WATERPIPE
WHERE DO WE STAND?

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Outline

- Anatomy and epidemiology
- Toxicology
- Evidence-based health effects
- Managing hookah dependence
- Policy on hookah

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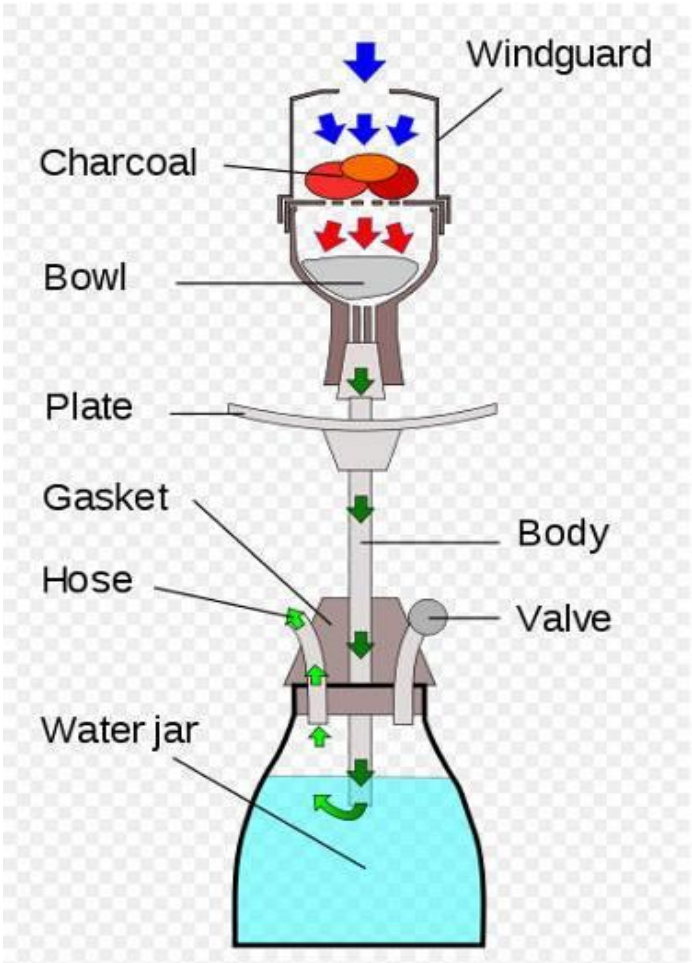

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Prevalence of Adult Waterpipe in Western Countries

Country	WP Use	Rate	Study
12th graders/ Arizona	current WP users	7%	Barnett et al, 2009
high school students/ Florida	ever WP users	11%	Barnett et al, 2009
US universities	current WP use	7 to 20%	Cobb et al, 2010
(a sample of 8745 students in eight colleges in the US)	ever WP use current WP use	29.5% 7.2%	Primack, Fertman, Rice, Adachi-Mejia, & Fine, 2010

