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Permalink

<https://escholarship.org/uc/item/6vq6679g>

Journal

American Journal of Health Behavior, 39(5)

ISSN

10873244 19457359

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Publication Date

2015-09-01

DOI

10.5993/AJHB.39.5.10

Peer reviewed

Arab-American Hookah Smokers: Initiation, and Pros and Cons of Hookah Use

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Objectives: To examine initiation, pros and cons of hookah tobacco smoking among Arab Americans. **Methods:** In this descriptive cross-sectional study, we recruited a community-based convenience sample of 458 adult Arab-American hookah smokers, mean age 28.4 years, who completed self-administered questionnaires. **Results:** Irrespective of sex, most participants initiated hookah tobacco use by young adulthood in private homes or hookah lounges influenced by friends and family. Women initiated hookah use later than men. Ever dual smokers (hookah smokers who ever smoked a cigarette) initiated hookah use later than cigarettes; however, early hookah initiators < 18 years initiated hookah and cigarettes concurrently. Participants enjoyed the flavors of hookah tobacco, and complained about coughing, dizzi-

ness, and headaches. **Conclusions:** Early and late initiation of hookah tobacco use warrant prevention programs targeting the youth and older adults in communities, colleges, and middle and high schools that include health education campaigns, and encouragement of voluntary smoke-free home rules. Tobacco control policies aimed to prevent initiation of hookah use should include regulation of hookah tobacco flavors, and should target the physical environments in neighborhoods, especially around schools and colleges, to reduce the proliferation of hookah lounges. Dual hookah tobacco and cigarette use warrant continuous monitoring.

Key words: hookah; waterpipe; initiation; Arab Americans; dual smoker

Am J Health Behav. 2015;39(5):680-697

DOI: <http://dx.doi.org/10.5993/AJHB.39.5.10>

Tobacco use continues to be the leading preventable cause of mortality worldwide, including the United States (US).^{1,2} In 2011, the World Health Organization (WHO) estimated that tobacco use is responsible for 6 million deaths globally each year.¹ In the US between 2010-2014, cigarette smoking and exposure to tobacco smoke resulted in about half a million premature deaths annually.² However, this estimate does not include deaths caused by other forms of combusted tobacco such as hookah tobacco.² Whereas efforts to control tobacco use tend to focus primarily on cigarette smoking, the increase in the popularity of hookah tobacco smoking has been reported in many regions of the world including the US.³⁻⁷ The 2014 Surgeon General Report presented a review

of the health risks related to smoking hookah tobacco, and emphasized the need to monitor its patterns of use.²

A hookah (waterpipe) consists of a bowl with holes in the bottom, a body, a water jar, and a flexible hose with a mouthpiece. Burning charcoal heats the hookah tobacco placed in the bowl, which produces the smoke that is drawn from the bowl, and through water upon inhalation by the smoker via the hose.^{4,5} The most popular hookah tobacco is *Maassel*, which is a mixture of sweetened and flavored tobacco.⁵ Hookah tobacco has been used throughout the Middle East for centuries, and smoking it is believed to be less harmful than cigarettes by many hookah smokers.^{8,9} However, we have recently identified that uptake of benzene (a hematotoxicant) in hookah smokers increased significantly following smoking hookah tobacco in hookah lounges, and in private homes.¹⁰ Hookah smokers are at a greater risk of exposure to benzene and carbon monoxide than cigarette smokers most likely due to the use of charcoal.¹¹ Similar to cigarette smokers, hookah smokers are exposed to the addictive ingredient nicotine, and

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considerable amounts of toxicants including carcinogenic polycyclic aromatic hydrocarbons, volatile aldehydes, and phenolic compounds, which could put them at risk of acute illnesses and chronic heart and lung diseases.¹²⁻¹⁸

The tradition of hookah smoking remains evident among the US Arab populations. Arab Americans report significantly higher ever and current hookah use rates than non-Arab Americans among high school and college students.¹⁹⁻²¹ Arab Americans emigrate from Arabic-speaking countries in southwestern Asia and North Africa, known as the Middle East or the Eastern Mediterranean Region.²² In 2010, it was estimated that 3.7 million Arab Americans were living in the 50 US states.²² Arab Americans grew by more than 72% between 2000 and 2010, and the largest number of Arab Americans live in California.^{22,23} About 817,455 Arab Americans are living in 55 of the 58 counties in California, including San Diego County.²³

Early age of initiation of tobacco use is a risk factor for its long-term use;²⁴ however, there is a paucity of research on initiation of hookah tobacco use.⁵ In Arab countries, hookah tobacco was reported as commonly used at an early age in school children, and is prevalent among young adult university students.^{25,26} The 2009-2011 Global Youth Tobacco Survey (GYTS) among students aged 13 to 15 years in Middle Eastern countries showed that current hookah use prevalence rates ranged from a low of 2.5% in Oman to a high of 36.9% in Lebanon, with high susceptibility of never smokers to initiate hookah smoking in the next year.^{27,28} In the US, the 2011 National Youth Tobacco Survey (NYTS) showed that 19.5% of high school 12th grade students reported ever hookah use, and 6.7% current use.²⁹ The 2013 US National College Health Assessment found that 24.4% of US college students reported ever hookah use, and 8.9% reported current use.³⁰

Sex is relevant for tobacco control.³¹ In Arab countries, overall, hookah use is higher among men than women.^{28,32} Hookah use among Arab women is generally more acceptable and considered less of a taboo than cigarette smoking, which may lead to its use at a young age in family settings.³³ For example, The 2005 GYTS in Lebanon found that 61.5% of boys and 50.4% of girls reported ever hookah use, and 38.3% of boys and 29.9% of girls reported current use.³² In representative samples of university students, hookah use was reported by 30.6% of men and 23.4% of women in Lebanon (2001),³⁴ and by 25.5% of men and 4.9% of women in Syria (2003).³⁵

Concurrent hookah tobacco and cigarette smoking is a concern because of potential compounded tobacco-related health risks, and complexity of controlling initiation and use. Data from 2005-2011 GYTS of participating Middle Eastern countries showed that dual hookah and cigarette use in schoolchildren ranged from a low of 0.9% in Yemen to a high of 11.9% in Lebanon.²⁷ This phenomenon

of dual tobacco products use is emerging in the US. Two studies among university students in North Carolina and Florida found that 55.4% and 35% of current hookah users, respectively, were also current cigarette users.^{36,37} To date, among dual tobacco product smokers, it is unclear whether cigarette use provided a gateway to hookah use or vice versa.⁵ A study in 2008-2011 among students in Jordan, mean age 12.6 years, found that hookah smoking led to the initiation of cigarette smoking.³⁸ A study among Arab-American adolescents found that hookah use was a significant predictor for experimenting with cigarettes.³⁹

It is noteworthy that hookah tobacco could be the first and only form of tobacco used.^{5,36,37} For example, among university students in North Carolina and Florida, 28.8% and 22% of current hookah users, respectively, had never tried a cigarette.^{36,37} In the Arab world hookah smokers may be loyal to smoking only hookah tobacco.⁵ Studies are needed to monitor exclusive hookah use, and dual hookah and cigarette use in the Middle East and in the US particularly among Arab Americans.

We identified 3 manuscripts on adult Arab Americans residing in the Midwest and East Coast states with small subsamples that reported hookah tobacco use addressing barriers to cessation (N = 50), use by health status (N = 90), and demographic risk factors for use (N = 143).⁴⁰⁻⁴²

This is the first study to examine initiation and behaviors of hookah tobacco smoking, and initiation of dual hookah and cigarette use among adult Arab-American hookah smokers by sex, and by early versus late age of hookah initiation (< 18 years vs ≥ 18 years). We also identify reasons for initiating hookah use, along with perceived positive (pros) and negative (cons) consequences of its use, thereby informing points of intervention to control hookah initiation and use.

METHODS

Participants and Study Design

This community-based cross-sectional descriptive study investigated hookah initiation, and dual hookah and cigarette initiation in a convenience sample of 458 adult Arab-American hookah smokers. Data were collected between 2006 and 2008 using a self-administered questionnaire. Inclusion criteria were: being Arab American, being 18 years or older, being a hookah tobacco smoker, being the one participant in the household, and living in San Diego County, California. An Arab American was defined as a person of Arab descent who either immigrated from any of the 22 Arab countries, or was born in the US to at least one parent or grandparent of Arab descent.

