

# How Does Tobacco Dependence Affect Determinants Related to Quitting Intention and Behaviour? Application of Protection Motivation Theory

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## Research Article

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# Abstract

**Objective:** This study used the PMT to examine the psychological-level predictors of quitting intention and behaviour with varying levels of nicotine dependence, with the goal of providing valuable evidence to promote theory-guided cessation interventions.

**Methods:** This is a cross-sectional study conducted from July to August 2020. Participants were randomly selected on the street in 26 provinces in mainland China. Data were collected via face-to-face interviews. Our data analysis was conducted in three steps. First, we employed descriptive statistics to present the overall characteristics of our sample. Second, we analysed the association between PMT constructs and quitting intention stratified by nicotine dependence. Third, we tested how quitting intention predicted quitting behaviour in each subgroup used logistic regression models.

**Results: For intention,** almost all the PMT constructs were significant predictors of quitting intention in the low-dependence group. There is no variable had a positive influence on quitting intention for the high-dependence group. **For behaviour,** quitting intention (OR=4.90, 95%CI:2.99-8.05) and nicotine dependence (OR=4.58, 95%CI:1.01-20.82) and e-cigarette use (OR=2.95, 95%CI:1.84-4.73) were significantly associated with quitting behaviour in full sample regression. However, in subsample regression, we only found a significant association between quitting intention and behaviour in the low-dependence and moderate-dependence group. In addition, We only found a significant association between e-cigarette use and quitting behaviour in the low-dependence group (Coef.=1.41, P<0.01).

**Conclusions:** Smokers with different nicotine dependence levels have different psychological predictors of quitting intention. Quitting intention was significantly associated with quitting behaviour only for the low and moderate nicotine dependence group. Our findings highlight the importance of providing accessible and affordable intensive smoking cessation interventions or smoking cessation medications for high-dependence smokers, and thus, more convincing research is necessary to determine how e-cigarette use affects quitting behaviour in long term.

## Introduction

China has taken some important steps forward in tobacco control in recent years. However, studies have found limited success in reducing smoking prevalence over the last decade. According to the China Adult Tobacco Survey (CATS), the smoking prevalence for males was 52.9% in 2010 [1], 52.1% in 2015 [2] and 50.5% in 2018[3]. One of the reasons for this high prevalence is the low quitting intention for current smokers in China (only 5.6% smokers have quitting intention) [3]. Quit intentions are a strong predictor of attempts to quit and attempts to quit are a strong predictor of successful smoking cessation. Therefore, it is critically meaningful to understand factors that are associated with quitting intention and behaviours to provide appropriate help for people to quit smoking.

A large number of studies have shown that many factors have a potential influence on quitting intention, but most previous nonintervention studies focused only on socioeconomic and demographic factors [4-

7]. The interventionable psychological pathway is still understudied. In addition, few studies are grounded in or guided by specific health behaviour theory when assessing quitting behaviour-related factors. As a result, how to effectively integrate the identified factors into theory-based smoking cessation strategies is almost untouched by researchers.

On the other hand, many past studies took tobacco dependence and other psychological measures as same-level factors [8-9], but an increasing number of studies found that nicotine dependence was the most consistent and significant variable that was not only associated with quitting attempts but can also impose effects on other psychological factors [4,10-11]. Thus, it is important to conduct further research based on different tobacco dependence statuses.

### **Evidence prior to this study**

In the previous year, psychological factors related to quitting activities have received some attention. Li et al used International Tobacco Control (ITC) China Survey data and found that higher quitting self-efficacy and more immediate intention to quit were independent predictors of quitting attempts [8]. A clinical study found that those who have fewer past failed attempts to quit and believe that it is not too late to quit are more likely to consider quitting [9]. Other researchers found that higher perceived severity and vulnerability to smoking-related diseases are associated with higher odds of quitting attempts [12]. A cohort study from six European countries found that a lower level of perceived addiction and health concerns and being a good example for children were among the most important reasons that predicted being a quitter [13].

With regard to nicotine dependence, studies have found that high nicotine dependence is associated with failure to quit attempts [11,14]. Tobacco users with a high Fagerstrom test for nicotine dependence (FTND) score were 1.83 and 3.30 times less likely to intend to quit, respectively[15]. Other researchers found that nicotine dependence not only has a direct impact on quitting behaviour but also has a joint influence on quitting intention to moderate the effect of smoking cessation interventions [16].

