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Point-of-sale health communication campaigns for cigarillos and waterpipe tobacco: Effects and lessons learned from two cluster randomized trials

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Abstract

Purpose.—Many adolescents and young adults hold erroneous beliefs that cigarillos and waterpipe tobacco (WT) are safer than cigarettes, contributing to use. Communication campaigns can correct misperceptions and increase risk beliefs. We tested point-of-sale (POS) communication campaigns focused on chemical exposure for cigarillos and WT.

Methods.—We conducted two cluster randomized trials at 20 gas stations with convenience stores (10 stores for cigarillos, 10 for WT) in North Carolina between June and November 2017. Within each trial, stores were randomly assigned to either the intervention (campaign messages displayed) or a no message control condition. We conducted intercept surveys with repeated cross-sectional samples of 50 adolescents and young adults (ages 16–25) per store, at baseline and follow-up.

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Declaration of Interests
SMN has served as a paid expert witness in government litigation against tobacco companies. The other authors have no other conflicts of interest to disclose.

Results.—There were 978 participants (mean age=20.9 years) in the cigarillo trial, and 998 participants (mean age=21.0 years) in the WT trial. Rates of campaign exposure were low (26% for cigarillos; 24.3% for WT). The cigarillo campaign increased knowledge that ammonia is in cigarillo smoke ($p<0.01$). There were also significant increases in knowledge about ammonia and cyanide in cigarillo smoke and arsenic in WT smoke ($p<.05$) in the sub-sample who reported exposure to the campaign. No differences were found in outcome expectancies, product attitudes, worry about chemical exposure, or behavioral intentions in either campaign.

Conclusions.—Garnering attention for communication campaigns in saturated POS environments, often dominated by tobacco advertising, is challenging. Our study demonstrates the feasibility of anti-tobacco campaigns at the POS and points to several lessons learned for future POS campaigns.

Keywords

tobacco countermarketing; point-of-sale; non-cigarette tobacco products

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Despite decades of prevention efforts, adolescents and young adults continue to use tobacco. While rates of cigarette smoking have decreased, use of other tobacco products has increased (Gentzke et al., 2019). Over one in four high school students and almost one in five young adults, ages 18–24, currently use tobacco, including cigars and waterpipe tobacco (WT) (Gentzke et al., 2019; Wang et al., 2018). Data from the 2019 National Youth Tobacco Survey demonstrate that cigars (including large cigars, little cigars, and cigarillos) were the second and WT was the fourth most used tobacco product by high school students (7.6% and 3.4%, respectively, reported past month use) (Wang et al., 2019). Similarly, data from the 2017 National Adult Tobacco Survey showed cigars were the third most used tobacco product by young adults (4.3% reported some day or daily use), followed by WT (2.5% reported some day or daily use) (Wang et al., 2018). Among cigar products, cigarillos are the most commonly used sub-type among adolescents and young adults (Corey et al., 2014; Kasza et al., 2017).

Many adolescents and young adults perceive WT and cigarillo use as safer than smoking cigarettes (Cornacchione et al., 2016; Sutfin et al., 2011), including believing the water in the waterpipes filters out toxins, and that because cigars are wrapped in tobacco leaves, they are less harmful than cigarettes wrapped in paper (Wackowski & Delnevo, 2016). Additionally, these products are typically used less frequently than cigarettes, which leads some to believe they are at lower risk of disease (Cornacchione et al., 2016). However, health effects from WT and cigarillo use are comparable to those from cigarette smoking. WT users are exposed to similar (and potentially higher) levels of toxins than cigarette smokers (Daher et al., 2010; St Helen et al., 2014), which are associated with increased risk for heart disease and various cancers (El-Zaatari et al., 2015; Montazeri et al., 2017; Waziry et al., 2017). Similarly, cigarillo toxins are at levels similar to, or greater than, cigarettes and use is associated with various cancers (Koszowski et al., 2017; National Cancer Institute, 2010).

Communication campaigns have been shown to be an effective strategy to influence knowledge, attitudes, and beliefs (including misperceptions) across many health behaviors

(Atkin & Rice, 2013; Snyder & LaCroix, 2013). Exposure to anti-smoking campaigns has reduced cigarette smoking initiation (Farrelly et al., 2017), increased anti-smoking attitudes and beliefs (Farrelly et al., 2002), and increased calls to cessation quitlines (Farrelly et al., 2007). However, few studies have assessed communication campaigns for products other than cigarettes. A recent systematic review found 19 studies on public education for non-cigarette tobacco products, with five for WT and one for cigars (Cornacchione Ross et al., 2019). One WT social media campaign was widely disseminated online, but outcomes only assessed online traffic of the campaign (i.e., reach), while changes in knowledge, attitudes, and behaviors of the target audience were not examined (Jawad et al., 2015). The other four studies included school-based education programs or informational presentations delivered via websites to college students (Anjum et al., 2008; Lipkus et al., 2011; Mays et al., 2016; Strasser et al., 2011). The study on cigars was a lab-based assessment of cigar smoking risk information (Strasser et al., 2011). Additional research is needed to inform large-scale communication efforts aimed at reducing adolescent and young adult use of tobacco products other than cigarettes.

Following the 1998 Master Settlement Agreement, which heavily restricted tobacco advertising, the tobacco industry shifted marketing efforts to retail environments (Feighery et al., 2004; Lavack & Toth, 2006). The point-of-sale (POS) represents the primary avenue for promotion of tobacco products. The tobacco industry spent $48.5 million in 2017 for point-of sale promotional indoor advertising (Federal Trade Commission, 2019). Moreover, nearly half (47.5%) of U.S. adolescents report visiting convenience stores at least weekly (Sanders-Jackson et al., 2015), and exposure to marketing has consistently been found to be associated with adolescent cigarette smoking (Robertson et al., 2015; Spanopoulos et al., 2014).

While the POS has a substantial amount of pro-tobacco marketing, this location can also be used to deliver counter-tobacco marketing. And yet few studies have tested the effects of antitobacco campaigns at the POS. Studies that have tested the effects of anti-tobacco messages or warnings at the point-of-sale, including at convenience stores, have shown that exposure to these messages is associated with increases in thinking about the health risks, interest in quitting cigarette smoking, and quit attempts (Coady et al., 2013; Li et al., 2012). Given the frequency with which adolescent and young adult visit these establishments (Martino et al., 2012; Sanders-Jackson et al., 2015), the POS is a promising venue for counter-tobacco communication campaigns.