To recruit respondents we used the Internet, Arab-American and San Diego County Yellow Pages to generate a list of Arab-American churches, mosques, Middle Eastern restaurants and grocery stores located in San Diego County. We met with governing bodies and owners and sought approval

Table 1
Demographics of Adult Arab-American Hookah Tobacco Smokers, San Diego, California (N = 458)

	Sex						Age first tried hookah ^{a,b}					
	Total		Men		Women		< 18 years		≥ 18 years		p ^c	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)		
Age (years)												
18 thru 20	102	(23.4)	51	(19.2)	51	(29.8)	.006	74	(42.8)	23	(9.5)	<.001
21 thru 25	144	(33.0)	93	(35.1)	51	(29.8)		52	(30.1)	87	(35.8)	
26 thru 35	105	(24.1)	75	(28.3)	30	(17.5)		33	(19.1)	67	(27.6)	
36 and older	85	(19.5)	46	(17.4)	39	(22.8)		14	(8.1)	66	(27.2)	
Mean (SD) ^d	28.4	(11.53)	28.3	(10.14)	29.2	(13.41)	.352	24.2	(8.39)	31.4	(12.18)	<.001
Median (Min-Max) ^e	24	(18-86)	24	(18-86)	24	(18-80)		22	(18-86)	26	(18-80)	
Sex												
Men	272	(59.6)	-	-	-	-		112	(63.3)	143	(56.5)	.161
Women	185	(40.4)	-	-	-	-		65	(36.7)	110	(43.5)	
Marital status												
Single/Never married	289	(67.2)	191	(72.1)	98	(59.4)	.024	132	(79.0)	143	(59.6)	<.001
Married	124	(28.8)	65	(24.5)	59	(35.8)		32	(19.2)	83	(34.6)	
Divorced/Separated/Widowed	17	(4.0)	9	(3.4)	8	(4.8)		3	(1.8)	14	(5.8)	
Education												
High school or less	99	(23.8)	58	(23.3)	41	(24.7)	.686	40	(24.1)	54	(22.9)	.110
Some college/vocational degree	158	(38.1)	92	(36.9)	66	(39.8)		72	(43.4)	82	(34.7)	
College degree	158	(38.1)	99	(39.8)	59	(35.5)		54	(32.5)	100	(42.4)	
Employment												
Employed part time/full time	295	(69.2)	196	(76.3)	99	(58.6)	<.001	122	(71.3)	160	(67.5)	.408
Not employed	131	(30.8)	61	(23.7)	70	(41.4)		49	(28.7)	77	(32.5)	
Annual income before taxes												
Up to \$30,000	87	(29.1)	53	(29)	34	(29.3)	.633	35	(28.9)	51	(30.4)	.118
\$30,000 to \$70,000	105	(35.1)	61	(33.3)	44	(37.9)		36	(29.8)	66	(39.3)	
Over \$70,000	107	(35.8)	69	(37.7)	38	(32.8)		50	(41.3)	51	(30.4)	
What do you consider yourself?												
Arab American	161	(38.5)	84	(33.2)	77	(46.7)	.008	71	(43.3)	82	(34.74)	.053
Middle Eastern	151	(36.1)	94	(37.2)	57	(34.5)		62	(37.8)	87	(36.9)	
Chaldean	91	(21.8)	67	(26.4)	24	(14.6)		24	(14.6)	60	(25.4)	
Other	15	(3.6)	8	(3.2)	7	(4.2)		7	(4.3)	7	(3.0)	
Where were you born?												
Arab country	249	(57.6)	159	(60.7)	90	(52.9)	.281	76	(44.4)	163	(67.9)	<.001
United States	165	(38.2)	93	(35.5)	72	(42.4)		84	(49.1)	71	(29.6)	
Other	18	(4.2)	10	(3.8)	8	(4.7)		11	(6.4)	6	(2.5)	
At what age did you come to the US?												
Mean (SD)	18.2	(11.01)	18.4	(9.90)	18.0	(12.75)	.804	14.8	(9.52)	19.7	(11.48)	<.001
Median (Min-Max)	18	(0-61)	19.5	(0-55)	17	(.5-61)		16	(0-55)	20	(.08-61)	
How many years have you lived in the US?												
Mean (SD)	15.8	(8.81)	14.9	(9.0)	17.2	(8.39)	.010	14.9	(8.01)	16.2	(9.31)	.151
Median (Min-Max)	17	(.25-51)	16	(.25-39)	18	(.67-51)		18	(.25-37)	15	(.50-51)	

Note. Due to missing values, some variables do not total the sample size 458.

a = 'Hookah' was referred to in the questionnaire as 'hookah tobacco'.

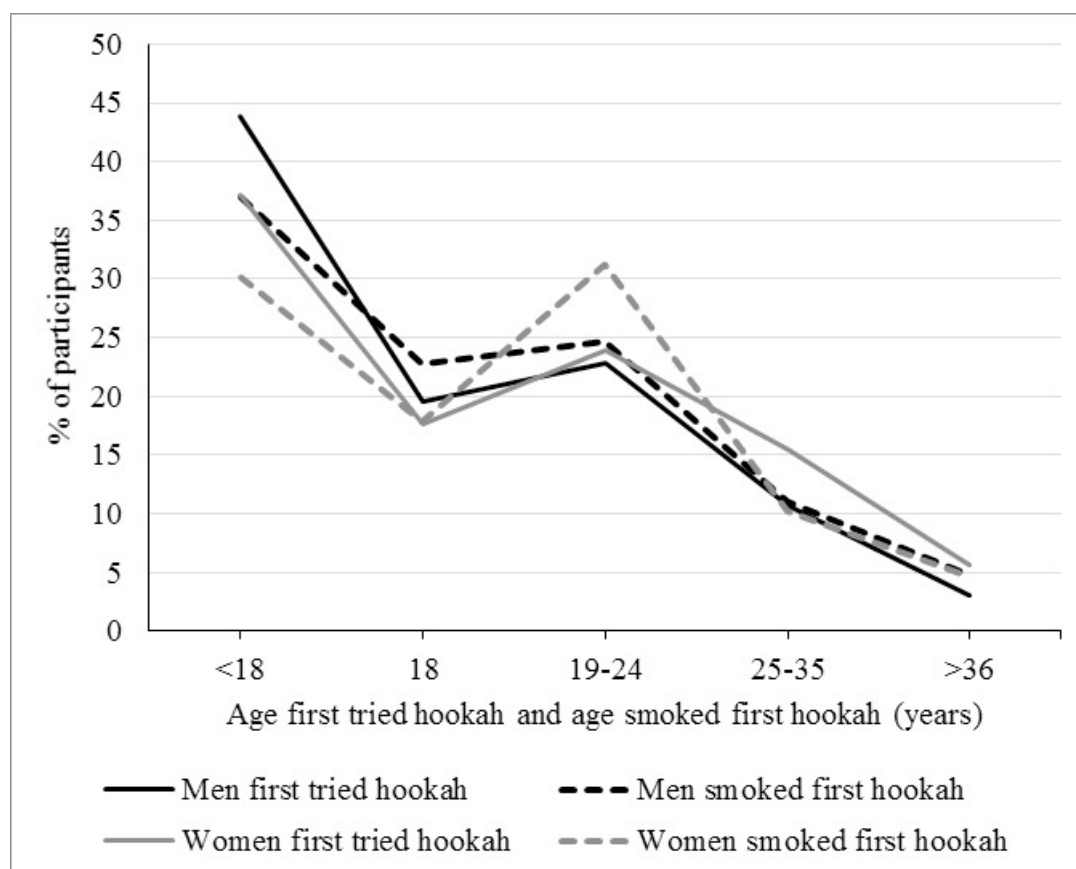
b = Participants were asked: About how old were you when you first tried to smoke hookah?

c = p - value from Chi-square test or t-test, as appropriate, for significance at p < .05; statistically significant p values are bolded.

d = SD is Standard Deviation

e = Min - Max is Minimum - Maximum

Figure 1
Age First Tried Hookah and Age Smoked First Hookah by Sex



for recruitment at their sites. Almost all agreed to participate. Flyers were posted at each site, and research assistants (RAs) were present on scheduled dates and times for recruitment. Through word-of-mouth, we identified additional recruitment sites, such as Arab-American festivals, barbershops, physicians' clinics, community organizations, and student clubs on college and university campuses. We also generated a list of Arabic language classes in colleges in San Diego County, and distributed recruitment flyers in approved classrooms. Participants were qualified via a brief screening questionnaire; respondents were asked: "Do you currently smoke hookah daily, weekly, monthly, occasionally or not at all?" Those who responded "daily, weekly, monthly or occasionally" were included in the study.

