Effect of Mentholated Cigarette Smoking on Use of Flavored JL ENDS and Switching Behavior

Nicholas I. Goldenson, PhD; Shivaani Prakash, MSc, PhD; Gem M. Le, PhD, MHS; Joshua G. Vose, MD, MBA; Erik M. Augustson, PhD, MPH
JUUL Labs, Inc. (San Francisco, CA)

Introduction

- Smoking mentholated (vs. non-mentholated) cigarettes is associated with increased levels of nicotine dependence and decreased rates of smoking cessation.[1]
- Use of electronic nicotine delivery systems (ENDS) has increased in recent years among adult smokers,[2] but there is little data examining differences by menthol smoking.
- This study examined if:

1. Adult smokers who use the JL ENDS (JUUL Labs, Inc.) and smoke mentholated cigarettes differ in demographics and smoking characteristics from those who smoke non-mentholated cigarettes.
2. Smoking mentholated (vs. non-mentholated) cigarettes is associated with past 30-day smoking abstinence ("switching") at 6-month follow-up.
3. The association of use of JL ENDS in flavors and switching differs among smokers of mentholated (vs. non-mentholated) cigarettes.

Methods

- Adult past 30-day smokers who recently purchased a JL ENDS Starter Kit (N=7,352) completed baseline, 1-month, and 6-month follow-up assessments.
- At baseline, participants reported whether they smoked mentholated cigarettes (yes/no).
- At the 1-month follow-up assessment, participants reported the JL ENDS flavor they used most often in past 30 days (recorded as tobacco; mint/menthol; non-tobacco/mint/menthol [NTM]), and past 30-day frequency and daily intensity of JL ENDS use and smoking.
- At the 6-month follow-up, participants reported if they had smoked in the past 30-days (yes/no).
- Differences in demographic, JL ENDS use, and smoking characteristics by mentholated cigarette smoking were assessed with chi-squared tests and one-way ANOVA.
- Logistic regression models assessed associations between:

1. Menthol cigarette smoking and likelihood of switching at 6-month follow-up.
2. Primary JL ENDS flavor used in the past 30-days at the 1-month follow-up and switching at 6-month follow-up stratified by menthol smoking status (mentholated vs. non-mentholated).

- Regression coefficients were exponentiated to obtain odds ratios (ORs) with 95% confidence intervals (CIs).

Results

- Participants who smoked mentholated (vs. non-mentholated) cigarettes were more likely to be younger (Mean age=30.1 vs. 33.2 years), female (51.6% vs. 42.7%), non-white (20.2% vs. 13.8%), use mint/menthol-flavored JL ENDS (46.0% vs. 17.3%), smoke fewer days per month (16.78 vs. 17.81), smoke fewer cigarettes/day (6.57 vs. 7.77) and report lower levels of cigarette dependence (44.57 vs. 45.75; *ps*<0.004; **Table 1**).
- Smoking mentholated (vs. non-mentholated) cigarettes at baseline was associated with greater unadjusted odds of switching at the 6 month follow-up (OR [95%CI] =1.19 [1.09, 1.31]; **Table 2**).
- After adjustment for sociodemographic and smoking covariates and JL ENDS flavor used at the 1-month follow-up, the association of mentholated cigarette smoking and switching was no longer significant (adjusted odds ratio: aOR [95% CI] = 1.03 [0.92, 1.15]; **Table 2**).
- Use of JL ENDS in NTM (vs. tobacco) flavors was associated with increased switching among non-menthol smokers (aOR [95% CI] = 1.22 [1.03, 1.45]) but not menthol smokers (aOR [95%CI] = 0.99 [0.71, 1.37]; **Table 3**).

Table 1: Sample Descriptive Characteristics by Mentholated Cigarette Smoking

Sociodemographic and Smoking Characteristics	Smoke Non-mentholated Cigarettes (N=4208)	Smoke Mentholated Cigarettes (N=3144)	Total (N=7352)	Difference (*p*)[a]
Age, *M* (*SD*)	33.24 (10.67)	30.12 (9.10)	31.91 (10.15)	<0.001
Sex				
Female	1784 (42.7)	1617 (51.6)		<0.001
Male	2374 (56.8)	1496 (47.8)		<0.001
Transgender	23 (0.6)	18 (0.6)		<0.001
Race/Ethnicity				
Hispanic	56 (1.4)	72 (2.3)	128 (1.8)	<0.001
African American	74 (1.8)	206 (6.7)	280 (3.9)	<0.001
White	3516 (86.2)	2445 (79.8)	5961 (83.5)	<0.001
American Indian	88 (2.2)	88 (2.9)	176 (2.5)	
Asian	324 (7.9)	221 (7.2)	545 (7.6)	
Pacific Islander	20 (0.5)	32 (1.0)	52 (0.7)	
College graduate (vs. less education)	1731 (44.7)	1067 (38.1)	2798 (41.9)	<0.001
Income > $50,000 (vs. less income)	2046 (58.2)	1548 (61.7)	3594 (59.7)	0.005
Baseline Smoking Characteristics				
Years regular smoker, yr, *M* (*SD*)	13.66 (10.55)	10.57 (8.78)	12.36 (9.96)	<0.001
Age started smoking regularly, yr, *M* (*SD*)	17.97 (3.41)	18.31 (3.79)	18.11 (3.58)	<0.001
Cigarette Dependence at baseline, *M* (*SD*)[b]	45.75 (17.29)	44.57 (17.00)	45.25 (17.17)	0.004
Smoking and JL ENDS Use at 30-Day Follow-Up				
Cigarettes/day, *M* (*SD*)	17.81 (11.05)	16.78 (10.87)	17.39 (10.99)	0.003
Days smoked in last month,d, *M* (*SD*)	7.77 (7.32)	6.57 (6.28)	7.28 (6.94)	<0.001
No. days vaped JL ENDS in past 30 days, *Mean* (*SD*)	25.26 (7.31)	25.55 (7.13)	25.38 (7.24)	0.09
No. vaping sessions per day, *Mean* (*SD*)	10.50 (11.46)	11.62 (12.95)	10.98 (12.13)	<0.001
Primary JL ENDS Flavor at 30-Day Follow-Up				
Use of JL ENDS in (Menthol/Mint) Flavor	729 (17.3)	1445 (46.0)	2174 (29.6)	<0.001
Use of NTM Flavor	2451 (58.2)	1495 (47.6)	3946 (53.7)	<0.001
Use of Tobacco Flavor	1028 (24.4)	204 (6.5)	1232 (16.8)	<0.001
Past 30-day smoking abstinence at 180-day follow-up	1971 (46.8)	1610 (51.2)	3581 (48.7)	<0.001

