HHS Public Access

Author manuscript

Prev Med. Author manuscript; available in PMC 2017 March 01.

Published in final edited form as:

Prev Med. 2017 March ; 96: 94–100. doi:10.1016/j.ypmed.2016.12.048.

U.S. adults' addiction and harm beliefs about nicotine and low nicotine cigarettes☆

Erin Keely O'Brien, **Anh B. Nguyen***, **Alexander Persoskie**, and **Allison C. Hoffman**

Center for Tobacco Products, Food and Drug Administration, United States

Abstract

This research described U.S. adults' beliefs about nicotine and low nicotine cigarettes (LNCs) using the nationally-representative Health Information National Trends Survey (HINTS-FDA 2015; *N* = 3738). About three quarters of people either were unsure of the relationship between nicotine and cancer or incorrectly believed that nicotine causes cancer. People who were non-White, less educated, age 65+, and never established smokers were most likely to be unaware that nicotine is not a cause of cancer. More than a quarter of people held the potentially inaccurate beliefs that LNCs would be less harmful and addictive than typical cigarettes. Whites were more likely than Blacks to believe LNCs were less harmful than typical cigarettes, and never smokers were more likely to believe this than established quitters. Whites and people with at least a college degree were more likely to believe that LNCs would be less addictive than typical cigarettes. Overall, we found that many people, particularly the demographic subgroups identified here, held incorrect beliefs about nicotine and potentially inaccurate beliefs about LNCs. Findings should be considered in assessing the public health impact of marketing low nicotine products. Incorrectly believing that nicotine causes cancer could discourage smokers from switching to safer nicotine-containing alternatives, and could lead nonsmokers to experiment with low nicotine tobacco products, believing that cancer risk would be reduced. Findings underscore the need to educate the public on the health effects of nicotine and LNCs, and can help public health practitioners determine which subgroups should be prioritized in targeted educational efforts.

Keywords

Nicotine; Low nicotine cigarettes; Beliefs; Perceptions; Demographic differences; Smoking

1. Introduction

Historically, U.S. smokers have had a poor understanding of the health consequences of smoking (Chapman & Liberman, 2005; Weinstein et al., 2005). They have persistently held the inaccurate belief that certain varieties of cigarettes (e.g., light and low tar) were lower risk than others (Cummings et al., 2004; National Cancer Institute, 2001), even after tobacco advertisements making these claims were restricted by legislation in 2009 (Yong et al.,

☆The authors declare there is no conflict of interest.

*Corresponding author at: U.S. Food and Drug Administration, Center for Tobacco Products, Office of Science, 10903 New Hampshire Avenue, Building 75, Room G420, Silver Spring, MD 20993-0002, United States.

2015). While smokers' overall understanding of the harms of tobacco use has improved over time (US Department of Health and Human Services, 2014), many still hold potentially inaccurate beliefs about the relative harms of low nicotine cigarettes (Hatsukami et al., 2013) and other classes of nicotine-containing products (Kiviniemi & Kozlowski, 2015; Borland et al., 2011) that could result in negative public health consequences. Some of these beliefs may be due to poor understanding of health effects of nicotine (Cummings et al., 2004; Bansal et al., 2004a). For example, while smokers may understand that nicotine causes addiction (US Department of Health and Human Services, 2014), they may not understand (Mooney et al., 2006) that most smoking-related disease is not caused by nicotine, but rather other chemicals present in tobacco or formed by tobacco combustion (US Department of Health and Human Services, 2014).

Public health could be negatively impacted in several ways if people fail to understand nicotine's role in tobacco-related disease. For example, smokers who believe that nicotine is the main cause of tobacco-related disease may be less willing to use nicotine replacement therapies (NRT) to support quit attempts (Shiffman et al., 2008a; Ferguson et al., 2011). Further, these smokers could be less willing to switch to a potentially less risky tobacco product that still contains nicotine. Additionally, people who believe that nicotine is a main cause of harm may believe that cigarettes (and other products) with lower levels of nicotine would be less risky. This could encourage smokers who want to avoid the health consequences of smoking to switch to lower nicotine products instead of quitting, such as when smokers switched to “light” cigarettes because they thought they would reduce the risk of smoking without having to quit (Kozlowski et al., 1998). As youth nonsmokers think about tobacco use on a continuum of harm (Ambrose et al., 2014), and harm perceptions have predicted smoking initiation among youth (Ambrose et al., 2014; Song et al., 2009), believing that a product is lower risk could encourage experimentation among susceptible non-smokers.

Several studies suggest that many smokers incorrectly believe nicotine causes tobacco-related cancer. A national representative survey of smokers (Cummings et al., 2004; Bansal et al., 2004b) and a focus group study of ethnically diverse smokers (Carpenter et al., 2011) found that over half of respondents were unaware that nicotine does not cause tobacco-related cancer. Additionally, a study of adult smokers found that most participants believed nicotine caused numerous other smoking-related ailments, including stroke, asthma, diabetes, gum disease, and emphysema (Mooney et al., 2006).

Research has also examined smokers' harm beliefs about low nicotine cigarettes (LNCs), or cigarettes labeled as “low nicotine.” While cigarettes marketed as “light” had lower machine-measured nicotine yield due to ventilation holes, the way that smokers used them did not reduce smoker exposure to nicotine. (National Cancer Institute, 2001) LNCs rely on low nicotine content tobacco rather than ventilation holes, and the use of at least some varieties of LNCs has resulted in reduced nicotine exposure (Hatsukami et al., 2010; Dermody et al., 2015). LNCs with a range of reduced nicotine levels have been marketed in the U.S. (e.g., Quest cigarettes (Strasser et al., 2007)), and often have been used in studies of smoking behavior and nicotine addiction (e.g., Spectrum cigarettes (Richter et al., 2016)). Smoking LNCs in the same manner and frequency as typical cigarettes results in the same

exposure to harmful chemicals other than nicotine, and could lead to increased exposure to harmful chemicals if smokers modify smoking behavior to compensate for lower nicotine levels (Hatsukami et al., 2010; Strasser et al., 2007; O'Connor et al., 2007a). However, several studies found that smokers hold potentially inaccurate beliefs about LNCs in general, believing they are safer than other cigarettes. A nationally representative survey of smokers found that over half believed that LNCs were less dangerous than regular cigarettes (Cummings et al., 2004). Further, an experimental study (Strasser et al., 2008) found that smokers assigned to view ads for one brand of LNCs believed them to be healthier and safer, and believed that switching to them could reduce exposure to tar, carcinogens, and other chemicals. Another study found that smokers believed LNCs to be associated with a lower risk of lung cancer, other cancers, emphysema, bronchitis, heart disease, and stroke (Hatsukami et al., 2013). These findings are especially important to consider in light of a tobacco industry document review that found that several tobacco companies developed LNCs in part because the companies believed smokers would be interested in LNCs due to the perception that LNCs were healthier (Dunsby & Bero, 2004).