Our research is guided by the Message Impact Framework (MIF) (Noar et al., 2016), which is derived from previous communication and health behavior theories (Fishbein & Ajzen, 1975; McGuire, 1989; Petty & Cacioppo, 1981). The framework suggests that characteristics of messages impact the extent to which the messages are attended to and recalled, which affects cognitive and emotional reactions to messages. These reactions are thought to impact knowledge, attitudes, and beliefs, and in the tobacco context, decrease susceptibility to and ultimately decrease tobacco use. While changing cognitively-oriented beliefs such as outcome expectations is important (Fishbein & Ajzen, 1975), recent work suggests that affectively-oriented beliefs are also crucial (Ferrer et al., 2016). McCaul and colleagues (2006) found health *worry* is the primary motive for quit attempts, and they also suggest

(McCaul et al., 2003) that increasing worry could motivate protective behavior, such as quitting smoking. A recent study of waterpipe users found *worry* to be associated with intentions to quit (Lipkus et al., 2011). We expect that increasing outcome expectations and worry will lead to reduced susceptibility among non-users and increased intentions to quit among users (Peters et al., 2007). Using this framework, the goal was to develop and implement messages that elicited strong cognitive and emotional reactions, leading to subsequent short-term changes in knowledge, attitudes, and beliefs about the harms of using WT and cigarillo products.

The objective of this study was to rigorously evaluate the impact of a cigarillo and WT print campaign on adolescents and young adults in a real-world setting: at the POS. The campaign messages used in this study were developed using a systematic, data-driven, three-phase process that culminated in an online experiment (Sutfin et al., 2019). In this study, we sought to determine the impact of such a campaign on a sample of U. S. adolescents' and young adults who had tried tobacco products or were susceptible to use such products. We hypothesized that participants from the intervention stores versus the no message control stores would report lower intentions to use cigarillos or WT, but increased worry, knowledge, negative product attitudes, and negative outcome expectancies. To our knowledge, this is the first study to test a POS campaign for non-cigarette tobacco products.

Methods

Campaign development.

We used a systematic, three-phase process to develop a health communication campaign to educate adolescents and young adults about cigarillos and WT (Sutfin et al., 2019). This process embodied best practices for the development of effective campaigns (Noar, 2006), and included research with the target audience, including focus groups, national surveys, and message testing (Cornacchione et al., 2016; Sutfin et al., 2019; Wiseman et al., 2016).

In the first phase, we conducted a qualitative focus group study and a cross-sectional nationally-representative survey to identify messaging approaches that were most salient to the target audience. We assessed whether long-term health consequences, cosmetic effects, or chemical content of tobacco product smoke were the most worrisome. Message reaction results indicated that messages focused on chemicals in the cigarillo/WT smoke were equally worrisome to messages about health effects for the full sample, but among a subsample of those who had ever used tobacco, constituent information was more worrisome than the other two types (Sutfin et al., 2019). Based on these findings, we developed chemical-focused messages guided by three principles from our previous research: (1) use of commonly known chemicals (Brewer et al., 2016; Hall et al., 2014); (2) pair with unappealing products (Hall et al., 2014); and (3) use a humorous sarcastic tone (Hill et al., 2005). We tested messages in an online survey in a nationally-representative sample, choosing the best performing messages for each product. Our message testing process, which is described in detail elsewhere (Sutfin et al., 2019), resulted in two unique chemical messages for each tobacco product that elicited the highest scores on attracting attention, negative product perceptions (e.g., gross), and perceived effectiveness (e.g., discouraging use). The chemicals used for cigarillos were cyanide and ammonia (Hoffmann & Hoffmann, 1998). The chemicals for WT were arsenic and formaldehyde (Shihadeh, 2003). An example message is, "*Cigarillo smoke contains Ammonia. The same tasty ingredient found in raw sewage*." Each message contained an image and a call-to-action in the corner (i.e., *Find out what you're really inhaling at* suckedin.net; see Figure 1).

Study design.

Because we were not able to randomize at the individual-level, we conducted two cluster-randomized trials in gas stations with convenience stores, which served as the cluster. One trial implemented messages about cigarillo-specific chemicals ("cigarillo trial"), and the other implemented messages about WT-specific chemicals ("WT trial"). We used a repeated cross-sectional design involving data collection at baseline (prior to campaign implementation) and follow-up (during campaign implementation) to measure the impact of each of the campaigns. We aimed to conduct 50 intercept surveys among our target population at each convenience store at both baseline and follow-up (independent samples) for each trial.

Store recruitment.

Stores in North Carolina (NC) were recruited with the help of an advertising company that had relationships with over 700 convenience stores in NC. We included stores within the Greensboro-High Point-Winston-Salem, NC Designated Market Area (DMA) and the Charlotte, NC DMA. Eligible stores were located in high to moderate traffic areas (based on proximity to other businesses, fast food restaurants, and traffic patterns), had at least one gas pump, and agreed to be randomized and display campaign messages if randomized to the intervention condition. The advertising company invited eligible stores to participate and confirmed locations at each store for message placement ("touch points"), which included gas pump toppers, gas pump handles, front door clings, cooler clings, counter clings, outdoor posters, and floor graphics. A total of 34 stores were invited, with 24 stores agreeing; 20 stores were selected to participate. Stores were randomly assigned to a product, resulting in 10 stores for the WT trial and 10 stores for the cigarillo trial.

Baseline data collection.

Baseline data collection occurred prior to the advertising company placing the messages at any stores. Stores that dropped out during baseline data collection were replaced (n=4). Reasons for drop out included store owner/manager changed their mind (n=2), not allowing data collectors on site for more than one day (n=1), and store owner/manager did not receive approval from the building landlord or management (n=1). Baseline data collection, which required recruitment of approximately 50 participants (range: 47–52) at each store, lasted between 2–13 days.

Store randomization to condition.

After baseline data collection, stores in each trial were matched using the following criteria: total number of touch points the store agreed to; high ($\geq$75,000) or low (< 75,000) city population; and high ($\geq$1350) or low (<1350) population density per square mile. Within each matched pair, stores in each trial were randomized to either the intervention (campaign implementation; n=5 in each trial) or the control (no campaign; n=5 in each trial) condition.

Campaign implementation.

All stores randomized to the intervention agreed to display messages on multiple pump toppers (Mean = 4.2) and some other locations (Table 1 and Figure 1). Stores displayed between 6–17 touchpoints (Mean = 12.0) at 2–7 different locations inside and outside of the store (Mean = 6.1). Messages were displayed at stores for an average of 11 days before follow-up data collection began (Range = 5–17 days).

