BRIEF REPORT

Correlates of Ever Having Used Electronic Cigarettes Among Older Adolescent Children of Alcoholic Fathers

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ABSTRACT

Introduction: Few studies have examined predictors of ever having used electronic cigarettes (or e-cigarettes) among older adolescents. This study examined correlates of ever having used e-cigarettes among adolescent children of alcoholic fathers.

Methods: Participants were 136 adolescents (50.7% male, 89.4% European American) from an ongoing longitudinal case-control study of children of alcoholic fathers. Adolescents reported on their mother's and father's parenting during middle adolescence (MA; *M* age = 13.8) and completed measures of their own, as well as their peers', substance use during late adolescence (LA; *M* age = 17.0). Parents completed measures of their own substance use at the MA assessment.

Results: More than one third (36.9%) of the participants reported ever using e-cigarettes. Parental monitoring during MA (odds ratio [*OR*] = 0.85, *p* < .05), lifetime use of cigarettes (*OR* = 3.88, *p* < .01), alcohol use (*OR* = 7.72, *p* < .05), marijuana use (*OR* = 4.07, *p* < .01), and peer substance use (*OR* = 1.34, *p* < .05) during LA were each uniquely associated with ever having used e-cigarettes. Ever having used e-cigarettes also was associated with more frequent current cigarette use (β = .38, *p* < .05), alcohol use (β = .30, *p* < .01), and marijuana use (β = .31, *p* < .05).

Conclusions: Results suggest that ever having used e-cigarettes in LA is a risk marker for substance use. Interventions to promote parental monitoring may be effective in curbing use of e-cigarettes and other substances in LA.

INTRODUCTION

Research suggests adolescent electronic cigarette (e-cigarette) use has been increasing rapidly. Although rates of conventional cigarette use have declined among high school students (from 28% in 2000 to 16% in 2011),¹ rates of e-cigarette use doubled from 2011 to 2012 (from 4.7% to 10.0% ever using e-cigarettes, 1.5% to 2.8% using in past 30 days).² These rates are likely low, given that these data are from 2012, when e-cigarettes were not as widely available and given that e-cigarettes are largely unregulated, often without restrictions on use by or sale to minors.²

Perhaps most alarming, among the 1.78 million middle and high school students who report ever using e-cigarettes, 160,000 (9%) reported never trying conventional cigarettes,² suggesting e-cigarettes may be an entry point for tobacco use. In a review of the literature, 7%–32% of adolescents who had used an e-cigarette had never used a conventional cigarette.³ Authors noted that this indicated that some adolescents were initiating nicotine use first with e-cigarettes instead of regular cigarettes. In fact, e-cigarettes may be advertised to appeal

to younger consumers,⁴ as celebrities have used them on television (e.g., Katherine Heigl on *The Late Show with David Letterman*)⁵ and have served as spokespeople for products (e.g., Jenny McCarthy for *Blu*).⁶ and marketing strategies have included creation of a “cool,” insiders’ culture, with its own lingo (e.g., “vaping”).⁶ Given that 90% of smokers begin tobacco use in their teens⁷ and e-cigarettes may introduce tobacco to individuals who would not use tobacco in conventional ways, understanding adolescents’ use of e-cigarettes is of great importance.

To date, few studies of adolescent e-cigarette use have been published. Among a national sample of adolescent males, two thirds were aware of, and one fifth was willing to try, e-cigarettes.⁸ In another nationally representative cross-sectional sample, among middle and high school cigarette “experimenters” (having had at least one puff of a cigarette), e-cigarette use was associated with high risk of lifetime smoking and current smoking.⁹ Adolescent males reported using e-cigarettes because they were discreet and efficient, more readily accessible, and perceived to be healthier than conventional cigarettes.¹⁰ Adolescents also frequently used e-cigarettes as

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smoking cessation devices; however, those who used e-cigarettes in quit attempts were less likely to quit smoking than those who did not.¹¹

Adult e-cigarette research also may inform studies of adolescents. Although quitting or reducing smoking was the primary reported use,^{12,13} many adults report using e-cigarettes to continue smoking with fewer perceived consequences¹² or to increase smoking in situations in which conventional smoking is limited by social mores and/or legal restrictions.¹³ Supporting this, both adult and adolescent e-cigarette users tend to also use conventional cigarettes, rather than ceasing conventional cigarette use.^{2,14}

In this study, we examined associations between ever using e-cigarettes and substance use (conventional cigarettes, marijuana, and alcohol) among children of alcoholic fathers and demographically matched controls. We also examined three domains of risk or protective factors as predictors of ever using e-cigarettes: parental behavior (parental monitoring and substance use), peer substance use, and conventional adolescent substance use. We hypothesized that parental monitoring would predict lower risk of ever using e-cigarettes, that parental substance use, peer substance use, and conventional substance use by the adolescent would increase the risk of ever using e-cigarettes, and that ever using e-cigarettes would predict greater current (30-day) cigarette, alcohol, and marijuana use, among those who ever used these substances.

