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The Impact of a Brief Cessation Induction Intervention for Waterpipe Tobacco Smoking: A Pilot Randomized Clinical Trial

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Abstract

Background—Waterpipe (WP) tobacco smoking delivers many of the same harmful toxicants as cigarette smoking and is on the rise in the US. This study evaluated the feasibility and initial efficacy of a brief personalized feedback intervention in affecting changes in WP smoking among current WP smokers.

Methods—Participants ($N=109$) were recruited as they entered WP lounges and completed a questionnaire and exhaled carbon monoxide (eCO) testing before entering the WP lounge. Participants were cluster-randomized to assessment-only control (AOC) or intervention conditions. The intervention condition received health risk information and personalized feedback on pre- and post-WP session eCO levels. Participants completed a survey at the end of the WP session and at 3-month follow-up.

Results—Compared to control, the intervention was effective in increasing knowledge of WP-related harms, correcting risk perceptions, increasing importance of quitting WP smoking, and increasing confidence in ability to quit WP smoking at post-WP session ($p<.05$). Differences were maintained for knowledge of WP-related harms, risk perceptions, and commitment to quitting WP at 3-month follow-up; however, no significant difference ($p>.05$) was observed in WP smoking (i.e., days smoked and number of WPs smoked) at 3-month follow-up between the intervention ($M=3.97$ days, $SD=9.83$; $M=6.45$ bowls, $SD=19.60$) and control conditions ($M=3.32$ days, $SD=5.24$; $M=3.49$ bowls, $SD=5.10$).

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Conclusions—The current research supports the use of personalized feedback as a useful intervention method to increase commitment to quit WP, but suggests more intensive interventions may be necessary to achieve WP cessation.

Keywords

waterpipe; smoking; intervention; cessation

Cigarette smoking rates have decreased by approximately 33%, while waterpipe (WP) smoking (also known as shisha, narghile, goza, and hookah) has taken an opposite course, with a 123% increase among U.S. young adults from 2000–2011 (Arrazola et al., 2015; Johnston L. D., 2014; Prevention, 2010). This increase in WP use is concerning because WP is one of the most frequently tried tobacco products among young adults (Berg et al., 2015; Gilreath et al., 2016) and WP smokers are exposed to much higher levels of the same toxicants present in combustible cigarette smoke (C. Cobb et al., 2010; Maziak et al., 2009; Shihadeh & Saleh, 2005). As a result, WP smoking is associated with many of the same negative health outcomes as combustible cigarette use, including cancer, lung disease, respiratory illness, and cardiovascular disease (Akl et al., 2010; C. Cobb et al., 2010). Moreover, because most WP tobacco contains significant levels of nicotine, WP smoking is likely to result in tobacco dependence as use of other nicotine-containing products (Aboaziza & Eissenberg, 2015; C. O. Cobb, Shihadeh, Weaver, & Eissenberg, 2011; Eissenberg & Shihadeh, 2009; Neergaard, Singh, Job, & Montgomery, 2007).

Despite the growing rates of WP smoking and its potential negative impact on health, only four studies have examined individual-level treatments for WP cessation. The first of these examined the efficacy of a traditional smoking cessation intervention in reducing WP rates among adults in Pakistan (Dogar et al., 2014). However, WP-only users demonstrated poorer long-term abstinence rates than those who used cigarettes, suggesting that WP-specific interventions may be needed. Three subsequent studies have examined the efficacy of interventions designed specifically to target WP smoking. Lipkus and colleagues (Lipkus, Eissenberg, Schwartz-Bloom, Prokhorov, & Levy, 2011) found that providing education on the harms associated with WP smoking resulted in greater but non-significant WP quit-rates among college students at 6-month follow-up. Similarly, Asfar and colleagues (Asfar, Al Ali, Rastam, Maziak, & Ward, 2014) documented promising 3-month abstinence rates (30 and 44%) in response to both brief (1 in-person, 3 phone sessions) and intensive (3 in-person, 5 phone sessions) WP interventions, respectively. Finally, in an uncontrolled online study, Essa-Hadad and colleagues (2015) found that participants decreased WP smoking from baseline to one-month follow-up in response to video- and text-based health information. Collectively, these data show promise for WP-specific interventions.

While these data provide preliminary evidence for the efficacy of interventions for WP smoking, no study has investigated a face-to-face WP cessation intervention in the U.S. WP smokers are typically non-daily, intermittent users of WP who do not consider themselves “smokers.” As a result, U.S. WP users are often unaware of the health harms associated with WP (Heinz et al., 2013; Kingsbury, Parks, Amato, & Boyle, 2016). Interventions that correct misperceptions among WP smokers, such as those utilized in

personalized feedback interventions, may be ideal. Personalized feedback interventions contrast individuals' perceived personal health risk and normative standards with discrepant and accurate information in order to motivate behavior change (Miller et al., 2013). For WP users, personalized feedback interventions could provide users with accurate information, target users' risk perceptions, and motivate behavior change. Personalized feedback is effective in increasing rates of cigarette smoking cessation, decreasing rates of cigarette smoking initiation (de Josselin de Jong, Candel, Segaar, Cremers, & de Vries, 2014), and preventing relapse among daily smokers (Elfeddali, Bolman, Candel, Wiers, & de Vries, 2012).

