

Patterns of waterpipe use and dependence: implications for intervention development

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Received 25 May 2004; received in revised form 15 September 2004; accepted 29 October 2004

Available online 24 December 2004

Abstract

Despite the dramatic increase of tobacco smoking via waterpipe in Arab societies, and the apparent potential of waterpipe use to produce tobacco-related disease, little is known about the pharmacological effects of this method of tobacco smoking, particularly its ability to support dependence. This review focuses on recent waterpipe research and current theories of dependence in an attempt to identify patterns of waterpipe use and features likely to reveal dependence. Recent work indicates that, relative to cigarette smoking, this form of tobacco use is characterized by more intermittent use, later age of onset, greater spread among women and lower interest in quitting or appreciation of addictive properties. Waterpipe use is associated with classic features of tobacco/nicotine dependence, as well as features unique to this tobacco use method. However, even shared features of dependence, such as craving and addiction-induced socio-cognitive behavioral changes, can be displayed differently in waterpipe users, indicating the need for waterpipe-specific research approaches. Preliminary evidence suggests that an important step toward dependence involves a transition from social to individual patterns of waterpipe use. Surveillance and research into factors affecting use and cessation of this tobacco use method should pave the way for the development of effective prevention and intervention strategies to curb the burgeoning waterpipe use epidemic.

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Keywords: Waterpipe; Dependence; Intervention development

1. Introduction

Waterpipe is a generic name for a device in which tobacco smoke passes through water prior to inhalation. The term incorporates centuries-old tobacco use methods usually associated with the orient, and encompasses different names and shapes from different cultures and regions (e.g., shisha, narghile, hookah, hubble-bubble; see Fig. 1). There is an alarming global revival of waterpipe use. This revival is particularly apparent in Arab societies (e.g., Maziak et al., 2004a), where recent surveys show that up to quarter of some populations currently use waterpipe (Chaaya et al.,

2003, 2004; Gadalla et al., 2003; Maziak et al., 2004b; Tamim et al., 2003; Varsano et al., 2003). Waterpipe use once involved unflavored raw tobacco, but, in the Arab region today, waterpipe use and spread is facilitated by tobacco that is sweetened and flavored (Maassel), introduced in the 1990s (Rastam et al., 2004). Popular claims about the filtering power of the water, as well as intermittent use patterns, may produce a false perception of minimal risk of tobacco-related dependence and disease (Kandela, 2000; Asfar et al., under review). In addition, the permissive attitude towards waterpipe use by women in Arab societies, as opposed to a taboo against their cigarette smoking (Asfar et al., under review), may lead to an escalation of waterpipe-related addiction and disease among Arab women.

Understanding the influence of waterpipe use on dependence and disease is challenging, because the upsurge in

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Fig. 1. As depicted here by the famous French painter Eugène Delacroix (1798–1863), the social character of waterpipe smoking and acceptability of its use by women may have their roots back in the culture of this region.

waterpipe use is relatively recent, and because many waterpipe users also use cigarettes. However, preliminary evidence suggests that waterpipe use can be addictive, is associated with negative health outcomes and may replace cigarettes when smokers quit (Maziak et al., 2004b; Shihadeh, 2003; Shafagoj et al., 2002; Nuwayhid et al., 1998). For example, cross-study comparisons suggest that, relative to a single cigarette, smoked in about 5 min, a single waterpipe use that occurs in approximately 45 min nearly doubles CO and triples nicotine exposure, with near equivalent effects on cardiovascular response (heart rate) (Maziak et al., 2004a). Further, recent results are consistent with the notion that dependence can develop among waterpipe users (Maziak et al., 2004c). Unfortunately, despite the potential public health magnitude of this emerging smoking method, currently, there are no effective prevention or intervention strategies to curb its spread. Preventing initiation and intervening with current users of this appealing and social form of tobacco use is likely be challenging, and requires continuous surveillance using standardized tools and careful research into issues of waterpipe-associated tobacco dependence and disease.

