Mediation of smoking abstinence self-efficacy on the association of nicotine dependence with smoking cessation

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Background: The nicotine dependence (ND) has negative and smoking abstinence self-efficacy (SASE) has positive effects on successful smoking cessation, but scant data is now available for what is the mediating role of SASE on the association of ND with successful smoking cessation. The aim of this study was to assess the abovementioned mediation. Methods: A case–control study was conducted with 642 successful spontaneous quitters as the cases, and 700 failed spontaneous quitters as the controls. ND and SASE were evaluated by Fagerström Test for Nicotine Dependence (FTND) scale and SASE scale, respectively. Propensity score as covariate in the regression model was used to adjust for potential confounders of age, age of smoking initiation, occupation, educational level and marital status. Total effect was decomposed into direct and indirect (mediating) effect using logistic regression based on the KHB method proposed by Holm et al. Results: After adjusting for the aforementioned potential confounders, the mediating effects among the total effect of ND on successful spontaneous smoking cessation were 32.90%, 12.14%, 35.64% and 83.03% for the total score of SASE and its three context-specific situation scores, i.e. positive/social situation, negative/affective situation and habit/addictive situation, respectively. Conclusions: This study indicates that SASE has a partial mediating effect on the association of ND with successful spontaneous smoking cessation. To boost the smokers’ SASE could increase the probability of successful smoking cessation.

Introduction

Tobacco use continues to be the leading cause of preventable death worldwide. Despite of current tobacco control activities, the prevalence of smoking in China remains at a high level. There are about 301 million current smokers in China, making China the largest consumer of tobacco in the world. According to the results of 'Global Adult Tobacco Survey (GATS) China 2010 Country Report', among ever smokers, successful smoking cessation rate (11.7%) in China was very low. Additionally, in China, the rural population, whose smoking severity is higher and cessation rate is lower than the urban people, is in the majority. Thus, in China, especially in rural areas, developing effective tobacco control measure to increase successful smoking cessation rate is extremely urgent and imperative.

Although several strategies are available for conducting tobacco control in the population, promoting smokers to quit is one of the main tactics. Numerous studies suggested that there were a number of variables associated with successful quitting, such as age, education, social class/occupation, marital status or living with a partner, number of smoking friends and social/family supports. Among those, nicotine dependence (ND) was one of the major risks for successful smoking cessation. In practice, there are now several methods, such as nicotine replacement therapy, to be used to help the smokers to quit. Nevertheless, to increase smoker's smoking abstinence self-efficacy (SASE; the smoker’s self-confidence or belief in their ability to refrain from smoking) should be the primary and important means for promoting smoking cessation. According to the self-efficacy theory of Bandura, person having higher level of self-efficacy will have the more possibility to succeed. A solid body of evidence proved that the level of SASE among ex-smokers was significantly higher than that of current smokers, and the higher the self-efficacy score, the more likely to quit successfully. Furthermore, data also showed that self-efficacy to refrain from smoking was negatively associated with ND. Thus, we wonder that whether and to what extent SASE plays a mediation role on the association of ND with successful smoking cessation. To our knowledge, few data are available about this topic up to now.

Therefore, in this study, we presume that: (i) smokers who have low ND degree tend to quit smoking successfully; (ii) smokers who have low ND tend to have higher level of SASE; (iii) the association of ND with successful smoking cessation is mediated by SASE. Based on the earlier hypotheses, we will assess the mediation of SASE on the association of ND with successful smoking cessation, which will provide evidence needed to better informed education for tobacco control intervention.

Methods

Subjects

This cross-sectional study was conducted from April to May, 2013, among the persons residing in 17 villages of three counties (Ping Yin, Ju Nan and Liang Shan) in Shandong, China. Male persons aged 18 or more and ever spontaneous quitted smoking were face-to-face interviewed by the well-trained investigators to complete a questionnaire that was designed based on GATS Core Questionnaire with Optional Questions. The total amount of valid questionnaires was 1429, among which, 596 were for current smoker (including 509 for current daily smoker and 87 for current occasional smoker) and 833 for ex-smoker.
Definitions