### **Theoretical framework**

Protection motivation theory (PMT) is a famous theory of behaviour change and is especially useful for addressing smoking behaviour [17]. The basic idea behind this theory is that prevention behaviour is driven by the evaluation of the risk and an evaluation of the coping response [18]. As shown in Figure 1, the PMT has seven elements: perceived severity, perceived susceptibility, intrinsic and extrinsic rewards, response efficacy, self-efficacy and response costs. Stronger motivation to specific health behaviour (such as quitting intention) can be expected if the perceived severity and vulnerability are high and rewards are low. Response efficacy and self-efficacy are expected to enhance protection motivation, whereas response costs are expected to reduce motivation [19-21].

As mentioned, assessing quitting behaviour by health theory can provide a more comprehensive evaluation framework of influential psychological variables and thus provide valuable evidence for

further smoking cessation interventions. One meta-analysis, which analysed six studies based on PMT and smoking cessation, concluded that coping appraisal variables showed stronger effects regarding the prevention of smoking and smoking cessation than threat appraisal variables [22]. A longitudinal study found that self-efficacy was the only construct that significantly predicted future quitting behavioural. Other researchers found that perceived rewards of tobacco use, especially intrinsic rewards, were consistently positively related to smoking intentions and behaviour [24-25].

## **Hypotheses**

In this study, we used the PMT to examine the psychological-level predictors of quitting intention and behaviour with varying levels of nicotine dependence, with the goal of providing valuable evidence to promote theory-guided cessation interventions. First, we want to assess how well the different constructs of this theory predict quitting intention and how this relationship varies across smokers with different nicotine dependence levels. Then, we examine how quitting intention and other identified factors are associated with actual quitting behaviour.

Based on the available literature, we hypothesized the following: 1. Smokers with different nicotine dependence levels have different psychological predictors of quitting intention. 2. The pathway between quitting intention and quitting behaviour was not significant for all smokers with varying levels of nicotine dependence.

This paper extends prior research along two dimensions. First, to the best of our knowledge, this is the first study to evaluate the association between quitting intention and its psychological predictors, especially in relation to nicotine dependence, in the context of behaviour change theory. Second, many studies have left the relation between psychological determinants and untested behaviour because effects on behaviour are often difficult or even impossible to measure. We recognize that intentions are important, but measuring the intention alone provides only a partial picture. We test psychological determinants and the target behaviour simultaneously.

## **Methods**

### **Study population and procedure**

This is a cross-sectional study conducted from July to August 2020. The School of Public Health, Peking University Health Science Centre sent investigators to 26 provinces in mainland China. Participants were randomly selected on the street in large business districts and large residential areas in urban regions. Data were collected via face-to-face interviews. Participants took approximately 10 min to complete all the assessments. We did not provide any incentives for participation. Adult daily smokers who smoked more than one year and lived in this city  $\geq 5$  years were considered eligible for participation. The questionnaires were designed by Peking University and consist of 50 items assessing demographic and sociological information, smoking and quitting information, individual health literacy and lifestyle information and aspects related to PMT.

## **Ethnic considerations**

The study protocol was approved by the ethics commission of Peking University Health Science Centre (Ethical approval number: IRB00001052-18055). All methods were performed in accordance with the ethnic guidelines and regulations. Informed consent were obtained from all participants. All the participants were informed that the statistical analyses would be conducted anonymously, and their information would be used for research purposes and published.

We state that there is no conflict of interest.

## **Measurements**

### **The measurement of quitting intentions and behaviour**

Quitting intentions were measured by the Transtheoretical Model (TTM). In the survey, the participants were asked, "Are you going to quit smoking? A: yes, within a month, B: yes, within 6 months, C: yes, but not within 6 months, D: no plan for quitting." the participants who chose A or B were classified as having quitting intentions. The reason is that according to the TTM, if a smoker does not want to quit within 6 months, he or she is classified as being in the precontemplation stage [26]. Quitting behaviour was measured by the following question. The respondents were asked, 'Have you tried to quit from smoking this year? A: Yes, B: No'.

