



Published in final edited form as:

Subst Use Misuse. 2019 ; 54(12): 1970–1979. doi:10.1080/10826084.2019.1624773.

E-cigarette Outcome Expectancies among Nationally Representative Samples of Adolescents and Young Adults

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Abstract

Objectives: We conducted nationally representative surveys of adolescents and young adults to examine associations between e-cigarette outcome expectancies and e-cigarette use.

Background: E-cigarette use among adolescents and young adults has grown rapidly in recent years, yet little research has examined the beliefs that may underlie this behavior among nationally representative samples.

Methods: $N=1,298$ adolescents (13–17) and 2,219 young adults (18–25) were surveyed using a probability-based web panel. Participants completed a survey that included a new outcome expectancy measure examining 3 positive (enjoyment, social influences, advantage over cigarettes) and 2 negative (health concerns, smoker association) expectancy domains and ever having used e-cigarettes [ever use].

Results: Confirmatory factor analyses demonstrated a good fit of the outcome expectancies' factor structure to the data. All outcome expectancies were associated with e-cigarette use in both populations in univariate analyses. In multiple logistic regression models controlling for several covariates, higher expected enjoyment was positively associated with a greater likelihood of e-cigarette use (aOR = 2.10, $p < .05$) among adolescents. Among young adults, enjoyment (aOR = 3.08, $p < .001$) was positively associated with a greater likelihood of use while both health concerns (aOR = 0.70, $p < .01$) and smoker association (aOR = 0.73, $p < .05$) were negatively associated with e-cigarette use.

Conclusions: This study suggests that expected enjoyment is robustly associated with e-cigarette use among both adolescents and young adults. Health concerns may also play a role in e-cigarette use. Implications for e-cigarette prevention efforts and future research directions are discussed.

Keywords

E-cigarette; adolescent; young adult; outcome expectancies

Declaration of Interest

The authors report no conflicts of interest.

1. Introduction

E-cigarette use among American adolescents and young adults has significantly grown in recent years. While only 1.5% of high school-aged adolescents used e-cigarettes in 2011, 20.8% had used e-cigarettes at least once by 2018 (Cullen et al., 2018). While e-cigarette use among adolescents has grown rapidly in recent years, adolescent usage of cigarettes, smokeless tobacco, cigars, pipe tobacco, and bidis have all significantly decreased (Singh, 2016). Recent research indicates that e-cigarettes are the most widely used tobacco product among adolescents (Wang et al., 2018). In addition, research indicates that for some adolescents and young adults, e-cigarette usage could ultimately lead to initiation of traditional cigarette smoking (Primack, Soneji, Stoolmiller, Fine, & Sargent, 2015; Soneji et al., 2017).

To better understand e-cigarette use and facilitate the development of effective messages to deter adolescent and young adult e-cigarette use, it is imperative to understand the beliefs that underlie this behavior (Creamer, Delk, Case, Perry, & Harrell, 2018; Rohde et al., 2018). A growing area of research has examined associations between beliefs about outcomes associated with e-cigarettes (i.e., outcome expectancies) and e-cigarette usage (Gibson et al., 2018). Outcome expectancy research has been informed by social cognitive theory (Bandura, 1989), which posits that individuals who expect positive outcomes to result from a behavior are more likely to engage in that behavior; the reverse is true for negative outcomes (Jones, Corbin, & Fromme, 2001).

Links between outcome expectancies and behavior have been consistently found across addictive behaviors such as alcohol use, cigarette smoking, and other forms of tobacco use (Barnett, Lorenzo, & Soule, 2017; Creamer et al., 2018; Lac & Brack, 2018). Most recently, studies have begun to extend this work to e-cigarettes. In a recent survey developed in part from qualitative interviews with young adult e-cigarette users, Pokhrel and colleagues (Pokhrel, Lam, Pagano, Kawamoto, & Herzog, 2018) demonstrated associations between young adults' positive and negative outcome expectations and e-cigarette willingness, use, and dependence. Positive youth outcome expectancies have also recently been linked with e-cigarette initiation in a longitudinal study (Creamer et al., 2018). While the importance of outcome expectancies has been demonstrated in adolescent and young adult populations, respectively, there is a relative dearth of evidence about whether e-cigarette outcome expectancies operate similarly across both populations.

