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Author manuscript

Tob Control. Author manuscript; available in PMC 2017 November 01.

Published in final edited form as:

Tob Control. 2016 November ; 25(Suppl 2): ii62–ii66. doi:10.1136/tobaccocontrol-2016-053174.**Adolescents' Interest in Trying Flavored E-Cigarettes**J.K. Pepper^{1,2}, K.M. Ribisl^{1,3}, and N.T. Brewer^{1,3}¹Department of Health Behavior, Gillings School of Global Public Health, University of North Carolina, Chapel Hill, NC, USA²RTI International, Research Triangle Park, NC, USA³Lineberger Comprehensive Cancer Center, University of North Carolina, Chapel Hill, NC, USA**Abstract**

Background—More U.S. adolescents use e-cigarettes than smoke cigarettes. Research suggests flavored e-cigarettes appeal to youth, but little is known about perceptions of and reasons for attraction to specific flavors.

Methods—A national sample of adolescents ($n=1,125$) ages 13-17 participated in a phone survey from November 2014-June 2015. We randomly assigned adolescents to respond to survey items about 1 of 5 e-cigarette flavors (tobacco, alcohol, menthol, candy, or fruit) and used regression analysis to examine the impact of flavor on interest in trying e-cigarettes and harm beliefs.

Results—Adolescents were more likely to report interest in trying an e-cigarette offered by a friend if it were flavored like menthol (OR=4.00, 95% CI 1.46-10.97), candy (OR=4.53, 95% CI 1.67-12.31), or fruit (OR=6.49, 95% CI 2.48-17.01) compared to tobacco. Adolescents believed that fruit-flavored e-cigarettes were less harmful to health than tobacco-flavored e-cigarettes ($p<.05$). Perceived harm mediated the relationship between some flavors and interest in trying e-cigarettes. A minority believed that e-cigarettes did not have nicotine (14.6%) or did not know whether they had nicotine (3.6%); these beliefs did not vary by flavor.

Discussion—Candy, fruit, and menthol-flavored e-cigarettes appeal to youth more than tobacco or alcohol-flavored, but the appeal is only partially explained by beliefs about reduced harm. Given adolescents' interest in trying e-cigarettes with certain flavors, policymakers should consider restricting advertisements promoting flavored products in channels that reach large numbers of young people. Future research should examine other reasons for the appeal of individual flavors, such as novelty and perceived prestige.

Keywords

e-cigarettes; adolescents; flavored tobacco products; perceived risk

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COMPETING INTERESTS: None.

INTRODUCTION

According to industry documents, cigarette manufacturers have long known that flavored products appealed to youth and have used flavors to target young people.[1] Flavors influence smoking initiation, increase smoking progression by masking the harsh taste of tobacco products, [1] and are particularly appealing to younger users.[2-4] Most adolescents who have experimented with tobacco products began with flavored products.[4] The Food and Drug Administration (FDA) Center for Tobacco Products banned the sale of flavored cigarettes (other than menthol) in the U.S. in 2009,[5] but in recently released deeming regulations, FDA did not extend the flavor ban to e-cigarettes.[6]

The availability and variety of flavors may be playing a role in the surging popularity of e-cigarettes. The National Youth Tobacco Survey (NYTS) shows that past 30 day use of e-cigarettes among high school students increased from 2% in 2011 to 13% in 2014.[7] Middle school students use rates for e-cigarettes rose from <1% to 4% over the same period. [7] E-cigarette liquids come in thousands of flavors,[8] and flavored e-cigarettes are particularly popular with youth.[9] NYTS data also show that among youth who used tobacco in 2014, 63% (1.58 million) had used a flavored e-cigarette.[10] Moreover, a recent national survey found that 81% of youth ever-users of e-cigarettes initiated e-cigarette use with a flavored product.[4] In a study of 127 youth and young adults in focus groups, participants stated that after curiosity (54%), appealing flavors were the second most popular reason for experimentation (43%).[11] Flavored e-cigarettes are a public health concern not only because they may contribute to youth experimentation, but also because the chemicals that serve as flavorants pose their own health hazards.[12, 13]

With the exception of a handful of studies that used potentially problematic control groups or conditions,[14, 15] the emerging literature generally links flavored e-cigarettes and youth appeal.[9, 11] The purpose of our study is to examine interest in specific sweet and menthol flavors among a national sample of adolescents. Further, we wish to explore whether perceived harm mediates the relationship between flavors and interest in use and observe whether this relationship varies by specific flavor.

