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## RESEARCH AND PRACTICE

### **Hookah: Prevalence, Perceived Harmfulness, and Factors Associated with Its Use among College Students**

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#### **ABSTRACT:**

**Introduction:** Given the increased use and availability of hookah among the US college students, coupled with the health risks related to its use, the current study examined awareness and use of hookah among college students as well as what characteristics are related to the use of hookah.

**Methods:** The study utilized a self administered anonymous survey to gather information about hookah use from the students in an undergraduate general education class ( $n = 108$ ).

**Results:** The survey results indicated that the large majority of students were aware of hookah, and nearly half of them had used hookah more than once. Level of social activity ( $p = .016$ ) and perceived healthy lifestyle ( $p = .042$ ) were the independent predictors of hookah use. The use of hookah was perceived as more harmful than alcohol use, but not as harmful as cigarette smoking.

**Conclusions:** The findings of this study can serve as a baseline for further studies on the subject, the results of which can lead to development of preventive programs targeting the populations that are most prone to hookah use.

**Key words:** hookah, water pipe, prevalence of hookah use, perception of harmfulness, factors related to hookah use

## INTRODUCTION

Smoking hookah, which is the inhaling of a lit tobacco mixture through a waterpipe, has obscure origins but has been practiced for centuries in the Middle East (Tamim et al., 2003). The terminology for hookah varies depending upon region, which includes shisha, narghile, arghile, hubble bubble, and goza among others (Moziak, Ward, Soweid, & Eissenberg, 2004). The main ingredient of hookah is *tumbak*, a dark paste tobacco lit by charcoal ember, which is placed on a tray on top of a pipe connected to a glass bottle half filled with water (Tamim et al., 2003). A burning charcoal is placed atop the *tumbak*, which is often soaked in molasses and mixed with fruit pulp and flavorings for creating aromatic smoke. Upon inhalation, the smoke passes through the waterpipe body, bubbles through the water in the bottle, and is carried through the hose to the smoker (Shihadeh, 2003).

The hookah smoke that emerges from the waterpipe contains substantial amount of toxicants known to cause lung cancer, oral cancer, heart diseases, and periodontal diseases (Natto, Baljoun, & Bergstrom, 2005; WHO, 2005; Radwan, Mohamed, El-Setouhy, & Israel, 2003). In addition, second-hand smoke from waterpipes is a mixture of tobacco smoke and the smoke from the fuel such as charcoal or wood cinders, which include high levels of carbon monoxide, heavy metals, and carcinogens (Maziak, Ward, et al, 2004, Sajid, Akhter, & Malik, 1993). However, there may be fewer perceived adverse health effects associated with hookah smoking than with cigarette smoking (Primack et al., 2008; Smith, Curbow, & Stillman, 2007), partly based on the notion of a filtering effect of water, through which the smoke passes before it is inhaled (Maziak, Fouad, et al., 2004; Shihadeh, 2003). Given such, it was important for this study to examine how hookah's harmfulness is perceived compared to other better known substances, including cigarettes and alcohol.

During the past decade, there has been a dramatic increase in hookah smoking in the Eastern Mediterranean region (Warren, Jones, Eriksen, & Asma, 2006; Rastam et al., 2004; Kandela, 2003). In a 2003 survey among a representative sample of hookah smokers in cafes/restaurants in Aleppo, Syria, most hookah smoking initiation was reported to have occurred during the 1990s across most age groups (Rastam et al., 2004). For example, in 2002, 43% of entering students at American University of Beirut reported they had used hookah at least once compared to 30% in 1998 (Chaaya et al., 2004). Another trend to note is that the habit of hookah smoking, which was traditionally limited to older men, spreading to other groups, particularly women and young adults (Maziak, Fouad, et al., 2004). An example of such phenomenon can be found in Tamim et al. (2003)'s 2001 survey, in which 32.4% of a proportionate random sample of university students in Lebanon indicated regular use of hookah.

