Published in final edited form as:

Tob Control. 2014 September ; 23(5): 385–388. doi:10.1136/tobaccocontrol-2012-050814.

Public Education about Relative Harm of Tobacco Products: An intervention for tobacco control professionals

Lois Biener, Ph.D.,

Center for Survey Research, University of Massachusetts Boston, 100 Morrissey Blvd., Boston, MA 02125, 617-287-7200, 617-287-7210 (fax), lois.biener@umb.edu

Amy L. Nyman, M.A.,

Center for Survey Research, University of Massachusetts Boston, 100 Morrissey Blvd., Boston, MA 02125, amy.nyman@umb.edu

Irina Stepanov, Ph.D., and

Masonic Cancer Center, University of Minnesota, MMC 806, 420 Delaware St SE, Minneapolis, MN 55455, stepa011@umn.edu

Dorothy Hatsukami, Ph.D.

University of Minnesota, Tobacco Research Programs, 717 Delaware St SE, Minneapolis, MN 55414, hatsu001@umn.edu

Abstract

Background—In the United States, new regulations require the collection of information on tobacco constituents by brand and variety and publication of this information in a way not likely to be misconstrued by consumers. Understanding of such information becomes increasingly important as new tobacco products come onto the market and modifications are made to reduce the toxicity of some products. This pilot study assessed current knowledge of tobacco control professionals regarding relative harmfulness of several tobacco products, and evaluated an online educational intervention aimed at improving understanding of variations in nicotine and tobacco specific *N*-nitrosamines (TSNAs).

Methods—Fifty-two tobacco control professionals participated in an online intervention which presented and discussed the results of constituent analyses of Camel Snus and Marlboro Snus compared to several conventional smokeless tobacco. Comparisons to cigarettes were also discussed. Pre- and post-test questions assessed understanding of the concepts.

Results—Pretest responses demonstrated that 31% did not know that cigarettes are more harmful than smokeless tobacco; 50% or more did not know that smokeless products higher in nicotine are likely to be more effective substitutes for cigarettes; that TSNAs are the major carcinogens in tobacco and that the new snus products tend to be lower in TSNAs than conventional spit tobacco.

Correspondence to: Lois Biener.

CONTRIBUTORSHIP STATEMENT:

LB, IS, and DH collaborated on defining the learning objectives. LB and AN created the online educational tool. AN analyzed the data. All authors contributed to writing the manuscript.

After participating in the intervention, knowledge increased on all points except one on which pretest results showed 100% correct.

Conclusions—Public education campaigns are urgently needed for tobacco control professionals, and then for consumers to increase awareness and understanding of the continuum of risk among tobacco products.

Keywords

smokeless tobacco; snus; harm reduction; tobacco specific n-nitrosamines; perceptions of health risks

BACKGROUND

The Family Smoking Prevention and Tobacco Control Act (FSPTC) requires tobacco companies to report the level of harmful and potentially harmful constituents in their products, by brand and sub-brand.¹ Additionally, it requires that the Secretary publish the list of tobacco product constituents in a manner that is not misleading to lay persons (Section 904). Researchers disagree about providing information about tobacco product toxicant levels to laymen. Because consumers have misconstrued differential tar readings, for example, to imply differential health risk for cigarette varieties that are equally harmful,^{2–4} there is some sentiment against publishing this information. However, others believe access to accurate product constituent information is a human right, and that it is important to communicate the information in a manner that minimizes misperception.⁵ In the absence of well-publicized information that some tobacco products have substantially lower rates of major toxicants, consumers are left to believe erroneously that noncombustible tobacco products are as toxic as combustible ones, and as a consequence, smokers who are unable or unwilling to quit tobacco use can be discouraged from choosing to move to a potentially less harmful product.^{6–8} Indeed, research shows that smokers with accurate risk estimates are more willing to quit smoking by using snus.^{9,10}

Misperception is widespread about the relative harmfulness of smoking compared to using smokeless tobacco. Studies have demonstrated this misperception among youth, adults, medical professionals, academics and tobacco retailers.^{11–18} To date, there are no published studies examining knowledge among tobacco control professionals. Because these professionals have a major role in transmitting information to tobacco users, it is essential that they be well informed about emerging products. We assessed knowledge about relative toxicity of new and conventional products and tested the effectiveness of an educational intervention to improve understanding.

