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# Differences in Current Hookah and Cigarette Smoking Status Attitudes and Beliefs at a Florida University: A Discriminant Analysis

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## ABSTRACT

*Rising college hookah use, in the absence of cigarettes, suggests attitudinal differences among both forms of tobacco consumption. This study examines which smoking attitudes/beliefs are most distinguishing across current non-smokers, cigarette smokers, hookah smokers, and dual (cigarette and hookah-only) smokers at a Florida university. Self-administered questionnaire data from 373 university students were categorized into four groups based on self-reported 30-day smoking status. Discriminant analysis was used to examine maximal differences between groups across perceived peer acceptability of cigarette smoking, peer acceptability of hookah smoking, hookah smoking harmfulness, and attitude toward peer hookah smoking. Descriptive analyses indicated an overall awareness of hookah smoking harmfulness across all four groups. Discriminant analysis findings indicated peer acceptability of cigarette smoking ( $r = .75$ ) contributed the most to attitude/belief differences across all four groups. Pairwise group comparisons showed a significant attitudinal mean difference in peer acceptability to cigarettes for cigarette smokers vs hookah smokers ( $T=3.9$ ,  $p=.001$ ). Study findings underscore the need for campus-based anti-smoking social norm approaches targeting positive hookah smoking peer use attitudes. Programming efforts are recommended to implement the use of self-reported perceived peer acceptability to cigarette smoking as a potential risk indicator for students at-risk for cigarette or dual use.*

**Castañeda, G., Barnett, T.E., Romero, S., Lee, M.J., & MacInnes, J. (2019). Differences in current hookah and cigarette smoking status attitudes and beliefs at a Florida university: A discriminant analysis. *Florida Public Health Review*, 16, 1-9.**

## BACKGROUND

Despite decreases in U.S. cigarette smoking prevalence and hookah smoking prevalence among Florida high schoolers, the rising prevalence of college hookah smoking is an increasing public health concern (Fevrier et al. 2018; Barnett et al., 2013a; Barnett et al., 2013c; Akl et al., 2010; O'Malley et al., 2008; Jackson & Aveyard, 2008; Eissenberg & Shihadeh, 2009). Several university-based cross-sectional studies have reported rising hookah smoking prevalence (20-40% for ever use and 5-20% for current use) and early hookah smoking initiation among college students (29% pre-college and 34% freshman year of college) (Eissenberg et al., 2008; Primack et al., 2008; Fielder et al., 2012; Primack et al., 2013; Barnett et al., 2013a). In a 2013 study assessing Florida college student hookah smoking, both ever use (46.4% vs 42.1%) and past year use (28.4% vs 19.6%) rates exceeded those of cigarette smoking (Barnett et al., 2013a). More recent Florida college hookah ever use (64%) and current use (34%)

rates suggest a continued increase in hookah smoking prevalence (Martinasek et al., 2017).

Furthermore, prevalence studies have also shown that 35.4% of college students who smoked hookah within the past year (Primack et al., 2008) had never smoked cigarettes and 65% of current hookah smokers (Jackson and Aveyard, 2008) had never smoked cigarettes. In addition, current college students have been associated with a significantly higher risk of being hookah-only users or dual (hookah and cigarette) users, as compared to cigarette-only users (Lee et al., 2014). These data suggest college hookah use in the absence of cigarette smoking may be linked to attitudinal differences among both forms of tobacco consumption (Grekin and Ayna, 2012).

Cross-sectional studies examining normative beliefs regarding hookah use among the U.S and Florida college population have indicated positive attitudes toward hookah use were significantly associated with current hookah use and intention to use hookah tobacco in the future (Eissenberg et al., 2007; Braun et

al., 2012; Barnett et al., 2013b; Martinasek et al., 2017). In addition to greater smoking frequencies, current smokers have been identified as a high-risk subgroup of smokers, given they are more likely to perceive that peers would be more accepting of hookah and cigarette use, as compared to nonusers (Noland et al., 2016). Noland et al (2016) suggested significant differences in attitudes and beliefs between current cigarette and current hookah smokers when using perceived social norm composite scores; however, it was not clear which attitudes or beliefs drove the largest differences between current cigarette and hookah smoker groups nor whether the group comparison drawn was between cigarette-only and hookah-only users.

