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EARLY SYMPTOMS OF NICOTINE DEPENDENCE AMONG ADOLESCENT WATERPIPE SMOKERS

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Abstract

BACKGROUND—Although waterpipe smoking is increasingly popular among youth and can lead to nicotine dependence (ND), no studies have documented how ND develops in waterpipe smokers. We examined the emerging symptoms of ND among adolescent waterpipe smokers in Lebanon.

METHODS—Individual confidential interviews were used to evaluate ND in 160 waterpipe smokers and 24 cigarette smokers from a sample of 498 students enrolled in 8th and 9th grades in Lebanon.

RESULTS—Among waterpipe smokers, 71.3% endorsed at least one Hooked on Nicotine Checklist (HONC) symptom and 38.1% developed the full syndrome of ND (3 criteria using the International Classification of Diseases, 10th revision). The early symptoms of ND among waterpipe smokers were craving (25%), feeling addicted (22.5%), and failed quit attempts (14.3%). Among those who reached the respective milestones, median tobacco use when the first

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CONTRIBUTORS

RB and WM conceptualized and designed the study. FMF obtained the data. RB analyzed the data. RB and JRD wrote the first draft of the manuscript. FMF, KDW, TE, WM provided critical intellectual feedback to the manuscript. All authors read and approved the final manuscript.

COMPETING INTERESTS

None declared

HONC symptom emerged was 7.5 waterpipes/month with smoking frequency of 6 days/month; the median tobacco use for the full syndrome of ND was 15 waterpipes/month with smoking frequency of 15 days/month. Among those who had already reached the milestones, the first HONC symptom appeared 10.9 months after the initiation of waterpipe smoking and the full syndrome of ND was reached at 13.9 months. In addition, cues such as seeing or smelling waterpipe, and the café environment triggered craving in most waterpipe smokers with symptoms of ND.

CONCLUSIONS—Symptoms of ND develop among adolescent waterpipe smokers at low levels of consumption and frequency of use. Craving for nicotine triggered by waterpipe-specific cues is reported even at this young age. Waterpipe-specific ND prevention and intervention programs for youth are needed.

Keywords

Waterpipe; Hookah; Lebanon; Nicotine Dependence; Non-cigarette tobacco products; Adolescents

INTRODUCTION

Tobacco smoking is a major preventable cause of premature death worldwide.¹ Nicotine, a component of tobacco, is addictive and leads to nicotine dependence (ND) that is mostly responsible for failed quit attempts and continued tobacco use.^{1, 2} Tobacco-related morbidity and mortality are higher than that for all other forms of drug addiction combined.² Non-cigarette tobacco products deliver significant amounts of nicotine and show addictive potential similar to cigarettes,^{3, 4} thus representing a major factor in sustaining ND and contributing to tobacco-related morbidity and mortality.⁵

Waterpipe smoking (hookah, narghile, shisha) is an emerging tobacco use method for youth in the Middle East and globally.⁶ Studies about waterpipe's addictive potential indicate that its use is associated with considerable exposure to nicotine, and some of the known symptoms of ND in tobacco smokers such as abstinence-induced withdrawal and craving that are relieved by subsequent smoking.^{7,8} In a survey of 268 waterpipe smokers (mean age=30 years) in Aleppo-Syria, 59.2% reported unsuccessful quit attempts during the past year.⁹ These studies indicate that waterpipe smoking can lead to ND, yet no study has attempted to characterize the natural course of ND among adolescent waterpipe smokers or how ND among waterpipe smokers might differ from that in cigarette smokers.

Unlike cigarettes, waterpipe is a predominantly intermittent tobacco use method with long smoking sessions averaging an hour.⁶ A single waterpipe session exposes smokers to 1.7 times the amount of nicotine, and about 50 times the volume of smoke inhaled compared to a single cigarette (48.6 liters vs. 1 liter).^{11,10} Accessibility to tobacco is another factor that can influence how ND can develop and its characteristics.¹² Unlike cigarettes, waterpipe is a stationary, multi-component, and social tobacco use method.¹³ In addition, the café environment, in which waterpipe smokers usually socialize, provides waterpipe-specific cues that can shape ND amongst them.¹³ So while limited accessibility and intermittent use might hinder the development of physical dependence, larger amounts of inhaled smoke/nicotine, length of smoking session and its strong social cues may facilitate dependence in a

waterpipe-specific fashion.¹³ It is therefore of interest to examine the timing and characteristics of ND in waterpipe smokers in order to guide the development of waterpipe-specific prevention and intervention strategies.

