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RESEARCH ARTICLE



# Smoking behaviors among Middle Eastern college women in the United States

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## ABSTRACT

**Objective:** to examine factors associated with cigarette and hookah smoking among Middle Eastern (ME) Arab college women. **Participants:** 406 adult women of ME Arabic background, currently enrolled in or recently graduated from a US college. **Methods:** a cross-sectional design, using an anonymous online survey of demographic characteristics, sociocultural factors, and access to health care factors. Data analysis included regression model to identify predictors of smoking behaviors. **Results:** Smoking rates were 21% and 19% for cigarette and hookah smoking. Cigarette smoking was higher with having liberal attitudes toward sexuality and lower among those having a healthcare provider. Hookah smoking was higher among students who are Muslim, involved in student organizations, have higher acculturation-heritage levels, and have more liberal attitudes toward women. Hookah smoking was lower among students born in the US, attending college part-time, and having higher religiosity levels. **Conclusions:** The study findings have several implications for interventions to address smoking behaviors among ME Arab college women through community organizations and within college campuses.

## ARTICLE HISTORY

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## KEYWORDS

College women; health behaviors; immigrant women; Middle Eastern Arab; smoking

## Introduction

### Cigarette smoking

Cigarette smoking remains the leading cause of preventable disease, disability, and death in the United States. According to the Centers for Disease Control and Prevention,<sup>1,2</sup> smoking contributes to more than 480,000 deaths annually (1 in 5 deaths), as more than 16 million Americans are living with a smoking related disease.<sup>1</sup> Cigarette smoking among young adults in the US remains a health concern, despite several decades of health warnings about the risks associated with cigarette smoking and the declining social acceptability of tobacco use. In 2020, the current daily rates of cigarette smoking among adults in the US were 11% among women and 14% among men.<sup>3</sup> According to the National Survey on Drug Use and Health, the daily rate of cigarette smoking among adults 22-23 years old has more than doubled between 2009 and 2018, with an increase from 20% to 43%.<sup>4</sup>

In the context of college and university campuses, in a survey of 1,350 college students, 41% reported smoking in the past year and 28% reported smoking in the past 30 days.<sup>5</sup> In another survey of 14,138 students in 4-year colleges across the US, 46% reported having used tobacco products in the past year and 33% reported currently using tobacco products.<sup>6</sup> A systematic review of smoking among Middle Eastern (ME) Arab immigrants in the US shows much higher rates, climbing as high as 69%.<sup>7</sup>

### Hookah smoking

Hookah smoking originated in ME regions and involves using a water pipe for flavored tobacco.<sup>8,9</sup> A single hookah smoking session can last as long as 60 min.<sup>8</sup> Among ME men and women, hookah smoking is more acceptable than cigarette smoking.<sup>10-17</sup> Inaccurate perceptions around hookah smoking in this population include it being viewed as non-addictive and having less harmful effects than cigarettes, which are masked by hookah's aromatic fragrance and pleasant taste.<sup>8,16,18,19</sup> In fact, one single hookah smoking session produces 100 times the smoke volume and yields 40 times the tar of a single cigarette.<sup>20-22</sup> Young adults 18-24 years, college age, account for 55% of water pipe smokers in the US.<sup>23</sup>

The phenomenon of hookah smoking has dramatically increased on US college campuses. In 2018-2019, in the US, 50% of hookah lounges were located within 3 miles of a community college. In a study published in 2022, spatial clustering was significant ( $p < .05$ ) from at least 0.4 miles for hookah lounges and 0.3 miles for all tobacco retailers. Slightly less than 47% (46.8%) of hookah lounges and 31.6% of all tobacco retailers were located within 3 miles of four-year colleges and universities.<sup>24</sup>

Among college students in the US, 64% of students reporting having ever smoked hookah and 34% reported smoking hookah within the previous 30 days.<sup>25</sup> Hookah smoking is disproportionately higher among college students of ME Arab descent (62%) compared to non-Arab students

(11%).<sup>26,27</sup> Similarly, studies found that 81% of Arab students had tried a waterpipe, compared to 38% of White students, 26% of Black students, and 41% of Asian students.<sup>19,27,28</sup>

### **College women from Middle Eastern Arab backgrounds**

The majority of immigrants from the ME in the US are from Arabic speaking Middle Eastern countries. The population of Arab immigrants is one of the fastest growing immigrant groups in America. According to the Arab American Institute,<sup>29</sup> the populations who identify as Arab speaking in the US census grew more than 42% between 2000 and 2017. They also estimate that nearly 3.7 million Americans trace their roots to an Arab country, with the majority of them having ancestral ties to Lebanon, Syria, Palestine, Egypt, and Iraq.<sup>29</sup>

Arab immigrants from the ME share conservative views and similar linguistics, which are different from other ME groups.<sup>30</sup> Immigrants from the non-Arab ME countries of Israel, Turkey, and Iran have different cultural beliefs and tend to come from more liberal societies compared to ME Arab immigrants. Therefore, this study focuses on ME college women from Arab backgrounds.

### **Factors that influence smoking behaviors**

The effect of acculturation on smoking is not homogenous and may differ among men and women within the same culture. In other words, the effect of acculturation on smoking is a complex phenomenon. A study of Arab immigrants in the US, who are predominantly male, found that smoking rates were higher among less assimilated individuals than those who leaned toward the mainstream American culture.<sup>31</sup> Even though these findings are similar to findings from studies on Asian immigrants, women had the reverse association in which smoking rates were higher with higher levels of assimilation to the US mainstream culture.<sup>32,33</sup> Further, smoking rates among Mexican Americans have been found to decrease among males and increase among females with the number of years in the US.<sup>34</sup> Little is known about the effect of acculturation on hookah smoking.