With the increase in hookah smoking in the United States in the last decade (WHO, 2005), hookah cafes have opened across the United States (Lewin, 2006; Koch, 2005). Estimates of the number of hookah bars vary (Lewin, 2006; Koch, 2005), but as of October 2008, 470 hookah bars in the United States were listed on a hookah bar directory, and the number was growing by approximately five new hookah bars per month (Hookah-bars.com, n.d.). However, given the fact that many hookah bars are not listed in such directories, the actual number of hookah bars may be much larger (Pease, 2009).

Among a sample of 8,745 students in eight U.S. colleges that represented the south, northeast and western regions of the United States, 30% reported that they had tried hookah and 7% indicated the use of hookah in the past 30 days (Primack, Fertman, Rice, Adachi-Mejia, & Fine, 2009). In another survey conducted among the 602 undergraduate students in an urban university located in southeast Michigan, 15% reported they had used hookah at least once, and 5% stated they had used hookah more than 10 times in the past year (Grekin & Ayna, 2008). However, given the response rates of 28-30%, it is important to conduct further research to confirm these findings.

One of the reasons for increased use of hookah may be due to the social nature of its use. Previous studies conducted in the Middle East found that most hookah smokers initiated smoking with friends (Asfar, Ward, Eissenberg, & Maziak, 2005; Maziak, Eissenberg, & Ward, 2005; Maziak, Fouad, et al, 2004). Smoking hookah was strongly related to socialization with peers and leisure time activities (Maziak, Fouad, et al, 2004). The same study found that hookah smokers reported having more friends than non-hookah smokers, and were also more likely to have hookah-smoking friends (Maziak, Fouad, et al, 2004). Anecdotal evidence indicates that many young college students in the United States learn about hookah smoking through peers (Spear, 2005; Koch, 2005; Lewin, 2006), and they use hookah primarily at hookah cafes and in other group settings such as fraternity gatherings (Lewin, 2006). Primack, et al. (2009) reported that the college students who participated in organized sports were more likely to use hookah. This may be related to the social nature of hookah smoking, but few other empirical studies have been conducted in the United States to examine such social patterns of hookah users.

Given the increased use and availability of hookah among the US college students (Hookah-bars.com, n.d.; Lewin, 2006; Koch, 2005), it is important to identify potential predictors of hookah use. The current study examined the level of awareness of hookah, prevalence of use, perception of harmfulness of hookah, and the characteristics associated with hookah use among college students. Increased knowledge in these areas may serve to help focus prevention efforts on the populations that are most at risk for using hookah.

## **METHODS**

**Participants:** A convenience sample of 195 male and female students enrolled in one section of a midwest university undergraduate general education course was used for this study. The study was approved by the university's Human Subjects Institutional Review Board (HSIRB) and was administered to consenting students at the end of one class period. After administration of the survey, all forms were mailed to two blinded investigators for separate data entry. Of the 121 students in attendance on the day of survey administration, 117 chose to participate; 108 of these surveys were complete and used for analyses (response rate of 55.4% according to the standard definitions by American Association for Public Opinion Research, 2009).

**Measures:** The survey questionnaire items were developed and piloted by the investigators based on the existing standardized tobacco survey instruments and similar surveys used in previous studies (Center for Disease Control and Prevention, 2001; Maziak, Ward, Afifi Soweid, & Eissenberg, 2005; Ward, Vander Weg, Relyea, DeBon, & Klesges, 2006). Questionnaire items assessed demographic factors, including age, gender, level of education, ethnicity of the student, ethnicity of the student's friends, and military experience. Participants' awareness and exposure

to hookah were assessed by the responses (true, false) to the following statements: 'I have never heard of hookah before this survey,' 'I know someone who uses hookah,' and 'I have been in a room where hookah was being used.' In addition, responses to the following question were used to examine the use of hookah among the participants: 'Which of the following best describes your experience with hookah? (I have never used hookah, I have used hookah only once, I have used hookah more than once but not regularly (i.e., not more than once a week), either currently or in the past I have used hookah regularly (i.e., at least once a week)).' We dichotomized the variable 'hookah use' by grouping the first two categories together, while combining the latter two categories. This was an attempt to focus our investigation on the use of hookah that was beyond a single (non-recurring) experimental trial.

