Testing the Effects of Hookah Tobacco Social Media Risk Communication Messages Among Young Adults

Andrea C. Johnson, PhD, MPH[1,*], **Darren Mays, PhD, MPH**[2]

[1]Department of Psychiatry, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA

[2]Department of Internal Medicine, Wexner Medical Center, Cancer Control Program, The Ohio State University Comprehensive Cancer Center, Columbus, OH

Abstract

Background: Hookah tobacco is commonly used among young adults, and use is driven in part by widespread misperceptions about risks. Social media use, particularly Instagram, is prominent in this population and exposure to commercial and user-generated content promoting hookah commonly occurs.

Aims: This study tested the effects of hookah tobacco risk messaging for delivery via Instagram as a strategy to offset exposure to content promoting hookah use among young adults.

Methods: Young adult hookah smokers were recruited online for a 2×3 between subjects experiment (n=601). Participants completed pre-exposure measures and were randomized to view hookah tobacco Instagram ads (commercial or user-generated) with risk messages (none, risk education, or graphic risk). Stimuli were presented as a simulated Instagram feed. After viewing the stimuli, participants completed post-exposure outcome measures.

Results: There was a statistically significant main effect of risk message type, but no significant main effect of Instagram ad type or risk message type by ad type interactions. Exposure to the graphic risk and risk education messages were associated with lower intentions to engage with hookah tobacco ads on Instagram. Graphic risk and risk education messages produced greater negative emotional response and the graphic messages increased motivation to quit compared to Instagram ads alone.

Discussion: Findings provide preliminary evidence that hookah tobacco risk messages delivered via Instagram can offset the influence of content promoting the use of hookah tobacco.

Conclusion: This study represents an example of risk message testing and the results suggest the messages warrant further testing via social media delivery.

Keywords

hookah; waterpipe; tobacco; marketing; education; social media

*Corresponding Author:** Andrea C. Johnson, PhD, MPH, Department of Psychiatry, Perelman School of Medicine, 3535 Market Street Philadelphia, PA 19104-3309; andrea.johnson1@pennmedicine.upenn.edu.

Introduction

Young adults are a priority population for tobacco prevention and control (National Cancer Institute, 2016), and evidence indicates young adulthood (18 to 30) is a vulnerable developmental period when tobacco use initiation and escalation occurs (Villanti, Niaura, Abrams, & Mermelstein, 2019). Hookah tobacco, also called waterpipe, shisha, and narghile, is one of the most commonly used tobacco products in this group (Kasza et al., 2017; Robinson, Wang, Jackson, Donaldson, & Ryant, 2018) and hookah tobacco use among young adults poses substantial risks of health harms and addiction. Hookah tobacco smoking exposes users to dozens of harmful chemicals, is linked to symptoms of nicotine dependence, and is associated with health harms such as cancer (Aboaziza & Eissenberg, 2015; Bahelah et al., 2016; Cobb, Ward, Maziak, Shihadeh, & Eissenberg, 2010). Population Assessment of Tobacco and Health (PATH) study data estimates indicate about 9.2% of young adults 18–24 were past 30-day hookah smokers in 2016 and had the highest rates of use from 2013–2016 (Sharma et al., 2020). Hookah use in the US is driven in part by commonly held beliefs that hookah tobacco is not harmful or addictive (Akl et al., 2013; Hair et al., 2017b). Additionally, a common feature of hookah use behavior is that it is inherently social (Akl et al., 2013). Many hookah users have peers who have tried and hold positive attitudes toward hookah (Heinz et al., 2013). Recent work has also shown that adult tobacco users are commonly exposed to and engage with hookah content on social media (Donaldson, Hoffman, Zandberg, & Blake, 2017; Hebert et al., 2018; Link, Cawkwell, Shelley, & Sherman, 2015).

Social media use, specifically platforms such as Instagram, is prominent (71%) among young adults (Smith & Anderson, 2018) and is a source of exposure to content promoting hookah tobacco. As of September 2020, #hookah has 9.4 million posts on Instagram and hookah tobacco brands had tens of thousands of followers (e.g., Social Smoke (n=30,300), Fumari (n=31,700), and Al Fakher USA (n=45,300)). Although paid tobacco advertising on Instagram including hookah pipe imagery is prohibited (Facebook, n.d.), unpaid pro-tobacco advertising for hookah is abundant (Allem, Chu, Cruz, & Unger, 2017; Ben Taleb, Laestadius, Asfar, Primack, & Maziak, 2018). Unpaid advertising comprises both commercial and user-generated advertisements (ads) (Allem et al., 2017; Ben Taleb et al., 2018; Jackler, Li, Cardiff, & Ramamurthi, 2019). Such ad exposure is concerning because it creates an information environment that predominately communicates a pro-tobacco narrative (Flay, 1999), portrays hookah as safe (Fishbein M & Ajzen I, 2010), and is coupled with social reinforcement by way of engagement with posts (e.g., likes, sharing, comments) (Bandura, 2018; Fitzpatrick et al., 2019).

Ample evidence supports the conclusion that tobacco advertising exposure leads to tobacco use in young people (Lovato, Watts, & Stead, 2011; U.S. Department of Health and Human Services, 2012). Despite abundant tobacco-related ad exposure that occurs on Instagram, there is limited evidence on how such ads affect young hookah smokers, including their risk appraisals or motivation to quit hookah tobacco (Lienemann et al., 2019; McCloud, Kohler, & Viswanath, 2017). Moreover, there is minimal research on the potential effects of messages designed to communicate the risks of hookah use as a strategy for

offsetting the influences of promoting messages on Instagram (Jawad, Abass, Hariri, & Akl, 2015). Addressing misperceptions by way of risk messaging can shift beliefs and increase motivation to quit smoking for tobacco products (Farrelly, Davis, Haviland, Messeri, & Healton, 2005; Farrelly et al., 2017), including hookah tobacco (Lipkus & Mays, 2018; Mays, Tercyak, & Lipkus, 2016). However, to our knowledge, no studies have tested hookah prevention messages for young adults on social media, and specifically those designed for delivery via Instagram. To begin to address this research gap, this study tested the effects of hookah tobacco risk communication messaging for delivery via Instagram among young adult hookah smokers.