Several studies suggest that the public may be unaware that cigarettes described as “low nicotine” are not necessarily less addictive. Although studies using cigarettes with varying levels of nicotine content have found that “very low nicotine cigarettes” (cigarettes with dramatically reduced nicotine content, e.g., 0.05 mg yield) can be minimally addictive, cigarettes with less dramatic reductions in nicotine (e.g., 0.3 mg yield) are not less addictive than typical cigarettes (Hatsukami et al., 2010; Dermody et al., 2015; Donny et al., 2014; Lee & Kahende, 2007). A nationally representative survey found that more than one-third of smokers believed LNCs were less addictive (Cummings et al., 2004), and a study of undergraduate smokers and nonsmokers found that most believed LNCs were less addictive than Marlboro Lights (O'Connor et al., 2007a). A survey of Quitline callers found that 16% believed that switching to LNCs could improve one's chances of quitting (Bansal-Travers et al., 2010).

Smokers who intend to quit or who recently quit could be particularly susceptible to smoking LNCs if they believe that they present lower health risks. Research specifically on beliefs about nicotine and LNCs in these smoker subgroups is sparse and inconsistent. One study found that a *higher* proportion of smokers who were trying to quit believed nicotine caused cancer (Bansal-Travers et al., 2010), compared to nationally representative samples of smokers (Bansal et al., 2004b). However, another study found that smokers who intended to quit within the next year were *less* likely to hold this belief (Cummings et al., 2004).

1.1. Purpose of the current study

This study was exploratory and addressed several gaps in the literature on beliefs about nicotine and LNCs. First, this study assesses how beliefs among smokers intending to quit and recent quitters may differ from other smokers, addressing inconsistencies in the literature (Cummings et al., 2004; Bansal-Travers et al., 2010). Second, this study examines these beliefs among people who have never been established smokers (never smokers). Previous research on beliefs about nicotine and LNCs rarely included never smokers, and this group is important to study as they may be more interested in trying tobacco products

perceived as less risky (Shiffman, 2004; Czoli & Hammond, 2014). Third, the current study assesses differences in these beliefs among demographic subgroups. Identification of these subgroups can help public health practitioners prioritize providing accurate information about LNCs and nicotine to those who need it most.

2. Method

2.1. Participants and design

We analyzed data from a special round of the Health Information National Trends Survey (HINTS) conducted by the National Cancer Institute in partnership with the FDA (HINTS-FDA 2015). HINTS-FDA 2015 ($N = 3738$) is a cross-sectional, probability-based nationally representative survey of U.S. non-institutionalized civilian adults aged 18 or older. The data were collected in 2015 through self-administered mail surveys sent to a random sample of non-vacant residential addresses. The weighted response rate was 33%. Additional methodological information is available elsewhere (Westat, 2015).

2.2. Measures

2.2.1. Nicotine beliefs—Two items assessed the beliefs that nicotine is the main substance in cigarettes that causes addiction and cancer: “Nicotine is the main substance in tobacco that makes people want to smoke,” and “The nicotine in cigarettes is the substance that causes most of the cancer caused by smoking.” Response categories for both included *Strongly disagree, Disagree, Agree, Strongly agree*, and *Don't know*. Because the first statement is true, we recoded responses as incorrect if they were *Disagree* or *Strongly disagree*. Because the second statement is false, we recoded responses as incorrect if they were *Agree* or *Strongly agree*. This recoding approach is consistent with past research (Cummings et al., 2004; Bansal et al., 2004a; Mooney et al., 2006).

2.2.2. Low nicotine cigarette beliefs—Two items assessed LNC beliefs. First, respondents rated whether a cigarette advertised as “low nicotine” would be more or less harmful than a typical cigarette. Second, respondents rated whether a cigarette advertised as “low nicotine” would be more or less addictive than a typical cigarette. Both items had five response options that ranged from *Much less [harmful to your health/addictive] than a typical cigarette* to *Much more [harmful to your health/addictive] than a typical cigarette*, with a midpoint of *Equally [harmful to your health/addictive]*. LNCs include a range of nicotine levels, and their addictiveness and harmfulness depend on their nicotine level (Hatsukami et al., 2010; Donny et al., 2014). Therefore, because it is not clear which responses are correct, we retained the full range of response options.

2.2.3. Demographic characteristics—Demographic variables were recoded from original response options (Westat, 2015) into discrete categories such that unweighted sample size was sufficient for analysis ($n \geq 50$ per cell). These include age (18–24; 25–44; 45–64; 65+years), sex (male; female), sexual identity (heterosexual; lesbian, gay, bisexual [LGB]), race/ethnicity (White; Black; Hispanic; all others), and educational attainment (High School diploma, GED, or less; some college, vocational, or technical training; college graduate; postgraduate).

2.2.4. Smoking characteristics—Consistent with past research (Fagan et al., 2007; Bonhomme et al., 2016; Jamal et al., 2015), respondents who had not smoked at least 100 cigarettes in their lifetime were classified as *never smokers*. Respondents who smoked at least 100 cigarettes in their lifetime and were currently smoking every day or some days were classified as smokers. Smokers were further classified as *smokers intending to quit* if they affirmed they were "seriously considering quitting smoking cigarettes in the next 6 months" and *smokers not intending to quit* otherwise. Respondents were classified as quitters if they smoked at least 100 cigarettes in their lifetime and were not currently smoking at all. Quitters were further classified as *recent quitters* if they had quit less than a year ago or as *established quitters* if they had quit 1 year ago or more.