The current study evaluated the feasibility and initial efficacy of a brief, one-session, personalized feedback intervention in (a) increasing knowledge of WP-related harms, (b) increasing motivation to quit WP smoking, and (c) decreasing WP smoking among WP lounge patrons. It was hypothesized that, compared to the assessment-only control (AOC) condition, the intervention condition would (1) display greater understanding of the harms of WP smoking at post-session and 3-month follow-up, (2) be more motivated and confident in their ability to change their WP smoking behaviors at post-session and 3-month follow-up, and (3) smoke WP less frequently at 3-month follow-up.

METHOD

Participants

Using a convenience sample approach, participants were recruited as they entered one of three WP lounges in urban and suburban areas in the Midwest US between August and December 2014. Participants were eligible to participate if they were 18 years old. Permission to recruit was obtained from the owner at all lounges. See Figure 1 for a flow diagram of participant randomization and retention.

Procedures

Baseline and post-session measures were administered in the field outside the WP lounge. Those eligible and willing to participate completed informed consent, HIPAA documentation, and study questionnaires. Most patrons came to the WP lounge in groups of 2–4 people; therefore, to avoid contamination between study conditions (i.e., some members of the group in the control and others in the intervention condition), intact groups were cluster randomized into either the control or intervention condition based on the natural groups in which they approached the WP lounge. For example, if four participants approached together and were consented into the study, they were considered one cluster and were randomized together to a respective condition. Participant clusters were randomized using a random number generator in blocks of four. During the first phase of the study, participants completed measures and provided a breath sample for exhaled carbon monoxide (eCO) measurement. Baseline eCO results were recorded but not shared with the participants. Upon completion of the baseline assessment, participants were told to smoke as they typically would and entered the WP lounge. When exiting the WP lounge, all participants again provided a breath sample for eCO measurement. The results of this assessment were not shared with individuals in the control condition. Participants in the

intervention condition were administered the intervention following eCO testing and then completed post-session measures. During intervention administration, participants were taken to the side and away from participants completing other study measures in order to avoid contamination with those taking surveys, and particularly those in the control condition. Participants were also discouraged from sharing their personalized feedback with others. Participants in the control condition completed post-session measures immediately following eCO testing. Involvement in the first phase of the study (i.e., at the WP lounge) lasted between 30 minutes and 3 hours depending on the amount of time spent inside the WP lounge. Participants were compensated \$15 for their time and effort during phase one of the study. Three months post-baseline, participants were given the opportunity to complete a follow up survey. Completion of this survey took approximately 10 minutes. Participants were given the option to complete the survey over the phone or online. See Table 1 for a list of assessments and timing. Baseline procedures were conducted from 2014–2015 with all follow-up procedures conducted in 2015. Participants were compensated with an additional \$10 for completion of the follow-up survey. All study procedures were approved by the university's Institutional Review Board.

Intervention—The intervention was administered immediately following the ad libitum WP smoking session and prior to the completion of post-session assessment measures. Intervention administration took approximately 5 minutes and was delivered by three graduate research assistants trained in brief motivational interventions. As such, the therapist used a non-confrontational approach, asked open-ended questions, and attempted to create a discrepancy between values and goals and current WP use. As participants in the intervention condition exited the WP lounge, they were invited to discuss WP smoking with a researcher. Participants were provided a handout with educational information that was presented by the research assistant. Participants were provided information regarding the volume of inhaled smoke during a typical WP smoking session, harmful constituents contained in WP tobacco and smoke, secondhand WP smoke, and nicotine in WP tobacco. Finally, participants were provided biochemical feedback of their eCO pre- and post-WP smoking. These measures were discussed in relation to smoker status. For example, participants with eCO readings above 26ppm were informed their eCO was similar to that of a heavy cigarette smoker or someone smoking a pack and a half of cigarettes or more per day. The researcher answered participant questions and participants completed post-session measures immediately after completing the intervention. Participants were not explicitly instructed to quit smoking WP during the intervention. Researchers were unblinded to participant condition.

Measures

Demographics—Participants completed self-report items assessing age, gender, ethnicity, and employment status at baseline.

Hooked on WP—At baseline, participants responded to a question asking, “Do you consider yourself “hooked” on using hookah?” Participants responded by circling, “yes,” “no,” or “I have never smoked hookah” (Heinz et al., 2013).

Last Marijuana Use—Participants reported their most recent marijuana use via the question, “How long as it been since you last used marijuana?” Responses were transformed to number of days since last marijuana use. Last marijuana use was assessed at baseline.

