

# Correlation between nicotine dependence and barriers to cessation between exclusive cigarette smokers and dual (water pipe) smokers among Arab Americans

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**Background:** Evidence suggests that dual cigarette and water pipe use is growing among minority groups, particularly among Arab Americans. Differences in nicotine dependence and barriers to smoking cessation among such dual smokers have not been previously examined in this population. We examined potential differences that might exist between exclusive cigarette smokers and dual smokers (cigarette and water pipe) pertaining to nicotine dependence and barriers to cessation among Arab Americans.

**Methods:** We conducted a cross-sectional study using a convenience sample of self-identified Arab immigrant smokers (n=131) living in the Richmond, VA metropolitan area. Data were collected using four questionnaires: Demographic and Cultural Information questionnaire, Tobacco Use questionnaire, Fagerström Test for Nicotine Dependence (FTND) questionnaire, and Barriers to Cessation questionnaire. We examined differences in nicotine dependence and barriers to cessation between exclusive cigarette smokers and dual smokers of cigarettes and water pipe. Furthermore, we explored the correlations of these measures with select variables.

**Results:** There was a significant difference in the FTND scores between the exclusive cigarette smokers (mean M=2.55, standard deviation [SD] =2.10) and dual smokers (M=3.71, SD =2.42);  $t(129) = (2.51)$ ,  $P=0.0066$ . There was also a significant difference in the Barriers to Cessation scores between exclusive cigarette smokers (M=38.47, SD =13.07) and dual smokers (M=45.21, SD =9.27);  $t(129) = (2.56)$ ,  $P=0.0058$ . Furthermore, there was a highly significant correlation among FTND scores, Barriers to Cessation scores, and past quit attempts among dual smokers.

**Conclusion:** Water pipe tobacco smoking seems to be both adding to the dependence potential of cigarette smoking and enhancing barriers to cessation in our study sample. However, the high correlation between quit attempts, FTND, and barriers to cessation needs further investigation to ascertain the possible reasons behind it. This preliminary study utilized a cross-sectional survey among participants of a rather small convenience sample, especially in the dual smokers group. Thus, there is a need to examine these differences via a longitudinal design in a larger sample.

**Keywords:** Arab Americans, cessation barriers, dual use, nicotine dependence, water pipe smoking

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## Introduction

Cigarette use is the most prevalent form of tobacco consumption in the United States (US).<sup>1</sup> Nevertheless, water pipe tobacco smoking (WTS), one of the alternative forms of tobacco use, has steadily gained popularity globally<sup>2-4</sup> and in the US.<sup>5-7</sup> WTS

prevalence reached up to 20% in some young adults' samples within the US.<sup>5</sup>

Determining the nicotine content of WTS is not a straightforward process. The concentration of nicotine delivered by a water pipe depends on the type and amount of tobacco used in every WTS sitting.<sup>8,9</sup> Additionally, the nicotine delivered through WTS depends on the length, frequency, and depth of each inhalation.<sup>10,11</sup> Nevertheless, some studies have shown that the amount of nicotine delivered by water pipes is comparable to that of cigarettes.<sup>10</sup> Similar to cigarette use, WTS creates nicotine dependence, but WTS is likely to cause more harm than cigarettes.<sup>10,12,13</sup> WTS results in higher plasma levels of carboxyhemoglobin and more than a 50-fold increase in inhaled smoke volume, which may correlate with higher morbidity and mortality.<sup>5</sup>

Furthermore, WTS has a profound social appeal, which makes it popular among its smokers.<sup>14</sup> Rastam et al<sup>11</sup> evaluated the potential of WTS versus cigarette smoking in suppressing abstinence and craving symptoms in dual smokers. They found both smoking methods to be comparable in terms of efficacy of suppressing these symptoms. In addition, many water pipe smokers perceive WTS as less harmful than cigarettes.<sup>14,15</sup> WTS is associated with 1) lower interest regarding quitting than cigarette smoking and 2) an overarching strong social dependence that complements the neuropharmacological changes that confirm it as an established smoking modality, creating dependence.<sup>16</sup> Other studies suggest that some cigarette smokers attempt to taper their nicotine dependence by transitioning to WTS.<sup>17</sup> There is a false belief that quitting WTS is much easier than quitting cigarette smoking.<sup>18</sup> These aforementioned beliefs, among others, may help create dual smokers of cigarette and water pipe.