Therefore, this study seeks to build on current literature findings by identifying: 1) which particular attitudinal and belief variables (perceived peer acceptability of hookah smoking; perceived peer acceptability of cigarette smoking; perceived hookah smoking harmfulness; and attitude toward peer hookah smoking) bear the most weight in terms of discriminating between current cigarette-only and hookah-only smoking status groups (i.e. current non-smokers, current cigarette-only smokers, current hookah-only smokers and current dual (cigarette- and hookah-only) smokers; and 2) whether these attitudinal/belief differences are significant across all possible cigarette and hookah smoking status group pair combinations. The identification of specific attitudinal and/or belief discriminant variables across all four cigarette and hookah smoking status groups can inform targeted campus-based tobacco prevention programming approaches.

## STUDY DATA AND METHODS

### *Study Design*

This study was a between-subjects cross-sectional research design. The original sample consisted of 1203 university students; however, after students were categorized into mutually exclusive current hookah and cigarette smoking status groups, the final sample size was 373 university students. Students were categorized by current smoking status into the following four groups: 1) current non-smokers ( $n=213$ ; 57.1%); 2) current cigarette-only smokers ( $n=73$ ; 19.6%); 3) current hookah-only smokers ( $n=64$ ; 17.2%); 4) current dual (cigarette- and hookah-only) smokers ( $n=23$ ; 6.2%). Students were classified into each group based on self-report responses on current non-use and current cigarette-only and/or hookah-only use, defined as use within the past 30 days.

### *Recruitment*

Study recruitment consisted of a systematic random sample selecting every 10<sup>th</sup> individual approaching any of three designated campus locations at a large

university in the state of Florida. Systematic random sampling was used to reduce potential bias in participant selection due to visual appearance or demeanor. Campus locations were targeted in terms of student traffic, racial diversity, college major, and year in school (undergraduate and graduate). Data collection was conducted for approximately 4-6 hours across 10 different days and times, differing in scheduled days and times on a weekly basis. Upon obtaining 75-100 completed surveys at one campus location, sample data were examined for adequate representation of the target population and the research team proceeded with data collection at another location. Each campus location was equipped with five laptop computers containing the survey administered via the computer-assisted personal interview (CAPI) program. Potential survey respondents were offered a \$5 gift card for their participation in the study and given the gift card upon survey completion. University IRB approval was obtained for the study protocol and survey.

### *Variables*

Data were obtained on tobacco use, including cigarette and hookah smoking, as well as beliefs and attitudes toward cigarette and hookah smoking.

*Demographics.* Demographic characteristics including age, sex, race, ethnicity (Hispanic), current student level in school (undergraduate versus graduate level) and student enrollment status (full-time versus part-time) were collected. Respondents who were not current students were excluded from the study.

*Tobacco use.* Participants who self-reported ever use for cigarettes or hookah in their lifetime were separately asked to report use within the past year or past 30 days. Current tobacco use self-report responses were assessed for mutually exclusive smoking status categories consisting of cigarette-only, hookah-only, and dual (cigarette- and hookah-only) use within the past 30 days. Current non-smokers were derived from participant self-reported responses for no tobacco use within the past 30 days.

*Belief and attitudinal variables.* Perceived peer acceptability of cigarette smoking (PAC) was worded as: "Among your close friends, how acceptable is cigarette smoking?" Perceived peer acceptability of hookah smoking (PAH) was measured with an analogous item: "Among your close friends, how acceptable is waterpipe/hookah smoking?" Questions assessing peer acceptability (PAC and PAH) were measured using a 5-point rating scale ranging from 1-unacceptable to 5-very acceptable.

Perceived hookah smoking harmfulness (HH) was determined via respondents' level of agreement or disagreement to the following statement: "Smoking tobacco from a waterpipe is harmful to my health". Responses for hookah smoking harmfulness were

measured via a 5-point scale ranging from 1- strongly disagree to 5- strongly agree. Attitude toward peer hookah smoking (APH) was assessed with the following item: “How “cool” do your friends look when they use a waterpipe/hookah?” Responses for this item ranged from 1- not at all cool to 4- very cool. Cigarette and hookah smoking attitude and belief questions captured peer acceptance and personal beliefs about hookah smoking harmfulness (Noland et al., 2016; Helme et al., 2007; Stephenson & Helme, 2006).