Other Tobacco/Nicotine Use—Participants responded to questions regarding their tobacco and nicotine use patterns. For each product, participants indicated their current use on a 0 to 3 scale where 0 = never tried, 1 = tried once, 2 = tried several times, and 3 = use frequently. Participants were considered ever-users if they reported lifetime use of any of the assessed products. Participants who reported never trying any product were considered never-tryers. Products assessed included electronic cigarettes, vapor devices, tobacco cigarettes, smokeless tobacco, and nicotine replacement therapy (e.g., lozenge, patch, inhaler, nasal spray, gum). Tobacco and nicotine use were assessed at baseline only.

Friends' WP Smoking—At baseline, participants indicated on a 0–5 scale, the number of their 5 closest friends whom have ever tried smoking WP (Heinz et al., 2013).

Knowledge of WP-Related Harms—Two true or false questions assessed participants' knowledge of WP-related harms (Prevention, 2016). These included “the water in hookah filters out the toxins and carcinogens (or cancer-causing materials) in the WP smoke” (Correct answer: False) and “a 60-minute hookah session delivers approximately the same amount of nicotine and tar as a whole pack of cigarettes” (Correct answer: True). Correct responses were coded as 1 and incorrect responses were coded as 0. The number of correct responses was summed to create a total score indicating the number of correct responses. WP knowledge questions were assessed at baseline, post-session, and 3-month follow-up.

Perceived Harmfulness of WP—Perceived absolute harmfulness of WP smoking (“how harmful do you think hookah is to your health?”) was measured on an eleven-point Likert scale from 0 (“not at all harmful”) to 10 (“extremely harmful”) and was assessed at all three study time points.

Commitment, Confidence in Ability, and Importance of Quitting WP—Participants indicated their commitment to quit WP smoking, their confidence in their ability, and importance of doing so via three self-report questions. Responses ranged from 1 (“not at all committed/confident/important”) to 10 (“very committed/confident/important”). Commitment, confidence, and importance were assessed at all three time points.

WP Smoking—At follow-up, participants completed a 3-month Timeline Followback calendar (Brown, 1998; Sobell, Brown, Leo, & Sobell, 1996) via phone interview with a trained researcher. Participants reported the number of days they smoked WP and the number of bowls smoked each day. Number of days smoked and number of bowls smoked were totaled to calculate measures of WP use at 3-month follow-up.

Carbon Monoxide Exposure—Exhaled carbon monoxide (eCO), a marker of smoke exposure, was assessed using a CoVita handheld eCO detector. eCO was assessed at baseline, immediately before entering the WP lounge, and post-session, immediately after exiting the WP lounge.

Data analytic plan

Bivariate comparisons between treatment conditions (control or intervention) and all categorical variables were made using a chi-square test or Fisher's exact test, as appropriate. Similar comparisons of continuous variables, after assessing normality, were made using Student's t-test or the Wilcoxon-Mann-Whitney test, as appropriate. Results of the bivariate comparisons are given as count (%), mean (SD), or median (25th %, 75th %). Linear mixed models for repeated measures were used to test the independent effect of the intervention on the various WP behavior, knowledge, and perception dependent variables while controlling for other covariates. Because subjects arrived and were recruited into the study in what are likely to be homogeneous groups, a random effect for group was included in the model. Covariates for inclusion in these models (number of friends whom have tried WP, ethnicity, employment status, and study recruitment location) were selected from the available demographics as well as those that were significant in bivariate comparisons between the control and intervention conditions.

Covariates for gender, baseline WP smoking, hooked on WP, marijuana use, other tobacco/nicotine use, and baseline motivation to quit WP smoking were also included in these models. A variety of covariance structures for these mixed models were considered and those yielding models with the lowest Akaike Information Criterion (AIC) were used. Backward elimination was used to remove the least significant covariates from the modeling process. A two-sided p-value of $< .05$ was considered statistically significant.

RESULTS

Sample

Of the 109 participants who completed study procedures, 108 were included in the baseline analyses (one participant had never smoked WP and had no intention to begin smoking). Fifty-five participants were allocated to the control condition and 53 were randomized to the intervention condition. Three participants withdrew from the study at post-session, and one did not complete the post-session assessment due to illness (96.3% retention at post-session). Sixty-seven participants (62.0% retention from baseline) completed the 3-month follow-up phone assessment (Figure 1). Those who did not complete the follow-up were more likely to be from WP lounge one, have greater baseline commitment to quit WP smoking, and use fewer tobacco/nicotine products ($p < .05$). See Table 2 for complete demographic information.

Perceived harmfulness—Participants in both the intervention and control conditions reported similar ratings of perceived WP harmfulness at baseline (Model adjusted mean (standard error); AOC = 5.66 (1.53); Intervention = 6.44 (1.61); $p = 0.4863$). Participants in the intervention condition reported significantly higher perceived harmfulness ratings at post-session [AOC = 5.54 (1.53); Intervention = 9.47 (1.61); $p = 0.0047$] and 3-month follow-up [AOC = 6.30 (1.56); Intervention = 9.25 (1.64); $p = 0.0253$] (Figure 2).