Approximately 45 English-Arabic bilingual RAs, recruited from the community and colleges were trained to recruit, screen, and collect data using a standardized protocol. RAs enrolled qualified participants, obtained a written informed consent, and gave instructions on completing a paper-and-pencil self-administered hookah use questionnaire,

such as skip patterns and open-ended questions. Participants completed the questionnaire in their homes or in our research center in the presence of the RAs. Upon completion of the questionnaire, the RAs provided an incentive based on participant preference of either \$20 in cash or a prepaid \$20 international phone card, and 2 tickets for \$100 quarterly drawings. Also, \$100 was awarded on a quarterly basis to the RA with the most recruited participants.

We checked the content validity of the hookah questionnaire items by consulting the literature on hookah use and US national surveys on tobacco use;^{33,43-45} by inviting a panel of experts on tobacco use in our research center to review the questions; and by conducting focus groups with adult Arab-American hookah smokers. Survey completion time ranged between 60 and 100 minutes. Each questionnaire item was displayed in English and Arabic, and respondents were given their choice of language in which to complete the questionnaire, including the open-ended questions. Arabic was the interview language chosen by 46.2% of respon-

Table 2
Hookah Initiation and Use Behaviors among Adult Arab-American
Hookah Smokers, San Diego, California (N = 458)

	Sex						Age first tried hookah ^{a,b}					
	Total		Men		Women		p ^c	< 18 years		≥ 18 years		
	N	(%)	N	(%)	N	(%)		N	(%)	N	(%)	
About how old were you when you first tried to smoke hookah? (years)												
<18	177	(41.2)	112	(43.9)	65	(37.1)	.218	177	(100)	0	(0.0)	<.001
18 ^d	81	(18.8)	50	(19.6)	31	(17.7)		0	(0.0)	81	(32.0)	
19-24	100	(23.3)	58	(22.8)	42	(23.9)		0	(0.0)	100	(39.5)	
25-35	54	(12.4)	27	(10.7)	27	(15.4)		0	(0.0)	54	(21.3)	
>36	18	(4.2)	8	(3.1)	10	(5.7)		0	(0.0)	18	(7.1)	
Mean (SD) ^e	19.5	(7.34)	18.9	(6.22)	20.5	(8.64)	.032	14.6	(2.68)	23	(7.61)	<.001
Median (Min-Max) ^f	18	(3-63)	18	(5-54)	18	(3-63)		15	(3-17)	20	(18-63)	
About how old were you when you smoked your first hookah? (years)												
<18	146	(34.1)	94	(36.9)	52	(30.1)	.179	142	(81.6)	0	(0.0)	<.001
18	89	(20.8)	58	(22.7)	31	(17.9)		18	(10.3)	67	(27.2)	
19-24	117	(27.3)	63	(24.7)	54	(31.2)		12	(6.9)	105	(42.7)	
25-35	56	(13.1)	28	(11.0)	28	(10.2)		1	(0.6)	55	(22.4)	
>36	20	(4.7)	12	(4.7)	8	(4.6)		1	(0.6)	19	(7.7)	
Mean (SD)	20.5	(7.54)	19.8	(6.66)	21.5	(8.58)	.023	16.3	(3.65)	23.6	(8.13)	<.001
Median (Min-Max)	18	(5-65)	18	(5-54)	19	(7-65)		16	(5-50)	20	(18-65)	
p ^g	<.001		<.001		<.001			<.001		<.001		
If first tried hookah <18 years, age first tried to smoke hookah? (years)												
3 thru 9	10	(5.6)	5	(4.5)	5	(7.7)	.542	10	(5.6)	-	-	
10 thru 12	20	(11.3)	13	(11.6)	7	(10.8)		20	(11.3)	-	-	
13	8	(4.5)	4	(3.6)	4	(6.2)		8	(4.5)	-	-	
14	14	(7.9)	11	(9.8)	3	(4.6)		14	(7.9)	-	-	
15	39	(22.0)	21	(18.8)	18	(27.7)		39	(22.0)	-	-	
16	51	(28.8)	35	(31.3)	16	24.6)		51	(28.8)	-	-	
17	35	(19.8)	23	(20.5)	12	(18.5)		35	(19.8)	-	-	
Mean (SD)	14.6	(2.68)	14.7	(2.54)	14.4	(2.92)	.375	14.6	(2.68)	-	-	
Median (Min-Max)	15	(3-17)	16	(5-17)	15	(3-17)		15	(3-17)	-	-	
The first time you tried to smoke hookah, were you...?												
Alone	17	(3.8)	10	(3.7)	7	(3.9)	.006	8	(4.6)	7	(2.8)	.004
With friend(s)	349	(77.4)	222	(82.2)	127	(70.2)		123	(70.3)	210	(83.7)	
With family	83	(18.4)	37	(13.7)	46	(25.4)		43	(24.6)	33	(13.1)	
The first time you tried to smoke hookah, were you at...?												
Home	58	(15.5)	26	(11.7)	32	(20.9)	.042	35	(28.9)	51	(30.4)	.118
Friend's home	152	(40.5)	91	(41.0)	61	(39.9)		36	(29.8)	66	(39.3)	
Hookah lounge	165	(44.0)	105	(47.3)	60	(39.2)		50	(41.3)	51	(30.4)	
Have you ever been to a hookah lounge?												
Yes	350	(80.5)	210	(80.8)	140	(80.0)	.843	145	(86.8)	190	(77.2)	.015
No	85	(19.5)	50	(19.2)	35	(20.0)		22	(13.2)	56	(22.8)	
Do you smoke hookah daily, weekly, monthly or not at all? ^h												
Daily	44	(9.6)	33	(12.1)	11	(5.9)	.118	17	(9.6)	25	(9.9)	.034
Weekly	123	(26.9)	76	(27.8)	47	(25.4)		49	(27.7)	63	(24.9)	
Monthly	118	(25.8)	67	(24.5)	51	(27.6)		57	(32.2)	56	(22.1)	
Occasionally	173	(37.8)	97	(35.5)	76	(41.1)		54	(30.5)	109	(43.1)	

(continued on next page)

Table 2 (continued)
Hookah Initiation and Use Behaviors among Adult Arab-American
Hookah Smokers, San Diego, California (N = 458)

	Sex						Age first tried hookah ^{a,b}					
	Total		Men		Women		p ^c	< 18 years		≥ 18 years		
	N	(%)	N	(%)	N	(%)		N	(%)	N	(%)	
Did you smoke hookah during the past 7 days?												
Yes	237	(52.9)	144	(53.7)	93	(51.7)	.668	96	(55.2)	125	(50.0)	.294
No	211	(47.1)	124	(46.3)	87	(48.3)		78	(44.8)	125	(50.0)	
Did you smoke hookah during the past 30 days?												
Yes	350	(77.8)	206	(76.6)	144	(79.6)	.456	48	(55.2)	78	(57.4)	.749
No	100	(22.2)	63	(23.4)	37	(20.4)		39	(44.8)	58	(42.2)	
What type of hookah tobacco do you currently smoke?												
Smoke only flavored	393	(93.1)	235	(95.5)	158	(89.6)	.064	159	(96.4)	217	(91.6)	.096
Smoke only unflavored	12	(2.8)	4	(1.6)	8	(4.5)		4	(2.4)	8	(3.4)	
Smoke both equally	17	(4.0)	7	(2.8)	10	(5.7)		2	(1.2)	12	(5.1)	
How many hookah heads do you usually smoke on the day you smoke? ^d												
1	325	(76.5)	192	(75.6)	133	(77.8)	.872	112	(68.3)	200	(82.6)	.003
2	74	(17.4)	46	(18.1)	28	(16.4)		39	(23.8)	30	(12.4)	
3 or more	26	(6.1)	16	(6.3)	10	(5.8)		13	(7.9)	12	(5.0)	
Mean (SD)	1.3	(0.77)	1.3	(0.61)	1.4	(0.97)	.444	1.44	(0.83)	1.25	(0.73)	.022
Median (Min-Max)	1	(0.25-8)	1	(0.25-4)	1	(0.5-8)		1	(0.5-7)	1	(0.25-8)	
How long do you usually smoke hookah on the days that you smoke? (Minutes)												
<30	32	(7.9)	18	(7.4)	14	(8.5)	.943	10	(6.3)	21	(9.0)	.004
30	81	(19.9)	47	(19.3)	34	(20.7)		21	(13.2)	57	(24.4)	
60	164	(40.3)	103	(42.4)	61	(37.2)		62	(39.0)	101	(43.2)	
90	20	(4.9)	11	(4.5)	9	(5.5)		11	(6.9)	9	(3.8)	
120	71	(17.4)	41	(16.9)	30	(18.3)		35	(22.0)	32	(13.7)	
>120	39	(9.6)	23	(9.5)	16	(9.8)		20	(12.6)	14	(6.0)	
Mean (SD)	76.9	(59.60)	76	(56.90)	78.2	(63.60)	.830	87.8	(63.49)	67.4	(54.20)	.001
Median (Min-Max)	60	(5-480)	60	(5-420)	60	(5-480)		60	(5-420)	60	(5-480)	
Which days of the week do you usually smoke hookah at home? Check all that apply.												
Monday-Thursday	60	(18.5)	34	(17.3)	26	(20.2)	.523	38	(43.2)	31	(24.0)	.003
Friday	195	(60.0)	115	(58.7)	80	(62.0)	.547	42	(47.7)	41	(32.0)	.020
Saturday	226	(69.5)	140	(71.4)	86	(66.5)	.361	47	(53.4)	71	(55.5)	.765
Sunday	74	(22.8)	43	(21.9)	31	(24.0)	.660	22	(25.0)	41	(32.0)	.264
What time do you usually smoke hookah at home? Check all that apply.												
Morning (6 a.m. - 12:59 p.m.)	0	(0.0)	0	(0.0)	0	(0.0)	-	6	(6.7)	3	(2.2)	.083
Afternoon (1 p.m. - 5:59 p.m.)	21	(6.3)	10	(5.0)	11	(8.2)	.227	25	(28.1)	19	(13.7)	.007
Evening (6 p.m. - 12:59 a.m.)	296	(87.8)	178	(87.7)	118	(88.1)	.918	62	(69.7)	103	(74.1)	.465
Night (1 a.m. - 5:59 a.m.)	65	(19.3)	32	(15.8)	33	(24.6)	.046	16	(18.0)	23	(16.5)	.780