Smoking behaviors among young adults are also influenced by social networks as well as psychosocial stress. College students with higher levels of perceived stress and lower levels of social support have been found to have higher rates of cigarette smoking.<sup>5,35</sup> Further, hookah smoking has been integrated into the “social scene” on many university campuses. Students have reported socialization as a primary motivation for waterpipe (hookah) use.<sup>27,36</sup> Social influence plays a role in normalizing the behavior among young adults and on college campuses. Millennials have been found to view hookah smoking as a form of social interaction and a way to expand social networks, which in many cases was encouraged by strong family influence.<sup>37</sup> Tobacco use among Arab Americans, (cigarettes and hookah) are associated with having family and friends who use tobacco.<sup>38</sup>

Religiosity is thought to have a protective effect against risky health behaviors in young adults. Religion represents

regular engagement in religious activities, such as prayer, meditation, or study of the holy book.<sup>39,40</sup> Religiosity has been invoked as a justification for behaviors and actions, which in turn influences and informs behavior and structures actions that are reflected in the belief systems.<sup>41,42</sup> Adherence to religion and religious observances has been associated with lower rates of hookah smoking among Iranian college students<sup>39</sup> and with lower cigarette smoking in the US.<sup>43</sup>

In contrast, stress has been shown to negatively affect health behaviors and the adoption of maladaptive risky behaviors.<sup>16</sup> One source of stress is the resurgence of racial hostility against immigrants, particularly ME Arab groups, due to social and political association of Arab identity with terrorism.<sup>44</sup> Perceived experiences of discrimination has been associated with risky health behaviors, including smoking, among members of minority groups.<sup>45,46</sup> Lastly, smoking behaviors are influenced by cultural beliefs around women, especially with the increasing cultural acceptance of hookah smoking among Arab women in private and public spaces.<sup>47–49</sup>

In summary, despite the rapid increase in ME Arab immigration to the US over the past two decades, little is known about the smoking behavior in this population. Numerous studies have examined health behaviors among college students in the US. However, little is known about the health behaviors of ME Arab college women. Therefore, the purpose of this study was to examine the rates and correlates of cigarette and hookah smoking among ME Arab college women in the US.

## **Methods**

This is a descriptive, cross-sectional study of the rates and correlates of smoking among 406 ME Arab college women in the US, using an anonymous online survey data collected in 2018-2019. The Institutional Review Board (IRB) at Rutgers University reviewed and approved the study prior to commencing recruitment or data collection activities. Informed consent was provided on the first page of the online survey and participants were required to indicate their agreement to take part in the study.

### **Study Sample and Recruitment**

The eligibility criteria for the study included being a female, 18 years of age and above, and currently enrolled in college or a recent graduate from college (within the past 6 months). Additionally, the eligibility was limited to those who self-identified as ME of Arabic background and being first- or second-generation immigrant or on a student visa. Excluded from the study were 3rd generation and beyond ME Arab immigrants. Studies have shown their health behaviors closely resemble mainstream American culture, rather than their heritage culture.<sup>50</sup> These findings are explained by the predictive factors that influence Arab Americans acculturation, including the amount of exposure to American culture, reflected in number of years in the US, as well as, generational status. Generation status beyond

second-generation report higher levels of engagement with American culture and lower levels of traditional Arab customs, beliefs, and social networks.<sup>51,52</sup>

Sample size calculations were based on assuming a 3:1 ratio of outcomes (i.e., 25% yes, 75% no; or vice versa) and a medium effect size of 0.4 for the bivariate analysis as well as the approach of Courvoisier and colleagues for the number of study variables entered in the multivariate analysis.<sup>53</sup> As a result, a sample size of 406 provided greater than 80% power at a significance of  $\alpha < 0.05$  to test the associations between study outcomes and predictors.

We used the approach of recruiting key-informants and cultural navigators to adapt the study instruments and develop the plan for recruitment and data collection. The study survey was reviewed and pilot-tested by a key-informant group of five ME Arab college women in a focus group meeting.<sup>35,54</sup> Survey items were revised to ensure cultural appropriateness and sensitivity, clarity, and relevance to the targeted study population. In addition, the key-informant group assisted with identifying potential recruitment organizations and events, spreading the word about the study through their networks, student organizations, and community events.

Study advertisement took place *via* brochures and flyers distributed during ME/Arabic cultural, religious, and social events in New Brunswick, Newark, and Paterson, New Jersey. The researchers and collaborating key-informants attended these events to answer any questions interested individuals had about the study. This approach increased the credibility of the researchers and the research study.

Additionally, study advertisement included email announcements distributed to members of cultural and faith-based organizations on college campuses and surrounding communities. All electronic and printed study advertisement included a link and QR code for interested participants to access the study survey, beginning with a page to screen for their eligibility and obtain informed consent. The online data collection platform, REDCap survey, is a secure data capturing software housed at the researchers' institution, without tracking their IP addresses.

### **Study variables and measurement**

The study outcomes included cigarette smoking and hookah smoking, which were measured using two (yes/no) items. The study predictors included demographic characteristics, socio-cultural factors, and access to health services. The demographic characteristics included age, country of birth, student status (full-time vs. part-time), marital status, place of residence (campus, off-campus, with parents), sources of income (parent, earned, or scholarship), parent's level of education, reason for immigration to the US, religion, and affiliation with religious, student, or community organizations.

Socio-cultural factors included psychosocial factors (social support, psychosocial stress, and perceived discrimination) and cultural factors (religiosity, acculturation, sexual beliefs, and patriarchal beliefs). Access to health services included having health insurance, a healthcare provider, and access to healthcare information. Social support in this study referred to a person's access to supportive individuals and resources

that can positively affect personal adjustment, social behavior, health maintenance, and recovery from illness.<sup>55</sup> Social Support was measured using 5 items from the ENRICH Social Support Instrument (ESSI).<sup>56</sup> The Cronbach's alpha for this instrument was 0.88 in this study.

Psychosocial stress is defined as the individual's perception of a psychological situation as challenging or exceeding his or her own resources and a threat to their own well-being.<sup>57</sup> It was measured using the Perceived Stress Scale (PSS),<sup>58</sup> a 4-item instrument that measures the degree to which individuals find their lives stressful, including the degree to which they find their lives unpredictable, uncontrollable, and overloading. The Cronbach's alpha for this instrument was 0.83 in this study.

Perceived discrimination is defined as negative portrayals based upon externally attributed identities that transform the ways that individuals shape their identities and invoke a sense of alienation.<sup>44</sup> Perceived discrimination was measured using an 11-items scale adapted from the original 33-item Perceived Religious Discrimination Scale (PRDS).<sup>59</sup> The items were modified to reflect the contexts of perceived ME and religious discrimination. The Cronbach's alpha for this instrument was 0.92 in this study.

