

Waterpipe (Shisha) Tobacco Smoking: What is the Evidence that it Supports Nicotine/ Tobacco Dependence?

(and why should you care?)

Thomas Eissenberg, Ph.D. Director, Center for the Study of Tobacco Products Department of Psychology Virginia Commonwealth University, Richmond, Virginia, USA



Thomas Eissenberg:

- Has no relevant financial relationships to disclose.
- Will not be discussing the off-label or investigational use of products.
- Research reported in this presentation was supported by the U.S. National Institutes of Health and the Center for Tobacco Products of the U.S. Food and Drug Administration. The content is solely the responsibility of the author and does not necessarily represent the official views of the NIH or the FDA.
 - Fogarty International Center (R03 TW008371).
 - National Cancer Institute (R01 CA120142, R01 CA103827).
 - National Institute on Drug Abuse (R01 DA 024876; P50 DA 036105).

Acknowledgments.

- Colleagues:
 - Wasim Maziak, M.D., Ph.D.
 - Alan Shihadeh, Sc.D.
 - Ken Ward, Ph.D.
- VCU students and staff.

Questions to answer.

- What is nicotine/tobacco dependence?
- What does nicotine/tobacco dependence look like?
- Do waterpipe smokers exhibit signs of dependence?
- Why should you care?

Answers.

- Nicotine/tobacco dependence is compulsive nicotine/tobacco use caused by drug-induced changes in neurochemistry/biology.
- Nicotine/tobacco dependence includes:
 - self-reported compulsion to use products that deliver nicotine,
 - impaired ability to quit despite a desire to do so,
 - preoccupation with use.
- At least some waterpipe tobacco smokers are nicotine/tobacco dependent. More work required to characterize fully.
- We should care about dependence on waterpipe tobacco smoking because this form of tobacco use is associated with substantial user toxicant exposure as well as disease burden.

Review of waterpipe tobacco smoking.





- Hookah
- Narghile
- Arghile
- Shisha or shisha-pipe
- Goza
- Hubble-bubble

What are the flavors of waterpipe tobacco?

- Fruit: Apple (caramel, double, green, red, or sour), Apricot, Banana, Blueberry, Cantaloupe, Cherry, Cherry banana, Coconut, Grape, Guava, Kiwi, Lemon, Lemon-lime, Mandarin, Mango, Melon, Mixed fruit, Orange, Passion fruit, Peach, Pear, Pineapple, Pomegranate, Raspberry, Strawberry, Strawberry kiwi, Watermelon.
- Candy/Dessert/Spice: Banana split, Bubble gum, Candy, Cappuccino, Caramel, Chocolate mint, Cinnamon, Coffee, Cola, Frappucinno, Honey, Jasmine, Licorice, Mint, Molasses, Orange soda, Pistachio, Red tea, Root beer, Rose, Vanilla.
- Alcohol: Cocktail, Margarita, Pina colada.
- Tangiers F-line (caffeinated): Apple, Cocoa, Kashmir, Root beer.

Waterpipe tobacco packaging.

AL FAKHER النكهة الممتازة - الرائحة الزكية - طعم اليوم المكونات: تبغ. عسل. جليسرين. نكهات طبيعية **COMPONENTS** : Tobacco - Molasses - Preservatives - Natural Flavour ALFAKHER APPLE 250 Gr نيكوتين : ٠،٠٥٪، قطران : ٠٪ Nicotine : 0,05%, Tar : 0% 291100 730056 ۲۵۰ غرام 250 Grams تحذير صحى : التدخين سبب رئيسي لسرطان وأمراض الرئة وأمراض القلب والشرايين Health Warning : Smoking is a main cause of Lung cancer, Lung diseases and of Heart and arteries diseases صالحة لمدة JUN 2006 تاريخ الانتاج: عامين من تاريخه

Waterpipe use in the Arab world (13-15 year olds).



Maziak et al., 2015

Waterpipe use in the US (high school students).



Fig. 2 Trends in past 30 day (current) waterpipe tobacco smoking among US high school students from 2011 to 2014.

Soule et al., 2015

Nicotine is found in waterpipe smokers (N=37).



Data from Blank et al., 2011. (see also Maziak et al., 2011; Neergard et al., 2007; Bacha et al., 2007; Shafagoj et al., 2002)

WP-delivered vs cigarette-delivered nicotine (N=54).



Cobb et al., 2011

WP users inhale 50 times the smoke.