Previous research into risk perceptions associated with e-cigarettes often compares the effects of e-cigarette use and combustible cigarette use. Findings from recent studies suggest that adolescents and young adults may have similar perceptions about the comparative health effects of using e-cigarettes versus combustible cigarettes. That is, when asked to compare outcomes expected of e-cigarettes in comparison to traditional cigarettes, respondents routinely indicate that e-cigarettes have fewer potential negative health effects (Amrock, Lee, & Weitzman, 2016; Hendricks et al., 2015; Hershberger, Karyadi, VanderVeen, & Cyders, 2017). Positive beliefs about the potential for e-cigarettes to be a healthier alternative to traditional cigarettes have been positively associated with e-cigarette use in young adult (Hershberger et al., 2017) and adolescent (Kong, Morean, Cavallo, Camenga, &

Krishnan-Sarin, 2014) populations. While a number of studies have assessed how adolescents and young adults compare e-cigarettes to traditional cigarettes, it is unclear whether expectancies of e-cigarette harms to health are similar for adolescents and young adults.

Perceptions of social ramifications and personal sensory experiences of e-cigarette use have previously been examined across adolescent and young adult populations. Beliefs about personal experience, such as pleasurable aromas, tastes, or sensations associated with e-cigarette use have been linked to greater likelihood to use e-cigarettes as well as more frequent use among adolescents and young adults (Creamer et al., 2018; Morean et al., 2019; Morean & L'Insalata, 2017; Pokhrel et al., 2018; Pokhrel, Little, Fagan, Muranaka, & Herzog, 2014). Social outcome expectancies related to e-cigarette use have also been examined both in comparison to combustible cigarette use as well as regarding social perceptions of e-cigarette users. Previous research suggests young adults may be drawn to e-cigarettes because of perceptions of comparative social benefits, such as being able to vape indoors or discretely vape (Pokhrel, Herzog, Muranaka, & Fagan, 2015). Users have also described appearing socially desirable (Pokhrel et al., 2014) or avoiding social stigma associated with combustible cigarette smoking (Soule, Rosas, & Nasim, 2016) as reasons for using e-cigarettes. Adolescent e-cigarette use has also been associated with perceptions of e-cigarette devices as “cool” (Kong et al., 2014) or more socially appealing than combustible cigarettes (Diez, Cristello, Dillon, De La Rosa, & Trucco, 2019) as well as attempts to replicate socially desirable “vape tricks” (Pepper et al., 2017). Outcome expectancies have been shown to vary between tobacco users and non-users and between e-cigarette users and non-users (Hershberger et al., 2017; Kong et al., 2014). However, potential differences between adolescent and young adult personal sensory and social e-cigarette expectancies have not been directly compared.

Research is needed to understand how various positive and negative outcome expectancies are associated with e-cigarette use among adolescents and young adults using nationally representative samples. Beliefs strongly associated with e-cigarette use can then become the target of messages in the form of product warnings and tobacco education campaigns that seek to prevent and reduce e-cigarette use. In the current study, we sought to understand what positive and negative outcome expectancies were associated with use of e-cigarettes among nationally representative samples of adolescents and young adults. Specifically, we sought to examine how a range of outcome expectancies – including health, sensory/enjoyment, cigarette comparative, and social outcomes of using e-cigarettes – were associated with adolescent and young adult ever use of e-cigarettes.

2. Methods

2.1 Participants

Data for this study were collected from a nationally representative sample of adolescents and young adults (ages 13–25) from all 50 states. Participants were recruited through GfK Custom Research's online KnowledgePanel®. KnowledgePanel is a probability-based web panel designed to be representative of the United States whose members are recruited through address-based sampling designed to improve population coverage and more

effectively recruit hard-to-reach populations such as young adults and individuals from various minority groups. GfK contacted KnowledgePanel members between the ages of 18–25 years old and invited them to participate in the survey. To recruit 13–17 year olds and adults 18–25 years old, GfK contacted adult KnowledgePanel members with a 13–25 year old in their household and randomly selected a 13–25 year old from the household to invite to participate in the survey. Consent (participants ages 18–25) or assent (participants ages 13–17) was obtained for each participant, and parental consent was also obtained for adolescents ages 13–17. Of 8,665 individuals invited to participate in the survey, 4,506 individuals completed an initial screener (52.0% screener completion rate). A total of 861 individuals were ineligible after completing the screener (e.g., outside the age range or parent did not provide consent for youth to complete), resulting in 3,645 qualified individuals. From this qualified sample, 3,517 completed surveys (96.5% survey completion rate). All surveys were completed between March and April 2016, with each participant who completed the survey receiving a \$10 cash equivalent incentive for their participation. A total of 1,298 adolescents and 2,219 young adults comprised the final sample. The study was approved by the Wake Forest School of Medicine Institutional Review Board.