Religiosity is defined as the extent one practices and adheres to the laws and customs of their religion.<sup>60</sup> Religiosity was measured using a 3-item instrument developed by Haj-Yahia.<sup>61</sup> The score indicates the level of religiosity among Arab women. The Cronbach's alpha for this instrument was 0.92 in this study.

Acculturation is a process by which an individual must negotiate a new host culture while determining whether to maintain the practices and beliefs of his or her own heritage culture.<sup>62</sup> Acculturation was measured using 18 items from the Vancouver Index of Acculturation (VIA)<sup>63</sup> to generate two subscale scores for acculturation - one on heritage culture and another on mainstream culture. Higher scores indicate higher levels of acculturation for each subscale. The Cronbach's alpha coefficients for this instrument in this study were 0.93 for the acculturation heritage subscale and 0.91 for the acculturation-mainstream subscale.

Beliefs toward sexuality refer to the attitudes and behaviors related to beliefs toward sexuality.<sup>64</sup> Beliefs toward sexuality was measured using 8 items on the Beliefs toward Sexuality Scale that combines items from two instruments, the Attitudes Toward Premarital Sexuality Scale<sup>64</sup> and the Perceived Parental Attitudes about Sexuality Scale.<sup>65</sup> Higher scores on the Beliefs toward Sexuality Scale indicate more liberal views toward sexuality. The Cronbach's alpha for this instrument was 0.91 in this study.

Patriarchal beliefs include the continuum of holding traditional-versus-egalitarian views of gender roles. Patriarchal beliefs were measured using the Attitudes toward Women Scale, which includes 18 items on traditional-patriarchal and liberal-egalitarian attitudes toward women.<sup>66</sup> Higher scores indicate more liberal-egalitarian attitudes toward women. The Cronbach's alpha for this instrument was 0.91 in this study.

Lastly, access to health services in this study included type of health insurance, having a primary healthcare provider (HCP), having seen a HCP in the past year, and access

to health information. These factors were assessed using (yes/no) questions developed by the study team.

### Data analysis

First, descriptive (univariate) analysis was used to summarize characteristics of the study sample, as shown in Tables 1 and 2. Second, bivariate analysis, using Chi-square and t-test, was used to examine associations between study predictors and smoking behaviors, as shown in Tables 1 and 2. Third, multivariate analysis, using logistic regression, was used to build predictive models for smoking behaviors. Predictors that were found significant in the bivariate analysis at  $p < 0.05$  were included in the multivariate analysis. The regression predictive models used a hierarchical approach to examine the predictors in 3 blocks: individual, sociocultural, and access to health services, as shown in Tables 3 and 4.

Subsequently, a final logistic regression analysis was conducted using a backward stepwise Wald method (significance level = 0.05) for cigarette and hookah smoking that included

only the statistically significant predictors from the bivariate analysis at the  $p < 0.05$ . Stepwise regression allows for an iterative construction of a predictive model by entering all the predictors in an initial model followed by multiple steps of removing non-significant predictors in succession and testing for statistical significance after each iteration. Table 5 presents the surviving predictors in the stepwise approach, using the criteria of “POUT” value of 0.10 and “PIN” value of 0.05 (i.e., variables were entered in the initial model if their  $p$  value was  $< 0.10$  and predictors were kept in the final model if their  $p$  value was  $< 0.05$ ). The regression models included the calculation of adjusted Odds Ratios (aOR) and 95% confidence intervals (95% CI) for the aORs. The Statistical Package for the Social Sciences (SPSS) software, version 27, was used for analyzing the study data.

### Results

Among the 406 participants in this study, the mean age was 21 years. Most of the participants reported being single

**Table 1.** Characteristics of the study sample (categorical variables) and bivariate analysis of the associations between smoking behaviors and the categorical study predictors, using chi-Square.

Variables	Categories	All		Cigarette smoking (yes)		Hookah smoking (yes)	
		n	%	%	X <sup>2</sup> (P)	%	X <sup>2</sup> (P)
US born	No	76	19.2%	20.2%	0.063	22.1%	0.561
	Yes	320	80.8%	21.4%	(.802)	18.7%	(0.454)
Parents live in NJ	No	111	27.7%	25.5%	1.683	14.4%	2.711
	Yes	290	72.3%	19.5%	(0.194)	21.7%	(0.100)
Student attendance status	Full time	334	85.4%	19.9%	0.748	22.8%	6.987
	Part time	57	14.6%	25.0%	(0.387)	7.0%	(0.008)
Student status	Undergraduate	307	80.2%	21.6%	0.265	20.8%	0.531
	Graduate	76	19.8%	18.9%	(0.607)	17.1%	(0.466)
Full-time work	No	336	83.6%	19.2%	3.303	19.0%	0.165
	Yes	66	16.4%	29.2%	(0.069)	21.2%	(0.684)
Single	No	122	30.4%	26.4%	3.230	13.1%	4.494
	Yes	279	69.6%	18.5%	(0.072)	22.2%	(0.034)
Mother has college	No	167	41.9%	19.9%	.222	18.6%	0.178
	Yes	232	58.1%	21.8%	(0.638)	20.3%	(0.673)
Father has college	No	61	15.3%	15.0%	1.516	24.6%	1.188
	Yes	339	84.7%	22.0%	(0.218)	18.6%	(0.276)
Immigrated to US for education	No	173	42.8%	21.9%	0.141	21.4%	0.646
	Yes	231	57.2%	20.3%	(0.707)	18.2%	(0.422)
Immigrated to US for socioeconomic	No	146	36.1%	21.5%	0.038	22.6%	1.350
	Yes	258	63.9%	20.7%	(0.846)	17.8%	(0.245)
Religion	Christian	127	31.9%	26.8%	3.387	11.8%	7.160
	Muslim	257	64.6%	18.6%	(0.066)	23.3%	(0.007)
Belongs to Student Organizations	No	258	63.9%	22.0%	.391	14.0%	14.237
	Yes	146	36.1%	19.3%	(0.532)	29.5%	(<0.001)
Belongs to Religious Organizations	No	267	66.1%	22.7%	1.396	15.7%	7.320
	Yes	137	33.9%	17.6%	(0.237)	27.0%	(0.007)
Daily interactions	Mostly ME	109	27.6%	15.7%	6.369	19.3%	0.968
	Mostly non-ME	101	25.6%	16.0%	(0.041)	16.8%	(0.616)
	Equal mix of both	185	46.8%	26.2%		21.6%	
Have health Insurance	No	26	6.5%	20.0%	.020	30.8%	2.302
	Yes	371	93.5%	21.2%	(0.887)	18.6%	(0.129)
Have a primary HCP	No	26	6.5%	28.6%	4.983	22.1%	0.671
	Yes	371	93.5%	18.3%	(0.026)	18.5%	(0.413)
Have seen a HCP past year	No	80	31.0%	22.3%	0.123	22.6%	0.821
	Yes	178	69.0%	20.7%	(0.726)	18.6%	(0.365)
Obtain health information from the internet	No	181	44.8%	24.8%	2.298	13.8%	5.449
	Yes	223	55.2%	18.5%	(0.130)	23.3%	(0.020)
Obtain health information from family/friends	No	107	26.5%	19.8%	0.123	25.2%	2.984
	Yes	297	73.5%	21.4%	(0.726)	17.5%	(0.084)
Obtain health information from television	No	385	95.3%	21.8%	2.978	19.2%	0.579
	Yes	19	4.7%	5.3%	(0.084)	26.3%	(0.447)