Methods

Procedures

We recruited young adult hookah smokers (18–30 years) through online crowdsourcing for a 2×3 between subjects experiment. We collected data through the internet-based crowdsourcing platform Amazon Mechanical Turk (mTurk) (Jeong et al., 2018; Kraemer, Strasser, Lindblom, Niaura, & Mays, 2017). Randomization and data quality assurance procedures were utilized to prohibit duplicate responses (i.e., ballot stuffing) using Qualtrics features. Registered mTurk users in the U.S. reviewed a brief description of the study and, if interested, proceed to complete self-report screening questions determining their eligibility. Eligible participants were 18–30 years of age who were current hookah users defined as smoking hookah at least once in the past 30 days. Participants were incentivized using standard mTurk procedures where they received $1 for a HIT. The study protocol was approved by the host institution's Institutional Review Board.

Eligible, consented participants completed pre-exposure measures and were randomized to one of 6 conditions. The experimental exposure followed a 2 (hookah tobacco ad type: commercial or user-generated) by 3 (risk message: none, risk education, or graphic risk) design. Four messages from each category were shown in relevant conditions. For instance, participants viewed four risk messages randomly interspersed with four hookah tobacco ads or four hookah tobacco ads alone based on the condition to which they were randomized. Stimuli were displayed as a simulated Instagram feed within a participant's browser. For all conditions, participants were instructed to scroll through at their own pace.

For all hookah ads, we chose categories and characteristics of images for the experiment based on the existing literature (Allem et al., 2017; Ben Taleb et al., 2018). Specifically, we used images from four categories: individual use, social gathering use, hookah pipe imagery, and branded product promotion for commercial and user generated ad conditions. For commercial content, we identified images in public posts made by commercial accounts, posts that were tagged with commercial accounts, or commercial posts under the #hookah hashtag on Instagram (Allem et al., 2017). For user-generated content, we identified images from public posts by individual accounts with 100 or more likes from under the top #hookah posts on Instagram. We identified images and saved them by screenshot in April 2019, and confirmed the images were still posted publicly prior to data collection as done in previous work (Ben Taleb et al., 2018).

From the initial pool of candidate images, we selected one image from each category (individual use, social gathering use, hookah pipe imagery, and branded product promotion) for each type of ad (commercial or user-generated), and these were repeated for each relevant condition for the experiment. This was based on an initial pretest with n=288 to identify ads that resonated with the target population (data not shown). Selection was based on high positive attitude scores using a valid measure (Lipkus, Mays, & Tercyak, 2017; Phan et al., 2019). Ads were shown to be posted from each hookah-specific account. We standardized final images across the experimental conditions for consistency (i.e., geolocation was removed, the number of likes was standardized).

We chose risk messages from previously tested hookah tobacco risk message content (Johnson, Lipkus et al., 2019; Phan et al., 2019). We designed risk messages in two categories reflecting different approaches for non-cigarette tobacco risk communication (Cornacchione Ross, Noar, & Sutfin, 2019). First, messages included public education with appealing visuals similar to imagery commonly found on Instagram under #hookah (e.g., a hookah pipe, exhaled smoke). Second, we included graphic or pictorial warning type messages such as those found on tobacco product packaging globally. We chose images from a graphic warning database (World Health Organization Framework Convention on Tobacco Control, n.d.), paired them with corresponding text content displayed in white font on a black background. We designed both types of risk messages to communicate similar risks of hookah tobacco. All risk messages appeared as though they were delivered from an academic-based Instagram account and were standardized to zero likes to mimic the environment where there is little to no prevention messaging or social reinforcement. Risk messages also displayed a tagline of #unfollowhookah to signal a call-to-action to unfollow the hashtag.

Measures

Pre-exposure measures included demographics, hookah and other tobacco use, and social media use. Post-exposure outcomes included message related outcomes, such as pro-tobacco message engagement, message attitudes, and message emotional response. Primary hookah related outcomes included hookah tobacco risk appraisals and motivation to quit smoking hookah. We also embedded a timer to track the duration of exposure to the stimuli in seconds.

Demographics.—Demographic characteristics assessed included age, sex, race, ethnicity, educational attainment, and gross annual income (Hu et al., 2016).

Hookah Tobacco Smoking.—To assess hookah tobacco smoking, we first screened individuals on past 30 day use, "On how many of the past 30 days did you smoke tobacco in a hookah?" Among eligible participants, we subsequently asked "Which of the following best describes your hookah tobacco smoking? Usually I smoke hookah…" Participants selected one of the following: less than monthly, monthly, weekly, or daily (Mays et al., 2016). We also collected participants' preferred hookah tobacco brand by asking, "What hookah brand do you typically use?" and provided a list of brands including Al Fakher, Fumari, Social Smoke, Starbuzz, Tangier, or Other brand (NIDA & FDA, n.d.).

Cigarette Smoking & Other Tobacco Use.—We measured cigarette smoking with two valid items to define current smokers as those who smoked 100 or more lifetime cigarettes and currently smoked cigarettes every day or some days (Hu et al., 2016). To characterize other tobacco product use, we measured if participants used electronic cigarettes, large cigars, little cigars/cigarillos, and smokeless tobacco in the past 30 days. For descriptive purposes, we created a variable indicating 0, 1, or 2+ other tobacco products used in the past 30 days.