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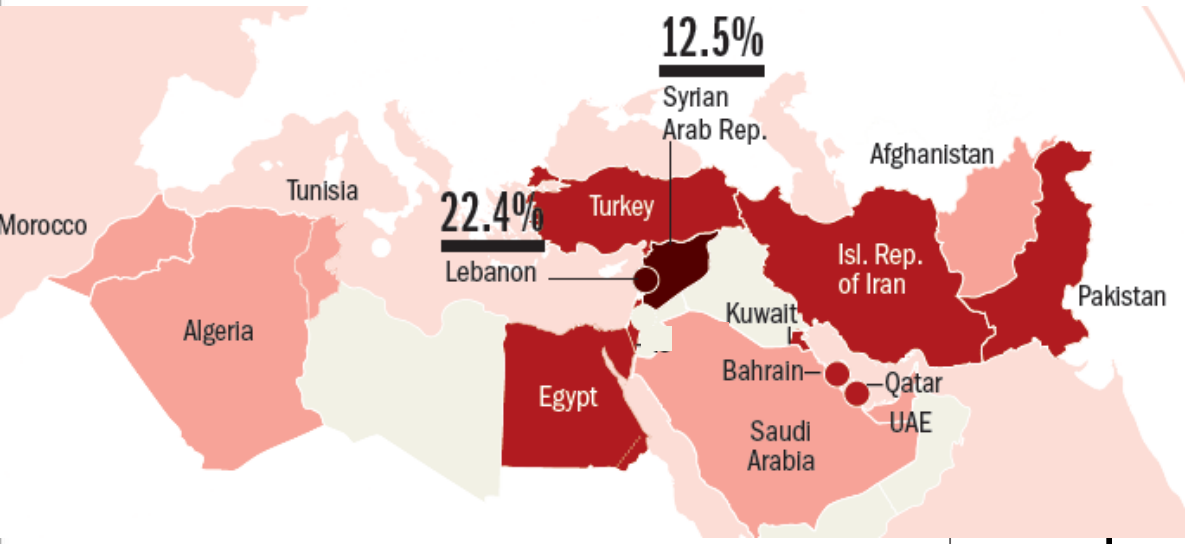
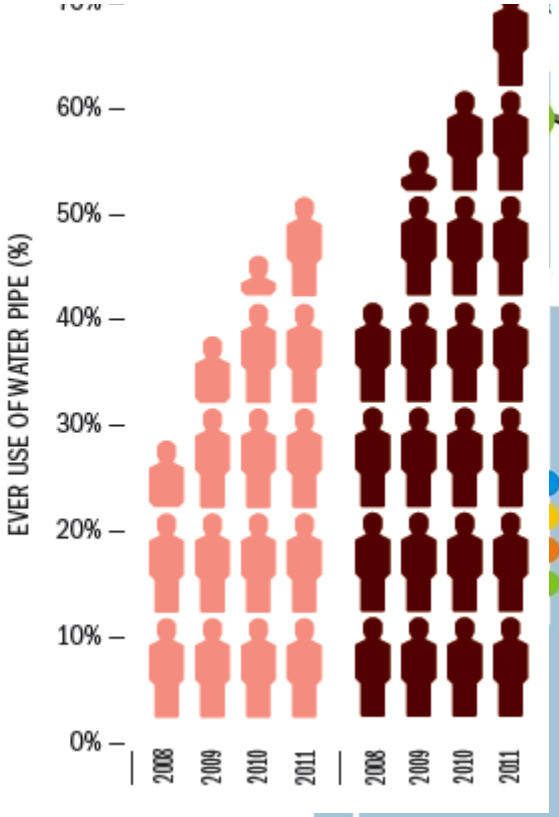
Waterpipe is a growing threat ....



Percentage of adults currently using water pipes in Middle Eastern countries
The Tobacco Atlas, 5th edition

The prevalence of waterpipe use among students has increased dramatically in Jordan
The Tobacco Atlas, 5th edition



TOXINS IN HOOKAH

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Toxins in WP

- **Polyaromatic Hydrocarbons (PAH):**
  - 100 chemicals formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco
- **Nitrosamines (TSNA):**
  - only in tobacco products
  - formed from nicotine and related compounds by a nitrosation reaction that occurs during the curing and processing of tobacco
- **Heavy metals:**
  - Arsenic
  - Beryllium
  - Chromium
  - Cobalt
  - Lead
  - Nickel

Toxicant Yields

Toxin (ng)	Waterpipe[1]	Cigarette[2]
Arsenic	165	80
Beryllium	65	300
Chromium	1340	37
Cobalt	70	0.17
Lead	6870	60
Nickel	990	17

[1]Shihadeh, 2003; [2]Hoffman, 2000

Cigarettes vs. WP

Chemicals Found in Hookah Smoke *versus* Cigarette Smoke

Adapted from Shihadeh and Saleh, 2005; and Asotra, 2005

Chemical	Yield from 10 gm hookah tobacco[a]	Yield from 1 cigarette[b]	Multiple of average cigarette smoke value
"Tar," mg	802	Range: 1-27 Average: 11.2	72X
Nicotine, mg	2.96	Range: 0.1-2 Average: 0.77	4X
Carbon monoxide CO, mg	143	Range: 1-22 Average: 12.6	11X
PAH Phenanthrene, µg (co-carcinogen)	0.748	0.2-0.4	2.5X
Fluranthracene, µg (co-carcinogen)	0.221	0.009-0.099	4X
Chrysene, µg (tumor initiator)	0.112	0.004-0.041	5X

