Adolescent E-Cigarette Expectancies: Measure Development and Preliminary Validity of the Electronic Nicotine Vaping Outcomes Measure for Youth

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Paul T. Harrell[1,2], Kelli J. England[1,2], Tracey E. Barnett[3], Vani N. Simmons[4,5], Richard W. Handel[2] and Amy C. Paulson[1]

[1]Department of Pediatrics, Division of Community Health and Research, Eastern Virginia Medical School (EVMS), Norfolk, VA, USA. [2]Department of Psychiatry and Behavioral Sciences, EVMS, Norfolk, VA, USA. [3]Department of Biostatistics and Epidemiology, School of Public Health, University of North Texas Health Science Center, Fort Worth, TX, USA. [4]Department of Health Outcomes and Behavior, Moffitt Cancer Center, Tampa, FL, USA. [5]Department of Psychology, University of South Florida, Tampa, FL, USA.

ABSTRACT

BACKGROUND: Electronic nicotine delivery systems ("e-cigarettes") are the nicotine product most commonly used by adolescents. Research, treatment, and policy could benefit from measures of adolescent e-cigarette beliefs about outcomes of use (ie, expectancies). In the current study, we developed and tested an adolescent electronic nicotine vaping expectancy measure.

METHODS: A focus group with adolescents evaluated potential e-cigarette expectancy items. A panel of national experts assisted in revision of these items. Finally, items were administered to a sample of adolescents 14-17 years old (N = 267, *Mean age* 15.6, *SD* = 1.1, 50.9% Female, 50.2% Non-Hispanic White, 22.5% Non-Hispanic Black, 14.2% Hispanic) in a large Southeastern metropolitan area in the United States.

RESULTS: Exploratory Factor Analysis revealed a four factor solution: Negative Consequences (Cronbach's α = .92); Positive Reinforcement (α = .83); Negative Affect Reduction (α = .95); and Weight Control (α = .89). Subscales were significantly correlated with vaping susceptibility and lifetime vaping. Subscales successfully differentiated susceptible adolescents from confirmed non-susceptible adolescents, with susceptible adolescents reporting more positive expectancies, eg, Positive Reinforcement, M = 5.0, SD = 2.0 vs M = 3.0, SD = 2.1, P < .001, η^2 = 0.19, and less negative expectancies, M = 5.5, SD = 2.3 vs M = 6.5, SD = 2.6, P = .001, η^2 = 0.04. Similar results were found comparing adolescents who have never vaped nicotine with those who have vaped nicotine. Hierarchical linear regression demonstrated subscales were significant predictors of lifetime vaping after controlling for demographics, vaping ad exposure, and peer/family vaping.

CONCLUSIONS: A preliminary version of an adolescent expectancy measure appears reliable and valid based on expert input and pilot testing with adolescents. Promising results were found in the domains of concurrent validity, discriminant validity, and incremental validity. Future research and evaluation efforts will be able to use this tool to further prevention and treatment goals.

KEYWORDS: adolescent, e-cigarettes, expectancies, exploratory factor analysis, measure development, vaping

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CORRESPONDING AUTHOR: Paul T. Harrell, Department of Pediatrics, Division of Community Health and Research, Eastern Virginia Medical School, P.O. Box 1980, Norfolk, VA 23501, USA. Email: harrelpt@evms.edu

Introduction

Youth trajectories of tobacco use are of critical importance for the future of public health. Most tobacco use begins in adolescence.[1,2] and adolescents are particularly vulnerable to long-term tobacco use.[3-5] E-cigarettes are the tobacco product most commonly used by youth.[6,7] Despite declines in adolescent cigarette smoking in the United States, overall tobacco product use by high school students increased in recent years, particularly from 2017 to 2019,[8] largely fueled by JUUL,[9] particularly flavored products,[10] as well as other "pod mod" devices using protonated nicotine formulations with high levels of nicotine.[11-13]

Rates of current (past-month) e-cigarette use rose to over one in four 12th grade students in 2019,[10,14] declining in pre-COVID 2020 only after a media frenzy related to reported vaping associated lung injuries led to over 2000 hospitalizations and over 60 deaths before vitamin E acetate in THC formulations was identified as a primary cause.[15,16] Later in 2020, COVID-19 profoundly changed many aspects of adolescent lives, as lockdowns limited social interactions with peers. This likely reduced adolescent substance use,[17,18] as well as led to increases in mental health issues, such as anxiety and depression.[19] The epidemic of e-cigarette use is arguably now in an

endemic stage with high levels of nicotine vaping among youth, at similar rates to alcohol and marijuana.[7]

Understanding of adolescent e-cigarette use can be enhanced by theoretical models. The choice to vape is driven, at least, partially, by beliefs about the outcomes one expects from vaping. In Social Cognitive Theory and other frameworks, these beliefs are referred to as "expectancies."[20,21] Experimental evidence supports a causal role for expectancies in altering drug perceptions and sustaining use.[22-24] Precise measurements of expectancies are likely to be useful in addressing adolescent use patterns, while still maximizing any harm reduction potential, by supporting development of interventions to appropriately modify beliefs (eg, advertising, labelling requirements, policies).

Researchers have examined associations with measures modified from smoking expectancy questionnaires, most notably the Smoking Consequences Questionnaire (SCQ).[25] For example, the Smoking Consequences Questionnaire for E-cigarettes (SCQ-EC) used items from the adult version of the SCQ.[26] The SCQ-EC can be separated into positive and negative subscales[27]; these subscales significantly correlated with electronic nicotine delivery system (ENDS) dependence among a sample of adults who use e-cigarettes.[28] Other measures focused specifically on young adult populations and developed items through the use of focus groups and expert panel input, such as the Electronic Nicotine Vaping Outcomes (ENVO) scale; ENVO subscales of Positive Reinforcement, Negative Consequences, Negative Affect Reduction, and Weight Control significantly correlated with vaping susceptibility and lifetime vaping.[29]

Less is known about adolescent beliefs about e-cigarettes, despite the importance of this population for predicting long-term population health. Although there are existing measures that have been evaluated with adolescents,[30-32] we are aware of no e-cigarette expectancy measure that was developed specifically with adolescents. However, there is at least one cigarette smoking expectancy measure developed specifically for adolescents: the Adolescent SCQ.[33] This measure features several differences from adult measures, perhaps most notably the use of third person items, rather than first person items. These third person items theoretically allow for respondents with no personal experience with substance use to more easily provide their opinion on the effects. In the current paper, we used a similar approach to develop a questionnaire for e-cigarettes with a modern, contemporary sample of adolescents using a mixed-methods approach involving a focus group, expert feedback, surveys, and psychometric analysis.