METHODS

Participants

From November 2014 to June 2015, the Carolina Survey Research Laboratory (CSRL) at the University of North Carolina recruited a probability sample of 1,125 U.S. adolescents for a telephone survey using random-digit-dial landline and cell phone frames. CSRL oversampled counties with higher prevalence of low-income respondents and cigarette smokers. To be eligible for the study, adolescents had to be ages 13-17 and speak English or Spanish. Interviewers first obtained verbal consent from adolescents' parents or guardians and then verbal assent from the adolescents. The response rate among adolescents was 66% (American Association for Public Opinion Research formula 4). The institutional review board at the University of North Carolina approved the study.

Procedures and Measures

Adolescents first heard the following description of e-cigarettes: “The next few questions are about electronic or e-cigarettes and other vaping devices, such as e-hookah and vape pens. Popular brands include Blu, Vuse, NJOY, and Flavor Vapes.” The computer-assisted telephone interviewing software then randomly assigned adolescents to 1 of 5 flavor conditions: “tobacco” (the control condition); “alcohol, like scotch or champagne”; “menthol”; “candy, like chocolate or vanilla”; or “fruit, like cherry or peach”. Adolescents responded about their interest in trying an e-cigarette in that flavor: “If one of your best friends were to offer you an e-cigarette or other vaping device with [flavor condition], would you use it?” We recoded their responses on this primary outcome variable so that a value of 0 corresponded to “definitely no” or “probably no” and a value of 1 corresponded to “definitely yes” or “probably yes.” We assessed their perceptions of health risks with the item “If you regularly used an e-cigarette or other vaping device with [flavor condition], how harmful to your health do you think it would be?” Response options were “not at all” (coded as 1), “moderately” (2), “very” (3), or “extremely” (4). In addition, we assessed adolescents’ perceptions of whether the product in their assigned flavor condition had any nicotine (“no” coded as 0 and “yes” as 1).

Demographic measures included sex, race/ethnicity, age, region, and mothers’ education (categories: high school or less; some college or Associate’s degree; Bachelor’s degree or more; and don’t know). We recoded to create 3 categories of e-cigarette users: never users, ever users (used 1 time but not in the past 30 days), and current users (used 1 time in the past 30 days). We did not exclude ever or current e-cigarette users as these young people could still have differing levels of interest in using particular flavors and beliefs about the harm of particular flavors. We similarly recoded smokers as never smokers, ever smokers (smoked 1 time but not in the past 30 days), and current smokers (smoked 1 time in the past 30 days).

Data Analysis

To check whether random assignment created demographically equivalent groups by flavor condition, we used chi square tests for categorical demographic variables (sex, race/ethnicity, region, mothers’ education, e-cigarette use, and cigarette smoking) and linear regression for the continuous demographic variable (age). Using logistic regression, we examined the effects of flavor condition on interest in trying e-cigarettes if offered by a friend and on beliefs about whether the e-cigarette contained nicotine. We used linear regression to assess the association between flavor and perceived harm. Tobacco flavor was the reference category in these three regressions. Next we assessed whether perceived harm mediated the relationship between flavor and interest in trying e-cigarettes and used a Sobel test to examine the significance of the mediation effect. In the mediation analysis, we used findings from the bivariate regression of interest on flavor to dichotomize flavor as menthol/candy/fruit vs. tobacco/alcohol. Finally, we conducted multivariable logistic regression of willingness to try e-cigarettes including flavor, perceived harm, cigarette smoking, e-cigarette use, and other demographic variables as predictors. We conducted analyses using Stata version 12. Regression coefficients are presented as odds ratios or standardized Betas. Analyses used two-tailed statistical tests and a critical α of 0.05.