According to the WHO data, some definitions are as follows: smokers are defined as those who have/had smoked 100 or more cigarettes (or the equivalent amount of tobacco) during their lifetime; Current smokers refer to those who comply with the criterion of smoker, and smoke any tobacco product at the time of the survey; Current daily smokers are defined as those who comply with the criterion of smoker, and smoke at least once a day at the time of the survey; Current occasional smoker are defined as those who comply with the criterion of smoker, and smoke but not every day at the time of the survey; Current ex-smokers are people who comply with the criterion of smokers but do not smoke at all for 2 years or more continuously at the time of the survey. Failed quitters refer to those who comply with the criterion of smokers, and had not smoked at all for less than 2 years continuously at the time of the survey.

Measure and instruments

We assessed basic demographic information, including age, race, education, occupation, marital status and other smoking-related questions.

Velicer et al.’s short form (nine-item) smoking abstinence self-efficacy scale (SASES) was used to assess SASE. The scale consists of three situational factors, i.e. positive/social situation (SASEP), negative/affective situation (SASEN), and habit/addictive situation (SASEH). Items are rated on a five-point Likert-type scale ranging from completely sure as 5 to completely unsure as 1. The total (SASET) and its three context-specific scores as mentioned above are calculated to measure the self-efficacy levels, higher score indicates the higher level of self-efficacy. The total scale showed high internal consistency reliability in this study (Cronbach’s alpha = 0.884).

Participants’ level of ND was assessed using the Fagerström test for nicotine dependence (FTND) scale, which measured physical as well as psychological tobacco dependence. The FTND scale consists of six items and each item has a weighted score that ranges from 0 to 3. The total scale showed good internal consistency reliability in this study (Cronbach’s alpha = 0.689).

Data analysis

Pearson’s χ² test with Fisher’s exact probability was performed to compare the distribution of the categorical variables between case and control groups. If Bartlett’s test for equal variances between case and control groups is not statistically significant, one-way analysis of variance was used to test the differences of means of metric variables; otherwise, the Kruskal–Wallis equality-of-populations rank test was used. FTND score was categorized into tertiles as linear trend to represent low, middle and high levels of ND and rescored inversely. SASE scores (including SASET, ASESP, SASEN and SASEH) were also categorized into tertiles as linear trend to represent low, middle and high levels. Propensity score as the covariate in the regression model was used to adjust for the potential confounders of age, age of smoking initiation, occupation, educational level and marital status. The mediation analysis was conducted that the total effect (the effect of treatment variable X on outcome variable Y without mediating variable M) was decomposed into direct effect (the effect of treatment variable X on outcome variable Y when controlling for mediating variable M) and indirect (mediating) effect (the effect of treatment variable X on outcome variable Y through mediating variable M) using logistic regression based on the KHB method proposed by Holm et al. The proportion of mediating effect among the total effect (magnitude measure of mediating effect) was calculated as the indirect effect divided by the total effect. All statistical analyses were carried out with STATA/SE version 13.1 (Stata Corporation, College Station, TX, USA). All reported probabilities (P value) were two-sided, and that <0.05 was considered statistically significant.

Results

Sample characteristics

The demographic characteristics of both the successful spontaneous smoking quitters (cases) and the failed spontaneous smoking quitters (controls) were summarized in table 1. The distribution of educational level, marital status between the case and control groups was significantly different. Compared with the failed spontaneous smoking quitters, the successful spontaneous smoking quitters had significant higher age, SASET, ASESP, SASEN, SASEH scores and lower age of smoking initiation and FTND score.

Mediation analysis

Smokers with lower level of ND were more likely to quit smoking successfully (OR = 1.195, 95% CI: 1.051–1.358, P = 0.007). All the adjusted results of the mediation analysis were reported in table 2. As for the total score of SASE, the partial mediating effect on the association of ND with successful spontaneous smoking cessation was observed, and after adjusting for the potential confounders of age, age of smoking initiation, occupation, educational level and marital status, the mediating effect (indirect effect) was 32.90% among the total effect of ND on successful spontaneous smoking cessation.

