



## Supplement Articles

# Marketing Influences on Perceptions of Reduced Nicotine Content Cigarettes

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## Abstract

**Introduction:** The Food and Drug Administration announced intent to reduce the nicotine content in cigarettes. There is limited evidence on how reduced nicotine content cigarette (RNC) marketing affects product beliefs and use, and research on this is needed to inform regulations.

**Methods:** In an online experiment, 426 young adult cigarette smokers (aged 18–30 years) were randomized in a 2 (implicit: red package vs. blue package) × 2 (explicit: corrective message vs. no corrective message) design to view an advertisement for previously commercially available RNCs. Outcomes were advertisement content recall, product beliefs, and use intentions. Participants' responses to open-ended assessment of their beliefs about the stimuli were coded to identify prevailing themes.

**Results:** Red packaging and corrective messaging were independently associated with greater advertisement content recall ( $p = .01$  and  $p = .04$ , respectively). There were no significant main or interaction effects on product beliefs or use intentions. Controlling for condition, advertisement content recall was significantly associated with less favorable product beliefs ( $p < .001$ ) and favorable product beliefs were associated with intent to use the product ( $p < .001$ ). Open-ended responses converged on the finding that respondents were interested in RNCs, but expressed skepticism about effectiveness and value.

**Conclusions:** Brief exposure to an RNC advertisement with red packaging and corrective messaging were each independently associated with greater advertisement content recall. The results indicate: (1) interest and confusion among young adult smokers regarding RNCs, (2) beliefs about RNCs are influenced by marketing, and (3) beliefs are associated with intention to use RNCs.

**Implications:** Findings from this study demonstrate the importance of advertising effects on beliefs about RNC products and support the need to regulate advertising and labeling alongside product regulation. More detailed study of advertisement features that affect consumers' beliefs about RNCs and how they impact their processing of explicit messaging about product risks will be important to guide regulatory decision-making.

## Introduction

Cigarette smoking remains the leading cause of preventable death in the United States.<sup>1</sup> Nicotine in cigarettes is highly addictive and sustains the long-term, dependent smoking that produces this preventable public health burden.<sup>1</sup> Cigarettes are a commonly used tobacco product among young adults<sup>2</sup> and young adulthood is characterized by vulnerability to smoking initiation, escalation, and solidifying long-term smoking and nicotine dependence.<sup>3-5</sup> For these reasons, our study focused on young adults as a priority population for tobacco control research.

In 2017, the Food and Drug Administration (FDA) announced a comprehensive regulatory plan to accelerate efforts to prevent and reduce smoking-related deaths, including potential steps to reduce nicotine content of cigarettes.<sup>6</sup> The Family Smoking Prevention and Tobacco Control Act (TCA) authorized FDA to issue regulations to reduce nicotine content in cigarettes to non-addictive levels to reduce the immense public health burden of smoking.<sup>6-9</sup> There is growing evidence that such regulations may achieve this goal by helping more smokers quit and preventing those who try cigarettes from becoming addicted.<sup>10</sup> In 2018, FDA took the first step to develop such regulations by publishing an Advance Notice of Proposed Rulemaking detailing the issues FDA is considering and requesting public feedback to inform decision-making.<sup>11</sup>

Critically, regulations to reduce the nicotine content of cigarettes must address how manufacturers market, package, and label these products and how risk information is communicated through labeling requirements. There is abundant evidence that tobacco industry marketing produces misperceptions about the risks of tobacco use and influences behavior.<sup>12</sup> Historically, cigarette companies marketed products to consumers and labeled them with descriptors (eg, “low,” “light”) implying information about their associated risks.<sup>1,12</sup> It is now known that these descriptors were intentionally misleading, they influenced risk perceptions and cigarette use, and they are now prohibited by the TCA.<sup>1</sup> Despite the TCA’s ban of misleading descriptors, many smokers are unaware of this labeling change and consumers’ perceptions about the risks of smoking<sup>13,14</sup> are shaped by implicit features of cigarette marketing and packaging, including coloring.<sup>12,15</sup> Color in cigarette marketing influences consumers’ beliefs, including those about product risks and nicotine level. For example, red cigarette packaging produces beliefs that a product has higher risks,<sup>16</sup> blue packaging produces beliefs that products have less robust flavor and less risk,<sup>17,18</sup> and white packaging communicates lower risks and lower nicotine content.<sup>15</sup> Thus, implicit information communicated through visuals on cigarette marketing and packaging including color affect consumers’ beliefs and represent an important consideration for tobacco regulation.<sup>19,20</sup> For reduced nicotine content cigarettes (RNCs), there is some evidence regarding consumers’ beliefs about product risks<sup>21-23</sup> and associations with RNC use,<sup>24</sup> but research on how RNC advertising features such as implicit risk information impacts these beliefs is extremely limited.

