

Letters

RESEARCH LETTER

Flavors of e-Cigarettes Used by Youths in the United States

Adolescent e-cigarette use has increased substantially since 2016.¹ To counteract such trends, public health agencies are considering regulatory restrictions of e-cigarettes in flavors popular among youths.^{2,3}



Related article page 2095

Whether certain flavors warrant inclusion or exemption from regulatory policies is unclear because recent estimates of the specific e-cigarette flavors adolescents use are lacking.

The myriad e-cigarette products available has complicated flavor preference research. JUUL's e-cigarette product, which has 8 flavor options, constituted 75% of all US e-cigarette sales in late 2018.⁴ This study estimated the prevalence of JUUL e-cigarette flavors used among US youths in 2019.

Methods | The Monitoring the Future (MTF) study surveyed nationally representative samples of US 8th-grade (response rate, 87%), 10th-grade (86%), and 12th-grade (80%) students from February 13 to June 3, 2019.¹ By design, every student had a 1-in-3 probability of being randomly assigned a module containing JUUL questions presented via tablet accompanied by pictures of JUUL devices. Weighted prevalences (with 95% CIs) of responses to "Which JUUL flavor do you use most often?" (forced-choice options; see **Figure**) were analyzed among past 30-day JUUL users by grade and further stratified by past 30-day use frequency (<20 vs ≥20 days). Analyses used Stata MP version 15.1 software (StataCorp) with "svy:" commands to account for MTF's complex sampling design. The University of Michigan Institutional Review Board ap-

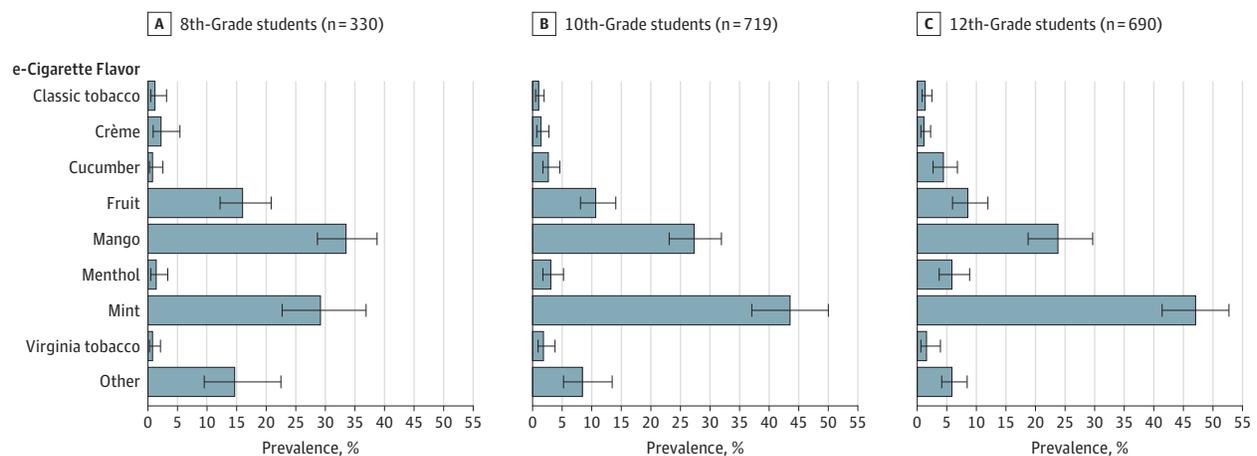
proved the study. Informed consent (active or passive, per school policy) was obtained from parents for students younger than 18 years and from students aged 18 years or older.

Results | Among all 42 531 MTF respondents, 14 191 (33.36%) were administered the JUUL module, of whom 18.8% reported past 30-day vaping of any nicotine product and 12.6% reported using JUUL (7% in 8th grade, 15% in 10th grade, and 16% in 12th grade). The analytic sample included 1739 past 30-day JUUL users with flavor preference data (50% female; 5.0% black; 11.3% Hispanic; 2.3% Asian; 63.9% white; and 17.6% other race/ethnicity).