There is evidence that information on relative harmfulness can be presented in an effective manner. Biener and Bogen found that when consumers viewing advertisements for potentially reduced exposure cigarettes (Eclipse and Advance) were given information explaining the difference between reduced exposure to toxicants versus reduced risk, they rated the products as being of significantly higher risk than consumers viewing the advertisements without that information.¹⁹ Research with a convenience sample of smokers in four countries showed that exposure to a 4-page text pamphlet about the relative

harmfulness of smokeless tobacco and nicotine replacement products compared to smoked tobacco demonstrated a slight but significant improvement in accurate knowledge of the risks of these products²⁰ and a significant increase in the willingness to try the less harmful non-combusted products.²¹ This paper describes the content and pilot evaluation of an educational presentation on nicotine and toxic constituents in tobacco and the related health risks aimed at educated laymen, in this case tobacco control professionals.

THE EDUCATIONAL PRESENTATION

Nicotine can be present in two forms – protonated and unprotonated, or ‘free nicotine’, which easily crosses cellular membranes to reach the brain faster than the protonated form.²² Previous studies have shown that smokeless products vary in their free nicotine content,²³²⁴ and that products with higher free nicotine levels are more addictive.²²²⁵ However, among novel “spitless” smokeless tobacco products, the products with higher free nicotine content could be more effective in satisfying smokers and completely substituting for cigarettes compared to those with less free nicotine.^{26–28} Non-combustible tobacco products contain fewer known carcinogens than cigarette smoke. Tobacco-specific *N*-nitrosamines (TSNA) are the major carcinogens in smokeless tobacco.²⁹³⁰ Among the TSNA identified in tobacco and cigarette smoke, *N*’-nitrosonornicotine (NNN) and 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK) are most important due to their relative abundance and carcinogenicity.³¹ We previously demonstrated that levels of NNN and NNK vary substantially among smokeless tobacco products marketed in the U.S., with novel “spitless” and dissolvable products generally containing lower levels.²³²⁴ We presented the sum of NNN and NNK content in various tobacco products to our participants, and for simplicity referred to this value as “TSNA”.

The objectives of the presentation were to convey the following information:

- Nicotine is what makes tobacco addictive, but is not toxic to adults in small amounts.³²³³
- Smokeless tobacco products higher in free nicotine are more likely to substitute for cigarettes.²⁶²⁷
- Tobacco specific *N*-nitrosamines (TSNAs) are the major known cancer-causing agents in tobacco.^{34–36}
- Although exposure to higher levels of TSNA increases risk of cancer, we don't know how much of an increase would make someone more likely to get cancer.³⁷
- It is difficult to compare levels of nicotine and TSNAs in smokeless tobacco and in cigarettes because smoking the tobacco changes the impact of the constituents on the body, and there are many additional toxicants in cigarette smoke.
- Portion size of smokeless products must be considered in assessing exposure. Bigger pouches mean a larger dose of both nicotine and TSNAs, given the same level per gram of tobacco.
- Available data indicate that new snus products contain lower levels of TSNAs than conventional products.²⁴

- Camel Snus is higher in nicotine levels than Marlboro Snus.²⁶
- Snus is less dangerous than cigarettes but not “safe”. (Objective added after Trial One.)³⁸³⁹

METHODS

The research participants were volunteers from the New Product Watch, a web-based national monitoring network made up of tobacco researchers and state tobacco program staff and their community partners. They periodically reported observations of new smokeless products available in their area. In the summer of 2010, the project enlisted a subset of the participants to purchase new smokeless tobacco products and send them to Masonic Cancer Center, University of Minnesota for analysis of nicotine and TSNA.⁴⁰ An online, interactive educational presentation was designed to convey the relatively complex information about these two constituents. Two trials of the educational presentation were implemented. After the first trial, the presentation was revised to address concepts that were misperceived or not adequately communicated. A total of 52 state program employees and researchers viewed and completed one of the two trials.

A set of 9 multiple choice pre-test questions designed to measure baseline knowledge appeared prior to the educational presentation. Those nine questions were then re-asked at various places in the presentation after relevant explanatory material had been presented. The questions and their response alternatives are available online as supplementary material.

Tobacco Analyses

Upon arrival in the University of Minnesota’s laboratory, product samples were sealed in plastic sleeves and refrigerated until analysis. All analyses were performed by standard validated methods described elsewhere²⁴.

Presentation

The on-line presentation was a slide show with embedded questions. It covered the nature and role of free nicotine and TSNA in tobacco products, compared lab analyses of these constituents in newly collected smokeless samples with those of conventional smokeless products, compared smokeless products with cigarettes in terms of composition and usage, examined regional, brand and flavor differences in content of smokeless product samples, and addressed the issue of portion size. The final version of the presentation with imbedded questions and answers is available online as a supplementary file.