ME=Middle Eastern.

**Table 2.** Characteristics of the study sample (continuous variables) bivariate analysis of the associations between smoking and the continuous study predictors, using t-test.

Variables	n	All Mean (SD)	Cigarette smoking		t (p)	Hookah smoking		t (p)
			No Mean (SD)	Yes Mean (SD)		No Mean (SD)	Yes Mean (SD)	
Age	387	20.9 (4.41)	21.07 (4.78)	20.42 (2.75)	-1.189 (0.235)	20.94 (4.73)	20.90 (2.76)	-0.076 (0.940)
Acculturation-Heritage Score	392	3.02 (0.78)	3.09 (0.74)	2.74 (0.84)	-3.68 (0.001)	2.97 (0.80)	3.25 (0.65)	2.810 (0.003)
Acculturation-Mainstream Score	392	2.74 (0.70)	2.75 (0.70)	2.68 (0.65)	-0.820 (0.206)	2.71 (0.70)	2.83 (0.68)	1.372 (0.085)
Perceived Stress Score	390	1.99 (0.69)	2.04 (0.68)	1.81 (0.70)	-2.70 (0.004)	1.94 (0.70)	2.20 (0.58)	3.009 (0.001)
Social Support Score	387	3.49 (0.54)	3.50 (0.54)	3.50 (0.55)	-0.386 (0.350)	3.50 (0.539)	3.47 (0.56)	-0.443 (0.329)
Perceived Discrimination Score	386	2.67 (0.63)	2.70 (0.63)	2.70 (0.62)	0.054 (0.479)	2.66 (0.641)	2.74 (0.58)	1.069 (0.143)
Attitudes Toward Women Score	384	2.92 (0.56)	2.91 (0.56)	2.99 (0.60)	0.98 (0.164)	2.90 (0.586)	3.02 (0.512)	1.672 (0.048)
Beliefs Toward Sexuality Score	381	2.11 (0.73)	2.05 (0.72)	2.36 (0.71)	3.50 ( $<0.001$ )	2.13 (0.753)	2.05 (0.63)	-0.791 (0.215)
Religiosity Score	382	3.38 (0.68)	3.40 (0.71)	3.30 (0.59)	-1.08 (0.141)	0.68 (0.683)	1.72 (0.040)	1.61 (0.054)

Note: SD=standard deviation.

**Table 3.** Logistic regression analysis of predictors - cigarette smoking.

Predictors	Cigarette smoking						
	B	SE	Wald	df	Sig.	Exp(B)	95% CI
<b>Individual predictors (N=320)</b>							
Age (M=21)	-0.076	0.056	1.828	1	0.176	0.927	0.830-1.035
US born (Yes vs. No)	0.031	0.370	0.007	1	0.934	1.031	0.500-2.128
Parents reside in NJ (Yes vs. No)	-0.439	0.342	1.644	1	0.200	0.645	0.330-1.261
Student attendance status (Part-time vs. Full-time)	0.057	0.520	0.012	1	0.913	1.059	0.382-2.933
Student enrollment status (Graduate vs. Undergraduate)	-0.451	0.528	0.732	1	0.392	0.637	0.226-1.791
Full time work status (Yes vs. No)	0.513	0.506	1.029	1	0.310	1.670	0.620-4.501
Single status (Yes vs. No)	-0.625	0.334	3.496	1	0.062	0.535	0.278-1.031
Mother attended college (Yes vs. No)	-0.105	0.306	0.117	1	0.732	0.901	0.494-1.642
Father attended college (Yes vs. No)	-0.030	0.455	0.004	1	0.948	0.971	0.398-2.367
Immigrated to US for education reason (Yes vs. No)	-0.115	0.301	0.146	1	0.702	0.891	0.494-1.608
Immigrated to US for socioeconomic reason (Yes vs. No)	-0.807	0.322	0.073	1	0.788	0.917	0.487-1.725
Religion (Muslim vs. Christian)	-0.147	0.320	0.210	1	0.647	0.864	0.461-1.617
Belong to student organizations (Yes vs. No)	-0.253	0.327	0.597	1	0.440	0.776	0.409-1.475
Belong to religious organizations (Yes vs. No)	-0.162	0.309	0.276	1	0.599	0.850	0.464-1.558
Daily interactions (an equal mix of both vs. mostly ME)	0.324	0.185	3.058	1	0.080	1.383	0.962-1.990
Constant	1.219	1.543	0.624	1	0.429	3.385	
<i>Omnibus Tests of Model Coefficients</i> Chi-square = 15.939; df = 15; p=0.386							
<i>Model Summary</i> -2 Log likelihood = 315.101; Cox & Snell R <sup>2</sup> =4.9%; Nagelkerke R <sup>2</sup> =7.5%							
<b>Sociocultural predictors (N=327)</b>							
Acculturation-Heritage Score	-0.394	0.208	3.588	1	0.058	0.675	0.449-1.014
Acculturation-Mainstream Score	-0.167	0.246	0.459	1	0.498	0.846	0.522-1.371
Perceived Stress Score	-0.379	0.256	2.190	1	0.139	0.684	0.414-1.131
Social Support Score	-0.403	0.308	1.717	1	0.190	0.668	0.365-1.221
Perceived Discrimination Score	0.454	0.282	2.588	1	0.108	1.574	0.906-2.735
Attitudes toward Women Score	-0.003	0.382	.000	1	0.994	0.997	0.472-2.108
Beliefs toward Sexuality Score	0.744	0.291	6.535	1	0.011	2.105	1.190-3.725
Religiosity Score	0.256	0.255	1.004	1	0.316	1.292	0.783-2.131
Constant	-1.229	2.198	.313	1	0.576	0.292	
<i>Omnibus Tests of Model Coefficients</i> Chi-square = 27.807; df = 8; p<0.001							
<i>Model Summary</i> -2 Log likelihood = 369.136; Cox & Snell R <sup>2</sup> =7.1%; Nagelkerke R <sup>2</sup> =10.9%							
<b>Access to health services (N=383)</b>							
Health Insurance (Yes vs. No)	0.084	0.542	0.024	1	0.877	1.088	0.376-3.149
Have a primary HCP (Yes vs. No)	-0.593	0.297	3.979	1	0.046	0.553	0.308-0.990
Seen a HCP in past year (Yes vs. No)	0.193	0.319	0.386	1	0.544	1.213	0.649-2.267
Obtain health information from the internet (Yes vs. No)	-2.62	0.279	0.884	1	0.347	0.769	0.446-1.329
Obtain health information from family/friends (Yes vs. No)	0.169	0.326	0.270	1	0.603	1.185	0.625-2.245
Obtain health information from television (Yes vs. No)	-1.370	1.047	1.711	1	0.191	0.254	0.033-1.980
Constant	-1.055	0.589	3.205	1	0.073	0.348	
<i>Omnibus Tests of Model Coefficients</i> Chi-square = 10.005; df = 6; p=0.124							
<i>Model Summary</i> -2 Log likelihood = 387.807; Cox & Snell R <sup>2</sup> =2.6%; Nagelkerke R <sup>2</sup> =4.0%							