Collected demographic information included age (<15, 15-19, 20-24, 25-29, 30-34, >35), gender, level of education (freshman, sophomore, junior, senior, other), race/ethnicity (Asian/Pacific islander, Black/African-American, Hispanic/Latino, White/Non-Hispanic, Arab/Middle Eastern, South Asian, other), race/ethnicity of friends, and military experience (yes, no). Data regarding socialization and healthy lifestyle behaviors were collected through the following questions: 'Over the past month, on average how many times a week did you engage in primarily social activities for longer than an hour at a time? (2 times or less per week, 3-5 times per week, 6-8 times per week, 9 or more times per week);' 'How often do you wear a seatbelt in the car? (always, almost always, often, occasionally, rarely, never);' 'Over the past month, on average how many cigarettes did you smoke in a week? (none, 1-10 cigarettes, 11-20 cigarettes, 21-40 cigarettes, more than 40 cigarettes);' 'Over the past month, on average how much time a week do you spend doing rigorous exercise? (less than 1 hour, 1-3 hours, more than 3 but less than 6 hours, 6 or more hours).' In addition, the following question was used to measure the participant's personal assessment of the healthiness of his lifestyle: 'In your opinion, do you lead a healthy lifestyle? (very healthy, somewhat healthy, not very healthy, unhealthy).'

The following question was used to assess the respondent's perceived healthiness/harmfulness of a list of behaviors: 'How would you rate each of the following items regarding the impact on your health, with "1" being very unhealthy and "7" being very healthy?' To measure how hookah use was perceived relative to other healthy/harmful behaviors, participants were asked to rate the harmfulness/healthiness of the four other behaviors (smoking cigarettes, drinking alcohol, exercising regularly, and socializing with friends) as well as that of using hookah.

**Statistical Analysis:** Frequencies were run on awareness, exposure, and use of hookah. Pearson Chi-Square tests were conducted on all social and lifestyle variables to examine their bivariate associations with hookah use.

Binary logistic regression analysis was conducted to determine independent predictors of hookah use. The model was built with the forced entry method. Given the explorative nature of the study, the model was built by first including all variables significantly associated with hookah use from bivariate analysis ( $p < .10$ ). Then the non-significant variables were removed in backwards fashion, albeit with exceptions based on their potential significance in developing preventive programs. SPSS version 14.0 was used for all statistical analyses.

## RESULTS

The sample consisted of 108 students with 55% being female ( $n = 59$ ). Fifty three percent were 19 or under ( $n = 57$ ), 46% were between 20 and 24 ( $n = 50$ ), and 1% of the participants ( $n = 1$ ) was older than 24. The sample was representative of all four undergraduate grade levels, ranging from a low of 17% seniors ( $n = 18$ ) up to 37% sophomores ( $n = 40$ ). The sample was racial/ethnically homogeneous, with 89% identifying as white ( $n = 96$ ) and only 11% of the respondents ( $n = 12$ ) identifying in any other category.

As shown in Table 1, 85% of the sample had heard of hookah. Nearly two-thirds of the respondents had tried hookah at least one time, with 10% having used it regularly.