RESULTS

Table 1 contains the proportion of respondents in each trial who answered each question correctly before and after viewing the presentation. Between the two trials, revisions were made with the goal of clarifying several objectives that were not well-achieved in the first trial. Pre-testing showed a similar pattern of knowledge in the two trials and, on the whole, objectives that were well met in Trial 1 were also well met in Trial 2. Learning successfully increased from pre to post-test for all but one of the questions (where knowledge was

already 100%). Modification of two content areas to reduce confusion lead to improved understanding of the related points. New material and a new question were added for the second trial to address concerns about promoting snus as safe. Significantly more respondents provided correct answers post-viewing than pre.

DISCUSSION

Ensuring tobacco control professionals are well informed about the relative harmfulness of tobacco products is a first step to increasing the accuracy of consumer knowledge on this topic. This study highlighted the need for education among this group of tobacco control professionals, 30% of whom were unaware that cigarette smoking is more harmful than using smokeless tobacco. After viewing the presentation, more than 90% identified cigarettes as more harmful. Awareness that TSNA's are the major carcinogen in tobacco is important since it is a prime target of modification in new products. Understanding the importance of free nicotine levels allows identification of which non-combustible products are better substitutes for cigarettes. The presentation was relatively successful in improving knowledge on both of these issues. The results suggest this is a promising approach for educating professionals. Overall, the stated learning objectives were successfully communicated to respondents by the end of our second trial. A few issues could still benefit from further clarification: those in which the post-test proportion of correct answers fell at two-thirds or below. These included varying nicotine levels of snus brands and issues surrounding portion size.

Respondents were generally challenged but not overwhelmed by the technicality of the presentation, but it's important to remember that the sample consisted of tobacco researchers and program professionals who possess the motivation and background to process this type of information, and not a representative sample of either these populations or of the general public. A different approach would likely be needed for the general public and might also be necessary for less motivated tobacco control professionals. But even for the professionals targeted in this study further refinement would be useful. It would be better to break the presentation into several sessions and vary the graphic presentation. It would also be better to perform post-testing some time after viewing the presentation to measure knowledge retention. A refined presentation should then be evaluated on a larger more representative group of professionals. This pilot study shows that a large proportion of this selected group of tobacco control professionals who were interested in emerging products understand neither the role of TSNA's in tobacco-related disease nor the importance of free nicotine levels in products that can potentially substitute for cigarettes. A random selection of professionals may well have even lower levels of knowledge on these issues. Educational interventions such as the one presented here are important as more modified risk products are marketed in the U.S.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

FUNDING

This work was supported by contracts HHSN261201100513P and HHSN26120100438P as well as grant #R01 CA141531 from the National Cancer Institute.

