

# Public misperception that very low nicotine cigarettes are less carcinogenic

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## ABSTRACT

**Objective** The USA is considering a very low nicotine content (VLNC) cigarette standard. We sought to characterise the prevalence and correlates of the incorrect belief that VLNC cigarettes are less carcinogenic than current cigarettes, as this could reduce motivation to quit.

**Methods** Participants were a nationally representative sample of 650 adult smokers in the USA. In 2015–2016, before the VLNC proposal became public, these smokers took part in an online survey. We used multivariate weighted analyses to calculate ORs and percentages and a  $\chi^2$  test to examine the association between variables.

**Results** Overall, 47.1% of smokers believed that smoking VLNC cigarettes for 30 years would be less likely to cause cancer than smoking current cigarettes. This misperception was more common among smokers who were aged above 55 (56.6%) and black (57.4%). Additionally, 23.9% of smokers reported they would be less likely to quit if the USA adopted a VLNC standard. Thinking that VLNC cigarettes would be less carcinogenic was associated with smokers reporting they would be less likely to quit ( $P<0.01$ ).

**Conclusions** Many smokers had the misperception that smoking VLNC cigarettes is less likely to cause cancer, and some stated that they would be less likely to quit. A VLNC standard may be more effective if accompanied by a communication campaign that emphasises the continued dangers of smoking VLNC cigarettes due to the many toxic chemicals in smoke.

## INTRODUCTION

In July 2017, the US Food and Drug Administration (FDA) charted a game-changing approach to tobacco regulation: reduce the nicotine in combustible cigarettes and simultaneously encourage innovation in safer nicotine products.<sup>1 2</sup> A nicotine reduction policy involves requiring that the nicotine content in combustible tobacco be reduced to non-addictive levels.<sup>3</sup> The result would be ‘very low nicotine content’ (VLNC) cigarettes.<sup>4 5</sup> Recent studies show VLNC cigarettes lead to less dependence, fewer cigarettes smoked per day and increased quit attempts compared with controls.<sup>6–12</sup> Public support for nicotine reduction is high.<sup>13</sup> A 2015 WHO report has highlighted the potential of nicotine reduction.<sup>4</sup> The US FDA is considering a VLNC product standard,<sup>1 14</sup> and other countries are also exploring VLNC policies.<sup>5 15</sup>

One concern is that the public may misinterpret how VLNC cigarettes are different from current cigarettes, leading to unintended consequences.<sup>16</sup> A widespread (and incorrect) belief is that nicotine is the main carcinogen in cigarettes.<sup>17</sup> This belief may

come from the decades of health messaging linking nicotine and smoking and smoking and cancer. If smokers see VLNC cigarettes as less harmful than current cigarettes, they may be less motivated to quit or to switch to safer nicotine products. We were unable to find any estimates of the national prevalence of the misperception that VLNC cigarettes are less carcinogenic than current cigarettes.<sup>18 19</sup>

We sought to characterise the prevalence and demographic correlates of the misperception that VLNC cigarettes are less carcinogenic than current cigarettes (ie, the VLNC misperception). This information can prepare regulators for potential unintended consequences and inform communication efforts to correct the misperception. In particular, we hypothesised that the VLNC misperception is less prevalent for smokers with higher educational attainment. People who have more education may be more likely to have learnt that nicotine causes addiction but does not directly cause cancer. We also hypothesised that having the VLNC misperception would be associated with lower intention to quit smoking if FDA enacted a VLNC standard.

## METHODS

### Participants

We identified participants by random digit dialling of US landlines and cellphones, with an approximate coverage of 98% of US households.<sup>20</sup> After completing a phone survey, participants were eligible to take part in a subsequent online VLNC survey. Those who did not complete the online survey received a mailed paper survey to complete. Participants completed the survey from October 2015 through January 2016, before news of the FDA’s VLNC proposal became public. Of 2570 adults invited to take the survey, 1758 completed it, resulting in a response rate of 68.4%. Of the 1758 adults, 650 were smokers, whose data comprise the analytic sample. One of the survey questions, about the likelihood of quitting, was not included in the print survey, resulting in a lower sample size for that item ( $n=354$ ). Further details about the sampling design are available in separate papers.<sup>20</sup> (Baig SA, Morocco KE, Agans RP, *et al.* Developing effective messages about the chemicals in cigarette smoke: The role of reactance and education). Participants received compensation for their time.