2.2 Outcome Expectancy Measures

To examine the positive and negative consequences that youth attribute to e-cigarette use, we reviewed both qualitative (Kong et al., 2014; Pokhrel et al., 2015) and quantitative (Harrell et al., 2015; Hendricks et al., 2015; Pokhrel et al., 2014) research on motivations for and deterrents of e-cigarette use. Twenty-one items were developed or adapted from this previous work to represent three positive and two negative outcome expectancy domains that we identified a priori from the above literature. These were enjoyment, social influences, and advantage over cigarettes (positive expectancies), and health concerns and smoker association (negative expectancies). This set of items contains content recently identified as critical when assessing beliefs about e-cigarettes (i.e., perceptions of benefits, harms, addiction, and social aspects) (Gibson et al., 2018). Items were presented to respondents separately as positive (n=11 items) and negative (n=10 items) belief groupings. For example, the stem presented before the set of positive items stated, “Below are what some people think of as good things about using e-cigarettes or other vaping devices.” followed by “*If I were to use an e-cigarette or other vaping device, I would...*” Participants answered the items on a 5-point response scale ranging from (1) *definitely wouldn't* to (5) *definitely would* (see Table 1).

2.3 Tobacco Use and Demographics

Previous research has found significant associations between e-cigarette and other tobacco use, such that adolescents and young adults who have ever used e-cigarettes are more likely to be susceptible to cigarette use than exclusive users of other tobacco products (e.g. waterpipe tobacco, cigars, or smokeless tobacco) (Singh, 2016; Trinidad et al., 2017). To test for associations between e-cigarette and other tobacco use, survey respondents were asked whether they had ever used cigarettes, waterpipe tobacco, and cigarillos, as well as e-cigarettes. For each product, participants were shown images of the product along with a corresponding description. Demographic characteristics were also assessed and included sex, age, race, ethnicity, and both mother and father's highest level of education as a proxy

for socioeconomic status (coded as less than a 4-year college degree or a 4-year college degree or more education).

2.4 Data Analysis

Confirmatory factor analyses were used to confirm the dimensionality of the positive and negative outcome expectancy measures (Bollen, 1989). Measurement models were estimated in Mplus Version 7.11. To account for the complex sampling design, TYPE=COMPLEX was specified to accommodate unequal probabilities of selection as well as a non-response adjustment and a stratification factor. Estimation was performed using ESTIMATOR= MLR; a maximum likelihood estimation procedure which is robust to non-normality of observations. Items were retained if they loaded with the specified factor at 0.5 or greater. Indicators of model fit included the root mean squared error of approximation (RMSEA; 0.05 or less), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI) (both 0.90 or greater) (Hu & Bentler, 1999). While preliminary analyses suggested a qualitatively invariant measurement pattern of latent constructs across age groups, there was evidence that the magnitude of the loadings varied for positive expectancies. Therefore, the CFA model for positive outcome expectancies was fit separately for adolescents and young adults, and to be consistent across analyses was also fit separately for negative expectancies. Model testing was approached as an iterative process, with modification indices examined and some error variances correlated in the final step of model specification.

Descriptive statistics, correlations, and t-tests were computed on outcome expectancy subscales, followed by weighted logistic regression models to test associations with e-cigarette use using PROC SURVEYLOGISTIC in SAS v. 9.4. Models included sex, age, race, ethnicity, mother and father's education, and previous tobacco use as covariates. To examine how positively- and negatively-valenced outcome expectancies were associated with e-cigarette use individually and in combination, these regression models were computed first with only positive scales, then with only negative scales, and finally with both positive and negative scales together. Adjusted odds ratios along with 95% confidence intervals are reported.

3. Results

3.1 Confirmatory Factor Analysis

A three-factor model of positive expectancies fit the data for adolescents (CFI = .99, TLI = .98, RMSEA= .04) and young adults (CFI = .97, TLI = .96, RMSEA= .04). The positive factors were enjoyment (4 items, α =.93 for adolescents, α =.91 for young adults), social influences (3 items, α =.88, α =.83), and advantage over cigarettes (4 items, α =.90, α =.88). A two-factor model of negative expectancies fit the data for adolescents (CFI = .99, TLI = .98, RMSEA= .04) and young adults (CFI = .98, TLI = .97, RMSEA= .04), after dropping two negative outcome expectancy items due to low factor loadings. The negative factors were health concerns (4 items, α =.87 for adolescents, α =.84 for young adults) and smoker association (4 items, α =.79, α =.75; see Table 1).

3.2 Participant Characteristics and Descriptive Statistics

Table 2 reports adolescent and young adult demographic characteristics. The adolescent sample was 51.1% male, 70.7% White, and 15.2% Black, while the young adult sample was 41.1% male, 69.2% White, and 15.3% Black. Overall, 11.6% of adolescent respondents and nearly 30% of young adult respondents had ever used e-cigarettes [ever use]. Among adolescents, 13.8% had ever used traditional cigarettes whereas a much greater percentage of young adults (41.1%) had ever used traditional cigarettes.