Social Media Use.—We assessed social media use frequency with 10 items (Smith & Anderson, 2018). We asked participants to, "Please indicate how often you use each online platform." Item responses ranged from 1 = Not at all, 2 = Less often, 3 = About once a day, and 4 = Several times a day. Items asked about the following platforms: Facebook, Instagram, YouTube, Snapchat, Twitter, WhatsApp, Reddit, Pinterest, LinkedIn, and Tumblr. These items were summed to create a score with higher values indicating greater social media use across platforms ($\alpha = 0.72$).

Engagement.—Based on the literature (Curtis et al., 2018; de Vreese & Neijens, 2016; Hair et al., 2017a; Hebert et al., 2017; Neiger et al., 2012), we developed items to capture hypothetical engagement with the hookah tobacco ads viewed. We introduced items with the question stem: "Thinking about some of the sample posts you viewed, if and how would you hypothetically engage with similar posts that were pro-tobacco on Instagram? Check all that apply." We created these items for the study and used exploratory factor analysis (EFA) to determine their factor structure (Suh, 2015). For analyses, we used the 7 "active" engagement items: 1. I would "like" the post, 2. I would comment on the post, 3. I would tag a friend in a comment, 4. I would share the post on Instagram, 5. I would share the post on another social media site, 6. I would search for similar posts, and 7. I would start to follow the hashtag #hookah. Based on participants' responses to these items, we analyzed a variable indicating any intended active engagement (yes/no).

Positive Attitudes.—We measured message attitudes using 9 items adapted from previous work (Lipkus et al., 2017; Phan et al., 2019). The items ranged on a 7 point semantic differential scale using the following positive descriptors: Exciting, Engaging, Unique, Appealing, Strong Visuals, Interesting, Convincing, Applicable To Me, and Socially Acceptable. We summed responses to the items to create a score where higher values indicate more positive attitudes toward the messages ($\alpha = 0.90$).

Emotional Response.—We measured emotional response with 4 items capturing the extent to which participants felt frightened, anxious, nervous, and worried in response to the messages viewed (Johnson et al., 2019). Participants responded on a 4-point scale of 1 = Not At All to 4 = Extremely. We averaged the responses to create a score with higher values indicating a stronger emotional response ($\alpha = 0.95$).

Risk Appraisals.—We used 4 items to capture participants' hookah tobacco risk appraisals (i.e., perceived risks, worry about risks) (Lipkus & Mays, 2018). Perceived risk of harm was measured by asking "What do you think is your chance of getting a serious smoking-related disease, such as cancer, lung disease, or heart disease, if you continue to

smoke hookah tobacco? Would you say…" (1 = No chance to 7 = Certain to happen). Worry about harm was measured by asking "How much do you worry that your health is being hurt by your hookah tobacco smoking?" (1 = Not at all to 7 = Very much). Perceived risk of addiction was measured as "What do you think is your chance of becoming addicted to nicotine in hookah tobacco if you continue to smoke? Would you say…?" (1 = No chance to 7 = Certain to happen). Finally, worry about addiction was assessed by asking "How worried are you about becoming addicted to nicotine from hookah if you continue to smoke it?" (1 = Not at all to 7 = Very much). The 4 items had good internal consistency (α = 0.80) and we averaged them to create a score with higher values indicating stronger risk appraisals.

Motivation to Quit.—We measured motivation to quit smoking hookah using 4 items (Boudreaux et al., 2012; Mays et al., 2016). The four items asked about the importance of quitting, readiness to quit within the next month, confidence to quit within the next month, and motivation to quit right now. Participants responded on a scale ranging from 0 = Not at all to 10 = Very much. We averaged the 4 items to create a score with higher values indicating stronger motivation to quit (α = 0.93).

Analyses

Analyses included descriptive statistics for the sample, Pearson correlations between outcome variables, and bivariate tests to determine if participant characteristics differed by study condition. To test effects of the experimental conditions, we used multivariable logistic for engagement and linear regression for all other outcomes. All models adjusted for participant characteristics that differed significantly by experimental conditions, and included variables for hookah smoking frequency, cigarette smoking, and social media use as covariates as well. We report adjusted odds ratios (aOR) for logistic regression, unstandardized beta coefficients (*B*) for linear regression, and 95% confidence intervals (CI) for all estimates.

Results

We screened a total of 1,717 individuals' eligibility. The reasons for which participants were ineligible were outside of the study age range (n=496), not smoking hookah in the past 30 days (n=196), or both criteria (n=424). A total of N = 601 (35%) met eligibility criteria and completed the study. Table 1 shows the sample characteristics. Participants averaged 26 (SD = 3.1) years of age, 64% were male, 71% were white, and 87% attained a college education or higher. Participants reported usually smoking hookah tobacco less than monthly (20%), monthly (30%), weekly (38%), or daily (12%). The most common hookah brand preferred was Starbuzz (39%). More than half of participants were current cigarette smokers (60%) and used 1 or 2+ other tobacco products in the past 30 days (52%). The mean social media use score was 2.6 (SD = 0.6) where higher values indicate greater frequency of use across platforms. A majority of the sample indicated they use Instagram (85%). The average time of exposure to the experimental stimuli was 38.4 seconds (SD = 99.0).

We assessed if randomization was successful in evenly distributing sample characteristics from Table 1. Those with less than a college education were underrepresented in commercial ad groups compared to user-generated ad groups (χ^2 (5, n = 601) = 11.3, p = 0.05). Those

of non-white race were more likely to receive the commercial and user-generated ad only conditions (χ^2 (5, n = 601) = 19.2, $p < .01$). The time of stimuli exposure differed by study condition where those individuals exposed to the risk education ($B = 28.49$, $p = 0.004$) and graphic risk ($B = 30.74$, $p = 0.002$) had a longer time spent on the page, compared to those who viewed ads without risk messages. This was expected as the risk education and graphic risk groups viewed more stimuli overall. There were no significant differences for the time of stimuli exposure by commercial ads compared to user-generated ads.