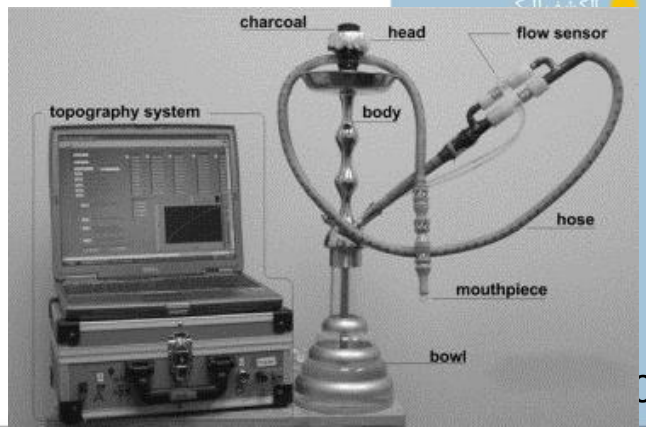
[a] Ten grams of tobacco mixture used in hookah bowl, 171 2.6-second puffs of 0.631 volume each, spaced 30 s apart, fueled with 1.5 quick-lighting charcoal disks.

[b] Reported ranges of commercial cigarettes (Jenkins et al, 2000), and arithmetic mean for 1294 domestic cigarette brands tested by FTC for 1998 (FTC, 2000).

Shihadeh, A. and Saleh, R. 2005. Polycyclic aromatic hydrocarbons, carbon monoxide, "tar", and nicotine in the mainstream smoke aerosol of the narghile water pipe. *Food and Chemical Toxicology* 43(5):655-661. Asotra, K. 2005. "Hooked on Hookah: What You Don't Know Can Kill You." TRDRP Newsletter, 7(3):August 2005.

Cigarettes vs. WP (Puff Topography)

	Cigarettes	Waterpipe
Puffs	8-12	50-200
Duration/minute	5-7	20-80
Smoke/liters	0.5-0.6	0.15-1
Carbon Monoxide/ ppm	4.0	35.5



WHO Advisory Note: "Waterpipe Tobacco Smoking: Health Effects, Research Needs and Recommended Actions by Regulators, 2005

CAN HOOKAH CAUSE DEPENDENCE?

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Hookah Dependence

- One session of 10 gm WP tobacco produce 4 times the nicotine in one cigarette

- Daily use of WP produced a 24-hr urinary cotinine level of 0.785 microg/ml (equivalent to smoking 10 cigarettes/day)

  Neergaard J. et al. 2007

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Nicotine Dependence (3)

All were significantly associated with the number of sessions smoked per day. (Auf RA. et al. 2012)

- Time to the first smoke of the day
- Smoking even when ill
- Time to tobacco craving
- Hating to give up the first smoke of the day

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Health effects of WPs

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Box 1 Adverse health effects associated with waterpipe 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 (FEV_1, FVC, FEV_1/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 ZM, et al. Tob Control 2015;0:1–13. doi:10.1136/tobaccocontrol-2014-051908

The effects of waterpipe tobacco smoking on health outcomes: an updated systematic review and meta-analysis

Reem Waziry, Mohammed Jawad, Rami A.Ballout, Mohammad Al Akel and Elie A Akl, 2016

Waterpipe tobacco smoking is likely associated with:

- Oral cancer
- Lung cancer
- Respiratory diseases
- Low birthweight
- Metabolic syndrome
- Cardiovascular disease
- Mental health

Waterpipe tobacco smoking is likely not associated with:

- Oesophageal cancer
- Gastric carcinoma
- Bladder cancer
- Prostate cancer
- Hepatic C infection
- Periodontal disease
- Gastro-oesophageal reflux disease
- Infertility
- Mortality

Conclusion:

There is accumulating evidence about the association of waterpipe tobacco smoking with a growing number of health outcomes

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Inhalation Toxicology

http://informahealthcare.com/iht
ISSN: 0895-8378 (print), 1091-7691 (electronic)

Inhal Toxicol, 2013; 25(9): 492–497
 DOI: 10.3109/08958378.2013.806613

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RESEARCH ARTICLE

The acute effects of waterpipe smoking on lung function and exercise capacity in a pilot study of healthy participants

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[1]King Hussein Cancer Center, Cancer Control Office, Amman, Jordan, [2]Department of Psychology, Virginia CommonWealth University, Richmond, VI, USA, and [3]School of Medicine, Jordan University, Amman, Jordan

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Table 1. Sample characteristics and changes observed after a waterpipe session.