### **The measurement of nicotine dependence**

The Fagerstrom Test for Nicotine Dependence is a 6-item scale that measures physical dependence on nicotine [27]. In the survey, the participants were asked '1. How soon after you wake up do you smoke your first cigarette? 2. Do you find it difficult to refrain from smoking in places where it is forbidden? 3. Which cigarette would you hate most to give up? 4. How many cigarettes/day do you smoke? 5. Do you smoke more frequently during the first hours after waking than during the rest of the day? 6. Do you smoke if you are so ill that you are in bed most of the day?' Each answer was coded from 0 to 3. Scores on the test range from 0 to 10 (0-3 indicates low nicotine dependence; 4-6 indicates moderate-dependence;  $\geq 7$  indicates high-dependence) [28].

### **The measurements of PMT constructs**

PMT constructs were assessed using the PMT scale, which was based on the work of Xu et al. [29]. We also improved and adjusted some of the questions to make them fit for measures of quitting intention. Specifically, the scale comprised 21 items using a 7-point Likert-type response scale from 1 (definitely disagree) to 7 (definitely agree). Each construct subscale includes three items, and we computed the mean as the subscale score. We have published the details of this scale and evaluation process elsewhere [30].

**Perceived severity** was measured by: 'The earlier a person starts smoking, the greater the harm', 'More smokers get sick than nonsmokers', and 'Smokers die earlier than nonsmokers'. **Perceived vulnerability** was measured by: 'I would become addicted if I smoked', 'I would get sick if I smoked', and 'If I smoke, I may die earlier'. **Intrinsic rewards** were measured by: 'Smoking makes people feel comfortable', 'Smoking helps people concentrate', and 'Smoking enhances brainwork'. **Extrinsic rewards** were measured by: 'Smokers look cool and fashionable', 'Smoking is good for social networking', and 'The life of a smoker is happier than that of a nonsmoker'. **Self-efficacy** was measured by: 'I am confident that I can quit smoking successfully', 'I have the ability to stop smoking', and 'I think stopping smoking is easy for me'. **Response efficacy** was measured by: 'People will feel good by not smoking', 'People will be less likely to get disease if they do not smoke', and 'Quitting smoking is good for disease recovery'. **Response cost** was measured by: 'A person may be isolated if they quit smoking', 'Refusing a cigarette offer is very impolite', and 'One will miss the enjoyment if he or she quits smoking'.

## Other variables

We also collected several variables of individual characteristics and sociodemographic information, including sex, age, marital status, ethnicity, education, yearly income, chronic diseases, life satisfaction, alcohol drinking and job. Furthermore, we assess smoking status, including the number of cigarettes per day, e-cigarette usage, and smoking cessation information (i.e., quitting attempts and quitting methods).

## Data analysis

Our data analysis was conducted in three steps. First, we employed descriptive statistics to present the overall characteristics of our sample. Second, we analysed the association between PMT constructs and quitting intention stratified by nicotine dependence. Third, we examined how quitting intention was associated with quitting behavior in each subgroup.

**Step 1:** Categorical variables are presented as counts and percentages. Comparisons of PMT construct scores between different groups were performed.

**Step 2:** Binary Logistic Regression models were used to test the association between seven PMT constructs and quitting intention. All the samples were classified as low nicotine dependence, moderate dependence and high dependence.

**Step 3:** To examine intention and behaviour simultaneously, we first identified the factors associated with quitting behaviour. Then, we used Logistic Regression models to examine how intention was associated with actual behaviour in each nicotine dependence group.

We chose appropriate demographic covariates by correlation  $>0.30$  with both independent and outcome variables.

## Results

## **Descriptive statistics**

We approached 738 smokers. After screening, 613 were identified as eligible for interviews. The participants were from 26 provinces in Mainland China. Table 1 shows the descriptive statistics for the overall sample. The mean age of the study population was  $37.95 \pm 14.31$ . Males accounted for 91.7 percent of the sample (n=562). A total of 297 (48.5%) study subjects wanted to quit tobacco. The majority of the people had low nicotine dependence (70.0%).

Table 2 shows the subscale score of PMT. High-dependence smokers had the lowest mean score (SD) of perceived severity of smoking related diseases, self-efficacy and response efficacy of quitting and the highest mean score (SD) of intrinsic and extrinsic rewards of smoking, and response cost of quitting.