Lebanon is among the countries most affected by the waterpipe epidemic,¹⁴ with the highest prevalence of current waterpipe smoking among 13–15 year olds globally (36.9%).¹⁵ Therefore, Lebanon provides a natural lab for studying the development of ND among waterpipe smokers.

The *Waterpipe Dependence in Lebanese Youth (WDLY)* Study is the first prospective study of the development of ND in waterpipe smokers. It aims at determining if waterpipe smokers can develop ND with nondaily use and how symptoms of ND experienced by waterpipe smokers are compared to cigarette smokers. It also aims to determine at what age ND begins among waterpipe smokers. Using baseline data, we describe symptoms of ND among adolescent waterpipe smokers in relation to the duration, quantity and frequency of waterpipe use.

METHODS

The study was conducted in Lebanon, an upper-middle income country with gross national income of US\$9,870 per capita and a population of 4.5 million in 2013.¹⁶

Design

The WDLY is a longitudinal study of 498 adolescents enrolled in 8th and 9th grades at baseline (mean age $\pm$ standard deviation, 14.0 $\pm$ 1.1 years). Since the development of ND can be a protracted process,¹⁷ we included in this study waterpipe, cigarette, and susceptible nonsmokers to be able to measure initial and important ND milestones during the 3 year study. We report baseline data for interviews conducted in 2015. The study was approved by the institutional review boards of Florida International University, and the American University of Beirut.

Recruitment

Schools with 8th and 9th grades from 4 regions in Lebanon (Beirut, Mount Lebanon, Nabatiye, South Lebanon) were identified using a list from the Lebanese Ministry of Education. Schools were considered eligible if they agreed to participate and provided space to ensure privacy of interviews. The Ministry of Education list had 178 schools with 8th and 9th grades, of which 38 schools agreed to participate and lent support to the study. Letters requesting parental consent were sent to the parents of all 8th and 9th grade students in the 38 schools. After obtaining written parental consents and students' assents, a brief, in-class, self-administered recruitment survey about students' smoking status was used to determine eligibility.

To allow us to compare cigarette and waterpipe smokers, students were eligible to participate if they currently (past 30 days) smoked either cigarettes or waterpipe, but not both. We also included those susceptible to initiating smoking in the future, but since the current study

focuses on early symptoms of ND, susceptible nonsmokers were excluded from the current analysis.

Data collection

We developed the study questionnaire in line with existing literature on patterns of waterpipe smoking^{3, 6–11, 18} and domains of ND among adolescents.^{17, 19–23} The questionnaire was pilot-tested in a group of 8th graders who were not part of the study sample. Questionnaires were administered by trained interviewers and are composed of four modules: socio-demographics, smoking-related behaviors, ND, and psychological traits. All modules were translated to Arabic and back translated to English for comparison and fine-tuning following standard techniques.²⁴ Interviewers met participants individually and all interviews were conducted in private rooms on schools' premises to protect confidentiality and minimize social desirability bias.

Dates of the first symptom of ND and key smoking milestones (smoking initiation, first inhalation, smoking a whole cigarette/waterpipe head) were recorded. Four methods were used to improve recall of appearance of ND symptoms and milestones: bounded recall, decomposition, personal landmarks, and the depiction of these landmarks visually to create a personal calendar for each student.^{21, 23} Following an established methodology,^{21, 23} if exact dates were not recalled, we recorded the 7th of the month for events that occurred at beginning of the month, the 14th for events occurring in the middle of the month, and the 21st for events at end of the month.

Instruments and measures

Stages of Physical Dependence (PD) is a 3-item measurement of the progression of PD on tobacco.²⁵ PD develops through stages of wanting, craving and needing^{25, 26} which correlate with structural²⁶ and functional²⁷ changes in smoker's brain. This measure has been used with cigarette and smokeless tobacco users,^{25,28} but not with waterpipe smokers. Wanting was assessed by the item: "If I go too long without smoking, the first thing I will notice is a mild desire to smoke that I can ignore," craving was assessed by the item: "If I go too long without smoking, the desire for smoking becomes so strong that it is hard to ignore and it interrupts my thinking," and needing was assessed by the item: "If I go too long without smoking, I just cannot function right, and I know I will have to smoke just to feel normal again." Responses were: describes me not at all, describes me a little, describes me pretty well, and describes me very well. Any response above 'describes me not at all' is considered an endorsement.²⁵ Participants are assigned to the stage corresponding to the most advanced symptom endorsed (wanting, craving, or needing).^{25, 26} Participants who do not endorse any of the 3 items do not have PD. As this instrument does not produce a score by tallying items, internal reliability is not applicable.