One potential regulatory measure to counter effects of RNC advertising is to require corrective messaging explicitly communicating product risks on marketing and packaging.<sup>25</sup> Like prior studies, we define corrective messaging as messages that may be required to complement and build on other required risk message content (eg, warning labels) to convey product risks to consumers through marketing and packaging.<sup>26</sup> Cigarette advertising and labeling must display text-only warnings communicating the risks of smoking.<sup>27,28</sup> However, evidence demonstrates text-only warnings are unlikely to be viewed or attended to by consumers.<sup>26,29,30</sup> Corrective messaging

may aid in addressing misperceptions that are not addressed by required warnings or that are conveyed implicitly by other marketing and packaging features (eg, color). For RNCs, some research demonstrates that exposure to advertising with corrective messaging addressing tar and nicotine content is associated with less favorable product beliefs and increased harm perceptions, but this evidence is limited to a few studies and none have focused on young adult smokers.<sup>26,31</sup>

The aim of this study was to examine the effect of visual characteristics communicating implicit risks (eg, package color) and explicit corrective messaging in RNC marketing among young adult smokers. Our research is guided by a conceptual framework including theoretical and empirical evidence characterizing how tobacco advertising affects consumers.<sup>32-34</sup> According to this framework, consumers are exposed to advertising content with specific features, and subsequently recall advertising contents. This exposure and content recall affect product beliefs, and exposure, content recall, and product beliefs impact consumers’ behavioral intention and behavior.<sup>32-34</sup> Guided by this theoretical foundation, we examined how implicit (pack coloring) and explicit (corrective messaging) risk information in RNC advertising affect advertisement content recall, product beliefs, and use intentions in a sample of young adult cigarette smokers.

## Methods

### Sampling and Design

We conducted an experimental study through the internet-based crowdsourcing platform Amazon Mechanical Turk (mTurk). Evidence supports the use of mTurk for tobacco research, particularly experimental investigations of messaging effects.<sup>35,36</sup> Data quality assurance measures included prohibiting duplicate responses and using verification to prevent automated completion (ie, by bots). Registered mTurk users in the United States reviewed a brief study description and, if interested, proceeded to complete self-report screening questions to determine their eligibility. Eligible participants included young adult cigarette smokers aged 18–30 years. Current smokers were those who had smoked 100 or more cigarettes and currently smoke some days or every day. Non-smokers and those outside the study age range were ineligible. Interested, eligible participants provided informed consent online and then proceeded with procedures.

Participants completed a brief online survey with exposure to experimental stimuli. Prior to stimuli exposure, participants completed measures assessing demographics, cigarette smoking, and other tobacco use measures described below. Participants were then randomized in a 2 (implicit: red package or blue package) × 2 (explicit: corrective message or no corrective message) between-subjects design to view a Quest cigarette advertisement. The original print advertisement was for previously commercially available Quest brand RNCs that was adapted for the experimental conditions. Though RNCs are not currently available to consumers, the Quest product advertisements provide a useful simulation for RNC products and associated advertisements in the context of forthcoming FDA regulations.