Knowledge of WP-related harms—The intervention had a significant effect on participants' knowledge of WP-related harms. Participants responded correctly to a similar

number of knowledge-based WP questions at baseline [AOC = 0.61 (0.80); Intervention = 0.77 (0.84); $p = 0.7892$]. Compared to those in the control condition, participants in the intervention condition had a significantly greater increase in the number of correct responses at post-session [AOC = 0.53 (0.80); Intervention = 3.91 (0.84); $p < 0.0001$] and 3-month follow-up [AOC = 2.26 (0.82); Intervention = 4.88 (0.86); $p = 0.0006$].

Confidence in ability to quit WP, importance of, and commitment to quitting WP

The intervention had a significant short-term effect on participants' confidence in their ability to quit WP smoking. While participants in the control condition displayed similar but higher ratings for confidence in ability to quit WP smoking at baseline [AOC = 9.19 (0.92); Intervention = 8.76 (0.97); $p = 0.5529$], the intervention condition endorsed greater confidence in their ability to quit smoking WP at post-session [AOC = 7.08 (0.92); Intervention = 8.98 (0.97); $p = 0.0132$], but not at 3-month follow-up [AOC = 9.11 (0.96); Intervention = 10.10 (1.03); $p = 0.2367$] (Figure 3).

The intervention had an initial significant effect on self-reported importance of quitting WP. Participants in the control and intervention conditions displayed similar ratings for the importance of quitting WP at baseline [AOC = 3.40 (0.59); Intervention = 3.32 (0.54); $p = 0.8417$]. However, the intervention condition endorsed significantly greater importance of quitting at post-session [AOC = 3.84 (0.76); Intervention = 5.51 (0.76); $p = 0.0455$] but did not differ from the controls at 3-month follow-up [AOC = 5.12 (1.03); Intervention = 6.47 (1.12); $p = 0.3255$].

The intervention significantly increased commitment to quitting WP smoking. Again, on average, both conditions endorsed similar commitment ratings at baseline [AOC = 3.45 (0.83); Intervention = 3.50 (0.95); $p = 0.9441$], but the intervention condition had marginally higher ratings at post-session [AOC = 3.25 (0.83); Intervention = 4.78 (0.95); $p = 0.0542$] and 3-month follow-up [AOC = 4.13 (0.89); Intervention = 6.61 (1.04); $p = 0.0077$] (Figure 4).

Behavioral outcomes—At 3-month follow-up, no statistical differences were observed between conditions in number of days smoking WP [AOC = 2.00 (1.27); Intervention = 3.34 (1.38); $p = 0.4599$] or number of WP bowls smoked [AOC = 3.33 (0.85); Intervention = 2.52 (0.96); $p = 0.5274$]. Overall, approximately 45% of participants in both conditions reported no WP use during the three months following the baseline assessment.

DISCUSSION

The present study is the first to evaluate the effectiveness of a brief, face-to-face, personalized feedback intervention in decreasing WP tobacco use among WP lounge patrons. While this type of intervention has been successful for other substances of abuse, it has never been applied to WP smoking. This study is also unique in that the intervention was provided unexpectedly to patrons entering a WP lounge (suggesting that their motivation at the time was at its lowest) and included biochemical feedback of their WP tobacco use/exposure (e.g., eCO). Overall, the intervention was effective in changing perceptions of risk, intentions to quit smoking WP in the future, and knowledge of specific WP-related harms.

These changes were often maintained three months post-intervention. However, those who received the intervention did not report statistically significantly different WP smoking behavior than those in the AOC condition at the 3-month follow-up.

Similar to other studies of U.S. WP smokers, WP lounge patrons reported low levels of perceived harmfulness of WP smoking and had a poor understanding of WP health-related facts prior to receiving corrective information (Chan & Murin, 2011; Lipkus et al., 2011; Smith et al., 2011; Ward et al., 2007). Those who received educational and personalized feedback displayed improved knowledge of WP-related harms and greater perceptions of harm that was maintained during the 3-month follow-up period. This finding is consistent with previous research showing that a brief educational message about WP smoking can increase perceptions of harm (Lipkus et al., 2011; Mays, Teracyak, & Lipkus, 2015).

Those who received the intervention reported greater commitment to quitting WP smoking compared to those in the AOC condition at a 3-month follow-up. Similarly, the intervention condition displayed a greater initial increase in importance of quitting than those in the AOC condition. Approximately 45% of participants in both conditions displayed continuous abstinence during the three months following the intervention. A previous intervention had been effective at inducing WP cessation using a behavioral intervention (Asfar et al., 2014); however, this intervention offered additional support such as longer counseling sessions, additional consultations on the quit date, and community-based intervention strategies. Including additional components such as setting a quit date and/or follow-up consultations may be necessary for the initiation and maintenance of behavioral changes.