Follow-up data collection.

After messages were displayed for at least five days at the intervention stores, follow-up data collection began. Messages continued to be displayed during the entire follow-up period. Follow-up data collection lasted between 2–19 days (Mean = 9 days) to recruit approximately 50 participants (Range = 16–55) at each store. Data collection was halted early by the manager's request at two stores after 2–5 days of follow-up data collection, resulting in achieving fewer than the target of 50 completions in these stores.

Participants.

Eligible participants included adolescents and young adults ages 16–25 who were either ever users of tobacco products or susceptible to using tobacco, and who had not participated in the study previously (i.e., at another store or at baseline; see Measures). The focus of the study was on prevention of product use, not cessation; therefore we included those who had tried tobacco products, as well as those that were susceptible to tobacco product use.

Procedure.

Upon arrival, teams of two trained data collectors announced their presence to store staff and set up at a table with a recruitment sign placed outside the convenience store. Data collectors approached customers believed to be in the eligible age range as the customer filled their car with gas or after they left the convenience store to determine interest and eligibility. This was done to recruit both people who visited but did not enter the store, and those who only entered the store but did not get gas. Eligible participants completed the full survey (mean completion time = 8 minutes, 7 seconds) on an iPad. Participants received a $10 Starbucks gift card. All study procedures were approved by the Wake Forest School of Medicine Institutional Review Board (Protocol Number: IRB00025230). A waiver of parental consent for minors was approved by the Wake Forest School of Medicine Institutional Review Board. Participant assent/consent was obtained prior to survey completion.

Measures.—Survey measures were identical between baseline and follow-up and across the two trials. Measures selection was guided by the MIF. Outcome variables in both trials were: knowledge, outcome expectancies, attitudes, worry, and behavioral intentions.

Lifetime tobacco use (screener survey).—To assess lifetime tobacco product use, individuals were asked "Have you ever used any of these tobacco products, even one or two times? Select all that apply." Tobacco products included cigarettes, little cigars, cigarillos, large premium cigars, e-cigarettes or other vaping devices, WT, smokeless tobacco, or any other tobacco product. Tobacco product images were provided.

Tobacco use susceptibility (screener survey).—Susceptibility was assessed with a single question for each product "If one of your best friends were to offer you [tobacco product], would you use it?" (Orlan et al., 2019). Response options were "definitely no", "probably no", "probably yes", and "definitely yes". A response of "definitely no" categorized an individual as a non-susceptible non-user.

Demographics.—We assessed age, sex, race (White, Black or African American, American Indian or Alaskan Native, Asian, Pacific Islander, or Other), and ethnicity (Not Hispanic or Hispanic, Latino, or Spanish origin). Participants indicated their mother's highest degree or level of schooling (some high school or below, high school diploma or GED, some college [no degree], Associate's degree, Bachelor's degree, Master's degree, Professional/Doctoral degree, or Don't know) as a proxy for socioeconomic status (Ennett et al., 2001; King et al., 2018; O'Loughlin et al., 2014).

Store behavior.—Participants were asked whether they purchased gas and whether they went into the convenience store.

Message recognition.—Participants were asked to select which messages they saw at the convenience store from a set of four messages (i.e., select all that apply). The messages presented included the two that were displayed in the intervention stores and two decoy messages that were not displayed but contained a similar design and theme. Accurately selecting at least one of the two correct messages displayed was considered message recognition.

Chemical knowledge.—Knowledge of chemicals found in cigarillo and WT smoke was assessed with one item for each chemical: "[Cigarillo/Hookah] smoke contains [chemical]." Response options were *yes, no,* and *don't know*. We collapsed *don't know* and *no* into a single response category to compare correct responses with incorrect or uncertain responses.

Outcome expectancies.—Outcome expectancies relevant to the campaign were assessed with two items: "If I smoke [cigarillos/tobacco in a hookah], I will inhale harmful chemicals" and "If I smoke [cigarillos/tobacco in a hookah], it will be bad for my health". Response options were on a five-point scale from *strongly disagree* to *strongly agree.*

Attitudes.—Attitudes toward cigarillos and WT were assessed using five semantic differential items: "Smoking [cigarillos/tobacco in a hookah] is…" *bad-good, unpleasant-pleasant, harmful-harmless, unenjoyable-enjoyable, and negative-positive*. These items were averaged (range 1–5) with a Cronbach's alpha of 0.89.

Worry.—Worry about inhalation of the two chemicals featured in our campaign messages was assessed by this question: "If you smoked [cigarillos/tobacco in a hookah], how much would you worry about inhaling [chemical]?" Response options were *not at all, a little, somewhat,* and *a lot* (range 1–4).

Behavioral intentions.—A three-item scale was used to measure behavioral intentions for tobacco product use: "How interested are you in smoking [cigarillos/tobacco in a hookah] in the next year?", "How likely are you to smoke [cigarillos/tobacco in a hookah] in the next year?", "How much do you plan to smoke [cigarillos/tobacco in a hookah] in the next year?" Response options were *not at all, a little, somewhat,* and *a lot.* We created a scale representing the sum of these three items (range: 3–12), with a Cronbach's alpha of 0.94.

Statistical analysis.

Descriptive statistics were used to characterize participants at baseline and follow-up. The procedures SURVEYFREQ and SURVEYREG in SAS version 9.4 were used to assess differences in sociodemographic characteristics and tobacco use behaviors between the intervention and control stores at baseline and follow-up. These procedures account for the potential within-store correlation of responses in this cluster-randomized, repeated cross-sectional trial design (Murray, 1998). Rao-Scott chi-square tests for categorical variables and F-tests from linear regressions for continuous variables were performed. The impact of the messages on behavioral intentions, product attitudes, worry, chemical knowledge, and outcome expectancies was examined using random-effects regression modeling. Analyses were performed at the individual level with potential correlation of responses among participants visiting the same store accounted for by including a random effect for store. Terms in the model included whether a participant was from an intervention or control store, the time point of the measurement (baseline or follow-up), an intervention-by-time point interaction and sociodemographic characteristics and tobacco use behaviors that were significantly different between intervention and control groups at baseline or follow-up. Testing the significance of the coefficient for the interaction term assesses the intervention impact. Testing change within intervention and control stores was assessed using least-squares means. Linear random-effects regression modeling was performed using PROC MIXED for continuous outcomes and mixed-effects logistic regression modeling using PROC GLIMMIX for binary outcomes in SAS Version 9.4 to account for potential clustering of responses. Models were fit separately for each outcome and each trial.