2. Initiating standardized waterpipe surveillance

An important early step in dealing with an emerging public health threat is to initiate active surveillance in order to assess its spread, predict its course and design control strategies. The success of active surveillance is contingent upon standard definitions and assessment tools. Lessons learned from decades of surveillance for cigarette smoking show that if we do not pay proper attention to standardizing assessment definitions and tools, interpreting and comparing data across different epidemiological surveys can be challenging. Various smoking surveillance systems and surveys have used different indicators of ever-, current-

and ex-cigarette smoking status, creating confusion when attempting to draw the larger picture of the smoking epidemic (Maziak et al., *in press*). In 1998, the World Health Organization (WHO) published guidelines to help unify definitions and questionnaire items used to assess different tobacco use methods worldwide (WHO, 1998). One feature of these guidelines is that they were sensitive to different patterns of use: Three categories of use were recommended for adolescent smokers, whose cigarette use is intermittent (i.e., daily, weekly, monthly), while two categories are recommended for adults (i.e., daily, occasional; WHO, 1998). This distinction is also relevant for waterpipe users, with whom intermittent use patterns predominate (Asfar et al., *under review*; Tamim et al., 2003; Chaaya et al., 2003). Thus, a three-level categorization may be more appropriate for this tobacco use methods. Application of a three-level categorization has been shown to differentiate between meaningful levels of waterpipe use (Fig. 2, top), and to provide a proxy measure for assessing dependence. Self-reported waterpipe use according to the daily–weekly–monthly taxonomy is well correlated with users' perception of being hooked on waterpipe and to other indices of dependence (Fig. 2, bottom) (Maziak et al., 2004c).

Recently, a discussion was initiated among tobacco researchers and public health professionals in the Arab

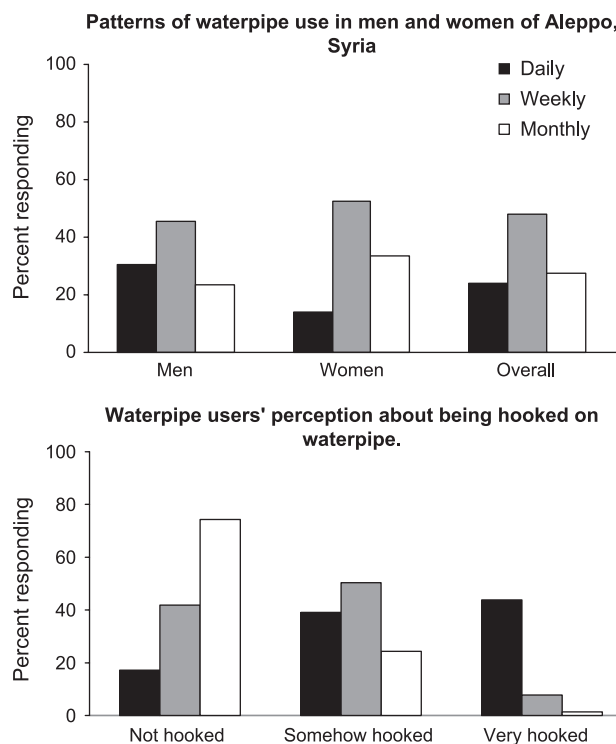


Fig. 2. The top panel shows patterns of use for waterpipe smokers in cafés/restaurants in Aleppo, Syria, and demonstrates the predominance of weekly and monthly (i.e., intermittent) use patterns of waterpipe. The bottom pattern shows these users' perceptions of being hooked on waterpipe according to their frequency of waterpipe use ($p < 0.001$ for all three groups for each pattern of use, according to linear trend analysis) (data from Maziak et al., 2004c).

region and elsewhere (www.globalink.org) in order to reach a consensus about standard definitions and core assessment tools for waterpipe surveillance early in the epidemic. A 10-item questionnaire was developed, a shorter version of which is presented in Appendix A (Maziak et al., *in press*). In the absence of other standardized surveillance tools to assess waterpipe use, we hope that this instrument can provide a good starting point for effective surveillance that will allow comparison of waterpipe smoking trends across different populations and time frames.