The World Health Organization's International Classification of Diseases, 10th Revision (ICD-10) has 6 criteria and endorsement of 3 of these criteria during a 12-month period is required for the diagnosis of the syndrome of tobacco dependence.²¹ We also obtained a continuous score of ICD-10 by tallying the number of endorsed criteria.²⁹ Internal reliability (α) of the Arabic version of ICD-10 was 0.76 in this study.

The Hooked on Nicotine Checklist (HONC) is a 10-item measurement of autonomy that assesses symptoms, rather than behaviors, to allow its use with any form of nicotine delivery and with participants of all ages.^{30–32} The HONC has been extensively validated among adolescent and adult cigarette and smokeless tobacco users,^{23, 31, 32} but has not been used with waterpipe smokers. Each HONC item represents a symptom of ND and has yes/no options. Endorsement of any item indicates a loss of autonomy over tobacco use. Although a loss of autonomy often leads to a ICD-10 defined syndrome of dependence, a loss of autonomy is not synonymous with ICD-10 tobacco dependence.^{21, 22} We also obtained a continuous score of the HONC by tallying the number of endorsed items.^{21, 22} Internal reliability (α) of the Arabic version of HONC was 0.74 in this study.

The Lebanon Waterpipe Dependence Scale (LWDS-10J) is a 10-item measurement that assesses primarily physical dependence and motivation for smoking.³ Scores on this measurement correlate with the number of waterpipe smoking sessions per week and the number of waterpipe heads smoked per session.³³ We used the modified 10-item measurement as it shows better psychometric properties than the original 11-item LWDS scale.³³ Internal reliability (α) of the Arabic version of the LWDS-10J was 0.74 in this study.

The Syrian Center for Tobacco Studies-28 (SCTS-28) is a battery of items addressing behaviors, attitudes and symptoms related to waterpipe use and dependence (see Table 5). Items were developed using a theory-driven, iterative process, and review of dependence concepts/domains based on qualitative data from waterpipe smokers.³⁴ It consists of 28-items with response options 'true', 'somewhat true', and 'not true', and scores of 2, 1, and 0, respectively. Any response other than 'not true' to an item was considered a positive response to that item. Internal reliability (α) of the Arabic version of the SCTS-28 was 0.80 in this study.

Data analysis

To calculate the mean age (in years) at smoking milestones and appearance of individual symptoms of ND, a participant's date of birth was subtracted from the date when the event of interest took place. Time intervals between each smoking milestone (initiation, inhalation, smoking a whole cigarette/waterpipe head) and ND milestones (the 1st HONC symptom, or the 3rd ICD-10 criterion) were calculated. It should be noted that means were calculated based only on subjects who reached the particular milestones, i.e. they do not represent a survival analysis. When data showed a Poisson distribution, we reported the median amount (waterpipes per month, cigarettes per month) and frequency (days per month) of tobacco use that corresponded to the time when the participant experienced the first HONC symptom, the third ICD-10 criterion, and each stage of PD (Wanting, Craving, Needing).

We employed three symptom-based dependence measures (HONC, ICD-10, PD) to allow for comparisons between waterpipe and cigarette smokers, and two measures specific to waterpipe (SCTS-28, LWDS-10J) to describe the main symptoms of ND among waterpipe smokers. We evaluated the internal reliability of these measures using Cronbach's alpha with a value >0.70 indicating acceptable internal reliability.³⁵ In addition, we evaluated the convergent construct validity of waterpipe-specific ND measurements using two different

methods.²⁹ First, because measurements that have good convergent construct validity are highly correlated as they measure the same underlying concept²⁹ (ND in this case), Spearman's rank-order correlation (r_s) was used to test the association between scores on the HONC, ICD-10, LWDS-10J, and SCTS-28. Second, measurements of ND have good convergent construct validity if they are associated with other indicators of ND.²⁹ Consequently, we tested the relationship between scores on the LWDS-10J, SCTS-28 and the different stages of PD (a component of ND).

