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Association between preference for using alcohol beverage-named e-liquids and alcohol use among high school youth

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Abstract

Background: There are thousands of e-liquid flavors available, and some are named after alcohol beverages (e.g., “pina colada”). It is unclear whether use of e-liquids with alcohol beverage names is associated with adolescent alcohol use. E-cigarettes and alcohol are co-used in adolescents; therefore, it is important to investigate these associations.

Methods: Eight Southeastern Connecticut high schools were surveyed in Spring 2015 (N = 7045). We examined the association between preference for using e-liquid flavors and alcohol drinking status (i.e., no past month alcohol use, past month alcohol use but no binge drinking, and past month binge drinking) in ever e-cigarette users (N = 1311).

Results: Among ever e-cigarette users who preferred using e-liquids with alcohol beverage names (N = 111), 30.6 % had no past month alcohol use, 19.8 % had past month alcohol use but did not binge drink in the past month, and 49.5 % binge drank in the past month. Multinomial logistic regression (controlling for demographics and including other e-cigarette flavors that were highly endorsed, i.e., fruit and candy) revealed that the preferences of alcohol beverage-named-e-liquid (OR: 2.84, CI: 1.70–4.75) and fruit flavored e-liquids (OR: 1.55, CI: 1.14–2.11), but not

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Contributors' statements

Dr. Jackson conceptualized the current study, contributed to interpretation of data, wrote the first draft and reviewed and revised the manuscript. Ms. Wu conducted data analysis, contributed to interpretation of data and helped with the initial first draft of manuscript. Dr. Haeny contributed to the interpretation of the data and critical editing of manuscript. Drs. Kong, Camenga, Morean, Simon, Bold and Krishnan-Sarin contributed to the conceptualization of the current study, survey item development, interpretation of data, and critical editing of the manuscript. All authors approved the final manuscript as submitted and agreed to be accountable for aspects of the work.

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candy flavored e-liquids was associated with past-month binge drinking compared to no past-month alcohol use.

Conclusion: This evidence suggests that the preference for using alcohol beverage- and fruit-named e-liquid flavors is associated with past-month binge drinking among adolescents. Understanding the associations between alcohol beverage-named e-liquids and alcohol use in adolescents may help inform tobacco regulatory strategies that aim to decrease the use/appeal of e-cigarettes.

Keywords

E-cigarette; Adolescents; Alcohol; Flavors

1. Introduction

E-liquids are available in thousands of flavors (e.g., mango, mint, vanilla; Zhu et al., 2014). Many of these flavors are appealing to youth because they have a sweet and fruity taste and they have unique names (Morean et al., 2018; Pepper et al., 2016; Rose et al., 2019; Soneji et al., 2019). Adolescents cite e-liquid flavors as a primary reason for using e-cigarettes (Kong et al., 2015). Central to the current study, many e-liquids come in a variety of flavors that are named after alcohol beverages (e.g., pina colada and strawberry daiquiri; Jackler et al., 2018; Krusemann et al., 2018). E-liquid flavors named after alcohol beverages may mislead adolescents to believe they are consuming alcohol or may influence youth to use alcohol beverages. Conversely, youth who drink alcohol may be more drawn to e-cigarettes with alcohol names.

Given that rates of adolescent use of e-cigarettes and alcohol beverages are high (Cullen et al., 2018; Substance Abuse and Mental Health Services Administration (SAMHSA, 2015), and alcohol and nicotine exposure have negative effects on the developing brain (Squeglia et al., 2015; Yuan et al., 2015), it is important to understand if there is a relationship between preference for alcohol beverage-named e-liquid flavors and actual alcohol use in adolescents. Therefore, this study aimed to examine the association between preference for alcohol beverage-named e-liquid flavors and past-month alcohol use outcomes (defined as past month alcohol use and past month binge drinking). We also controlled for use of fruit and candy e-liquid flavors, since these are the most popular e-liquid flavors used by youth (Harrell et al., 2017; Morean et al., 2018; Pepper et al., 2016), in order to isolate the association between alcohol beverage-named e-liquids and alcohol drinking. Understanding the associations between alcohol beverage-named e-liquids and alcohol use in adolescents is important to the Food and Drug Administration's goal of implementing regulatory strategies to decrease the use/appeal of e-cigarettes among youth.

2. Methods

2.1. Survey procedures and participants

Eight Southeastern Connecticut (CT) high schools (N = 7045) were surveyed in Spring 2015 (overall participation rate among those in attendance on the day of the survey: 83.8 %). Full methods for survey collection have been published previously (Bold et al., 2017; Krishnan-

Sarin et al., 2017). The Yale University Institutional Review Board and school administrators approved all study procedures.