3. Patterns of waterpipe use and quitting

Most of what we know currently about patterns of waterpipe use in Syria comes from two surveys done in 2003 in the city of Aleppo. These surveys were conducted among representative samples of university students (total 587, 52.6% women, mean age 22 years), and waterpipe users among café customers (total 268, 40% women, mean age 30 years) (Maziak et al., 2004b,c). Briefly, the student survey was carried out at Aleppo University's dormitories (total 19), where four women's and four men's dormitories were selected randomly, and within each dormitory, a sampling frame was used to recruit about 75 participants. In the café survey, 17 cafés were selected out of total 112 in Aleppo, and within each café, participants were recruited by random selection of pre-numbered waterpipes. Although the café survey sample is not representative of waterpipe smokers in Aleppo at large, as it involved only waterpipe smokers who visit cafés, the difference between the two surveys in terms of age and use patterns of participants suggests that they have caught smokers at different stages of waterpipe use evolution (beginners—students, established—café customers) (Asfar et al., *under review*). Findings from these surveys confirmed the predominance of intermittent use patterns for waterpipe (see Fig. 2, top) (Asfar et al.). Social smoking was also a salient feature, with most waterpipe users initiating and currently using waterpipes with their peers or family, and often sharing the same waterpipe with their peers (Maziak et al., 2004b; Asfar et al., *under review*). Noticeably, women who use waterpipe tend to initiate their waterpipe use later than men, and with family members rather than friends, giving further support to the apparently tolerant attitude in Arab societies toward waterpipe use by women (Asfar et al., *under review*). Generally, initiation of waterpipe use tends to occur later than that for cigarettes in Syria (Asfar et al., *under review*; Maziak and Mzayek, 2000). However, given the recency of the current surge in waterpipe use, we are likely to be at the growth stage of this smoking method, when people of all ages are initiating at approximately the same period (Rastam et al., 2004). Thus, the limited data currently available are consistent with the notion that a stable age-related pattern of waterpipe initiation has not been reached yet (unlike for cigarettes, see Fig. 3). This notion is supported by recent

data from Arab American adolescents, where initial tobacco use experience is often with waterpipe rather than cigarettes (Kulwicki and Rice, 2003).

Among adolescents, cigarette smoking patterns vary according to situational circumstances, with some smoking more outside the home, during the weekends and/or on special occasions (Nichter et al., 2002). Similar patterns may occur with waterpipe use. Indeed, a seasonal escalation of waterpipe use was observed in association with increased opportunity for outdoor recreation, holidays and, in the case of students, exams and periods of stress (Asfar et al., *under review*; Maziak et al., 2004b). Also among students, current waterpipe use was associated with current cigarette smoking, as well as ex-cigarette smoking, indicating that switching between tobacco use methods may be common among youth (Maziak et al., 2004b). In contrast, cigarette smoking among older café customers was lower than that in the general population (Asfar et al., *under review*; Maziak, 2002). This apparent age-related difference may be due to the fact that recent waterpipe initiates tend to come from the greater pool of people who have a liberal attitude towards smoking in general, while older and more established smokers tend to be more smoking method-oriented. Similar results have been observed among young adult military recruits in the US,