For the purposes of this study, grouped data were examined across the following four belief or attitudinal variables: 1) perceived peer acceptability of cigarette smoking (PAC); 2) perceived peer acceptability of hookah smoking (PAH); 3) perceived hookah smoking harmfulness (HH); and 4) attitude toward peer hookah smoking (APH). Student current smoking status categories were mutually exclusive (i.e. between-subjects).

#### *Analysis*

A discriminant analysis was conducted to examine group differences across PAC, PAH, HH, and APH between the following four mutually exclusive student smoking status groups: 1) current non-smokers; 2) current cigarette-only smokers; 3) current hookah-only smokers; and 4) current dual smokers (cigarette- and hookah-only). Differences across all four student smoking status groups on each discriminant belief and attitudinal variable were tested with Bonferroni adjusted multiple comparison tests between the following six possible group pair combinations: 1) current non-smoker vs current cigarette smoker; 2) current non-smoker vs current hookah smoker; 3) current non-smoker vs current dual smoker; 4) current cigarette smoker vs current hookah smoker; 5) current cigarette smoker vs current dual smoker; and 6) current hookah smoker vs current dual smoker.

## **STUDY RESULTS**

### *Sample*

Table 1 demonstrates overall and smoking group-based sample descriptive statistics for demographics and belief /attitudinal questions. Chi-square tests were used for bivariate data analyses examining associations across participant demographic characteristics and tobacco status. Significant relationships were identified between males ( $\chi^2_{(3)} = 8.65, p=.03$ ), Hispanics ( $\chi^2_{(3)} = 11.81, p=.008$ ) and smoking status (see Table 1). A Brown-Forsythe ANOVA was conducted to examine the relationship between age and current smoking group statuses. A statistically significant difference in mean age across smoking status groups was determined ( $F_{(3)} = 4.78, p = .003$ ). A Dunnett C post-hoc test revealed that age

was lower among current hookah smokers ( $20 \pm 1.99, p < .05$ ) compared to current cigarette smokers ( $22 \pm 3.48$ ).

A descriptive analysis of the data indicated current non-smokers ( $2.24 \pm 1.01$ ), current cigarette smokers ( $2.03 \pm 1.21$ ), and current hookah smokers ( $1.89 \pm 1.04$ ) reported “somewhat acceptable” levels of peer acceptability toward hookah smoking. Alternatively, current dual smokers reported “very acceptable” levels of peer acceptability ( $1.43 \pm 0.79$ ). Mean attitude toward peer hookah smoking responses suggested current non-smokers ( $3.23 \pm 0.69$ ), cigarette smokers ( $2.89 \pm 0.89$ ), and hookah smokers ( $2.89 \pm 0.86$ ) reported their friends look “somewhat cool” when they use hookah. Alternatively, current dual smokers reported their friends look “cool” when they use hookah ( $2.43 \pm .90$ ).

Results indicating agreement with hookah smoking harmfulness to health were reported across all student smoking status groups (current non-smokers ( $2.00 \pm 0.89$ ), current cigarette smokers ( $2.02 \pm .98$ ), current hookah smokers ( $2.02 \pm 1$ ), and current dual smokers ( $1.83 \pm .83$ )). Complete item-level descriptives across current smoking status groups are provided in Table 1.

### *Discriminant Analysis*

The descriptive discriminant analysis indicated two significant discriminant functions:  $\chi^2_{(12)} = 81.155, p < .001$  and  $\chi^2_{(6)} = 99.4, p = .035$  (Table 2). Given that discriminant analysis results demonstrated that the first discriminant function ( $D1_A$ ) accounted for 84.4 % of the group differences across all four belief and attitudinal discriminating variables (PAC, PAH, HH and APH), and the second discriminant function ( $D2_A$ ) only accounted for 15.1 %, only the first discriminant function was considered (eigenvalue .217) (Table 2). According to the structure matrix, perceived peer acceptability of cigarette smoking (PAC) contributed the most to group differences across all four student smoking status groups (Table 3). The following two questions and the first discriminant function indicated strong correlations: 1) perceived peer acceptability of cigarette smoking (PAC) ( $r = .746$ ); and 2) attitude toward peer hookah smoking (APH) ( $r = .612$ ).

