Association of Flavored JL ENDS Use and Subsequent Cigarette Smoking Among Adult Never Established Smokers

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Introduction

- Use of electronic nicotine delivery systems (ENDS) in non-tobacco (vs. tobacco) flavors is prevalent among adult ENDS users, smokers and non-smokers.[1-3]
- Epidemiological[4] and laboratory[5] evidence suggest that the appeal of flavored ENDS may differ by smoking status, and that use of ENDS in non-tobacco (vs. tobacco) flavors may be associated with cigarette smoking.[6]
- However, it is unknown if use of JL ENDS (JUUL Labs, Inc) in non-tobacco (vs. tobacco) flavors is associated with combustible cigarette smoking among adult Never Established Smokers.
- This longitudinal study assessed if use of JL ENDS in non-tobacco (vs. tobacco) flavors is associated with combustible cigarette smoking over a 1-year period among adult Never Established Smokers.

Methods

- Adult Never Established Smokers (never smoked a cigarette in lifetime or smoked < 100 cigarettes in lifetime; **Table 1**) who recently purchased a JL ENDS Starter Kit completed 1-month, 2-month, 3-month, 6-month, 9-month and 12-month follow-up assessments as part of a prospective cohort study.
- At each follow-up, participants reported the primary JL ENDS flavor they used most often in the past 30-days ("Which JUULpod flavor have you used most often in the past 30 days?") and if they had smoked in the past 30-days (yes/no).
- Repeated-measure logistic regression models adjusted for sociodemographic and smoking covariates assessed the association of primary JL ENDS flavor use and past 30-day combustible cigarette smoking across the follow-up period.

Table 1: Smoking Status Definitions

Baseline Smoking Status	Definition	Derivation
Never Established Smoker	• Never smoked cigarettes, not even one puff or • Ever smoked cigarettes, even one or two puffs; and smoked less than 100 cigarettes in their entire life	• Ever smoking = 'No'; or • Ever smoking = 'Yes'; and lifetime smoking <100 cigarettes

Note: Ever Smoking = "Have you ever smoked a cigarette, even one or two puffs?"
Lifetime smoking = "How many cigarettes have you smoked in your entire life? A pack usually has 20 cigarettes in it."

Results

- Aggregated across all follow-up assessments, a greater proportion of Never Established Smokers who primarily used JL ENDS in Mint (84.6%) and Mango (83.4%) flavors in the past 30 days reported past 30-day abstinence from cigarette smoking, compared to those who primarily used Virginia Tobacco (73.5%) and Menthol (74.3%) flavors; primary users of Classic Tobacco (58.5%) reported the lowest past 30-day smoking abstinence rate (**Table 2**).
- In the unadjusted repeated-measure logistic regression model, compared to primary use of Virginia Tobacco, primary use of Mint (OR [95% CI] = 0.68 [0.62, 0.75]), Mango (OR [95% CI] = 0.69 [0.62, 0.76]), Creme (OR [95% CI] = 0.85 [0.75, 0.97]), Fruit (OR [95% CI] = 0.78 [0.68, 0.89]) and Cucumber (OR [95% CI] = 0.71 [0.62, 0.82]) were significantly associated with decreased odds of past 30-day combustible cigarette smoking across the study follow-up period (**Table 3**).
- Primary use of Classic Tobacco (vs. Virginia Tobacco) was associated with increased odds of past 30-day smoking (OR [95% CI] = 1.38 [1.13, 1.67]; **Table 3**).
- After covariate adjustment (**Table 4**), the association of primary use of Mint (OR [a95% CI] = 0.76 [0.68, 0.85]), Mango (aOR [95% CI] = 0.73 [0.65, 0.81]), Creme (aOR [95% CI] = 0.85 [0.74, 0.98]), Fruit (aOR [95% CI] = 0.82 [0.70, 0.96]) and Cucumber (aOR [95% CI] = 0.80 [0.68, 0.93]) flavors, compared to primary use of Virginia Tobacco, remained significantly associated with decreased odds of past 30-day combustible cigarette smoking across the study follow-up period, and primary use of Classic Tobacco (vs. Virginia Tobacco) was associated with increased odds of past 30-day smoking (aOR [95% CI] = 1.34 [1.09, 1.64]; **Table 5**).
- 74.2% of participants reported ever-smoking (**Table 4**), and in the fully-adjusted regression model lifetime smoking was strongly associated with increased odds of past 30-day smoking (OR [95% CI] = 3.14 [2.82, 3.50]; Table 5).