Note. Due to missing values, some variables do not total the sample size 458.

a = 'Hookah' was referred to in the questionnaire as 'hookah tobacco'.

b = Participants were asked: About how old were you when you first tried to smoke hookah?

c = p - value from Chi-square test or t-test, as appropriate, for significance at p < .05; statistically significant p values are bolded.

d = Age 18 years is the age at which one is legally considered an adult in the US, and the minimum age at which individuals can purchase tobacco legally.

e = SD is Standard Deviation

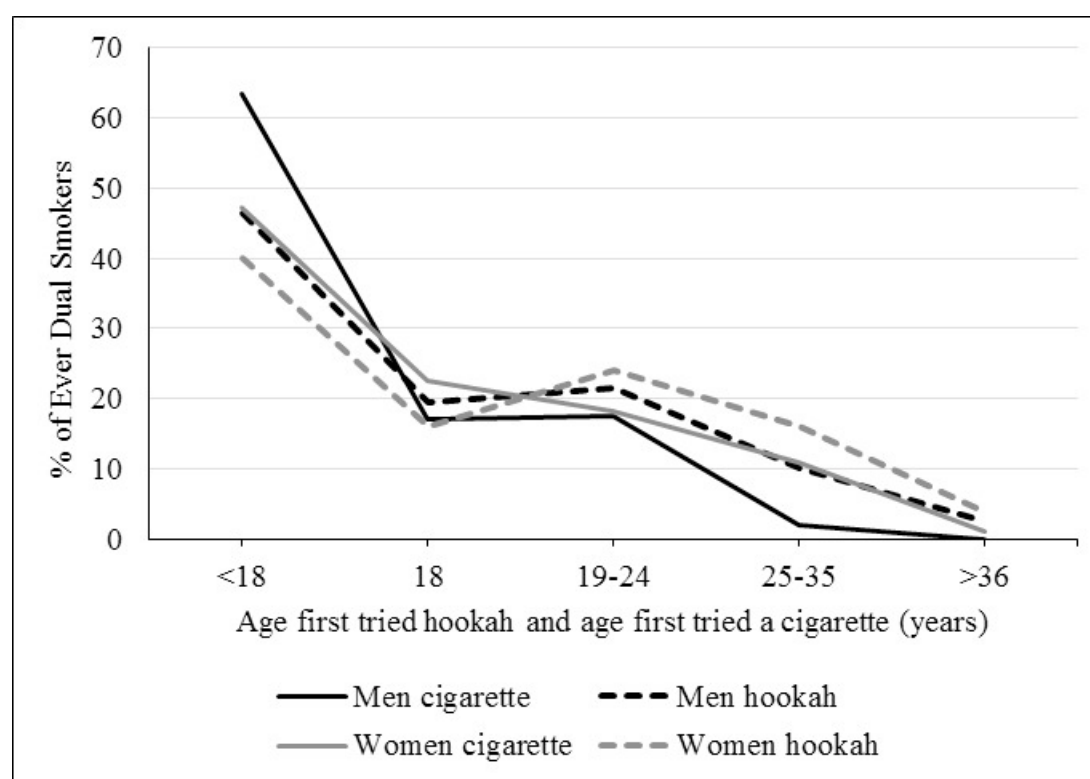
f = Min - Max is Minimum - Maximum

g = p - value from paired t-test, age first tried to smoke hookah vs age smoked first hookah.

h = Daily: at least once each day, Weekly: at least once each week but less than daily, Monthly: at least once a month but less than weekly, and Occasionally: at least once a year but less than monthly.

i = 'A hookah head' was defined in the questionnaire as 'one Ras' or '10 grams of hookah tobacco'.

Figure 2
Ever Dual Smokers: Age First Tried Hookah and Age
First Tried a Cigarette by Sex



dents. We translated open-ended Arabic responses to English for data entry.

To ensure linguistic comparability of all study instruments for the English and Arabic versions, we used a published protocol for translation and back translation.^{46,47} We then used published protocols to evaluate sources of response error of the hookah questionnaire by conducting cognitive interviews with 3 male and 3 female bilingual Arab-American hookah smokers recruited from the community.⁴⁸ Taking into consideration appropriateness to potential respondents' cultural context, questions that were not clear were rephrased. The questionnaire was pre-tested on 6 Arab-American hookah smokers (3 men; 3 women), and pilot-tested on 12 Arab-American hookah smokers (6 men; 6 women). This manuscript addressed the following measures.

Measures

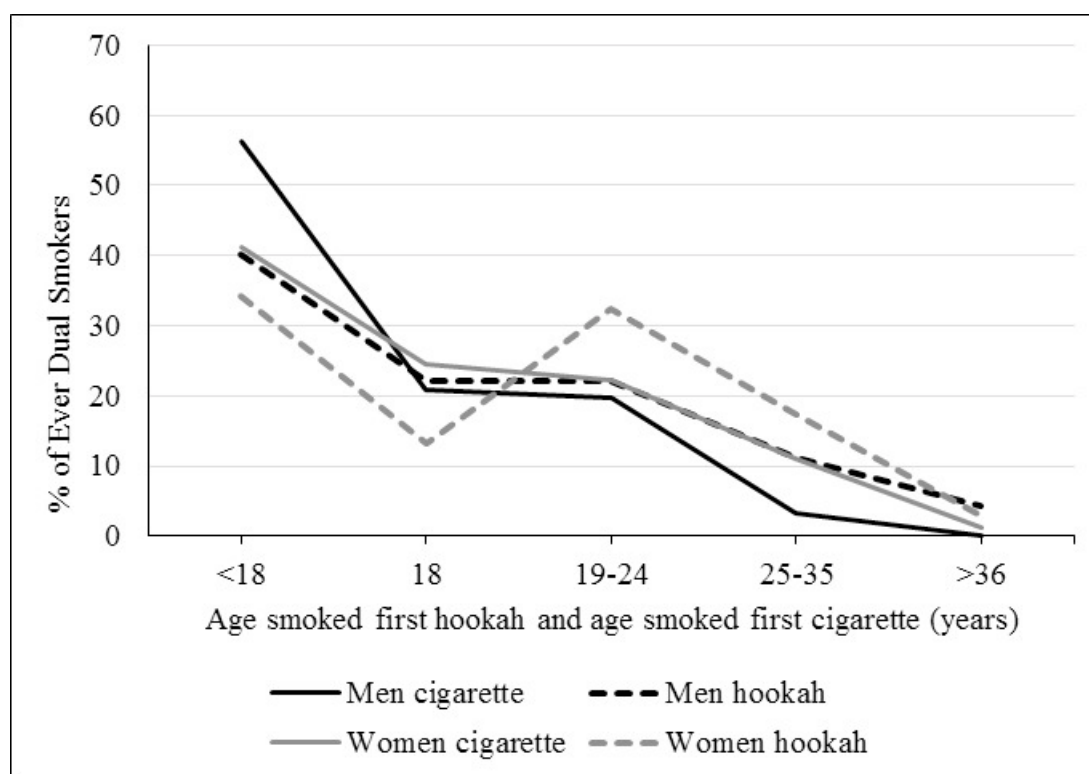
Socio-demographic characteristics. We asked about age, sex, marital status, education, employment, income, ethnicity, country of birth, age immigrating to the US, and number of years living in the US.