Descriptive statistics for outcome variables and the correlations among them are shown in Table 2. Engagement was correlated with positive message attitudes ($r = 0.34$, $p < .001$), emotional response ($r = 0.17$, $p < .001$), risk appraisals ($r = 0.20$, $p < .001$), and motivation to quit ($r = 0.16$, $p < .001$). Positive attitudes were associated with greater emotional response ($r = 0.22$, $p < .001$), risk appraisals ($r = 0.28$, $p < .001$), and motivation to quit ($r = 0.31$, $p < .001$). Emotional response was correlated with greater risk appraisals ($r = 0.39$, $p < .001$) and motivation to quit ($r = 0.45$, $p < .001$). Lastly, risk appraisals were correlated with motivation to quit ($r = 0.53$, $p < .001$).

In multivariable analyses, there were statistically significant main effects of risk message type, but no significant main effect of Instagram ad type or risk message type by ad type interactions. Therefore, all interactions were removed for reporting and results. Results of the multivariable models are shown in Table 3.

For message related outcomes, exposure to the risk education and graphic risk messages were associated with lower intentions to engage with hookah tobacco ads on Instagram (aOR = 0.50, 95% CI 0.31 to 0.80 and aOR = 0.40, 95% CI 0.25 to 0.64, respectively). Risk education and graphic risk messages were also associated with greater emotional response ($B = 0.24$, 95% CI 0.08 to 0.40 and $B = 0.78$, 95% CI 0.61 to 0.94, respectively). Compared to participants who smoked less than monthly, weekly and daily hookah use was associated with greater intentions to engage with hookah tobacco ads on Instagram (aOR = 2.67, 95% CI 1.55 to 4.60 and aOR = 4.66, 95% CI 2.09 to 10.38, respectively). Daily hookah use was associated with an increased emotional response to the messages as well ($B = 0.29$, 95% CI 0.03 to 0.55). Greater social media use was positively associated with all message related outcomes.

For outcomes that were hookah related, exposure to the graphic risk messages was associated with greater motivation to quit smoking hookah compared to exposure to Instagram ads alone ($B = 0.89$, 95% CI 0.31 to 1.47). More frequent hookah use was associated with greater risk appraisals, and motivation to quit smoking was lower among those reporting weekly hookah smoking ($B = -1.10$, 95% CI -1.78 to -0.42) compared to those reporting smoking less than monthly. Current cigarette smokers had significantly higher estimates than nonsmokers for all outcomes except motivation to quit smoking hookah. Greater social media use frequency across platforms was positively associated with all hookah related outcomes as well.

Discussion

This study is among the first to test the effects of messages communicating risks about hookah tobacco on Instagram among young adults. This study provides preliminary evidence that hookah tobacco risk messages delivered via Instagram can offset the promoting influence of unpaid hookah tobacco advertisements. Brief exposure to risk messages was associated with increased emotional response and decreased intentions to engage with hookah tobacco ads on Instagram. Exposure to graphic risk messages was also associated with increased motivation to quit smoking hookah. Both hookah and cigarette tobacco use was associated with greater intent to engage with hookah tobacco ads on Instagram as well as increased risk appraisals. Social media use was positively associated with all message and hookah related outcomes.

This study builds on the literature by understanding effective content for hookah risk messaging. Findings align in that brief exposure to risk messages for non-cigarette tobacco products can increase emotional response and motivation to quit (Cornacchione Ross et al., 2019). Furthermore, graphic imagery can have stronger effects than text alone to deter use of hookah and other tobacco product related outcomes (Islam, Salloum, Nakkash, Maziak, & Thrasher, 2016; Noar et al., 2016; Sutfin et al., 2019). Yet, neither risk messaging condition was significantly associated with positive attitudes at the multivariable level. One potential reason is we did not separately measure constructs specific to the advertisements and risk messaging tested, an important methodological consideration for the future.

Results diverge from some literature on elevated risk appraisals (Cornacchione Ross et al., 2019). More frequent users endorsed higher risk appraisals overall and were least likely to be motivated to quit. Less frequent users indicated lower risk appraisals overall but were also not motivated to quit. It may be the case that risk messaging that uses graphics commonly seen on Instagram (e.g., hookah pipe, exhaled smoke) solicits less attention if it fits into the current informational environment or that pictorial warnings have shown less impact on perceptions about disease likelihood (Noar, Rohde, Barker, Hall, & Brewer, 2020). Testing tailored approaches could garner more interest. Modern advertising typically uses targeted user attributes (Berg et al., 2017; Evans, Thomas, Favatas, Smyser, & Briggs, 2019). Both eye-catching and tailored messaging may be needed to stand up to the volume of content users encounter to shift risk appraisals and motivation to quit (Allem et al., 2017; Ben Taleb et al., 2018).

Findings add to the existing literature on social media and the mode of delivery for hookah risk messaging. Importantly, there was no difference in outcomes measured based on whether participants viewed commercial or user-generated ads. This suggests that both types of ads were equally appealing, further supporting the need for risk messaging. In this pro-tobacco communication environment, we showed two types of brief risk messaging demonstrated efficacy to offset pro-hookah ad effects. This was partially based on a newly developed measure of social media engagement. Continued testing may provide a greater indication of adequate levels of counter-messaging that are required to decrease engagement and other outcomes.

The study findings should be interpreted in light of its limitations. The study was cross-sectional and did not test effects of the experimental exposure on behaviors. Future longitudinal studies should examine this accounting for temporal precedence, explicit attention checks, and a control with no exposure. We used a convenience sample that differs demographically from the general population (e.g., higher educational attainment), which limits generalizability. Eligibility was not restricted to those with an Instagram account and stimuli exposure was simulated. Exposure within one's Instagram account or seeing peers' posts may generate different responses. Individuals may have seen the ads as we chose recent, top public posts from Instagram. It is also unclear if individuals follow #hookah, if they post unpaid hookah advertisements, or if the number of likes impacted outcomes. The #unfollowhookah prompt may have been a moot call-to-action, so this and engagement with additional prompts should be assessed further. Although randomization may have addressed some of these factors through equal distribution, such endogenous concerns (e.g., Instagram engagement use patterns) should be considered for future studies in this area. It will also be important to capture a broader range of individual characteristics related to hookah use (e.g., waterpipe ownership, nicotine dependence) and contextual factors (e.g., social interactions smoking hookah) that may impact message- and hookah-related outcomes.