Table 3 reports correlations between outcome expectancy subscales and e-cigarette use for both adolescents (lower diagonal) and young adults (upper diagonal), as well as subscale means and standard deviations. Positive perceptions of enjoyment, social aspects, and perceptions that e-cigarettes were better than traditional cigarettes were significantly positively correlated with ever using e-cigarettes (all $p < .001$), and these correlations held for both adolescents and young adults. Health concerns and smoker association were significantly negatively associated with ever using e-cigarettes (all $p < .001$), and again held for both adolescents and young adults.

Figure 1 presents means for outcome expectancy dimensions by age group and e-cigarette ever-use status. Results from independent-samples t-tests demonstrated the same pattern of effects described above, with significant differences for all outcome expectancy dimensions between both e-cigarette ever users and e-cigarette never users (all $p < .001$). These differences were consistent across both adolescent and young adult samples (Figure 1).

3.3 Logistic Regression Results for Adolescents

Multivariable logistic regression models examining adolescent e-cigarette use demonstrated an association between higher expected enjoyment and greater use of e-cigarettes (positive expectancies model: aOR = 2.06, $p < .05$, see Table 4). Conversely, greater health concerns were associated with a lower likelihood of e-cigarette use (negative expectancies model: aOR = 0.53, $p < .001$) among adolescents. Interestingly, when positive and negative expectancies were included together in the combined model, only greater expectations of product enjoyment was associated with greater e-cigarette use. Previous use of traditional cigarettes, waterpipe tobacco, and cigarillos were all significantly positively associated with e-cigarette use among adolescents in all models (see Table 4).

3.4 Logistic Regression Results for Young Adults

Multiple logistic regression models examining young adult e-cigarette usage also demonstrated an association between higher expected enjoyment and greater likelihood of e-cigarette use (positive expectancies model: aOR = 3.41, $p < .001$, see Table 5). Greater health concerns were also associated with lower young adult e-cigarette usage in the negative (aOR = 0.57, $p < .001$) model. In the combined model, both of these results held, and perceiving e-cigarette users as similar to traditional cigarette smokers (i.e., smoker association) also predicted a lower likelihood of e-cigarette use (aOR = 0.73, $p < .05$). Similar to adolescents, young adults' previous use of traditional cigarettes, waterpipe tobacco, and cigarillos – as well as age – were significantly associated with e-cigarette use (see Table 5).

4. Discussion

This study examined positive (enjoyment, social influences, and advantage over cigarettes) and negative (health concerns, smoker association) outcome expectancies and their associations with e-cigarette use in nationally representative samples of adolescents and young adults. Our results indicate that expected enjoyment was consistently associated with use of e-cigarettes in both adolescent and young adult populations. Enjoyment held for all models in both samples, with higher odds ratios for young adults. This suggests that expected enjoyment of e-cigarettes – including factors such as taste, stress relief, and doing vape tricks – is a major factor in e-cigarettes’ appeal to adolescents and young adults, mirroring some previous research on adolescent and young adult perceptions of e-cigarettes (Kong et al., 2014; Pepper et al., 2017; Pokhrel et al., 2018). These findings are also consistent with work showing that e-cigarettes come in a wide variety of flavors that are very appealing to youth (Jackler & Ramamurthi, 2017; Vasiljevic, Petrescu, & Marteau, 2016).

While perceptions of e-cigarette enjoyment was associated with a greater likelihood of use, expectancies of negative health concerns were associated with a lower likelihood that adolescents and young adults had used e-cigarettes. In combined positive/negative models, negative health concerns were only associated with a lower likelihood of young adult ever use, but not for adolescents. This may indicate that beliefs about enjoyment (e.g., flavors, stress relief) essentially cancel out concerns about the health consequences of using e-cigarettes for adolescents. Our findings thus suggest that beliefs about the harms of e-cigarettes likely play a role in their use, and are consistent with prior research that finds individuals with low perceptions of e-cigarette risk to be more likely to use e-cigarettes (Gorukanti, Delucchi, Ling, Fisher-Travis, & Halpern-Felsher, 2017; Pokhrel et al., 2018; Pokhrel et al., 2014).

Despite evidence from previous research as to the negative effects of exposure to e-cigarettes in social environments (Pepper et al., 2017; Phua, Jin, & Hahm, 2017; Pu & Zhang, 2017), our study found no associations between positive social influence outcome expectancies and e-cigarette use for either adolescents or young adults after controlling for demographics, tobacco use, and other outcome expectancies. Negative social influences (smoker association) were only significantly associated with e-cigarette use among young adults in our model combining positive and negative expectancy dimensions. While interesting, these findings should be interpreted with caution. Our analyses were only able to examine associations between outcome expectancies and ever having used e-cigarettes. This precluded our study from examining more granular differences in outcome expectancies that may exist between experimenters and frequent users (Gibson et al., 2018; Morean & L’Insalata, 2017). Considering this, the relative lack of social influence on ever use among adolescents and young adults may indicate that expectancies regarding personal effects (enjoyment or health risks) are more strongly associated with the initial decision to use e-cigarettes, whereas social influences may help reinforce and extend use over time.