Note: ME=Middle Eastern.

**Table 4.** Logistic regression analysis of predictors - hookah smoking.

Criterion variable Predictors	Hookah smoking						
	B	SE	Wald	df	Sig.	Exp(B)	95% CI
<b>Individual predictors (N=324)</b>							
Age (M=21)	0.032	0.043	0.558	1	0.455	1.033	0.949-1.124
US born (Yes vs. No)	-0.915	0.371	6.073	1	0.014	0.401	0.194-.829
Parents reside in NJ (Yes vs. No)	0.799	0.411	3.766	1	0.052	2.223	0.993-4.978
Student attendance status (Part-time vs. Full-time)	-1.363	0.680	4.016	1	0.045	0.256	0.067-0.971
Student enrollment status (Graduate vs. Undergraduate)	-0.341	0.494	0.475	1	0.490	0.711	0.270-1.874
Full time work status (Yes vs. No)	0.760	0.521	2.131	1	0.144	2.139	0.771-5.937
Single status (Yes vs. No)	0.240	0.381	0.397	1	0.528	1.272	0.602-2.686
Mother attended college (Yes vs. No)	-0.301	0.325	0.858	1	0.354	0.740	0.392-1.399
Father attended college (Yes vs. No)	0.156	0.434	0.129	1	0.720	1.169	0.499-2.738
Immigrated to US for education reasons (Yes vs. No)	-0.180	0.313	0.332	1	0.564	0.835	0.452-1.541
Immigrated to US for socioeconomic reasons (Yes vs. No)	0.002	0.316	0.000	1	0.966	1.002	0.539-1.862
Religion (Muslim vs. Christian)	0.878	0.383	5.248	1	0.022	2.405	1.135-5.097
Belong to student organizations (Yes vs. No)	0.807	0.325	6.162	1	0.013	2.242	1.185-4.240
Belong to religious organizations (Yes vs. No)	0.549	0.305	3.235	1	0.072	1.731	0.952-3.148
Daily interactions (an equal mix of both vs. mostly ME)	0.371	0.187	3.906	1	0.048	1.448	1.003-2.092
Constant	-3.130	1.568	3.983	1	0.046	0.044	
<i>Omnibus Tests of Model Coefficients</i>	Chi-square = 38.619; df = 15; p=0.001						
<i>Model Summary</i>	-2 Log likelihood = 291.649; Cox & Snell R <sup>2</sup> =11.2%; Nagelkerke R <sup>2</sup> =17.6%						
<b>Sociocultural predictors (N=331)</b>							
Acculturation-Heritage Score	0.660	0.253	6.817	1	0.009	1.936	1.179-3.178
Acculturation-Mainstream Score	-0.103	0.251	0.171	1	0.680	0.902	0.552-1.474
Perceived Stress Score	0.313	0.246	1.617	1	0.204	1.368	0.844-2.216
Social Support Score	0.304	0.302	1.017	1	0.313	1.356	0.751-2.448
Perceived Discrimination Score	0.430	0.278	2.405	1	0.121	1.538	0.893-2.650
Attitudes toward Women Score	0.816	0.374	4.750	1	0.029	2.261	1.086-4.708
Beliefs toward Sexuality Score	-0.230	0.273	0.714	1	0.398	0.794	0.466-1.355
Religiosity Score	0.600	0.267	5.038	1	0.025	0.549	0.325-0.927
Constant	-5.952	2.203	7.299	1	0.007	0.003	
<i>Omnibus Tests of Model Coefficients</i>	Chi-square = 28.140 df = 8; P=<0.001						
<i>Model Summary</i>	-2 Log likelihood = 352.166; Cox & Snell R <sup>2</sup> =7.1%; Nagelkerke R <sup>2</sup> =11.3%						
<b>Access to health services (N=387)</b>							
Health Insurance (Yes vs. No)	-0.576	0.470	1.501	1	0.220	0.562	0.224-1.412
Have a primary HCP (Yes vs. No)	-0.209	0.318	0.433	1	0.510	0.811	0.435-1.512
Seen a HCP in past year (Yes vs. No)	-0.102	0.323	0.100	1	0.752	0.903	0.479-1.702
Obtain health information from the internet (Yes vs. No)	0.474	0.309	2.351	1	0.125	1.606	0.877-2.942
Obtain health information from family/friends (Yes vs. No)	-0.365	0.307	1.412	1	0.235	0.694	0.380-1.268
Obtain health information from television (Yes vs. No)	0.190	0.601	0.100	1	0.752	1.210	0.372-3.931
Constant	-0.736	0.537	1.879	1	0.170	0.479	
<i>Omnibus Tests of Model Coefficients</i>	Chi-square = 8.984; df = 6; p=0.175						
<i>Model Summary</i>	-2 Log likelihood = 352.166; Cox & Snell R <sup>2</sup> =2.3%; Nagelkerke R <sup>2</sup> =3.7%						

Note: ME=Middle Eastern.