As for the three context-specific scores of SASE, after adjusting for the aforementioned potential confounders, the mediating effects (indirect effects) on the association of ND with successful spontaneous smoking cessation were 12.14%, 35.64% and 83.03% for the SASET, ASESP, SASEN and SASEH, respectively.

Discussion

It is self-evident that to conduct tobacco control is imperative and urgent, since tobacco use is the leading cause of preventable death worldwide. Although previous data indicated that ND was the major risk factor for the unsuccessful smoking cessation and relapse,
this kind of information will undoubtedly discourage the smokers with moderate and high degree of ND from trying to quit. It should be noted that ND does not only mean physical dependence, since psychological dependence also plays an important role. In addition, publications before have focused mainly on the relation of ND to smoking cessation, however, this relationship may be more complex. Studies also demonstrated that SASE had positive impact on successful smoking cessation through self-efficacy. A prospective study revealed that a high level of knowledge about a disease or health condition is identified as an essential element of perceived susceptibility and self-efficacy is recognized as playing a central role in patient’s decision making and adaptation. The randomized controlled studies showed that patients educated with disease-related information could improve their self-efficacy. The true reason for this phenomenon needs further to be explored. As for the context-specific scores of SASE, those mediating effects on the association of ND with successful smoking cessation were different, the biggest is in the habitual/addictive situation (83.03%). The randomized controlled studies showed that patients educated with disease-related information could improve their self-efficacy and lower level of ND or both [in our data, FTND was much higher correlated with SASEH ($r = -0.675$) than SASEP ($r = -0.366$) and SASEN ($r = -0.394$)], this would make them much easier to refrain from smoking, so as to increase more possibility of successful smoking cessation.

Knowledge about a disease or health condition is identified as an essential element of perceived susceptibility and self-efficacy is recognized as playing a central role in patient’s decision making and adaptation. The randomized controlled studies showed that patients educated with disease-related information could improve their self-efficacy. A prospective study revealed that a high level of perceived susceptibility along with high self-efficacy would be more likely to cause patients to reduce smoking. Those evidences and our findings suggest that it should be worth to be attention to bettering informed education so as to boost the smoker’s abstinence self-efficacy to increase the

### Table 1 The characteristics of successful smoking quitters and failed smoking quitters

<table>
<thead>
<tr>
<th>Variables</th>
<th>Successful quitters ($n = 642$)</th>
<th>Failed quitters ($n = 700$)</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>61.403 ± 11.529</td>
<td>56.274 ± 12.146</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age group (young/middle/old)</td>
<td>48/223/371</td>
<td>115/298/287</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age of smoking initiation</td>
<td>21.467 ± 5.575</td>
<td>22.461 ± 6.928</td>
<td>0.045</td>
</tr>
<tr>
<td>Occupation(farmer/others)</td>
<td>480/162</td>
<td>525/175</td>
<td>0.950</td>
</tr>
<tr>
<td>Education (low/middle/high)</td>
<td>186/370/86</td>
<td>147/446/107</td>
<td>0.003</td>
</tr>
<tr>
<td>Marital status (married/unmarried/others)</td>
<td>573/8/61</td>
<td>663/5/32</td>
<td>0.001</td>
</tr>
<tr>
<td>SASET</td>
<td>2.767 ± 0.826</td>
<td>2.584 ± 0.699</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SASEP</td>
<td>2.518 ± 0.822</td>
<td>2.396 ± 0.778</td>
<td>0.005</td>
</tr>
<tr>
<td>SASEN</td>
<td>2.543 ± 1.091</td>
<td>2.277 ± 0.931</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SASEH</td>
<td>3.239 ± 0.956</td>
<td>3.079 ± 0.851</td>
<td>0.001</td>
</tr>
<tr>
<td>FTND</td>
<td>3.081 ± 2.816</td>
<td>3.359 ± 2.584</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Data are presented as mean ± SD or frequency. Age group: young = age < 45, middle = 45 ≤ age < 60, old = age ≥ 60. Education: low = less than primary school, middle = primary and middle school, high = high school or more; SASET: total score for smoking abstinence self-efficacy; SASEP: score for smoking abstinence self-efficacy of positive/social situation; SASEN: score for smoking abstinence self-efficacy of negative/affective situation; SASEH: score for smoking abstinence self-efficacy of habitual/addictive situation. FTND: score for Fagerstrom Test of Nicotine Dependence.