### *Multiple Comparisons*

Mean discriminant group score differences and corresponding p-values are provided in Table 4. A Bonferroni multiple comparison test, with adjusted p-values, confirmed significant group differences across current smoking status group pairs for the following three attitudinal questions: 1) peer acceptability to hookah smoking: (a) non-smokers vs dual smokers ( $T=3.69, p=.002$ ); (b) non-smokers vs hookah smokers ( $T=2.71, p=.04$ ); 2) peer acceptability to cigarette smoking: (a) non-smokers vs cigarette smokers ( $T=6.42, p < .001$ ); (b) non-smokers vs dual smokers ( $T=4.26, p < .001$ ); (c) hookah smokers vs cigarette

smokers (T=3.9, p=.001); (d) hookah smokers vs dual smokers (T=3.01, p=.02); and 3) attitude toward peer hookah smoking: (a) non-smokers vs dual smokers (T=4.62, p<.001); (b) non-smokers vs hookah smokers (T=3.01, p=.02); (c) non-smokers vs cigarette smokers (T=3.01, p=.02).

Taken together, pairwise comparisons suggest the largest attitudinal group differences were present across the peer acceptability to cigarette smoking question for the current non-smokers vs dual smokers group pair, closely followed by the current non-smokers versus current cigarette smokers group pair. Of note, significant group belief differences were not found between any smoking status group pair for hookah smoking harmfulness (see Table 4).

**DISCUSSION**

The college tobacco literature points to attitudinal and belief differences between hookah and cigarette

smoker groups, with a large proportion of hookah-only users reporting cigarette smoking never use (Grekin and Ayna, 2012). This study focused on identifying which particular hookah and cigarette smoking attitude or belief variables differentiated most between the following four college hookah and cigarette smoking status groups: 1) current non-smokers; 2) current cigarette-only smokers; 3) current hookah-only smokers and 4) current dual (cigarette- and hookah-only) smokers. Our findings indicated perceived peer acceptability to cigarette smoking, distinguished most between current hookah and cigarette status groups. The hookah and cigarette status group comparison results indicated the largest attitudinal difference across all four student smoking status groups was between the current non-smokers and current dual smokers group pair.

**Table 1: Descriptive Statistics across Current Hookah and Cigarette Smoking Status Groups**

Factor	Non-Smokers (NS) N=213 (%)	Cigarette Smokers (CS) N=73 (%)	Hookah Smokers (HS) N=64 (%)	Dual Smokers (DS) N=23 (%)	Total N=373 (%)	Missing N (%)	χ <sup>2</sup> (df)	Sig.
<i>Gender</i>						0	8.65(3)	.034
Male	43.2	61.6	54.7	43.5	48.8			
Female	56.8	38.4	45.3	56.5	51.2			
<i>Ethnic origin</i>						1 (0.3)		
Hispanic or Latino	18.8	26.0	39.1	17.4	23.6		11.81(3)	.008
<i>Race</i>						0	12.75(9)	.174
Black or African American	6.1	8.2	4.7	0	5.9			
Asian or Asian American	9.9	17.8	12.5	8.7	11.8			
White	67.6	54.8	56.3	56.5	62.5			
Other	14.5	17.7	26.7	26.0	19.9			
<i>Student Status</i>						0		
Undergraduate	82.2	79.5	87.5	87.0	82.8			
Graduate	17.8	20.5	12.5	13.0	17.2			
<i>Student Enrollment</i>						0		