Hookah use initiation. Two questions on hookah use initiation were recommended by the focus

groups of adult Arab-American hookah smokers. Participants were asked the age at which they first tried hookah, and the age at which they smoked their first hookah. The reliability coefficient, Cronbach's alpha, for the 2 questions was 0.93. The difference in these 2 measures was explained to participants. Age of first trying hookah was when the participant did not intend to smoke a hookah, but first puffed hookah through an invitation to try it; age of first smoking hookah was when they intended to smoke, and smoked or shared at least one hookah head. We defined early hookah initiators as those who first tried to smoke hookah at an age younger than 18 years (< 18 years), and late hookah initiators as those who first tried at ages 18 years or older (≥ 18 years). Participants were also asked about the location and with whom they first tried to smoke hookah, and about the reasons they started to smoke hookah using the open-ended question: "What caused you to start smoking hookah?"

Hookah use behaviors. We asked participants about frequency of use, past 7 and 30 days use, number of hookah heads smoked per day, length of time smoking hookah per day, days and times of the day that hookah tobacco was smoked, and

Figure 3
Ever Dual Smokers: Age Smoked First Hookah and Age
Smoked First Cigarette by Sex



whether they had ever been to a hookah lounge.

Dual hookah and cigarette use initiation. We asked participants who were ‘ever dual smokers’ about ever and current cigarette use, the age at which they first tried and smoked their first cigarette, and the age at which they first tried and smoked hookah. We defined ‘ever dual smokers’ as hookah smokers who ever tried a cigarette, and ‘current dual smokers’ as hookah smokers who smoked cigarettes every day or on some days.

Pros and cons of hookah use. We used 2 open-ended questions: “What do you enjoy most about smoking a hookah?” and “What bothers you most about smoking a hookah?”

Data Analysis

Data were double entered and 100% verified, and analyzed using 2-tailed statistical tests ($\alpha = .05$) in SPSS version 19. Distributions of characteristics of respondents and their hookah use behaviors by sex and by early versus late hookah use initiation were determined by chi-square tests for categorical variables, or independent sample t-tests for continuous variables. Paired t-tests were used to determine differences in ages between first tried and smoked first hookah among hookah

smokers, and among ever dual smokers by sex and by early versus late hookah initiation. For open-ended questions, an *a priori* codebook was developed by the principal investigator (PI) and reviewed by the study team. Participants’ responses were manually grouped into categories by 3 coders comprised of the PI, the data manager, and an Arab-American hookah smoker graduate college student intern. The code book was updated by emerging themes. Category percentages and direct quotes are presented.

RESULTS

Demographic characteristics of 458 adult Arab American hookah smoking participants are presented by sex, and by early versus late hookah initiation in Table 1. Age ranged from 18 to 86 years, with a mean (M) of 28.4 years. Approximately 56.4% were young adults between the ages of 18 and 25 years old. Most participants were never married, had some college education or a college degree, were employed, and had an income above \$30,000. Participants considered themselves Arab Americans, Middle Easterners, Chaldeans, or Other. Those who chose the ‘Other’ option identified themselves by either their country of origin, such

Table 3
Dual Hookah and Cigarette Initiation among Adult Arab-American Hookah Smokers, San Diego, California (N = 458)

	Sex						Age first tried hookah ^{a,b}					
	Total		Men		Women		p ^c	< 18 years		≥ 18 years		p ^c
	N	(%)	N	(%)	N	(%)		N	(%)	N	(%)	
Have you ever tried or smoked a cigarette, even a few puffs?												
Yes ^d	276	(61.2)	171	(62.9)	105	(58.7)	.370	114	(65.5)	145	(57.5)	.097
No	175	(38.8)	101	(37.1)	74	(41.3)		60	(34.5)	107	(42.5)	
Do you currently smoke cigarettes every day, some days, or not at all?												
Not at all	132	(48.2)	72	(42.6)	60	(57.1)	.035	57	(50.9)	70	(49.0)	.939
Some days ^e	75	(27.4)	48	(28.4)	27	(25.7)		27	(24.1)	37	(25.9)	
Every day ^e	67	(24.5)	49	(29.0)	18	(17.1)		28	(25.0)	36	(25.2)	
Ever Dual Smoker: Age first tried to smoke a cigarette? (years)												
<18	141	(57.3)	97	(63.4)	44	(47.3)	.008	80	(76.9)	56	(41.8)	<.001
18	47	(19.1)	26	(17.0)	21	(22.6)		16	(15.4)	29	(21.6)	
19-24	44	(17.9)	27	(17.6)	17	(18.3)		6	(5.8)	37	(27.6)	
25-35	13	(5.3)	3	(2.0)	10	(10.8)		2	(1.9)	11	(8.2)	
>36	1	(0.4)	0	(0.0)	1	(1.1)		0	(0.0)	1	(0.7)	
Mean (SD) ^f	17.1	(4.77)	16.4	(3.66)	18.4	(6.0)	.004	15.3	(3.46)	18.6	(5.22)	<.001
Median (Min-Max) ^g	17	(4-38)	16	(7-25)	18	(4-38)		16	(4-26)	18	(9-38)	
Ever Dual Smoker: Age smoked first cigarette? (years)												
<18	123	(50.6)	86	(56.2)	37	(41.1)	.034	74	(71.2)	45	(34.4)	<.001
18	54	(22.2)	32	(20.9)	22	(24.4)		18	(17.3)	33	(25.2)	
19-24	50	(20.6)	30	(19.6)	20	(22.2)		10	(9.6)	39	(29.8)	
25-35	15	(6.2)	5	(3.3)	10	(11.1)		2	(1.9)	13	(9.9)	
>36	1	(0.4)	0	(0.0)	1	(1.1)		0	(0.0)	1	(0.8)	
Mean (SD)	17.7	(4.53)	16.9	(3.54)	19	(5.64)	.002	16.1	(2.95)	19	(5.15)	<.001
Median (Min-Max)	17	(7-38)	17	(8-26)	18	(7-38)		16	(7-26)	18	(10-38)	
p ^h	<.001		<.001		.039			<.001		.035		
Ever Dual Smoker first tried cigarettes <18 years: Age first tried to smoke a cigarette? (years)												
4 thru 9	10	(7.1)	8	(8.2)	2	(4.5)	.424	7	(8.8)	2	(3.6)	.820
10 thru 12	21	(14.9)	14	(14.4)	7	(15.9)		12	(15.0)	9	(16.1)	
13	8	(5.7)	5	(5.2)	3	(6.8)		5	(6.3)	3	(5.4)	
14	14	(9.9)	13	(13.4)	1	(2.3)		9	(11.3)	4	(7.1)	
15	27	(19.1)	16	(16.5)	11	(25)		3	(16.3)	13	(23.2)	
16	34	(24.1)	22	(22.7)	12	(27.3)		18	(22.5)	14	(25.0)	
17	27	(19.1)	19	(19.6)	8	(18.2)		16	(20.0)	11	(19.6)	
Mean (SD)	14.3	(2.67)	14.3	(2.58)	14.4	(2.88)	.785	14.2	(2.9)	14.6	(2.29)	.730
Median (Min-Max)	15	(4-17)	15	(7-17)	15	(4-17)		15	(4-17)	15	(9-17)	

(continued on next page)

as Lebanese, Egyptian, or by ethnicity other than Chaldean, such as Kurdish, Assyrian.