RESULTS

Participants

Adolescents' mean age was 15.1 years, and half were female (Table 1). The majority of participants were non-Hispanic White (76%) and reported that their mothers had attended at least some college (65%). Most adolescents had never smoked cigarettes (89%) or used e-cigarettes (85%), but 4% were current smokers and 5% were current e-cigarette users.

Effects of Flavor Descriptor

Adolescents reported that, if offered by a friend, they were more likely try menthol (8.3%, OR = 4.00, 95% CI 1.46, 10.97), candy (9.3%, OR = 4.53, 95% CI 1.67, 12.31), or fruit-flavored e-cigarettes (12.8%, OR = 6.49, 95% CI 2.48, 17.01) compared to tobacco-flavored e-cigarettes (2.2%) (Figure 1). Interest in trying alcohol flavors (4.0%) and tobacco flavor did not differ. Adolescents perceived fruit-flavored e-cigarettes to be less harmful than tobacco-flavored ones (mean 2.71 vs. 2.87, $B = -0.08$, $p < .05$), but they did not view the other flavors as more harmful (alcohol = 3.00, menthol = 2.87, and candy = 2.78). Flavor was not associated with perceived presence of nicotine. A minority of participants reported that e-cigarettes, regardless of flavor, had no nicotine (14.6%), or they were not sure if e-cigarettes had nicotine (3.6%).

Mediation

Perceptions of e-cigarette harm partly explained (i.e., mediated) the relationship between flavor and interest in trying e-cigarettes if offered by a friend (Figure 2). Adolescents believed that menthol, candy, or fruit-flavor e-cigarettes were less harmful than tobacco or alcohol-flavored ones ($B = -0.15$, $p < .01$). Greater perceived harmfulness was associated with less interest in trying e-cigarettes (OR = 0.31, 95% CI 0.22, 0.43). Controlling for perceived harm reduced the association between flavor and interest in trying (Sobel $z = 2.84$, $p < .01$), and the association remained statistically significant (OR = 3.24, 95% CI 1.78, 5.90), a pattern of findings that indicates partial mediation.

Multivariable Predictors of Interest in Trying E-Cigarettes

In a multivariable regression, interest in trying e-cigarettes if offered by a friend was correlated with flavor condition (menthol, candy, or fruit vs. tobacco or alcohol) and perceived harm as reported above, as well as region, cigarette smoking, and e-cigarette use (Table 2). Compared to adolescents living in the Midwest (4.9% interested), adolescents living in the Northeast were more interested in trying e-cigarettes (8.4%; OR = 3.33, 95% CI 1.20, 9.22). Only 3.3% of never cigarette smokers were interested in trying e-cigarettes, compared to 30% of ever smokers (OR = 3.16, 95% CI 1.45, 6.89) and 63% of current smokers (OR = 7.82, 95% CI 2.86, 21.32). The pattern was similar for past e-cigarette use. Only 2% of never e-cigarette users were interested in trying e-cigarettes in the situation described (a particular flavor offered by a friend), whereas 31% of ever users (OR = 12.47, 95% CI 5.89, 26.41) and 57% of current users (25.75, 95% CI 10.30, 64.36) would try the product in that scenario. Sex, age, race/ethnicity, and mothers' education were not associated with interest in trying e-cigarettes if offered by a friend.

DISCUSSION

Among a national sample of U.S. adolescents, we found that adolescents were more interested in trying e-cigarettes described as having menthol, candy, or fruit flavors than tobacco or alcohol flavors. Belief that these sweet and menthol flavors of e-cigarettes were less harmful explained some of the difference in interest. Most adolescents believed that e-cigarettes, regardless of flavor, contain nicotine. However, around one in five adolescents did not believe or were unsure of whether e-cigarettes have nicotine, a potential cause for concern.