Methods

Item development

Focus group. To initially assess youth perspectives on potential expectancy items and the third person format, a focus group was conducted with 6 adolescents at a local co-ed Young Men's Christian Association (YMCA) in Spring of 2017. Non-smoker status was bio-verified using a Vitalograph BreathCO monitor to measure exhaled breath and provide expired air carbon monoxide (eCO) concentration readings. Five of the adolescents provided an eCO reading of 1 parts per million (ppm); one provided an eCO reading of 0 ppm. Cut-points to distinguish general population smokers from non-smokers range from 4 ppm to 10 ppm.[34,35] The Society for Research on Nicotine and Tobacco (SRNT) Treatment Research Network recommends investigators select an appropriate cut-point within this range based on local smoke-free policies and level of air pollution.[35] Based on our assessment of these factors, we chose a cut-off of 6 ppm. Adolescents ranged from 13-18 years old (M = 15.3, SD = 2.1). Four identified as Male and two identified as Female. In terms of race and ethnicity, three of the adolescents identified as Non-Hispanic White, one identified as Non-Hispanic African American, one identified as Non-Hispanic Multiracial (African American and White), and one identified as Hispanic White. Written informed consent was provided by the parent or legally authorized representative and the adolescents provided written assent for focus group participation. This project was approved by the Eastern Virginia Medical School (EVMS) Institutional Review Board (IRB), approval number 16-10-EX-0227-EVMS.

Focus groups began with icebreakers that asked adolescents to indicate their favorite television show. Next, participants were asked to describe the first time they saw an e-cigarette being used. This was followed by questions asking about anticipated effects from using an e-cigarette. Adolescents were asked what effects they expected immediately after use, in the following weeks or months, in the next year, five or 10 years from now, and in a lifetime. In addition, further probes assessed for any positive effects, any negative effects, any personal effects, and any social effects related to e-cigarette use. Next, copies of the Adolescent Smoking Consequences Questionnaire were handed out.[33] Participants were asked what they thought about the questionnaire, specifically asking about the instructions, the question themes, the specific questions used, the third-person format, whether or not the questions would be useful in determining if adolescents were likely to start using e-cigarettes, and how the questions could be improved. As the focus group was designed to investigate generalizability of prior young adult e-cigarette focus group results and adolescent smoking expectancy items, theme saturation was not tested or assessed.

Expert panel delphi method. We established an expert panel of five doctoral-trained tobacco and ENDS experts to provide feedback. We used a modified Delphi Panel method to refine focus group content. The Delphi method is a structured group communication process used to establish consensus opinion by seeking mutual agreement from a group of experts.[36] Informed by the focus group and prior literature, we first drafted an adolescent e-cigarette expectancy item bank. Experts were e-mailed the draft of the item bank, as well as a summary of focus group feedback. The expert panel provided initial input that was used to refine the item list. This was followed by forms including proposed items and content validity questions. These

questions asked how the items related to predicting e-cigarette initiation and/or long-term usage. As is common practice with the Delphi method, experts were asked to rate the items as "Not relevant" (1), "Somewhat relevant" (2), "Quite relevant" (3), or "Very relevant" (4). Additional comments were also provided to allow further revisions. Finally, we conducted a group call to reach consensus on the items.

Survey

Participants and procedures. Survey items were then administered to a sample of adolescents along with related measures to examine concurrent and discriminant validity. Procedures received EVMS IRB approval, approval number 17-08-FB-0164-EVMS. Waiver of consent was approved by the IRB due to the provision of pertinent information to the adolescents, the research could not practicably be carried out without the waiver, the waiver did not adversely affect the rights and welfare of participants, and the research involved no more than minimal risk to the participants. Modified informed consent was provided by the adolescents at the beginning of the survey. Inclusion criteria involved the ages of 14-17. Exclusion criteria included any age outside of this range or not completing the survey. Data were collected from April to August, 2018. There were 79 participants who did not complete the expectancy survey. Only completers were included in the final sample. We recruited a final sample of 267 adolescents (14-17 years old, M = 15.6, SD = 1.1) through a local YMCA (81%), internet outreach (11%), a pediatric clinic (5%), and a substance use treatment center (3%) in a large metropolitan area in Southeastern United States. Respondents were surveyed in April through August, 2018. Participants provided consent online and were paid US$10 (via Amazon gift card) for survey completion to help reduce selection bias. As shown in Table 1, survey respondents were balanced by gender (51% female). In terms of race and ethnicity, 14% self-identified as Hispanic, 50% self-identified as Non-Hispanic (NH) White, 23% as NH Black, 3% NH Asian, and 8% NH Multiracial. As all questions were required for completion, there were no missing data on any of the variables.

Measures

Demographics. Participants reported their age, race, ethnicity, and gender.

Tobacco product use. Participants were instructed that throughout the survey, "vaping device" refers to electronic devices that vaporize nicotine for inhalation, including but not limited to electronic cigarettes, e-cigarettes, e-vapes, vapes, vape pens, mods, tanks, and e-hookah. They indicated the first tobacco product they ever tried, "even one puff." Options included a vaping device, a dripping method to add e-liquid to an

Table 1. Survey Sample Characteristics.

	N	%
Age	*M* = 15.6	*SD* = 1.08
Gender[a]		
Male	128	47.9
Female	136	50.9
Race/Ethnicity		
Non-hispanic caucasian/White	133	49.8
Non-hispanic african-american/Black	60	22.5
Non-hispanic asian	9	3.4
Non-hispanic multiracial	21	7.9
Non-hispanic other	6	2.2
Hispanic	38	14.2
Cigarette susceptibility[b]		
Confirmed non-susceptible	183	68.5
Smoking susceptible	84	31.5
E-cigarette susceptibility[b]		
Confirmed non-susceptible	114	42.7
Vaping susceptible	153	57.3
Cigarette or cigar smoking status		
Never smoked a cigarette or cigar	232	86.9
Experimented[c]	30	11.2
Current (past-month) smoking	15	5.6
E-cigarette use status		
Never used	215	80.5
Experimented[c]	33	12.4
Current (past-month) use	19	7.1
Computer vaping ad exposure		
I don't do this[d]	19	7.1
Never[e]	50	18.7
Rarely	79	29.6
Sometimes	80	30.0
Most of the time	26	9.7
Always	13	4.9%
Smartphone vaping ad exposure		
I don't do this[d]	15	5.6
Never[e]	60	22.5
Rarely	75	28.1
Sometimes	77	28.8
Most of the time	25	9.4
Always	15	5.6