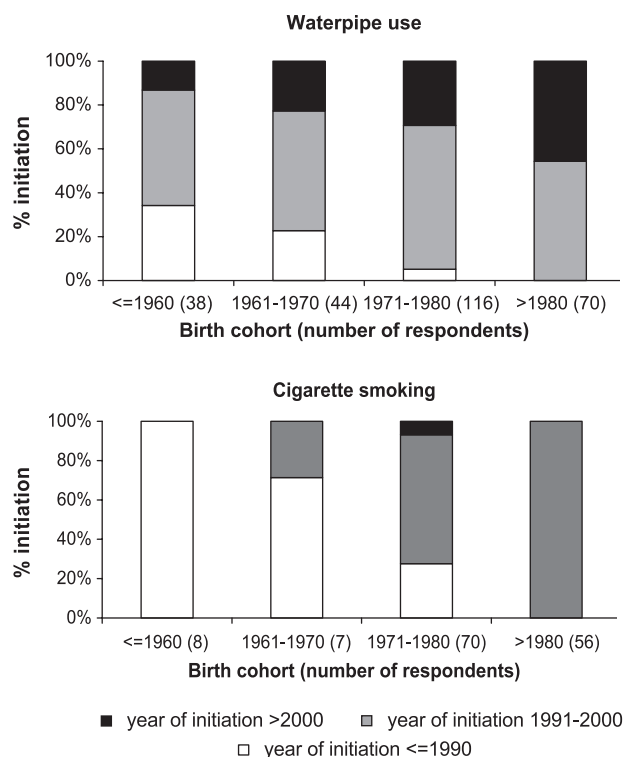


Fig. 3. Data are from a cross sectional survey completed in 2003 among a random sample (268) of waterpipe smokers among café customers in Aleppo. Top panel shows the proportion of current waterpipe users of different birth cohorts according to their year of initiation categorized into three decade-long groups, and bottom panel shows the same data for cigarette smoking (Rastam et al., 2004).

where recruits who reported using waterpipe were more likely than non-users to smoke cigarettes and other tobacco products such as cigars, bidis and smokeless tobacco (Ward et al., 2004a).

In Syria, correlates of waterpipe use among university students were older age, male gender, originating from a city, having friends who smoke waterpipe and coming from a household where a greater number of waterpipe use episodes occur daily (Maziak et al., 2004b). These results suggest that smoking method-specific cues (e.g., sight of waterpipe versus cigarette) can exist in parallel to cues related to smoking in general (e.g., sight of smoke). This notion of smoking method-specific cues is supported by the finding that only friends who smoke waterpipe and number of waterpipes smoked in the household were related to waterpipe smoking among students (Maziak et al., 2004b).

Similar smoking method-specific determinants were also seen for waterpipe quit attitude, which are important for assessing waterpipe dependence and predicting cessation outcomes. So, among the 28% of café survey participants who were interested in quitting, interest in quitting was independently associated with having used waterpipe for fewer years, not increasing the frequency of use over time, and having family members who do not use waterpipe or disapprove of its use (Ward et al., in press(b)). Comparison of quit attitude and perceived challenges to quitting between waterpipe beginners (university students) and established smokers (café customers) shows that established smokers demonstrate lower interest in quitting and lower perceived challenge to quitting. As already mentioned, this can be related to the fact that established waterpipe smokers seem to be more smoking method-oriented, and generally perceive waterpipes to be less harmful than cigarettes (Asfar et al., under review). Therefore, successful cessation interventions for waterpipe users may be particularly effective if they are implemented early in the waterpipe use career, and involve recruitment of family members in the cessation effort. Another factor that is likely to be related to successful cessation intervention development is the understanding of features of tobacco dependence among waterpipe users.

4. The study of dependence among waterpipe users

Cigarette smoking involves self-administration of nicotine, a dependence producing psychomotor stimulant (APA, DSM-IV, 1994). Dependence is a chronic condition involving repeated drug self-administration despite known health risks, high financial costs and multiple quit attempts (APA, DSM-IV, 1994). The compulsive self-administration characteristic of the dependent user is thought to be a behavioral manifestation of neuropharmacological changes in the brain reward pathways (Koob and LeMoal, 1997).