Interest in trying e-cigarettes was highest for fruit flavors, almost six times higher than interest in tobacco-flavored e-cigarettes. Although menthol and candy flavors were also more appealing than tobacco flavor, alcohol and tobacco did not differ. This equivalence may be related to the specific examples of alcohol that we provided (“like scotch or champagne”). Underage drinkers are most likely to drink malt beverages, beer, or specific brands of liquors.[16] Interest may have been higher if we had described alcoholic flavors that correspond to these products or brands (such as “Jack Daniel’s whiskey”). We suspect that our prior research on this topic did not find similarly elevated interest in candy and fruit flavors because our comparison group was unclear (i.e., “an e-cigarette” with no flavor specified) and far fewer adolescents were aware of or had experimented with e-cigarettes in 2011 than in 2014-2015.[7, 14]

Adolescents perceived that e-cigarettes with fruit flavors were less harmful than those with tobacco flavor. After controlling for other factors, they held similar beliefs about menthol and candy. Mediation analyses showed that perceived harmfulness explained some of the association between flavor and interest. Risk beliefs are a central predictor of many adult and adolescent health behaviors, including smoking.[17-19] An important developmental difference is that, although adults treat some high-risk behaviors as categorically off-limits, adolescents weigh the pros and cons of even very dangerous activities.[20] Thus, perceived harmfulness can help to explain interest in e-cigarette experimentation. As many adolescents misunderstand the risks of smoking,[21] perceived harmfulness may also potentially serve as a point of intervention to educate adolescents about the harms of nicotine-containing products, particularly among adolescents who are unsure about the presence of nicotine in e-cigarettes.

Strengths of our study include that we used an experimental design with a national probability sample of adolescents from the U.S. The experimental design allows for causal inference and mediation analysis. Limitations include that the description of e-cigarettes that our study used may not match current terminology, particularly given rapid development of new products in the marketplace. The phone survey mode prevented us from showing participants images of different models and brands of vaping devices to aid comprehension. While some respondents may not have fully understood the term menthol, interviewers offered an explanation if asked. Finally, our response rate was 66% and our sample had few smokers or e-cigarette users, although this is understandable given our focus on adolescents who are susceptible to initiation.

E-cigarettes remain in public health limbo as scientists try to understand their harm reduction potential. While we wait for this research to mature, adolescents are experimenting with e-cigarettes in increasing numbers,[7] and some physicians are even recommending e-cigarettes to adolescents as a way to quit smoking.[22] Additional research is needed to understand factors that generate adolescents' interest beyond flavor descriptors. These factors may include enticing e-liquid names (e.g., "Fairy Nectar"), novelty of flavors and packaging, and perceptions of luxury and prestige brands. The availability of and attraction to flavored e-cigarettes may contribute to product interest among adult cigarette smokers who can use e-cigarettes to quit smoking or engage in complete product substitution; thus, an outright ban on flavors could have adverse effects on overall harm reduction efforts. However, flavored e-cigarettes may also be contributing to surging rates of adolescent experimentation. This trend is troubling given that the nicotine in e-cigarettes can lead to addiction or cause problems in adolescent brain development.[23] An intriguing possibility is that some flavors may appeal to adults but not to youth, allowing for e-cigarettes to serve a vehicle for harm reduction (shaded quadrant in Figure 3). For example, it may be possible to pair tobacco flavor with other non-sweet flavors that have no youth appeal. In the meantime, the public health community should work to restrict advertisements that promote youth-targeted flavors in channels that reach large numbers of young people. Further, public health efforts should focus on restricting the accessibility of flavored tobacco products to youth (e.g., Chicago's ban on the sale of flavored tobacco products within 500 feet of schools)[24] and strongly enforcing new FDA regulations banning the sale of all e-cigarettes to minors. [6]

Acknowledgments

None.

FUNDING: Research reported in this manuscript was supported by grant number P50CA180907 from the National Cancer Institute and FDA Center for Tobacco Products (CTP). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH or the Food and Drug Administration.

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What this paper adds

- Prior research suggests substantial interest in flavored cigarettes and other flavored tobacco products among adolescents.
- Rising interest in e-cigarettes among youth may be partially related to the thousands of available flavors, despite the potential harmful effects of flavorants.
- Few national studies have examined adolescents' preferences among specific flavors or whether the mediators of the relationship between flavors and interest in use vary by specific flavor.
- This study demonstrates that adolescents are not equally interested in all non-tobacco flavors and that perceived harm is one driver of the relationship between some flavors and interest in use.