Full-time	94.8	93.2	98.4	100	95.4		
Part-time	5.2	6.8	1.6	0	4.6		
<b>Age</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>F(df)</b>	
	21 (2.75)	22 (3.48)	20 (1.99)	21 (2.73)	21 (2.74)	0	4.78(3) .003
<b>Peer Acceptability Hookah</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>Mean (SD)</b>		
(1-Very acceptable to 5- Unacceptable)	2.24 (1.01)	2.03 (1.21)	1.89 (1.04)	1.43 (0.79)	2.08 (1.06)	0	
<b>Peer Acceptability Cigarettes</b>							
(1-Very acceptable to 5- Unacceptable)	3.75 (1.14)	2.77 (1.34)	3.48 (1.18)	2.61 (1.23)	3.45 (1.26)	0	
<b>Attitude Toward Peer Hookah Smoking</b>							
(1- Very cool to 4- Not at all cool)	3.23 (.69)	2.89 (0.89)	2.89 (0.86)	2.43 (.90)	3.05 (0.81)	24 (6.4)	
<b>Hookah Smoking Harmfulness</b>							
(1- Strongly Agree to 5- Strongly Disagree)	2.00 (.89)	2.02 (.98)	2.02 (1)	1.83 (.83)	1.99 (0.92)	0	

**Table 2: Summary Statistics for the First and Second Discriminant Functions**

	Eigenvalue	% of variance	Wilk's Lambda		
			Chi-square	df	P-value
First DA <sup>a</sup>	.217	84.4	81.155	12	<.001
Second DA <sup>a</sup>	.039	15.1	99.4	6	.035

<sup>a</sup>DA refers to discriminant analysis

**Table 3: Structure matrix: Correlations (standardized loadings) between Discriminant Function and Belief/Attitudinal Questions.**

Item	Function
<b>Discriminant Analysis</b>	<b>1</b>
Perceived Peer Acceptability to Hookah Smoking (PAH)	.404
Perceived Peer Acceptability to Cigarette Smoking (PAC)	.746
Attitude Toward Peer Hookah Smoking (APH)	.612

**Table 4: Multiple Comparisons Between Current Smoking Status Group Pairs (n=349).**

Predictor	(I) Group	(J) Group	<sup>a</sup> Mean Difference (I-J)	Std. Error	T-statistic	<sup>b</sup> Sig
Peer Acceptability Hookah	Cigarette Smoker	Non-smoker	.19558	.14575	1.3419	1.0
		Hookah Smoker	.21896	.18403	1.1898	1.0
		Dual Smoker	.67481	.25697	2.6260	.054
	Hookah Smoker	Non-smoker	.41454*	.15319	2.7061	.043
		Dual Smoker	.45584	.26127	1.7447	.491
	Dual Smoker	Non-smoker	.87038*	.23588	3.6899	.002
Peer Acceptability Cigarettes	Cigarette Smoker	Non-smoker	1.04277 *	.16245	6.4190	<.001
		Hookah Smoker	.79944 *	.20511	3.8976	.001
		Dual Smoker	.07624	.28642	0.2662	1.0
	Hookah Smoker	Non-smoker	.24332	.17075	1.4250	.93
		Dual Smoker	.87568*	.29120	3.0071	.017
	Dual Smoker	Non-smoker	1.11900*	.26290	4.2564	<.001
Attitude Toward Peer Hookah Smoking	Cigarette Smoker	Non-smoker	.33665*	.11189	3.0088	.017
		Hookah Smoker	<.00001	.13756	<.00001	1.0
		Dual Smoker	.45584	.18917	2.4097	.099
	Hookah Smoker	Non-smoker	.33665*	.11189	3.0088	.017
		Dual Smoker	.45584	.18917	2.4097	.099
	Dual Smoker	Non-smoker	.79249*	.17142	4.6231	<.001
Hookah Smoking Harmfulness	Cigarette Smoker	Non-smoker	.06026	.12570	0.4794	1.0
		Hookah Smoker	.01177	.15872	0.0742	1.0
		Dual Smoker	.20131	.22163	0.9083	1.0
	Hookah Smoker	Non-smoker	.04849	.13212	0.3670	1.0
		Dual Smoker	.18954	.22533	0.8412	1.0
	Dual Smoker	Non-smoker	.14105	.20343	0.6934	1.0

<sup>a</sup>The mean difference is significant at the 0.05 level.

<sup>b</sup>Bonferroni adjusted p-values.