Dual smoking combines the ease of carrying a pack of cigarettes in one's pocket, with the socially pleasant opportunity to use WTS when it is available. This could create more potential for nicotine dependence and strengthen the barriers to quitting.<sup>6</sup> Dual smokers represented a substantial percentage (9.3% versus 22% exclusive cigarette use and 6.1% exclusive water pipe use) of a US university population surveyed in a previous study,<sup>6</sup> which was spread over a 6-year span, with the smokers' percentage being 37.4%. Others also found that dual use of cigarettes and WTS is much higher than exclusive WTS in their samples.<sup>17,19,20</sup> This supports the notion that WTS is usually an intermittent process,<sup>16</sup> accomplished through a complex apparatus<sup>2</sup> that is not as easy to transport as cigarettes.

Tobacco use among Arab Americans is higher than the national average in previous studies, wherein it ranged from

35.4%<sup>20</sup> to 38.9%.<sup>21</sup> Moreover, Jamil et al<sup>20</sup> found WTS (3.5%) and dual smoking (4.3%) of cigarettes and water pipe to be highest among Arab Americans in a study that also included non-Middle Eastern white Americans. There could be many reasons why tobacco use and especially WTS is high among Arab Americans.<sup>16</sup> WTS is integrated into the social fabric of traditional Arabic society: youngsters would not smoke cigarettes in front of parents, but a parent would offer his child a puff of water pipe at family gatherings for fun.<sup>22</sup> Tobacco use rates in some of Arab Americans' countries of origin are >50% among adult men.<sup>23</sup> This could help enforce tobacco use as a social norm among Arab Americans, especially in men, and potentially spreading among women.<sup>16</sup> Furthermore, being in the US and acculturating with the US society does not seem to discourage tobacco use; in fact, acculturation was positively correlated with the number of cigarettes smoked daily.<sup>19</sup> Thus, we hypothesize that Arab Americans who smoke cigarettes and water pipe are more dependent on nicotine and have more barriers to cessation than exclusive cigarette smokers. We attempted to incorporate proxy indicators for quitting smoking, which are 1) the desire to quit smoking and 2) the confidence in one's ability to quit smoking, to account for possible correlation of WTS to cessation behavior, as indicated in the literature.<sup>17,18</sup> Nevertheless, to our knowledge, no studies have evaluated the potential differences in dependence and barriers to cessation between dual smokers and exclusive cigarette smokers. Therefore, the purpose of this study was to explore the potential differences between exclusive cigarette smokers and dual smokers, in terms of nicotine dependence and barriers to cessation, among Arab Americans.

## Methods

### Participants

Participants in this cross-sectional study were recruited from the Richmond metropolitan area between June and December 2010. A convenience sampling technique was used to recruit all participants who volunteered in response to a widespread advertisement about the study, which was disseminated through local media, social networking sites, and fliers distributed in Middle Eastern grocery stores, restaurants, lounges, and faith-based organizations in Richmond, VA. These are venues where our target population of Arab Americans is likely to visit. The advertisement included an announcement and an invitation to participate in a survey about smoking habits among Arab Americans, and the invite emphasized that current smokers, former smokers, as well as those who had never smoked were invited to participate.

Arab Americans were able to participate by contacting the telephone number provided. The research assistant received calls and scheduled appointments to meet the participants in person in order to fill in the questionnaires. In addition, both the principal investigator (LH) and the research assistant approached potential participants in places known to host large numbers of Arab Americans of the area and where a social interaction could have been possible (eg, the Islamic Cultural Center in Richmond) within the data collection period to increase participation in the study.

The current study is a subanalysis of smokers ( $n=131$ ) who are part of the abovementioned study that included Arab Americans ( $N=221$ ) living in the Richmond metropolitan area. The main study sample included 56.8% men and 43.2% women. Both smokers and nonsmokers were recruited. The age range was 18–60 years ( $M=28.4$  years, median =25 years). The majority of the men (67.6%) and around one third (32.2%) of the women smoked any form of tobacco. As noted earlier, only current smokers are included in this analysis, which focused on contrasting nicotine dependence and barriers to cessation between exclusive cigarette smokers and dual smokers. The total number of participants in our sample was 133 cigarette smokers (104 exclusive smokers and 29 dual smokers). We excluded two cases from the analysis phase because they did not complete the Barriers to Cessation questionnaire. Thus, the final study sample comprised 131 smokers (103 exclusive smokers and 28 dual smokers). See Table 1 for additional demographic data pertaining to the current sample ( $n=131$ ).