**Table 1**  
*Frequencies of Awareness, Exposure, and Use of Hookah (N = 108)*

	<i>n</i>	<i>% (95% CI)</i>
Awareness		
Have heard of hookah	92	85.2 (78.5 – 91.9)
Never heard of hookah	16	14.8 (8.1– 21.5)
Exposure to Other Hookah Users		
Know someone who uses hookah	75	69.4 (60.7 – 78.1)
Do not know anyone who uses hookah	33	30.6 (21.9 – 39.3)
Exposure to Environment Where Hookah Was Used		
Have been in a room where hookah was being used	66	61.1 (51.9 – 70.3)
Never been in a room where hook was being used	42	38.9 (29.7 – 48.1)
Use		
Have never used hookah	41	38.0 (28.9 – 47.1)
Have used hookah once	14	13.0 (6.7 – 19.3)
Have used more than once but not regularly	42	38.9 (29.7 – 48.1)
Have used regularly <sup>a</sup>	11	10.2 (4.5 – 15.9)

*Note.* <sup>a</sup>Either currently or in the past, has used hookah regularly (at least once a week).

Table 2 displays factors associated with level of hookah use. Those participants who smoke more than a pack of cigarettes per week were significantly more likely to have used hookah more than once ( $\chi^2 = 12.68, p < .001$ ) than those who smoke a pack or less per week. Self-perception of healthy lifestyle showed a significant negative association with hookah use, with the respondents who declared unhealthy lifestyle (unhealthy, not very healthy) being more likely to have used hookah more than once ( $\chi^2 = 12.05, p = .002$ ) compared to those who reported healthy lifestyle (very healthy, somewhat healthy). A greater percentage of respondents who engaged in primarily social activities at least 3 times a week reported multiple use of hookah compared to those who participated in such outings less than 3 times a week ( $\chi^2 = 10.33, p = .006$ ). However, respondents' reported amount of rigorous exercise per week was not significantly associated with hookah use ( $\chi^2 = 5.408, p = .144$ ).

**Table 2**  
*Lifestyle Events Associated with Hookah Use (N = 108)*

Lifestyle Event	Frequency of Hookah Use		Pearson Chi-Square	two-tailed p value
	Never Used or Used only Once	Used More than Once/Regularly		
	<i>n</i> (%)	<i>n</i> (%)		
<b>Cigarette Use<sup>a</sup></b>				
1 pack or less/week	52 (59.1)	36 (40.9)	12.676	<.001
More than 1 pack/week	3 (15.0)	17 (85.0)		
<b>Healthy Lifestyle<sup>b</sup></b>				
Not very healthy	4 (25.0)	12 (75.0)	12.047	.002
Somewhat healthy	38 (49.4)	39 (50.6)		
Very healthy	13 (86.7)	2 (13.3)		
<b>Rigorous Exercise<sup>c</sup></b>				
Less than 1 hr/week	16 (48.5)	17 (51.5)	5.408	.144
1-3 hrs per week	16 (45.7)	19 (54.3)		
3-6 hrs per week	10 (43.5)	13 (56.5)		
More than 6 hr/week	13 (76.5)	4 (23.5)		
<b>Social Outings of 1 Hour or More<sup>d</sup></b>				
Twice or less/week	13 (86.7)	2 (13.3)	10.334	.006
3 – 5 times/week	32 (49.2)	33 (50.8)		
6 or more times/week	10 (35.7)	18 (64.3)		
<b>Ethnicity of Friends<sup>e</sup></b>				
Has friends of Middle Eastern descent	4 (23.5)	13 (76.5)	6.059	.013
Does not have friends of Middle Eastern descent	40 (44.0)	51 (56.0)		

*Note. Results in the table are based on the responses to the following questions in the survey:*

*<sup>a</sup>Over the past month, on average how many cigarettes did you smoke in a week? <sup>b</sup>In your opinion, do you lead a healthy lifestyle? <sup>c</sup>Over the past month, on average how much time a week do you spend doing rigorous exercise? <sup>d</sup>Over the past month, on average how many times a week do you engage in primarily social activities for longer than an hour at a time? <sup>e</sup>Describe the ethnicity of your friends you frequently meet or talk to.*

The model's goodness of fit was acceptable ( $\chi^2 = 4.350, p = .739$ , Hosmer-Lemeshow test). Five outliers were identified (standardized residual values greater than 2), but none of the Cook's statistic and standardized DFBeta values were greater than 1, suggesting no unduly influential cases. VIF values for all predictors were between 1 and 1.3, indicating low multicollinearity between the predictors. Colinearity diagnostics also showed large loadings of variances on different dimensions, further indicating limited multicollinearity.