2.2.5. Believability of low nicotine cigarettes—Respondents were asked, "How believable is it that a cigarette could be 'low nicotine?'" Four response options ranged from *Not at all believable* to *Very believable*.

2.3. Data analysis

Analyses were conducted using SAS 9.3 and SAS-callable SUDAAN 11.0. Analyses used jackknife replicate weights as recommended (Westat, 2015) to generate nationally representative estimates and to account for the complex sampling design.

2.3.1. Nicotine beliefs—Two weighted multinomial logistic regression analyses assessed the association between demographic and smoker characteristics and (Chapman & Liberman, 2005) nicotine addiction beliefs and (Weinstein et al., 2005) nicotine cancer beliefs. In each analysis, all predictors were entered simultaneously. These analyses modeled the odds of incorrect and unsure responses, adjusting for all covariates.

2.3.2. Low nicotine cigarette beliefs—Two weighted multiple linear regression analyses assessed the association between demographic and smoker characteristics and (Chapman & Liberman, 2005) LNC harm belief and (Weinstein et al., 2005) LNC addiction belief. In each analysis, all predictors were simultaneously entered. Both analyses controlled for believability of LNCs, as we were interested in the association between the predictor and dependent variables above and beyond the extent to which LNCs were believable.

3. Results

Descriptive statistics for all dependent variables are reported by demographic characteristic (Table 1) and smoking status (Table 2).

3.1. Nicotine beliefs

3.1.1. Belief that nicotine makes cigarettes addictive—Most people (83%) correctly believed that nicotine is the main substance in cigarettes that makes people want to smoke. A small proportion disagreed with the statement (5%), and 12% responded as unsure. The weighted multinomial logistic regression found that no demographic or smoking characteristics were associated with nicotine addiction belief (results not shown).

3.1.2. Belief that nicotine causes most smoking-related cancer—Approximately one-quarter of people (27%) correctly disagreed with the statement that "nicotine is the substance that causes most of the cancer caused by smoking," while most people either incorrectly agreed with the statement (49%) or responded that they were unsure (24%).

The weighted multinomial logistic regression model found that members of certain demographic groups had higher odds than others of responding incorrectly (Table 3). These included people who were age 65 and older, people who were Black, Hispanic, or other race, and those with a High School education or less. People who were Black or who had a High School education or less also had higher odds of responding that they were unsure.

Nicotine beliefs also differed based on smoking status. Compared to current smokers who do not intend to quit and established quitters, never smokers had higher odds of incorrectly believe that nicotine is the substance that causes most smoking-related cancer. Compared to recent and established quitters, never smokers had higher odds of responding that they were unsure.

3.2. Low nicotine cigarette beliefs

3.2.1. Belief about the harmfulness of LNCs—The mean relative harm rating of an LNC compared to a typical cigarette was slightly below the scale's midpoint of *Equally harmful*, ($M = 2.77$, $SE = 0.04$). While few people rated LNCs as more harmful than typical cigarettes (7%) and most rated them as equally harmful (64%), many (30%) rated them as less harmful.

The weighted multiple linear regression model accounted for a significant proportion of variance in LNC harm beliefs ($R^2 = 0.10$; Table 4). Compared to Whites, people who were Black rated LNCs as more harmful. Compared to never smokers, established quitters rated LNCs as more harmful.

3.2.2. Belief about the addictiveness of LNCs—The mean relative addictiveness rating of an LNC compared to a typical cigarette was slightly below the scale's midpoint of *Equally addictive* ($M = 2.80$, $SE = 0.05$). While few rated LNCs as more addictive than typical cigarettes (7%) and most rated them as equally addictive (65%), many (28%) rated them as less addictive.

The weighted multiple linear regression model accounted for a significant proportion of variance in LNC addiction beliefs ($R^2 = 0.12$; Table 4). People who were Hispanic and other race perceived LNCs to be more addictive compared to Whites. Compared to those with a High School education or less, those with a college degree and those with a postgraduate education believed that LNCs were less addictive. Perceived addictiveness of LNCs did not vary by smoking status.

4. Discussion

This study used nationally representative data to assess beliefs about nicotine and LNCs among never smokers, current smokers differing in quit intentions, former smokers differing

in time since quitting, and various demographic groups. Although most people (83%) believed that nicotine is the main substance in cigarettes that makes people want to smoke, about half (49%) incorrectly believed that nicotine is the main substance in cigarettes that causes cancer, and another 24% were unsure. People who were more likely to hold incorrect beliefs about nicotine's role in causing smoking-related cancer included those who were never smokers, Black, Hispanic, or other race, age 65 or older, and less educated. More than a quarter of people believed cigarettes advertised as 'low nicotine' would be less harmful and less addictive than typical cigarettes. LNC harm beliefs were lower among people who were White and higher among established quitters, and addiction beliefs were lower among people who were White or college educated. Overall, people who were non-White or less educated were more cautious about the harms of nicotine and LNCs: they were more likely to believe that nicotine caused cancer, but less likely to believe that reducing the nicotine in cigarettes would result in the product being less harmful or addictive.

4.1. Nicotine beliefs

Most people (73%) either incorrectly believed that nicotine is the main substance in cigarettes that causes cancer or were unsure about the relationship between nicotine and cancer. Our estimate is substantially higher than results of a survey conducted in the early 2000s, which found that about half of participants were either incorrect or had no opinion about the relationship between nicotine and cancer (Cummings et al., 2004; Bansal et al., 2004b). These findings may differ because prior research excluded never smokers, who we found were significantly more likely to hold incorrect beliefs about nicotine and cancer.