Demographic data	Mean (range)	
Age (years)	20.4 (18–25)	
Average height (cm)	179.3 (169–192)	
Average weight (kg)	80.6 (54–107)	
Average BMI (kg/m^2)	25.0 (17.6–32.2)	
Frequency of WTS (waterpipes per week)	4 (0.5–14)	
Years of WTS	3.7 (1–7)	
Changes following waterpipe session	Pre-exposure to waterpipe smoking Mean (median; IQR)	Post-exposure to waterpipe smoking Mean (median; IQR)
Carbon monoxide level (ppm)	3.7 (3; 3)	24.4 (21; 19)
Average minutes of exercise time completed	9.4 (10; 1.5)	9.2 (10; 2)
Average watts	138.6 (145; 15)	136.3 (145; 25)
VO_2 (L/min)[a]	1.86 (1.87; 1.89)	1.7 (1.7; 2)

[a]Significance testing was conducted for VO_2 values – significance was detected (one-sided p-value <0.05).

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Table 2. Change in respiratory parameters evaluated pre and post waterpipe exposure in 24 healthy males.

Parameter	Pre-waterpipe exposure: Mean (median; IQR)	Post-waterpipe exposure: Mean (median; IQR)	p Value[a]
FEV_1 (L/sec)	5.03 (4.795; 1.43)	4.95 (4.915; 1.24)	–
$FEF_{25-75\%}$ (L)	5.51 (5.595; 1.74)	5.29 (5.125; 1.95)	$p<0.05$*
FVC (L)	5.94 (5.9; 1.67)	5.89 (5.83; 1.68)	–
DLCO mL/mmHg/min	40.6 (41.15; 12.38)	42.5 (40.2; 11.95)	–
Baseline respiratory rate	17.7 (18.0; 2.0)	19.7 (20.0; 3)	$p<0.05$*
Borg scale at mid exercise	1.7 (1.5; 0)	2.4 (1.5; 2.0)	$p<0.05$*
Borg scale at peak exercise	4.4 (3.5; 1.5)	5.2 (5; 2.62)	$p<0.05$*
Breathing reserve (%)	43.88 (46.5; 17.0)	42.54 (44.5; 14.0)	–
VE max (l/min)	97.5 (93.65; 32.28)	98.9 (95.5; 17.18)	–
O_2 sat (%) at peak	96.4 (96.0; 3.0)	96.1 (96.0; 2.0)	–

[a]Significant one-sided p value (<0.05) – Non-significant one-sided p value.

**significant one-sided p-value (<0.05)
- Non-significant one-sided p-value

Table 3. Change in cardiac parameters evaluated pre and post waterpipe exposure in 24 healthy males.

Parameter	Pre-waterpipe exposure Mean (median; IQR)	Post-waterpipe exposure Mean (median; IQR)	*p* Value[a]
Baseline heart rate	82.9 (83.0; 26.0)	85.3 (84; 23.75)	–
Baseline systolic blood pressure	118.9 (121.0; 30.75)	129.2 (130.0; 15.0)	$p<0.05$
Baseline diastolic blood pressure	73.6 (75.5; 12.25)	73.6 (74.5; 18.0)	–
Baseline pulse pressure (SBP–DBP)	45.3 (46.0; 18.25)	55.6 (52.5; 22.25)	$p<0.05$
Baseline HR*SBP, mmHg/min/1000	9.9 (10.1; 3.74)	11.1 (10.5; 3.84)	$p<0.05$
Peak heart rate	179.3 (181.0; 24.25)	178.5 (180.0; 18.0)	–
Peak systolic blood pressure	169.5 (164.0; 37.75)	164.1 (163.5; 38.75)	–
Peak diastolic blood pressure	81.3 (82.5; 26.25)	78.8 (81.5; 36.5)	–
Peak pulse pressure (SBP–DBP)	88.2 (88.0; 38.0)	85.4 (87.0; 42.75)	–
Peak HR*SBP, mmHg/min/1000	30.3 (29.5; 8.1)	29.2 (28.97; 7.44)	–
O_2 pulse (ml/beat) at peak	10.89 (11.6; 4.43)	9.97 (9.5; 2.4)	$p<0.05$
HR/VO_2 (beats/ml/Kg) at peak	3.52 (3.5; 1.55)	3.91 (3.8; 1.4)	$p<0.05$

