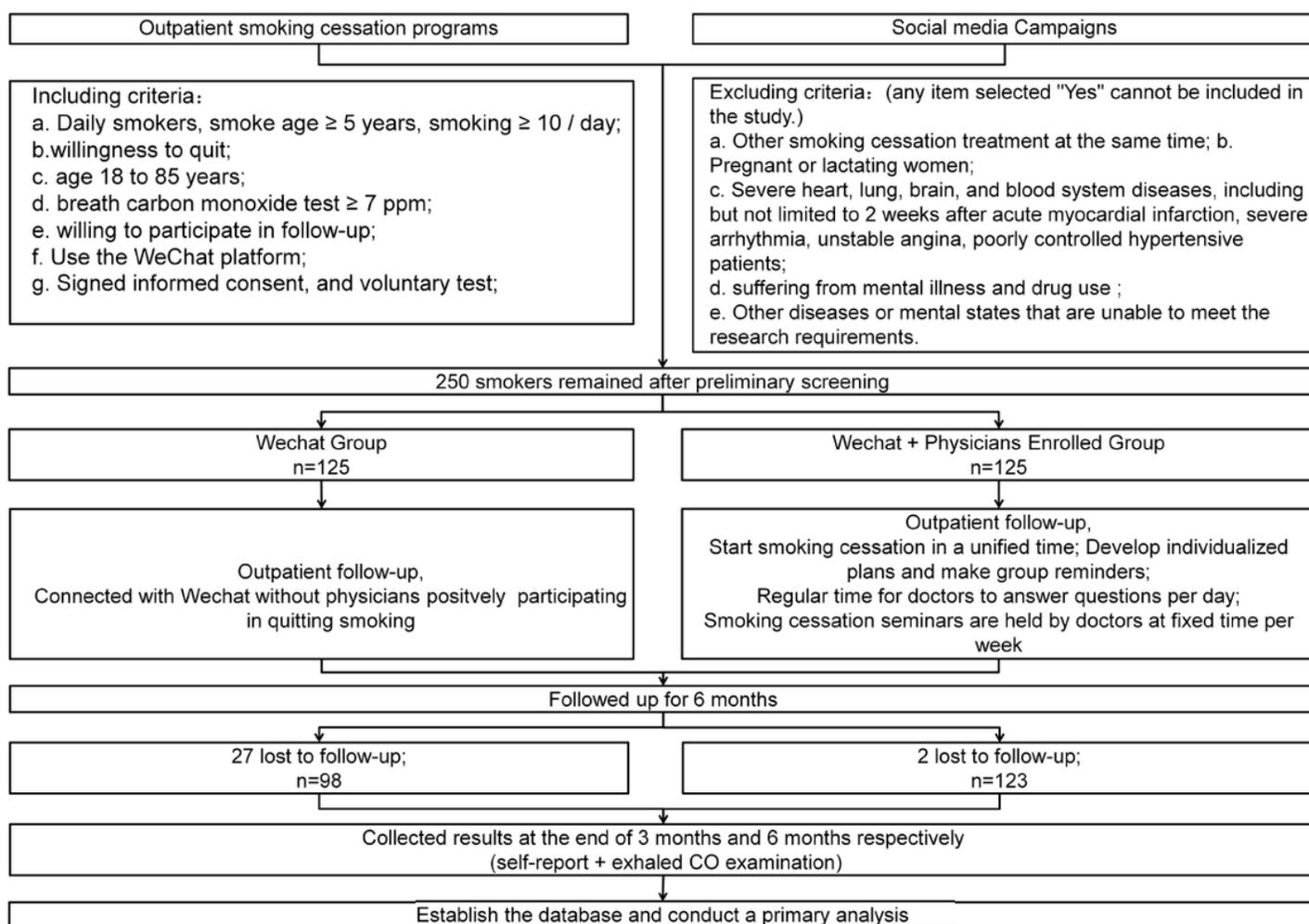


Figure 1

Study flowchart.

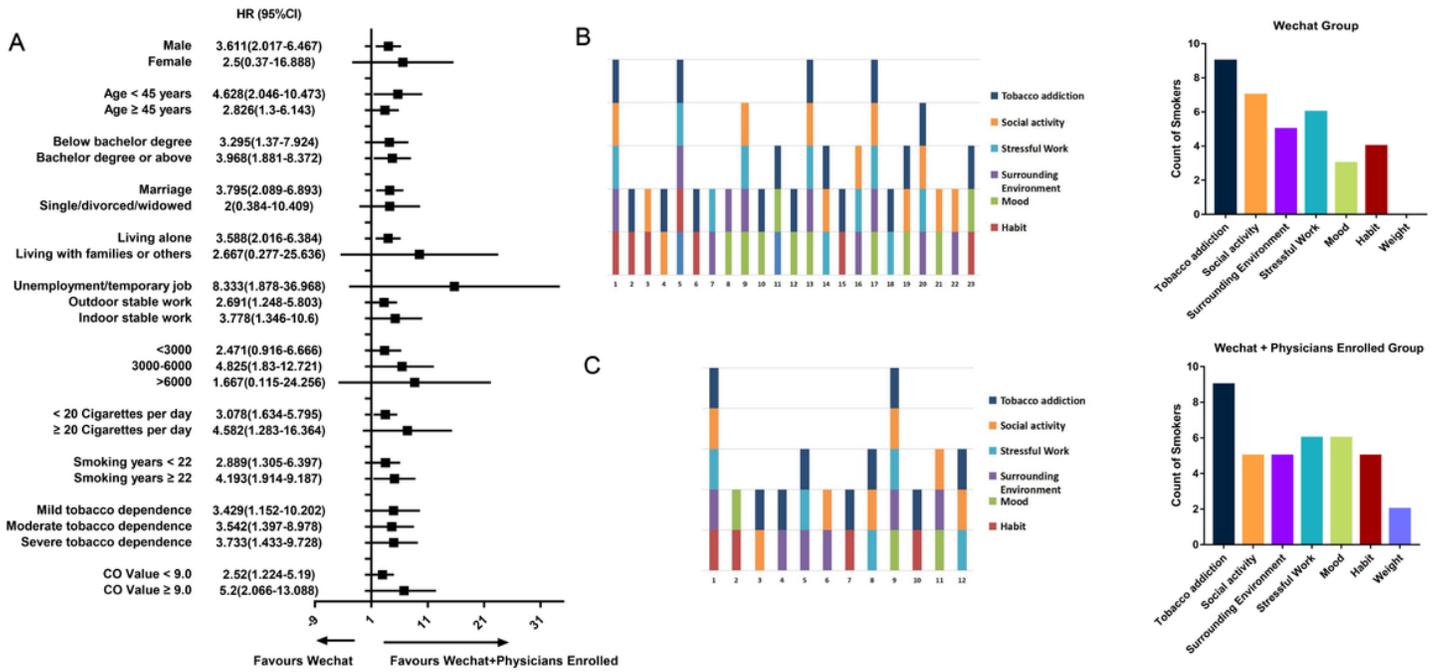


Figure 2

Subgroup analysis results and analysis of relapse causes. (A) The relationship between doctor participation and smoking cessation rate in different subgroups after beginning quitting 3 months. (B) The main reason for failed smoking cessation in Wechat group. (C) The main reason for failed smoking cessation in WeChat + physicians enrolled group.