### Procedures and measures

The survey introduced the concept of VLNC cigarettes and asked about perceived cancer risk from smoking these cigarettes: ‘Imagine the government required tobacco companies to remove most of the nicotine from cigarettes. Compared to smoking current cigarettes, smoking cigarettes with much less



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nicotine for 30 years would cause...’ The response options were ‘A lot less risk of lung cancer’, ‘A little less risk of lung cancer’, ‘The same risk of lung cancer’, ‘A little greater risk of lung cancer’ and ‘A lot greater risk of lung cancer’. We dichotomised these responses to reflect either believing VLNC cigarettes are less carcinogenic than current cigarettes (coded as 1) or believing VLNC cigarettes are equally or more carcinogenic (0). The survey also asked, ‘If the government required tobacco companies to remove most of the nicotine from cigarettes, would that make you...’ The five-point response scale ranged from ‘A lot less likely to quit smoking’ to ‘A lot more likely to quit smoking’. We dichotomised these responses to be less likely to quit smoking (1) or equally or more likely to quit smoking (0). The survey also collected demographic information (age, sex, education, poverty, race, Hispanic ethnicity and sexual orientation) and asked about smoking behaviour and cigarette type. The survey measured education as 15 categories ( $\leq$ 4th grade through doctorate) that were reduced to four categories for analysis. We defined smokers as those who currently smoke ‘some days’ or ‘every day’ and have smoked at least 100 cigarettes in their lifetime.<sup>21</sup> We coded smoking ‘light’, ‘ultralight’, ‘mild’, ‘gold’, ‘blue’ or ‘silver’ cigarettes as smoking ‘light or equivalent’ cigarettes.

### Data analysis

Percentages and ORs were weighted, and frequencies were unweighted. We conducted weighted multivariate logistic regression to examine demographic correlates of the VLNC misperception. The model included the demographic variables (age, sex, education, poverty, race, Hispanic ethnicity and sexual orientation) and smoking ‘light’ (or equivalent) cigarettes. We also analysed likelihood of quitting if a VLNC standard was in place and conducted a  $\chi^2$  test to determine the association between the VLNC misperception and likelihood of quitting. Analyses were two-tailed, with critical alpha of 0.05, and conducted using SAS V.9.4.

### RESULTS

The mean age of participants was 43.1 years (range 18–84). Most smokers were white (78.5%) or black (14.9%); 6.2% were Hispanic. Half (50.0%) the smokers were male, and 6.5% were gay, lesbian or bisexual. Almost half (46.7%) had not attended college, and 29.7% lived in poverty (below the federal poverty level).

Overall, 47.1% of smokers had the VLNC misperception, believing that VLNC cigarettes are less likely to cause cancer than current cigarettes (table 1). The misperception was more common among smokers aged 55 or older than among smokers aged 18–34 (56.6% vs 42.0%, adjusted OR (AOR) 1.90; 95% CI 1.14 to 3.15). The oldest age group did not differ from smokers aged 35–54. The misperception was more common among black than white smokers (57.4% vs 45.1%, AOR 1.67; 95% CI 1.00 to 2.79). The prevalence of the misperception did not differ across education level ( $P>0.10$ ). The prevalence of the misperception was also consistent across sex, poverty, Hispanic ethnicity and sexual orientation.

Moreover, 23.9% of smokers reported that they would be less likely to quit smoking if the government required tobacco companies to remove most of the nicotine from cigarettes. Smokers with the VLNC misperception were more likely to report that they would be less likely to quit compared with those without the VLNC misperception (32.0% vs 15.8%,  $P<0.01$ ).