The current research identified racial and educational disparities in understanding the effects of nicotine that may help explain the lower use of NRT in particular demographic groups (Fu et al., 2008; Trinidad et al., 2011). Past research concluded that NRT underutilization by racial/ethnic minorities was related to differences in NRT's perceived safety (Shiffman et al., 2008a; Carpenter et al., 2011) rather than differences in access to NRT (Fu et al., 2008). A national survey (Shiffman et al., 2008a) and a focus group study (Carpenter et al., 2011) indicated that Black smokers and smokers with low education levels were more concerned about the safety of NRT than Whites and people with higher education. We found that these same groups were more likely to believe that nicotine causes cancer.

4.2. Beliefs about low nicotine cigarettes

Over a quarter of people held the potentially inaccurate beliefs that LNCs were less harmful and less addictive than typical cigarettes. This is problematic, as switching to LNCs does not reduce exposure to constituents that cause tobacco-related diseases (Hatsukami et al., 2010; Strasser et al., 2007), and some studies found that LNCs previously on the market were not less addictive than typical cigarettes (Hatsukami et al., 2010; Lee & Kahende, 2007). We found that White and more educated people were more likely to believe that LNCs were less harmful and addictive than typical cigarettes. Although these groups may not have traditionally been considered vulnerable populations in tobacco research (Point of sale tobacco marketing disproportionately targeting vulnerable populations, n.d.), these findings suggest that they could be considered as such in the marketing of LNCs. Our findings also indicate that while people may be well-informed that nicotine is addictive, they may not

realize that nicotine content must be reduced to very low levels before there is a potential reduction in addictiveness (Donny et al., 2014).

4.3. Smoker education on nicotine

Using nicotine replacement therapy (NRT) as prescribed significantly improves one's chance of successfully quitting smoking (Stead et al., 2012; Etter & Stapleton, 2006). However, most smokers do not use NRT when attempting to quit (Shiffman et al., 2008b), and those who do use it at a lower dose and for less time than recommended (Shiffman et al., 2008a; Shiffman et al., 2003), which could reduce its efficacy (Stead et al., 2012). Smokers who believe that nicotine is the main cause of tobacco related disease (Shiffman et al., 2008a; Ferguson et al., 2011), including cancer (Carpenter et al., 2011; Vogt et al., 2006), may be less willing to use NRT as recommended. Educating smokers on the health effects of nicotine, especially on the relationship between nicotine and cancer, could combat incorrect beliefs that serve as a barrier to using NRT, benefitting public health by increasing successful quitting. Smokers' healthcare providers serve as a source of information about smoking cessation and NRT (Stead et al., 2013; Thorndike et al., 1998). Healthcare provider's counseling strategies can be informed by being aware of the high prevalence of smokers who hold incorrect beliefs about nicotine and cancer, particularly in the groups identified here—people who are non-White, age 65 or older, or less educated.

4.4. Implications for tobacco regulation

FDA assesses the population health impact of authorizing new tobacco products for marketing and determines whether companies can market their product with modified risk information. Understanding public beliefs related to LNCs provides information on the potential population health impact of authorizing them for marketing, as harm beliefs are related to tobacco product use (Song et al., 2009; O'Connor et al., 2007b). Our findings, coupled with those of prior studies (Cummings et al., 2004; Bansal et al., 2004b), suggest that when some people see cigarettes advertised as “low nicotine,” they may conclude that these cigarettes are less harmful and addictive than typical cigarettes. Certain sub-groups (e.g., Whites and the college educated) may be especially likely to hold these beliefs about LNCs. These findings indicate that smokers may benefit from better communications about the health effects of nicotine to prevent unintended consequences from the marketing of LNCs.

FDA could implement product standards requiring the reduction of nicotine content in tobacco products (but not to zero) to reduce their addictiveness. Our findings suggest that if such a standard were implemented, it would be important to educate consumers on the role of nicotine in tobacco-related disease to prevent them from assuming that lower nicotine products are less harmful.

4.5. Limitations and future directions

One limitation was the small sample size of smokers not intending to quit and recent quitters; the lack of differences between these and other smoker groups could be due to insufficient statistical power. Future research could oversample these groups. Future research could also compare beliefs about nicotine and LNCs by type of tobacco product currently

used; HINTS-FDA 2015 did not assess current use of all tobacco products. Another limitation was the reliance on single-item measures of beliefs about nicotine and LNCs. Future research could use multi-item scales to better assess these beliefs, as multi-item measures could provide a more comprehensive and sensitive assessment of between group differences (Diamantopoulos et al., 2012; Bowling, 1997; Burns & Grove, 1997).

Additionally, this research did not assess the effect of having incorrect beliefs about nicotine on perceptions of specific disease risk from using LNCs, nor did it assess intentions to use LNCs. For example, it is possible that believing that nicotine causes cancer is related to believing that low nicotine products offer a lower risk of cancer, which could affect intentions to use the product. Studying how nicotine beliefs relate to perceived disease risks and intentions would help inform the population impact of the marketing of low nicotine products, as well as public education efforts.

Further, this study focused on low nicotine cigarettes, and results may not generalize to other classes of tobacco products. Future research could assess whether the advertised nicotine levels in other tobacco products are related to beliefs about the extent to which they are harmful, disease-causing, and addictive. For example, e-cigarettes advertise a range of nicotine levels. Given that e-cigarette use is rising rapidly (Arrazola et al., 2015; Delnevo et al., 2016), it would be relevant for future research to assess how harm beliefs are related to advertised nicotine level.

5. Conclusions

This analysis of nationally representative U.S. data found a high prevalence of incorrect beliefs about the relationship between nicotine and cancer, particularly among never smokers, recent quitters, and segments of the population including people who are not White, age 65 or older, and those with lower levels of education. Additionally, we found that many people, particularly non-Whites and the college educated, believed LNCs to be less harmful and addictive than typical cigarettes. These results indicate that educating the public on the health effects of nicotine could benefit public health and provide insight on the potential impact of the marketing of low nicotine tobacco products.

References

Ambrose BK, Rostron BL, Johnson SE, et al. Perceptions of the relative harm of cigarettes and e-cigarettes among US youth. Am. J. Prev. Med. 2014 Aug; 47(2 Suppl 1):S53–S60. [PubMed: 25044196]

Arrazola R, Singh T, Corey C, et al. Tobacco use among middle and high school students — United States, 2011–2014. Morb. Mortal. Wkly Rep. 2015; 64(14):381–385.

