



## Short Communication

## Comparative analysis of waterpipe and cigarette suppression of abstinence and craving symptoms

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## ABSTRACT

This study's objective is to examine the relative effectiveness of cigarettes and waterpipe (WP) in reducing tobacco abstinence symptoms in dual cigarette/WP smokers. Sixty-one dual cigarette/WP smokers participated (mean age  $\pm$  SD 22.0  $\pm$  2.6 year; mean cigarettes/day 22.4  $\pm$  10.1; mean WPs/week 5.2  $\pm$  5.6). After 12-hour abstinence participants completed two smoking sessions (WP or cigarette), while they responded to subjective measures of withdrawal, craving, and nicotine effects administered before smoking and 5, 15, 30 and 45 min thereafter. For both tobacco use methods, scores on measures of withdrawal and craving were high at the beginning of session (i.e., before smoking) and were reduced significantly and comparably during smoking. Analysis of smoking and recovery (post-smoking) phases showed similarity in the way both tobacco use methods suppressed withdrawal and craving, but the recovery of some of these symptoms can be faster with cigarette use. This study is the first to show the ability of WP to suppress abstinence effects comparably to cigarettes, and its potential to thwart cigarette cessation.

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## 1. Introduction

Waterpipe smoking (WP), also known as hookah, narghile, and shisha, involves the inhalation of smoke after passage through water. WP is a centuries-old tobacco use method associated traditionally with Middle Eastern societies, but has surged in popularity among youth worldwide in the past two decades (Maziak, 2011).

Waterpipe smoking is associated with nicotine exposure as indexed by levels of nicotine and its metabolites in blood and other bodily fluids (e.g. Eissenberg & Shihadeh, 2009). Tobacco abstinence symptoms have also been reported in WP smokers, and these symptoms were reduced by subsequent WP use (Maziak et al., 2009). Moreover, some cigarette smokers may use WP during a cigarette cessation attempts (Asfar et al., 2008), perhaps as a means of reducing the severity of tobacco abstinence effects. Tobacco abstinence symptom suppression that results from switching to WP during a cigarette cessation attempt may lead to continued WP use (i.e., through negative reinforcement, Eissenberg, 2004) or relapse to cigarettes because of lower accessibility of WP compared to cigarettes. In either case, the resulting continuation of tobacco use threatens the

potential health benefit of the cessation attempt. In order to account for the cigarette replacement potential of WP in our cessation efforts, we need to understand its underlying mechanisms and nuances, especially given the difference in smoking patterns and subsequently nicotine delivery between WP (i.e. more prolonged and intermittent) and cigarettes. This study aims to examine the relative effectiveness of WP and cigarettes in reducing tobacco abstinence symptoms in dual cigarette/WP smokers.

## 2. Materials and methods

## 2.1. Participants

Study participants were recruited through advertisements and by word-of-mouth and were invited to the Syrian Center for Tobacco Studies (SCTS) clinical lab in Aleppo, Syria. Volunteers were included in the study if they were 18 to 55 years of age, reported smoking one or more WPs per week and 10 or more cigarettes per day during the past 6 months, and were in good general health. Volunteers were excluded if they reported any medical or psychological problems, were breastfeeding, or were pregnant. This analysis includes 61 subjects (56 male, mean age  $\pm$  SD 22.0  $\pm$  2.6 years, mean weekly WPs 5.2  $\pm$  5.6; mean daily cigarettes 22.4  $\pm$  10.1), who agreed to participate in this study and followed the IRB-approved study protocol.

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## 2.2. Design and procedures

In this within-subject study, each participant completed two smoking sessions that differed by tobacco use method (WP or cigarette; session order was randomized). Participants were asked to abstain from all tobacco products for at least 12 h (verified with expired air CO levels  $\leq 10$  ppm) prior to the start of 2 sessions (separated by at least 48 h), where they smoked either WP or their usual cigarette brand *ad libitum*. For the cigarette session, participants were provided with their preferred brand of cigarette and started a 5-minute cigarette use episode. For the WP session, participants were provided with their preferred brand and flavor of WP tobacco, as well as other necessary materials, and they completed a 30 min *ad libitum* session. Both sessions were concluded 45 min after smoking onset. Participants who completed the entire protocol were paid 2000 Syrian Lira ( $\approx 40$  USD).

## 2.3. Outcome measures

The primary outcomes of this study were subjective measures of tobacco abstinence and nicotine effects that were translated into Arabic, computerized, and pilot tested in a previous study (Maziak et al., 2009). Participants were trained to use a computer keyboard and mouse to respond to the following measures which were administered in both sessions before smoking and exactly at 5, 15, 30 and 45 min after smoking onset. 1) The Hughes–Hatsukami Withdrawal scale (HH, adapted from Buchhalter, Acosta, Evans, Breland, & Eissenberg, 2005) consists of 11 items presented as visual analog scales anchored with *not at all* on the left and with *extremely* on the right. 2) The Tiffany–Drobes Questionnaire on Smoking Urges (QSU-brief, adapted from Cox, Tiffany, & Christen, 2001) consists of 10 items (and two factors – intention to smoke, and anticipation of relief from withdrawal) that are rated on a scale ranging from 0 (strongly

disagree) to 6 (strongly agree). 3) The Direct Effects of Nicotine scale (DENS, adapted from Kleykamp, Jennings, Sams, Weaver, & Eissenberg, 2008) consists of 10 visual analog scale items (scales' details in Table 1).