Note: N=7,352.
Denominators may be less than totals in column heads due to missing data.
[a]Tests of differences in sample characteristics by menthol smoking status were conducted with χ^2 tests for categorical variables and 1-way ANOVA for continuous variables.
[b]Cigarette dependence was assessed with 15-items from the Wisconsin Inventory of Smoking Dependence Motives[3] and Nicotine Dependence Symptom Scale[4] that was validated in the PATH study[5] (Range: 15-75).

JLI Science

Table 2: Association of Smoking Mentholated Cigarettes and Switching at 6-Month Follow-Up.

Regressor	OR Unadjusted	OR Adjusted[a]	OR Adjusted[b]
Smoke Non-mentholated Cigarettes	*Ref*	*Ref*	*Ref*
Smoke Mentholated Cigarettes	1.19 (1.09, 1.31)	1.13 (1.03, 1.25)	1.03 (0.92, 1.15)

Note: N=7,352.
[a]Adjusted for JL ENDS flavor used at 30-day follow-up assessment.
[b]Adjusted for JL ENDS flavor used at 30-day follow-up assessment, Age, Sex, Race/Ethnicity, Income, Education level, Years regular smoker, Age started smoking regularly, Cigarette dependence at baseline, Cigarettes smoked/day at 30-day follow-up, Days smoked in last month at 30-day follow-up, JL ENDS sessions/day at 30-day follow-up, Days used JL ENDS in last month at 30-day follow-up.

Table 3: Association of Flavored JL ENDS Use and Switching at 180-day follow-up stratified by Smoking Mentholated Cigarettes.

Primary JL ENDS Flavor	OR Unadjusted	OR Adjusted[a]
Smoke Non-mentholated Cigarettes		
Tobacco	*Ref*	*Ref*
Menthol/Mint	1.49 (1.23, 1.81)	1.13 (0.91, 1.40)
Non-Tobacco/Mint/Menthol	1.37 (1.19, 1.59)	1.22 (1.03, 1.45)
Smoke Mentholated Cigarettes		
Tobacco	*Ref*	*Ref*
Menthol/Mint	1.01 (0.75, 1.35)	1.02 (0.73, 1.41)
Non-Tobacco/Mint/Menthol	1.06 (0.79, 1.41)	0.99 (0.71, 1.37)

Note: N=7,352.
[a]Adjusted for Age, Sex, Race/Ethnicity, Income, Education level, Years regular smoker, Age started smoking regularly, Cigarette dependence at baseline, Cigarettes smoked/day at 30-day follow-up, Days smoked in last month at 30-day follow-up, JL ENDS sessions/day at 30-day follow-up, Days used JL ENDS in last month at 30-day follow-up.

Conclusions

- Over 75% of participants, smokers of mentholated and non-mentholated cigarettes, reported using JL ENDS in non-tobacco flavors.
- Adult JL ENDS users who smoked mentholated cigarettes significantly differed from non-mentholated smokers in their sociodemographic and smoking characteristics.
- After controlling for sociodemographic, smoking and JL ENDS use covariates, smoking menthol cigarettes was not associated with higher switch rates at the 6-month follow-up assessment.
- Use of NTM-flavors was associated with switching for smokers of non-mentholated (but not mentholated) cigarettes, suggesting that ENDS in non-tobacco flavors may be important for this group.

References

1. Villanti AC, Collins LK, Niaura RS, Gagosian SY, Abrams DB. Menthol cigarettes and the public health standard: a systematic review. BMC Public Health. 2017;17(1):983.
2. Bao W, Xu G, Lu J, Snetselaar LG, Wallace RB. Changes in Electronic Cigarette Use Among Adults in the United States, 2014-2016. Jama. 2018;319(19):2039-2041.
3. Smith SS, Piper ME, Bolt DM, et al. Development of the Brief Wisconsin Inventory of Smoking Dependence Motives. Nicotine Tob Res. 2010;12(5):489-499.
4. Shiffman S, Waters A, Hickcox M. The nicotine dependence syndrome scale: a multidimensional measure of nicotine dependence. Nicotine Tob Res. 2004;6(2):327-348.
5. Strong DR, Pearson J, Ehlke S, et al. Indicators of dependence for different types of tobacco product users: Descriptive findings from Wave 1 (2013-2014) of the Population Assessment of Tobacco and Health (PATH) study. Drug Alcohol Depend. 2017;178:257-266.