[a]1 respondent indicated "Genderqueer" for gender identity; 2 indicated they preferred not to answer the question.
[b]Susceptibility measured using Expanded Susceptibility to Smoking Index (Strong et al, 2015).
[c]"Experimented" refers to lifetime usage, but no current (past-month) usage.
[d]Indicating no use of the exposure outlet (Computer or Smartphone).
[e]Indicating no vaping advertisement exposure on the exposure outlet.

e-cigarette, a cigarette, little cigars, smokeless tobacco, hookah, pipe, bidi, none ("never tried a tobacco product"), or other. Adolescents were asked, "where did the electronic cigarette (eg, vape-pen, e-cig, etc.) you first used (or tried) come from?" Options included a friend, a family member, a salesperson, online, and from a gas station or store. In addition, respondents were asked, "What is the vaping device you have used most often?" Options were disposable, cartridge-based, refillable tank system, JUUL, a dripping device (eg, dripbox, squonk mod, bottomfeeder mod), and other. Those who reported using a vaping device were asked about any use in the past 30 days. Similar questions were asked about traditional combustible cigarettes and cigars. Besides skip patterns, there were no missing data on any of these variables.

Expectancy items. Expectancy items were derived from prior scales and focus group input initially including 51 items in the domains of taste, negative affect reduction, negative consequences, and weight control; we then refined items with expert panel feedback. Respondents rated 31 expectancy items in these domains from 0 ("Strongly Disagree") to 9 ("Strongly Agree").

Tobacco product susceptibility measures. To assess susceptibility for tobacco use, we administered the validated expanded susceptibility to smoking index (ESSI).[37] This measure consists of four items that assess susceptibility to smoking by asking questions such as, "If your best friend were to offer you a cigarette, would you smoke it?" Response options were *definitely not, probably not, probably yes,* or *definitely yes.* Respondents who did not report *definitely not* on all questions were classified as susceptible.[38] Based on prior research, we collapsed scores, coding as follows: 1 = definitely not, 2 = probably not, and 3 = probably yes or definitely yes.[37] The average of the four items comprises the susceptibility score. An additional four items based on the ESSI were adapted for susceptibility to vaping, similar to modifications done by other researchers.[39]

Vaping ad exposure. Questions were adapted from the National Youth Tobacco Survey.[40] Adolescents were asked how often they saw ads or promotions for vaping devices when using the internet or a smartphone. Options responses were coded as follows: 0 = *I don't do this* or *Never,* 1 = *Rarely*, 2 = *Sometimes*, 3 = *Most of the time*, and 4 = *Always.*

Family and peer vaping device use. Participants were asked, "Does anyone in your immediate family, like your parents, or a brother or sister use vaping devices?" Regarding peers, the survey inquired, "Do any of your close friends use vaping devices?" Response options consisted of 0 = *no* or *don't know* and 1 = *yes.* Responses were summed for a score ranging from 0 to 2.

Lifetime nicotine vaping. Anyone who denied ever using a vaping device was assigned a score of 0 for lifetime vaping. Participants who reported any vaping were asked, "About how many times in your life do you think you have used a vaping device?" Response options consisted of 1 = *1-24*; 2 = *25-49*; 3 = *50-74*; 4 = *75-100*; and 5 = *Over 100.*

Data analysis plan

Classical test theory analyses examined descriptive statistics of items. Missing data was handled by listwise deletion. Exploratory Factor Analysis (EFA) with maximum likelihood extraction and promax rotation was used to investigate preliminary factor solutions. A variety of solutions were attempted to maximize item inclusion, theoretical impact, and conceptual clarity. When determining items to include, we examined factor loadings, specifically attempting to reduce the number of secondary loadings above .3, while still being mindful of theoretical concerns.[41,42] Appropriateness of data for factor analysis was evaluated by Kaiser-Meyer-Olkin (KMO) criteria and Bartlett's Test of Sphericity. KMO tests the adequacy of the sample size for factor analysis, with values between 0.8 and 1.0 indicating adequate size, whereas Bartlett's Test of Sphericity examines the null hypothesis that variables are orthogonal and unrelated, with a significant value indicating factor analysis is appropriate.[43] When evaluating number of factors to retain, we used the Kaiser-Guttman criterion, parallel analysis with 500 repetitions[44] and Velicer's minimum average partial test.[45] Cronbach's alpha analyses evaluated inter-item internal consistency reliability.[46]

Factor scores were created by averaging across items. To examine preliminary content validity, bivariate correlations were conducted in relation to the following constructs: cigarette smoking susceptibility, nicotine vaping susceptibility, nicotine vaping advertisement exposure, family/peer vaping, and personal lifetime vaping. As a further measure of validity, a separate set of analyses compared expectancy subscale scores of e-cigarette susceptible vs non-susceptible adolescents and ever-users vs never-users using Analyses of Variance (ANOVA). As one of the comparisons violated the assumption of homoscedasticity, we conducted Welch's W ANOVA tests, which are recommended as superior to the classical F-test ANOVA.[47] Incremental validity was examined using a hierarchical linear regression model predicting lifetime vaping. In an initial regression step, known correlates of vaping were examined, namely, age, race/ethnicity, vaping ad exposure, and peer and family vaping. In the following steps, vaping expectancy subscales were added to the model one at a time.

Results

Focus group

We conducted one focus group with adolescents at a local YMCA. See focus group subsection in the Methods section for information on demographics. We first inquired about the third person format (eg, "People enjoy the nicotine buzz from e-cigarettes) instead of a first person format (eg, "I enjoy the

nicotine buzz from e-cigarettes."). The youth interviewed were generally supportive of this more general format. One male participant indicated, "I think that's better because not all people vape." A second male focus group member agreed a third person format was appropriate, saying, "so that people that don't vape can answer this more clearly."

In regards to consequences, we first queried the youth about immediate effects. The youth interviewed reported a number of likely immediate effects including light headedness, headache, nausea, throat burn, and good taste. These effects were believed to vary based on level of use and to be less harsh than traditional combustible cigarettes. One adolescent indicated e-cigarette use would lead to, "light-headedness…if it's your first time using." Another noted, "I'm guessing there's like less of that [throat burn] with a vape [than with a cigarette], so I think it's like the easier option for teenagers."

When asked about effects after repeated use, the adolescents interviewed suspected different types of effects over time, including shortness of breath, tolerance, and dependence. One female respondent said, "I think personally that the side effects won't affect you as much if you use it like every day." Another male respondent with a history of e-cigarette use similarly said, "If you get used to it and you enjoy it, then like in a month you're going to be using it, like regularly." When asked about long-term issues (e.g., over years of use), youth reported health problems and addiction issues would be likely, albeit potentially less so than with traditional combustible cigarettes. For example, one female respondent stated, "I personally believe that it won't be as bad as like cigarettes are. Cause I know cigarettes give you like cancer." Another agreed: "Not as bad as cigarettes, but like still would have consequences." Effects were suspected to be delayed over a longer time period, with one respondent stating, "I think someone would probably get sickish, like when they get older." Addiction was also thought to be a likely consequence, with one youth stating that a person who regularly uses e-cigarettes would need to, "like do it all the time; otherwise you don't really feel well."