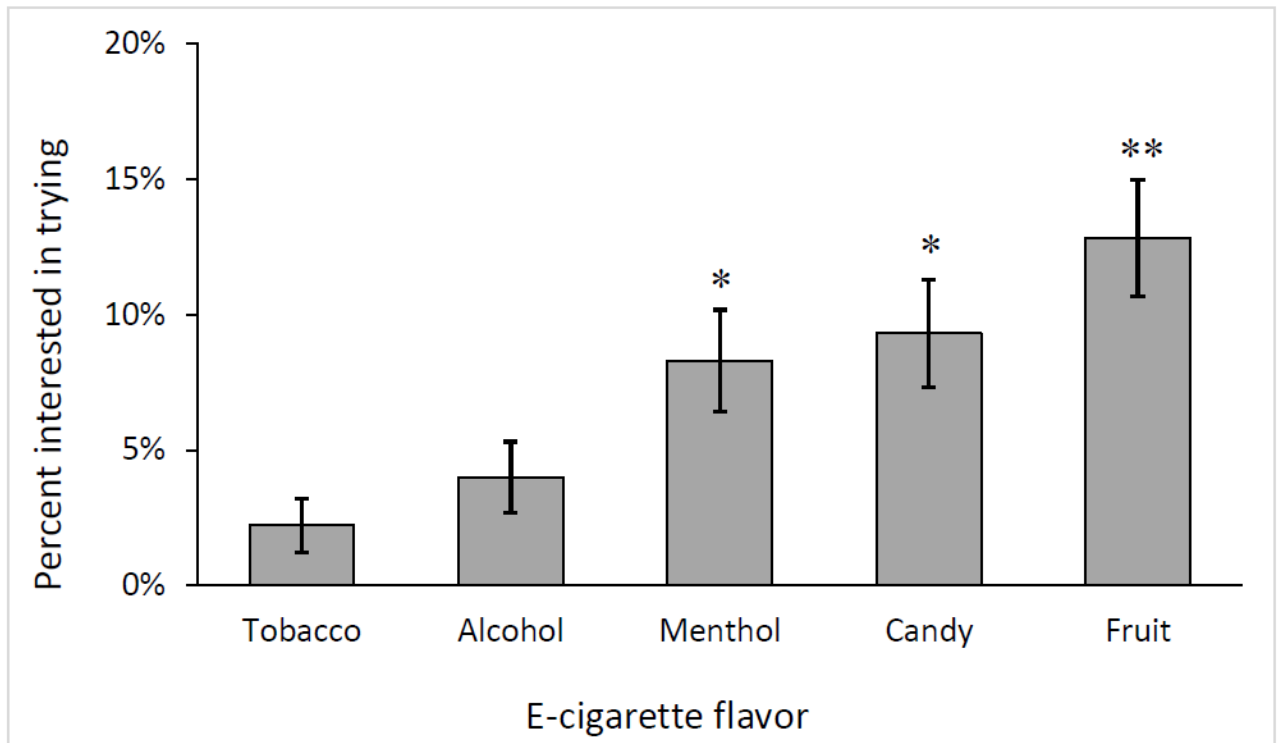


Figure 1. Interest in trying an e-cigarette if offered by a friend. Error bars show standard errors. * $p < .01$ and ** $p < .001$ different from tobacco flavor.

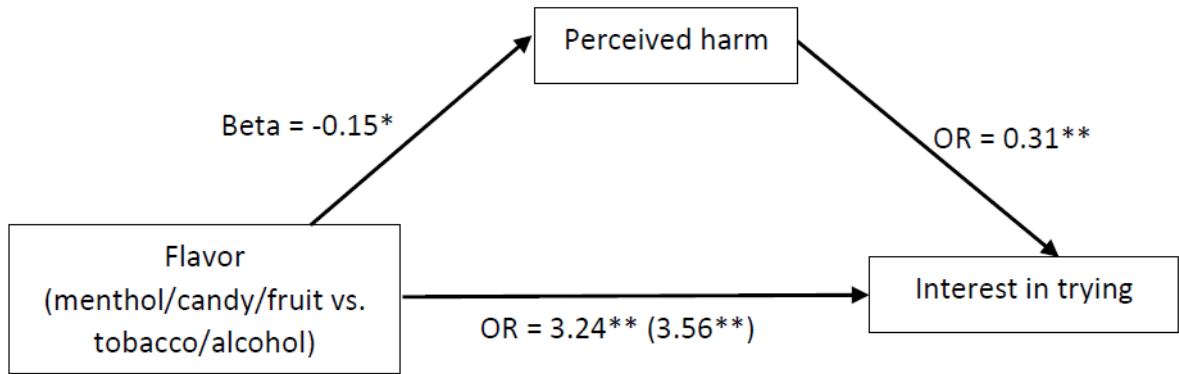


Figure 2.