Bansal MA, Cummings KM, Hyland A, Giovino GA. Stop-smoking medications: who uses them, who misuses them, and who is misinformed about them? Nicotine & Tobacco Research. 2004a; 6:303–310. [PubMed: 15203804]

Bansal M, Cummings K, Hyland A, Giovino G. Smokers' beliefs about nicotine and the safety/efficacy of nicotine medications. Nicotine & Tobacco Research. 2004b; 6:1–8. [PubMed: 14982682]

Bansal-Travers M, Cummings KM, Hyland A, Brown A, Celestino P. Educating smokers about their cigarettes and nicotine medications. Health Educ. Res. 2010; 25(4):678–686. [PubMed: 20064838]

Bonhomme M, Holder-Hayes E, Ambrose B, et al. Flavoured non-cigarette tobacco product use among US adults: 2013–2014. Tob. Control. 2016; 25(5):ii4–ii13. [PubMed: 27794065]

Borland R, Cooper J, McNeill A, O'Connor R, Cummings KM. Trends in beliefs about the harmfulness and use of stop-smoking medications and smokeless tobacco products among cigarettes smokers: findings from the ITC four-country survey. Harm Reduction Journal. 2011; 8:1–11. [PubMed: 21219609]

Bowling, A. Research Methods in Health. Buckingham: Open University Press; 1997.

Burns, N., Grove, S. The Practice of Nursing Research: Conduct, Critique, & Utilization. Philadelphia: W.B Saunders and Co.; 1997.

Carpenter MJ, Ford ME, Cartmell K, Alberg AJ. Misperceptions of nicotine replacement therapy within racially and ethnically diverse smokers. J. Natl. Med. Assoc. 2011; 103(9–10):885–894. [PubMed: 22364057]

Chapman S, Liberman J. Ensuring smokers are adequately informed: reflections on consumer rights, manufacturer responsibilities, and policy implications. Tob. Control. 2005; 14:ii8–ii13. [PubMed: 16046703]

Cummings KM, Hyland A, Giovino GA, Hastrup JL, Bauer JE, Bansal MA. Are smokers adequately informed about the health risks of smoking and medicinal nicotine? Nicotine & Tobacco Research. 2004; 6(Suppl3):333–340.

Czoli CD, Hammond D. Cigarette packaging: youth perceptions of “natural” cigarettes, filter references, and contraband tobacco. J. Adolesc. Health. 2014 Jan; 54(1):33–39. [PubMed: 24012064]

Delnevo CD, Giovenco DP, Steinberg MB, Pearson JL, Niaura RS, Abrams DB. Patterns of electronic cigarette use among adults in the United States. Nicotine & Tobacco Research. 2016; 18(5):715–719. [PubMed: 26525063]

Dermody SS, Donny EC, Hertsgaard LA, Hatsukami DK. Greater reductions in nicotine exposure while smoking very low nicotine content cigarettes predict smoking cessation. Tob. Control. 2015; 24(6):536–539. [PubMed: 25192771]

Diamantopoulos A, Sarstedt M, Fuchs C, Wilczynski P, Kaiser S. Guidelines for choosing between multi-item and single-item scales for construct measurement: a predictive validity perspective. J. Acad. Mark. Sci. 2012; 40(3):434–449.

Donny EC, Hatsukami DK, Benowitz NL, Sved AF, Tidey JW, Cassidy RN. Reduced nicotine product standards for combustible tobacco: building an empirical basis for effective regulation. Prev. Med. 2014; 68:17–22. [PubMed: 24967958]

Dunsby J, Bero L. A nicotine delivery device without the nicotine? Tobacco industry development of low nicotine cigarettes. Tob. Control. 2004 Dec; 13(4):362–369. [PubMed: 15564619]

Etter JF, Stapleton JA. Nicotine replacement therapy for long-term smoking cessation: a meta-analysis. Tob. Control. 2006 Aug; 15(4):280–285. [PubMed: 16885576]

Fagan P, Augustson E, Backinger C, et al. Quit attempts and intention to quit cigarette smoking among young adults in the United States. Am. J. Public Health. 2007; 97(8):1412–1420. [PubMed: 17600244]

Ferguson SG, Gitchell JG, Shiffman S, Sembower MA, Rohay JM, Allen J. Providing accurate safety information may increase a smoker's willingness to use nicotine replacement therapy as part of a quit attempt. Addict. Behav. 2011; 36(7):713–716. [PubMed: 21371825]

Fu SS, Kodl MM, Joseph AM, et al. Racial/ethnic disparities in the use of nicotine replacement therapy and quit ratios in lifetime smokers ages 25 to 44 years. Cancer Epidemiol. Biomark. Prev. 2008 Jul; 17(7):1640–1647.

Hatsukami DK, Kotlyar M, Hertsgaard LA, et al. Reduced nicotine content cigarettes: effects on toxicant exposure, dependence and cessation. Addiction. 2010 Feb; 105(2):343–355. [PubMed: 20078491]

Hatsukami DK, Heishman SJ, Vogel RI, et al. Dose–response effects of Spectrum research cigarettes. Nicotine & Tobacco Research. 2013; 15(6):1113–1121. [PubMed: 23178320]

Jamal A, Homa D, O'Connor E, et al. Current cigarette smoking among adults—United States, 2005–2014. MMWR Morb. Mortal. Wkly Rep. 2015; 64(44):1233–1240. [PubMed: 26562061]

Kiviniemi MT, Kozlowski LT. Deficiencies in public understanding about tobacco harm reduction: results from a United States national survey. Harm Reduction Journal. 2015; 12(1):1–7.