Findings from the present study are important given the recent attention and call to action to intervene on the rapid increase in WP tobacco smoking (123% increase) in the U.S. (Jawad, McEwen, McNeill, & Shahab, 2013; Prevention, 2010; Ward, Siddiqi, Ahluwalia, Alexander, & Asfar, 2015). The misperception that WP tobacco smoking is less harmful than other forms of tobacco is likely contributing, in large part, to its use. Therefore, brief, simple to administer educational interventions have the potential to reach a large number of individuals and shape attitudes towards WP tobacco smoking. Corrective feedback about the harm of smoking WP tobacco is especially important, given the diversifying tobacco landscape.

The study has several limitations. First, WP smoking quit attempts were not directly assessed, ignoring those who may have experienced relapse early in cessation – a common quitting pattern for many tobacco users (Piasecki, 2006). In addition, measures for assessing use patterns differed at baseline and FU. For this reason, longitudinal comparisons were not appropriate. Future research is needed to allow for such observations. Second, participants were those entering a WP lounge in a Midwestern state; therefore, results may not generalize to those actively seeking treatment, international samples, people living in other regions, or individuals who tend to smoke WP in their home. Third, individuals who had not previously smoked WP were allowed to participate in the current study. Although the number of patrons who did not smoke WP was low, there may be differential effects of the intervention on those who did and did not smoke at the time of study enrollment. Fourth, information was not gathered regarding other behaviors (e.g., other tobacco use, number of people sharing a

hookah) in the WP lounge. Because these behaviors can influence eCO, future studies should gather additional contextual information. Also, while face-valid or used in previous studies, many of the measures utilized in the current study lack information on their psychometric properties. Finally, participants were given corrective feedback about the harms of WP tobacco outside of a WP lounge. Given that this intervention had opposing goals from those of a WP lounge owner, the ability to disseminate this model of intervention into a real-world setting may be difficult. However, this study has important implications as it demonstrates the utility of a very brief intervention in changing perceptions and intentions to quit among WP users at a time when their motivation to quit is likely at its lowest. Therefore, this intervention may be feasible in other settings in which time and resources are limited (e.g., college campuses, medical clinics). In addition, this intervention may be even more impactful in the form of a mass-media intervention and/or on college campuses. Future studies should examine the impact of such an intervention and also examine the impact on non-WP smoking populations to understand the impact of such interventions on prevention efforts.

Despite these limitations, a brief personalized feedback intervention for WP tobacco use was effective in changing perceptions of harm and motivation to quit in a sample of WP patrons when spontaneously provided this intervention. Future research is needed to examine the feasibility of conducting such an intervention in other settings, such as medical clinics or college campuses. Additionally, given that this intervention was brief, future studies could build on this work by adding components of motivational enhancement therapy such as building self-efficacy, providing easily accessible services for those who would like help quitting WP, and providing additional relevant personalized feedback.

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References

- Aboaziza E, Eissenberg T. Waterpipe tobacco smoking: what is the evidence that it supports nicotine/tobacco dependence? *Tob Control*. 2015; 24(Suppl 1):i44–i53. DOI: 10.1136/tobaccocontrol-2014-051910 [PubMed: 25492935]
- Akl EA, Gaddam S, Gunukula SK, Honeine R, Jaoude PA, Irani J. The effects of waterpipe tobacco smoking on health outcomes: a systematic review. *Int J Epidemiol*. 2010; 39(3):834–857. DOI: 10.1093/ije/dyq002 [PubMed: 20207606]
- Akl EA, Jawad M, Lam WY, Co CN, Obeid R, Irani J. Motives, beliefs and attitudes towards waterpipe tobacco smoking: a systematic review. *Harm Reduct J*. 2013; 10:12.doi: 10.1186/1477-7517-10-12 [PubMed: 23816366]
- Al Rashidi M, Shihadeh A, Saliba NA. Volatile aldehydes in the mainstream smoke of the narghile waterpipe. *Food Chem Toxicol*. 2008; 46(11):3546–3549. DOI: 10.1016/j.fct.2008.09.007 [PubMed: 18834915]
- Arrazola RA, Singh T, Corey CG, Husten CG, Neff LJ, Apelberg BJ. ... Prevention. Tobacco use among middle and high school students - United States, 2011–2014. *MMWR Morb Mortal Wkly Rep*. 2015; 64(14):381–385. [PubMed: 25879896]