Results

Cigarillo trial

Participants.—The cigarillo trial included 978 participants. Participants were 43% female, 56% White, 34% Black or African American, and 12% Hispanic. Table 2 includes demographics for baseline and follow up participants, and Figure 2 summarizes the enrollment of participants in the cigarillo trial.

Message recognition.—At the intervention stores, 26% of participants recognized at least one of the two messages displayed. We assessed whether there were systematic differences, including sociodemographic characteristics, tobacco use, message placement, and customer behavior, between those who reported and those who did not report message recognition in the intervention condition. The only such difference was that participants who purchased gas (63.1%) were more likely to report exposure to at least one of the intervention messages than those who did not purchase gas (48.6%, $p<0.05$).

Outcomes.—In unadjusted models comparing conditions on chemical knowledge, outcome expectancies, product attitudes, worry, and behavioral intentions using random-effects regression modeling, we found one statistically significant difference between the changes from baseline to follow-up between the intervention and control groups (Table 3). In the intervention condition, correct ammonia knowledge increased from 35.4% at baseline compared to 44.8% at follow-up compared to the control condition where correct knowledge decreased from 47.0% at baseline to 37.8% at follow-up (Table 3). In a fully adjusted model, this intervention effect remained statistically significant (AOR=2.26; 95% CI: 1.33, 3.85; p=0.003) (Table 4). There were no effects on outcome expectancies, product attitudes, worry, or behavioral intentions in unadjusted (Table 3) or adjusted (Table 4) models.

We conducted analyses restricted to participants in the intervention conditions who reported recognizing a campaign message at follow-up (Table 5). As was found in the full sample, the intervention effect was statistically significant for an increase in chemical knowledge for ammonia (AOR=2.12; 95% CI: 2.04, 4.07; p=0.042) in fully adjusted models. However, we also found a significant intervention effect for an increase in chemical knowledge for cyanide (AOR=3.06; 95% CI: 1.54, 6.06; p=0.002).

Waterpipe trial

Participants.—The waterpipe trial included 998 participants. Participants were 44% female, 45% White, 44% Black or African American, and 13% Hispanic. Table 1 includes demographics for baseline and follow up participants, and Figure 2 summarizes the enrollment of participants in the WT trial.

Message recognition.—About 1 in 4 participants (24.3%) recognized at least one of the two messages displayed, similar to the cigarillo trial. Assessing for systematic differences between those who reported and did not report message recognition in the intervention condition (examining the same set of variables as above), exposure was associated with the number of touch points where intervention messages were displayed (13.6 touch points vs. 12.6; $p<0.05$) and with a significantly greater likelihood of having all of the gas pumps display the intervention messages versus only having some gas pumps display the intervention messages ($p<0.05$).

Outcomes.—In both unadjusted and fully adjusted models comparing the conditions on chemical knowledge, outcome expectancies, product attitudes, worry, and behavioral intentions using random-effects regression modeling, we found no differences between the intervention and control groups (Tables 3 and 4).

In analyses restricted to participants in the intervention conditions who reported message recognition at follow-up (Table 5), the intervention effect for significant increases in knowledge about arsenic from baseline to follow-up was statistically significant in adjusted models (AOR=2.35; 95% CI: 1.11, 4.99; p=0.026).

Discussion

The goal of this study was to test the implementation of a POS communication campaign focused on cigarillos and WT. In the cigarillo trial, there was a significant effect of the intervention messages on knowledge about ammonia for the full sample. Additionally, our POS campaigns increased knowledge about the chemicals shown in messages among those who reported message recognition. In the few weeks the messages were posted, in a marketing space dominated by tobacco industry promotions, we were able to increase knowledge of ammonia in cigarillo smoke for the full sample and of chemicals in cigarillos and WT in the sub-sample of adolescent and young adult consumers exposed to the messages.

However, the campaign did not influence other hypothesized outcomes, including outcome expectancies, product attitudes, worry, or behavioral intentions. Knowledge, which may be necessary for behavior change, is not sufficient to reduce tobacco product use intentions. The most obvious explanation for the lack of impact on persuasive outcomes was minimal exposure to our messages in a crowded marketing environment. The initial phase in the MIF (Noar et al., 2016) and "hierarchy of effects" models is garnering exposure and attracting attention (Hornik, 2002), which is critical for downstream effects on beliefs and behavior (Greenwald & Leavitt, 1984;). However, only 25% of our sample reported recognizing a campaign message (i.e., *reach*), which is far below CDC recommended levels of 75% exposure (Center for Disease Control and Prevention, 2014). In addition, given that our campaign was in the field for a few weeks, *frequency* of exposure was also minimal, with many participants likely seeing the messages only a single time. Following nine months of exposure to required POS signage at licensed tobacco retailers in New York City, awareness of that campaign doubled (30% to 67%) with increases in knowledge that the illustrated health effects are caused by smoking (Coady et al., 2013). Our campaign was significantly shorter than this, and apparently not long enough to produce the kind of campaign reach needed for broad exposure and impact. Since a hierarchy of effects is such that only a fraction of those exposed will change their beliefs, our ability to impact persuasive outcomes was limited by our lack of message reach.

Moreover, the POS has become increasingly crowded with tobacco marketing. The tobacco industry's large promotional spending in retail environments reflects their approach to capture current and potential tobacco users' attention at the POS (Lavack & Toth, 2006; Loomis et al., 2006). In the WT trial, we found that message recognition was associated with more message placements. Given that the POS is crowded with advertising of all types, including pro-tobacco ads, more anti-tobacco message placements (i.e., touchpoints) may be needed to have an impact. This is especially important as more visits to the store may generally lead to *more* exposure to tobacco advertising and potentially more tobacco purchases.

We also found that strategic placement significantly impacted message recognition. For example, placing messages at the gas pump increased message recognition. Future POS campaigns may consider concentrating messages around gas pumps. Given the ease of paying for gas at the pump, store entry is often not necessary for many consumers visiting convenience stores with gas stations.

Thus, several lessons learned from these trials were that: (1) increased message exposure likely requires a much longer message placement period, and future POS messaging studies should place messages for significantly longer periods of time than we did in the current study (i.e., months); (2) health communication campaigns at the POS should saturate the marketing space to compete with pro-tobacco advertising; the combination of more messages and a longer exposure period is likely to produce greater impact than observed in the current study; and (3) including campaign messages on gas pumps, in addition to other outdoor locations may be promising for message delivery. Overall, future research should attempt to determine the optimal level of saturation at the POS, taking into account both message placement and frequency of exposure.