The amount of harmful and addictive constituents in waterpipe smoke is likely to be influenced by puffing

patterns, waterpipe size, as well as type of tobacco and charcoal used. For example, relative to a cigarette (0.41% CO by volume) some waterpipe combinations produced smoke with substantially greater CO levels (small waterpipe; 1.36–1.40%), though others produced smoke with comparable CO levels (large waterpipe; 0.38–0.41%) (Sajid et al., 1993). In a study using machine-smoked waterpipe with a standard smoking protocol Alan Shihadeh (2003) demonstrated that the nicotine, but not tar, content of waterpipe smoke was reduced by the presence of water (Shihadeh, 2003). Furthermore, a recent study performed at the University of Jordan shows that waterpipe tobacco, both unflavored and flavored, has been found to contain large amounts of nicotine with average nicotine content of 166.4 mg/head (range=36–826 mg/head; a “head” can contain 15–25 g of tobacco; Hadidi and Mohammed, 2004), compared to 10.2 mg/cigarette for cigarettes sold in the US (range=7.2–13.4 mg/cigarette; Kozlowski et al., 1998) and 76.3 mg/cigar for cigars sold in the US (range=5.9–335.2 mg/cigar, note that smoke pH is particularly relevant with cigars, where the smoke is often not inhaled; Henningfield et al., 1999). Within the 13 common brands of waterpipe tobacco studied, Hadidi and Mohammed (2004) found a wide variation in nicotine content that appeared to depend on whether the tobacco was flavored (i.e., the more common *Maassel*, with a mean of 3.35 mg/g; range=1.8–6.3) or not (35.65 mg/g; range=30.0–41.3). This difference has been ascribed mainly to the process of preparation of flavored tobacco usually by adding honey, glycerin and other flavors/additives. Comparison of nicotine intake from one 45-min smoking session of flavored tobacco with four 8-puff smoking bouts of cigarettes over a 2.5-h period, in a relatively comparable abstinence conditions, shows that plasma nicotine level is about three times as high for waterpipe (60 ng/ml; Shafagoj et al., 2002) compared to cigarettes (16.33 ng/ml; data are from smokers of “light” and “ultra-light” cigarettes; see Breland et al., 2002). Overall, these data suggest that, relative to cigarette use, waterpipe use can deliver the same or greater doses of the dependence-producing drug nicotine.

Subjective data indicate that about a quarter of established waterpipe smokers in Syria are daily users, half of whom perceive themselves to be “very hooked” on waterpipe (Fig. 3) (Maziak et al., 2004c). Most waterpipe users believe that the cigarette represents the more addictive form of tobacco use. However, data regarding nicotine delivery and the high rate of failed quit attempts suggest that this issue is worthy of further investigation (Asfar et al., under review).

In addition to pharmacologic adaptation, dependence involves behavioral, cognitive and social components (Brandon et al., 2004; Eissenberg, 2004; Glautier, 2004). For example, the behavior of cigarette smokers can be influenced by the many distinctive stimuli (smell and taste of smoke; lighting of cigarette) that predict nicotine administration reliably (Dols et al., 2000; Mucha et al., 1998).

Importantly, waterpipe use can produce specific stimuli that differ from those produced during cigarette smoking (e.g., the smell and taste of smoke from sweetened and flavored waterpipe tobacco; the feel of the mouthpiece; visual stimuli associated with the waterpipe itself) and these specific stimuli can interact with more general smoking-related cues (e.g., hand-to-mouth motion, restaurant or café setting) (Maziak et al., 2004d). The interaction of both sets of cues can shape behavior, thus as we will discuss further, behavioral adaptation appears to occur in heavy users such that the waterpipe becomes an increasingly central part of life, influencing choices regarding socializing and requiring a good deal of effort to ensure reliable access (Maziak et al., 2004c).

When an analysis was conducted on correlates of frequency of waterpipe use among established adult smokers, as a proxy for dependence, results suggested that an important step toward dependence involves a transition from social to individual patterns of waterpipe use (Maziak et al., 2004c). More frequent waterpipe users tend to exhibit an individual and indoor pattern of use, compared to less frequent users, for whom use was more likely to occur outdoors and within a social context (Table 1) (Maziak et al., 2004c). Moreover, the periodic pattern of waterpipe smoking observed in the early stages (among students) in association with increased opportunities of outdoor recreation, tends to diminish among

more established users. Likewise, sharing the same waterpipe, a unique social feature that was predominant among students, becomes less frequent among more established smokers (Asfar et al., under review). Other characteristics of heavy users that may be indicative of dependence include modification of one's behavior and social environment to accommodate waterpipe use, which represents one of the well-established manifestations of tobacco dependence (APA, DSM-IV, 1994; U.S. Department of Health and Human Services, 1988). Consistent with this, heavy users among café customers were more likely to report possessing and carrying their own waterpipe to places where it would not be otherwise available, and considering waterpipe availability when selecting recreational venues (Maziak et al., 2004c). Undoubtedly, the interplay between the social versus individual aspect of waterpipe use and its relation to level of dependence represents a novel and unique feature of this method of tobacco use that warrants further in-depth research.