REFERENCES

1. US Congress. The Family Smoking Prevention and Tobacco Control Act and Federal Retirement Reform. Public Law No: 111-31. 2009 HR 1256.
2. Borland R, Yong HH, King B, et al. Use of and beliefs about light cigarettes in four countries: findings from the International Tobacco Control Policy Evaluation Survey. *Nicotine Tob. Res.* 2004; 6(Suppl 3):S311–S321. [PubMed: 15799594]
3. Kozlowski LT, Pillitteri JL. Beliefs about "Light" and "Ultra Light" cigarettes and efforts to change those beliefs: an overview of early efforts and published research. *Tob. Control.* 2001; 10(Suppl 1):i12–i16. [PubMed: 11740039]
4. Shiffman S, Pillitteri JL, Burton SL, et al. Smokers' beliefs about "light" and "ultra light" cigarettes. *Tob Control.* 2001; 10(Suppl. 1):17–23.
5. Kozlowski LT, Edwards BQ. "Not safe" is not enough: smokers have a right to know more than there is no safe tobacco product. *Tob Control.* 2005; 14(Suppl 2):ii3–ii7. [PubMed: 16046699]
6. Hatsukami DK, Biener L, Leischow SJ, et al. Tobacco and Nicotine Product Testing. *Nicotine Tob. Res.* 2012; 14(1):7–17. [PubMed: 21460383]
7. Phillips CV, Wang C, Guenzel B. You might as well smoke; the misleading and harmful public message about smokeless tobacco. *BMC Public Health.* 2005; 5:7. [PubMed: 15661071]
8. Waterbor JW, Adams RM, Robinson JM, et al. Disparities between public health educational materials and the scientific evidence that smokeless tobacco use causes cancer. *J. Cancer Educ.* 2004; 19(1):17–28. [PubMed: 15059752]
9. Gartner CE, Jimenez-Soto EV, Borland R, et al. Are Australian smokers interested in using low-nitrosamine smokeless tobacco for harm reduction? *Tob Control.* 2010; 19:6, 451–456.
10. Lund KE. Association Between Willingness to Use Snus to Quit Smoking and Perception of Relative Risk Between Snus and Cigarettes. *Nicotine Tob. Res.* 2012; 14(10):1221–1228. [PubMed: 22416114]
11. Overland S, Hetland J, Aaro LE. Relative harm of snus and cigarettes: what do Norwegian adolescents say? *Tob. Control.* 2008; 17(6):422–425. [PubMed: 18849315]
12. Borland R, Cooper J, McNeill A, et al. 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 Reduct. J.* 2011; 8:11. [PubMed: 21575206]
13. Wikmans T, Ramstrom L. Harm perception among Swedish daily smokers regarding nicotine, NRT-products and Swedish Snus. *Tobacco Induced Diseases.* 2010; 8:9. [PubMed: 20707898]
14. O'Connor RJ, Hyland A, Giovino GA, et al. Smoker awareness of and beliefs about supposedly less-harmful tobacco products. *Am. J. Prev. Med.* 2005; 29(2):85–90. [PubMed: 16005803]
15. 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 Research.* 2007; 9(10): 1033–1042.
16. Lund I, Scheffels J. Perceptions of the Relative Harmfulness of Snus Among Norwegian General Practitioners and Their Effect on the Tendency to Recommend Snus in Smoking Cessation. *Nicotine Tob. Res.* 2012; 14(2):169–175. [PubMed: 22025541]
17. Peiper N, Stone R, Van Zyl R, et al. University faculty perceptions of the health risks related to cigarettes and smokeless tobacco. *Drug Alcohol Rev.* 2010; 29(2):121–130. [PubMed: 20447218]
18. Heavner KK, Rosenberg Z, Tenorio F, et al. Retailers' knowledge of tobacco harm reduction following the introduction of a new brand of smokeless tobacco. *Harm Reduct. J.* 2010; 7:7. [PubMed: 20338062]

19. Biener L, Bogen K, Connolly G. Impact of corrective health information on consumers' perceptions of "reduced exposure" tobacco products. *Tob. Control.* 2007; 16:306–311. [PubMed: 17897988]
20. Borland R, Li L, Cummings KM, et al. Effects of a Fact Sheet on beliefs about the harmfulness of alternative nicotine delivery systems compared with cigarettes. *Harm Reduct J.* 2012; 9:19. [PubMed: 22687137]
21. O'Connor RJ, Norton K, Bansal-Travers M, et al. US smokers' reactions to a brief trial of oral nicotine products. *Harm Reduct J.* 2011; 8:1. [PubMed: 21219609]
22. Tomar SL, Henningfield JE. Review of the evidence that pH is a determinant of nicotine dosage from oral use of smokeless tobacco. *Tob. Control.* 1997; 6(3):219–225. [PubMed: 9396107]
23. Stepanov I, Jensen J, Hatsukami D, et al. Tobacco-specific nitrosamines in new tobacco products. *Nicotine Tob. Res.* 2006; 8(2):309–313. [PubMed: 16766423]
24. Stepanov I, Jensen J, Hatsukami D, et al. New and traditional smokeless tobacco: Comparison of toxicant and carcinogen levels. *Nicotine Tob. Res.* 2008; 10(12):1773–1782. [PubMed: 19023828]
25. Hatsukami DK, Severson HH. Oral spit tobacco: addiction, prevention and treatment. *Nicotine Tob. Res.* 1999; 1(1):21–44. [PubMed: 11072386]
26. Hatsukami DK, Jensen J, Anderson A, et al. Oral tobacco products: Preference and effects among smokers. *Drug Alcohol Depend.* 2011; 118(2–3):230–236. [PubMed: 21515003]
27. Kotlyar M, Hertsgaard LA, Lindgren BR, et al. Effect of Oral Snus and Medicinal Nicotine in Smokers on Toxicant Exposure and Withdrawal Symptoms: A Feasibility Study. *Cancer Epidemiol. Biomarkers Prev.* 2011; 20(5):1048–1048.
28. Rogers JD, Biener L, Clark PI. Test marketing of new smokeless tobacco products in four US cities. *Nicotine Tob. Res.* 2010; 12(1):69–72. [PubMed: 19917598]
29. Hoffmann D, Djordjevic MV. Chemical composition and carcinogenicity of smokeless tobacco. *Advances in Dental Research.* 1997; 11(3):322–329. [PubMed: 9524432]
30. Smokeless tobacco and some tobacco-specific N-nitrosamines. Lyon, France: IARC Working Group on the Evaluation of Carcinogenic Risks to Humans; 2007.
31. Hecht SS. Biochemistry, biology, and carcinogenicity of tobacco-specific N-nitrosamines. *Chem. Res. Toxicol.* 1998; 11(6):559–603. [PubMed: 9625726]
32. U.S. Department of Health and Human Services. Health Consequences of Smoking: Nicotine Addiction: A Report of the Surgeon General. Center for Health Promotion and Education. Office on Smoking and Health; 1988.
33. U.S. Department of Health and Human Services. How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Office on Smoking and Health; 2010.
34. Yuan JM, Gao YT, Murphy SE, et al. Urinary Levels of Cigarette Smoke Constituent Metabolites Are Prospectively Associated with Lung Cancer Development in Smokers. *Cancer Res.* 2011; 71(21):6749–6757. [PubMed: 22028322]
35. Yuan JM, Knezevich AD, Wang RW, et al. Urinary levels of the tobacco-specific carcinogen N'-nitrosonornicotine and its glucuronide are strongly associated with esophageal cancer risk in smokers. *Carcinogenesis.* 2011; 32(9):1366–1371. [PubMed: 21734256]
36. Church TR, Anderson KE, Caporaso NE, et al. A Prospectively Measured Serum Biomarker for a Tobacco-Specific Carcinogen and Lung Cancer in Smokers. *Cancer Epidemiol. Biomarkers Prev.* 2009; 18(1):260–266. [PubMed: 19124507]
37. Hatsukami DK, Benowitz NL, Rennard S, et al. Biomarkers to assess the utility of potential reduced exposure tobacco products. *Nicotine Tob. Res.* 2006; 8(4):599–622.
38. Levy DT, Mumford EA, Cummings KM, et al. The relative risks of a low-nitrosamine smokeless tobacco product compared with smoking cigarettes: estimates of a panel of experts. *Cancer Epidemiology, Biomarkers, and Prevention.* 2004; 13(12):2035–2042.
39. Luo J, Ye W, Zendehele K, et al. Oral use of Swedish moist snuff (snus) and risk for cancer of the mouth, lung, and pancreas in male construction workers: A retrospective cohort study. *The Lancet.* 2007:2015–2020.