### Table 2 The adjusted results of mediation of SASE on the association of ND with successful smoking cessation

<table>
<thead>
<tr>
<th>Mediation variable</th>
<th>Effect</th>
<th>β</th>
<th>SE(β)</th>
<th>z</th>
<th>$P$</th>
<th>OR(95% CI)</th>
<th>Mediation* (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SASET</td>
<td>Total effect</td>
<td>0.127</td>
<td>0.057</td>
<td>2.200</td>
<td>0.026</td>
<td>1.136(1.015–1.271)</td>
<td>32.90</td>
</tr>
<tr>
<td></td>
<td>Direct effect</td>
<td>0.086</td>
<td>0.067</td>
<td>1.280</td>
<td>0.202</td>
<td>1.089(0.953–1.242)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indirect effect</td>
<td>0.042</td>
<td>0.035</td>
<td>1.200</td>
<td>0.232</td>
<td>1.043(0.974–1.117)</td>
<td></td>
</tr>
<tr>
<td>SASEP</td>
<td>Total effect</td>
<td>0.127</td>
<td>0.057</td>
<td>2.200</td>
<td>0.026</td>
<td>1.136(1.015–1.271)</td>
<td>12.14</td>
</tr>
<tr>
<td></td>
<td>Direct effect</td>
<td>0.112</td>
<td>0.061</td>
<td>1.830</td>
<td>0.067</td>
<td>1.118(0.992–1.261)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indirect effect</td>
<td>0.015</td>
<td>0.021</td>
<td>0.730</td>
<td>0.468</td>
<td>1.016(0.974–1.059)</td>
<td></td>
</tr>
<tr>
<td>SASEN</td>
<td>Total effect</td>
<td>0.128</td>
<td>0.057</td>
<td>2.200</td>
<td>0.026</td>
<td>1.136(1.015–1.271)</td>
<td>35.64</td>
</tr>
<tr>
<td></td>
<td>Direct effect</td>
<td>0.082</td>
<td>0.061</td>
<td>1.340</td>
<td>0.180</td>
<td>1.086(0.963–1.224)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indirect effect</td>
<td>0.046</td>
<td>0.022</td>
<td>2.050</td>
<td>0.041</td>
<td>1.047(1.002–1.093)</td>
<td></td>
</tr>
<tr>
<td>SASEH</td>
<td>Total effect</td>
<td>0.128</td>
<td>0.057</td>
<td>2.200</td>
<td>0.026</td>
<td>1.137(1.016–1.272)</td>
<td>83.03</td>
</tr>
<tr>
<td></td>
<td>Direct effect</td>
<td>0.022</td>
<td>0.074</td>
<td>0.290</td>
<td>0.770</td>
<td>1.022(0.883–1.182)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indirect effect</td>
<td>0.106</td>
<td>0.048</td>
<td>2.200</td>
<td>0.026</td>
<td>1.112(1.013–1.222)</td>
<td></td>
</tr>
</tbody>
</table>

SASE: smoking abstinence self-efficacy. ND: nicotine dependence. SASET: total score for smoking abstinence self-efficacy; SASEP: smoking abstinence self-efficacy of positive/social situation; SASEN: smoking abstinence self-efficacy of negative/affective situation; SASEH: smoking abstinence self-efficacy of habitual/addictive situation. Total effect is the effect of ND on smoking cessation without considering self-efficacy; Direct effect is the effect of ND on smoking cessation when controlling for self-efficacy; Indirect effect is the effect of ND on smoking cessation through self-efficacy. *Mediation (%) is calculated by Indirect effect/Total effect x 100. Adjusted for age, age of smoking initiation, occupation, educational level and marital status.
probability of successful smoking cessation in the tobacco control intervention.

The potential limitations in our study need to be considered. First, this was only a case–control study, even though it is a community-based research, bias e.g. selected and recall bias might exist and could distort the results. Second, our sample is only for male smokers, whether the results are suitable for female smokers need to be further tested. Finally, since successful smoking cessation has a complex etiology generated by many factors, other uninvestigated variables could also alter the results.