Data on socio-demographics, smoking milestones, and symptoms of ND were summarized using percentages and means (with standard deviations (SD)). Pearson's Chi-squared or linear-by-linear association tests, as appropriate, were used to test associations among categorical variables. Normality was checked for quantitative variables and Student's *t* test, or Wilcoxon Mann-Whitney/Kruskal–Wallis tests, as appropriate, were used to compare group differences in quantitative variables. Cramer's V statistic was used to determine the magnitude of association among categorical variables. All tests were two-tailed and a level of significance was set at $p < 0.05$. Data were analyzed using SPSS-20 (IBM Corp., Armonk, NY) and SAS-9.3 (SAS Institute Inc., Cary, NC).

RESULTS

Socio-demographics

Out of 498 participants recruited, 298 susceptible nonsmokers and 16 dual users of waterpipe and cigarettes were excluded from the current analysis. Therefore, this study was restricted to 160 current waterpipe and 24 current cigarette smokers ($N=184$). Overall, 49.5% were females, and 53.8% were recruited from public schools. Females represented 56.9% of waterpipe smokers, and only 8.3% of cigarette smokers (see Table 1 for socio-demographic comparisons). This striking gender difference likely reflects the social acceptability of waterpipe, but not cigarette smoking among females in the Middle Eastern context.^{6, 36} Because of the small and gender-skewed sample of cigarette smokers, only limited comparisons with waterpipe smokers were undertaken.

Smoking milestones

Table 2 presents the number and percentage of participants who experienced important smoking milestones (initiation, inhalation), and ND (first HONC symptom, ICD-10, PD), and age of attaining each milestone. There were no significant differences in the mean age reported for experiencing the first HONC symptom (13.9 years for cigarette and 14.1 years for waterpipe; $p=0.48$), age of attaining ICD-10 (14.7 years for cigarette and 14.6 years for waterpipe, $p=0.84$), or for reaching the Wanting ($p=0.86$), Craving ($p=0.58$), or Needing ($p=0.65$) stages of PD between waterpipe and cigarette smokers.

Table 3 shows the median time interval between smoking milestones and the appearance of the first HONC symptom or attaining ICD-10 dependence criteria. These data pertain only to those participants who experienced the given outcome.

Early symptoms of ND and patterns of tobacco use

There were no significant differences in the proportion of waterpipe and cigarette smokers who reported HONC symptoms or met ICD-10 dependence criteria. One or more HONC items were endorsed by 75.0% of cigarette smokers and 71.2% of waterpipe smokers ($p=0.70$). The average number of HONC items endorsed was 2.3 (2.3) for cigarette smokers and 2.0 (2.1) for waterpipe smokers ($p=0.67$). ICD-10 dependence criteria were met by 25.0% of cigarette smokers and 38.1% of waterpipe smokers ($p=0.17$). The average number of ICD-10 criteria endorsed was 2.1 (1.3) for cigarette smokers and 2.2 (1.6) for waterpipe smokers ($p=0.73$).

As measured by the HONC, the earliest emerging symptoms among waterpipe smokers were craving (25.0%), feeling addicted (22.5%), and a failed quit attempt (14.3%) (Table 4). Median tobacco use per month when the first HONC symptom emerged was 7.5 waterpipes and 27.5 cigarettes ($p<0.001$). Median smoking frequency per month when the first HONC symptom emerged was 6 days for waterpipe and 13.5 days for cigarette smokers ($p=0.09$).

Based on the appearance of ICD-10 dependence criteria, “A strong desire or sense of compulsion to take tobacco” was the most common first criterion of ND among waterpipe smokers (27.5%), “Difficulties in controlling tobacco-taking behavior in terms of its onset, termination, or levels of use” and “A strong desire or sense of compulsion to take tobacco” were the most common second criteria of ND and were equally endorsed by 23.8% of waterpipe smokers, while “Difficulties in controlling tobacco-taking behavior in terms of its onset, termination, or levels of use” was the most common third criterion of ND and was endorsed by 24.4% of waterpipe smokers in this study. Median tobacco use per month when ICD-10 criteria were met was 15 waterpipes and 115 cigarettes ($p<0.001$), and a median smoking frequency per month of 15 days for waterpipe and 23 days for cigarette smokers ($p=0.27$).