## **The association between seven PMT constructs and quitting intention**

The association between the seven PMT constructs and quitting intention was different depending on nicotine dependence level (Table 3). For the low-dependence group, almost all the PMT constructs were significant predictors of quitting intention. Stronger intentions were significantly associated with higher perceived severity (OR=1.31, 95%CI:1.09-1.57), vulnerability (OR=1.20, 95%CI:1.01-1.43), self-efficacy (OR=1.19, 95%CI:1.04-1.35), and response efficacy (OR=1.24, 95%CI:1.03-1.50) but were inversely associated with intrinsic rewards (OR=0.83, 95%CI:0.70-0.98).

For the moderate-dependence group, only perceived vulnerability (OR=1.44, 95%CI:1.01-2.06) was positively associated with quitting intention. Interestingly, we found that no variable had a positive influence on quitting intention for the high-dependence group.

## **The role of quitting intention to behaviour in the full sample**

To evaluate the predictive effect of quitting intention on behaviour, we changed the dependent variable to quitting behaviour and accounted for tobacco dependence, e-cigarette use and demographic factors. As shown in Figure 2, quitting intention (OR=4.90, 95%CI:2.99-8.05) and nicotine dependence were significantly associated with quitting behaviour. The OR of the e-cigarette use variable was 2.95 (95% CI 1.84 to 4.73), which suggests that e-cigarette use has a positive association with quitting behaviour.

## **The role of quitting intention to behaviour in subgroup analysis**

To examine how tobacco dependence influence the relationship between quitting intention and behaviour, we reconducted the abovementioned regressions with different nicotine dependence subsamples separately. The results are shown in Table 4. It is worth noting that we only found a significant association between quitting intention and behaviour in the low-dependence group (Coef.=1.67, P<0.01) and moderate-dependence group (Coef.=1.41, P<0.01). The coefficient of the high-dependence group was not statistically significant. A similar pattern can be observed for the association between e-cigarette use and quitting behaviour. We only found a significant association between e-cigarette use and quitting behaviour in the low-dependence group (Coef.=1.34, P<0.01).

## Discussion

This study joins the debate in recent years on the factors related to quitting behaviours and provides evidence from a more general perspective. These Chinese data provide a comprehensive picture of how PMT variables are associated with quitting intention and how intention affects quitting behaviour for smokers with different nicotine dependences. The study provides new and potentially important information. It successfully shows that the relationship between PMT variables and quitting intention is substantially impacted by nicotine dependence level. In other words, smokers with different nicotine dependence levels have different psychological predictors of quitting intention (**first hypothesis**).

The results of the present study showed that most PMT variables significantly predicted protection motivation for low nicotine-dependent smokers. However, consistent with other studies, not all PMT measures had the same strength in predicting quitting intention [24,30]. A previous meta-analysis showed that coping appraisal variables, especially self-efficacy, were the strongest predictors of protection motivation and behaviour [22]. Notably, none of these factors can promote smoking intention for high-dependence smokers. These findings highlight the necessity of accounting for smokers' nicotine dependence levels when designing smoking cessation interventions. The findings could also encourage policymakers and health practitioners to implement tailored behavioural interventions and thus contribute to achieving better smoking-reduction outcomes.

It is worth noting that actual quitting behaviour is affected by quitting intention, tobacco dependence and e-cigarette usage. However, quitting intention is significantly associated with quitting behaviour only for the low and moderate dependence group (**second hypothesis**). This finding is consistent with previous research showing that greater nicotine dependence is associated with weaker motivation to quit smoking and lower abstinence rates. In addition, we recognize that intentions are important, as they 'get the ball rolling'[29]; however, these findings indicate that the association between quitting intention to behaviour is influenced by nicotine dependence level. Given that many higher-dependence smokers may have difficulty pursuing abstinence depending on motivation intervention alone, our study calls for the promotion of accessible and affordable intensive smoking cessation interventions or smoking cessation medications for high-dependence smokers in China. Our previous study found that the limited use of smoking cessation medications in China is a problem. The main barrier to accessing these medications is their cost. An obvious remedy would be to add them to the essential-drugs list so that the cost could largely reimbursable, but this is not currently under consideration for the Chinese government [31].