There were some limitations to this study. The repeated cross-sectional design did not allow for assessing changes in participants' behavior. Randomization at the store level and the feasibility of recruiting a large number of stores resulted in some imbalances in participant characteristics between intervention and control stores; however, these factors were adjusted for in our modeling to minimize potential bias. Stores were matched on several store-level characteristics with randomization occurring within pairs to minimize imbalance at the store level. Additionally, there were variations in how many messages each store agreed to display, yielding different saturation levels between stores in the intervention conditions. Participants in the control condition may have been exposed to messages at intervention stores, potentially diluting the effect of the messages, although our data suggest participants in control stores had minimal exposure to the campaigns. We assessed worry with a single item, potentially limiting content validity. Finally, we recruited a convenience sample of participants; therefore, our sample may not be representative of the population that visits these stores nor of consumers in other regions of the country.

Results from this study highlight the challenge of garnering attention for health communication campaigns in a saturated POS retail environment, often dominated by pro-tobacco advertising. However, this environment also provides multiple placement options for counter-tobacco messaging in places that typically have increased marketing targeted towards vulnerable populations, including youth (Cantrell et al., 2013; Lee et al., 2015; Stead et al., 2016). Despite low message recognition, we found some changes in knowledge about chemicals in WT and cigarillo smoke. We also successfully recruited 20 retailers and we learned several lessons that can be applied to future campaigns at the POS. While such campaigns are challenging, they provide ample opportunities to reach at-risk audiences at locations where, in some cases, they are purchasing the tobacco product itself. Indeed, in 2018, a year after our campaign, the Food and Drug Administration (FDA) launched a POS campaign aimed at encouraging cigarette smokers to quit (EveryTryCounts.gov). The campaign ran in 35 counties for at least 24 months and was featured both at gas pumps and throughout the stores, which reflects the lessons learned in our trial – the value of a long campaign exposure period with many stores, high message saturation of stores, and including message placements on gas pumps. Future work on anti-tobacco POS campaigns is warranted, including studies that advance an understanding of how to increase reach and frequency of exposure to anti-tobacco messaging in a crowded POS environment. To our knowledge, our study represented the first real-world test of POS campaigns for cigarillos and WT, and further investment in this important channel to reach at-risk and tobacco-using youth is warranted.

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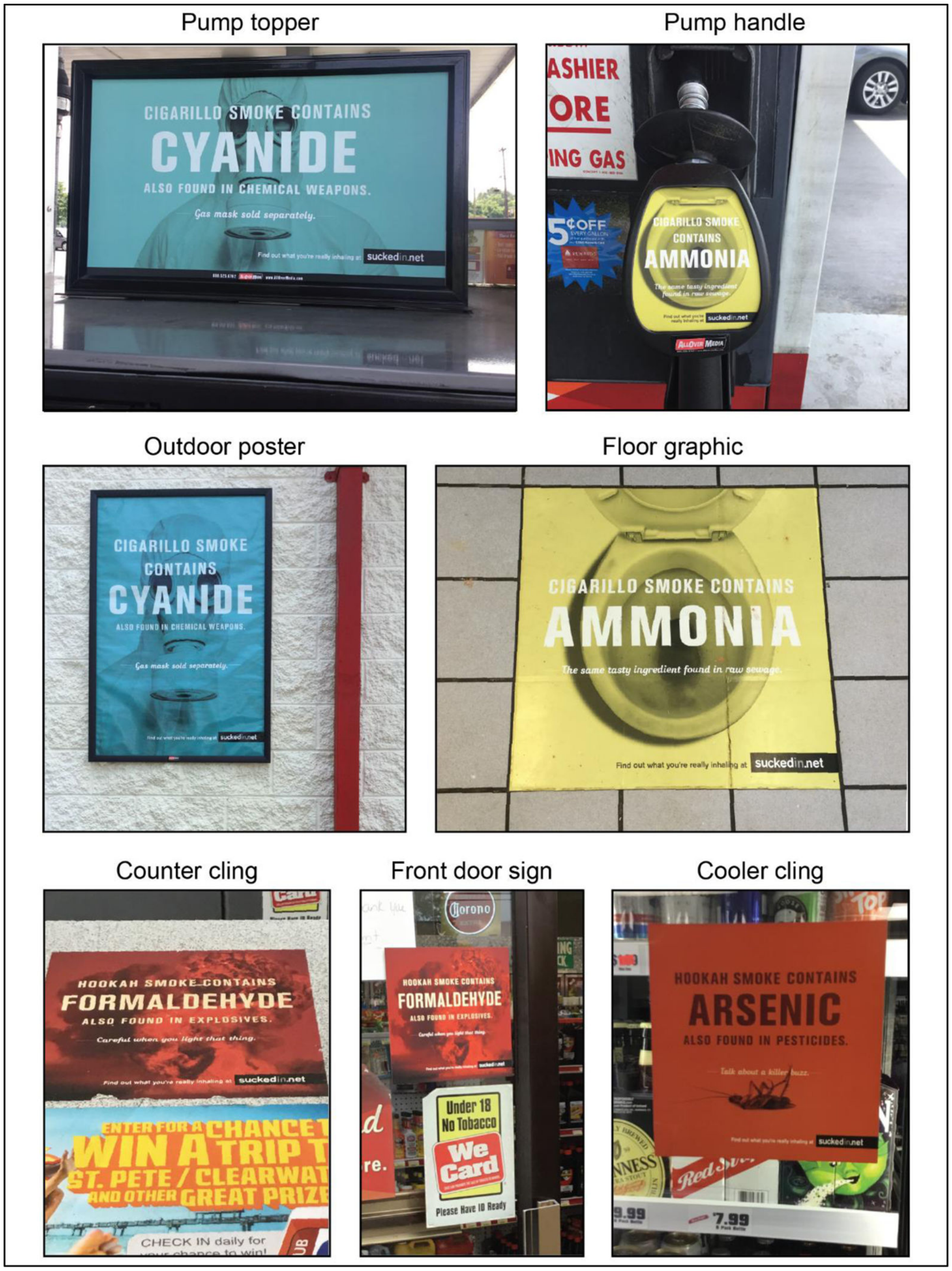

Figure 1.
Example WT and Cigarillo Messages in Various Locations in Intervention Stores