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Table 2: Proportion of Never Established Smokers Reporting Past 30-Day Smoking Abstinence by Primary Flavor Used in Past 30 Days Across Follow-Up

Primary Flavor	1-Month Follow-Up n (%) (N=10 032)	2-Month Follow-Up n (%) (N=9850)	3-Month Follow-Up n (%) (N=9602)	6-Month Follow-Up n (%) (N=8404)	9-Month Follow-Up n (%) (N=8591)	12-Month Follow-Up n (%) (N=8135)	Aggregated Across Follow-Ups n (%) (N=54 614)
Virginia Tobacco	471 (70.7)	420 (68.1)	427 (73.7)	420 (77.5)	467 (75.0)	437 (76.7)	2642 (73.5)
Mint	3168 (83.7)	3238 (84.5)	3342 (84.6)	3743 (85.7)	4311 (84.4)	4282 (84.7)	22084 (84.6)
Mango	2892 (83.4)	2826 (82.7)	2725 (84.3)	1733 (82.9)	1302 (82.9)	1125 (83.8)	12603 (83.4)
Creme	580 (79.2)	473 (78.3)	431 (77.8)	276 (76.0)	250 (77.2)	208 (82.2)	2218 (78.4)
Fruit	381 (78.9)	375 (80.1)	342 (81.2)	254 (84.7)	209 (81.0)	179 (81.4)	1740 (80.9)
Cucumber	496 (82.7)	486 (79.9)	430 (79.9)	294 (81.0)	216 (80.3)	179 (78.5)	2101 (80.6)
Classic Tobacco	36 (48.6)	35 (49.3)	51 (60.0)	56 (58.9)	57 (63.3)	74 (65.5)	309 (58.5)
Menthol	156 (70.0)	184 (78.3)	174 (71.9)	220 (77.7)	262 (75.1)	255 (72.4)	1251 (74.3)

Note: Primary Flavor = "Which JUULpod flavor have you used most often in the past 30 days? (Check one)."
Past 30-day abstinence from combustible cigarette smoking = "In the past 30 days, have you smoked a cigarette, even one or two puffs?"
Aggregated Across Follow-Ups = Sum across 1-month, 2-month, 3-month, 6-month, 9-month and 12-month follow-up assessments.

Table 3: Associations of Primary JL ENDS Used in Past 30 Days and Past 30-Day Combustible Cigarette Smoking Across Follow-Up Among Never Established Smokers

Regressor – Primary Flavor	Past 30-Day Smoking OR (95% CI)
Virginia Tobacco	*Ref*
Mint	0.68 (0.62, 0.75)
Mango	0.69 (0.62, 0.76)
Creme	0.85 (0.75, 0.97)
Fruit	0.78 (0.68, 0.89)
Cucumber	0.71 (0.62, 0.82)
Classic Tobacco	1.38 (1.13, 1.67)
Menthol	0.94 (0.82, 1.09)
Time Effects	
Time	0.98 (0.97, 0.99)

Note: N=14 275 participants; 54 614 observations.
Primary Flavor = "Which JUULpod flavor have you used most often in the past 30 days? (Check one)."