Measure	Waterpipe	Cigarette
Puff number	84.9 (6.4)*	15.8 (0.8)
Puff volume (mL)	833.5 (65.7)*	71.2 (3.8)
Total volume (I)	51.6 (5.0)*	1.1 (0.1)
IPI (s)	35.4 (2.7)*	24.4 (1.5)

Note: Mean (SEM). Asterisks indicate P<0.05.

```
Cobb et al., 2011
```

Dependence? ICD-10 criteria.

- A strong desire or sense of compulsion to take the substance.
- Impaired capacity to control substance-taking behavior in terms of onset or termination; unsuccessful efforts to reduce or control use.
- Preoccupation with substance use, as manifested by giving up alternative pleasures or spending a great deal of time obtaining/ using the substance
- Persistent substance use despite clear evidence of harmful consequences.
- A physiological withdrawal state when use is reduced/ceased.
- Evidence of tolerance to the effects of the substance.

WHO, 1992

Dependence? ICD-10 criteria.

- A strong desire or sense of compulsion to take the substance.
- Impaired capacity to control substance-taking behavior in terms of onset or termination; unsuccessful efforts to reduce or control use.
- Preoccupation with substance use, as manifested by giving up alternative pleasures or spending a great deal of time obtaining/ using the substance
- Persistent substance use despite clear evidence of harmful consequences.
- A physiological withdrawal state when use is reduced/ceased.
- Evidence of tolerance to the effects of the substance.

WHO, 1992

Strong desire or sense of compulsion...

"Sometimes I crave [waterpipe] at work, I go to the restaurant and I order waterpipe and sit there. I know the places [that offer waterpipe], not all restaurants offer waterpipe in the morning." (Palestinian woman; Nakkash et al., 2011).



"I like to dominate everything, but the narghile has completely dominated me. That bothers me. My happiness is related to the narghile. It is essential for having a good time..." (Hammal et al., 2008).

Abstinence-induced urge and craving.



Maziak et al., 2009 (61 Syrian waterpipe smokers, overnight abstinence).

Strong desire or sense of compulsion...

"Craving has also been reported in a survey of waterpipe tobacco smokers in the United Kingdom (Jackson & Aveyard, 2008), qualitative studies of Syrian (Hammal et al., 2008) or British waterpipe smokers (Jawad et al., 2013), as well as in a laboratory study of waterpipe tobacco smokers in the United States (Cobb et al., 2011)."

Aboaziza & Eissenberg, 2015, p. 49.

"I usually smoke narghile [waterpipe] once daily, but sometimes I smoke more. Because even when I have already smoked it, seeing or smelling narghile makes me feel that I need to smoke again, and I usually do smoke." (Hammal et al., 2008)





Impaired capacity to control use...

- In a survey study of 151 current Egyptian waterpipe smokers, 62% reported previous quit attempts (Auf et al., 2012).
- In a survey of 268 current waterpipe smokers in Syria, 28% reported in interest in quitting and 17% reported a failed quit attempt in the past year (Ward et al., 2005).
- In a randomized clinical trial of behavioral/pharmacological assisted quitting for Syrian waterpipe smokers (Ward et al., 2013):
 - 84% reported readiness to quit
 - 80% reported they were very or moderately confident in their ability to quit
 - Continuous, objectively verified abstinence was observed in 9/50 participants (i.e., 18%).

Preoccupation with use.

"I sit from 7:00 in the morning till 6:30 in the evening; I have two nafas in the morning, one nafas in the afternoon, and when there is not much work, I smoke up to three *nafas* until 2:00 in the afternoon. [...] At home, sometimes in the evening, we prepare two *nafas*, we would enjoy it while gathering at night." (Lebanese man)



Nakkash et al., 2011

Preoccupation with use.

"My cousin wouldn't go out and wouldn't go to a party with his friends without having with him his waterpipe handbag, all its accessories and all the [tobacco-filled] heads..." (Syrian woman).





Nakkash et al., 2011

Preoccupation with use...

Random sample of 268 Syrian waterpipe smokers (Maziak et al., 2004).

•63% choose café/restaurant based on waterpipe availability (77% of daily smokers)

•42% carry waterpipe with them (69% of daily smokers).

A more standardized measure? The LWDS-11.

- Number of times you could stop waterpipe for > 7 days?
- Percent of income you would spend on waterpipe smoking?
- Number of days you could spend without waterpipe?
- Number of waterpipes you usually smoke per week?
- Do you smoke waterpipe to relax your nerves?
- Do you smoke waterpipe to improve your morale?
- Do you smoke waterpipe when you are seriously ill?
- Do you smoke waterpipe alone?
- Are you ready not to eat in exchange for a waterpipe?
- Do you smoke waterpipe for pleasure?
- Do you smoke to please others (conviviality)?

Salameh et al., 2008

LWDS and its variants (LWDS-10J, LWTDS).