Although social media platforms such as Instagram and Facebook are continually updating policies and surveillance activities, it is important to maintain pace with testing and dissemination of prevention messages to communicate risk and curb hookah tobacco use among young adults in the current informational climate (Abroms, Gold, & Allegrante, 2019). This study represents an example of risk message testing and results suggest the messages warrant further testing via social media delivery. This work has practical relevance to support the Food and Drug Administration (FDA) and other entities that deliver public education messaging on tobacco products through social media (FDA, 2019). By assessing both tobacco advertisements and risk messaging simultaneously, this research can help inform real-world applications for tobacco control communication efforts designed to offset content promoting hookah use to young people via social media such as Instagram.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

Aboaziza E, & Eissenberg T (2015). Waterpipe tobacco smoking: What is the evidence that it supports nicotine/tobacco dependence? Tobacco Control, 24 Suppl 1, i44–i53. doi:10.1136/tobaccocontrol-2014-051910 [PubMed: 25492935]

Abroms LC, Gold RS, & Allegrante JP (2019). Promoting health on social media: The way forward. Health Education & Behavior: The Official Publication of the Society for Public Health Education, 46(2_suppl), 9–11. doi:10.1177/1090198119879096 [PubMed: 31742461]

Akl EA, Jawad M, Lam WY, Co CN, Obeid R, & Irani J (2013). Motives, beliefs and attitudes towards waterpipe tobacco smoking: A systematic review. Harm Reduction Journal, 10, 12–7517–10–12. doi:10.1186/1477-7517-10-12 [PubMed: 23816366]

Allem JP, Chu KH, Cruz TB, & Unger JB (2017). Waterpipe promotion and use on Instagram: #Hookah. Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco, doi:ntw329

Bahelah R, DiFranza JR, Fouad FM, Ward KD, Eissenberg T, & Maziak W (2016). Early symptoms of nicotine dependence among adolescent waterpipe smokers. Tobacco Control, 25(e2), e127–e134. doi:10.1136/tobaccocontrol-2015-052809 [PubMed: 27113610]

Bandura A (2018). Toward a psychology of human agency: Pathways and reflections. Perspectives on Psychological Science: A Journal of the Association for Psychological Science, 13(2), 130–136. doi:10.1177/1745691617699280 [PubMed: 29592657]

Ben Taleb Z, Laestadius LI, Asfar T, Primack BA, & Maziak W (2018). #Hookahlife: The rise of waterpipe promotion on Instagram. Health Education & Behavior: The Official Publication of the Society for Public Health Education, 1090198118779131. doi:10.1177/1090198118779131

Berg CJ, Haardorfer R, Getachew B, Johnston T, Foster B, & Windle M (2017). Fighting fire with fire: Using industry market research to identify young adults at risk for alternative tobacco product and other substance use. Social Marketing Quarterly, 23(4), 302–319. doi:10.1177/1524500417718533 [PubMed: 30271276]

Boudreaux ED, Sullivan A, Abar B, Bernstein SL, Ginde AA, & Camargo CA Jr. (2012). Motivation rulers for smoking cessation: A prospective observational examination of construct and predictive validity. Addiction Science & Clinical Practice, 7, 8-0640-7-8. doi:10.1186/1940-0640-7-8

Cobb C, Ward KD, Maziak W, Shihadeh AL, & Eissenberg T (2010). Waterpipe tobacco smoking: An emerging health crisis in the United States. American Journal of Health Behavior, 34(3), 275–285. doi:10.5555/ajhb.2010.34.3.275 [PubMed: 20001185]

Cornacchione Ross J, Noar SM, & Sutfin EL (2019). Systematic review of health communication for non-cigarette tobacco products. Health Commun, 34(3), 361–369. doi:10.1080/10410236.2017.1407274 [PubMed: 29236542]

Curtis BL, Lookatch SJ, Ramo DE, McKay JR, Feinn RS, & Kranzler HR (2018). Meta-analysis of the association of alcohol-related social media use with alcohol consumption and alcohol-related problems in adolescents and young adults. Alcohol Clin Exp Res, 42(6), 978–986. doi:10.1111/acer.13642 [PubMed: 29786874]

de Vreese CH, & Neijens P (2016). Measuring media exposure in a changing communications environment. Communication Methods and Measures, 10(2–3), 69–80. doi:10.1080/19312458.2016.1150441

Donaldson EA, Hoffman AC, Zandberg I, & Blake KD (2017). Media exposure and tobacco product addiction beliefs: Findings from the 2015 Health Information National Trends survey (HINTS-FDA 2015). Addictive Behaviors, 72, 106–113. doi:S0306-4603(17)30140-5 [PubMed: 28390232]

Evans WD, Thomas CN, Favatas D, Smyser J, & Briggs J (2019). Digital segmentation of priority populations in public health. Health Education & Behavior: The Official Publication of the Society for Public Health Education, 46(2_suppl), 81–89. doi:10.1177/1090198119871246 [PubMed: 31742454]

Facebook. (n.d.). Advertising policies: Tobacco products. Retrieved from https://www.facebook.com/policies/ads/prohibited_content/tobacco#

Farrelly MC, Davis KC, Haviland ML, Messeri P, & Healton CG (2005). Evidence of a dose-response relationship between "truth" antismoking ads and youth smoking prevalence. Am J Public Health, 95(3), 425–431. doi:10.2105/AJPH.2004.049692 [PubMed: 15727971]