Table 4: Primary JL ENDS Flavor, Sociodemographics and Smoking Characteristics of Never Established Smokers

Variable	N (%) or Mean (SD)	Available No.[c]
Primary JL ENDS Flavor[a]		—
Virginia Tobacco	3597 (6.6)	
Mint	26 101 (47.8)	
Mango	15 118 (27.7)	
Creme	2830 (5.2)	
Fruit	2150 (3.9)	
Cucumber	2606 (4.8)	
Classic Tobacco	528 (1.0)	
Menthol	1684 (3.1)	
Sociodemographic Characteristics[b]		
Age, yr, *Mean (SD)*	25.67 (8.28)	14275
Sex		14174
Male	8713 (61.5)	
Female	5368 (37.9)	
Transgender	93 (0.7)	
Race/Ethnicity		13185
Non-Hispanic White	8939 (67.8)	
Non-Hispanic African-American	695 (5.3)	
Non- Hispanic Asian	867 (6.6)	
Non- Hispanic Other Race	718 (5.4)	
Hispanic Ethnicity	1966 (14.9)	
Marital Status		13880
Married	1793(12.9)	
Divorced, Separated or Widowed	839 (6.0)	
Never Married	11 248 (81.0)	
Highest Level of Education Completed		12525
High school graduate or less education	4334 (34.6)	
Some college or associate degree	5080 (40.6)	
Bachelor's degree or more education	3111 (24.8)	
Smoking Characteristics[b]		
Ever Smoked in Lifetime	10 591 (74.2)	14275

Note: [a]N=54 614 observations; [b]N=14 275 participants.
[c]Number of participants or observations with (non-missing) data available for the respective variable and denominators for percentages reported for categorical variables.

Table 5: Associations of Primary JL ENDS Flavor Use and Covariates with Past 30-Day Smoking Across Follow-Up Among Never Established Smokers

Regressor	Past 30 - Day Smoking OR (95%CI)
Virginia Tobacco	*Ref*
Mint	0.76 (0.68, 0.85)
Mango	0.73 (0.65, 0.81)
Creme	0.85 (0.74, 0.98)
Fruit	0.82 (0.70, 0.96)
Cucumber	0.80 (0.68, 0.93)
Classic Tobacco	1.34 (1.09, 1.64)
Menthol	0.99 (0.84, 1.16)
Time Effects	
Time	0.98 (0.97, 1.00)
Sociodemographic Covariates	
Age	1.03 (1.02, 1.03)
Sex	
Male	*Ref*
Female	1.06 (0.98, 1.14)
Transgender	1.20 (0.82, 1.76)
Race/Ethnicity	
Non-Hispanic White	*Ref*
Non-Hispanic African-American	0.90 (0.75, 1.08)
Non-Hispanic Asian	1.35 (1.17, 1.55)
Non-Hispanic Other Race	1.00 (0.85, 1.18)
Hispanic Ethnicity	1.05 (0.95, 1.17)
Marital Status	
Married	*Ref*
Divorced, Separated or Widowed	1.26 (1.05, 1.50)
Never Married	0.92 (0.81, 1.05)
Highest Level of Education Completed	
High school graduate or less education	*Ref*
Some college or associate degree	0.99 (0.91, 1.08)
Bachelor's degree or more education	0.87 (0.79, 0.96)
Smoking Covariates	
Ever Smoked in Lifetime	3.14 (2.82, 3.50)

Note: N=44 621observations. N=11 586 participants.

Conclusions

- At the 12-month follow-up assessment, past 30-day smoking abstinence rates were over 65% among primary users of all JL ENDS flavors.
- After adjustment for sociodemographic covariates and lifetime smoking, adult Never Established Smokers who used JL ENDS in non-tobacco (vs. tobacco) flavors were less likely to report past 30-day combustible cigarette smoking.
- Use of JL ENDS Classic Tobacco (vs. Virginia Tobacco) was associated with increased odds of past 30-day smoking.
- Future research among never smokers is needed to determine if this association is causal and to elucidate potential mechanisms underlying the association of ENDS use in non-tobacco (vs. tobacco) flavors and smoking.

References

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