5. What is likely to be unique about dependence in waterpipe users?

Many of the dependence features mentioned above are modulated by nicotine, and thus are likely to be shared by other tobacco use methods. Waterpipe users, however, may experience dependence in some ways that differ from other tobacco use methods. First, the waterpipe use pattern is predominantly intermittent. An intermittent use pattern may decrease the likelihood of physical dependence on nicotine (Shiffman, 1989), but may support conditional tolerance and/or withdrawal (Eissenberg, 2004). An intermittent use pattern may also render uninformative self-report items traditionally used to assess dependence in cigarette smokers (e.g., number of cigarettes smoked daily, time of first cigarette in the morning). Second, the social aspects of waterpipe use suggest that waterpipe-specific factors, such as number of friends using waterpipe and family behavior/attitude related to waterpipe, can influence waterpipe use and cessation (Maziak et al., 2004b; Ward et al., in press(b)). Third, waterpipe users may value highly some unique features of this tobacco use method, including its smell, taste and social ambience (Maziak et al., 2004c,d). Even shared features of dependence of tobacco use, such as craving and addiction-induced socio-cognitive behavioral changes, can be displayed differently in waterpipe users due to its specific makeup (e.g., waterpipe size limits mobility during use, although small, hand-held models are beginning to appear on the market in some Arab countries; preparation and use demands time; and use is frequently in a social context). Therefore, examination of dependence in waterpipe users and developing cessation interventions for them likely requires a waterpipe-specific approach.

Table 1
Factors related to frequency of waterpipe use according to multinomial logistic regression analysis

	Daily OR (95% CI) ^a	Weekly OR (95% CI)
Gender (male)	3.34 (1.11–10.05)	1.01 (0.51–1.99)
Smoking waterpipe mainly alone	6.69 (1.33–33.59)	1.94 (0.45–8.28)
Share the same waterpipe	0.27 (0.09–0.81)	0.61 (0.30–1.22)
Place of usual waterpipe smoking (home)	30.60 (5.21–179.61)	4.31 (0.86–21.49)
Smoke waterpipe now more frequently than when started	6.79 (2.34–19.73)	1.80 (0.84–3.87)
Hooked on waterpipe		
Not hooked	ref	ref
Somehow hooked	3.84 (1.27–11.59)	2.54 (1.25–5.16)
Very hooked	42.20 (4.16–428.22)	4.14 (0.47–36.18)
Carry waterpipe with if needed	2.09 (0.70–6.23)	2.26 (1.02–4.99)
Waterpipe is important for selecting cafe/ restaurants	1.54 (0.55–4.22)	1.89 (0.98–3.64)

Data are from a study of 268 waterpipe users sampled in cafés where waterpipes were available (Maziak et al., 2004c).

^a Odds ratio and 95% confidence interval for the comparison with the monthly smoking category using polytomous logistic regression adjusted for the following variables: believe can quit waterpipe anytime, will to quit waterpipe, ever daily cigarette smoking, and think of waterpipe when it is not available.

6. Developing smoking cessation interventions for waterpipe users

Information about patterns of use, beliefs/attitudes, as well as dependence features of waterpipe can help guide intervention development in terms of format, timing, intensity, and target groups. One strategy for intervention development in the Arab region focuses on collecting information about regional patterns of tobacco consumption, as well as on local health care systems, in order to modify existing effective cessation interventions to suit local tobacco users and local health systems (Maziak et al., 2004e). Applying this approach for the development of cessation interventions for waterpipe users is plausible and can involve multiple stages (Appendix B).