When asked specifically about health risks and items proposed for survey inclusion, most focus group members felt that e-cigarettes would not be as bad as traditional combustible cigarettes, but would still have consequences, such as lung problems (eg, shortness of breath and asthma). Members described light-headedness, headaches, shortness of breath, lung issues, and breathing issues as potential negative physical feelings. There was uncertainty, but some cautious agreement that use would lead to health problems. One respondent summarized, "And like with [e-cigarettes] you don't really know why you agree [they are dangerous], but it's just not good – There is so many unknowns, when it comes to e-cigarettes." Participants generally agreed stress relief and negative affect reduction were common reasons for using.

> "I think those are like the two biggest questions, I think those like hit the mark – I think that's a good section." – *Male adolescent*

> "Yeah, cuz you kinda know from like cigarettes, like after stressful situations, because I'm sure everyone knows someone who smokes cigarettes. It kinda has the same kind of effect like after stressful situations. Like my mom will go outside and have a cigarette or use her vape. Stressful situations, definitely there's an increase." – *Male adolescent*

Delphi panel expert input

The panel reviewed a summary of the adolescent focus group and an initial adolescent e-cigarette expectancy item bank of 9 items in the domain of taste, 15 items related to negative affect reduction, 13 items related to negative consequences, and 14 items related to weight control. After receiving their feedback and making some revisions, a revised list was provided to the expert panel for content validity assessment. Based on their feedback, several items were removed for further consideration. For example, an item referring to the taste of e-cigarettes as "weak" was removed due to feedback that the item was too ambiguous. Our revised items for survey administration included 7 items in the domain of taste, 7 items related to negative affect reduction, 10 items related to negative consequences, and 7 items related to weight control.

Surveys

Survey participant tobacco use characteristics. Less than a third (32%) of adolescents were identified as susceptible for cigarette smoking, but a majority (57%) were susceptible for nicotine vaping. Over one in four (27%) reported ever using a tobacco product. Of those who used a tobacco product, over three in five (70%) reported vaping. Most said they got their first device from a friend (62%), followed by from a brick and mortar store (15%), a family member (14%), or online (6%). Few respondents reporting dripping (7% overall; 24% of those who ever used tobacco). Use of a cigarette or cigar was more common than dripping, but still relatively rare (13% overall; 47% of ever-users). Most adolescents reported at least some use of the internet on a computer (93%) or a smartphone (94%). Some adolescents reported they never saw vaping advertisements on a computer (19%) or smartphone (23%), but most reported seeing such advertisements at least rarely (computer: 74%; smartphone: 72%) with sizable percentages reporting seeing these advertisements most of the time or always (computer: 15%; smartphone: 15%).

Exploratory factor analysis and reliability. We initially examined 31 items through Exploratory Factor Analysis. See supplemental Table 1. In examining factor loadings, 4 items included secondary factor loadings above .3. These items were deleted from the model. As shown in Table 2, the final model

Table 2. Exploratory Factor Analysis Rotated Factor Loadings for Final Model (n = 267).

ITEM	F1	F2	F3	F4	SUBSCALE α
Negative consequences					.92
1. E-cigarettes are dangerous	**0.75**	0.14	−0.11		
2. By vaping, a person risks developing heart disease	**0.73**		−0.15		
3. The more a person vapes, the more they risk their health	**0.70**		0.18	−0.17	
4. Vaping is likely to cause serious health problems that are not yet known	**0.77**				
5. Vaping is hazardous to a person's health	**0.87**		0.14	−0.12	
6. By vaping, a person risks heart disease and lung cancer	**0.85**		0.13		
7. People worry that vaping will lower their quality of life	**0.54**	−0.18		0.20	
8. By vaping, a person risks getting cancer	**0.77**			0.16	
9. Vaping is taking years off a person's life	**0.76**				
Positive reinforcement					.83
10. People enjoy the strong taste of vaping		**0.46**	0.25		
11. E-cigarettes taste nice	−0.21	**0.46**	0.19	0.11	
12. People like the different flavors in e-cigarettes	0.13	**0.80**			
13. A person will enjoy the flavor of an e-cigarette		**0.68**			
14. A person enjoys the taste sensations while vaping		**0.83**			
Negative affect reduction/Negative reinforcement					.95
15. Vaping can relieve stress			**0.79**		
16. Using an e-cigarette helps a person after stressful situations			**0.85**		
17. When a person is upset with someone, an e-cigarette helps them cope			**0.88**		
18. When a person is angry, an e-cigarette can calm them down		−0.10	**0.95**		
19. Vaping calms a person down when they feel nervous			**0.97**		
20. E-cigarettes help a person deal with anxiety or worry		0.13	**0.70**		
Weight and appetite control					.89
21. Vaping allows a person to avoid eating			−0.16	**0.84**	
22. Vaping controls a person's appetite				**0.75**	
23. E-cigarettes keep a person from overeating			0.18	**0.54**	
24. Vaping keeps a person's weight down			0.25	**0.53**	
25. E-cigarettes curb a person's appetite			0.25	**0.56**	
26. Vaping helps a person control their weight				**0.75**	
27. E-cigarettes keep a person from eating more than they should				**0.78**	

Note. F1-4 indicates Factors 1-4. Factor loadings ≥.3 shown in **bold**. Factor loadings < |.1| are suppressed (not shown).

consisted of 27 items. Kaplin-Meyer-Olkin (.913) and Bartlett's Test of Sphericity, χ^2 (351, 267) = 5099.54, $P < .001$, both indicated appropriateness of the data for factor analysis. The goodness-of-fit chi-square test suggested an 8-factor model, but Kaiser-Guttman criterion, parallel analysis with 500 replications, and Velicer's MAP tests (both versions) all supported a 4-factor solution. We note that simulation studies have shown the chi-square test does not always accurately retrieve the correct number of factors (generally resulting in too many factors),[48-50] so we selected the 4-factor solution. Subscales were reliable, with Cronbach's α ranging from 0.83-0.95 (see Table 2).