**Table 5.** Stepwise logistic regression analysis of predictors for smoking behaviors, using backward wald method.

Surviving predictors	B	SE	Wald	df	Sig.	Exp(B)	95% CI
<b>Cigarette Smoking (N=344)</b>							
Acculturation-Heritage Score	-0.356	0.200	3.161	1	0.075	0.701	0.473-1.037
Beliefs Toward Sexuality Score	0.566	0.237	5.721	1	0.017	1.761	1.108-2.800
Have a primary HCP (Yes vs. No)	-0.747	0.298	6.298	1	0.012	0.474	0.264-0.849
Obtain health information from the internet (Yes vs. No)	-0.453	0.275	2.722	1	0.099	0.636	0.371-1.089
Constant	-0.676	0.972	0.484	1	0.487	0.508	
<i>Omnibus Tests of Model Coefficients</i>	Chi-square = 25.075; df = 4; p<0.001						
<i>Model Summary</i>	-2 Log likelihood = 340.723; Cox & Snell R <sup>2</sup> =6.9%; Nagelkerke R <sup>2</sup> =10.7%						
<b>Hookah smoking (N=352)</b>							
Religion (Muslim vs. Christian)	0.713	0.339	4.423	1	0.035	2.040	1.050-3.964
Student attendance status (Part-time vs. Full-time)	-1.207	0.547	4.863	1	0.027	0.299	0.102-0.874
Acculturation-Heritage Score	0.480	0.224	4.593	1	0.032	1.616	1.042-2.506
Attitudes toward Women Score	0.904	0.278	10.546	1	0.001	2.468	1.431-4.259
Constant	-4.728	1.407	11.286	1	<0.001	0.009	
<i>Omnibus Tests of Model Coefficients</i>	Chi-square = 25.858; df = 4; p<0.001						
<i>Model Summary</i>	-2 Log likelihood = 328.532; Cox & Snell R <sup>2</sup> =7.1%; Nagelkerke R <sup>2</sup> =11.1%						

Notes: Variables entered in the analysis included being single, religion, student attendance status, acculturation-heritage score, perceived stress score, attitudes toward women score, beliefs toward sexuality score, religiosity score, having a primary HCP, and obtaining health information from the internet. However, this table shows only the predictors that survived the stepwise method, using the criteria of "POUT" value of 0.10 and "PIN" value of 0.05.

(70%). Most of the participants reported (81%) being born in the United States. Participants reported the reasons for their family's immigration to the US were socio-economic (64%), education (57%), and/or seeking political freedom (30%). Regarding religious affiliation, 65% reported being Muslim and 32% being Christian. About one third of the participants reported involvement in student (36%), community (34%), and/or religious (34%) organizations. More details about characteristics of the study sample are shown in Tables 1 and 2.

A plurality of participants reported that their daily interactions were with an equal mix of ME and non-ME students (47%), while 28% had daily interactions with mostly ME students, and 26% had daily interactions with mostly non-ME students. Regarding college and work status, most of the participants reported being full-time students (85%), enrolled in undergraduate programs (80%), and being employed (53%). Regarding parental education, 58% had mothers with college/graduate degrees and 85% had fathers with college/graduate degrees. Regarding access to health services, most participants reported having health insurance (94%), a primary HCP (94%), saw a HCP in past year (69%), and access to health information through the internet (61%) and/or from family and friends (74%).

### Cigarette smoking

In this study, 19% of the women reported smoking cigarettes either every day or some days. As shown in Table 1, the bivariate analysis revealed that cigarette smoking was significantly higher among students who reported daily interactions with an equal mix of ME and Non-ME students ( $X^2 = 6.369$ ;  $p=0.041$ ) as well as among those who have a primary HCP ( $X^2 = 4.983$ ;  $p=0.026$ ). In addition, participants who reported cigarette smoking had significantly lower levels of acculturation-heritage ( $t = -3.67$ ;  $p=0.001$ ), lower levels of perceived stress ( $t = -2.70$ ;  $p=0.004$ ), and more liberal beliefs toward sexuality ( $t=3.50$ ;  $p<0.001$ ), as shown in Table 2.

Using multivariate analysis, we examined the factors associated with cigarette smoking, including the individual, sociocultural, and access to health care factors, as shown in Table 3. In the first predictive model, individual factors explained 5% – 8% of the variability in cigarette smoking ( $X^2 = 15.939$ ;  $p=0.386$ ). However, none of the individual predictors were significantly associated with cigarette smoking. In the second predictive model, sociocultural factors explained 7% – 11% of the variability in cigarette smoking ( $X^2 = 27.807$ ;  $p<0.001$ ). In this model, the odds of cigarette smoking were 2 times higher among those with more liberal beliefs toward sexuality (aOR: 2.105; 95% CI: 1.190–3.725). In the third predictive model, access to health services factors accounted for 3% – 4% of the variability in cigarette smoking ( $X^2 = 10.005$ ,  $p=0.124$ ). In this model, the odds of cigarette smoking were 45% lower among those who reported having a primary HCP (aOR: 0.553; 95% CI: 0.308–0.990).