Farrelly MC, Duke JC, Nonnemaker J, MacMonegle AJ, Alexander TN, Zhao X, … Allen JA (2017). Association between the real cost media campaign and smoking initiation among youths - United States, 2014–2016. MMWR Morb Mortal Wkly Rep, 66(2), 47–50. doi:10.15585/mmwr.mm6602a2 [PubMed: 28103214]

Fishbein M, & Ajzen I. (2010). Predicting and changing behavior: The Reasoned Action Approach. New York, NY: Psychology Press. ISBN-13: 978–1138995215

Fitzpatrick M, Johnson AC, Tercyak KP, Hawkins KB, Villanti AC, & Mays D (2019). Adolescent beliefs about hookah and hookah tobacco use and implications for preventing use. Preventing Chronic Disease, 16, E05. doi:10.5888/pcd16.180093 [PubMed: 30629484]

Flay BR (1999). Understanding environmental, situational and intrapersonal risk and protective factors for youth tobacco use: The Theory of Triadic Influence. Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco, 1 Suppl 2, S111–4; discussion 569–70.

Food and Drug Administration. (2019). Public health education. Retrieved from https://www.fda.gov/tobacco-products/public-health-education

Hair E, Pitzer L, Bennett M, Halenar M, Rath J, Cantrell J, … Vallone D (2017a). Harnessing youth and young adult culture: Improving the reach and engagement of the truth® campaign. J Health Commun, 22(7), 568–575. doi:10.1080/10810730.2017.1325420 [PubMed: 28548610]

Hair E, Rath JM, Pitzer L, Emelle B, Ganz O, Halenar MJ, … Vallone D (2017b). Trajectories of hookah use: Harm perceptions from youth to young adulthood. American Journal of Health Behavior, 41(3), 240–247. doi:10.5993/AJHB.41.3.3 [PubMed: 28376968]

Hebert ET, Case KR, Kelder SH, Delk J, Perry CL, & Harrell MB (2017). Exposure and engagement with tobacco- and E-cigarette-related social media. The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine, 61(3), 371–377. doi:S1054-139X(17)30194-5 [PubMed: 28669801]

Hebert ET, Vandewater EA, Businelle MS, Harrell MB, Kelder SH, & Perry CL (2018). Real time assessment of young adults' attitudes toward tobacco messages. Tobacco Regulatory Science, 4(1), 644–655. doi:10.18001/TRS.4.1.10 [PubMed: 29503825]

Heinz AJ, Giedgowd GE, Crane NA, Veilleux JC, Conrad M, Braun AR, … Kassel JD (2013). A comprehensive examination of hookah smoking in college students: Use patterns and contexts, social norms and attitudes, harm perception, psychological correlates and co-occurring substance use. Addict Behav, 38(11), 2751. doi:10.1016/j.addbeh.2013.07.009. [PubMed: 23934006]

Hu SS, Neff L, Agaku IT, Cox S, Day HR, Holder-Hayes E, & King BA (2016). Tobacco product use among adults - United States, 2013–2014. MMWR. Morbidity and Mortality Weekly Report, 65(27), 685–691. doi:10.15585/mmwr.mm6527a1 [PubMed: 27416365]

Islam F, Salloum RG, Nakkash R, Maziak W, & Thrasher JF (2016). Effectiveness of health warnings for waterpipe tobacco smoking among college students. International Journal of Public Health, 61(6), 709–715. doi:10.1007/s00038-016-0805-0 [PubMed: 26971508]

Jackler RK, Li VY, Cardiff RAL, & Ramamurthi D (2019). Promotion of tobacco products on Facebook: Policy versus practice. Tobacco Control, 28(1), 67–73. doi:10.1136/tobaccocontrol-2017-054175 [PubMed: 29622602]

Jawad M, Abass J, Hariri A, & Akl EA (2015). Social media use for public health campaigning in a low resource setting: The case of waterpipe tobacco smoking. Biomed Res Int, Article ID 562586 doi:10.1155/2015/562586

Jeong M, Zhang D, Morgan JC, Ross JC, Osman A, Boynton MH, … Brewer NT (2018). Similarities and differences in tobacco control research findings from convenience and probability samples. Annals of Behavioral Medicine: A Publication of the Society of Behavioral Medicine, doi:10.1093/abm/kay059

Johnson AC, Lipkus I, Tercyak KP, Luta G, Rehberg K, Phan L, … Mays D (2019). Development and pretesting of risk-based mobile multimedia message content for young adult hookah use. Health Education & Behavior, Supplement on Health Promotion in the Era of Social Media and Digital Communication, 46(2S), 97S–105S. doi:10.1177/1090198119874841

Kasza KA, Ambrose BK, Conway KP, Borek N, Taylor K, Goniewicz ML, … Hyland AJ (2017). Tobacco-product use by adults and youths in the United States in 2013 and 2014. The New England Journal of Medicine, 376(4), 342–353. doi:10.1056/NEJMsa1607538 [PubMed: 28121512]

Kraemer JD, Strasser AA, Lindblom EN, Niaura RS, & Mays D (2017). Crowdsourced data collection for public health: A comparison with nationally representative, population tobacco use data. Preventive Medicine, 102, 93–99. doi:S0091-7435(17)30252-9 [PubMed: 28694063]

Lienemann BA, Rose SW, Unger JB, Meissner HI, Byron MJ, Baezconde-Garbanati L, … Cruz TB (2019). Tobacco advertisement liking, vulnerability factors, and tobacco use among young adults. Nicotine Tob Res, 21(3), 300–308. doi:10.1093/ntr/nty220 [PubMed: 30329102]