**Table 3**

*Multivariable Analysis of Factors Associated with Multiple Hookah Use (N = 108)*

	Odds Ratio	95% CI
Social Outings per week		
Twice or less	Ref	
3-5 times	9.18	1.5 – 55.5
6 times or more	16.52	2.4 – 111.3
Reported Life Style		
Unhealthy/ Not very healthy	Ref	
Somewhat healthy	0.48	0.1 – 2.4
Very healthy	0.07	0.0 – 0.7
Cigarette Smoking		
20 or less cigarettes per week	Ref	
21 or more cigarettes per week	3.53	.8 – 15.2
Perceived Harmfulness of Hookah	.70	.49 – 1.00

*Note.* CI = confidence interval. <sup>a</sup>Hosmer & Lemeshow  $\chi^2 = 4.350$  ( $p = .739$ ). Cox & Snell  $R^2 = .289$ . Nagelkerke  $R^2 = .385$ . All the variables shown in the table have been included in the final model.

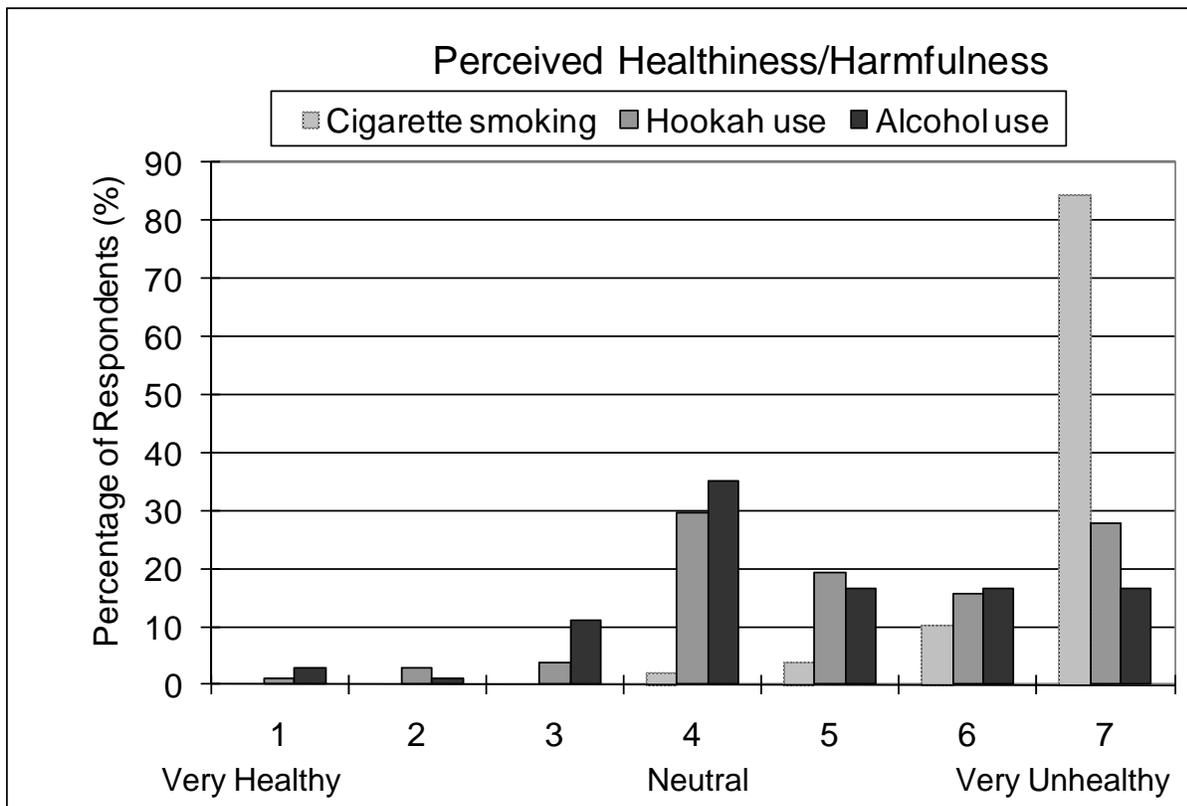
As shown in Table 3, the odds of multiple hookah use were 9 times greater for the students who engaged in at least an hour-long social outings 3-5 times a week compared to those who had two or less such weekly social outings,  $OR = 9.2$  (95%  $CI = 1.5 - 55.5$ ). Furthermore, the odds of multiple hookah use were almost 17 times greater for the students who engaged in social outings 6 times or more per week than those who were involved in two or less weekly social outings,  $OR = 16.5$  (95%  $CI = 2.4 - 111.3$ ). Table 3 also indicates that the students who declared their life style to be very healthy were far less likely to have used hookah multiple times compared to those who reported an unhealthy life style,  $OR = .07$  (95%  $CI = .0 - .7$ ). However, the students who reported their life style as somewhat healthy were not significantly different in hookah use from those who reported an unhealthy life style,  $OR = 0.48$  (95%  $CI = .1 - 2.4$ ).