Importantly, the relationship between e-cigarette use and quitting attempts is substantially impacted by nicotine dependence level. Although previous work argues that e-cigarettes may be valuable as a smoking cessation approach [32], the current findings only support this to some extent. In particular, we have not identified an association between e-cigarette use and positive quitting attempts in moderate- and high-dependence smokers. On the other hand, among those with very low nicotine dependence, we observed an association between e-cigarette use and more positive quitting attempts. However, since the

safety and long-term outcomes of e-cigarettes are still uncertain and because we used a cross-sectional design, caution should be used when interpreting these results.

Our study has several limitations. First, all the information we collected was based on self-report without verification, and the respondents' interpretations of some questions might vary. Second, these analyses are limited by the available variables, especially regarding e-cigarette use. In particular, we did not separate lifetime use and recent users. This may have weakened the effects. Third, we may also have unmeasured confounders that contributed to quitting intention, such as chronic disease. However, because all the information was collected at random, we believe the overall findings are meaningful.

Despite these limitations, our findings have some policy and theoretical implications. First, this study extends existing research in critical ways, primarily in relation to how nicotine dependence may alter the relationship between quitting intention and behaviour. This suggests that enhancing Chinese smokers' quitting intention regarding smoking is only leads to quitting attempts for some smokers. Therefore, it is important to have some smoking cessation services available to high-dependence smokers. A suitable plan for quitting should be developed depending on an individual's level of nicotine dependence. Second, the current findings show a complex relationship between e-cigarette use and quitting attempts that may warrant different research for different types of users. In particular, e-cigarette use may have potential with respect to promoting quitting among low-dependence smokers, but it may be less appropriate to use e-cigarettes as a kind of cessation medicine among highly dependent smokers. Future research using experimental and longitudinal designs is needed to evaluate these preliminary findings.

## **Conclusion**

The present study findings revealed that smokers with different nicotine dependence levels have different psychological predictors of quitting intention. Quitting intention was significantly associated with quitting behaviour only for the low and moderate nicotine dependence group. Our findings highlight the importance of providing accessible and affordable intensive smoking cessation interventions or smoking cessation medications for high-dependence smokers, and thus, more convincing research is necessary to determine how e-cigarette use affects quitting behaviour. Taken together, the results of this empirical analysis not only contribute to identifying the determinants of psychological predictors of quitting intention but also provide further evidence to how nicotine dependence affects quitting behaviour in a developing country and add to earlier research on this topic.

## **Declarations**

### **Ethics approval and consent to participate**

This study was approved by the Peking University. Verbal informed consent were obtained from all participants.

### **Authors' contributions**

HX L finished the first draft. MJ C Y T Z Q P Y and LC Z conduct this survey. CC managed the study. All authors have approved the final paper for submission.

### **Consent for publication**

Not applicable

### **Availability of data and material**

The data of the studies is accessible via Peking University, School of Public Health.

### **Competing interests**

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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## Tables

Table 1.

## Descriptive statistics for the overall sample

<b>Demographics</b>	<b>n/%</b>
<b>Age</b>	
18–29	240 (39.2)
30–39	86 (14.0)
40–49	133 (21.7)
50 and above	154 (25.1)
Mean (SD)	37.95 (14.31)
<b>Sex</b>	
Male	562 (91.7)
Female	51 (8.3)
<b>Ethnicity</b>	
Han	544 (88.7)
Other	69 (11.3)
<b>Marriage</b>	
Single	230 (37.5)
Married	359 (58.6)
Divorced or widowed	24 (3.9)
<b>Educational attainment</b>	
Master/above	41 (6.7)
Bachelor	319 (52.0)
High school	129 (21.0)
Middle school	79 (12.9)
Primary school/lower	45 (7.3)
<b>Number of cigarettes per week</b>	
1–50	287 (46.8)
51–100	125 (20.4)
101–150	163 (26.6)

>150	38 (6.2)
Mean (SD)	74.86 (90.48)
<b>Have quitting intention</b>	
Yes	297 (48.5)
No	316 (51.5)
<b>Quitting behaviour</b>	
Yes	112 (18.3)
No	501 (81.7)
<b>Nicotine dependence</b>	
Low	429 (70.0)
Moderate	148 (24.1)
High	36 (5.9)
<b>Have chronic disease</b>	
Yes	104 (17.0)
No	509 (83.0)
<b>Total</b>	613

Table 2.