Conclusions

This study shows that SASE has partial mediating effect on the association of ND with successful smoking cessation. To enhance the smokers’ SASE could increase the probability of successful smoking cessation. This finding needs to be confirmed by further researches.

Acknowledgements

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Conflicts of interest: None declared.

Key points

- Nicotine dependence has negative effect on the successful smoking cessation.
- Lower nicotine dependence could increase the smokers’ smoking abstinence self-efficacy.
- Smoking abstinence self-efficacy has partial mediating effect on the association of nicotine dependence with successful smoking cessation.

References

Effectiveness of pharmacotherapy in behavioural therapeutic smoking cessation programmes

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Background: In 2011, pharmacotherapy as a part of smoking cessation treatment was reimbursed through the basic health insurance in the Netherlands. We examine the (cost-)effectiveness of pharmacotherapy added to behavioural therapy. Methods: An observational study was conducted using data from the suppliers of the smoking cessation programmes together with information on costs from health insurance company Achmea. National suppliers, general practitioners and healthcare centres offered four different programmes. (i) Behavioural support (=therapy); (ii) Behavioural support combined with nicotine replacement therapy (NRT); (iii) Behavioural support combined with smoking cessation aids (=medication) (SCA); (iv) Behavioural support combined with NRT and SCA. The primary independent variable was the programme type, and the primary outcome was whether someone quit smoking. To examine the effectiveness of the different programmes logistic regression and logistic multilevel analyses were performed. Bootstrapping was used to evaluate cost-effectiveness. Results: The results indicate that behavioural support combined with SCA has more quitters than the reference programme of behavioural support alone, and it also seems the most cost-effective programme for general practitioners and healthcare centres. Behavioural therapy combined with NRT had also more quitters, although the difference with the reference programme was smaller. Conclusion: Behavioural support combined with SCA seems the most successful programme. However, as we performed an observational study, firm conclusions about the differences in effectiveness between the programme types cannot be made. Future research should consider the type of smoker (smoking history, amount of cigarettes per day).

Introduction

Worldwide 5 million people die each year due to the direct and indirect consequences of smoking, which equals one death per 6 s.¹ In the Netherlands, 19 000 people died in 2012 due to smoking-related diseases.² Smokers lose an average of 4.1 life years and 4.6 healthy life years in comparison with non-smokers.³ This high loss in healthy life years is mainly caused by the higher risks of chronic obstructive pulmonary disease, several types of cancer (particularly lung cancer) and cardiovascular diseases.⁴ Besides, smokers also have an increased risk of non-fatal diseases like osteoporosis, periodontal disease, impotence, male infertility and cataracts.⁵

Studies showed that most smokers want to stop although attempts to quit smoking fail frequently.⁶ In 2010, 25% of the Dutch smokers tried to quit, though the percentage of successes varied between 4 and 10%.⁷ Most quitters try to give up smoking on their own, without any help.⁸ However, cessation based on willpower alone without professional help has an effectiveness of only 3–5%.⁹ Several studies demonstrated that the use of smoking cessation programmes increases the rate of successful attempts.¹⁰–¹⁶ Thereby, smoking cessation programmes show a better cost-effectiveness than many other life-preserving medical interventions.¹⁷

Unfortunately, smoking cessation programmes are relatively expensive and research showed that costs are a threshold for people who want to stop smoking.¹⁸,¹⁹ A Cochrane review of nine trials, found that financial reimbursement caused a 1.29 (95% confidence interval (CI): 1.05–1.59) times higher rate of quitting attempts while a 2.45 (95% CI: 1.17–5.12) times higher rate of abstinence was found.²⁰ Also implementation of reimbursed smoking cessation programmes led to an increased use of it.²¹

Since January 2011, different types of smoking cessation aids were included in the basic health insurance in the Netherlands and health insurance company Achmea subsequently contracted diverse suppliers: general practitioners, healthcare centres and national providers.²² Due to a revision of the Dutch government pharmacotherapy as part of smoking cessation programmes was removed from the basic health insurance in January 2012 and only behavioural therapy was included.²³ The partnership ‘Stoppen met Roken’...