Correlations. As shown in Table 3, correlations were generally consistent with expectations. As expected, vaping susceptibility positively correlated with subscales related to positive reinforcement (PR), $r = .46$, $P < .01$, negative affect reduction (NAR), $r = .50$, $P < .01$, and weight control (WC), $r = .43$, $P < .01$, while negatively correlating with negative consequences expectancies (NC), $r = -.28$, $P < .01$. Similar results were found with lifetime vaping, PR, $r = .21$, $P < .01$, NAR, $r = .34$, $P < .01$, WC, $r = .30$, $P < .01$, and NC, $r = -.21$, $P < .01$, Cigarette susceptibility was positively correlated with vaping susceptibility, $r = .63$, $P < .01$, as well as with expectancy subscales, albeit generally to a lesser degree than vaping susceptibility, PR, $r = .27$, $P < .01$, NAR, $r = .41$, $P < .01$, WC, $r = .43$, $P < .01$, and NC, $r = -.16$, $P < .05$. Smartphone vaping ad exposure was positively correlated with internet/computer vaping ad exposure, $r = .64$, $P < .01$, as well as peer and family vaping, $r = .14$, $P < .05$ and positive expectancy subscales, PR, $r = .21$, $P < .01$, NAR, $r = .19$, $P < .01$, and WC, $r = .19$, $P < .01$.

Analyses of variance comparing e-cigarette susceptible and non-susceptible youth. As shown in Figure 1, subscales successfully differentiated e-cigarette susceptible from confirmed non-susceptible adolescents, with e-cigarette susceptible youth reporting more positive expectancies, viz, positive reinforcement,

Table 3. Correlations Between Tobacco Risk Factors, Lifetime Vaping, and Questionnaire Subscales.

	1	2	3	4	5	6	7	8	9	10
1. Vaping susceptibility	—									
2. Cigarette susceptibility	.63**	—								
3. Internet vaping ad exposure	.18*	.11*	—							
4. Smartphone vaping ad exposure	.14*	.11	.64**	—						
5. Peer and family vaping	.45**	.25**	.12*	.14*	—					
6. Lifetime vaping	.53**	.45**	.00	.00	.26**	—				
7. Negative consequences	−.28**	−.16*	.01	−.02	−.13*	−.21**	—			
8. Positive reinforcement	.46**	.27**	.22*	.21**	.21**	.21**	.04	—		
9. Negative affect reduction	.50**	.41**	.16**	.19**	.26**	.34**	−.08	.56**	—	
10. Weight control	.43**	.43**	.21**	.19**	.11	.30**	−.10	.49**	.67**	—

Note. N = 267. *P < .05 **P < .01.

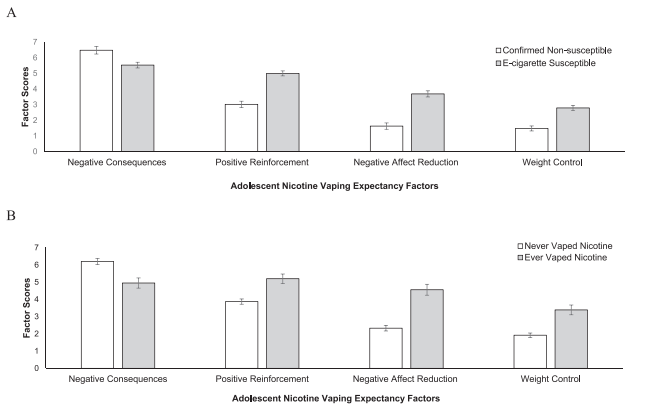

Figure 1. Analyses of Variance (ANOVAs) comparing expectancy subscale averages between e-cigarette susceptible and confirmed non-susceptible adolescents (Panel A) and between adolescents who have ever vaped nicotine and never vaped nicotine (Panel B). *Note.* Average expectancy scores (± standard error) rated on a scale from 0 ("Strongly Disagree") to 9 ("Strongly Agree"). All comparisons statistically significant, $P \leq .002$. η^2 range from .04 - .19.

M = 5.00, SD = 1.98 vs M = 3.02, SD = 2.13, P < .001, η^2 = .19, negative affect reduction, M = 3.69, SD = 2.43 vs M = 1.63, SD = 2.17, P < .001, η^2 = .16, and weight control, M = 2.79, SD = 2.03 vs M = 1.48, SD = 1.71, P < .001, η^2 = .11, as well as less negative consequences expectancies, M = 5.53, SD = 2.28 vs, M = 6.48, SD = 2.59, P = .002, η^2 = .04. Similar results were found with analyses of youth who had ever vaped nicotine as compared to those who have never vaped nicotine. Specifically, youth who had ever vaped nicotine reported more positive expectancies, namely, positive reinforcement, M = 5.20, SD = 2.07 vs M = 3.87, SD = 2.24, P < .001, η^2 = .06, negative affect reduction, M = 4.56, SD = 2.39 vs M = 2.33, SD = 2.36, P < .001, η^2 = .13, and weight control, M = 3.39, SD = 2.14 vs M = 1.92, SD = 1.85, P < .001, η^2 = .09, as well as less negative consequences expectancies, M = 4.95, SD = 2.24 vs M = 6.20, SD = 2.45, P < .001, η^2 = .04.

Incremental validity. Hierarchical regressions revelated associations between expectancy subscales and lifetime vaping above and beyond other significant correlates (Table 4). Age, race/ethnicity, gender, smartphone vaping ad exposure, and peer/family vaping explained 11% of the variance (P < .001). Negative consequences expectancies explained an additional 3% of the variance, P = .005. We then added positive reinforcement expectancies, which explained a further 4% of the variance, P < .001. We next added negative affect reduction expectancies; this explained an additional 3% of the variance, P = .002. Finally, weight control expectancies explained an additional 2% of the variance, P = .011, for a total of 22% of the variance explained by the full model.

Discussion

The current study sought to develop and assess psychometrics for an expectancy measure for adolescent nicotine vaping. Electronic nicotine expectancy items were developed via a focus group and Delphi expert panel input. These items were then administered to adolescents in the local community of a Southeastern United States (US) metropolitan area. Adolescent nicotine vaping was relatively common, with close to one-fifth reporting lifetime usage, although it should be noted current past-month use was lower than state and national averages. Exploratory factor analyses led to a 4-factor solution: negative consequences, positive reinforcement, weight and appetite control, and negative affect reduction. Subscales based on the factors were reliable according to Cronbach's alpha measures. The subscales significantly correlated with vaping susceptibility and lifetime vaping. Analyses of variance (ANOVA) indicated

Table 4. Hierarchical Linear Regression Predicting Lifetime Vaping With Adolescent Expectancy Subscales.