The odds of multiple hookah use were almost 4 times greater for the students who smoke an average of more than a pack of cigarette per week than for the students who smoke a pack or less than a pack of cigarettes per week, but was not statistically significant,  $OR = 3.53$  (95%  $CI = .8 - 15.2$ ). In addition, the odds of multiple hookah use decreased by 42% for each increase in hookah's perceived harmfulness scale (1-5),  $OR = .70$  (95%  $CI = .5 - 1.0$ ), but was also not

statistically significant. None of the demographic factors had a significant effect on hookah use once other independent predictors were controlled for.

Figure 1 shows the continuum of perceived harmfulness of cigarette smoking, hookah use, and alcohol use. The large majority of participants viewed cigarette smoking as at least mildly unhealthy (98.1%), with most (84.3%) considering it as very unhealthy. In contrast, perceived harmfulness of hookah use, as well as that of alcohol use, was more evenly distributed across the scale.

**Figure 1**  
*Comparison of Perceived Healthiness/Harmfulness between Cigarette, Hookah, and Alcohol Use (N = 108)*



## DISCUSSION

This survey, conducted to examine awareness and use of hookah as well as the factors associated with hookah use among undergraduate college students, found that the majority of students in the study were familiar with hookah, over half of them had tried it, and one in ten reported regular use. Perceived harmfulness of hookah use was similar to that of alcohol use but lower than that of cigarette smoking. Level of social activity and perceived healthy lifestyle were the independent predictors of hookah use.

In this study 59% of the students reported they have tried hookah at least once, which is much higher than what was reported in previous studies conducted on the U.S. college students (30% in Primack et al., 2009; 15% in Grekin & Ayna, 2008). Average age of the students included in these three studies was similar, but the percentage of male students in this study (45%) was higher than those of the previous studies (37% and 24%, respectively). Gender was not significantly associated with hookah use (either multiple or single) in this study, while it was significantly related to hookah use in a previous study (Primack et al., 2009), albeit only in a bivariate analysis; it did not turn out to be a significant independent predictor of hookah use once the other significant predictors were controlled for.

Potential difference in availability of hookah bars in the areas where the surveys were conducted could also have contributed to the difference in the level of hookah use among the three studies. In addition, the difference in response rate between this study (55.4%) and the previous two studies (28-30%) could have influenced the outcome. In other words, it is possible that a larger percentage of non-respondents (compared to respondents) tended to use hookah, contributing to the difference in percentage of students who have reported hookah use between the present and previous studies.