Link AR, Cawkwell PB, Shelley DR, & Sherman SE (2015). An exploration of online behaviors and social media use among hookah and electronic-cigarette users. Addictive Behaviors Reports, 2, 37–40. doi:10.1016/j.abrep.2015.05.006 [PubMed: 26167519]

Lipkus IM, Mays D, & Tercyak KP (2017). Characterizing young adults' susceptibility to waterpipe tobacco use and their reactions to messages about product harms and addictiveness. Nicotine Tob Res, 19(10), 1216–1223. [PubMed: 27799355]

Lipkus IM, & Mays D (2018). Comparing harm beliefs and risk perceptions among young adult waterpipe tobacco smokers and nonsmokers: Implications for cessation and prevention. Addictive Behaviors Reports, 7, 103–110. doi:10.1016/j.abrep.2018.03.003 [PubMed: 29892704]

Lovato C, Watts A, & Stead LF (2011). Impact of tobacco advertising and promotion on increasing adolescent smoking behaviours. Cochrane Database Syst Rev, 10(CD003439) doi:10.1002/14651858.CD003439.pub2

Mays D, Tercyak KP, & Lipkus IM (2016). The effects of brief waterpipe tobacco use harm and addiction education messages among young adult waterpipe tobacco users. Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco, 18(5), 777–784. doi:10.1093/ntr/ntv223. [PubMed: 26438650]

McCloud RF, Kohler RE, & Viswanath K (2017). Cancer risk-promoting information: The communication environment of young adults. Am J Prev Med, 53(3S1), S63–S72. doi:10.1016/j.amepre.2017.03.025 [PubMed: 28818248]

National Cancer Institute. (2016). Tobacco control research priorities for the next decade: Working group recommendations for 2016 – 2025. Retrieved from https://cancercontrol.cancer.gov/pdf/nci-tobacco-control-research-priorities-rpt-feb-2016.pdf

Neiger BL, Thackeray R, Van Wagenen SA, Hanson CL, West JH, Barnes MD, & Fagen MC (2012). Use of social media in health promotion: Purposes, key performance indicators, and evaluation metrics. Health Promotion Practice, 13(2), 159–164. doi:10.1177/1524839911433467 [PubMed: 22382491]

NIDA & FDA. (n.d.). Population Assessment of Tobacco and Health (PATH) study [United States] restricted-use files. ICPSR36231-v7. Ann Arbor, MI: Inter-university consortium for political and social research, 2016-11-28. 10.3886/ICPSR36231.v7.

Noar SM, Rohde JA, Barker JO, Hall MG, & Brewer NT (2020). Pictorial cigarette pack warnings increase some risk appraisals but not risk beliefs: A meta-analysis. Hum Commun Res, 46(2–3), 250–272. doi:10.1093/hcr/hqz016 [PubMed: 32565612]

Noar SM, Hall MG, Francis DB, Ribisl KM, Pepper JK, & Brewer NT (2016). Pictorial cigarette pack warnings: A meta-analysis of experimental studies. Tobacco Control, 25(3), 341–354. doi:10.1136/tobaccocontrol-2014-051978 [PubMed: 25948713]

Phan L, Villanti A, Leshner G, Wagener T, Stevens E, Johnson AC, … Mays D (2019). Content development and pretesting of hookah tobacco public education messaging in young adults. In D. Mays (Chair), Research to Inform Hookah Tobacco Regulation: From Product Characteristics, to use Behavior, to Public Education. Symposium Conducted at the NIH Tobacco Regulatory Science Meeting, Bethesda, MD, October 2019.

Robinson JN, Wang B, Jackson KJ, Donaldson EA, & Ryant CA (2018). Characteristics of hookah tobacco smoking sessions and correlates of use frequency among US adults: Findings from Wave 1 of the Population Assessment of Tobacco and Health (PATH) study. Nicotine Tob Res, 20(6), 731–740. doi:10.1093/ntr/ntx060 [PubMed: 28340148]

Sharma E, Bansal-Travers M, Edwards KC, Halenar MJ, Taylor KA, Kasza KA, … Stanton CA (2020). Longitudinal pathways of exclusive and polytobacco hookah use among youth, young adults and adults in the USA: Findings from the PATH study Waves 1–3 (2013–2016). Tob Control, 29(Suppl 3), s155–s162. doi:10.1136/tobaccocontrol-2020-055625 [PubMed: 32321849]

Smith A, & Anderson M (2018). Social media use in 2018. Retrieved from http://www.pewinternet.org/2018/03/01/social-media-use-in-2018/

Suh Y (2015). The performance of maximum likelihood and weighted least square mean and variance adjusted estimators in testing differential item functioning with nonnormal trait distributions. Structural Equation Modeling: A Multidisciplinary Journal, 22(4), 568–580. doi:10.1080/10705511.2014.937669

Sutfin EL, Cornacchione Ross J, Lazard AJ, Orlan E, Suerken CK, Wiseman KD, … Noar SM (2019). Developing a point-of-sale health communication campaign for cigarillos and waterpipe tobacco. Health Communication, 34(3), 343–351. doi:10.1080/10410236.2017.1407277 [PubMed: 29236565]

U.S. Department of Health and Human Services. (2012). Preventing tobacco use among youth and young adults: A report of the surgeon general. Retrieved from https://www.surgeongeneral.gov/library/reports/preventing-youth-tobacco-use/

Villanti AC, Niaura RS, Abrams DB, & Mermelstein R (2019). Preventing smoking progression in young adults: The concept of prevescalation. Prevention Science: The Official Journal of the Society for Prevention Research, 20(3), 377–384. doi:10.1007/s11121-018-0880-y [PubMed: 29525899]

World Health Organization Framework Convention on Tobacco Control. (n.d.). WHO FCTC health warnings database. Retrieved from http://www.who.int/tobacco/healthwarningsdatabase/en/

Table 1:

Sample Characteristics (N=601)