40. Stepanov I, Biener L, Knezevich A, et al. Monitoring Tobacco-Specific N-Nitrosamines and Nicotine in Novel Marlboro and Camel Smokeless Tobacco Products: Findings From Round 1 of the New Product Watch. *Nicotine Tob. Res.* 2012; 14(3):274–281. [PubMed: 22039075]

WHAT THIS PAPER ADDS

This paper documents apparent widespread lack of knowledge among a selected group of tobacco control professionals about the relative harm of snus versus cigarettes and the implications of variations in the levels of tobacco specific n-nitrosamines. It also presents the results of a pilot test of the first known online educational tool to improve knowledge of new tobacco products.

Table 1

Percent correct answers by trial.

Question # and associated learning objective	Trial 1 (n = 24)			Trial 2 (n=28)			Improvement in % Correct Trial 2 over Trial 1
	Correct Pre	Correct Post	Difference	Correct Pre	Correct Post	Difference	
1. Nicotine makes tobacco addictive.	100%	100%	0	100%	100%	0	0
2. Products higher in nicotine substitute better for cigarettes.	33%	79%	+46	50%	82%	+32	3
3. Higher levels of TSNAs mean higher risk of cancer, but can't say how much more for a given increase in levels.	15%	21%	+6	46%	71%	+25	50
4. Camel Snus is higher in nicotine than Marlboro Snus.	11%	75%	+64	25%	57%	+32	-18
5. TSNAs are the major carcinogen in tobacco.	48%	100%	+52	--	--	--	--
6. New snus is lower in TSNAs than conventional smokeless.	19%	100%	+81	50%	100%	+50	0
7. Cigarettes are more harmful than smokeless tobacco.	69%	92%	+23	71%	100%	+29	
8. Pouch size is an important determinant of exposure to toxicants.	15%	39%	+24	54%	64%	+10	25
9. [Check on understanding of color codes in graphs].	81%	100%	+19	57%	96%	+39	-4
10. Snus is safer than cigarettes, but not safe.	--	--	--	68%	93%	+25	--
Mean number correct answers	3.92	7.00	3.08***	5.21	7.64	2.43***	

Note:

p<.0001