The final logistic regression analysis for cigarette smoking, using backward stepwise Wald method, included the

statistically significant predictors from the bivariate analysis, as shown in Table 5. The surviving significant predictors for cigarette smoking were beliefs toward sexuality and having a primary HCP ( $X^2 = 25.075$ ;  $p<0.001$ ). These variables predicted 7% – 11% of the variability in cigarette smoking. In this analysis, the odds of cigarette smoking were 76% higher among with women with more liberal beliefs toward sexuality (aOR: 1.761; 95% CI: 1.108–2.800) and 53% lower among those who reported having a primary HCP (aOR: 0.474; 95% CI: 0.264–0.849).

### Hookah smoking

In this study, 21% of the participants reported smoking hookah either every day or some days. As shown in Table 1, the bivariate analysis revealed that hookah smoking was significantly higher among students who are full-time ( $X^2 = 6.987$ ;  $p=0.008$ ), single ( $X^2 = 4.494$ ;  $p=0.034$ ), or Muslim ( $X^2 = 7.160$ ;  $p=0.007$ ), belong to student organizations ( $X^2 = 14.237$ ;  $p<0.001$ ) or religious organizations ( $X^2=7.320$ ;  $p=0.007$ ), and obtain their health information from the internet ( $X^2 = 5.449$ ;  $p=0.020$ ). In addition, participants who reported hookah smoking had significantly higher levels of acculturation-heritage ( $t=2.810$ ,  $p=0.003$ ), higher levels perceived stress ( $t=3.009$ ;  $p=0.001$ ), and more liberal-egalitarian attitudes toward women ( $t=1.672$ ;  $p=0.048$ ) as shown in Table 2.

Using multivariate analysis, we examined the predictors of hookah smoking, including the individual, sociocultural and access to care factors, as shown in Table 4. In the first predictive model, individual factors explained 11% – 18% of the variability in hookah smoking ( $X^2 = 38.619$ ;  $p=0.001$ ). In this model, the odds of hookah smoking were over 2 times higher among Muslim students (aOR: 2.405; 95% CI: 1.135–5.097) as well as those who reported belonging to student organizations (aOR: 2.242; 95% CI: 1.185–4.240). Further, the odds of hookah smoking were 45% higher among students who reported daily interactions with an equal mix of Middle Eastern and non-Middle Eastern students compared to mostly ME students (aOR: 1.448; 95% CI: 1.003–2.092).

In contrast, the odds of hookah smoking were 60% lower among students born in the US (aOR: 0.401; 95% CI: 0.194–0.829) and 74% lower among part-time students (aOR: 0.256; 95% CI: 0.067–0.971). In the second predictive model, sociocultural factors explained 7% – 11% of the variability in hookah smoking ( $X^2 = 28.140$ ;  $p<0.001$ ). In this model, the odds of hookah smoking were about 2 times higher with higher levels of acculturation-heritage (aOR: 1.936; 95% CI: 1.179–3.178) and with more liberal-egalitarian attitudes toward women (aOR: 2.261; 95% CI: 1.086–4.708). In contrast, the odds of hookah smoking were 45% lower with higher levels of religiosity (aOR: 0.549; 95% CI: 0.325–0.927). In the third predictive model, access to health services predictors explained 2% – 4% of the variability in hookah smoking ( $X^2 = 8.984$ ,  $p=0.175$ ). However, none of the access to care services predictors were significantly associated with hookah smoking.

The final logistic regression analysis for hookah smoking, using backward stepwise Wald method, included the



statistically significant predictors from the bivariate analysis, as shown in Table 5. The surviving significant predictors for hookah smoking were religion, student attendance status, acculturation-heritage, and attitudes toward women ( $X^2 = 25.858$ ;  $p < 0.001$ ). These variables predicted 7% – 11% of the variability in hookah smoking. In this analysis, the odds of hookah smoking were 2 times higher among Muslim women (aOR: 2.040; 95% CI: 1.050–3.964) and women with more liberal-egalitarian attitudes toward women (aOR: 2.468; 95% CI: 1.431–4.259). The odds were also 65% higher with higher levels of acculturation-heritage (aOR: 1.616; 95% CI: 1.042–2.506) and 70% lower among part-time students (aOR: 0.299; 95% CI: 0.102–0.874).

## Discussion

The rates of smoking behaviors among ME Arab college women in this study were 19% and 21% for cigarette and hookah smoking, respectively. These rates are much higher than the 4% smoking rates reported among immigrant women of various backgrounds in the US.<sup>67,68</sup> The smoking rates in this study are similar to those reported among Arab immigrants living in Colorado (19% were current cigarette smokers and 21% were current hookah smokers).<sup>69</sup> Other studies reported the rate of ever-using hookah among college students in the US between 42% and 64%, which is believed to have been prompted by social influence and acceptability present at student organizations on college campuses.<sup>37,70,71</sup>

Regarding the individual predictors for smoking behaviors, hookah smoking was associated with place of birth, belonging to student organizations, student attendance status, and religion. Being born in the US was a protective factor in this study, contributing to 60% lower odds of hookah smoking. These results may be explained by hookah smoking in the United States, which is not a “social norm” and may be culturally-prescribed and closely tied to identity formation.<sup>72</sup> Belonging to student organizations in this study contributed to doubling the odds of hookah smoking. Research has demonstrated the strong context for hookah use as a social activity,<sup>70</sup> especially the type of social influence and acceptability present at student organizations on college campuses.<sup>37,70,71</sup>

It is important to note that the two individual predictors for hookah smoking that survived in the regression analysis were student attendance status and religion. Being a part-time student was a protective factor in this study, contributing to a 74% lower odds of hookah smoking. This may be explained as follows, students enroll in part-time programs due to their financial need to work, which makes it difficult for them to acquire a sense of on-campus belonging. Consequently, there is less opportunity to socialize in groups, who may expose them to hookah smoking events and opportunities. The lack of social influence may explain the decrease in hookah smoking rates among part-time students.<sup>70</sup> In addition, participants who identified as Muslim in this study had double the odds of hookah smoking, compared to Christian students (23% vs. 12%). These findings

are similar to findings reported in other studies among Arab immigrant women in the US,<sup>24,26,41</sup> which could be an indicator of cultural acceptance of hookah smoking rather than religion itself.