2.2. Ever use of e-cigarettes

Participants who responded “yes” to “Have you ever tried an e-cigarette, even just one or two puffs?” were classified as e-cigarette ever users.

2.3. Preference for using e-liquid flavors

Participants were asked: “Which e-cigarette flavor do you prefer when you use e-cigarettes?” Participants selected all that applied from the following response options: “mint (spearmint, wintergreen, peppermint)”, “menthol”, “tobacco”, “fruit (cherry, blueberry, strawberry, coconut)”, “coffee (espresso, latte, cappuccino)”, “candy or dessert (chocolate, Jolly Rancher)”, “spice (clove, cinnamon, nutmeg)”, “vanilla”, “alcohol (pina colada, strawberry daiquiri, bourbon, rum, brandy)”, “other” and “I don’t know”.

2.4. Past month alcohol use

We created a 3-level variable to capture past-month alcohol use. The three variables were: no past month alcohol use, past month alcohol use but no binge drinking, and past month binge drinking. We created the 3-level variable using the following items: 1) “During the past 30 days, on how many days did you drink one or more alcohol beverages?” and 2) “During the past 30 days, how often did you have 5 or more drinks on one occasion?” Youth who indicated they had consumed alcohol at least once in the past month (Question 1) but who reported no binge drinking (Question 2), were classified as “past month alcohol users with no binge drinking.” Youth who indicated they had consumed 5 or more drinks on a single occasion at least once in the past month (Question 2) were classified as “past month binge drinkers.” Youth who indicated that they did not drink in the past 30 days (Question 1 or 2) were defined as having no past month alcohol use.

2.5. Statistical analysis

We performed a multinomial logistic regression to evaluate the association of past-month alcohol use (3-levels: no past-month alcohol use, past-month alcohol use but no binge drinking, and past-month binge drinking) and alcohol beverage-named e-liquid flavor preference, adding fruit-named and candy-named flavor preferences into the model as covariates. The model also controlled for demographics (age, race, sex). Chi-Square tests were utilized to examine univariate associations between the preference for using alcohol beverage-named e-liquid flavors with preference for using candy and fruit flavored e-liquids to quantify the overlap in endorsing these flavors. Analyses were based on available data and SAS version 9.4 was used. The alpha level for statistical significance was set at 0.05.

3. Results

The current analyses focused on a subsample of ($N = 1311$) youth who were e-cigarette ever users and had data on both e-liquid flavor preference and past month alcohol drinking. The analytic sample was 50.1 % male, 59.9 % White, 16.2 % Hispanic, 12.5 % Multi-race, 6.5 % Black, 2.4 % Other, 2.2 % Asian, with a mean age of 16.2 ($SD = 1.21$).

Of the 1311 e-cigarette ever users, 8.5 % (N = 111) reported that they preferred using alcohol beverage-named e-liquid flavors (top five e-liquid flavor preferences were: fruit (49.4 %), candy (25.7 %), vanilla (20.8 %), mint (12.5 %) and alcohol beverage-named (8.5 %). Other flavors were preferred below 8.5 %) and 50.8 % (N = 666) reported no past month alcohol use, 19.4 % (N = 254) reported past month alcohol use but no binge drinking, and 29.8 % (N = 391) reported past month binge drinking. In the sample of adolescents who preferred alcohol beverage-named e-liquid flavors, 88.3 % also reported that they preferred fruit-named flavors and 59.5 % preferred candy-named flavors. Furthermore, alcohol beverage-named e-liquid flavor preference was correlated with fruit-named ($X^2 = 73.26$, $p < .0001$) and candy-named ($X^2 = 72.35$, $p < .0001$) flavor preference.

Multinomial logistic regression (Table 1) revealed that preference for using alcohol beverage-named e-liquid flavor was associated with past month binge drinking compared to no past month alcohol use (OR: 2.84, CI: 1.70–4.75). The preference for using fruit-named e-liquids was also associated with past month binge drinking (OR: 1.55, CI: 1.14–2.11) but the preference for using candy-named e-liquids was not associated with past month binge drinking (OR: 1.25, CI: 0.89–1.77). Gender, race and age were also correlated with drinking (see Table 1). Additionally, a separate analysis using past month e-cigarette users revealed that preference for using alcohol beverage-named e-liquid flavor was associated with past month binge drinking as well (OR: 6.17, CI: 2.54–15.01).