[a]Significant one-sided *p* value (< 0.05) – Non-significant one-sided *p* value.

The effect of regular waterpipe tobacco smoking on pulmonary function and exercise capacity in young healthy males: a pilot study

Hawari FI[1, 2], Obeidat NA[2], Ghonimat IM[3], Ayub HS[4], Dawahreh SS[3]

(under review)

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Figure 1 Reported respiratory symptoms in the past year in young male waterpipe smokers and nonsmokers

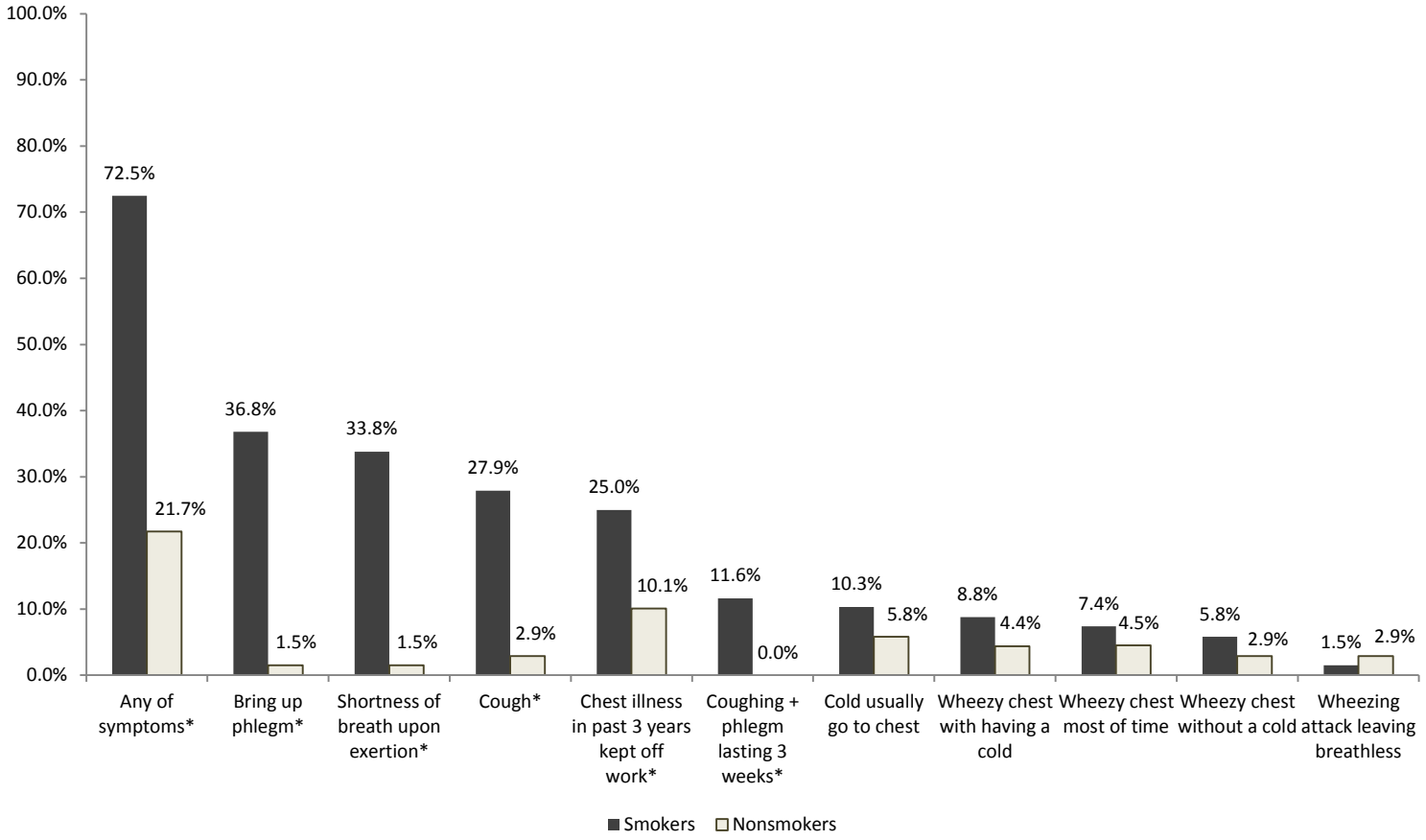

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Table 1. Baseline characteristics of sample of young male waterpipe smokers and nonsmokers

	WTS (n=69)	Nonsmokers (n=69)	p-value
Mean age (range)	22.1 (19.0-26.1)	21.4 (18.2 – 26.4)	0.0016
Height in cm	176.6 (164-192)	176.1 (164-189)	NS
Weight in Kg	79.8 (59-122)	73.5 (47-104)	0.0015
BMI (kg/m^2)	25.6 (17.8-34.2)	23.7 (16.5-32.2)	0.0012
Waterpipe heads per week	8.9	-	
Years smoking waterpipe (range)	4.9 (3-8)	-	
CO (ppm)	4.2 (1-13)	2.2 (0-9)	0.000

Table 2. Cardiopulmonary results comparing young male waterpipe smokers and nonsmokers

	WTS (n=69)	Nonsmokers (n=69)	p-value
Pulmonary parameters			
FEV1, L (% predicted)	4.4 (98.9)	4.4 (102.4)	0.05
FVC, L (% predicted)	5.2 (94.0)	5.0 (98.0)	0.04
PEF, L (% predicted)	7.7 (86.9)	8.4 (92.2)	0.03