PREDICTOR	β	*B*	*SE*	*P*	ΔR^2
Step 1					.107
Age	.174	.160	.055	.004	
Race/Ethnicity	−.047	−.092	.116	.427	
Gender	−.121	−.238	.116	.041	
Smartphone vaping ad exposure	−.033	−.022	.039	.579	
Peer and family vaping	.222	.308	.084	<.001	
Step 2					.026
Negative consequences	−.165	−.066	.024	.005	
Step 3					.037
Positive reinforcement	.203	.088	.026	<.001	
Step 4					.032
Negative affect reduction	.224	.087	.027	.002	
Step 5					.020
Weight control	.195	.096	.038	.011	

Note. β = standardized coefficient; *B* = unstandardized coefficient; Race: 0 = Hispanic or other non-white racial-ethnic group; 1 = Non-Hispanic White; Gender: 0 = Male or other; 1 = Female.

the subscales successfully differentiated susceptible from non-susceptible adolescents, as well as those who have ever vaped as compared to those without any lifetime history of vaping. Finally, hierarchical linear regression revealed that the subscales demonstrated incremental validity, predicting lifetime vaping over and above other significant correlates of vaping.

Items differed from adult expectancy items by the use of third-person statements, similar to items used for traditional combustible cigarettes in the adolescent smoking consequences questionnaire.[33] This approach was confirmed as a useful approach by adolescents in the focus group and Delphi expert panel input. A similar approach was recently taken with the Vaping Consequences Questionnaire among adolescents who do not use e-cigarettes.[30] We found here that items were significantly different among adolescents who have used and have never used e-cigarettes. The expectancy items identified were similar to cigarette smoking, but with a heightened importance of taste. There were fewer factors in this adolescent measure than in a previously developed young adult measure,[29] perhaps indicating that youth have less refined, more simplistic views of e-cigarettes. Similarly, the Smoking Consequences Questionnaire for Adults (SCQ-A) consists of 10 factors when administered to a sample of experienced cigarette smokers,[26] compared to only 4 factors for the initial survey development with a younger sample of college students.[25] Other adolescent e-cigarette expectancy measures similarly consisted of only 3 factors, even fewer than the 4 factors found in the present study.[31,32] For example, the Sensory E-cigarette Expectancies Scale (SEES) consists of the factors Pleasurable Physical Sensations, Enjoyment of Taste and Smell, and Enjoyment of Vapor Clouds.[31] The factors for the Smoking Expectancy Scale for Adolescents (SESA) are Costs, Social Benefits, and Affective/Weight Benefits.[32]

Expectancies in the current questionnaire (ENVO-Y) generally correlated positively with internet and smartphone sources of ad exposure, with the exception of negative consequences expectancies. Youth e-cigarette marketing exposure is on the rise.[51] In particular, social media marketing is common. Over 70% of adolescents use more than one social media platform and close to one-quarter of adolescents are online "almost constantly."[52] Although the Master Settlement Agreement with tobacco companies in the US placed strong regulations on traditional combustible cigarette marketing via traditional methods, such as print or television, marketing of other forms of tobacco, such as e-cigarettes, or by alternative methods (internet, smartphone) are less regulated, if at all. Tobacco brand and product promotions are common on social media platforms,[53-57] despite platform policies banning tobacco advertising.[58-60] Reducing youth exposure to tobacco marketing may reduce positive expectancies for e-cigarettes and ultimately use.

There are some notable limitations with the current study. We only used one focus group, thus focus group results lack saturation or implied generalizability. However, the focus group was designed to investigate generalizability of prior young adult e-cigarette focus group results and adolescent smoking expectancy items. In other words, the focus group was designed for a more limited purpose of confirming or refuting prior results and items. An additional weakness of the study is the cross-sectional design; therefore, causation cannot be inferred. Future research should consider longitudinal and experimental designs to help investigate a causal role for e-cigarette expectancies. The study used a convenience sample of adolescents that may not be

representative; convenience samples inherently involve selection bias. This self-selection bias may have been altered by the inclusion of an Amazon gift card as incentive. Rates of e-cigarette use within the sample were relatively low, compared with national estimates.[7] However, it is a strength of this study that it included adolescents with and without a history of e-cigarette use, as this allowed for direct comparisons between groups. This survey was restricted to a local sample in a Southeastern US metropolitan area. Although the sample was relatively diverse, future research should examine the generalizability of the findings. The measures of vaping ad exposure, family/peer vaping, and lifetime nicotine vaping do not appear to have undergone formal psychometric validity testing. We did not conduct a power analysis, although our sample size meets the threshold recommendations for factor analysis of at least 100 or 200 participants.[61,62]

Conclusion

Further research is needed to understand and reduce problematic youth usage. At the same time, it is important that work to reduce youth usage does not inadvertently encourage traditional combustible cigarette smoking. Precise measurement of expectancies may help meet this goal. The long-term health consequences of ENDS use at individual and population levels are intensely debated.[63,64] Although more research is needed to understand long-term effects of vaping independent of combustible use, we can recognize the prevention of initiation of e-cigarette and other tobacco use by adolescents as an important goal to minimize any long-term consequences. The proper application of expectancy theory and other psychological principles can help achieve this objective. The expectancy measure developed here is one of several tools that can help in these efforts.

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Author contributions

Author PTH conceived of the study with the support of TEB. Author PTH applied for funding with support from RWH and TEB. Authors PTH, KJE, VNS, TEB, and ACP supported the conduct of the study. Author PTH conducted the statistical analysis with the support of RWH. Author PTH wrote the initial draft of the manuscript. All authors critically reviewed the manuscript for important intellectual content.