4. Discussion

This study is the first to demonstrate that preference for using alcohol beverage-named e-liquid flavors in e-cigarettes is associated with past month binge drinking among youth. However, it is important to note that our evidence of an association between preference for using alcohol beverage-named e-liquids and alcohol consumption does not infer causality. It is possible that the adolescents in our sample that have a preference for alcohol drinking in general may have started using alcohol beverage named e-liquids prior to consuming alcohol because e-cigarettes are more accessible. Future longitudinal studies are needed to better inform if preference of alcohol beverage-named e-liquids leads to alcohol use behaviors or vice versa. Further, we focused on alcohol beverage-named e-liquids and did not actually examine alcohol levels in these e-liquids. While some e-liquids have been shown to contain ethyl alcohol as a constituent (Poklis et al., 2017) and impact psychomotor performance (Valentine et al., 2016), we do not know if the alcohol beverage-named e-liquid flavors actually contain alcohol. Future studies need to examine if youth are drawn to these e-liquids because of their alcohol-based names, flavors, or because of the actual alcohol content. Overall, the novel findings of this study suggest that high school students who prefer using alcohol beverage named e-liquids are 2.84 times more likely to binge drink alcohol than those who do not prefer using alcohol beverage named e-liquids.

We also observed that preference for fruit-named e-liquids was also associated with alcohol drinking outcomes among youth in our study. This association may exist because youth binge drinkers frequently consume alcohol beverages that are fruity (Naimi et al., 2016) and therefore may be drawn to fruit flavors in e-liquids. Given the popularity of candy-named flavors, it is unclear why preference for candy flavors was not associated with drinking

outcomes. It is possible that these differences may be related to that fact that many alcohol-beverage named e-liquids have fruits in their name or packaging. For example, flavors like “strawberry daiquiri” or “pina colada” (which also often show pictures of fruit on the packaging) may be considered under both fruit and alcohol e-liquid preference categories.

Future studies should investigate the association between the use or preference for flavored alcohol beverages and flavored e-cigarettes to fully understand the role flavors play in substance use in adolescents. In addition, future studies also need to consider the influence of other covariates such as peer alcohol use on the relationship between alcohol use and preference for alcohol beverage-named e-liquids. Further understanding of these factors is critical to the development of interventions and regulatory actions to prevent use of both substances.

Initiation of tobacco and alcohol use during adolescence is associated with increased risk for tobacco and alcohol use disorders in adulthood (Dawson et al., 2008; United States Department of Health and Human Services, 2014) as well as alcohol-related problems (Chung et al., 2018; Siqueira and Smith, 2015). Adolescent e-cigarette users are more likely to use alcohol in comparison to non-e-cigarette users (Wong and Fan, 2018) and to exhibit problematic drinking behavior such as binge drinking (Oh et al., 2019; Parikh and Bhattacharyya, 2018).

In summary, these novel findings suggest that preference for using alcoholic beverage-named e-liquid flavors and fruit flavors among adolescent e-cigarette users is associated with past-month binge drinking among youth. Regulatory actions that restrict the naming of e-liquids after alcohol beverages and fruits may be important to reduce the appeal of e-cigarettes among youth.

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Table 1

Demographics and e-liquid flavor preference associated with past month alcohol consumption.

		Past Month Alcohol Use OR(95%CI) (ref. no past month drinking)	Past Month Binge Drinking OR(95%CI) (ref. no past month drinking)
Flavor preference (ref. no preference for specific flavor)	Alcohol-named e-liquids	1.57 (0.84-2.92)	2.84 (1.70-4.75) ***
	Fruit e-liquids	1.25 (0.90-1.75)	1.55 (1.14-2.11) *
	Candy e-liquids	1.01 (0.69-1.51)	1.25 (0.89-1.77)
Demographic Covariates	Male (ref. female)	0.56 (0.41-0.77) **	1.19 (0.89-1.58)
	Asian (ref. White)	0.96 (0.35-2.62)	0.51 (0.16-1.66)
	Black (ref. White)	0.65 (0.35-1.20)	0.29 (0.14-0.61) *
	Hispanic (ref. White)	0.50 (0.32-0.79) *	0.62 (0.42-0.92) *
	Multi-race (ref. White)	0.49 (0.29-0.83) *	0.75 (0.49-1.15)
	Another race (ref. White)	0.94 (0.35-2.58)	0.64 (0.23-1.77)
	Age	1.26 (1.10-1.44) **	1.54 (1.37-1.75) ***

Notes:

*
< 0.05**
< 0.001***
< 0.0001.