Perceived harm mediates effect of flavor descriptors on interest in trying e-cigarettes.

Numbers in parentheses show the association between flavor and interest in trying before

controlling for perceived harm. Path values are standardized Betas or odds ratios. * $p < .01$,

** $p < .001$.

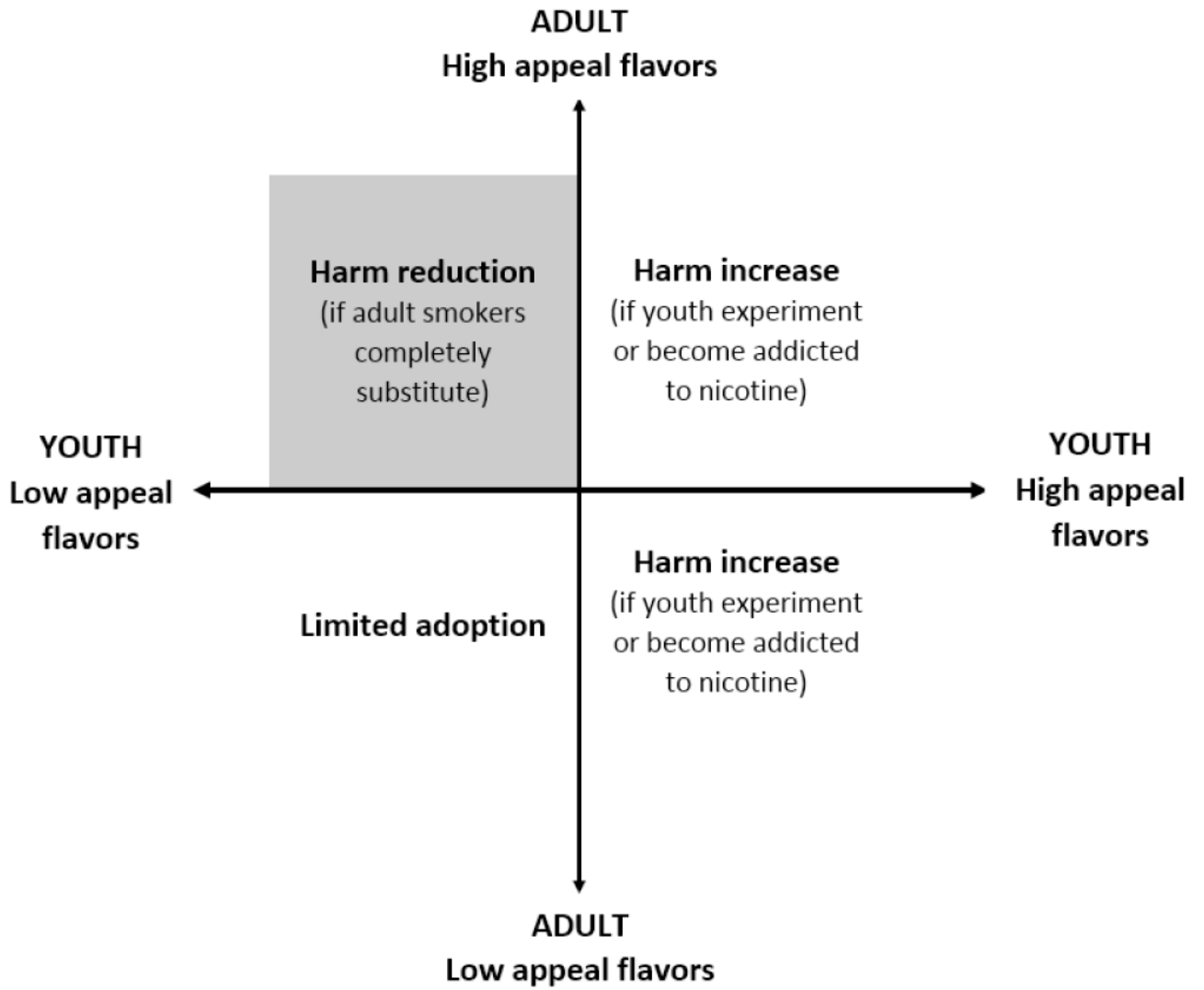


Figure 3. Ideal flavors for harm reduction among adult smokers and prevention of use among youth.

Table 1Participant Characteristics ($n=1,125$)

Characteristic	<i>n</i>	%
Sex		
Male	561	49.9
Female	564	50.1
Age: mean (sd)	15.1 (1.4)	
Race/Ethnicity		
Non-Hispanic White	859	76.4
Non-Hispanic other race	182	16.2
Hispanic	84	7.5
Mother's education		
High school or less	218	19.4
Some college or Associate's degree	186	16.5
Bachelor's degree or more	545	48.4
Don't know	176	15.6
Region		
Northeast	154	13.7
Midwest	285	25.3
South	545	48.4
West	141	12.5
Cigarette smoking		
Never smoker	1004	89.2
Ever smoker ^a	80	7.1
Current smoker ^b	41	3.6
E-cigarette use		
Never user	958	85.2
Ever user ^a	109	9.7
Current user ^b	58	5.2

Note. Missing values (<.1% of the sample) were recoded to mean or mode.

^a At least 1 time but not in past 30 days.

^b At least 1 time in past 30 days.

Table 2Correlates of interest in trying e-cigarettes if offered by a friend ($n=1,125$)

	Number interested / Total number in category	(%)	Multivariable correlates	
			OR	(95% CI)
Overall	83/1,125	(7.4%)		