Item score of the PMT

Item and Primary Subconstructs	Mean (SD)		
	Low dependence	Moderate dependence	High dependence
Perceived severity	5.59(1.44)	5.40(1.70)	4.51(1.75)
Perceived vulnerability	4.74(1.49)	5.12(1.53)	5.03(1.34)
Intrinsic rewards	4.81(1.56)	5.38(1.46)	5.66(1.28)
Extrinsic rewards	3.54(1.37)	3.41(1.46)	4.17(1.39)
Self-efficacy	4.42(1.82)	3.48(1.85)	2.87(1.73)
Response efficacy	4.96(1.30)	4.75(1.43)	4.15(1.42)
Response cost	3.41(1.57)	3.76(1.62)	4.17(1.69)

Table 3.

Logistic regression models of the quitting intention regressed on the PMT variables by tobacco dependence

	Quitting intention					
	Low dependence		Moderate dependence		High dependence	
	OR	95%CI	OR	95%CI	OR	95%CI
<b>Severity</b>	1.31*	1.09-1.57	0.87	0.62-1.23	0.77	0.33-1.81
<b>Vulnerability</b>	1.20*	1.01-1.43	1.44*	1.01-2.06	1.75	0.54-5.66
<b>Intrinsic rewards</b>	0.83*	0.70-0.98	0.82	0.62-1.08	0.55	0.23-1.32
<b>Extrinsic rewards</b>	1.01	0.83-1.25	1.11	0.79-1.57	0.43	0.14-1.34
<b>Self-efficacy</b>	1.19*	1.04-1.35	1.16	0.93-1.44	0.35	0.12-1.01
<b>Response efficacy</b>	1.24*	1.03-1.50	1.13	0.82-1.56	1.90	0.50-7.24
<b>Response cost</b>	0.88	0.74-1.05	0.75	0.55-1.03	0.64	0.32-1.28
<b>R<sup>2</sup></b>	0.17		0.15		0.42	

Note: \*p<0.05

We controlled for sex, education attainment, alcohol drinking in all the models.

Table 4.

Logistic regression models of the quitting behaviour regressed on quitting intention and e-cigarette use by tobacco dependence

	Quitting behaviour					
	Low dependence		Moderate dependence		High dependence	
	Coefficient	P value	Coefficient	P value	Coefficient	P value
<b>Quitting intention</b>	1.67*	0.00	1.41*	0.00	34.20	0.99
<b>E-cigarette use</b>	1.34*	0.00	0.55	0.24	16.72	0.99
<b>R<sup>2</sup></b>	0.13		0.15		0.22	

Note: We controlled for sex, education attainment, alcohol drinking in all the models.