Using nationally representative samples, we demonstrated fairly similar findings with regard to what outcome expectancies are associated with e-cigarette use in both adolescents and youth adults. One of the key findings is the association of expectancies of personal

enjoyment and use among both adolescents and young adults. Enjoyment expectancies were the only dimension associated with both cohorts across positive and combined expectancy models. These findings are similar to previous research which has highlighted the importance of positive beliefs about the experience of using e-cigarettes among adolescents (Patrick et al., 2016) and young adults (Pokhrel et al., 2018). Our findings add additional empirical support for the need for the development of public health messaging and educational campaigns to message against experiential outcomes. Previous research examining self-reported side effects of e-cigarette use provides potential negative personal experience outcomes that could be incorporated into messages. For example, messages might emphasize the potential for users to experience bleeding gums, sore or dry throat, or headaches after using e-cigarettes (Dawkins, Turner, Roberts, & Soar, 2013; Farsalinos, Romagna, Tsiapras, Kyzopoulos, & Voudris, 2014). Messages could also help young people understand the personal, social and health consequences of nicotine addiction, which may help reduce expected enjoyment of e-cigarette use (Roditis, Jones, Dineva, & Alexander, 2019).

In addition to associations between personal enjoyment expectancies, our study provides additional empirical evidence about the associations between health harm perceptions and e-cigarette use. Our data on the role of health harm perceptions supports the need for education about potential health hazards of e-cigarettes, which could be achieved through product warnings, tobacco education campaigns, and other interventions for youth (Noar et al., 2018). Indeed, increasing the perceptions of harm from e-cigarettes should be an immediate priority for youth tobacco prevention and education efforts. Toward this end, the FDA's *The Real Cost* campaign has begun to communicate about the risks of e-cigarettes, an important step forward in communicating with adolescents about e-cigarettes. Of course, other policy solutions such as restricting flavors and regulating advertising – both of which have been enacted with traditional cigarettes – are other avenues to be considered given their potential to reduce the appeal of e-cigarettes to youth.

Our study is not without limitations. The data presented in this study are cross-sectional, and we are unable to make causal conclusions about the role of these beliefs in impacting behavior. Also, while we constructed five scales representing potentially important dimensions of outcome expectancies (Gibson et al., 2018), our scales may have excluded other potentially important outcome expectancies. Recent work published since our data were collected contribute important measurement instruments and possible additional domains of e-cigarette beliefs that were not available at the time of our study (Morean & L'Insalata, 2017; Pokhrel et al., 2018). Additionally, our data were limited by only examining ever use of e-cigarettes. This limitation prevented our ability to examine more granular associations among experimenters and regular users for both adolescents and young adults, something that future studies should examine. Finally, our study did not employ an exploratory factor analysis as some prior outcome expectancy research has done (Diez et al., 2019; Pokhrel et al., 2014). Since our items were in the context of a national survey, we were limited to an a priori set of items that did not allow for a large item pool of candidate items.

Future research examining outcome expectancies for both adolescents and young adults should build upon our findings and examine how social influence outcomes impact not only

ever use but also frequency of e-cigarette use. It should also be noted that, while research examining differences in expectancies between e-cigarette users and never-users is common (see Pokhrel et al., 2014; Trinidad et al., 2017), the sources of knowledge informing e-cigarette perceptions within these groups is different. E-cigarette users' expectancies are informed by personal experience, while never users' expectancies are indirectly formed through exposure to advertising, seeing other people use e-cigarettes, and so forth. Future work on adolescent and young adult outcome expectancies should attempt to determine the most influential media sources and discussion networks that influence, shape, and form expectancies about e-cigarette use. Future outcome expectancy research should also consider including expectancy dimensions examining whether outcomes such as appearing to be more like an influential media referent (such as a prominent e-cigarette using celebrity or influencer) or the ability to share e-cigarettes with close friends may influence e-cigarette use or dependency.

Altering outcome expectancies – and ultimately decreasing e-cigarette use among young people – will be best informed by the careful study of what factors shape outcome expectancies as well as what kinds of messages may change those beliefs. Future research should investigate not only the sources of information that inform outcome expectancies, but also how the strength of different outcome expectancy dimensions influences use. Investigating the relative strength of e-cigarette outcome expectancies would more fully align e-cigarette research with theories of reasoned action (Ajzen & Fishbein, 1980) as well previous expectancy research into traditional cigarettes (Stacy et al., 1990). Determining the effects of strongly versus weakly held e-cigarette outcome expectancies could aid future message design to combat the most salient e-cigarette outcome expectancies for at-risk populations. Such messages could ultimately be deployed in the form of product warnings and in communication campaigns to reduce e-cigarette use behavior among adolescents and young adults. These are worthy efforts, as their ultimate result will be decreased tobacco use and improved public health for our nation's youth.