## Procedure

Ethical approval was obtained from the Virginia Commonwealth University institutional review board. There

was a brief screening step to confirm eligibility for the study, which was done either via telephone if participants responded to the advertisement or before data collection if participants were approached directly, as previously described. Upon participants' agreement, they signed the consent form and were given the study questionnaire. No identifying information was included on any of the measures. All participants completed the questionnaires in the presence of the study's principal investigator (LH) or the research assistant working on the study, who responded to any questions during the process. The average time to complete the questionnaires was approximately 20 minutes. Participants did not receive any compensation.

## Measure

For the current analysis, we focused on two types of tobacco smokers: 1) exclusive cigarette smokers – defined as participants reporting past 30-day cigarette smoking in any frequency and no WTS at all; and 2) dual smokers – defined as participants reporting last 30-day cigarette and WTS at any frequency. Participants from both groups completed the study questionnaire that included the following instruments. These are validated instruments that have been used before in previous work as per the citations provided; however, we could supply the questionnaires upon request. They were all filled out in English as per the language preference of all the study participants:

1. Demographic and Cultural Information questionnaire: A 21-item instrument that was used to obtain demographic, cultural information and other relevant information such as country of origin and language spoken at home.<sup>24</sup> Relevant results pertaining to acculturation effects on the sample have been published elsewhere.<sup>19</sup>
2. Tobacco Use questionnaire: A 32-item questionnaire that pertains to smoking history, smoking habits, past quit attempts, attitudes and beliefs toward tobacco use, and desire to quit.<sup>25</sup> Participants were prompted to fill in the type of tobacco used by them in this questionnaire. This questionnaire was previously used by Haddad and Petro-Nustas<sup>24</sup> and showed high validity and reliability. The internal consistency of the Tobacco Use questionnaire was 0.79.
3. Fagerström Test for Nicotine Dependence questionnaire: The Fagerström Test for Nicotine Dependence (FTND) scale consists of six items and measures nicotine dependence in cigarette smokers;<sup>26</sup> it has been used and validated in many studies.<sup>27,28</sup> Participants who smoked cigarettes were invited to fill in this questionnaire,

**Table 1** Sample characteristics ( $N=131$ )

Measure	n	Mean	SD	95% CI
Age at time of survey (years)	130	28.00	10.3	26.21, 29.78
Length of stay in the US (years)	111	28.34	20.51	24.48, 32.19
Cigarettes per day	128	9.87	6.7	8.70, 11.04
FTND score	131	3.54	2.42	3.12, 3.96
Barriers to Cessation score	131	39.91	12.63	37.72, 42.09
Addiction barriers	131	13.78	6.64	12.64, 14.93
External barriers	131	16.95	6.04	15.91, 17.99
Internal barriers	131	7.41	3.64	6.78, 8.04
Desire to quit smoking (scale 0–10)	131	4.99	2.61	4.52, 5.44
Confidence in ability to quit smoking (scale 0–10)	127	5.29	3.02	4.76, 5.82

**Abbreviations:** CI, confidence interval; SD, standard deviation; FTND, Fagerström test for nicotine dependence.

which encompassed both exclusive cigarette smokers and dual smokers. The instructions informed that the questionnaire pertains to their cigarette smoking exclusively; however, there was no explicit advice given by the research assistant while filling in the questionnaire. The score of this scale ranges from 0 to 10.

4. Barriers to Cessation questionnaire: This scale consists of 19 items and contains three subscales in addition to the “gaining weight” item.<sup>29</sup> These include the following:
- 1) Addiction Barriers subscale (eight items): addiction barriers include items like “Fear of failing to quit” and “Thinking about never being able to smoke again”;
  - 2) External Barriers subscale (seven items): external barriers include items like “No encouragement or help from friends” and “Seeing things or people which reminded you of smoking”; and
  - 3) Internal Barriers subscale (three items): internal barriers include items like “Feeling less in control of your moods.”
- The overall score has been previously used to evaluate the barriers to nicotine dependence in multiple studies for cigarette smoking.<sup>30,31</sup> The instructions informed that the questionnaire pertains to their cigarette smoking exclusively; however, there was no explicit advice given by the research assistant while filling in the questionnaire. The score for this scale ranges from 0 to 95.