REFERENCES

1. USDHHS. *Preventing tobacco use among youth and young adults: A report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2012.
2. Blanco C, Florez-Salamanca L, Secades-Villa R, Wang S, Hasin DS. Predictors of initiation of nicotine, alcohol, cannabis, and cocaine use: results of the national epidemiologic survey on alcohol and related conditions (NESARC). *Am J Addict*. 2018;27(6):477-484. doi:10.1111/ajad.12764.
3. Volkow ND, Boyle M. Neuroscience of addiction: relevance to prevention and treatment. *Am J Psychiatr*. 2018;175(8):729-740. doi:10.1176/appi.ajp.2018.17101174.
4. Giedd JN. The teen brain: insights from neuroimaging. *J Adolesc Health*. 2008;42(4):335-343. doi:10.1016/j.jadohealth.2008.01.007.
5. Kandel D, Kandel E. The Gateway Hypothesis of substance abuse: developmental, biological and societal perspectives. *Acta Paediatr*. 2015;104(2):130-137. doi:10.1111/apa.12851.
6. USDHHS. E-cigarette Use Among Youth and Young Adults. *A Report of the Surgeon General*. Atlanta, GA: Publications and Reports of the Surgeon General; 2016.
7. Miech JLD, O'Malley PM, Bachman JG, Schulenberg JE, Patrick ME. *Monitoring the Future National Survey Results on Drug Use, 1975-2022: Volume 1, Secondary School Students*. Ann Arbor: Institute for Social Research; 2023.
8. Miech R, Johnston L, O'Malley PM, Bachman JG, Patrick ME. Adolescent vaping and nicotine use in 2017-2018 - U.S. National estimates. *N Engl J Med*. 2019;380(2):192-193. doi:10.1056/NEJMc1814130.
9. Huang J, Duan Z, Kwok J, et al. Vaping versus JUULing: how the extraordinary growth and marketing of JUUL transformed the US retail e-cigarette market. *Tobac Control*. 2019;28(2):146-151. doi:10.1136/tobaccocontrol-2018-054382.
10. Cullen KA, Gentzke AS, Sawdey MD, et al. E-cigarette use among youth in the United States, 2019. *JAMA*. 2019;322. doi:10.1001/jama.2019.18387.
11. Spindle TR, Eissenberg T. Pod mod electronic cigarettes-an emerging threat to public health. *JAMA Netw Open*. 2018;1(6):e183518. doi:10.1001/jamanetworkopen.2018.3518.
12. Barrington-Trimis JL, Leventhal AM. Adolescents' use of "pod mod" E-cigarettes - urgent concerns. *N Engl J Med*. 2018;379(12):1099-1102. doi:10.1056/NEJMp1805758.
13. Ali FRM, Seaman EL, Crane E, Schillo B, King BA. Trends in US E-cigarette sales and prices by nicotine strength, overall and by product and flavor type, 2017-2022. *Nicotine Tob Res*. 2022. doi:10.1093/ntr/ntac284.
14. Miech R, Johnston L, O'Malley PM, Bachman JG, Patrick ME. Trends in adolescent vaping, 2017-2019. *N Engl J Med*. 2019;381(15):1490-1491. doi:10.1056/NEJMc1910739.
15. Adkins SH, Anderson KN, Goodman AB, et al. Demographics, substance use behaviors, and clinical Characteristics of adolescents with e-cigarette, or vaping, product use-associated lung injury (EVALI) in the United States in 2019. *JAMA Pediatr*. 2020;174(7):e200756. doi:10.1001/jamapediatrics.2020.0756.
16. Blount BC, Karwowski MP, Shields PG, et al. Vitamin E acetate in bronchoalveolar-lavage fluid associated with EVALI. *N Engl J Med*. 2020;382(8):697-705. doi:10.1056/NEJMoa1916433.
17. Gentzke AS, Wang TW, Cornelius M, et al. Tobacco product use and associated factors among middle and high school students - national youth tobacco survey, United States. *MMWR Surveill Summ*. 2022;71(5):1-29. doi:10.15585/mmwr.ss7105a1.
18. Compton WM, Flannagan KSJ, Silveira ML, et al. Tobacco, alcohol, cannabis, and other drug use in the US before and during the early phase of the COVID-19 pandemic. *JAMA Netw Open*. 2023;6(1):e2254566. doi:10.1001/jamanetworkopen.2022.54566.
19. Johnston LD, Miech RA, O'Malley PM, Bachman JG, Schulenberg JE, Patrick ME. *Monitoring the Future National Survey Results on Drug Use, 1975-2021: Overview, Key Findings on Adolescent Drug Use*. Ann Arbor: University of Michigan Library; 2022.
20. Brandon TH, Herzog TA, Irvin JE, Gwaltney CJ. Cognitive and social learning models of drug dependence: implications for the assessment of tobacco dependence in adolescents. *Addiction*. 2004;99(Suppl 1):51-77. doi:10.1111/j.1360-0443.2004.00737.x.
21. Hendricks PS, Brandon TH. Smoking-related expectancies. In: *Interpersonal and Intrapersonal Expectancies*. England: Routledge; 2016:62-68.
22. Copeland AL, Brandon TH. Testing the causal role of expectancies in smoking motivation and behavior. *Addict Behav*. 2000;25(3):445-449. doi:10.1016/s0306-4603(99)00003-9.
23. Harrell PT, Juliano LM. Caffeine expectancies influence the subjective and behavioral effects of caffeine. *Psychopharmacology (Berl)*. 2009;207(2):335-342. doi:10.1007/s00213-009-1658-5.
24. Harrell PT, Juliano LM. A direct test of the influence of nicotine response expectancies on the subjective and cognitive effects of smoking. *Exp Clin Psychopharmacol*. 2012;20(4):278-286. doi:10.1037/a0028652.
25. Brandon TH, Baker TB. The Smoking Consequences Questionnaire: the subjective expected utility of smoking in college students. *Psychol Assess: J Consult Clin Psychol*. 1991;3(3):484.