## Figures

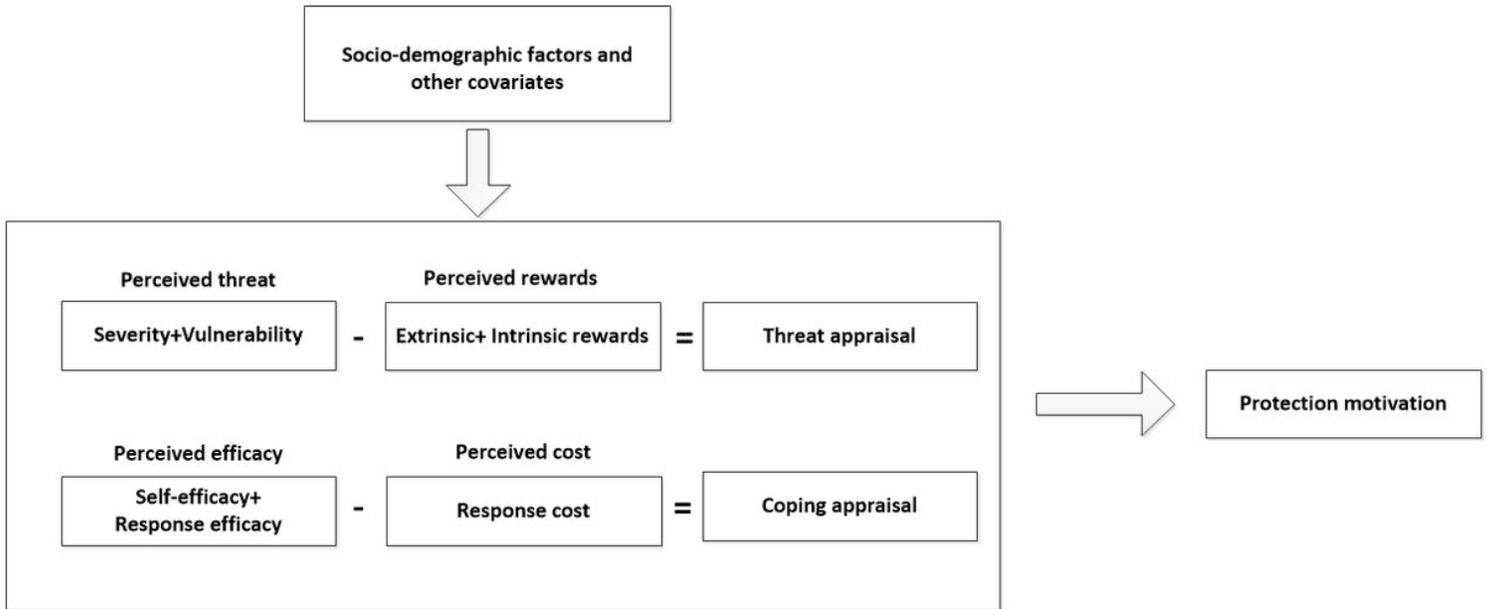


Figure 1

Protection motivation theory framework

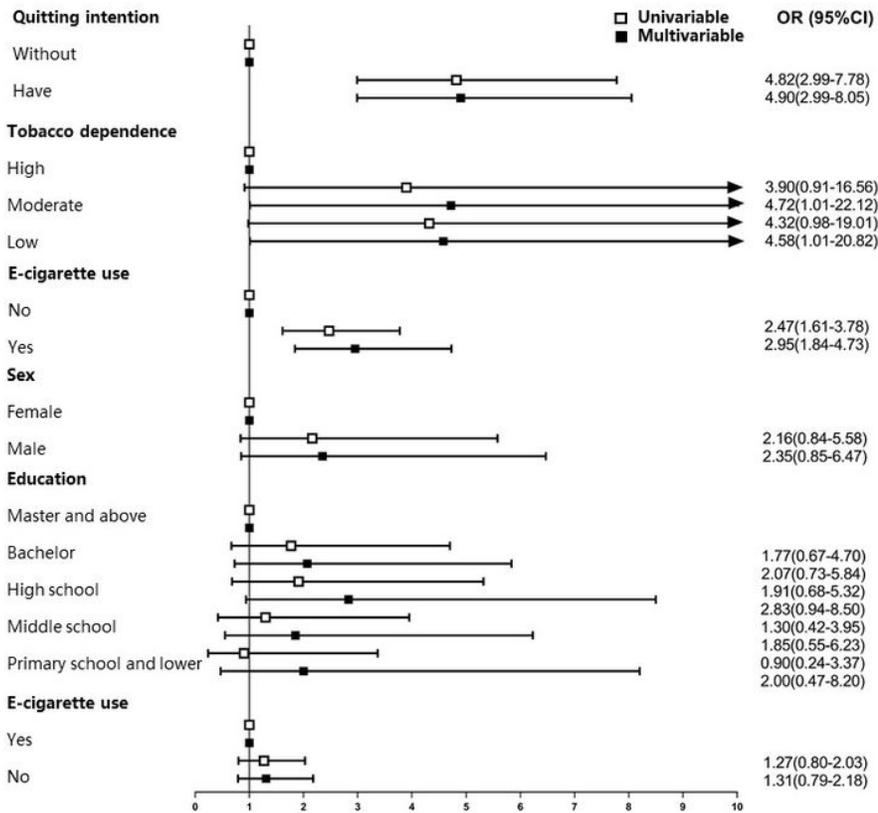


Figure 2

Factors associated with quitting behaviour