- Empirically validated in several samples (Salameh et al., 2008; Salameh et al., 2014; Primack et al., 2014).
- Higher scores associated with greater use frequency (Kassim et al., 2014; N=180, mean age =29.5; 52% daily WP smokers):



Also, the WTQ.

- How many times a day (if at all) do you smoke waterpipe?
- If you smoke waterpipe, do you inhale when you smoke?
- How soon after you wake up do you smoke your first waterpipe?
- Do you find it difficult to refrain from using tobacco in places where it is forbidden (e.g., Mosque, Church, library, school, movies)?
- Do you use tobacco more frequently during the first hours after waking up than you do during the rest of the day?
- Do you use tobacco more during the first 2 hours after waking up than during the rest of the day?

Alzyoud et al., 2016.

WTQ validation (Alzyoud et al., 2016).

- 333 Jordanian adolescents.
- All self-reported waterpipe users (27%<14 years; 33% girls).

		Nicotine dependence among waterpipe users			
	All participants	Low;	Moderate;	High;	
		89 (26.7)	128 (38.4%)	116	
				(34.8%)	
Waterpipe use characteristics	N (%)	%	%	%	p-value
Age of initiation					
8-10 years	36(10.81)	16.7	30.6	52.8	0.07
11-13 years	102(30.63)	14.7	37.3	48.0	
14-16years	58(17.42	24.1	48.3	27.6	
Heads smoked per d	lay ***				< 0.0001
≤ 1	219(65.77)	34.2	39.3	26.5	
2-3	86(25.83)	12.8	34.9	52.3	
≥ 4	24(7.21)	4.2	41.7	54.2	

- How many days in a row could you comfortably go without smoking hookah?
- How often do you get annoyed when hookah smoking is not allowed (such as in someone's home who doesn't allow it)?
- How often do you prefer smoking hookah instead of doing other activities?
- Would you smoke hookah if you were so sick that you stayed home from work or school?
- How often do you smoke hookah alone?
- The last time you smoked hookah, how soon after waking up in the morning did you smoke your first bowl of hookah?

Sidani et al., 2016.

US-WDS validation (Sidani et al., 2016).

- 413 US past-year WP users aged 18-30.
- Random selection from a national panel.

WTS dependence % 1 2 3+ $21+$ 18–20 ≤ 17	
Dependence scale ^e Row %	
0 52.9 96.7 2.9 0.4 33.7 51.7 14.7	′ \
1 25.4 88.8 10.6 0.6 26.7 54.3 19.1	
2 or more 22.7 55.2 23.0 21.9 13.0 43.5 43.5	

Growing evidence of waterpipe dependence.

- Nicotine, a dependence-producing drug, is in the tobacco, the smoke, and the user.
- Self-reported compulsion to use WP.
- Impaired ability to quit despite a desire to do so.
- Preoccupation with use.
- Validated measures emerging.
- Evidence could be stronger (abstinence syndrome; tolerance, use despite health effects): more work and <u>better measures</u> required.
- Why should we care?

"I started smoking [waterpipe] when I was young and I know its side effects and I know what it does to my lungs. I go up the stairs, I start panting. But I cannot [stop it] because I am addicted to it, I would not mind stopping it but I cannot." (Palestinian man)



Nakkash et al., 2011

Why should we care about WP dependence?



Mean smoke toxicant content for waterpipe and cigarette.

Toxicant (mg)	Waterpipe ¹	Cigarette ²
Tar	802	22.3
Nicotine	2.96	1.74
СО	145	17.3
¹ Shihadeh and Saleh, 2005; ² Djordjevic et al., 2000		

36 times the tar, 1.7 times the nicotine, 8.4 times the CO!

WP session vs Cig "tar": Many times the PAH yield

Known/suspected carcinogen	WP (ng/session)	Cig (ng/cig)	Ratio
Naphthalene	2130	236	9.0
Acenaphthylene	180	50.4	3.6
Acenaphthene	487	25.3	19.2
Fluorene	437	119	3.7
Phenanthrene	2650	110	24.1
Anthracene	493	38.1	12.9
Fluoranthene	2380	46.2	51.5
Pyrene	2510	33.2	75.6
Chrysene + Benz[a]anthracene	677	35	19.3
Benzo fluoranthenes	370	10.1	36.6
Benzo[a]pyrene	307	7.9	38.9
Benzo[g,h,i]perlyene	140	2.5	56.0
Di-benzo[a,h]anthracene	147	0.6	245.0
Indeno[1,2,3-cd]pyrene	183	3.5	52.3

Waterpipe data from Sepetdjian et al., 2008; cigarette data from Gmeiner et al., 1977. For a comprehensive review see Shihadeh et al., 2015.