About one-half of the participants were born in an Arab country, 38.2% were born in the US,

and 4.2% were born in another country, such as France, Mexico, or Canada. Of participants who were born in an Arab country, 35.1% were born in Iraq, 27.9% were born in Lebanon, and 37%

Table 3 (continued)
Dual Hookah and Cigarette Initiation among Adult Arab-American Hookah Smokers, San Diego, California (N = 458)

	Sex						Age first tried hookah ^{a,b}					
	Total		Men		Women		p ^c	< 18 years		≥ 18 years		
	N	(%)	N	(%)	N	(%)		N	(%)	N	(%)	
Ever Dual Smoker: Age first tried to smoke hookah? (years)												
<18	114	(44.0)	74	(46.5)	40	(40.0)	.495	114	(76.9)	0	(0.0)	<.001
18	47	(19.1)	31	(19.5)	16	(16.0)		0	(0.0)	47	(32.4)	
19-24	58	(17.9)	34	(21.4)	24	(24.0)		0	(0.0)	58	(40.0)	
25-35	32	(5.3)	16	(10.1)	16	(16.0)		0	(0.0)	32	(22.1)	
>36	8	(0.4)	4	(2.5)	4	(4.0)		0	(0.0)	8	(5.5)	
Mean (SD)	19.1	(6.79)	18.5	(6.05)	20	(7.77)	.100	14.6	(2.76)	22.6	(6.93)	<.001
Median (Min-Max)	18	(3-63)	18	(5-54)	18	(3-63)		15	(3-17)	20	(18-63)	
Ever Dual Smoker: Age smoked first hookah? (years)												
<18	99	(37.9)	65	(40.1)	34	(34.3)	.107	95	(84.8)	0	(0.0)	<.001
18	49	(18.8)	36	(22.2)	13	(13.1)		8	(7.1)	37	(26.2)	
19-24	68	(26.1)	36	(22.2)	32	(32.3)		7	(6.3)	61	(43.3)	
25-35	35	(13.4)	18	(11.1)	17	(17.2)		1	(0.9)	34	(24.1)	
>36	10	(3.8)	7	(4.3)	3	(3.0)		1	(0.9)	9	(6.4)	
Mean (SD)	20.1	(7.09)	19.6	(6.77)	21	(7.54)	.111	16.3	(4.21)	23.4	(7.46)	<.001
Median (Min-Max)	18	(5-65)	18	(5-54)	19	(7-65)		16	(5-50)	20	(18-65)	
p ⁱ	<.001		<.001		<.001			<.001		.001		
p ^j	<.001		<.001		<.001			.060		<.001		
p ^k	<.001		.004		.032			.652		<.001		

Note. Due to missing values, some variables do not total the sample size 458.

a = 'Hookah' was referred to in the questionnaire as 'hookah tobacco'.

b = Participants were asked: About how old were you when you first tried to smoke hookah?

c = p - value from Chi-square test or t-test, as appropriate, for significance at p < .05; statistically significant p values are bolded.

d = 'Ever Dual Smoker' is a hookah smoker who ever tried or smoked a cigarette.

e = 'Current Dual Smoker' is a hookah smoker who smoked cigarettes every day or some days.

f = SD = Standard Deviation

g = Min - Max = Minimum - Maximum

h = p - value from paired t-test, age first tried to smoke cigarette vs age smoked first cigarette.

i = p - value from paired t-test, age first tried to smoke hookah vs age smoked first hookah.

j = p - value from paired t-test, age first tried to smoke cigarette vs age first tried to smoke hookah.

k = p - value from paired t-test, age smoked first cigarette vs age smoked first hookah.

were born in other Arab countries. The majority of the participants' mothers (89.7%) and fathers (92.3%) were born in an Arab country. Compared to national demographics data on Arab Americans based on the US Census Bureau's American Community Survey (2006-2010),⁴⁹ the sample participants overrepresented Iraqi Americans (35.8% vs 5%), but constituted similar percentages of Lebanese Americans (26.9% vs 26%), were younger (M=28.4 years vs 33 years), more likely to be single/never married (67.2% vs 35.1%), unemployed (30.8% vs 5%), and less likely to be born in the US (38.2% vs 56.2%).

The mean ages of men and women did not differ

significantly. More women than men were married, and unemployed. Compared to late hookah initiators, early hookah initiators were younger, more likely to be single/never married, born in the US, or immigrated to the US at a younger age.

Age of Initiation of Hookah Smoking

Table 2 shows hookah use initiation, frequency, amount, and length of time spent smoking hookah by sex and by early versus late hookah initiation. A total of 41.2% of the participants overall first tried hookah smoking at an age younger than 18 years, and 42.1% between the ages of 18 years and 24 years. About one-third smoked their first hookah

Table 4
Responses to the Survey Question: What Caused You to Start Smoking Hookah?
(N = 436)

	N	(%)	Quotes
Friend(s)	212	(48.6)	'friends introduced me to hookah, invited by a friend to try it, a friend encouraged me, a friend said that it was enjoyable, because friends did it, I enjoy it with my friends, friends at parties, hanging out with friends, gathering at a friend's house, watching a friend smoking it, with friends who smoke hookah regularly, a friend had a hookah, usually when friends go out, it is to drink coffee and smoke, friends took me to a hookah lounge, wanted to join my friends, to fit in with friends, peer pressure, pressure from friends to start smoking it, the homies, buddies, my boyfriend, Whitney's boyfriend, my friend Sally'
Family	44	(10.1)	'my mother, dad, parent, big bro, brothers, my sister and her friends, my uncle, niece, husband, ex-husband, I was visiting my cousins, family gatherings, family back home were smoking it, family members each have one hookah, parents had guests so I prepared it and tried it, family tradition, everyone else smokes hookah in the family'
Enjoyment/Fun/Recreation	37	(8.5)	'it's fun, because I like it, I enjoy it, nothing else to do, boredom, recreation'
Experimentation/Curiosity	35	(8.0)	'curious about it, heard a lot about it, another experience in life, it was a new habit in my high school, I saw men smoking hookahs so I tried to do the same, the smoke looks interesting, seemed interesting, the hookah looks interesting, I wanted to try it, to try it once in my life, try something new, I wanted to taste it, to see how it feels, to see how it tastes'
Socializing ^a	28	(6.4)	'a social activity, social events, social pass time, to be social, parties'
Culture	16	(3.6)	'working with lots of Middle Eastern friends, it is culture, part of culture, family tradition, heritage, missing home'
Taste/Smell	12	(2.8)	'I love the smell of it, it tastes good, many flavors'
Relaxation/Stress Reliever	9	(2.1)	'a good stress healer, I was stressed-out in life, relaxing, way to kick back, stress from school'
Other	9	(2.1)	'being around it so much, many hookah lounges, there are many hookah lounges back home, being in a nice atmosphere with friends, there is nowhere else to go, only hookah lounges, no reason, to quit cigarettes'
Don't know	33	(7.8)	'I don't know'

Note

a = Socializing category was generated because responses did not reference friends or family.

at an age younger than 18 years, and about half between the ages of 18 years and 24 years. There was a one-year difference overall between first trying hookah smoking and actually smoking their first hookah (M=19.5 years vs 20.5 years, $p < .001$).

Men first tried to smoke hookah at an age significantly younger than women (M=18.9 years vs 20.5 years, $p = .032$), with a mean difference of 1.64 years. Similarly, men smoked their first hookah at an age significantly younger than women (M=19.8 years vs 21.5 years, $p = 0.23$), with a mean difference of 1.76 years. For both men and women, there was a one-year difference between first trying hookah and actually smoking their first hookah (Figure 1).

Among early hookah initiators there was 1.7-year difference between first trying hookah smoking

and smoking their first hookah (M=14.6 years vs 16.3 years, $p < .001$), compared to only half a year difference among late hookah initiators.

For participants ages 35 to 86 years (M=47.4 years), age for first trying hookah smoking and age actually smoking their first hookah were [M(SD), 27.6 years (11.31), Range, 8-63 years] and [M(SD), 29.8 years (11.40), Range, 15-65 years], respectively. For this age group, 17.5% (N = 14) first tried hookah smoking at an age < 18 years, 23.7% (N = 19) between 18-24 years, 36.3% (N = 29) between 25-35 years, and 22.5% (N = 18) between 37-63 years.