Our on-going work to develop primary care-based cessation programs for cigarette smokers in Syria indicates that a comprehensive, systematic and multi-disciplinary approach provides a highly effective mechanism to develop culturally appropriate interventions (Maziak et al., 2004e). This approach in Syria has involved the formation of a multi-disciplinary team, consisting of medical anthropologists, psychologists, epidemiologists, behavioral pharmacologists and physicians. Ethnographic (e.g., key informant interviews, focus groups) and epidemiological data collection has been used to assess correlates of cigarette use and cessation, treatment needs, and existing resources. Clinical laboratory methods have been used to understand delivery of nicotine and other toxicants of local cigarettes, as well as subjective and objective responses to smoking and deprivation. All these data have been used, in an iterative fashion, to inform the development and testing of the novel intervention (Maziak et al., 2004e). We are currently analyzing our first pilot cigarette cessation intervention, where we focus on outcome as well as process evaluation including; setting, intervention format, interventionist skills, use of self-help materials, phone call, feasibility of NRT, and feasibility of behavioral modification counseling with variable intensity. While our current focus has been on cigarette smoking, we believe that such approach can be adapted for the waterpipe. So in the face of temptation to use existing smoking cessation interventions of cultural context, the availability of resources, or individual differences in use patterns, our approach will hopefully allow for the intervention to be driven by the features of the behavior to be modified, and in the environment where the modification occurs.

7. Conclusions

Waterpipe use is becoming a global phenomenon, and we are only beginning to learn about its spread and health and addictive effects. Controlling this public health threat requires the initiation of effective surveillance as well as the development of prevention and intervention strategies. These goals are contingent on the initiation of multi-disciplinary

research into the harmful and addictive properties of waterpipe and factors influencing its spread. Knowledge obtained from such research can be used in an iterative way to develop and test prevention and intervention strategies to curb waterpipe use. An important message to take from research done so far is that we should not wade into waterpipe prevention and intervention development with a cigarette mentality. This form of tobacco use has unique features that are likely to reflect on patterns of use and dependence as well as the development of interventions to deal with it.

Acknowledgements

This work was supported by USPHS grants R01 TW05962, R21 TW006545, and IC Health Proposal Development Grant.

Appendix A. Suggested core questions for waterpipe surveillance (adapted from a 10-item version, (Maziak et al., in press))

Ever use

- (1) Have you ever smoked waterpipe (even one or two inhalations)?
(Yes, no)

Current use (for ever users)

- (2) Do you currently smoke waterpipe (at least once in the previous month)? (Yes, no)

Former use (for ever users who do not smoke currently)

- (3) Did you smoke waterpipe at least once a month for three consecutive months in the past? (Yes, no)

Pattern of use/exposure (for current users)

- (4) Which of the following choices describes best your waterpipe smoking?

Usually, I smoke waterpipe monthly (at least once per month but less than weekly)

Usually, I smoke waterpipe weekly (at least once per week but less than daily)

Usually, I smoke waterpipe daily (at least once per day, or on most days of the month)

Appendix B. Suggested steps for developing waterpipe cessation intervention

- (1) Apply epidemiological, formative (interviews, focus groups) and clinical laboratory methods to learn about different aspects of dependence among waterpipe users including proximal and distal factors related to waterpipe use, experiences with quitting, withdrawal symptoms and nicotine exposure.
- (2) Develop valid self-report instruments to measure waterpipe dependence and inform intervention intensity and format, guided by formative work and dependence theory and practice, then validate the

resultant instrument among a group of waterpipe users (psychometric properties, and its ability to predict smoking and quitting).

- (3) Apply collected knowledge to smoking cessation interventions currently being developed in the EMR to arrive at a modified intervention tailored to the needs of treatment-seeking waterpipe users.
- (4) Pilot test the resultant intervention on a small sample of waterpipe smokers, collect process evaluation data to refine the intervention, and then test it in a randomized, control trial with a representative sample of waterpipe users.

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