Advertisement stimuli were adapted from a prior study by Lochbuehler et al. and complete stimuli are available from this prior publication.<sup>26</sup> Advertisements systematically varied based on two factors in the two by two design: (1) implicit product risk information (red packaging, blue packaging) and (2) presence of explicit

corrective message (yes, no). Advertisements for all conditions displayed three Quest cigarette packages labeled as “light” cigarettes, each of which showed a text statement underneath. The statement under the first pack said “Low Nicotine,” the statement under the second said “Extra Low Nicotine,” and the statement under the third said “Nicotine Free.” Below the displayed packs, the ad contained text indicating that Quest cigarettes labeled as “Nicotine Free” contained nicotine.<sup>26</sup> The original advertisement displayed packs that are blue in color and appear diagonally with arrows moving from low, to extra low, to nicotine free.<sup>26</sup> To alter implicit risk conveyed,<sup>17,18</sup> the ad was digitally edited to align the packs horizontally and alter pack color from blue to red.<sup>16,24,26</sup>

The corrective message was displayed directly above the packages in relevant conditions. The corrective message read “Nicotine free does not mean risk free. Quest contains as much tar as a light cigarette.” The language for the corrective message was specifically designed to correct misperceptions about the risks of RNCs that may be drawn from the original Quest advertisement content demonstrated in prior studies.<sup>16,37</sup> The corrective message made comparison with “light” cigarettes because packs displayed in the stimuli were labeled as “light” and to offset information contained in the advertisement about Quest tar yields. This provided consumers with a point of reference to a commonly recognized product without conveying numeric content that could be misleading.<sup>38,39</sup>

Advertisement stimuli from the prior study contained some differences other than the experimental manipulations, such as variation in text and background imagery. To create the final stimuli for this study, we edited the advertisement stimuli in Adobe Photoshop to ensure all features other than the experimental manipulations were consistent across conditions. Participants viewed stimuli for as long as they wished, during which time we collected data on duration of exposure. Immediately after the exposure, they responded to an open-ended prompt that asked for their thoughts and opinions about the advertisement viewed and then completed quantitative outcome measures including advertisement content recall, product beliefs, and intentions to use the Quest product. All study procedures were reviewed and approved by the host institution’s Institutional Review Board.

## Measures

### Cigarette Smoking

We measured cigarette smoking at eligibility screening using valid items assessing lifetime smoking of 100 or more cigarettes (yes or no) and current smoking (now smoking every day, some days, or not at all).<sup>40</sup> We defined current smokers as those who smoked 100 lifetime cigarettes and now smoked “every day” or “some days.” We used the six-item Fagerström Test for Nicotine Dependence (FTND) to measure nicotine dependence.<sup>41</sup> We summed responses to the items to create a score with higher values indicating greater nicotine dependence (range 0–10).

### Open-Ended Response

After exposure to the cigarette advertisement and prior to answering additional questions, participants responded to an open-ended prompt asking them to “Please type your thoughts or opinions about the ad you just viewed.”

### Advertisement Content Recall

We measured recall of the advertisement content using six items with true/false and multiple choice responses. The six items were

introduced by stating “Based on the ad you just viewed, please respond to the following statements.” Correct responses were: (1) Quest cigarettes contain no nicotine at all (False); (2) Nicotine free cigarettes are less harmful than regular cigarettes (False); (3) Quest cigarettes contain as much tar as a light cigarette (True); (4) What color were the cigarette packs? (red or blue, respectively); (5) How did the cigarette packages appear in the ad? (Straight across for red packs, lowest nicotine level placed highest on the ad for blue packs); and (6) What statement best captures the content of the warning label? (This product is not intended for use in quitting smoking). Each item was coded as correct or incorrect, with coding for some items specific to conditions to which participants were randomized. We analyzed item-level responses and created a recall score where higher values indicate greater recall by summing the number of correct responses.

### Product Beliefs

We used a seven-item scale to measure beliefs about Quest cigarettes shown in the advertisements.<sup>16,24,26,37</sup> The seven items stated: (1) Quest cigarettes are lower in tar than regular cigarettes; (2) Quest cigarettes are less addictive than regular cigarettes; (3) Quest cigarettes are less likely to cause cancer than regular cigarettes; (4) Quest cigarettes have fewer chemicals than regular cigarettes; (5) Quest cigarettes are healthier than regular cigarettes; (6) Quest cigarettes make smoking safer; and (7) Quest cigarettes help people quit smoking. The response scale for each item ranged from 1 = Definitely not true to 5 = Definitely true. These items were developed in prior research and are designed to capture product beliefs that consumers may draw from the stimuli content.<sup>16,24,26</sup> The items had good internal consistency (Cronbach’s  $\alpha = 0.84$ ) and responses were summed to create a score with higher values indicating more favorable product beliefs.