- Asfar T, Al Ali R, Rastam S, Maziak W, Ward KD. Behavioral cessation treatment of waterpipe smoking: The first pilot randomized controlled trial. *Addict Behav.* 2014; 39(6):1066–1074. DOI: 10.1016/j.addbeh.2014.02.012 [PubMed: 24629480]
- Berg CJ, Stratton E, Schauer GL, Lewis M, Wang Y, Windle M, Kegler M. Perceived harm, addictiveness, and social acceptability of tobacco products and marijuana among young adults: marijuana, hookah, and electronic cigarettes win. *Substance use & misuse.* 2015; 50(1):79–89. [PubMed: 25268294]
- Brown RA, Burgess ES, Sales SD, Whiteley JA, Evans DM, Miller IW. Reliability and validity of a smoking timeline follow-back interview. *Psychology of Addictive Behaviors.* 1998; 12(2):101.
- Chan A, Murin S. Up in smoke: the fallacy of the harmless Hookah. *Chest.* 2011; 139(4):737–738. DOI: 10.1378/chest.10-2985 [PubMed: 21467052]
- Cobb C, Ward KD, Maziak W, Shihadeh AL, Eissenberg T. Waterpipe tobacco smoking: an emerging health crisis in the United States. *Am J Health Behav.* 2010; 34(3):275–285. [PubMed: 20001185]
- Cobb CO, Shihadeh A, Weaver MF, Eissenberg T. Waterpipe tobacco smoking and cigarette smoking: a direct comparison of toxicant exposure and subjective effects. *Nicotine Tob Res.* 2011; 13(2):78–87. DOI: 10.1093/ntr/ntq212 [PubMed: 21127030]
- de Josselin de Jong S, Candel M, Segaar D, Cremers HP, de Vries H. Efficacy of a Web-based computer-tailored smoking prevention intervention for Dutch adolescents: randomized controlled trial. *J Med Internet Res.* 2014; 16(3):e82.doi: 10.2196/jmir.2469 [PubMed: 24657434]
- Dogar O, Jawad M, Shah SK, Newell JN, Kanaan M, Khan MA, Siddiqi K. Effect of cessation interventions on hookah smoking: post-hoc analysis of a cluster-randomized controlled trial. *Nicotine Tob Res.* 2014; 16(6):682–688. DOI: 10.1093/ntr/ntt211 [PubMed: 24376277]
- Doran N, Godfrey KM, Myers MG. Hookah Use Predicts Cigarette Smoking Progression Among College Smokers. *Nicotine Tob Res.* 2015; 17(11):1347–1353. DOI: 10.1093/ntr/ntu343 [PubMed: 25586774]
- Eissenberg T, Shihadeh A. Waterpipe tobacco and cigarette smoking: direct comparison of toxicant exposure. *Am J Prev Med.* 2009; 37(6):518–523. DOI: 10.1016/j.amepre.2009.07.014 [PubMed: 19944918]
- Elfeddali I, Bolman C, Candel MJ, Wiers RW, de Vries H. Preventing smoking relapse via Web-based computer-tailored feedback: a randomized controlled trial. *J Med Internet Res.* 2012; 14(4):e109.doi: 10.2196/jmir.2057 [PubMed: 22903145]
- Essa-Hadad J, Linn S, Rafaeli S. A web-based program to increase knowledge and reduce cigarette and nargila smoking among Arab university students in Israel: mixed-methods study to test acceptability. *J Med Internet Res.* 2015; 17(2):e39.doi: 10.2196/jmir.2988 [PubMed: 25707034]
- Gilreath TD, Leventhal A, Barrington-Trimis JL, Unger JB, Cruz TB, Berhane K, ... Pentz MA. Patterns of alternative tobacco product use: Emergence of hookah and e-cigarettes as preferred products amongst youth. *Journal of Adolescent Health.* 2016; 58(2):181–185. [PubMed: 26598059]
- Heinz AJ, Giedgowd GE, Crane NA, Veilleux JC, Conrad M, Braun AR, ... Kassel JD. 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.* 2013; 38(11):2751–2760. DOI: 10.1016/j.addbeh.2013.07.009 [PubMed: 23934006]
- Jacob P 3rd, Abu Raddaha AH, Dempsey D, Havel C, Peng M, Yu L, Benowitz NL. Nicotine, carbon monoxide, and carcinogen exposure after a single use of a water pipe. *Cancer Epidemiol Biomarkers Prev.* 2011; 20(11):2345–2353. DOI: 10.1158/1055-9965.EPI-11-0545 [PubMed: 21908725]
- Jawad M, Jawad S, Waziry RK, Ballout RA, Akl EA. Interventions for waterpipe tobacco smoking prevention and cessation: a systematic review. *Sci Rep.* 2016; 6:25872.doi: 10.1038/srep25872 [PubMed: 27167891]
- Jawad M, McEwen A, McNeill A, Shahab L. The importance of addressing waterpipe tobacco smoking: research and policy responses. *Addiction.* 2013; 108(11):1887–1888. DOI: 10.1111/add.12341 [PubMed: 24118757]