We presented the differences between the two groups in the study shown in Table 2. The FTND scores and Barriers to Cessation scores were evaluated for correlation with factors that are likely to influence cessation behavior, as noted in Tables 3 and 4. Furthermore, we stratified the results by tobacco use type groups (ie, exclusive cigarette smokers versus dual smokers). The correlation analysis was performed for FTND scores, Barriers to Cessation overall scores, and other smoking profile variables. The smoking profile variables included number of cigarettes smoked daily, desire to quit smoking (scale 1–10), and confidence in one’s ability to quit smoking (scale 1–10).

## Analysis

We used JMP version 10 statistical package to analyze the study data. Relevant statistics were calculated for the entire sample and then stratified by smoking status (exclusive versus dual smokers). First, we described the sample for each group, and then we used two-tailed independent sample *t*-tests to examine the mean differences between exclusive and dual cigarette smokers in terms of selected smoking profile variables, FTND scores, and Barriers to Cessation scores. We accounted for the multiple comparisons by applying Bonferroni correction and setting the significance level to 0.016 instead of 0.05. Finally, Pearson’s correlation coefficient

was used to investigate correlations among smoking profile variables, FTND score, and Barriers to Cessation score for the whole sample and by group. Data were examined regarding distributions and trends, with the level of significance set to  $P=0.016$  or  $0.0125$  depending on the number of comparisons made, to account for Bonferroni correction for multiple comparisons.

## Results

### Sample characteristics

Our sample comprised 131 cigarette smokers. Among these, 21.4% ( $n=28$ ) were dual smokers. Among the whole sample of current smokers ( $N=131$ ), women comprised 28.6%. Participants were mainly born in Arab countries and had moved to the US, in addition to ten participants who were born in the US. There were 36 participants from Iraq, 24 from the Gulf countries, 24 from Syria, 17 from Egypt, 11 from other North African Arab countries, 5 from Yemen, and 4 from other countries. The age when the participants moved to the US ranged from 2 to 54 years (mean =20 years,  $SD =\pm 9.27$ ). Years lived in the US ranged from 1 to 46 years (mean =8.37,  $SD =\pm 7.84$ ).

Regarding their smoking profile, exclusive cigarette smokers were mostly men (70%), with mean age of 28 years ( $SD =\pm 10.3$ ), and the mean number of daily cigarettes smoked was 8.9 ( $SD =\pm 6.1$ ). Dual smokers were mostly men (77%), with mean age of 27.8 ( $SD =\pm 10.6$ ), mean number of daily cigarettes smoked was 12.9 ( $SD =\pm 7.9$ ), and mean number of daily water pipe sessions was 1.1 ( $SD =\pm 0.33$ ). Further sample characteristics are shown in Table 1.

### Differences between exclusive and dual smokers

The mean difference in the number of cigarettes smoked daily was significantly higher in the group of dual smokers (Table 2). The FTND scale showed good internal consistency, with Cronbach  $\alpha=0.75$ . FTND scores in the whole sample ranged from 0 to 9. There was a significant difference in the mean scores between the exclusive cigarette smokers ( $M=3.25$ ,  $SD=2.32$ ) and dual smokers ( $M=4.60$ ,  $SD=2.53$ );  $t(40.22) = (2.51)$ ,  $P=0.0144$ .