Acknowledgments

Research reported in this publication was supported by P50CA180907 from the National Cancer Institute and the 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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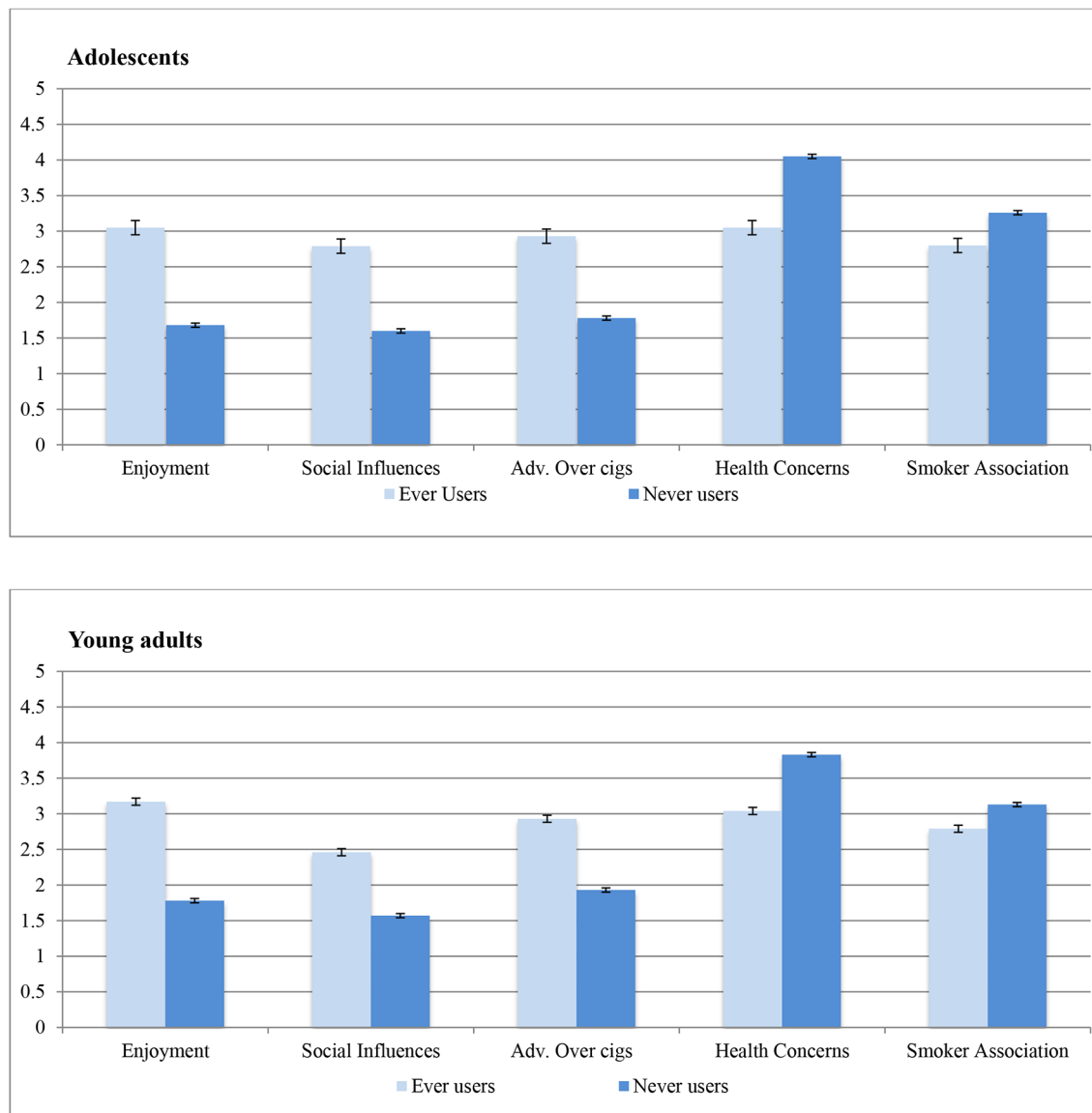


Figure 1: Outcome Expectancy Domain Means by Age Group and E-cigarette Ever-Use Status
Note. Error bars indicate standard errors. All expectancy dimension differences between users and non-users for both adolescents and young adults were statistically significant ($p < .001$).

Table 1.