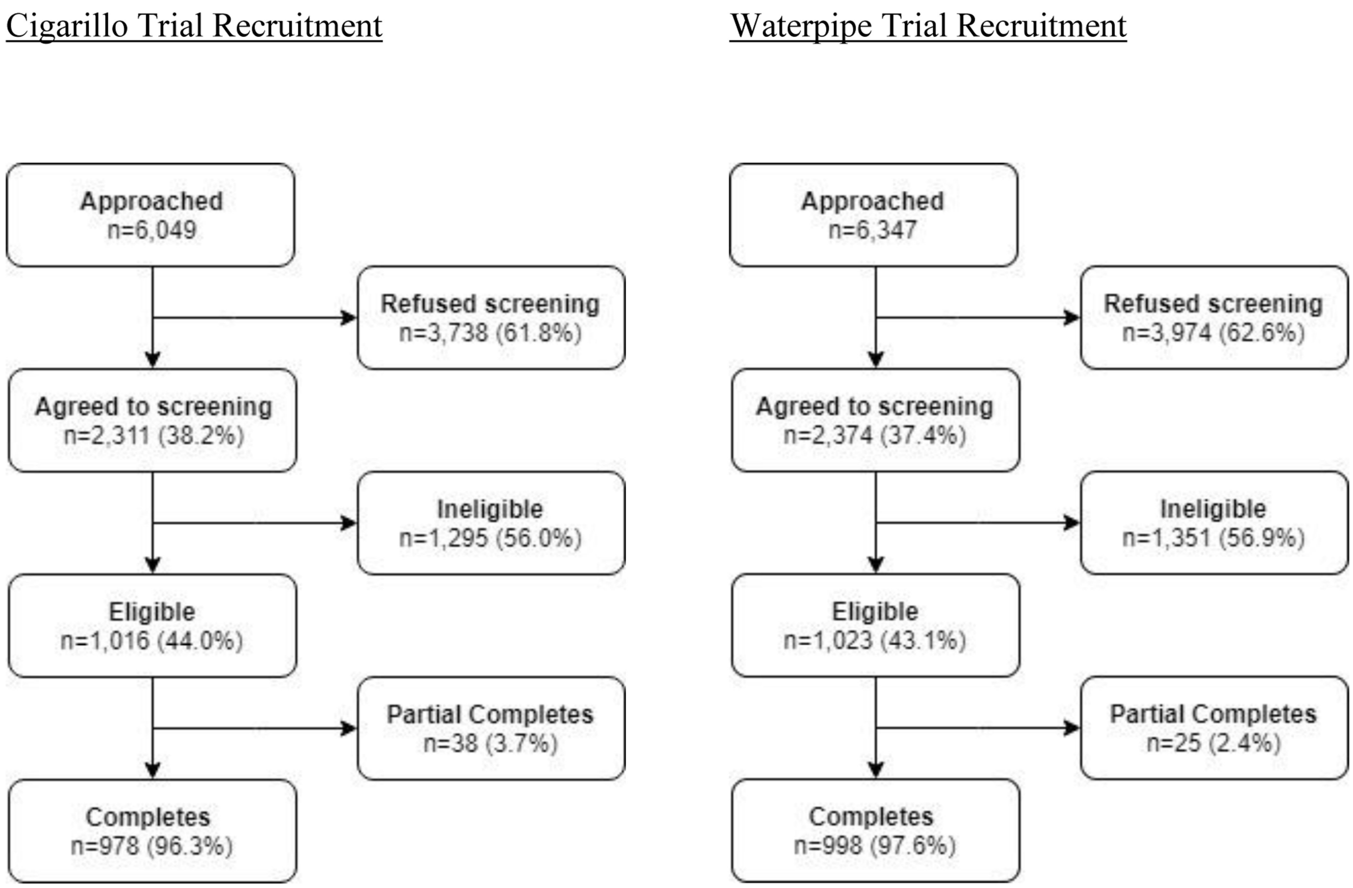

Figure 2.
Participant Recruitment and Enrollment

Table 1.

Campaign Implementation Locations across Stores.

		Locations (7)							
	Number of Locations (maximum is 7)	Pump Toppers (% of all at store)	Nozzles	Outdoor Poster	Door Cling	Counter Cling	Floor Graphic	Cooler Cling	Total Number of Touchpoints
Cigarillo Trial									
Store 1	5	2 (50%)	-	1	1	-	1	1	6
Store 2	7	5 (50%)	5	1	1	1	1	1	15
Store 3	6	5 (50%)	-	1	1	1	1	1	10
Store 4	7	4 (50%)	4	1	1	1	1	1	13
Store 5	2	6 (100%)	6	-	-	-	-	-	12
Waterpipe Trial									
Store 6	6	3 (38%)	3	1	1	-	1	1	10
Store 7	7	4 (50%)	4	1	1	1	1	1	13
Store 8	7	6 (75%)	6	1	1	1	1	1	17
Store 9	7	4 (40%)	4	1	1	1	1	1	13
Store 10	7	3 (50%)	3	1	1	1	1	1	11

Note. Locations are the unique places where messages were displayed. Touchpoints are how many placements were made in those locations. Touchpoint numbers are always higher because multiple messages can be placed in a single location type (e.g. 3 pump toppers at a single convenience stores with gas station).

Table 2.

Sociodemographic Characteristics and Tobacco Use Behaviors of the Pre and Post Intervention Samples of Participants by Trial and Intervention Group. Entries in table are N (%) or Mean (SD).