Waterpipe-specific aspects of ND

Table 5 presents participants’ responses to the SCTS-28 among waterpipe users only. A desire to quit smoking (*I want to quit smoking waterpipe*) was endorsed by 78.8% of waterpipe smokers. Sensory cues (*Just the sight or smell of waterpipe is enough to make me want to smoke*, 82.5%), psychological components (*I spend too much money on waterpipe*, 91.9%), withdrawal symptoms (*If I could not smoke waterpipe for a while, I would have difficulty concentrating*, 80.6%), and pleasure (*Smoking waterpipe is a good way to reward myself*, 79.4%) were among the most commonly endorsed items. Only 21.3% of waterpipe smokers usually shared a waterpipe.

Among adolescent waterpipe smokers, at least one HONC item was endorsed by 77.5% of those who endorsed “Just the sight or smell of waterpipe is enough to make me want to smoke,” 75.4% of those who endorsed “It would be very difficult to me to be in a restaurant, and not smoke waterpipe,” and 83.3% of those who endorsed “I smoke waterpipe usually with friends or in cafés/restaurants” ($p<0.001$, $p=0.03$, $p<0.001$, respectively).

Assessment of waterpipe-specific measures

We compared the LWDS-10J and SCTS-28 with the HONC and ICD-10. All measures were positively correlated with one another. The LWDS-10J and SCTS-28 were highly correlated ($r_s=0.74$), and both the LWDS-10J ($r_s=0.59$) and SCTS-28 ($r_s=0.55$) correlated well with the HONC. Similarly, both the LWDS-10J ($r_s=0.66$) and SCTS-28 ($r_s=0.60$) correlated well with ICD-10 ($p<0.01$ for all).

As well, scores on the SCTS-28 and LWDS-10J increased in proportion to the Stage of PD. Mean (SD) LWDS-10J scores were 5.0 (3.8) for subjects with no PD, 6.9 (4.4) for Wanting, 10.3 (3.5) for Craving, and 16.5 (3.9) for Needing ($p<0.001$). Similar patterns were observed for SCTS-28 scores with 18.9 (6.0) for no PD, 23.5 (8.4) for Wanting, 28.8 (6.1) for Craving, and 37.2 (5.1) for Needing ($p<0.001$).

DISCUSSION

This is the first study to examine the early symptoms of ND among adolescent waterpipe smokers. We used multiple measures of ND and employed memory-assistance techniques to improve recall of important smoking milestones. The early symptoms of ND among adolescent waterpipe smokers in Lebanon –as measured by ICD-10 and HONC– were craving and feeling addicted. As has been previously reported for cigarette smokers, adolescent waterpipe smokers can meet ICD-10 dependence criteria with nondaily use.^{22, 23} ICD-10 criteria were met by 38.1% of waterpipe smokers, who reported a median tobacco use at the time ICD-10 criteria were met of 15 waterpipes per month and a median smoking frequency of 15 days per month. Our findings extend those of previous research by demonstrating that infrequent use of a non-cigarette tobacco product can induce ICD-10 dependence in adolescents.^{31, 37}

Individual symptoms of ND appear before the full ICD-10 dependence criteria are met. In this study, median tobacco use when the first HONC symptom emerged was 7.5 waterpipes per month with a smoking frequency of 6 days per month. Among those reporting ND symptoms, the first HONC symptom emerged 10.9 months and ICD-10 criteria were met 13.9 months after the initiation of waterpipe smoking. Prior studies have shown large individual differences in the speed with which individual symptoms and the full ND syndrome develop.^{38–40} At this point in our longitudinal study we would only see dependence in those individuals prone to develop it rapidly. Over time, the observed median time to onset of ND symptoms will become longer as more youths in this cohort develop symptoms. The important observation is that many youths (average age of 14 years in this analysis) develop ICD-10 dependence within the first year of waterpipe use.