WP session vs Cig: Many times the aldehyde yield.

Compound	Waterpipe μg/episode	Cigarette µg/cigarette	Ratio
Formaldehyde	630	23	27.4
Acetaldehyde	2520	619	4.1
Acrolein	892	47	19.0
Propionaldehyde	403	46.5	8.7
Methacrolein	106	24	4.4

Data from Al Rashidi et al., 2008.

For a comprehensive review, see Shihadeh et al., 2015.

Machine yields predict user exposure (N=31).



Shihadeh & Eissenberg 2011

Metabolites of known carcinogens in WP smokers.

- Hospital setting, cross-over design, N=13 dual users
- All day ad lib cig smoking versus 3 WTS use sessions
- Measurements on day 4 of 4-day protocol.





Jacob et al, 2013.

Metabolites of known carcinogens in WP smokers.

- Urine samples collected from population in Aleppo.
- Mean cigarette use 27 cigs per day, mean WTS 2 per day.



Al Ali et al., 2015

CO is found in waterpipe smokers (N=37).



Expired CO increased pre- to post-session by 28-30 ppm in this study, with no differences by condition. Data from Blank et al., 2011.

Waterpipe CO relative to a cigarette.



Data from Eissenberg & Shihadeh, 2010 (see also Cobb et al., 2011).

Why care about CO inhalation (COHb>9%=poison).

- Acute intoxication is dangerous:
 - Ashurst et al., 2012 (N=1; syncope; 15.3%; USA).
 - Cavus et al., 2009 (N=1; syncope x 2; 31.1%; Turkey).
 - Clarke et al., 2012 (N=12; dizziness; 14%, England).
 - Karaca et al., 2013 (N=1; syncope, 31.1%; Turkey).
 - La Fauci et al., 2012 (N=1; syncope, 24%; Italy).
 - Lim et al., 2009 (N=1; syncope, 27.8%, Singapore).
 - Ozkan et al., 2013 (N=1; syncope, 32.7%; Turkey).
 - von Rappard et al., 2014 (N=3, unconscious, >20%, Switzerland).
 - Wang et al., 2015 (N=1; lethargy, 25.4%, Australia).
- Long-term CO exposure linked to CVD in cigarette smokers.

Evidence of harm of WP smoke from mouse lung.



Khabour et al., 2012; See also Rammah et al., 2012.

Evidence of harm of WP smoke from human lung.

%

- 19 nonsmokers.
- 21 waterpipe smokers:
 - Initiated 21 years,
 - Smoked for 4+ years,
 - Smoked 3.5 times/wk.
- Other indicators:
 - Elevated sputum and cough.
 - Trends toward decreased pulmonary function.
 - Elevated presence of macrophages.

Diffusing capacity (DLCO)



Strulovici-Barel et al., 2016.

Evidence of harm of WP smoke from humans.



Waked et al., 2012

Health effects of waterpipe tobacco smoking.

Acute effects

- Increased heart rate
- Increased blood pressure
- Carbon monoxide intoxication
- Impaired pulmonary function (FEF25-75, PEFR)
- Decreased exercise capacity
- ► Larynx and voice changes Long-term effects
- Ischaemic heart disease
- Impaired pulmonary function (FEV₁, FVC, FEV₁/FVC, FEF25-75, PEF, FRC, RV)
- Chronic obstructive lung disease
- Chronic bronchitis
- Emphysema
- Lung cancer
- Oesophageal cancer
- Gastric cancer
- Low birthweight
- Pulmonary problems at birth
- Periodontal disease
- Larynx and voice changes
- ► Lower bone density and increased fracture risk

FRC, functional residual capacity; FVC, forced vital capacity; PEF, peak expiratory flow; PEFR, peak expiratory flow rate; RV, residual volume.

El-Zaatari et al., 2015.

"I started smoking [waterpipe] when I was young and I know its side effects and I know what it does to my lungs. I go up the stairs, I start panting. But I cannot [stop it] because I am addicted to it, I would not mind stopping it but I cannot." (Palestinian man)



Nakkash et al., 2011

Conclusions.

- Nicotine/tobacco dependence is compulsive nicotine/tobacco use caused by drug-induced changes in neurochemistry/biology.
- Nicotine/tobacco dependence includes:
 - self-reported compulsion to use products that deliver nicotine,
 - impaired ability to quit despite a desire to do so,
 - preoccupation with use.
- At least some waterpipe tobacco smokers are nicotine/tobacco dependent. More work required to characterize fully.
- We should care about dependence on waterpipe tobacco smoking because this form of tobacco use is associated with substantial user toxicant exposure as well as disease burden.