	Cigarillo Trial (N = 978)				Waterpipe Trial (N = 998)			
	Baseline		Follow-Up		Baseline		Follow-Up	
	Intervention n=247	Control n=247	Intervention n=250	Control n=234	Intervention n=247	Control n=249	Intervention n=251	Control n=251
Demographics								
Age	20.7 (2.8)	21.1 (2.8)	20.9 (2.7)	21.0 (2.6)	21.1 (2.6)	20.6 (2.7)	21.2 (2.6)	21.2 (2.5)
Race White Non-White	130 (52.6) 117 (47.4)	169 (68.4) 78 (31.6)	124 (49.6)[b] 126 (50.4)	174 (74.4)[b] 60 (25.6)	128 (51.8) 119 (48.2)	120 (48.2) 129 (51.8)	101 (40.2) 150 (59.8)	106 (42.2) 145 (57.8)
Race Black Non-Black	91 (36.8)[a] 156 (63.2)	52 (21.1)[a] 195 (78.9)	103 (41.2)[b] 147 (58.8)	43 (18.4)[b] 191 (81.6)	102 (41.3) 145 (58.7)	101 (40.6) 148 (59.4)	122 (48.6) 129 (51.4)	122 (48.6) 129 (51.4)
Sex Female Male	112 (45.9) 132 (54.1)	99 (40.1) 148 (59.9)	108 (43.6) 140 (56.4)	94 (40.3) 139 (59.7)	98 (40.2) 146 (59.8)	119 (48.6) 126 (51.4)	116 (46.8) 132 (53.2)	101 (40.6) 148 (59.4)
Ethnicity Hispanic Non-Hispanic	31 (13.2) 204 (86.8)	38 (16.6) 191 (73.4)	21 (9.0) 213 (91.0)	22 (10.0) 198 (90.0)	27 (11.7) 203 (88.3)	37 (15.9) 196 (84.1)	32 (13.3) 208 (86.7)	24 (10.0) 215 (90.0)
Mother's Education At least college Less than college	80 (34.3)[a] 153 (65.7)	51 (21.8)[a] 183 (78.2)	72 (30.3) 166 (69.7)	57 (24.8) 173 (75.2)	82 (35.0)[a] 152 (65.0)	49 (20.6)[a] 189 (79.4)	81 (33.1)[b] 164 (69.9)	47 (20.0)[b] 188 (80.0)
Lifetime Tobacco Use								
Cigarettes	126 (51.0)	141 (57.1)	117 (46.8)[b]	136 (58.1)[b]	131 (53.0)[a]	110 (44.2)[a]	133 (53.0)	131 (52.2)
Little cigars	27 (10.9)	35 (14.2)	29 (11.6)	33 (14.1)	23 (9.3)	18 (7.2)	24 (9.6)	20 (8.0)
Cigarillos	115 (46.6)	112 (45.3)	121 (48.4)	103 (44.0)	121 (49.0)[a]	108 (43.4)[a]	131 (52.2)	125 (49.8)
Large Cigars	61 (24.7)	62 (25.1)	69 (27.6)	66 (28.2)	91 (36.8)[a]	57 (22.9)[a]	71 (28.3)	69 (27.5)
E-cigarettes	82 (33.2)	89 (36.0)	78 (31.2)	72 (30.8)	80 (32.3)	78 (31.3)	83 (33.1)	86 (34.3)
Waterpipe	71 (28.7)	65 (26.3)	75 (30.0)	62 (26.5)	93 (37.6)	90 (36.1)	91 (36.2)	76 (30.3)
Smokeless	37 (15.0)	50 (20.2)	39 (15.6)[b]	65 (27.8)[b]	46 (18.6)	33 (13.2)	28 (11.2)	45 (17.9)

[a]Denotes intervention and control are significantly different at baseline;

[b]Denotes intervention and control are significantly different at follow-up.

Table 3.

Behavioral Intentions, Attitudes, Worry, Knowledge, and Outcome Expectancies at Baseline and Follow-up by Intervention Group.

	Cigarillo Trial (N = 978)					Waterpipe Trial (N = 998)				
	Intervention		Control			Intervention		Control		
	Baseline	Follow-up	Baseline	Follow-up	p-value[6]	Baseline	Follow-up	Baseline	Follow-up	p-value[6]
	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %		Mean (SD) or %	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %	
Intentions[1]	5.14 (2.82)	5.34 (2.93)	5.04 (2.83)	5.26 (2.85)	0.893	4.83 (2.39)	4.69 (2.23)	4.80 (2.47)	4.77 (2.49)	0.766
Attitudes[2]	1.98 (0.96)	2.14 (1.11)	2.01 (1.00)	1.97 (1.00)	0.158	2.40 (0.96)	2.24 (0.93)	2.35 (1.05)	2.29 (1.02)	0.474
Worry[3]										
Cyanide	2.64 (1.15)	2.60 (1.16)	2.72 (1.12)	2.73 (1.15)	0.734	-	-	-	-	-
Ammonia	2.80 (1.14)	2.76 (1.18)	2.89 (1.13)	2.90 (1.14)	0.724	-	-	-	-	-
Arsenic	-	-	-	-	-	2.73 (1.16)	2.73 (1.14)	2.79 (1.17)	2.55 (1.23)	0.110
Formaldehyde	-	-	-	-	-	2.76 (1.17)	2.76 (1.15)	2.76 (1.19)	2.62 (1.23)	0.331
Knowledge[4]										
Cyanide	36.6	41.1	40.5	36.9	0.213	-	-	-	-	-
Ammonia	35.4	44.8	47.0	37.8	0.004	-	-	-	-	-
Arsenic	-	-	-	-	-	19.5	33.3	21.0	27.2	0.200
Formaldehyde	-	-	-	-	-	19.9	30.6	21.8	27.3	0.358
Outcome Expectancy[5]										
Bad for Health	70.8	58.5	74.4	68.4	0.381	48.8	49.6	48.8	44.6	0.428
Chemicals	61.3	51.0	69.8	60.1	0.926	45.7	39.6	40.4	37.6	0.610

1 Range 3–12 with higher scores indicating a greater intention to smoke;

2 Range 1–4 with higher scores indicating more worry.;

3 Range 1–4 with higher scores indicating more positive attitudes;

4 Percent who agree each chemical is in the product's smoke.;

5 Percent who strongly agree.

6 Unadjusted p-value comparing change in outcome from baseline to follow-up between intervention and control groups.

Table 4.

Change in Behavioral Intentions, Attitudes, Worry, Knowledge, and Outcome Expectancies by Intervention Group