Positive and Negative Outcome Expectancy Items and Subscales

Positive Outcomes "If I were to use an e-cigarette or other vaping device, I would."	Negative Outcomes "If I were to use an e-cigarette or other vaping device, I would."
Enjoyment ($\alpha = .93, .91$)	Health concerns ($\alpha = .87, .84$)
Like it (.90, .88) ^a	Worry about my health (.67, .61) ^d
Enjoy the taste (.89, .88) ^a	Wonder what I was inhaling (.62, .56) ^d
Feel less stressed (.87, .87)	Get sick because I wouldn't know when to stop (.86, .80)
Do vape tricks (.87, .76)	Get addicted (.86, .85)
Social influences ($\alpha = .88, .83$)	Smoker association ($\alpha = .79, .75$)
Have fun using it with friends (.94, .93)	Not get enough nicotine (.78, .75) ^{e,f}
Feel sophisticated (.74, .62) ^b	End up using other tobacco products too (.61, .55) ^e
Be more popular (.82, .71) ^b	Look like I was smoking cigarettes (.83, .76) ^f
Advantage over cigarettes ($\alpha = .90, .88$)	Look like I was trying to quit smoking (.75, .74)
Be safer than if I smoked cigarettes (.81, .77) ^c	
Have a better way to get nicotine (.84, .81) ^c	
Be able to hide use from others (e.g. parents) (.86, .76)	
Be able to vape wherever I want (.85, .85)	

Note. For expectancy scales: first coefficient alpha is for adolescents; second alpha is for young adults. For expectancy items: first number is adolescent item factor loading; second is for young adults. Superscript letters indicate items with correlated error variances. Correlated item variances were the same for both adolescent and young adult samples.

Table 2.Demographic and Tobacco Characteristics of the Adolescents ($N=1,298$) and Young Adults ($N=2,219$)

	Adolescents N (%) or <i>M</i> (SD)	Young Adults N (%) or <i>M</i> (SE)
Age	15.0 (1.38)	21.6 (2.33)
Sex		
Male	675 (51.1)	912 (41.1)
Female	623 (48.9)	1,307 (58.9)
Race/Ethnicity		
White	964 (70.7)	1622 (69.2)
Black	149 (15.2)	243 (15.3)
Asian/Pacific Islander	47 (4.1)	84 (6.0)
Mixed race or Other	137 (9.9)	239 (9.5)
Hispanic		
Yes	231 (22.7)	438 (21.6)
No	1,067 (82.3)	1,781 (79.4)
Parental Education		
Mother graduated college	556 (38.6)	749 (29.3)
Father graduated college	534 (38.0)	734 (29.3)
Tobacco Use (Ever Use)		
E-cigarettes	153 (11.6)	624 (29.8)
Cigarettes	172 (13.8)	890 (41.1)
Waterpipe	47 (3.8)	572 (23.0)
Cigarillos	60 (5.2)	529 (24.0)

Note. Percentages and means are weighted.

Table 3. Means, Standard Deviations, Correlations among Outcome Expectancy Subscales and E-cigarette Use

	Adolescents <i>M</i> (SD) or <i>N</i> (%)		Young Adults <i>M</i> (SD) or <i>N</i> (%)		1	2	3	4	5	6
1 + Enjoyment	1.84 (0.98)	2.19 (1.14)	-	0.84***	0.74***	-0.41***	-0.15***	0.53***		
2 + Social aspects	1.74 (0.92)	1.83(0.91)	0.87***	-	0.70***	0.34***	-0.07***	0.41***		
3 + Adv. over cigarettes	1.92 (1.00)	2.22 (1.09)	0.80***	0.77***	-	-0.37***	-0.10***	0.39***		
4 - Health concerns	3.94 (0.97)	3.60 (1.02)	-0.49***	-0.46***	-0.47**	-	0.57***	-0.35***		
5 - Smoker association	3.21 (0.96)	3.03 (0.95)	-0.24***	-0.17***	-0.21***	0.58***	-	-0.16***		
6 E-cig ever use	153 (11.6)	624 (29.8)	0.44***	0.40***	0.36***	-0.16***	-0.16***	-		

Note. Adolescents in lower diagonal; Young adults in upper diagonal. + = positive expectancy; - = negative expectancy; M=mean, SD=standard deviation.

p<.001.

Table 4.Weighted Logistic Regression Results for Adolescents ($n = 1,298$)