### Product Use Intentions

We measured intentions to use Quest cigarettes with a single item asking “If you could buy them, how likely is it that you would use Quest cigarettes in the next year?” Answer choices ranged from 1 = Definitely would not use to 4 = Definitely would use.

### Demographics

Demographic characteristics assessed included age, sex, race, ethnicity, educational attainment, employment, and annual income.<sup>40</sup>

### Analysis

We aimed to recruit a sample with approximately 100 participants in each experimental condition (approximate total  $n = 400$ ) in order to provide adequate statistical power to detect mean differences comparable to previous research on which the experimental stimuli and design were based.<sup>26</sup> Our analytic approach was guided by the conceptual framework described above characterizing a sequence where consumers are exposed to tobacco advertising, recall the content, formulate product beliefs, and develop behavioral intentions.<sup>32–34</sup> Accordingly, our analyses examined main effects of the experimental conditions and their interaction on advertisement content recall, product beliefs, and use intentions. Then, we conducted separate models to examine the proposed sequence by which advertisement content recall is hypothesized to affect product beliefs, and both recall and beliefs influence use intentions.<sup>32–34</sup>

We characterized the sample with descriptive statistics and used bivariate chi-squared and *t*-tests to assess associations between individual advertisement content recall items, the advertisement content recall score, and experimental conditions. We used analysis of covariance (ANCOVA) to examine main effects of the experimental conditions and their interaction on advertisement content recall, product beliefs, and intentions to use Quest cigarettes. Then, we created separate models to examine how experimental conditions affect advertisement content recall (Model 1), how the experimental factors and advertisement content recall affect product beliefs (Model 2), and how all of these predictors (experimental conditions, recall, product beliefs) affect intentions to use Quest cigarettes (Model 3).

All ANCOVAs examined main effects for experimental conditions, their interaction, and included covariates for age, sex, race, ethnicity, education, and nicotine dependence. We included demographic and smoking-related covariates based on research demonstrating their associations with smoking beliefs and behavior.<sup>30</sup> We examined least-squares mean differences by study conditions using Tukey–Kramer adjustment. For associations of interest among continuous predictor and dependent variables (eg, advertisement content recall with product beliefs), we produced beta coefficient estimates and 95% confidence intervals. We conducted all analyses using SAS version 9.4.

We coded open-ended responses using axial coding to identify prevailing themes. We first used a deductive process to categorize themes based on advertising receptivity items in the literature (eg, attractive, believable).<sup>42,43</sup> Then when coding for each theme, we used an inductive process to code responses that did not align with the initial coding scheme. Two independent coders coded all responses. Codes were not mutually exclusive and more than one code was permitted to be assigned to a single response. We achieved acceptable inter-rater reliability agreement between the two coders (average Cohen's kappa = .70, range .53–1.00).<sup>44–46</sup> The two coders discussed and resolved any discrepancies to achieve consensus. We report illustrative quotes for prominent themes based on conditions to which participants were randomized. We also report the theme frequency by condition.

## Results

In total, 998 individuals were interested in participating, 555 (55.6%) were eligible, and 426 (76.8% of those eligible) enrolled and completed study procedures. Table 1 displays sample characteristics. Participants viewed stimuli for an average of 13.80 seconds (*SD* = 18.82). Table 2 displays results of bivariate analyses of the proportion of participants correctly responding to advertisement content recall items and the advertisement content recall score by study condition (implicit: red package vs. blue package; explicit: corrective message vs. no corrective message). Participants were significantly more likely to state the correct pack color when the packs were red compared to blue ( $p = .01$ ) and more likely to state the correct pack appearance when the packs were red compared to blue ( $p < .001$ ). Participants were more likely to recall the warning label message when the packs were red compared to blue ( $p = .002$ ) and more likely to state that Quest cigarettes contain nicotine when the corrective message was present compared to no corrective message ( $p = .008$ ). The advertisement content recall score was higher among those in the red pack group ( $p = .01$ ) (Table 2).