While the largest attitudinal differences observed were anticipated (between group pairs consisting of either current non-smokers (i.e. lower-risk) or current dual smokers (i.e. higher-risk)), current non-smokers and current dual smokers were included in the analyses to provide a more holistic understanding of the upper and lower boundaries in attitudinal mean differences present in our sample. Specifically, group pair comparison findings between current cigarette smokers and current hookah smokers suggested significant attitudinal differences in peer acceptability to cigarettes. Alternatively, no significant attitudinal differences were found for this group pair (i.e. current cigarette smokers and current hookah smokers) on questions relating to hookah acceptability. This study's findings suggest that while both current cigarette and current hookah smokers perceive their peers are accepting of hookah use, current hookah smokers do not perceive their peers are accepting of cigarette use. Similar findings were reported in a youth sample as well, in which high school students reported a pattern of positive associations with hookah use, but did not endorse the same positive findings for cigarettes (Barnett & Livingston, 2017). In fact, current hookah smokers in our sample did not report significantly different perceived peer acceptability of cigarettes when compared to current non-smokers (i.e. both reported "somewhat unacceptable" levels on average). On the other hand, current dual smokers did not report significantly different perceived peer acceptability of cigarettes when compared to current cigarette smokers (i.e. both reported neutral levels on average). Of note, while dual smokers indicated higher levels of peer acceptability toward cigarette and hookah smoking, awareness of hookah smoking harmfulness was prominent across all four smoking status groups, including dual smokers. These findings indicate the increased vulnerability of current dual (cigarette- and hookah-only) smokers in terms of higher levels of perceived peer acceptability for both cigarette and hookah smoking, as compared to the other three student smoking status groups (current non-smokers, current cigarette-only smokers, and current hookah-only smokers).

While one study reported that dual tobacco users had significantly lower levels of perceived hookah smoking harmfulness, as compared to cigarette-only and hookah-only users (Latimer et al., 2014); in our study, hookah smoking harmfulness was the least differentiating variable across any of the current hookah and cigarette status groups. These results may indicate a shift in hookah harmfulness beliefs for dual users, such that dual users are now reporting similarly high rates of perceived hookah smoking harmfulness to other hookah and cigarette status groups; however, longitudinal inquiry is warranted to examine this

speculation. In addition, given the stark contrast in perceived peer acceptability of cigarettes between current hookah and current cigarette users, it is possible dual (hookah- and cigarette-only) use initiation is more commonly begun with cigarette use, as opposed to hookah use. Longitudinal studies tracking dual (hookah- and cigarette-only) use initiation are also warranted to examine this hypothesis. Study findings underscore the need for anti-smoking programming among dual (hookah and cigarette-only) smokers, as evidenced by this group's higher rates of peer cigarette and hookah smoking acceptability despite awareness of hookah smoking harmfulness.

#### *Limitations*

Limitations to this study included the collection of self-reported data, subject to recall bias or social desirability bias. Findings were also taken from one university student sample which may not be generalizable to other young adults. Furthermore, while our cigarette and hookah smoking attitude and belief questions captured peer acceptance and personal beliefs about hookah and cigarette smoking, future studies could incorporate additional attitudinal/belief discriminating variables (Noland et al., 2016; Helme et al., 2007; Stephenson & Helme, 2006). In addition, this study was cross-sectional; thus, potential changes in harmfulness beliefs cannot be inferred.

#### **IMPLICATIONS FOR PUBLIC HEALTH**

As public health professionals continue to make strides in reducing cigarette consumption and normative acceptance of tobacco use via policy efforts and prevention programming (e.g., purchase use and possession laws, mass media anti-tobacco campaigns), among many others, this study provides data to support the use of perceived peer acceptability of cigarette smoking as a correlate for targeted anti-tobacco campus programming. Campus health professionals can use self-reported peer acceptability of cigarette smoking to tailor campus tobacco prevention initiatives for students identified as at-risk for cigarette or dual (cigarette and hookah) use. Our study findings fill a gap in the college tobacco literature by demonstrating the relative weight of perceived peer acceptability of cigarette smoking attitudes in determining attitudinal differences among college student current hookah and cigarette status groups. Taken together, such findings may be translated into targeted social norm campaign efforts to specifically diminish positive hookah smoking peer use attitudes, where the use of student perceived peer acceptability of cigarette smoking can be used by campus health professionals to gauge potential levels of risk for cigarette and/or hookah use.



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