	Ever used e-cigarettes (Model 1: Positive Expectancies) aOR (95% CI)	Ever used e-cigarettes (Model 2: Negative Expectancies) aOR (95% CI)	Ever used e-cigarettes (Model 3: Both Expectancies) aOR (95% CI)
Demographics			
Age	1.01 (0.85 – 1.20)	0.94 (0.81 – 1.11)	0.99 (0.84 – 1.18)
Sex			
Female	REF		REF
Male	.094 (0.56 – 1.61)	0.94 (0.59 – 1.59)	0.94 (0.56 – 1.59)
Race			
White	REF	REF	REF
Black	0.46 (0.14 – 1.54)	0.62 (0.20 – 1.96)	0.60 (0.20 – 1.81)
Asian/Pacific Islander	0.44 (0.08 – 2.44)	0.53 (0.11 – 2.48)	0.47 (0.08 – 2.72)
Other or Mixed race	1.23 (0.55 – 2.74)	1.28 (0.59 – 2.77)	1.09 (0.46 – 2.54)
Hispanic			
No	REF	REF	REF
Yes	1.22 (0.61 – 2.44)	1.37 (0.70 – 2.69)	1.37 (0.69 – 2.72)
Mother graduated college			
No	REF	REF	REF
Yes	1.12 (0.64 – 1.98)	1.22 (0.72 – 2.06)	1.07 (0.63 – 1.85)
Father graduated college			
No	REF	REF	REF
Yes	0.63 (0.34 – 1.18)	1.37 (0.70 – 2.69)	0.77 (0.43 – 1.37)
Tobacco use			
Ever used cigarettes	4.02 (2.14 – 7.55) ***	6.05 (3.42 – 10.68) ***	3.83 (2.06 – 7.10) ***
Ever used waterpipe	6.50 (2.64 – 16.00) ***	6.50 (2.64 – 16.00) ***	6.10 (2.39 – 15.57) ***
Ever used cigarillos	5.07 (1.98 – 13.00) ***	8.60 (3.41 – 21.66) ***	6.32 (2.48 – 16.11) ***
Outcome expectancies			
Enjoyment	2.06 (1.13 – 3.77) *	-	2.10 (1.18 – 3.73) *
Social influences	1.33 (0.72 – 2.45)	-	1.45 (0.77 – 2.75)
Adv. over cigarettes	0.99 (0.68 – 1.43)	-	0.93 (0.66 – 1.33)
Health concerns	-	0.53 (0.40 – 0.71) ***	0.87 (0.62 – 1.21)
Smoker association	-	0.90 (0.65 – 1.26)	0.68 (0.45 – 1.01)

Note. aOR = adjusted odds ratio. CI = confidence interval. REF= reference group.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Table 5.Weighted Logistic Regression Results for Young Adults ($n = 2,219$)

	Ever used e-cigarettes (Model 1: Positive Expectancies) aOR (95% CI)	Ever used e-cigarettes (Model 2: Negative Expectancies) aOR (95% CI)	Ever used e-cigarettes (Model 3: Both Expectancies) aOR (95% CI)
Demographics			
Age	0.92 (0.85 – 1.00)*	0.87 (0.81 – 0.94)*	0.92 (0.85 – 1.00)*
Sex			
Female	REF		REF
Male	1.06 (0.75 – 1.50)	1.27 (0.92 – 1.77)	1.14 (0.80 – 1.62)
Race			
White	REF		REF
Black	0.80 (0.44 – 1.45)	0.71 (0.43 – 1.17)	0.68 (0.38 – 1.19)
Asian/Pacific Islander	1.07 (0.52 – 2.19)	1.38 (0.70 – 2.72)	1.02 (0.52 – 1.98)
Other or Mixed race	1.09 (0.65 – 1.83)	1.00 (0.59 – 1.70)	0.97 (0.58 – 1.62)
Hispanic			
No	REF		REF
Yes	0.67 (0.42 – 1.08)	0.70 (0.44 – 1.12)	0.66 (0.41 – 1.07)
Mother graduated college			
No	REF		REF
Yes	0.75 (0.50 – 1.14)	0.83 (0.54 – 1.25)	0.75 (0.49 – 1.15)
Father graduated college			
No	REF		REF
Yes	0.60 (0.39 – 0.94)*	0.55 (0.35 – 0.85)*	0.59 (0.36 – 0.90)*
Tobacco use			
Ever used cigarettes	3.86 (2.62 – 5.67)***	5.07 (3.53 – 7.28)***	3.86 (2.62 – 5.67)***
Ever used waterpipe	3.55 (2.34 – 5.39)***	4.63 (3.14 – 6.82)***	3.55 (2.34 – 5.39)***
Ever used cigarillos	1.65 (1.10 – 2.49)***	2.26 (1.52 – 3.38)***	1.65 (1.10 – 2.49)*
Outcome expectancies			
Enjoyment	3.41 (2.52 – 4.63)***	-	3.08 (2.25 – 4.22)***
Social influences	0.78 (0.57 – 1.08)	-	0.87 (0.63 – 1.20)
Adv. over cigarettes	1.00 (0.79 – 1.27)	-	1.00 (0.78 – 1.28)
Health concerns	-	0.57 (0.46 – 0.70)***	0.70 (0.53 – 0.88)**
Smoker association	-	0.91 (0.71 – 1.15)	0.73 (0.55 – 0.96)*

Note. aOR = adjusted odds ratio. CI = confidence interval. REF= reference group.

* $p < .05$,

** $p < .01$,

*** $p < .001$.