- Johnston, LD., OM, PM, Miech, RA., Bachman, JG., Schulenberg, JE. Monitoring the Future national results on drug use: 1975–2013: Overview, Key Findings on Adolescent Drug Use. Ann Arbor: Institute for Social Research, The University of Michigan; 2014.
- Kingsbury JH, Parks MJ, Amato MS, Boyle RG. Deniers and Admitters: Examining Smoker Identities in a Changing Tobacco Landscape. *Nicotine Tob Res.* 2016; 18(11):2130–2137. DOI: 10.1093/ntr/ntw110 [PubMed: 27085084]
- Lipkus IM, Eissenberg T, Schwartz-Bloom RD, Prokhorov AV, Levy J. Affecting perceptions of harm and addiction among college waterpipe tobacco smokers. *Nicotine Tob Res.* 2011; 13(7):599–610. DOI: 10.1093/ntr/ntr049 [PubMed: 21471304]
- Mays D, Tercyak KP, Lipkus IM. The Effects of Brief Waterpipe Tobacco Use Harm and Addiction Education Messages Among Young Adult Waterpipe Tobacco Users. *Nicotine Tob Res.* 2015; doi: 10.1093/ntr/ntv223
- Maziak W, Jawad M, Jawad S, Ward KD, Eissenberg T, Asfar T. Interventions for waterpipe smoking cessation. *Cochrane Database Syst Rev.* 2015; (7):CD005549.doi: 10.1002/14651858.CD005549.pub3 [PubMed: 26228266]
- Maziak W, Rastam S, Ibrahim I, Ward KD, Shihadeh A, Eissenberg T. CO exposure, puff topography, and subjective effects in waterpipe tobacco smokers. *Nicotine Tob Res.* 2009; 11(7):806–811. DOI: 10.1093/ntr/ntp066 [PubMed: 19420278]
- Meier EM, Tackett AP, Miller MB, Grant DM, Wagener TL. Which nicotine products are gateways to regular use? First-trying tobacco and current use in college students. *Am J Prev Med.* 2015; 48(1 Suppl 1):S86–93. DOI: 10.1016/j.amepre.2014.09.018 [PubMed: 25528714]
- Miller MB, Leffingwell T, Claborn K, Meier E, Walters S, Neighbors C. Personalized feedback interventions for college alcohol misuse: an update of Walters & Neighbors (2005). *Psychol Addict Behav.* 2013; 27(4):909–920. DOI: 10.1037/a0031174 [PubMed: 23276309]
- Monzer B, Sepetdjian E, Saliba N, Shihadeh A. Charcoal emissions as a source of CO and carcinogenic PAH in mainstream narghile waterpipe smoke. *Food Chem Toxicol.* 2008; 46(9):2991–2995. DOI: 10.1016/j.fct.2008.05.031 [PubMed: 18573302]
- Neergaard J, Singh P, Job J, Montgomery S. Waterpipe smoking and nicotine exposure: a review of the current evidence. *Nicotine Tob Res.* 2007; 9(10):987–994. DOI: 10.1080/14622200701591591 [PubMed: 17943617]
- Piasecki TM. Relapse to smoking. *Clin Psychol Rev.* 2006; 26(2):196–215. DOI: 10.1016/j.cpr.2005.11.007 [PubMed: 16352382]
- Prevention, C. f. D. C. a. National Youth Tobacco Survey. Hookahs: 2010. Retrieved from Prevention, C. f. D. C. a. (2016, 12/1/2016)
- Saleh R, Shihadeh A. Elevated toxicant yields with narghile waterpipes smoked using a plastic hose. *Food Chem Toxicol.* 2008; 46(5):1461–1466. DOI: 10.1016/j.fct.2007.12.007 [PubMed: 18207299]
- Sepetdjian E, Shihadeh A, Saliba NA. Measurement of 16 polycyclic aromatic hydrocarbons in narghile waterpipe tobacco smoke. *Food Chem Toxicol.* 2008; 46(5):1582–1590. DOI: 10.1016/j.fct.2007.12.028 [PubMed: 18308445]
- Shihadeh A. Investigation of mainstream smoke aerosol of the argileh water pipe. *Food Chem Toxicol.* 2003; 41(1):143–152. [PubMed: 12453738]
- Shihadeh A, Saleh R. Polycyclic aromatic hydrocarbons, carbon monoxide, “tar”, and nicotine in the mainstream smoke aerosol of the narghile water pipe. *Food Chem Toxicol.* 2005; 43(5):655–661. DOI: 10.1016/j.fct.2004.12.013 [PubMed: 15778004]
- Smith JR, Edland SD, Novotny TE, Hofstetter CR, White MM, Lindsay SP, Al-Delaimy WK. Increasing hookah use in California. *Am J Public Health.* 2011; 101(10):1876–1879. DOI: 10.2105/AJPH.2011.300196 [PubMed: 21852640]
- Sobell LC, Brown J, Leo GI, Sobell MB. The reliability of the Alcohol Timeline Followback when administered by telephone and by computer. *Drug Alcohol Depend.* 1996; 42(1):49–54. [PubMed: 8889403]
- Ward KD, Eissenberg T, Gray JN, Srinivas V, Wilson N, Maziak W. Characteristics of U.S. waterpipe users: a preliminary report. *Nicotine Tob Res.* 2007; 9(12):1339–1346. DOI: 10.1080/14622200701705019 [PubMed: 18058352]

Ward KD, Siddiqi K, Ahluwalia JS, Alexander AC, Asfar T. Waterpipe tobacco smoking: The critical need for cessation treatment. *Drug Alcohol Depend.* 2015; 153:14–21. DOI: 10.1016/j.drugalcdep.2015.05.029 [PubMed: 26054945]

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Figure 1.
Participant Flow

Note. WP = waterpipe. [†]One participant reported never smoking WP with no intention to begin smoking and was therefore removed from analyses.