Although the limited sample size of cigarette smokers in this study that did not allow for robust comparison between waterpipe and cigarette smokers on main study outcomes, some general patterns have emerged. These include a similarity between the proportion of those who endorsed at least one HONC symptom or satisfying the ICD-10 dependence criteria, as well as intensity of symptoms (average number of endorsed ND symptoms). However, the appearance of the first HONC symptom and ICD-10 dependence criteria seem to occur earlier (from onset) and at a lower smoking frequency among waterpipe compared to

cigarette smokers. On the other hand, the prevalence and early symptoms of ND (craving and feeling addicted) among waterpipe smokers in this study were comparable to those among adolescent cigarette smokers from other studies.^{22,23,40,41,20,29,21}

It is plausible that dependence might develop more rapidly among waterpipe smokers compared to cigarette smokers. Waterpipe smokers must inhale deeply to use the waterpipe, but deep inhalation is not needed for a cigarette. While cigarette smokers spend approximately 5 minutes smoking a single cigarette, an average waterpipe smoking session lasts an hour.⁴² During one session, waterpipe smokers are usually exposed to larger doses of nicotine compared to smoking 1 cigarette.^{11, 42} On the other hand, cigarettes are more portable and offer more opportunities to smoke. The number of cigarette smokers in our sample was small, but our data suggest that ICD-10 dependence criteria develops at a lower frequency of use in waterpipe smokers (15 waterpipes vs 115 cigarettes per month ($p<0.001$)). These data should be interpreted in light of the differences in the dose of nicotine delivered and other differences between these two smoking methods.

Even at low levels of use, the majority of waterpipe smokers with ND symptoms reported responding to waterpipe-specific environmental cues, highlighting the importance of such cues for the development of ND in waterpipe smokers. Environmental factors, such as waterpipe sight, smell, and the café environment have been shown previously to affect the “waterpipe experience”.^{34, 43} When systematically measured for the first time in this study using SCTS-28, waterpipe smokers who experienced HONC symptoms of ND were more likely to endorse being responsive to these drug cues. We believe that this is the first study to show that drug cues, such as the sight and smell of waterpipe stimulate a desire to smoke the waterpipe, and thus can be important factors in the development of ND. It is evident that heavy and prolonged use of the waterpipe is not a prerequisite for the development of responsivity to drug cues.

This study has limitations. First, the small number of cigarette smokers provided limited statistical power to detect significant differences between waterpipe and cigarette smokers, but we expect that the sample size for cigarette smokers will increase during follow-up and our study will have more power over time. Second, the sample of cigarette smokers was almost all male. Third, unlike the LWDS-10J, the SCTS-28 was not developed to obtain an overall score of ND. We used scores for SCTS-28 mainly to measure how its items correlate with validated measures of lost autonomy and ND in general (HONC, ICD-10) and those specific to waterpipe (LWDS-10J). While the LWDS-10J assesses ND among waterpipe smokers, the SCTS-28 evaluates waterpipe-specific smoking behaviors and attitudes that are not captured by the LWDS-10J, but are more reflective of the strong social dimension of waterpipe smoking. Fourth, common to all studies of the natural history of ND, both prospective and retrospective, symptoms of ND are self-reported and reported retrospectively. Errors in recalling the dates of events which happened in the past are possible. However, we minimized such possibilities by the use of methods that improve recall of events^{21–23} and enrolled a very young cohort for which all events would be relatively recent. Finally, calculations of the time to onset of an event such as meeting ICD-10 dependence criteria are necessarily based only on those individuals who have already reached the milestone of interest. An analogy would be that the average time to

complete a marathon becomes slightly longer each time another runner passes the finish line. In a longitudinal study, the observed median times to reach a milestone become longer with each successive assessment as those who were slower to reach the milestone eventually make it. Therefore, figures reported in Table 3 should be viewed as representing only those individuals with a propensity to develop symptoms rapidly. Our results should be interpreted in light of these limitations.

CONCLUSIONS

This study shows that ICD-10 ND can appear within a relatively short time period after the initiation of waterpipe smoking among adolescents, and at a lower frequency of waterpipe use compared to cigarette smokers. Frequency and intensity of ND symptoms - as measured by HONC and ICD-10 - did not differ between waterpipe and cigarette smokers, nor did the age at the onset of ND milestones. However, our results show how waterpipe smoking involves different use behaviors, social context, and sensory experiences than cigarette smoking and more research is needed to explore how these differences might affect the development of ND or how it manifests behaviorally. Our data indicate that adolescent waterpipe smokers develop symptoms of ND, which indicates that waterpipe-specific prevention and intervention programs targeting youth are needed. These programs need to be tailored to the specifics of waterpipe as a tobacco use method with unique use patterns and a strong social dimension.

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What this paper adds

- No studies have documented the natural history of the development of symptoms of nicotine dependence (ND) among adolescent waterpipe smokers.
- Our data show that adolescent waterpipe smokers experience symptoms of ND within a relatively short time period after the initiation of waterpipe smoking. ND symptoms appear during infrequent, nondaily waterpipe use and can be shaped by waterpipe-unique social contexts and sensory cues.
- This ongoing study can help guide the development of waterpipe-specific prevention and intervention programs targeting youth.