Family, Friends, and Location of Hookah Initiation

The majority of men and women were with

Table 5
Responses to the Survey Question: What Do You Enjoy
Most about Smoking a Hookah? (N = 421)

	N	(%)	Quotes
Flavor(s) of tobacco/Smell	128	(30.4)	'the different flavors of tobacco, the long-lasting flavor, the taste of smoke, the taste of tobacco, the taste of the flavor, tastes good, the great taste, tastes better than cigarettes, the aroma, the smell of it's flavors'
Relaxation/Stress Reliever	70	(16.6)	'very relaxing, it makes me feel more relaxed, calming, chill out, I forget my problems, when I get mad it calms me down, relieves stress, pass time, taking time out, way to kick back, takes your mind off things, not thinking, soothing, smooth'
Socializing	44	(10.5)	'smoking with company, gatherings, it is good to socialize over hookah, great way to socialize, social smoking, making friends, hanging out, social interaction, people, bond with people, brings people close, it makes it easy to talk, conversations that follow, the stories'
Enjoyment/Fun	37	(8.8)	'pleasurable, something to do, an activity, fun time, having a good time, just smoke it for the fun of it, I enjoy it, it's fun, I like it, I love it'
Buzz/Feeling good	31	(7.4)	'the buzz it gives me, feeling afterwards, dizziness, feel good, feeling happy, feeling of getting a little high, feeling of lightheadedness, when it gets to my brain, special kind of high'
Friend(s)	27	(6.4)	'a reason to spend time with friends, being with friends, hanging out with boyfriend, a relaxed gathering with friends, fun time with friends, just for fun with my friends, enjoy smoking hookah with friends, share it with friends'
Sound of hookah/Smoke	22	(5.2)	'the sounds of the hookah, blowing smoke heavily from my mouth and nose, inhaling the smoke, playing with the smoke and flavors, I like making big clouds of smoke, when you breathe out the smoke, the circles of smoke I can blow, watching clouds of smoke, thick smoke, a lot of smoke'
Atmosphere/Entertainment	10	(2.4)	'Arabic music, atmosphere, entertainment, environment, nice setting with friends, hookah lounge'
Family/Culture	5	(1.2)	'socializing with a group of family, hookah is nice to be included with family, talking with family, it helps me bond with my dad, quality time with family, cultural connection, it reminds me of my country'
Other	14	(3.3)	'being cool, everything, gives you something to do, it helps me stay awake, losing weight, not addictive, sharing, style, the hookah, we all get along, liquor, it's healthy, no smell, not like cigarette'
Don't know	33	(7.8)	'I don't know'

friends when they first tried hookah smoking. Men were more likely than women to be with friends, and at a hookah lounge when they first tried to hookah smoking. Conversely, women were more likely than men to be with family, and at home when they first tried hookah. Regardless of sex, the majority of hookah smokers had been to a hookah lounge previously.

The majority of early and late hookah initiators were with friends when first tried to hookah smoking. However, early hookah initiators were 1.9 times more likely than late hookah initiators to be with family when first tried hookah (24.6% vs 13.1%, p

= .004). Early and late initiators did not differ significantly regarding the location of where first tried hookah smoking; the majority of persons in both groups had been to a hookah lounge previously.

Hookah Use Behaviors

About half of the participants reported hookah use during the past 7 days, and about three-fourths during the past 30 days. The majority smoked only flavored hookah tobacco, and about three-fourths smoked one hookah tobacco head on the day they smoked. A total of 40.3% reported spending 60 minutes smoking hookah tobacco on

Table 6
Responses to the Survey Question: What Bothers You Most about Smoking a Hookah? (N = 419)

	N	(%)	Quotes
Nothing	116	(27.7)	'it does not bother me, never thought about that, none, nothing at all, nothing much but then it runs out, nothing really bothers me about it'
Coughing/Dizziness/Headache	61	(14.5)	'dry mouth, dry lips, the feeling in my throat the next day, burns your throat, scratchy throat, makes my throat hurt, smoke in my throat, choking on the smoke, coughing, it makes me cough in the morning, it makes me cough a lot, breathing, harder to breathe regularly while playing sports, going to football practice the next day, it makes me dizzy, too dizzy, I will get dizzy if I use more charcoal, getting lightheaded after smoking it, lightheaded if I smoke too much, having headaches after smoking it, headache when I smoke too much, headaches at night, smoking for more than 20 minutes, smoking too much tires me, sometimes feel sick, stomach sickness, the feeling afterwards, next day feeling weird, the aftermath'
Health concerns/Hygiene/Sharing	51	(12.2)	'uncertainty of health consequences, possible health implications, it may cause illness, not that healthy, the fact that it is not good for my health, it's not good for you by any means, bad for you, health hazards/risks, the damage it causes, danger, it can cause cancer, it's bad for your lungs, my lungs, I know I am killing myself, worse than 10 packs of cigarettes, small debris inhaled, I don't recommend it to people, it's not clean, the hose is dirty, going from one mouth to another, when someone uses the same hookah with me, too many people to share with'
Setting up/Cleaning	50	(12.0)	'you have to change the coal often, heating the coal, hard to pack, assembling and preparing the hookah, it takes too long to prepare, when it is badly prepared, cleaning the hookah parts'
Aftertaste/After smell	34	(8.1)	'the taste after a while is too strong, aftertaste, smell sticks to my clothes, the smell it leaves on my hair, the smell on my body, the smell after a while gets annoying, the polluted smell in hookah lounges'
Tobacco smoke	32	(7.6)	'the smoky atmosphere, too much smoke'
Burnt tobacco/Harsh	16	(3.9)	'burnt taste, harshness of tobacco when burnt, if the charcoal is bad'
Other	18	(4.2)	'can't sleep, when I drop the hot coals, alcohol involved, not enough room in hookah lounge, cost, when too many people smoke together in a small area, the way people that don't like hookah look at you, when it's done, I miss it sometimes'
Don't know	41	(9.8)	'I don't know'

the day they smoked, and 31.9% spent 2 hours or more. Participants smoked hookah tobacco at home throughout the week, though mostly on Fridays and Saturdays and during the evening hours. Women were more likely than men to smoke hookah tobacco during the evening hours at home.

Dual Hookah and Cigarette Age of Initiation

Table 3 presents dual hookah and cigarette use initiation. A total of 61.2% of participants were 'ever dual smokers' and 31% (142 out of 458) were 'current dual smokers'. Overall, 57.3% of ever dual smokers first tried to smoke a cigarette at an age younger than 18 years. There was about half a year difference overall between having first tried

cigarette smoking and actually smoking their first cigarette ($M=17.1$ years vs 17.7 years, $p < .001$).

Ever dual smokers first tried cigarette smoking at an age significantly younger than when first tried hookah smoking ($M=17.1$ years vs 19.1 years, $p < .001$), and smoked their first cigarette at an age significantly younger than they smoked their first hookah ($M=17.7$ years vs 20.1 years, $p < .001$) (Figures 2 and 3).

Men were more likely than women to be current dual smokers (57.4% vs 42.8%, $p = .035$). Among ever dual smokers, men first tried cigarette smoking and actually smoked their first cigarette at an age significantly younger than women, with a mean difference of about 2 years. Both men and

women first tried and smoked their first cigarette at an age significantly younger than they first tried and smoked their first hookah.

Among ever dual smokers, late hookah initiators first tried and smoked their first cigarette at a significantly younger age than that at which they first tried and smoked their first hookah, but among early hookah initiators there was no significant difference in age between when they first tried a cigarette and first tried hookah ($M=15.3$ vs 14.6 , $p = .060$), or between when they smoked their first cigarette and when they smoked their first hookah ($M=16.1$ years vs 16.3 years, $p = .652$).

Reasons for Hookah Smoking Initiation

Table 4 presents responses to the open-ended question: 'What caused you to start smoking hookah?' About half of the responses indicated that friends were the reason they started smoking hookah. Responses ranged from simply friends smoked hookah in front of them to friends introduced them, invited them, encouraged them, or pressured them to smoke hookah.

Family was the second most reported reason for starting to smoke hookah. Responses ranged from naming close or distant family members to the perception that everyone in the family smokes hookah. Socializing without referencing friends, family or the Middle Eastern culture was a reason for initiation of hookah smoking.

Other reasons included curiosity, the aroma of the hookah tobacco, and the perception that it as an enjoyable relaxing recreational activity. Participants were encouraged to start smoking hookah in a home setting or at a hookah lounge.

Pros of Hookah Smoking

Table 5 presents responses to the open-ended question: 'What do you enjoy most about smoking a hookah?' About one-third of the responses indicated that participants enjoyed the taste and aroma of the many flavors of hookah tobacco. Others identified socializing with friends and family, feeling relaxed, feeling a good/buzz/high, experiencing a calming effect of bubbling water during inhalation, doing tricks with the hookah smoke, the entertaining atmosphere in hookah lounges, and a social smoking environment as pros of hookah smoking.