In the initial ANCOVAs examining main effects of the experimental conditions and their interaction on advertisement content

**Table 1.** Sample Characteristics ( $N = 426$ )

	N (%)	Mean ( <i>SD</i> )
Demographics		
Age	–	25.3 (3.1)
Male	251 (58.9%)	–
White race	331 (77.7%)	–
Hispanic	56 (13.2%)	–
Education—some college or higher	348 (81.7%)	–
Full-time employment	263 (62.5%)	–
Income > \$50,000/year	145 (34.4%)	–
Cigarette smoking		
Age of cigarette initiation	–	17.0 (2.6)
Cigarettes per day	–	10.2 (14.8)
Days smoked past week	–	5.5 (2.0)
Nicotine dependence score (six items, range 1–10)	–	3.0 (2.5)
Average recall (total correct) (six items, range 0–6)	–	3.4 (1.4)
Average belief score (seven items, range 1–5)	–	3.0 (0.8)
Average intention to use Quest (one item, range 1–4)	–	2.3 (0.9)
Study condition		
Red package, corrective message	110 (25.8%)	–
Red package, no corrective message	103 (24.2%)	–
Blue package, corrective message	105 (24.7%)	–
Blue package, no corrective message	108 (25.4%)	–

recall, product beliefs, and product use intentions, there was only a statistically significant main effect of the red package on advertisement content recall. There were no statistically significant main effects of package color or the corrective message on product beliefs or use intentions (data not shown). The interaction between package color and corrective message was not significant in any models, so it was removed from subsequent models.

Results of the ANCOVAs examining associations among experimental conditions, advertisement content recall (Model 1), product beliefs (Model 2), and use intentions (Model 3) are shown in Table 3. For advertisement content recall, the red package ( $B = 0.34$ ,  $SE = 0.14$ ,  $p = .01$ ) and corrective message ( $B = 0.28$ ,  $SE = 0.14$ ,  $p = .04$ ) were independently associated with greater recall. Participants viewing advertisements displaying blue packaging ( $M = 2.93$ ,  $SE = 0.14$ ) had lower correct advertisement content recall than red packaging ( $M = 3.27$ ,  $SE = 0.14$ ). Those exposed to advertisements with no corrective message ( $M = 2.96$ ,  $SE = 0.14$ ) had lower advertisement content recall than those with a corrective message ( $M = 3.24$ ,  $SE = 0.14$ ). Study conditions were not associated with product beliefs or intentions to use Quest cigarettes. Table 3 illustrates that greater advertisement content recall was associated with significantly less favorable product beliefs ( $B = -0.29$ ,  $SE = 0.02$ ,  $p < .001$ ) when controlling for experimental conditions. Favorable product beliefs were associated with greater intentions to use Quest cigarettes ( $B = 0.42$ ,  $SE = 0.06$ ,  $p < .001$ ) when controlling for the experimental conditions and advertisement content recall.

Open-ended responses converged on a pattern of themes indicating participants were interested in RNCs, but skeptical about effectiveness and value. Table 4 displays prevailing themes by experimental condition. The most prominent theme was associated with interest in the Quest product. One participant indicated “I think that’s an interesting concept that is kind of like a bridge between normal cigarettes and e-cigs” (blue package, corrective message). The second most common theme was skepticism around the

**Table 2.** Bivariate Statistics for Correct Recall Items

	Package color		Corrective message	
	Blue	Red	No	Yes
	%	%	%	%
1. Quest cigarettes contain no nicotine at all.	69.7	68.8	63.2	75.4**
2. Nicotine free cigarettes are less harmful than regular cigarettes.	50.2	43.7	46.1	48.0
3. Quest cigarettes contain as much tar as a light cigarette.	61.5	56.1	58.1	59.6
4. What color were the cigarette packs?	83.1	91.4**	87.5	86.7
5. How did the cigarette packages appear in the ad?	44.8	64.1***	53.8	55.0
6. What statement best captures the content of the warning label?	24.5	38.9**	27.5	35.6
Recall score [M (SD)]	3.3 (1.4)	3.6 (1.4)**	3.3 (1.4)	3.6 (1.4)*

Associations between experimental factors and individual recall items were assessed using chi-squared tests. Associations between experimental factors and the overall recall score were assessed using *t*-tests.

\**p* < .05, \*\**p* < .01, \*\*\**p* < .001.