Table 1

Selected baseline socio-demographic characteristics of a cohort of adolescent current smokers in Lebanon.

	Waterpipe smokers (n=160)	Cigarette smokers (n=24)	Total (N=184)	Cramer's V	p-value
	n (%)	n (%)			
Sex					<0.001
Male	69 (43.1)	22 (91.7)	91 (49.5)	0.33	
Female	91 (56.9)	2 (8.3)	93 (50.5)		
School type				0.16	0.03
Public	91 (56.9)	8 (33.3)	99 (53.8)		
Private	69 (43.1)	16 (66.7)	85 (46.2)		
Age				0.06	0.44
12–13 years	41 (25.6)	8 (33.3)	49 (26.6)		
14–15 years	94 (58.8)	13 (54.2)	107 (58.2)		
16–18 years	25 (15.6)	3 (12.5)	28 (15.2)		
Grade				0.06	0.41
8 th grade	79 (49.4)	14 (58.3)	93 (50.5)		
9 th grade	81 (50.6)	10 (41.7)	91 (49.5)		
Weekly school allowance (LBP) *				0.08	0.37
<10,000	18 (11.3)	1 (4.2)	19 (10.3)		
10,000–20,000	84 (52.5)	13 (54.2)	97 (52.7)		
>20,000	58 (36.2)	10 (41.6)	68 (37.0)		

* 1 \$US = 1,508 Lebanese Pounds (LBP) as of July 28th, 2015 (<http://themoneyconverter.com/USD/LBP.aspx>)

Table 2

Percentage of participants who attained each milestone and the mean age of attaining each milestone among a cohort of adolescent current smokers in Lebanon.

Milestone (ages are in years)	Waterpipe smokers		Cigarette smokers	
	No. (%)	Mean ^{**} (SD)	No. (%)	Mean (SD)
Age of first smoking	160 (100)	12.9 (1.9)	24 (100)	11.3 (4.9)
Age of first inhaling tobacco smoke into lungs [*]	160 (100)	12.9 (1.9)	16 (66.6)	13.3 (1.4)
Age first HONC item was experienced	114 (71.2)	14.1 (1.4)	18 (75.0)	13.9 (1.1)
Age first experienced Wanting (PD stage 2)	92 (57.5)	13.9 (1.3)	13 (54.2)	13.8 (1.4)
Age of attaining ICD-10 ND	61 (38.1)	14.6 (1.3)	6 (25.0)	14.7 (1.1)
Age first experienced Craving (PD stage 3)	42 (26.2)	14.3 (1.2)	7 (29.2)	14.2 (1.2)
Age first experienced Needing (PD stage 4)	14 (8.8)	15.0 (1.7)	7 (29.2)	14.7 (1.3)

^{*} As inhalation is required for waterpipe smoking, the age of inhaling was assumed to be the same as the age of first smoking a waterpipe.

^{**} None of the differences are statistically significant.

HONC = Hooked on Nicotine Checklist; PD = Stages of Physical Dependence; ICD-10 ND = International Classification of Diseases, Nicotine Dependence (3 criteria).

Table 3

The median time interval between smoking milestones and the appearance of the first HONC symptom or ICD-10 is shown only for those subjects who had already experienced these outcomes at the baseline survey.

No. (%)	Interval	Months
114 (71.2)	From the first use of waterpipe to appearance of the first HONC symptom	10.9
61 (38.1)	From the first use of waterpipe to ICD-10	13.9
50 (90.9)	From smoking a whole waterpipe head to the appearance of the first HONC symptom	0.6
37 (67.3)	From smoking a whole waterpipe head to ICD-10	5.0

ICD-10= International Classification of Diseases Nicotine Dependence (3 criteria).

HONC = Hooked on Nicotine Checklist

Table 4

Percentage of waterpipe smokers endorsing each HONC symptom as the first symptom and the total percentage of waterpipe smokers endorsing each symptom (N=160).