26. Copeland AL, Brandon TH, Quinn EP. The Smoking Consequences Questionnaire-Adult: measurement of smoking outcome expectancies of experienced smokers. *Psychol Assess*. 1995;7(4):484.
27. Harrell PT, Simmons VN, Pineiro B, et al. E-cigarettes and expectancies: why do some users keep smoking? *Addiction*. 2015;110(11):1833-1843. doi:10.1111/add.13043.
28. Garey L, Mayorga NA, Peraza N, et al. Distinguishing Characteristics of E-cigarette users who attempt and fail to quit: dependence, perceptions, and affective vulnerability. *J Stud Alcohol Drugs*. 2019;80(1):134-140.
29. Harrell PT, Brandon TH, Stark SE, et al. Measuring vaping-related expectancies in young adults: psychometric evaluation of the Electronic Nicotine Vaping Outcomes (ENVO) scale. *Drug Alcohol Depend*. 2023;246:109861. doi:10.1016/j.drugalcdep.2023.109861.
30. Morean ME, Davis DR, Bold KW, et al. Psychometric evaluation of the short-form vaping consequences questionnaire for use with high school adolescents who use and do not use E-cigarettes. *Nicotine Tob Res*. 2022;24(5):699-709. doi:10.1093/ntr/ntab237.
31. Morean ME, Davis DR, Kong G, Bold KW, Krishnan-Sarin S. Psychometric evaluation of the sensory e-cigarette expectancies scale for use with adolescents. *Addict Behav*. 2024;148:107869. doi:10.1016/j.addbeh.2023.107869.
32. Enlow PT, Felicione N, Williford DN, Durkin K, Blank MD, Duncan CL. Validation of the electronic cigarette expectancy scale for adolescents. *Subst Use Misuse*. 2022;57(2):212-221. doi:10.1080/10826084.2021.2002898.
33. Lewis-Esquerre JM, Rodrigue JR, Kahler CW. Development and validation of an adolescent smoking consequences questionnaire. *Nicotine Tob Res*. 2005;7(1):81-90. doi:10.1080/14622200412331328475.
34. Middleton ET, Morice AH. Breath carbon monoxide as an indication of smoking habit. *Chest*. 2000;117(3):758-763.
35. Benowitz NL, Bernert JT, Foulds J, et al. Biochemical verification of tobacco use and abstinence: 2019 update. *Nicotine Tob Res*. 2020;22(7):1086-1097.
36. Niederberger M, Spranger J. Delphi technique in health sciences: a map. *Front Public Health*. 2020;8:457. doi:10.3389/fpubh.2020.00457.
37. Strong DR, Hartman SJ, Nodora J, et al. Predictive validity of the expanded susceptibility to smoke index. *Nicotine Tob Res*. 2015;17(7):829-869. doi:10.1093/ntr/ntu254.
38. Pierce JP, Choi WS, Gilpin EA, Farkas AJ, Merritt RK. Validation of susceptibility as a predictor of which adolescents take up smoking in the United States. *Health Psychol*. 1996;15(5):355-361. doi:10.1037//0278-6133.15.5.355.
39. Bold KW, Kong G, Cavallo DA, Camenga DR, Krishnan-Sarin S. E-cigarette susceptibility as a predictor of youth initiation of E-cigarettes. *Nicotine Tob Res*. 2017;20(1):140-144. doi:10.1093/ntr/ntw393.
40. Marynak K, Gentzke A, Wang TW, Neff L, King BA. Exposure to electronic cigarette advertising among middle and high school students - United States, 2014-2016. *MMWR Morb Mortal Wkly Rep*. 2018;67(10):294-299. doi:10.15585/mmwr.mm6710a3.
41. Huntley ED, Juliano LM. Caffeine Expectancy Questionnaire (CaffEQ): construction, psychometric properties, and associations with caffeine use, caffeine dependence, and other related variables. *Psychol Assess*. 2012;24(3):592-607. doi:10.1037/a0026417.
42. Pett MA, Lackey NR, Sullivan JJ. *Making Sense of Factor Analysis: The Use of Factor Analysis for Instrument Development in Health Care Research*. Newcastle upon Tyne: Sage; 2003.
43. Shrestha N. Factor analysis as a tool for survey analysis. *Am J Appl Math Stat*. 2021;9(1):4-11.
44. Hayton JC, Allen DG, Scarpello V. Factor retention decisions in exploratory factor analysis: a tutorial on parallel analysis. *Organ Res Methods*. 2004;7(2):191-205.
45. O'Connor BP. SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behav Res Methods Instrum Comput*. 2000;32(3):396-402.
46. Bland JM, Altman DG. Statistics notes: cronbach's alpha. *Br Med J Int Ed*. 1997;314(7080):572.
47. Delacre M, Leys C, Mora YL, Lakens D. Taking parametric assumptions seriously: arguments for the use of Welch's F-test instead of the classical F-test in one-way ANOVA. *International Review of Social Psychology*. 2019;32(1):13.
48. Hayashi K, Bentler PM, Yuan KH. On the likelihood ratio test for the number of factors. in exploratory factor analysis. *Struct Equ Model*. 2007;14(3):505-526. doi:10.1080/10705510701301891.
49. Barendse M, Oort FJ, Timmerman M. Using exploratory factor analysis to determine the dimensionality of discrete responses. *Struct Equ Model: A Multidiscip J*. 2015;22(1):87-101.
50. Auerswald M, Moshagen M. How to determine the number of factors to retain in exploratory factor analysis: a comparison of extraction methods under realistic conditions. *Psychol Methods*. 2019;24(4):468.
51. Li X, Kaiser N, Borodovsky JT, et al. National trends of adolescent exposure to tobacco advertisements: 2012-2020. *Pediatrics*. 2021;148. doi:10.1542/peds.2021-050495.
52. Lenhart A. *Teens, Social Media & Technology Overview*. Washington, DC: Pew Research Center; 2015.
53. Richardson A, Ganz O, Vallone D. Tobacco on the web: surveillance and characterisation of online tobacco and e-cigarette advertising. *Tobac Control*. 2015;24(4):341-347. doi:10.1136/tobaccocontrol-2013-051246.
54. Williams RS, Derrick J, Ribisl KM. Electronic cigarette sales to minors via the internet. *JAMA Pediatr*. 2015;169(3):e1563. doi:10.1001/jamapediatrics.2015.63.
55. Camenga D, Gutierrez KM, Kong G, Cavallo D, Simon P, Krishnan-Sarin S. E-cigarette advertising exposure in e-cigarette naive adolescents and subsequent e-cigarette use: a longitudinal cohort study. *Addict Behav*. 2018;81:78-83. doi:10.1016/j.addbeh.2018.02.008.
56. Laestadius LI, Wahl MM, Pokhrel P, Cho YI. From Apple to Werewolf: a content analysis of marketing for e-liquids on Instagram. *Addict Behav*. 2019;91:119-127. doi: 10.1016/j.addbeh.2018.09.008.
57. Massey ZB, Brockenberry LO, Harrell PT. Vaping, smartphones, and social media use among young adults: snapchat is the platform of choice for young adult vapers. *Addict Behav*. 2021;112:106576. doi:10.1016/j.addbeh.2020.106576.
58. Jackler RK, Li VY, Cardiff RAL, Ramamurthi D. Promotion of tobacco products on Facebook: policy versus practice. *Tobac Control*. 2019;28(1):67-73. doi:10.1136/tobaccocontrol-2017-054175.
59. O'Brien EK, Hoffman L, Navarro MA, Ganz O. Social media use by leading US e-cigarette, cigarette, smokeless tobacco, cigar and hookah brands. *Tobac Control*. 2020;29(e1):e87-e97.
60. Fielding-Singh P, Epperson AE, Prochaska JJ. Tobacco product promotions remain ubiquitous and are associated with use and susceptibility to use among adolescents. *Nicotine Tob Res*. 2021;23(2):397-401.
61. Hair JF. *Multivariate Data Analysis*. Hoboken, NJ: Prentice Hall; 2009.
62. Watkins MW. Exploratory factor analysis: a guide to best practice. *J Black Psychol*. 2018;44(3):219-246. doi:10.1177/0095798418771807.
63. Samet JM, Barrington-Trimis J. E-cigarettes and harm reduction: an artificial controversy instead of evidence and a well-framed decision context. *Am J Publ Health*. 2021;111:e1-e3. doi:10.2105/AJPH.2021.306457.
64. Balfour DJK, Benowitz NL, Colby SM, et al. Balancing consideration of the risks and benefits of E-cigarettes. *Am J Publ Health*. 2021;111:e1-e12. doi:10.2105/AJPH.2021.306416.