TLC, L (% predicted)	7.0 (99.6)	7.2 (109.1)	0.002
CPET parameters			
VO_2, ml/min/kg (% predicted)	27.5 (57.5)	29.4 (61.2)	0.02
Exercise time, minutes	8.5	8.9	0.03
Heart rate, beats/min (% predicted)	163.9 (87.0)	175.9 (93.1)	0.000
Heart rate reserve, beats/min	25.3	14.6	0.000
Borg scale – mid	2.9	1.8	0.000
Borg scale – peak	5.4	3.9	0.000
Leg fatigue – mid	11.7	10.75	0.003
EELV, L – peak	2.9	2.4	0.04
EELV/TLC %	41.2	34.1	0.03
Pet CO_2, mmHg	38.0	36.4	0.04
VE/VCO_2	25.1	23.8	0.0018

WP Cessation?

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Interventions for waterpipe smoking cessation (Review)

Maziak W, Jawad M, Jawad S, Ward KD, Eissenberg T, Asfar T, 2015

Study	Type of study	Type of intervention	Risk Ratio for WP abstinence at 25 wks
Lipkus 2011	Randomized controlled web-based behavioral intervention	Behavioral Interventions only	1.46 (0.81, 2.62)
Mohlman 2013	Cluster-randomized controlled behavioral intervention	Behavioral Interventions only	3.25 (1.19, 8.89)
Dogar 2014	3-arm cluster randomized controlled non-inferiority trial	Behavioral Interventions vs Behavioral and Bupropion	2.28 (1.36, 3.83)

Conclusion:

Compared to control groups, waterpipe smoking cessation rates were higher in the intervention groups in all three studies, with a significant difference in two studies.