**Table 3.** Analysis of Covariance Results

	Model 1: DV: advertisement content recall	Model 2: DV: product beliefs	Model 3: DV: product use intentions
	<i>B</i> (95% CI)	<i>B</i> (95% CI)	<i>B</i> (95% CI)
Red package	0.34 (0.08 to 0.61)*	-0.03 (-0.16 to 0.10)	0.11 (-0.05 to 0.27)
Corrective message	0.28 (0.01 to 0.54)*	0.01 (-0.12 to 0.14)	-0.02 (-0.18 to 0.14)
Recall score	-	-0.29 (-0.34 to 0.24)**	0.05 (-0.02 to 0.12)
Belief score	-	-	0.42 (0.30 to 0.55)**

DV = dependent variable. All models included covariates for age, sex, race, ethnicity, education, and nicotine dependence. There were no statistically significant interactions between package color and corrective messaging so they were removed from all models.

\**p* < .05, \*\**p* < .001.

**Table 4.** Prevailing Themes in Participants' Open-Ended Responses by Study Condition

Coding theme	Study condition			
	Red package, corrective message ( <i>n</i> = 110), <i>n</i> (%)	Red package, no corrective message ( <i>n</i> = 103), <i>n</i> (%)	Blue package, corrective message ( <i>n</i> = 105), <i>n</i> (%)	Blue package, no corrective message ( <i>n</i> = 108), <i>n</i> (%)
Interested in Quest ( <i>n</i> = 153)	43 (39.1)	41 (39.8)	36 (34.3)	33 (30.6)
Skeptical ( <i>n</i> = 72)	19 (17.3)	22 (21.4)	16 (15.2)	15 (13.9)
Concern about effectiveness ( <i>n</i> = 45)	11 (10.0)	13 (12.6)	12 (11.4)	9 (8.3)
Concern about value ( <i>n</i> = 29)	9 (8.2)	10 (9.7)	5 (4.8)	5 (4.6)
Interested and Skeptical ( <i>n</i> = 23)	5 (4.5)	11 (10.7)	3 (2.9)	4 (3.7)

Not all mutually exclusive coding themes.

Quest RNCs, as one participant illustrated: “[It] Seemed like another ‘healthier cigarette’ gimmick” (red package, corrective message).

Subthemes that emerged from skepticism were concerns about product effectiveness and value. An example of concern about effectiveness was “They are trying to suggest their product is safer than normal cigs and it is not. The action of smoking combustible smoke is detrimental to your health regardless of nicotine content” (blue package, corrective message). Another participant exemplified concern about value of RNCs: “Why would you smoke a cigarette that has no nicotine? That is what I smoke and am addicted to. It’s like drinking non-alcoholic beer. It doesn’t make sense” (blue package, corrective message). Lastly, some participants expressed both interest and skepticism. For example, one participant indicated “It’s an interesting idea, I wonder though what effects they would still have on the lungs” (red package, no corrective message).

## Discussion

Our results indicate that after a brief exposure to an advertisement for RNCs, advertising features including color of packaging displayed (red or blue) and presence of a corrective message communicating potential risks were each independently associated with greater advertisement content recall. Young adult smokers were more likely to recall the pack color, placement, and the warning label content when they viewed advertisements displaying red cigarette packages. They were more likely to recall that Quest cigarettes contain nicotine and reported greater advertisement content recall overall when exposed to advertisements with a corrective message. Exposure to advertisements displaying products in red packaging and those featuring explicit corrective messaging stimulated content recall, and greater content recall was associated with less favorable beliefs about RNCs.

However, more favorable beliefs were associated with greater intent to use RNCs. Qualitative results supported these findings and provide context for young smokers' potential motivation and interest in using RNCs, including interest in the product but skepticism about its effectiveness and value. The main effects of pack color and corrective messaging were not associated with favorable beliefs or intent to use RNCs. This could be because the brief exposure was not sufficient to affect these outcomes, or the experimental manipulations did not sufficiently contrast to affect these outcomes (eg, contrast between blue and red packs was not sufficient enough to reflect implicit risk, stronger corrective messaging needed). It is also possible that other factors not assessed in this study affect the pathway from advertising exposure to product beliefs, intentions, and use. For example, in another recent study of RNCs, cigarette smokers' product beliefs and subjective product ratings interacted to influence subsequent RNC use.<sup>25</sup> This indicates smokers' first impressions of a new product are important to assess along with their product beliefs following advertising exposure.