Regarding the Barriers to Cessation score, the overall scale (19 items) showed very good internal consistency, with Cronbach  $\alpha=0.814$ . The scores for the whole sample ranged from 2 to 74. The Addiction Barriers and the External Barriers subscales showed good internal consistency, with Cronbach  $\alpha=0.717$  and  $0.724$  respectively, and the Internal Barriers subscale showed acceptable internal consistency,

**Table 2** Differences between the exclusive and dual smokers (N=131)

Comparison variable (dual – exclusive)	Difference	t-ratio	SE	95% CI	P-value
Cigarettes per day	4.43	2.77	1.59	1.185, 7.674	0.0089*
FTND score	1.35	2.56	0.53	0.284, 2.245	0.0144*
Barriers to Cessation score	6.75	3.10	2.17	2.398, 11.098	0.0029*
Addiction barriers	3.09	2.68	1.15	0.782, 5.393	0.0095*
External barriers	3.14	2.89	1.08	0.968, 5.325	0.0054*
Internal barriers	1.25	1.93	0.65	-0.049, 2.543	0.059

**Note:** \*Indicates significant P-value with Bonferroni correction (significance level is set to 0.016).

**Abbreviations:** CI, confidence interval; FTND, Fagerström test for nicotine dependence; SE, standard error.

with Cronbach  $\alpha=0.675$ . There was a significant difference in the overall mean scores between exclusive cigarette smokers ( $M=38.47$ ,  $SD=13.07$ ) and dual smokers ( $M=45.21$ ,  $SD=9.27$ );  $t(59.45)=(3.10)$ ,  $P=0.0029$ . This indicates that dual smokers reported significantly more perceived barriers than exclusive smokers. Furthermore, the two subscales with sufficient internal consistency were analyzed in the same fashion. For the Addiction Barriers subscale, there was a significant difference in the scores between exclusive cigarette smokers ( $M=13.13$ ,  $SD=6.91$ ) and dual smokers ( $M=16.21$ ,  $SD=4.92$ );  $t(129)=(2.21)$ ,  $P=0.0143$ . For the External Barriers subscale, there was a significant difference in the scores between exclusive cigarette smokers ( $M=16.28$ ,  $SD=6.20$ ) and dual smokers ( $M=19.43$ ,  $SD=4.76$ );  $t(129)=(2.49)$ ,  $P=0.0070$ .

### Correlation results of FTND scores and select variables

Among the participants in the overall sample (Table 3), there was a highly significant weak correlation between FTND scores and Barriers to Cessation score ( $r=0.30$ ,  $P=0.0005$ ); strong correlation with number of daily cigarettes ( $r=0.76$ ,  $P<0.0001$ ), and significant weak inverse correlation with the magnitude of the participants' confidence in ability to quit

smoking ( $r=-0.23$ ,  $P=0.0107$ ). However, this relationship remained statistically significant for some variables when stratified by smoker type, whether exclusive cigarette smokers or water pipe smokers.

### Correlation results of Barriers to Cessation scores and select variables

Among the overall sample participants (Table 4), the Barriers to Cessation score showed significant weak correlation with number of cigarettes smoked daily ( $r=0.27$ ,  $P=0.0018$ ) and FTND scores ( $r=0.30$ ,  $P=0.0005$ ). However, these relationships remained significant only for the dual smokers when stratified by group.

### Discussion

The results show a significant mean difference between exclusive smokers and dual smokers in their FTND scores and Barriers to Cessation scores. Dual smokers scored higher on the measure for nicotine dependence than exclusive smokers. This suggests that WTS in addition to cigarette smoking might have an additional effect that results in dual smokers scoring higher on a nicotine dependence scale compared to those using cigarettes exclusively. Similarly, the dual smokers scored higher on the Barriers

**Table 3** Correlation analysis among smoking profile status, Barriers to Cessation score, and FTND score among study participants

Variable	FTND score					
	Whole sample (N=131)		Exclusive cigarette smokers (n=103)		Dual smokers (n=28)	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Cigarettes per day	0.76	<0.0001*	0.71	<0.0001*	0.85	<0.0001*
Barriers to Cessation score	0.30	0.0005*	0.2	0.0418	0.59	0.0010*
Desire to quit smoking (scale 0–10)	-0.08	0.3407	-0.08	0.4156	0.08	0.0712
Confidence in ability to quit smoking (scale 0–10)	-0.23	0.0107*	-0.34	0.0006*	0.10	0.6135

**Notes:** Cutoff points for indicating the strength of the correlation are as follows:  $\pm 0.00$ = no correlation,  $\pm 0.20$ = weak correlation,  $\pm 0.50$ = moderate correlation,  $\pm 0.80$ = strong correlation, and  $\pm 1.00$ = perfect correlation. \*Indicates significant P-value with Bonferroni correction (significance level is set to 0.0125).