	Cigarillo Trial[1] (N = 978)			Waterpipe Trial[2] (N = 998)		
	Intervention Change	**Control Change**	**Intervention Effect[3]**	**Intervention Change**	**Control Change**	**Intervention Effect[3]**
	Beta (95% CI) p-value	**Beta (95% CI) p-value**	**Beta (95% CI) p-value**	**Beta (95% CI) p-value**	**Beta (95% CI) p-value**	**Beta (95% CI) p-value**
Intentions	0.27 (−0.24, 0.78) 0.296	0.13 (−0.38, 0.64) 0.615	0.14 (−0.58, 0.86) 0.703	−0.11 (−0.52, 0.31) 0.618	−0.10 (−0.52, 0.32) 0.631	−0.003 (−0.59, 0.59) 0.992
Attitudes	**0.21 (0.02, 0.40) 0.028**	−0.05 (−0.24, 0.13) 0.580	0.26 (−0.002, 0.53) 0.052	−0.18 (−0.36, 0.004) 0.056	−0.11 (−0.30, 0.07) 0.236	−0.06 (−0.32, 0.19) 0.623
Worry Cyanide	−0.05 (−0.26, 0.15) 0.611	−0.02 (−0.22, 0.19) 0.875	−0.04 (−0.33, 0.26) 0.804	-	-	-
Worry Ammonia	−0.08 (−0.28, 0.13) 0.474	0.02 (−0.19, 0.23) 0.849	−0.10 (−0.39, 0.20) 0.521	-	-	-
Worry Arsenic	-	-	-	−0.01 (−0.22, 0.20) 0.928	**−0.29 (−0.50, −0.07) 0.008**	0.28 (−0.02, 0.58) 0.069
Worry Formaldehyde	-	-	-	0.003 (−0.21, 0.22) 0.975	−0.16 (−0.38, 0.05) 0.131	0.17 (−0.13, 0.47) 0.275
	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value
Knowledge Cyanide (%)	1.17 (0.80, 1.71) 0.424	0.77 (0.52, 1.12) 0.173	1.52 (0.89, 2.61) 0.127	-	-	-
Knowledge Ammonia (%)	**1.47 (1.01, 2.15) 0.044**	**0.65 (0.45, 0.95) 0.025**	**2.26 (1.33, 3.85) 0.003**	-	-	-
Knowledge Arsenic (%)	-	-	-	**2.22 (1.44, 3.42) 0.0003**	1.38 (0.91, 2.12) 0.133	1.61 (0.88. 2.94) 0.126
Knowledge Formaldehyde (%)	-	-	-	**1.91 (1.24, 2.93) 0.003**	1.29 (0.84, 1.97) 0.241	1.48 (0.81, 2.71) 0.205
Expectancy Bad for Health (%)	**0.52 (0.35, 0.77) 0.001**	0.72 (0.47, 1.09) 0.118	0.72 (0.41, 1.28) 0.261	1.01 (0.70, 1.45) 0.970	0.87 (0.60, 1.25) 0.451	1.16 (0.69, 1.94) 0.574
Expectancy Chemicals (%)	**0.65 (0.45, 0.96) 0.028**	**0.56 (0.38, 0.83) 0.004**	1.17 (0.68, 2.03) 0.571	0.76 (0.52, 1.10) 0.143	0.93 (0.64, 1.36) 0.720	0.81 (0.48, 1.38) 0.441

[1] Model adjusts for mother’s education, Black race, ever use of cigarettes, ever use of smokeless tobacco, number of touchpoints, and going inside the store.

[2] Model adjusts for mother’s education, ever use of cigarettes, ever use of cigarillos, ever use of large cigars, number of touchpoints, and going inside the store.

[3] For continuous measures, this represents the difference in change between intervention and control. For binary measures, this represents the ratio of the intervention and control odds ratios.

Table 5.

Change in Behavioral Intentions, Attitudes, Worry, Knowledge, and Outcome Expectancies by Intervention Group (Exposed Only).

	Cigarillo Trial[1] (N=793)			Waterpipe Trial[2] (N=808)		
	Intervention Change	**Control Change**	**Intervention Effect[3]**	**Intervention Change**	**Control Change**	**Intervention Effect[3]**
	Beta (95% CI) p-value	**Beta (95% CI) p-value**	**Beta (95% CI) p-value**	**Beta (95% CI) p-value**	**Beta (95% CI) p-value**	**Beta (95% CI) p-value**
Intentions	0.04 (−0.72, 0.80) 0.926	0.14 (−0.36, 0.64) 0.588	−0.10 (−1.01, 0.81) 0.826	0.46 (−0.21, 1.14) 0.177	−0.10 (−0.53, 0.33) 0.651	0.56 (−0.24, 1.36) 0.168
Attitudes	0.04 (−0.23, 0.32) 0.762	−0.05 (−0.24, 0.13) 0.563	0.10 (−0.24, 0.43) 0.568	−0.11 (−0.40, 0.17) 0.444	−0.11 (−0.30, 0.08) 0.250	−0.001 (−0.34, 0.34) 0.994
Worry Cyanide	0.24 (−0.07, 0.56) 0.133	−0.01 (−0.22, 0.20) 0.915	0.25 (−0.12, 0.63) 0.188	-	-	-
Worry Ammonia	0.21 (−0.11, 0.52) 0.201	0.02 (−0.18, 0.23) 0.825	0.18 (−0.19, 0.56) 0.343	-	-	-
Worry Arsenic	-	-	-	0.03 (−0.31, 0.36) 0.878	**−0.29 (−0.50, −0.07)** **0.009**	0.31 (−0.08, 0.71) 0.121
Worry Formaldehyde	-	-	-	−0.01 (−0.35, 0.32) 0.933	−0.17 (−0.38, 0.05) 0.131	0.15 (−0.25, 0.55) 0.459
	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value	OR (95% CI) p-value
Knowledge Cyanide (%)	1.58 (0.89, 2.80) 0.118	0.77 (0.53, 1.13) 0.187	**2.12 (2.04, 4.07)** **0.042**	-	-	-
Knowledge Ammonia (%)	**2.00 (1.13, 3.55)** **0.018**	**0.65 (0.45, 0.95)** **0.027**	**3.06 (1.54, 6.06)** **0.002**	-	-	-
Knowledge Arsenic (%)	-	-	-	**3.31 (1.78, 6.17)** **0.0002**	1.41 (0.92, 2.16) 0.107	**2.35 (1.11, 4.99)** **0.026**
Knowledge Formaldehyde (%)	-	-	-	1.63 (0.85, 3.16) 0.144	1.32 (0.86, 2.01) 0.201	1.24 (0.57, 2.71) 0.591
Expectancy Bad for Health (%)	0.70 (0.38, 1.28) 0.247	0.72 (0.48, 1.10) 0.126	0.97 (0.46, 2.01) 0.930	0.83 (0.47, 1.49) 0.536	0.86 (0.60, 1.24) 0.427	0.97 (0.49, 1.92) 0.923
Expectancy Chemicals (%)	0.83 (0.46, 1.47) 0.520	**0.56 (0.38, 0.83)** **0.004**	1.48 (0.73, 2.98) 0.272	0.63 (0.34, 1.14) 0.123	0.93 (0.64, 1.36) 0.718	0.67 (0.33, 1.36) 0.266

[1] Model adjusts for mother's education, Black race, ever use of cigarettes, ever use of smokeless tobacco, number of touchpoints, and going inside the store.

[2] Model adjusts for mother's education, ever use of cigarettes, ever use of cigarillos, ever use of large cigars, number of touchpoints, and going inside the store.

[3] For continuous measures, this represents the difference in change between intervention and control. For binary measures, this represents the ratio of the intervention and control odds ratios.