HONC Symptom	No. of participants endorsing this as their first symptom, (%)[*]	Total No. of participants endorsing this symptom, (%)
Have you ever had strong cravings to smoke?	40 (25.0)	59 (36.9)
Have you ever felt like you were addicted to smoking?	36 (22.5)	54 (33.8)
Have you ever felt like you really needed a waterpipe?	18 (11.2)	33 (20.6)
Is it hard to keep from smoking in places where you are not supposed to, like school?	3 (1.8)	11 (6.9)
Have you ever tried to quit smoking but could not do it?	23 (14.3)	40 (25.0)
Do you smoke now because it is really hard to quit?	5 (3.1)	19 (11.9)
Did you find it hard to concentrate because you could not smoke?	13 (8.1)	8 (5.0)
Did you feel more irritable because you could not smoke?	5 (3.1)	20 (12.5)
Did you feel a strong need or urge to smoke?	21 (13.1)	44 (27.5)
Did you feel nervous, restless or anxious because you could not smoke?	11 (6.8)	34 (21.3)

* Percentages do not add up to 100% because some participants experienced more than 1 symptom simultaneously.

HONC = Hooked on Nicotine Checklist

Table 5

Early experiences of adolescent waterpipe smokers according to waterpipe-specific dependence measures (SCTS-28 and LWDS-10J).

Syrian Center for Tobacco Studies (SCTS-28) *	% of waterpipe smokers who endorsed each symptom
Smoking waterpipe helps me to concentrate	53.1
Smoking waterpipe is a good way to reward myself	79.4
When I smoke waterpipe, I feel less irritable, frustrated, or angry	35.0
When I smoke waterpipe, I feel less sad, blue, or depressed	48.8
When I smoke waterpipe, I have less insomnia or trouble sleeping	43.8
I enjoy blowing waterpipe smoke from my mouth and nose and the feeling of inhaling waterpipe smoke into my mouth and lungs	60.0
I am confident that I can quit smoking waterpipe anytime I want	40.0
I spend too much money on waterpipe	91.9
Smoking waterpipe makes me feel sociable	30.0
Smoking waterpipe makes me feel happy	71.9
Just the sight or smell of waterpipe is enough to make me want to smoke	82.5
Smoking waterpipe makes me feel energetic	34.4
Most of my friends smoke waterpipe	65.6
I smoke waterpipe usually with friends or in cafés/restaurants	54.4
When I smoke waterpipe I usually share it with others	21.3
Even if I was sure that waterpipe is not good for my health, I would still smoke as often	78.8
It would be very difficult to me to be in a restaurant, and not smoke waterpipe	78.1
It would be difficult for me to refuse an invitation to smoke waterpipe	51.9
If I was with someone who objected to my waterpipe smoking, I would smoke it anyway	15.6
My favorite waterpipe is the one I smoke after having gone an extended period without smoking it	17.5
If the cost of waterpipe smoking doubled, I would still smoke as often	69.4
I always make sure I have an adequate supply of waterpipe materials (tobacco, coal, foil, etc.)	35.0
If my waterpipe smoking session was to get interrupted, I would be annoyed	40.6
If I could not smoke waterpipe for a while, I would have difficulty concentrating	80.6
I usually allocate a special time of the day for smoking waterpipe	71.3
If I could not smoke waterpipe for a while, I would feel an urge or craving to smoke	33.1
I want to quit smoking waterpipe	78.8
I have family or friends who would like me to quit smoking waterpipe	91.9
Lebanon Waterpipe Dependence Scale-10J (LWDS-10J) **	% of waterpipe smokers who endorsed each symptom
<i>a. Psychosocial</i>	

Do you smoke waterpipe to improve your morale?	65.6
Do you smoke waterpipe to please others?	64.4
<i>b. Relaxation/pleasure</i>	
Do you smoke waterpipe for pleasure?	36.9
Do you smoke waterpipe to relax your nerves?	47.5
<i>c. Physical dependence</i>	
Do you smoke waterpipe when you are seriously ill?	50.6
Do you smoke waterpipe alone?	30.0
Number of times you could stop waterpipe for more than 7 days At least once (vs. none)	50.0
What percentage of income would you spend on waterpipe smoking? 50% of monthly income (vs. >50% of monthly income)	98.8
Number of days you could spend without waterpipe >7 days (vs. 7 days)	82.5
Number of waterpipes you usually smoke per week <7 waterpipes/week (vs. 7 waterpipes/week)	94.4

* These items are specific to waterpipe use patterns and include aspects associated with dependence that are not captured by the LWDS-10J.

** Categories were collapsed due to small cell sizes