### DISCUSSION

Nearly half of US smokers had the misperception that very low nicotine cigarettes are less likely to cause cancer than current cigarettes. This was higher than the 30% rate that O’Brien and

**Table 1** Misperception that very low nicotine cigarettes are less carcinogenic than current cigarettes (n=650 US smokers)

Variable	No. with misperception/ No. in category	Weighted%	AOR (95% CI)
Overall	316/650	47.1	n/a
Sex			
Female	174/334	52.4	ref
Male	142/316	41.9	0.73 (0.50 to 1.07)
Age, years			
18–34	84/208	42.0	ref
35–54	130/268	46.1	1.30 (0.83 to 2.06)
55+	102/174	56.6	1.90 (1.14 to 3.15)
Race			
White	213/461	45.1	ref
Black	79/139	57.4	1.67 (1.00 to 2.79)
Other	24/50	47.7	1.08 (0.49 to 2.37)

Differences between ages 18–34 and 55+ and between white and black races were statistically significant ( $P<0.05$ ). Model also included education, poverty, Hispanic ethnicity, sexual orientation and smoking ‘light’ or equivalent cigarettes, which were not statistically significant.  
AOR, adjusted OR; ref, reference group.

colleagues found when asking US smokers and non-smokers about the harmfulness of ‘a cigarette advertised as low nicotine’ compared with a typical cigarette.<sup>19</sup> The difference in results may reflect the way people think about ‘low’ nicotine versus cigarettes with ‘most’ of the nicotine removed, the inclusion of non-smokers, or the difference between the framing of the survey item as an advertising claim versus a government requirement. Past health and media messages about nicotine may have primed the public to believe lower nicotine means lower toxicity.<sup>17 22</sup> Incorrect perceptions about nicotine could also discourage use of safer nicotine products for smoking cessation, the other goal of FDA’s new approach.<sup>2</sup> We did not find the hypothesised correlation between the VLNC misperception and educational attainment. This may indicate that people learn about nicotine in cigarettes informally, outside of the education system. We found the misperception may be more common among black smokers than white smokers, a finding opposite to that of O’Brien and colleagues.<sup>19</sup> Further research on different beliefs among races may be necessary in order to develop communication campaigns that narrow rather than widen any racial disparities in these misperceptions. We also found that nearly a quarter of smokers reported that they would be less likely to quit smoking if FDA enacted a VLNC standard. This behavioural prediction was associated with the VLNC misperception, suggesting that the belief that VLNC cigarettes are less harmful may reduce motivation to quit among a substantial number of smokers.

A limitation of our study is that the survey was necessarily presenting a hypothetical situation because the USA does not presently have a VLNC policy in place. However, our study offers an important contribution by proactively investigating the prevalence of the VLNC misperception; regulators can prepare messaging in advance, aiming to minimise the potential unintended consequence of reducing smokers’ intentions to quit. Future research should examine the causal association between having the VLNC misperception and quitting intentions and behaviour, interactions with other motivators of quitting and perceived risk of VLNC cigarettes for health problems other than lung cancer. Additionally, researchers can investigate how the VLNC misperception and incorrect beliefs about nicotine affect interest in alternative nicotine products such as e-cigarettes.<sup>23</sup>

Countries that enact a VLNC standard should be prepared for possible unintended consequences of reducing the perceived risk of smoking. A communication campaign may strengthen the rollout of a VLNC policy by conveying to smokers that, while likely less addictive, VLNC cigarettes are just as toxic as current cigarettes.

#### What this paper adds

- ▶ The USA is considering a strategy to lower the nicotine content in cigarettes to non-addictive levels in order to reduce smoking and related deaths.
- ▶ If smokers see very low nicotine content (VLNC) cigarettes as less carcinogenic than current cigarettes, they may have less motivation to quit or to switch to a safer source of nicotine.
- ▶ In the first nationally representative survey of public beliefs about the carcinogenicity of VLNC cigarettes, 47% of smokers incorrectly thought that smoking these cigarettes is less likely to cause cancer than smoking current cigarettes. A quarter reported that they would be less likely to quit smoking if the USA enacted a VLNC standard.
- ▶ A VLNC standard may be more effective if accompanied by a communication campaign to reduce misperceptions about VLNC cigarettes and nicotine.

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