Kozlowski LT, Goldberg ME, Yost BA, White EL, Sweeney CT, Pillitteri JL. Smokers' misperceptions of light and ultra-light cigarettes may keep them smoking. Am. J. Prev. Med. 1998; 15(1):9–16. [PubMed: 9651633]

Lee CW, Kahende J. Factors associated with successful smoking cessation in the United States, 2000. Am. J. Public Health. 2007; 97(8):1503–1509. [PubMed: 17600268]

Mooney ME, Leventhal AM, Hatsukami DK. Attitudes and knowledge about nicotine and nicotine replacement therapy. Nicotin Tob. Res. 2006; 8(3):435–446.

National Cancer Institute. Risks associated with smoking cigarettes with low machine-measured yields of tar and nicotine. Smoking and Tobacco Control Monograph, 13. NIH publication 02-5047. Bethesda, MD: U.S. Dept of Health and Human Services, Public Health Service, National Institutes of Health, National Cancer Institute; 2001.

O'Connor R, Ashare R, Fix B, Hawk L, Cummings K, Schmidt W. College students' expectancies for light cigarettes and potential reduced exposure products. Am. J. Health Behav. 2007a; 31(4):402–410. [PubMed: 17511575]

O'Connor RJ, McNeill A, Borland R, et al. Smokers' beliefs about the relative safety of other tobacco products: findings from the ITC collaboration. Nicotine Tob Res. 2007b Oct; 9(10):1033–1042. [PubMed: 17943619]

Point of sale tobacco marketing disproportionately targeting vulnerable populations. Center for Public Health and Tobacco Policy; (Available;at: http://www.tobaccopolicycenter.org/documents/Disparities%20Fact%20Sheet%20FINAL.pdf)

Richter PSP, Bravo R, Lisko JG, Damian M, Gonzalez-Jimenez N, Gray N, Keong LM, Kimbrell JB, Kuklenyik P, Lawler TS, Lee GE, Mendez M, Perez J, Smith S, Tran H, Tyx R, Watson CH. Characterization of SPECTRUM variable nicotine research cigarettes. Tobacco Regulatory Science. 2016; 2(2):94–105. [PubMed: 26779559]

Shiffman S. Smoker and ex-smoker reactions to cigarettes claiming reduced risk. Tob. Control. 2004; 13(1):78–84. [PubMed: 14985602]

Shiffman S, Hughes JR, Pillitteri JL, Burton SL. Persistent use of nicotine replacement therapy: an analysis of actual purchase patterns in a population based sample. Tob. Control. 2003; 12:310–316. [PubMed: 12958394]

Shiffman S, Ferguson SG, Rohay J, Gitchell JG. Perceived safety and efficacy of nicotine replacement therapies among US smokers and ex-smokers: relationship with use and compliance. Addiction. 2008a; 103(8):1371–1378. [PubMed: 18855827]

Shiffman S, Brockwell SE, Pillitteri JL, Gitchell JG. Use of smoking-cessation treatments in the United States. Am. J. Prev. Med. 2008b Feb; 34(2):102–111. [PubMed: 18201639]

Song AV, Morrell HE, Cornell JL, et al. Perceptions of smoking-related risks and benefits as predictors of adolescent smoking initiation. Am. J. Public Health. 2009 Mar; 99(3):487–492. [PubMed: 19106420]

Stead LF, Perera R, Bullen C, et al. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst. Rev. 2012; 11 CD000146.

Stead LF, Buitrago D, Preciado N, Sanchez G, Hartmann-Boyce J, Lancaster T. Physician advice for smoking cessation. Cochrane Database Syst. Rev. 2013; 5 CD000165.

Strasser AA, Lerman C, Sanborn PM, Pickworth WB, Feldman EA. New lower nicotine cigarettes can produce compensatory smoking and increased carbon monoxide exposure. Drug Alcohol Depend. 2007; 86(2/3):294–300. [PubMed: 16930853]

Strasser A, Tang K, Tuller M, Cappella J. PREP advertisement features affect smokers' beliefs regarding potential harm. Tob. Control. 2008; 17:i32–i38. [PubMed: 18768457]

Thorndike AN, Rigotti NA, Stafford RS, Singer DE. National patterns in the treatment of smokers by physicians. JAMA. 1998; 279(8):604–608. [PubMed: 9486755]

Trinidad D, Perez-Stable E, White M, Emery S, Messer K. A nationwide analysis of US racial/ethnic disparities in smoking behaviors, smoking cessation, and cessation-related factors. Am. J. Public Health. 2011; 101(4):699–706. [PubMed: 21330593]

US Department of Health and Human Services. The Health Consequences of Smoking: 50 Years of Progress: a Report of the Surgeon General. Atlanta, GA: US Department of Health and Human

Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014.

Vogt F, Hall S, Marteau TM. General practitioners' beliefs about effectiveness and intentions to prescribe smoking cessation medications: qualitative and quantitative studies. BMC Public Health. 2006; 6:277. [PubMed: 17092346]

Weinstein ND, Marcus SE, Moser RP. Smokers' unrealistic optimism about their risk. Tob. Control. 2005; 14(1):55. (55p). [PubMed: 15735301]

Westat. Health Information National Trends Survey 4 (HINTS 4): HINTS-FDA Methodology Report. Rockville, MD: 2015.

Yong H, Borland R, Cummings R, et al. US smokers' beliefs, experiences and perceptions of different cigarette variants before and after the FSPTCA ban on misleading descriptors such as ‘light’, ‘mild’, or ‘low’. Nicotin Tob. Res. 2015 (epub ahead of print).

Prev Med. Author manuscript; available in PMC 2017 March 01.

Table 1

HINTS-FDA 2015 nicotine and low nicotine cigarette (LNC) belief item responses by demographic characteristic.