**Abbreviation:** FTND, Fagerström test for nicotine dependence.

**Table 4** Correlation analysis among smoking profile status, FTND score, and Barriers to Cessation score among study participants

Variable	Barriers to Cessation score					
	Whole sample (N=131)		Exclusive cigarette smokers (n=103)		Dual smokers (n=28)	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Cigarettes per day	0.27	0.0018*	0.20	0.0435	0.38	0.0516*
FTND score	0.30	0.0005*	0.2	0.0418	0.59	0.0010*
Desire to quit smoking (scale 0–10)	–0.17	0.0496	–0.16	0.0962	0.02	0.9160
Confidence in ability to quit smoking (scale 0–10)	–0.13	0.1342	–0.18	0.0755	0.04	0.8417

**Notes:** Cutoff points for indicating the strength of the correlation are as follows:  $\pm 0.00$ = no correlation,  $\pm 0.20$ = weak correlation,  $\pm 0.50$ = moderate correlation,  $\pm 0.80$ = strong correlation, and  $\pm 1.00$ = perfect correlation. \*Indicates significant P-value with Bonferroni correction (significance level is set to 0.0125).

**Abbreviation:** FTND, Fagerström test for nicotine dependence.

to Cessation scale even when each subscale was examined independently. The correlation between the FTND scores and Barriers to Cessation scores remained significant only in the dual smokers group.

The dependence potential created by WTS is difficult to measure in a standardized setting due to the nonuniformity of its use,<sup>6</sup> apart from the complementary dependence due to WTS in addition to cigarette use. Thus, we can attempt to interpret our findings as follows. A possible explanation is that WTS could be moderating the level of dependence on nicotine in dual smokers. Nicotine levels in the plasma of WTS users are similar to those arising from cigarettes in a laboratory-controlled setting,<sup>10</sup> and we know that experienced water pipe smokers, such as Arab Americans in this context, could inhale smaller but more frequent puffs, which can result in higher plasma nicotine levels.<sup>32</sup> Another possibility could be that dual smoking combines the convenience of smoking cigarettes, literally at the smoker's fingertips, to reach a fast kick of nicotine<sup>32</sup> when needed, in addition to the pleasure of having longer-term subjective effects<sup>10</sup> and a social friendly setting<sup>14</sup> as provided by WTS. Even more, incorporating these two possibilities together, we could expect that experienced Arab American WTS users could smoke both cigarettes and water pipe in a way that maintains more nicotine delivery and eventually dependence as opposed to their counterparts who only smoke cigarettes, and, culturally, they could be exposed to more opportunities to use WTS as well.

There was no significant correlation between barriers to cessation and desire to quitting or confidence in ability to quit smoking in either group, which amounts to the logical assumption that the more you smoke, the more barriers you would have to quitting and more the dependence on nicotine. Nevertheless, this finding remains true even after stratification by smoking groups in our study, which might suggest

that switching to water pipe in order to quit cigarettes could be a weakly supported argument in practice.

Despite what our findings indicate, we do not know if the possible increased degree of dependence in dual smokers, depicted by higher FTND and Barriers to Cessation scores, is due to increased nicotine plasma delivery or due to other factors that could be related to WTS. Only a controlled study addressing such factors with measurements of plasma nicotine and subjective effects can address this concern. It appears that exclusive cigarette smokers consume fewer cigarettes than dual smokers. Thus, the belief that smokers begin smoking water pipe to taper cigarette use could be just a myth, or perhaps smoking both forms of tobacco has a synergistic effect that leads dual smokers to become more addicted and ultimately smoke more than if they had used a single mode of smoking. This assumption needs to be explored through randomized studies.

Bearing the results of our study in mind, it is not possible to know whether people who use cigarettes are more addicted before or after using water pipe, meaning that WTS could be either moderating the dependence potential of cigarettes or that it is only those who are more addicted to nicotine who smoke more cigarettes and attempt to add to their nicotine kick by WTS.