Among 8th-grade past 30-day JUUL users (n = 330), the flavors most often used were mango (33.5%; 95% CI, 28.7%-38.7%), mint (29.2%; 95% CI, 22.7%-36.8%), fruit (16.0%; 95% CI, 12.1%-20.9%), and other (14.8%; 95% CI, 9.4%-22.6%) (Figure). In 10th grade (n = 719), mint (43.5%; 95% CI, 37.1%-50.1%), mango (27.3%; 95% CI, 23.1%-31.9%), fruit (10.8%; 95% CI, 8.1%-14.1%), and other (8.4%; 95% CI, 5.2%-13.4%) flavors were most popular. In 12th grade (n = 690), mint (47.1%; 95% CI, 41.5%-52.8%), mango (23.8%; 95% CI, 18.8%-29.7%), fruit (8.6%; 95% CI, 6.0%-12.0%), and other (6.0%; 95% CI, 4.3%-8.4%) flavors were most popular. In all grades, remaining flavors had prevalences less than 6.0%, including tobacco-related flavors (<2.0%) (Figure). Flavor preferences were generally similar across youths who used JUUL on 20 or more vs fewer than 20 days in the past month, although the relative popularity of the mint flavor was more pronounced among more frequent users (Table).

Discussion | In this sample of US youths who self-reported using JUUL e-cigarettes in 2019, mint was the most popular flavor

Figure. Flavor Used Most Often Among US Youths, Past 30-Day JUUL e-Cigarette Users



Weighted prevalence estimates of forced-choice responses to "Which JUUL flavor do you use most often?" The "other" category did not specify any flavor and could represent various flavors compatible with the JUUL device made by manufacturers other than JUUL Labs. Error bars indicate 95% CIs.

Table. Flavor Used Most Often Among US Youths, Past 30-Day JUUL e-Cigarette Users, Stratified by JUUL Use Frequency

Flavor	Flavor Most Often Used, Weighted % (95% CI) ^a	
	Youths Using JUUL <20 d	Youths Using JUUL ≥20 d
8th Grade		
No. of respondents	259	71
Classic tobacco	0.7 (0.2-3.0)	3.5 (1.0-11.0)
Crème	2.8 (1.1-6.9)	0 ^b
Cucumber	0.3 (0.04-2.2)	2.7 (0.6-10.6)
Fruit	16.0 (12.4-20.3)	16.4 (8.6-29.0)
Mango	36.7 (30.9-42.9)	21.1 (13.3-31.7)
Menthol	1.7 (0.7-4.2)	0 ^b
Mint	26.1 (19.8-33.6)	41.7 (30.3-54.0)
Virginia tobacco	0.9 (0.3-2.7)	0 ^b
Other ^c	14.9 (9.2-23.1)	14.7 (5.8-32.7)
10th Grade		
No. of respondents	532	187
Classic tobacco	1.1 (0.5-2.3)	0.9 (0.2-3.5)
Crème	1.7 (0.9-3.0)	0.8 (0.2-3.7)
Cucumber	2.7 (1.4-4.9)	2.9 (1.2-6.7)
Fruit	13.6 (10.1-18.0)	3.2 (1.5-7.0)
Mango	28.0 (23.4-33.2)	25.5 (18.6-33.7)
Menthol	2.4 (1.2-4.4)	4.8 (2.6-8.9)
Mint	40.2 (33.4-47.5)	52.1 (43.9-60.2)
Virginia tobacco	1.8 (0.6-5.0)	1.8 (0.8-4.1)
Other ^c	8.6 (5.6-13.0)	7.9 (3.0-19.4)
12th Grade		
No. of respondents	463	227
Classic tobacco	0.9 (0.5-1.8)	2.4 (1.1-5.4)
Crème	1.4 (0.7-2.9)	0.9 (0.2-3.7)
Cucumber	4.1 (2.5-6.8)	4.9 (1.9-12.0)
Fruit	11.1 (7.8-15.6)	3.8 (1.8-7.6)
Mango	26.3 (21.1-32.2)	19.2 (13.3-27.0)
Menthol	3.8 (2.1-7.0)	9.8 (6.2-15.1)
Mint	43.9 (37.6-50.4)	53.1 (45.3-60.9)
Virginia tobacco	1.5 (0.6-3.8)	1.8 (0.6-4.9)
Other ^c	7.0 (4.3-11.1)	4.1 (2.2-7.6)

^a Estimates are weighted percentages of forced-choice responses to "Which JUUL flavor do you use most often?" by category of self-reported number of days that respondent used JUUL in the past 30 days.

^b Confidence intervals not estimated because no respondents selected the respective flavor.

^c The "other" category did not specify any flavor and could represent various flavors compatible with the JUUL device made by manufacturers other than JUUL Labs.

in 12th and 10th grades and the second most popular in 8th grade. The 2015-2016 Population Assessment of Tobacco and Health (PATH) study found that among US youths who used a single flavor of e-cigarettes in the past 30 days, 10.8% reported using mint or menthol.⁵ In both 2015-2016 PATH youths⁵ and the current sample, tobacco-related e-cigarette flavors were unpopular and fruit-related flavors were popular.