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Air quality and second-hand WP exposure

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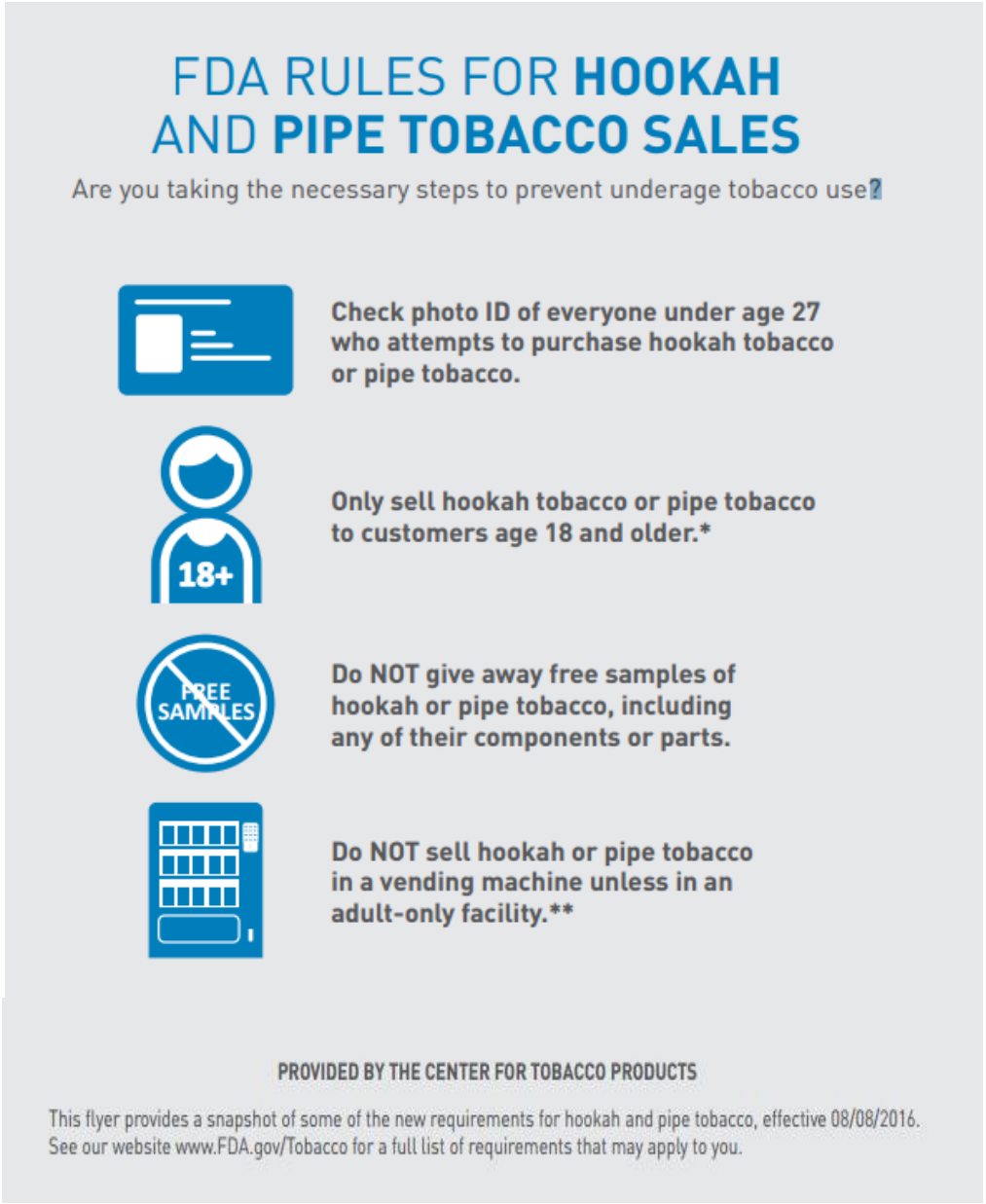
A review of air quality, biological indicators and health effects of second-hand waterpipe smoke exposure

Sumit R Kumar, Shelby Davies, Michael Weitzman, Scott Sherman, 2014

Summary of results:

- SHS from waterpipes results in exposure to hazardous level of particulate matter (PM) and carcinogenic PAH, CO, nicotine and bacterial LPS.
- The side stream smoke of WPS had nearly four times the carcinogenic PAH, four times the volatile aldehydes and 30 times the CO of one cigarette.
- Children living in the homes of hookah smokers had elevated levels of cotinine, NNAL and 3-HPMA depending on frequency of use.
- SHS from waterpipe may cause respiratory symptoms in non-smokers such as: wheezing, nasal congestion and chronic cough

FDA Regulates Waterpipe and other tobacco products



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