Hookah use was perceived as less harmful than cigarette use despite the fact that research supports the large intake of nicotine and toxins when using hookah (Natto, Baljoon, & Bergstrom, 2005; WHO, 2005; Radwan, Mohamed, El-Setouhy, & Israel, 2003); this result is consistent with the findings of Smith et al. (2007). It may be the method of delivery that generated the difference in perceived harmfulness between hookah and cigarette smoking. It is also possible that the pattern of use contributed to the difference in perceived harmfulness. In other words, the frequency of use (most hookah users consumed hookah less than twice a week whereas cigarette is generally used more frequently) might have defined the perceived level of harmfulness as opposed to the intensity of harmfulness per use. In addition, limited evidence of its addictiveness and carcinogenic risk might have impacted health education and public health policies related to hookah use and thus influenced public perception of its harmfulness.

Level of social activity was significantly associated with hookah use. This is consistent with the findings from previous studies that documented the use of hookah within a social context (Asfar et al, 2005; Maziak et al, 2005, Maziak, Fouad, et al., 2004). Given the hookah's Middle Eastern origin and the recent significant increase in regional hookah smoking (Warren, Jones, Eriksen, & Asma, 2006; Rastam et al., 2004; Kandela, 2003), it is not surprising that having close friends of Middle Eastern origin was strongly associated with hookah use in a bivariate analysis. However, the significance of this association diminished considerably once other factors were controlled, including level of social activity and healthy life style. It is possible that those who engage in a

large number of social outings have a pool of friends that are both large in number and diverse in ethnicity; such a scenario may explain why the friends' ethnicity didn't turn out to be an independent predictor of hookah use. It is also possible that the friends' ethnicity was not found to be a significant independent predictor of the outcome due to small sample size and homogeneous composition of the student body.

Perception of healthy lifestyle was also significantly related to hookah use. However, it was interesting to note that only the students who reported a very healthy lifestyle (rather than those who reported somewhat healthy lifestyle) were significantly less likely to use hookah than the participants who reported an unhealthy lifestyle. One of the possible explanations for this result is that avid health seekers may have avoided hookah use even at the hint of its harmfulness, while the students who reported a somewhat healthy life style did participate in hookah use given the perception of hookah's harmfulness that was far lower than that of cigarette smoking.

Although cigarette smoking was significantly related to hookah use in a bivariate analysis, it did not turn out to be an independent predictor of hookah use ( $p = .09$ ). It appears that a relatively high correlation between healthy lifestyle and cigarette smoking ( $r = -.378$ ) was partially responsible for this result. However, it is possible that this outcome might have been due to limited statistical power. Although cigarette use is considered a riskier activity than hookah use, the common nicotine content between the two activities may have contributed to the association between cigarette smoking and the use of hookah.

Perceived harmfulness of hookah did not turn out to be a statistically significant predictor of hookah use once the other predictors in the final model (level of social activity, perception of healthy lifestyle, cigarette smoking) were controlled for ( $p = .06$ ). However, this may also have been due to limited statistical power. It appears that although some of the students used hookah despite its perceived harmfulness, the majority of the students avoided using hookah more than once when they perceived it as harmful.

The present study used a small convenience sample, and only the students who attended the class the night of the survey were included. However, the response rate of 55.4% was substantially higher than that of previous studies conducted on the U.S. college students (Grekin & Ayna, 2008; Primack et al., 2009), which ranged from 28-30%. The homogeneity of race and age also limits generalizations to a larger population.

The findings of this study can serve as a knowledge base for further studies on the subject, the results of which can lead to development of preventive programs targeting the populations that are most prone to hookah use. Qualitative analyses would be advised to explore factors associated with hookah use that were not considered in the present study. In addition, since only a small percentage of the sample in the present study used hookah on a regular basis, the pattern of hookah use, which appears to be distinct from cigarette use, should be further explored to determine if level of perceived health threat associated with hookah use differs for those using often compared to casual users.

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