Figure 2.

Perceived Absolute Harmfulness of WP Smoking across Study Time Points

Note. WP = waterpipe. Mean ($\pm$ SEM) data for perceptions of harmfulness over time between treatment groups. * $p < .05$, ** $p < .01$.

Figure 3.

Confidence in Ability to Quit WP Smoking across Study Time Points

Note. WP = waterpipe. Mean ($\pm$ SEM) data for confidence in ability to quit over time between treatment groups. * $p < .05$, ** $p < .01$.

Figure 4.

Commitment to Quit WP Smoking across Study Time Points

Note. WP = waterpipe. Mean ($\pm$ SEM) data for commitment to quit over time between treatment groups. * $p < .05$, ** $p < .01$.

Table 1

Timing of Assessment Measures

Measure	Baseline	Post-Session	3-Month Follow-Up
Demographics	X		
Hooked on WP	X		
Last Marijuana Use	X		
Other Tobacco/Nicotine Use	X		
Friends' WP Smoking	X		
Knowledge of WP-Related Harms	X	X	X
Perceived Harmfulness of WP	X	X	X
Commitment, Confidence in Ability, and Importance of Quitting WP	X	X	X
WP Smoking			X
Carbon Monoxide Exposure	X	X	

Note. WP = waterpipe.

Table 2**Baseline Demographic and Covariate Variables by Condition**

Variable	Total (n=108)	Intervention (n=53)	Control (n=55)	p-value
Age	21.1 (5.08)	20.58 (5.25)	21.75 (4.93)	0.244
Gender				0.695
Female	26 (24.1%)	12 (22.6%)	14 (25.5%)	
Male	82 (75.9%)	41 (77.4%)	41 (74.5%)	
Ethnicity				0.612
Caucasian	53 (49.1%)	22 (41.5%)	31 (56.4%)	
African American	16 (14.8%)	9 (17.0%)	7 (12.7%)	
Latino/Hispanic	13 (12.0%)	6 (11.3%)	7 (12.7%)	
Native American	6 (5.6%)	3 (5.7%)	3 (5.5%)	
Asian	11 (10.2%)	7 (13.2%)	4 (7.3%)	
Other	9 (8.3%)	6 (11.3%)	3 (5.5%)	
Employment Status				0.354
Employed full time	45 (41.7%)	22 (41.5%)	23 (41.8%)	
Unemployed	6 (5.6%)	5 (9.4%)	1 (1.8%)	
Student	38 (35.2%)	19 (35.8%)	19 (34.5%)	
Employed part time	16 (14.8%)	7 (13.2%)	9 (16.4%)	
Homemaker	2 (1.9%)	----	2 (3.6%)	
Retired	1 (0.9%)	----	1 (1.8%)	
Study Recruitment Location				0.091
WP Lounge 1	43 (40.0%)	25 (47.2%)	17 (30.9%)	
WP Lounge 2	12 (11.0%)	3 (5.7%)	9 (16.4%)	
WP Lounge 3	53 (49.0%)	25 (47.2%)	29 (52.7%)	
Number of Friends tried WP	4 (3, 5)	4 (3, 5)	5 (3, 5)	0.033
Hooked on WP				0.236
No	90 (83.33%)	41 (77.36%)	49 (89.09%)	
Yes	10 (9.26%)	7 (13.21%)	3 (5.45%)	
I have never smoked [†] WP	8 (7.41%)	5 (9.43%)	3 (5.45%)	
Last Marijuana Use (in days)	4.0 (0.1, 90.0)	10.0 (0.4, 250)	2.1 (0.0, 28.1)	0.067
Other Tobacco/Nicotine Use				
No	8 (7.41%)	6 (11.32%)	2 (3.64%)	0.158
Yes	100 (92.59%)	47 (88.68%)	53 (96.36%)	
Baseline Commitment to Quit WP Smoking	2.00 (1.00, 5.00)	2.00 (1.00, 5.00)	1.00 (1.00, 5.00)	0.886
Past 30-day WP Smoking (number of days smoked) [*]	1.00 (0.00, 1.00)	1.00 (1.00, 2.00)	1.00 (0.00, 2.00)	0.479

Note. Values represent *n* (%), median (25th%, 75th %), and Mean (SD). WP = waterpipe.

^{*} Measure completed only by those who reported past month WP smoking.

[†] Participants denying previous WP smoking were retained in analyses if they reported a plan to smoke WP the night of data collection.