	Nicotine addiction belief			Nicotine cancer belief			LNC beliefs	
	% correct (95% Ci)	% incorrect (95% CI)	% unsure (95% CI)	% correct (95% CI)	% incorrect (95% CI)	% unsure (95% CI)	Harm[a] x̄ (SE)	Addiction[b] x̄ (SE)
Sex								
Female (*n* = 2018)	83 (80, 86)	5 (3, 6)	12 (10, 15)	25 (22, 28)	51 (47, 55)	24 (21, 28)	2.77 (0.03)	2.82 (0.03)
Male (*n* = 1497)	85 (81, 88)	4 (3, 6)	11 (8, 14)	29 (25, 34)	47 (42, 52)	24 (21, 28)	2.77 (0.04)	2.80 (0.05)
Sexual orientation								
Heterosexual (*n* = 3408)	84 (81, 86)	4 (4, 5)	12 (10, 14)	27 (24, 30)	49 (46, 52)	24 (22, 27)	2.75 (0.02)	2.78 (0.02)
Lesbian, gay, or bisexual (*n* = 105)	90 (81, 95)	4 (1, 12)	6 (3, 12)	45 (27, 64)	31 (19, 47)	24 (13, 42)	2.85 (0.06)	2.74 (0.09)
Race/ethnicity								
White (*n* = 2847)	86 (83, 86)	5 (4,6)	9 (8, 11)	32 (29, 35)	45 (41, 48)	24 (21, 26)	2.69 (0.02)	2.72 (0.03)
Black (*n* = 273)	78 (68, 86)	2 (0.5, 7)	20 (12, 30)	14 (9, 23)	57 (48, 66)	28 (20, 39)	2.95 (0.09)	2.90 (0.08)
Hispanic (*n* = 241)	80 (71, 87)	4 (2, 9)	16 (10, 23)	20 (13, 30)	54 (45, 63)	26 (18, 35)	2.94 (0.11)	3.03 (0.11)
Other (*n* = 281)	81 (70, 88)	6 (3, 15)	13 (7, 24)	25 (19, 32)	56 (47, 65)	19 (11, 20)	2.82 (0.07)	2.92 (0.09)
18–24 years (*n* = 108)	85 (77, 91)	4 (2, 9)	11 (6, 20)	22 (14, 33)	51 (40, 63)	27 (18, 38)	2.94 (0.16)	2.98 (0.16)
25–44 years (*n* = 775)	84 (79, 88)	6 (4,8)	10 (7, 14)	38 (33, 43)	40 (34, 46)	22 (18, 28)	2.83 (0.03)	2.77 (0.04)
45–64 years (*n* = 1457)	84 (81, 87)	4 (2, 5)	12 (10, 15)	23 (21, 26)	52 (49, 56)	24 (21, 28)	2.72 (0.04)	2.80 (0.03)
65+ years (*n* = 1288)	80 (77, 83)	4 (3, 6)	16 (13, 19)	16 (13, 19)	57 (42, 61)	27 (23, 31)	2.70 (0.03)	2.82 (0.03)
Education								
High school/GED or less (*n* = 964)	80 (75, 84)	5 (3, 8)	15 (12, 20)	19 (15, 24)	56 (51, 61)	25 (21, 29)	2.88 (0.06)	2.99 (0.07)
Some college (*n* = 1132)	86 (82, 89)	4 (3, 7)	10 (7, 13)	28 (23, 33)	47 (42, 52)	26 (21, 31)	2.73 (0.04)	2.74 (0.03)
College graduate (*n* = 906)	85 (80, 89)	3 (2, 6)	12 (8, 17)	32 (27, 37)	44 (40, 49)	24 (20, 30)	2.77 (0.03)	2.77 (0.03)
Postgraduate (*n* = 672)	86 (81, 90)	5 (2, 9)	10 (7, 13)	36 (31, 41)	44 (40, 49)	19 (15, 25)	2.71 (0.04)	2.65 (0.04)

[a]Response options ranged from 1 (*Much less harmful to your health than a typical cigarette*) to 5 (*Much more harmful to your health than a typical cigarette*), with a midpoint of 3 (*Equally harmful to your health*).

[b]Response options ranged from 1 (*Much less addictive than a typical cigarette*) to 5 (*Much more addictive than a typical cigarette*), with a midpoint of 3 (*Equally addictive*).

Table 2

HINTS-FDA 2015 nicotine and low nicotine cigarette belief item responses by smoking status.

	Never smoker ***n*** **= 2041**	**Smoker[a], intends to quit** ***n*** **= 305**	**Smoker[a], not quitting** ***n*** **= 174**		**Recent quitter** ***n*** **= 49**		**Established quitter** ***n*** **= 1045**
Nicotine beliefs	**% (95% CI)**	**% (95% CI)**	**% (95% CI)**		**% (95% CI)**		**% (95% CI)**
Addictiveness: *nicotine is the main substance in tobacco that makes people want to smoke*							
Correct (strongly agree + agree)	83 (79, 86)	86 (76, 92)	89 (79, 95)		93 (81, 98)		85 (80, 89)
Incorrect (strongly disagree + disagree)	3 (2,5)	8 (3,19)	5 (2,9)		4 (1, 17)		5 (3, 89)
Unsure	14 (11,18)	7 (3, 17)	6 (2,19)		3 (0, 24)		10 (6, 14)
Cancer: *the nicotine in cigarettes is the substance that causes most of the cancer caused by smoking*							
Correct (strongly disagree + disagree)	24 (21,28)	35 (26, 46)	37 (25,50)		28 (9, 62)		32 (27, 38)
Incorrect (strongly agree + agree)	50 (46, 53)	48 (37, 5)	38 (27, 49)		64 (29, 89)		44 (39, 49)
Unsure[b]	26 (23, 30)	17 (8, 30)	26 (16, 39)		7 (2, 20)		24 (19, 29)
			M (SE)	*M (SE)*	*M (SE)*	*M (SE)*	*M (SE)*
Low nicotine cigarette beliefs			95% CI	95% C	95% CI	95% CI	95% CI
Harm: *compared to a typical cigarette, would you think that a cigarette advertised as "low nicotine" would be…much less/ much more harmful than a typical cigarette*[b]			2.73 (0.03)	2.65 (0.08)	2.70 (0.10)	2.74 (0.21)	2.87 (0.03)
			2.67, 2.80	2.49, 2.82	2.50, 2.90	2.31, 3.17	2.81, 2.94
Addictiveness: *compared to a typical cigarette, would you think that a cigarette advertised as "low nicotine" would be…much less/much more addictive than a typical cigarette*[c]			2.79 (0.03)	2.75 (0.06)	2.780 (0.08)	2.86 (0.25)	2.79 (0.03)
			2.72, 2.85	2.63, 2.87	2.63, 2.96	2.37, 2.36	2.74, 2.85

Notes. All percentages are adjusted for sex, age (18–24; 25–44; 45–64; 65+), race/ethnicity, sexual orientation, and education. Sample size is small for recent quitters (*n* = 49) and statistics should be interpreted with caution.