Our results add to the literature on advertising features that influence young smokers' beliefs, reinforcing this is the case for RNCs. Some evidence suggests that although smokers do not perceive RNCs to be less harmful than conventional cigarettes, many endorse misperceptions about their addictiveness (ie, as addictive as regular cigarettes) and potential as a cessation aid (ie, do not help smokers quit).<sup>23</sup> Though regulations reducing the nicotine content of cigarettes to non-addictive levels hold great potential to reduce smoking-attributable morbidity and mortality, such measures should be implemented with attention to marketing and labeling requirements to ensure consumers are adequately informed about potential risks and benefits of the products. For instance, other research indicates concern that RNCs may lead smokers to use other tobacco products to compensate and achieve comparable nicotine levels.<sup>47</sup> In light of this and the current study's results, it appears critical that regulations to reduce nicotine content in cigarettes are accompanied by public education to address misperceptions about their potential risks and benefits. Importantly, findings of this study demonstrate the complexities of communicating about risks on RNC advertisements when competing with pro-tobacco marketing, where advertising features such as the color of packages displayed can convey implicit messages about RNCs. This suggests additional testing of corrective messaging for RNC advertising is needed relative to varying advertisement features such as the coloring, pack design, and other imagery. More detailed study of advertisement features that affect consumers' beliefs of RNCs and how they impact processing of explicit risk messaging will be important to guide regulatory decision-making.

Our findings also add to a growing body of research indicating a need for novel strategies for messaging to communicate about potential risks on tobacco marketing. Current US regulations require a small text-only warning message communicating health risks on US cigarette packages and advertisements. Although FDA recently proposed a rule for graphic cigarette warning labels,<sup>48</sup> given legal challenges to prior regulations it is unclear when this will be implemented.<sup>49</sup> Evidence indicates consumers are unlikely to attend to the text-only warnings on cigarette advertisements and they are less likely to recall the warning message contents.<sup>26,29,30</sup> Our study stimuli incorporated an explicit corrective message embedded directly into the advertisements' branded content. Our findings indicate such corrective messaging can enhance recall of key health-related information. Our results highlight the importance of future studies

to examine strategies such as optimizing placement of corrective messaging in RNC and other tobacco advertising to ensure consumers engage with the information and recall the contents, and to enhance the efficacy of messaging on target beliefs and behaviors.

The study findings should be interpreted in light of methodological limitations. The study was cross-sectional and did not test effects of the experimental exposure on behaviors. Future longitudinal studies should examine this. Our experimental design did not include a control condition with no advertisement exposure. Future studies should include such a control to assess how exposure to RNC advertising regardless of implicit and explicit risk information affects consumers' product beliefs and use intentions. We used a convenience sample, which decreases the generalizability. Although we used several recommended data quality control steps for crowdsourced studies, future studies should consider other steps such as measures to prevent inattentive responding.<sup>50</sup> Most likely, presence of any such responses led to underestimation of effects related to outcomes such as advertisement content recall in our study. The study used advertisements for an RNC brand that is not currently available to consumers, but it is likely to be similar to products that enter the market where RNC regulations are enacted. Additional research will be needed to test corrective message content in the current climate where descriptors such as "light" are banned. Finally, qualitative results were quantified to illustrate patterns in the results and should be interpreted with care due to the small cell counts. Future research is needed to investigate in greater depth the reasons why young smokers are interested and/or skeptical in RNCs documented here.

Despite these limitations, findings from this study demonstrate the importance of advertising effects on perceptions of RNC products and support the need to regulate marketing and labeling alongside product regulation. Results indicate the following: (1) interest and confusion among young adult smokers regarding RNCs; (2) beliefs about RNCs are influenced by marketing; and (3) more favorable beliefs are associated with stronger intention to use RNCs. These results can guide future research on features of RNC advertising that can and should be regulated, as well as recommendations for explicit risk messaging requirements.

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## Declaration of Interests

*None declared.*

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