Flavor				
Tobacco/alcohol (Ref)	14/451	(3.1%)	1.00	
Menthol/candy/fruit	69/674	(10.2%)	4.04	(1.89, 8.63)***
Perceived harm: mean (sd)	2.18	(0.65)	0.48	(0.31, 0.75)**
Sex				
Male (Ref)	41/561	(7.3%)	1.00	
Female	42/564	(7.5%)	1.68	(0.90, 3.12)
Age: mean (sd)	15.9	(1.15)	1.23	(0.94, 1.59)
Race/Ethnicity				
Non-Hispanic White (Ref)	65/859	(7.6%)	1.00	
Non-Hispanic other race	10/182	(5.5%)	0.99	(0.42, 2.33)
Hispanic	8/84	(9.5%)	1.14	(0.36, 3.60)
Mother's education				
High school or less (Ref)	20/218	(9.2%)	1.00	
Some college or Associate's degree	17/186	(9.1%)	1.16	(0.44, 3.05)
Bachelor's degree or more	37/545	(6.8%)	0.82	(0.35, 1.95)
Don't know	9/176	(5.1%)	1.35	(0.45, 4.08)
Region				
Midwest (Ref)	14/285	(4.9%)	1.00	
Northeast	13/154	(8.4%)	3.33	(1.20, 9.22)*
South	42/545	(7.7%)	1.23	(0.52, 2.92)
West	14/141	(9.9%)	2.17	(0.74, 6.34)
Cigarette smoking				
Never smoker (Ref)	13/1,004	(3.3%)	1.00	
Ever smoker ^a	24/80	(30.0%)	3.16	(1.45, 6.89)**
Current smoker ^b	26/41	(63.4%)	7.82	(2.86, 21.32)***
E-cigarette use				
Never user (Ref)	16/958	(1.7%)	1.00	
Ever user ^a	34/109	(31.2%)	12.47	(5.89, 26.41)***
Current user ^b	33/58	(56.9%)	25.75	(10.30, 64.36)***

Note. OR = odds ratio; CI = confidence interval; Ref = reference category.

^a At least 1 time but not in past 30 days.

^b At least 1 time in past 30 days.

* $p < .05$,

** $p < .01$,

 $p < .001$.

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