Dual smokers had significantly more barriers to cessation than exclusive cigarette smokers. This suggests that WTS in addition to cigarette smoking may intensify barriers to cessation compared to others who use cigarettes exclusively. Seventy percent of smokers want to quit, irrespective of their degree of nicotine dependence;<sup>33</sup> however, barriers to cessation hinder this motivation. Barriers to cessation does not only account for nicotine-dependence-related barriers but also for external and internal barriers.<sup>25</sup> This implies that dual smoking could strengthen some of these barriers. Our analysis of the subscales showed that dual smokers also

have significantly higher Addiction Barriers and External Barriers subscale scores, which could be associated with their WTS. It would be premature to conclude this without further investigation of the individual subscale contents and replicating our study in a different population. However, when attempting to correlate FTND and Barriers to Cessation scores in each group, we found that barriers to cessation had a much stronger significant correlation with FTND scores for dual smokers than for exclusive smokers. This could indicate that barriers to cessation could have greater impact on dual smokers within the same level of nicotine dependence. These findings are consistent with the notion of WTS having other unique and complex aspects in addition to simply being a nicotine delivery system.<sup>16</sup>

Some smokers either begin WTS or shift to it under the false impression that WTS is less addictive and that they can quit WTS more easily than cigarettes, as a sort of “weaning” mechanism with a different nicotine-containing product.<sup>12</sup> Some of our dual smoker participants may have been from this group who are highly addicted and still have a desire to stop smoking and attempt to do so through WTS. Another possible explanation would be that dual smokers who try to quit have a tendency to have more barriers to quitting as they have a greater number of quit attempts. Our data, however, do not grant the opportunity to explore these speculations.

Some scholars agree that WTS is the new emerging threat in the US tobacco control arena.<sup>12,16</sup> However, is dual use of WTS and cigarettes, rather than exclusive WTS, the main driver for this epidemic? There is higher prevalence of dual smokers as compared to exclusive water pipe smokers.<sup>6</sup> We found that dual smokers in our study reported higher dependence on nicotine than exclusive cigarette smokers. However, Arab American smokers might be more prone to WTS due to their heritage, as it has a very strong social aspect that goes along with the Arab culture; moreover, WTS is perceived to be less harmful and, thus, they could be adding WTS as a source of nicotine as a mere addition to heavily addicted cigarette smokers’ population and that WTS diffusion through this population actually occurs mainly through dual smoking rather than exclusive WTS. This assumption could be better examined through longitudinal design studies that look into the rate of adoption of exclusive smoking of tobacco products rather than complementary use to cigarette smoking.

Finally, WTS, when added to cigarettes, could be modifying nicotine dependence and barriers to cessation among cigarette smokers. The challenge in exploring the aforementioned aspects of dual use with confidence and accuracy lies

in the fact that there are no instruments specifically designed to measure nicotine dependency and barriers to cessation among dual smokers of tobacco products.

## Limitations

This study is the first assessment of the potential dependence-related differences between exclusive cigarette smokers and dual smokers among Arab Americans. To our knowledge, this has not been assessed in any other population to date. However, our study had a number of limitations. We used a nonrandom sampling technique in the study; thus, this study does not reflect the prevalence of smoking in Richmond, VA. The study was conducted on Arab Americans; thus its results should be interpreted carefully when translated to other immigrant groups or the general population of exclusive cigarette and dual smokers. Additionally, there were only 28 dual smokers in our study, which could have limited the variability in the group attributes. Furthermore, the FTND and Barriers to Cessation questionnaires have not been designed to explore multiple use of tobacco (ie, dual use). Thus, our results should be interpreted with caution. Nevertheless, this fact in itself highlights the gap in the available tools to measure nicotine dependence and barriers to cessation for dual and multiple use of tobacco in general and WTS in particular.

## Conclusion

This preliminary study attempts to assess the possible impact of WTS on nicotine dependence and barriers to cessation, when coupled with cigarette use. WTS appears to exacerbate the addictive properties of cigarette smoking and to enhance barriers to cessation among our study sample participants. These findings are alarming and need to be explored on a larger scale to explore them in a wider US population addressing this study’s limitations. Understanding the dynamics behind dual smokers’ nicotine dependence and barriers to cessation could be informative in developing a tailored smoking cessation intervention program for dual smokers. Dual smoking seems to pose unique difficulties with regard to smoking cessation. Thus, smoking cessation programs for dual use could focus on, for example, reasons for dual smoking and address different characteristics of tobacco products used, as well as addressing different social aspects of such products.

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## Disclosure

The authors report no conflicts of interest in this work.

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