Cons of Hookah Smoking

Table 6 presents responses to the open ended question: 'What bothers you most about smoking a hookah?' The most frequent response was that nothing bothered them about smoking hookah. However, participants conveyed a range of acute adverse experiences associated with smoking hookah tobacco, such as coughing, dizziness, or headaches. Others were uncertain of health concerns, hygiene related to sharing the hookah, hookah tobacco's related taste and smell, and the smoking atmosphere.

DISCUSSION

Our findings add to the literature on age of initiation of hookah smoking, dual hookah and cigarette smoking by sex and by early versus late hookah initiation among adult Arab-American hookah smokers. We found that the majority of participants, irrespective of sex, first tried smoking hookah tobacco before the age of 18 years, or as young adults, ages 18-24 years. Our results are consistent with findings that 69% of Arab Americans had their first hookah puff before the age of 25 years, and 40% before the age of 19 years.⁴² Preventing initiation of hookah smoking is an important factor for controlling its use.

We found that, irrespective of sex, there was a one-year difference between having first tried to smoke hookah and actually smoking a first hookah. Among early hookah initiators (< 18 years), there was more than one year (1.7 years) difference between the first attempt to smoke hookah and actually smoking a first hookah. This suggests that designing and evaluating interventions during the time period between the first attempt to smoke and actually smoking a first hookah are needed to prevent the progression from experimentation to regular use. Because the majority of this sample of hookah smokers first tried hookah during before high school, during high school, or during their college years, interventions should be implemented in these 3 levels of academic institutions.

For participants ages 35 to 86 years we found that they first tried hookah and smoked their first hookah at mean ages of 27.6 years and 29.8 years, respectively. This suggests that preventive measures need to target young adults and older adults.

About two-thirds of our sample of hookah smokers comprised the 'ever dual smokers' group (smoked both hookah and cigarettes during their lifetime). Ever dual smokers overall first tried cigarettes before they first tried hookah, with a 2-year difference. In contrast, early hookah initiators (< 18 years) first tried and smoked hookah and cigarettes within the same year. Our findings were consistent with a longitudinal study in Jordan that found that adolescents were experimenting with both tobacco products.⁵⁰ One study among adolescents in Jordan reported that hookah use was a gateway to cigarette use³⁸ and another reported that hookah use predicted future cigarette use and vice versa.⁵⁰ Whereas the literature is still unclear about age of initiation of hookah use, probably because it is emerging globally among different age groups,⁵ our findings suggest the need to include exclusive hookah use and dual hookah and cigarette use in ongoing monitoring and tobacco control measures.

Women first tried hookah and smoked their first hookah later than men, and were more likely to smoke in a home setting and with family. This is consistent with reports on the tolerant attitude in Arab cultures toward women smoking hookah.³³ In Arab countries women and young girls are more

likely to smoke hookah tobacco than other forms of tobacco, suggesting that hookah smoking carries less of a cultural stigma than does cigarette smoking.⁵¹ In the US, no sex difference in hookah experimentation among US high school students or college students has been reported.^{19,29,30}

Prevention at the Interpersonal and Community Levels

The great majority of respondents first tried smoking hookah with friends or family. This is consistent with studies in Arab countries and among Arab Americans showing that experimentation with hookah tobacco smoking was shaped by the social environment, including socializing with friends and family, and family tradition and culture.^{34,42,52-55} Hookah use among men and women is a common practice in the Middle East with strong cultural reinforcement.^{34,35,53,56} Because most hookah smoking takes place in social settings, prevention programs for Arab Americans and in the Arab countries should include families and peers.

Home, one's own home or a friend's home, was the most frequently reported place of initiation. This was especially likely to be the case for the 16.9% who reported they first tried hookah between the ages of 3 years and 12 years. Furthermore, the majority of participants smoked on weekend days and during the evening hours, and more than half did so in a home setting. Our previous research reports the high nicotine contamination on surfaces inside homes of hookah smokers.⁵⁷ Smoking at home risks exposing children to toxins, and also risks teaching them that the practice of smoking hookah is a customary part of socializing at home. Community-based preventive measures culturally-tailored to Arab-American families are needed and ought to include encouragement of voluntary smoke-free home rules.

Prevention at the Physical Environment Level

Hookah lounges were the second most commonly reported location of initiation. These commercial venues have been operating for decades in the Middle Eastern region, and are opening throughout the US to provide opportunities for non-smokers to start smoking hookah.^{53,58-60} Regulatory agencies should revisit policies that offer clean indoor air exemptions to hookah lounges, and assign their status as that of retail tobacco shops or businesses, thereby reducing the proliferation of these venues that offer easy and enticing access to hookah tobacco.⁶¹

Prevention at the Policy Level

Flavors, the good taste of the smoke, and the pleasant aroma of hookah tobacco were the most often reported enjoyable aspects of smoking hookah. Availability of a variety of flavors in hookah tobacco, and the pleasant smell of the smoke prompts people to start smoking hookah.^{61,62} Hookah tobacco flavors have been advertised with

enticing names such as 'sex on the beach' targeting young adults, and 'red gummi bear' targeting children. On June 22, 2009 The Family Smoking Prevention and Tobacco Control Act gave the US Food and Drug Administration (FDA) the authority to regulate tobacco products including emerging alternative tobacco products, such as hookah tobacco, to prevent and reduce tobacco use by young people.⁶³ On September 22, 2009 the FDA banned cigarettes with flavors such as candy and fruit;⁶⁴ however, this ban does not apply to flavored hookah tobacco. The FDA is encouraged to extend the ban on flavors of hookah tobacco to reduce the reinforcing properties that mask the harsh nature of smoke, and contribute to the false perception that hookah is a safe alternative to traditional tobacco products.

National Public Health Education Campaigns

In contrast to beliefs that smoking tobacco using a hookah is a safe way to smoke tobacco,⁹ participants reported acute adverse experiences associated with smoking hookah tobacco, such as coughing, dizziness, and headaches. These indicators of exposure to toxicants in hookah tobacco smoke are consistent with reports in the literature.¹⁷ For example, carbon monoxide poisoning due to hookah smoking can cause direct injury at the cellular level, leading to hypoxia and nonspecific neurological manifestations such as syncope (transient loss of consciousness), dizziness and headaches.⁶⁵ There is a great need for national public health education campaigns in the US warning about the harmful effects of hookah smoking.

Limitations and Strengths

This study employed a cross-sectional design which limits our ability to establish causality. A convenience sample was used; therefore, findings of this study may not be generalizable to other Arab-Americans. Data were collected through self-report, which is subject to social desirability response bias. The majority of participants were 35 years or younger (80.5%); future studies should include a larger sample size of hookah smoker older than 35 years of age to identify points of interventions for older adults. Despite these limitations, our findings contribute to the body of research on hookah use, and inform longitudinal and experimental studies designed to confirm possible reinforcing and punitive consequences in the current social ecology that might then be altered to curtail all tobacco smoking, including hookah. This is an important step in tobacco control, given the increasing size of the Arab-American population and the limited research available on their hookah tobacco use behaviors.

Conclusion

The majority of participants, irrespective of sex, initiated hookah tobacco during their childhood, adolescent or young adult years. Women initiated

hookah use later than men. Ever dual smokers initiated cigarette use before hookah use; however, those who initiated hookah use at an age < 18 years initiated hookah and cigarette use concurrently.

Tobacco control policies aimed to prevent initiation of hookah use should include regulation of hookah tobacco flavors, and should target the physical environments in neighborhoods especially around schools and colleges to reduce the proliferation of hookah lounges. Hookah tobacco prevention and cessation programs that are based in communities, colleges, and middle and high schools also are needed.

Our findings suggest continuous inclusion of standardized hookah prevalence questions in global and national surveillance systems to provide prevalence estimates among all age groups to inform international preventive measures by the WHO, particularly in the Eastern Mediterranean Region,⁶⁶ and in the US.

Human Subjects Statement

The study was approved by the Institutional Review Board of San Diego State University. Written informed consent for all study procedures was obtained before data collection.

Conflict of Interest Statement

All authors of this article declare they have no conflicts of interest.

Acknowledgments

This work was supported by the Tobacco-Related Diseases Research Program (TRDRP), under Grant number 14KT-0107 to Nada O. F. Kassem. We gratefully acknowledge the study participants and the 45 research assistants, without whose contribution the present study would not have been completed.

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