[a]Current smokers who smoked at least 100 lifetime cigarettes and were currently smoking every day or some days.

[b]Response options ranged from 1 (*Much less harmful to your health than a typical cigarette*) to 5 (*Much more harmful to your health than a typical cigarette*), with a midpoint of 3 (*Equally harmful to your health*).

[c]Response options ranged from 1 (*Much less addictive than a typical cigarette*) to 5 (*Much more addictive than a typical cigarette*), with a midpoint of 3 (*Equally addictive*).

Table 3

HINTS-FDA 2015 demographic characteristics and smoking status as predictors of nicotine cancer belief.

		Incorrect OR (95% CI)	Unsure OR (95% CI)
Sex	Female	*Referent*	*Referent*
	Male	0.86 (0.62, 1.20)	0.93 (0.66, 1.32)
Race/ethnicity	White	*Referent*	*Referent*
	Black	3.36 (1.79, 6.31)	3.55 (1.63, 7.73)*
	Hispanic	1.98 (1.07, 3.65)	1.64 (0.79, 3.39)
	Other	1.96 (1.27, 3.04)	1.46 (0.68, 3.14)
Age	18–24 years	*Referent*	*Referent*
	25–44 years	0.58 (0.27, 1.23)	0.59 (0.26, 1.35)
	45–64 years	1.37 (0.64, 2.96)	1.07 (0.46, 2.47)
	65+ years	2.38 (1.14, 4.99)	1.82 (0.77, 4.32)
Education	High school or less	*Referent*	*Referent*
	Some college	0.67 (0.49, 1.08)	0.85 (0.49, 1.47)
	College graduate	0.45 (0.29, 0.71)	0.51 (0.30, 0.89)
	Postgraduate	0.37 (0.23, 0.60)	0.35 (0.18, 0.67)
Sexual orientation	Heterosexual	*Referent*	*Referent*
	Lesbian, gay, bisexual	0.43 (0.16, 1.14)	0.68 (0.20, 2.26)
Smoking status	Never smoker	*Referent*	*Referent*
	Smoker[a], intends to quit	0.61 (0.36, 1.04)	0.41 (0.17, 1.01)
	Smoker[a], not quitting	0.46 (0.23, 0.94)	0.59 (0.26, 1.35)
	Recent quitter	1.09 (0.19, 6.33)	0.23 (0.08, 0.69)
	Established quitter	0.64 (0.46, 0.89)	0.64 (0.41, 0.99)

Note. Sample size is small for recent quitters ($n = 49$) and statistics should be interpreted with caution. "Referent" indicates the group to which the other groups are compared.

*$p < 0.05$.

[a]Current smokers who smoked at least 100 lifetime cigarettes and were currently smoking every day or some days.

Table 4

HINTS-FDA 2015 demographic characteristics and smoking status as predictors of low nicotine cigarette beliefs.

		Relative harmfulness[a] *B* (95% CI)	Relative addictiveness[b] *B* (95% CI)
Sex	Female	*Referent*	*Referent*
	Male	0.05 (−0.05, 0.14)	0.03 (−0.08, 0.14)
Race/ethnicity	White	*Referent*	*Referent*
	Black	0.26 (0.10, 0.42)*	0.08 (−0.05, 0.20)
	Hispanic	0.17 (−0.03, 0.36)	0.26 (0.07, 0.45)*
	Other	0.07 (−0.08, 0.22)	0.21 (0.04, 0.39)*
Age	18–24 years	*Referent*	*Referent*
	25–44 years	−0.08 (−0.34, 0.18)	−0.12 (−0.40, 0.17)
	45–64 years	−0.19 (−0.45, 0.08)	−0.06 (−0.35, 0.22)
	65+ years	−0.23 (−0.49, 0.03)	−0.03 (−0.32, 0.25)
Education	High school or less	Referent	Referent
	Some college	−0.05 (−0.18, 0.09)	−0.11 (−0.23, 0.02)
	College graduate	−0.03 (−0.16, 0.10)	−0.13 (−0.24, −0.03)*
	Postgraduate	−0.08 (−0.20, 0.04)	−0.26 (−0.39, −0.13)*
Sexual orientation	Heterosexual	*Referent*	*Referent*
	Lesbian, gay, bisexual	0.09 (−0.05, 0.23)	−0.01 (−0.20, 0.17)
Smoking status	Never smoker	*Referent*	*Referent*
	Smoker[c], intends to quit	−0.01 (−0.16, 0.15)	0.05 (−0.06, 0.16)
	Smoker[c], not quitting	0.01 (−0.21, 0.23)	0.06 (−0.12, 0.23)
	Recent quitter	0.04 (−0.40, 0.47)	0.11 (−0.39, 0.62)
	Established quitter	0.16 (0.08, 0.24)*	0.04 (−0.03, 0.10)
Believability of LNCs (control)		−0.19 (−0.26, −0.13)*	−0.21 (−0.26, −0.15)*

Notes. Unstandardized coefficients are reported. Sample size is small for recent quitters ($n = 49$) and results should be interpreted with caution.

"Referent" indicates the group to which the other groups are compared.

*$p < 0.05$.

[a]Current smokers who smoked at least 100 lifetime cigarettes and were currently smoking every day or some days.

[b]Response options ranged from 1 (*Much less harmful to your health than a typical cigarette*) to 5 (*Much more harmful to your health than a typical cigarette*), with a midpoint of 3 (*Equally harmful to your health*).

[c]Response options ranged from 1 (*Much less addictive than a typical cigarette*) to 5 (*Much more addictive than a typical cigarette*), with a midpoint of 3 (*Equally addictive*).