The significant sociocultural factors in this study were acculturation, attitudes toward women and sexuality, and religiosity. Participants with higher acculturation-heritage levels contributed to higher odds of hookah smoking. Acculturation in this study is defined as having two dimensions - maintaining cultural heritage and assimilating in the mainstream culture. Typically, in ME Arab cultures, the heritage culture is viewed as restrictive and protective, which discourages risky health behaviors.<sup>73</sup> In contrast, mainstream American culture is viewed as permissive and an advocate for individualism, which may encourage risky health behaviors. In this study, acculturation-heritage had a negative effect, contributing to increased odds of hookah smoking. This could be related to the cultural effect of social networks that increase exposure and have more accepting views toward hookah smoking.

Other significant sociocultural factors in this study were attitudes toward women and sexuality. Having more liberal-egalitarian attitudes toward women doubled the odds of hookah smoking and having more liberal attitudes toward sexuality doubled the odds of cigarette smoking. These results could be due to persisting perceptions around smoking as a sign of independence among female college students.<sup>13</sup>

Religiosity in this study had a protective effect, contributing to decreased odds of hookah smoking, which is similar to findings from other studies.<sup>39,41</sup> Nabipour and colleagues<sup>39</sup> argue that adhering to religious teachings and participating in religious activities may result in positive influence on self-esteem, a sense of self-efficacy, and personal conservatism. Additionally, religious participation provides opportunities to strengthen behaviors that reflect the belief systems of the community.<sup>42</sup>

An unexpected finding in this study was perceived discrimination. This variable was not a significant predictor of smoking behavior in this population. This finding is inconsistent with the findings of other research, whereby, perceived discrimination is linked to risky health behaviors, such as, smoking. The findings may be due to, the instrument's inability to fully capture the concept of perceived discrimination or due to the length of time perceived discrimination takes to influence health behaviors.<sup>2,74</sup> Data in this study does not allow for examination of potential reasons; thus further research is needed to validate measures and to explore the impact of discrimination experiences on health in this population.

Regarding access to care factors, having a primary HCP was associated with a 50% lower odds of cigarette smoking. Future research is needed to explore if having a primary HCP/Student Health Services as care point approaches can be effective in reducing smoking behaviors. Third, this study did not distinguish the source of primary care services/healthcare provider e.g., private, clinic-based, or college health center. Future research is needed to investigate differences in the sources of primary healthcare services.

In addition, this study did not address vaping behaviors/ use of e-cigarettes, which has become increasingly popular on

US campuses.<sup>75</sup> Future research on smoking behaviors among this population should include vaping/use of e-cigarettes.

### Limitations

There are a few limitations to consider when interpreting the results of this study. First, given the cross-sectional design of the study, the directionality of relationships cannot be established, which limits the ability to conclude causality. However, the purpose of this exploratory study was to examine associations between the study outcomes and the predictors.

Second, data was collected in the Northeastern region of the US and recruitment was primarily through Rutgers University, which is a public university. This could limit generalizability of the study findings to populations with similar characteristics to the study sample. As such, the study findings may not be generalizable to ME Arab college women in other parts of the country (e.g., Southern or Midwest regions) or who are enrolled in private universities or community colleges.

Further, participant responses may have been susceptible to social desirability bias. The study was conducted in 2018–2019, during the Trump presidency, a period in the US of heightened political rhetoric against immigrant groups, particularly ME Arab populations. During this period individuals from minority groups were possibly fearful based upon immigration origin and status and reluctant to fully disclose in this study. Social desirability bias was minimized using an anonymous online survey approach for data collection, allowing participants to complete the survey at convenient, private times/locations, thus eliminating the need to meet face-to-face with the researcher. However, it is not clear how much of an impact social desirability may have had, if any, on the study findings. Future studies should explore the impact of the political atmosphere on the health and wellbeing of ME Arab populations in the US.

Lastly, most of the instruments used in this study were not developed or tested for ME Arab populations in the US, which puts into question the ability of the instrument to capture the variables of interest to the study. This could have contributed to not being able to find statistically significant results, particularly for the effects of perceived discrimination and perceived stress. This limitation was minimized in this study by pilot-testing the survey items with a small group of ME Arab college women and using their feedback to ensure culturally relevant language and cultural appropriateness. The study also demonstrated that the instruments had adequate reliability. However, more studies are needed to evaluate the validity of these instruments for this use in ME Arab populations.

### Implications for practice and future research

The study findings have several implications for practice and future research. The findings highlight many opportunities to improve the health of ME college women in the US, an under-represented population in research and targeted health interventions. Foremost is the importance of college-based health service and primary care providers understanding and

addressing the health needs of young ME Arab women. Increasing provider awareness in all settings regarding risky health behaviors are important to reduce missed clinical opportunities to assess smoking behaviors, educate, and provide smoking cessation services when needed.

Colleges should integrate population health strategies through their health service, student life services, recreational centers, and student organizations, particularly cultural and religious student organization. Program interventions should also extend to the community and surrounding neighborhoods, such as community health centers, women's health centers, private practices, and community-based cultural and religious organizations. Strategies to promote services should begin with educating providers within and around the college or university settings of the unique cultural needs of this population.

The study findings indicate the need to target those who maintain their cultural heritage through events at their own cultural centers, groups, and social media outlets. These locations may present opportunities for interventions with easy access to this population with strategies customized to a specific cultural and/or religious targeted population. Optimal settings for targeted interventions include mosques, churches, religious community centers, and social media outlets that are predominantly used by ME Arab communities and are supported by the presence of trusted and respected leaders, who serve to protect the values and integrity of religious beliefs.<sup>76,77</sup> Within the context of religion, culture, and social support, these settings can have a sustainable effect on the health and wellbeing of this population.

Despite the contribution of this study in examining smoking behaviors among ME Arab college women in the US, literature on this population is lacking. Qualitative research is needed to further understand the mechanisms through which the predictors exert their influence on smoking behaviors and to identify specific intervention strategies to address risky health behaviors. Furthermore, this could be used to provide more in-depth understanding of the diversity within this population regarding religious affiliations and cultural norms and their influence on health behaviors. Lastly, future research is needed to develop measurement instruments with stronger psychometric properties to capture psychosocial and cultural constructs in this population.

### Conflict of interest disclosure

The authors have no conflicts of interest to report. The authors confirm that the research presented in this article met the ethical guidelines, including adherence to the legal requirements, of the USA and received approval from the Institutional Review Board of Rutgers University.

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