	M (SD)^a	n (%)
Age	26.1 (3.10)	-
Sex		
Female	-	217 (36.1)
Male	-	383 (63.7)
Race		
White	-	424 (70.6)
Non-white	-	177 (29.5)
Ethnicity		
Hispanic	-	137 (22.8)
Non-Hispanic	-	463 (77.0)
Education		
College Education or Higher	-	522 (86.9)
Less Than College Education	-	79 (13.1)
Income		
< $50,000/year	-	339 (56.4)
$50,000/year	-	261 (43.4)
Hookah User Type		
Less than monthly	-	121 (20.1)
Monthly	-	177 (29.5)
Weekly	-	231 (38.4)
Daily	-	72 (12.0)
Primary Hookah Brand Preference		
Al Fakher	-	86 (14.3)
Fumari	-	46 (7.7)
Social Smoke	-	101 (16.8)
Starbuzz	-	233 (38.8)
Tangier	-	104 (17.3)
Other Brand	-	30 (5.0)
Cigarette Smoking Status		
Current Smoker	-	362 (60.2)
Not a Current Cigarette Smoker	-	239 (39.8)
Other Tobacco Use in Past 30 Days		
No Other Tobacco Product Use	-	286 (47.6)
1 Other Tobacco Product Use	-	200 (33.3)
2+ Other Tobacco Product Use		115 (19.1)
Social Media Usage	2.6 (0.6)	-
Randomization Arms		
Risk Education Message, Commercial Ads	-	102 (17.0)
Risk Education Message, User-Generated Ads	-	104 (17.3)

	M (SD)[a]	n (%)
Graphic Risk Message, Commercial Ads	-	102 (17.0)
Graphic Risk Message, User-Generated Ads	-	99 (16.5)
Commercial Ads Only	-	95 (15.8)
User-Generated Ads Only	-	99 (16.5)

[a]*SD* = Standard Deviation. Some Ns for categories within variables do not sum to total sample size due to sporadic missing data (<5% of cases for any individual variable).

Table 2:

Descriptive and Bivariate Results

		Correlations				
	M (SD)[a]	1	2	3	4	5
1. Engagement	0.5 (0.50)	1.00	-	-	-	-
2. Positive Attitudes	4.6 (1.21)	0.34 ***	1.00	-	-	-
3. Emotional Response	1.9 (0.92)	0.17 ***	0.22 ***	1.00	-	-
4. Risk Appraisals	4.1 (1.32)	0.20 ***	0.28 ***	0.39 ***	1.00	-
5. Motivation to Quit	6.2 (3.03)	0.16 ***	0.31 ***	0.45 ***	0.53 ***	1.00

[a]Mean (Standard Deviation) displayed in the first column. Ranges are: 1. Engagement with Hookah Ads (yes/no), 2. Positive Attitudes to Messages (1 to 7), 3. Emotional Response to Messages (1 to 4), 4. Risk Appraisals to Hookah (1 to 7), 5. Motivation to Quit Hookah (4 items, 0 to 10).

*
p<.05;

**
<.01;

***
p<.001

Table 3:

Multivariable Estimates for Message and Hookah Related Outcomes

| | Message Related | | | Hookah Related | |
| | Engagement | Positive Attitudes | Emotional Response | Risk Appraisal | Motivation to Quit |
	aOR (95% CI)[a]	B (95% CI)[b]	B (95% CI)	B (95% CI)	B (95% CI)
Main Effects					
Risk Messaging					
No Messages	Reference	Reference	Reference	Reference	Reference
Risk Education Messages	0.50 (0.31 to 0.80) *[c]	−0.19 (−0.43 to 0.04)	0.24 (0.08 to 0.40) **	0.19 (−0.05 to 0.43)	0.30 (−0.28 to 0.88)
Graphic Risk Messages	0.40 (0.25 to 0.64) **	−0.21 (−0.45 to 0.02)	0.78 (0.61 to 0.94) ***	0.23 (−0.01 to 0.48)	0.89 (0.31 to 1.47) **
Advertisements					
Commercial Ads	Reference	Reference	Reference	Reference	Reference
User-Generated Ads	1.09 (0.75 to 1.60)	0.06 (−0.13 to 0.25)	0.08 (−0.06 to 0.21)	−0.07 (−0.27 to 0.13)	−0.35 (−0.83 to 0.12)
Covariates					
Hookah Use Frequency					
Less than monthly	Reference	Reference	Reference	Reference	Reference
Monthly	1.56 (0.89 to 2.72)	0.02 (−0.26 to 0.30)	0.18 (−0.02 to 0.37)	0.43 (0.14 to 0.71) **	−0.59 (−1.29 to 0.10)
Weekly	2.67 (1.55 to 4.60) *	−0.03 (−0.30 to 0.25)	−0.08 (−0.27 to 0.11)	0.29 (0.01 to 0.57) *	−1.10 (−1.78 to −0.42) **
Daily	4.66 (2.09 to 10.38) **	−0.02 (−0.40 to 0.36)	0.29 (0.03 to 0.55) *	0.61 (0.22 to 0.99) **	−0.41 (−1.34 to 0.51)
Cigarette Smoking					
No	Reference	Reference	Reference	Reference	Reference
Yes	4.06 (2.71 to 6.09) ***	0.34 (0.13 to 0.56) **	0.29 (0.14 to 0.44) ***	0.77 (0.56 to 0.99) ***	0.46 (−0.07 to 0.98)
Social Media Use	2.08 (1.50 to 3.00) ***	0.28 (0.11 to 0.46) **	0.27 (0.15 to 0.39) ***	0.19 (0.01 to 0.37) *	0.96 (0.53 to 1.40) ***

[a] All engagement estimates are exponentiated as adjusted odds ratios (aOR).

[b] The other models all display unstandardized beta coefficients (B)

[c] No interactions were significant and were removed. All models include covariates for education and race.

*
p<.05

**
p<.01

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***
$p < .001$.