Study limitations include generalizability only to JUUL users, lack of assessment of additional flavors used other than

respondents' first-choice preferences, potential for reporting error, and that youths who dropped out or were absent from school were not surveyed.

The US Food and Drug Administration is considering regulatory restrictions on the sale of flavored e-cigarettes but does not currently have any policies that prohibit sales of flavored e-cigarettes. Some local municipalities have prohibited sales of e-cigarettes in flavors other than mint, menthol, and tobacco or prohibited sales of all nontobacco flavors.³ JUUL voluntarily suspended sales of their product in flavors other than tobacco, menthol, or mint by some retailers.⁶ The current findings raise uncertainty whether regulations or sales suspensions that exempt mint flavors are optimal strategies for reducing youth e-cigarette use.

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Trends in Infant Pertussis Hospitalizations in the United States, 2009-2017

Pertussis infection can cause serious complications, particularly among infants younger than 2 months, who are too young to be vaccinated.¹ To reduce pertussis morbidity and mortality among young infants, the Advisory Committee on Immunization Practices (ACIP) issued a series of recommendation changes regarding antenatal administration of the tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) vaccine, the most recent of which was issued in 2012 and recommends administration in every pregnant woman, regardless of prior receipt.² Pertussis incidence among US infants younger than 1 year decreased after 2012³; however, data on trends in young infants are scarce. We examined trends in pertussis hospitalizations among infants younger than 2 months before and after the changes to the ACIP recommendations in 2012.

Methods | We used data from the Truven Health Analytics MarketScan Commercial databases, which contain deidentified patient-level data for individuals enrolled in US employer-sponsored private health insurance.⁴ The database includes all 50 states and is generally reflective of the privately insured population. We identified infants with a birth hospitalization occurring between January 1, 2009, and October 31, 2017, using *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* diagnosis codes (V30.xx-V39.xx) and *International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM)* diagnosis codes (Z38.xx). Because infant age in months was not available, we assigned the birth hospitalization admission date as the infant's date of birth. Infants who were not enrolled for at least 59 days after birth were excluded. We were unable to identify infant deaths.

The outcome of interest was pertussis hospitalization occurring between the date of birth and 2 months (60 days) of age. We defined a pertussis hospitalization as an inpatient admission with report of a pertussis-related code (*ICD-9-CM* code 033.0 or 033.9 or *ICD-10-CM* code A37.0x or A39.0x).

We calculated monthly pertussis hospitalization rates by dividing the total number of hospitalizations with a pertussis

Table. Characteristics of Infants in the Study Population, 2009-2017

	Year of Birth, No. (%)									
	2009	2010	2011	2012	2013	2014	2015	2016	2017 ^a	2017 ^a
Total No.	250 813	261 196	277 142	271 507	208 293	211 987	157 144	160 588	123 222	123 222
Sex										
Male	129 098 (51.5)	134 310 (51.4)	142 998 (51.6)	139 941 (51.5)	107 898 (51.8)	109 004 (51.4)	81 497 (51.9)	83 031 (51.7)	63 685 (51.7)	63 685 (51.7)
Female	121 715 (48.5)	126 886 (48.4)	134 144 (48.4)	131 566 (48.5)	100 395 (48.2)	102 983 (48.6)	75 647 (48.1)	77 557 (48.3)	59 537 (48.3)	59 537 (48.3)
Region of residence										
Northeast	49 942 (19.9)	52 642 (20.1)	58 255 (21.0)	55 844 (20.6)	43 821 (21.0)	51 764 (24.4)	30 970 (19.7)	30 009 (18.7)	24 428 (19.8)	24 428 (19.8)
North central	79 595 (31.7)	75 270 (28.8)	83 129 (30.0)	76 691 (28.2)	53 404 (25.6)	53 058 (25.0)	38 869 (24.7)	42 778 (26.6)	33 273 (27.0)	33 273 (27.0)
South	77 000 (30.7)	91 693 (35.1)	93 129 (33.6)	93 786 (34.5)	70 115 (33.7)	69 222 (32.6)	59 322 (37.7)	61 429 (38.2)	46 465 (37.7)	46 465 (37.7)
West	32 381 (12.9)	35 574 (13.6)	38 604 (13.9)	42 298 (15.6)	37 096 (17.8)	34 303 (16.2)	27 236 (17.3)	25 517 (15.9)	18 334 (14.9)	18 334 (14.9)
Unknown	11 895 (4.7)	6017 (2.3)	4025 (1.4)	2888 (1.1)	3857 (1.8)	3640 (1.7)	747 (0.5)	855 (0.5)	722 (0.6)	722 (0.6)

^a Excludes infants born after October 31, 2017, to allow for 60 days of follow-up.