## 2.4. Data analysis

In order to compare the effects of smoking cigarette and WP, subjective data were entered into a repeated model ANOVA with two within-subject factors: time (pre-smoking, 5, 15, 30 and 45 min after start of smoking) and condition (cigarette or WP). We report F, P and partial eta-squared for the repeated model ANOVA for the whole session analysis. F and P were calculated according to the Greenhouse–Geisser method, which corrects for any violation of the sphericity assumption. Partial eta-squared is an indicator of the proportion of total variability attributable to a factor. Results of the repeated model ANOVA analysis are listed in Table 1.

To compare the effects of smoking between cigarette and WP for relatively similar segments of the smoking sessions (because cigarette smoking lasted 5 min, while WP smoking lasted 30 min), we ran a series of contrast analyses using Least Squares means (LS means) as follows: 1) Condition main effects (for each time point) to detect the differences between two sessions at each time point. 2) Specific comparisons of particular session phases; *Smoking phase analysis*: (0 to 5 min cigarette vs. 0 to 5 min WP) to compare score changes during equal times of smoking, and (0 to 5 min cigarette vs. 0 to 30 min WP) to compare score changes during the whole smoking time; *Recovery phase analysis*: (5 to 15 min cigarette vs. 30 to 45 min WP) to compare score changes for the first recovery period during almost equal times, and (5 to 45 min cigarette vs. 30 to 45 min WP) to compare changes for the whole recovery period. Results of LS means comparisons are listed in Table 2.

**Table 1**  
Results of the repeated model ANOVA for the whole smoking session (waterpipe, cigarettes).

	Type			Time			Type* time		
	F	Sig.	$\omega^2$ *	F	Sig.	$\omega^2$	F	Sig.	$\omega^2$
<i>Hughes–Hatsukami Withdrawal scale</i>									
1–Urges to smoke	15.5	0.000	0.206	29.6	0.000	0.331	6.6	0.000	0.100
2–Irritability/frustration/anger	4.1	0.048	0.063	25.5	0.000	0.299	1.8	0.147	0.030
3–Anxious	5.3	0.024	0.082	19.0	0.000	0.241	0.6	0.604	0.010
4–Difficulty concentrating	1.2	0.280	0.019	10.6	0.000	0.150	0.7	0.538	0.012
5–Restlessness	14.5	0.000	0.195	21.2	0.000	0.261	0.8	0.471	0.014
6–Hunger	3.0	0.088	0.048	4.1	0.018	0.064	3.6	0.013	0.057
7–Impatient	4.8	0.032	0.075	37.5	0.000	0.384	2.2	0.095	0.036
8–Craving a cigarette/waterpipe/nicotine	7.6	0.008	0.113	28.9	0.000	0.325	10.5	0.000	0.149
9–Drowsiness	4.8	0.033	0.074	3.5	0.021	0.055	1.1	0.337	0.019
10–Depression/feeling blue	1.0	0.312	0.017	9.3	0.000	0.134	0.9	0.428	0.015
11–Desire for sweets	0.6	0.454	0.009	0.8	0.464	0.013	0.7	0.532	0.012
<i>The Tiffany–Drobes questionnaire of smoking urges</i>									
1–Intention to smoke	30.7	0.000	0.338	29.6	0.000	0.330	26.8	0.000	0.308
2–Anticipation of relief from withdrawal	15.1	0.000	0.201	22.0	0.000	0.268	18.4	0.000	0.235
<i>The direct effects of nicotine scale</i>									
1–Nauseous	1.0	0.325	0.016	2.3	0.087	0.037	7.0	0.000	0.105
2–Dizzy	0.1	0.722	0.002	15.5	0.000	0.206	20.7	0.000	0.257
3–Lightheaded	0.2	0.642	0.004	5.9	0.001	0.090	7.9	0.000	0.116
4–Nervous	0.4	0.540	0.006	12.5	0.000	0.173	1.0	0.393	0.017
5–Sweaty	0.2	0.695	0.003	1.2	0.324	0.019	1.8	0.142	0.029
6–Headache	0.4	0.537	0.006	1.4	0.256	0.022	1.7	0.168	0.028
7–Excessive salivation	0.3	0.585	0.005	3.5	0.015	0.056	2.9	0.031	0.047
8–Heart pounding	1.1	0.296	0.018	5.2	0.002	0.080	8.8	0.000	0.128
9–Confused	0.0	0.860	0.001	8.8	0.000	0.127	1.5	0.204	0.025
10–Weak	1.1	0.298	0.018	3.3	0.020	0.052	6.1	0.000	0.092

$\omega^2$ \* Partial eta-squared.

F and P were calculated according to Greenhouse–Geisser modification.

Score results on repeated model ANOVA with two within-factors; Type with 2 levels (cigarette and waterpipe) and time with 5 levels (pre-smoking, at 5 min, 15 min, 30 min, and 45 min after start smoking).

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