METHODS

Participants and Procedures

Participants were part of an ongoing longitudinal study examining developmental outcomes in children of alcoholic and matched control parents. Participants were initially recruited when the children were 12 months old, with 227 families classified into one of two groups: families with no or few alcohol problems since the child's birth (non-alcoholic group; $n = 97$) and families with alcoholic fathers (father-alcoholic group; $n = 130$). Families were assessed nine times (12, 18, 24, 36, and 48 months, and during kindergarten, fourth grade, sixth grade, middle adolescence [MA; M age = 13.8, $SD = 0.4$], and late adolescence [LA; M age = 17.0; $SD = 1.0$]). Recruitment procedures, inclusion and exclusion criteria, and determination of alcohol group status are described in greater detail in previous papers (e.g., see Eiden and colleagues¹⁵). This study includes data from the MA and LA assessments. At each age, both parents completed questionnaires and children completed questionnaires about substance use, their perception of parents' parenting behaviors, and peer substance use.

Data from the first 136 families who completed ongoing data collection at both the MA and LA assessments were used in this study. Of the adolescent participants (50.7% male), 89.4% were European American, 3.8% were African American, and 6.8% were of mixed ethnicity; 41.9% of mothers and 48.5% of fathers had no more than a high school diploma; 58.6% of biological parents were married and 36.0% were divorced/separated. On average, mothers were 43.7 years old ($SD = 4.5$; 32–54) and fathers were 46.0 ($SD = 5.9$; 34–71) at the MA assessment, with 56.6% of fathers meeting *Diagnostic and Statistical Manual of Mental Disorders IV* criteria for alcohol abuse or dependence.

Measures

Assessed During MA

The University of Michigan version of the Composite International Diagnostic Interview^{16,17} was used to assess parental alcohol abuse and dependence at the MA assessment. Details of group classification have been reported previously (see Eiden and colleagues¹⁵). To assess parental cigarette use at the MA assessment, mothers and fathers were asked "Do you currently smoke?" To assess parental marijuana use, they were asked "Have you used marijuana in the last 12 months?"

Perceived parental monitoring was assessed at MA by asking adolescent participants about their parents' knowledge of their behavior using an 18-item scale with responses ranging from *never* (0) to *always* (4). This scale includes items such as "How often does your [mom/dad] know what you do with your free time?"¹⁸ The scale had high internal consistency ($\alpha = .92$).

Assessed During LA

To assess substance use at the LA assessment, adolescent participants were asked whether they had *ever* used an e-cigarette, had more than a few sips of alcohol, smoked cigarettes, or used marijuana. Participants were also asked on how many of the last 30 days they had more than a few sips of alcohol or smoked cigarettes, with responses ranging from 0 days (0) to 20–30 days (6), and on how many occasions they used marijuana in the last 30 days, with responses ranging from *never* (0) to 40 or *more times* (6).

To assess peer substance use, adolescent participants were asked how many members of their peer group smoked cigarettes, drank alcohol, and used marijuana, with responses ranging from *none* (0) to *all* (4). This 3-item scale had adequate internal consistency ($\alpha = .74$).

Data Analytic Plan

Analyses were conducted using SPSS Statistics 21.¹⁹ First, descriptive analyses were conducted to examine the proportion of adolescents who used e-cigarettes and other substances. Then, the associations between e-cigarette use and cigarette, alcohol, and marijuana use, as well as parent characteristics including alcohol group status, parental cigarette and marijuana use, and parental knowledge, were examined. In order to determine the unique association between these variables and e-cigarette use, the variables that were significantly associated with e-cigarette use in bivariate analyses were then entered into a logistic regression predicting e-cigarette use. Lastly, regression analyses were run to examine the association between e-cigarette use and current cigarette and marijuana use among those who have ever used cigarettes or marijuana.

RESULTS

Over one third (36.9%) of adolescents reported using an e-cigarette at least once. Among adolescents who ever used an e-cigarette, 68.9% reported ever smoking a conventional cigarette; however, a substantial minority (31.1%) reported never smoking a cigarette. Adolescents who used cigarettes, marijuana, or alcohol were significantly more likely to report

Table 1. Characteristics of Sample, by Ever Used an Electronic Cigarette Status

Variables	Ever used an electronic cigarette	Never used an electronic cigarette	Significance test	
	% or <i>M</i> (<i>SD</i>)	% or <i>M</i> (<i>SD</i>)	χ^2	<i>t</i>
Child characteristics				
Gender ^a	60.0	45.5	2.40	
Ever smoked cigarettes ^b	68.9	14.3	37.51***	
Ever smoked marijuana ^b	84.4	28.6	35.48***	
Ever had more than a few sips of alcohol ^b	97.8	62.3	19.24***	
Parent characteristics				
Father alcoholism ^b	66.7	48.1	3.98*	
Mother smoking ^b	24.3	21.7	.40	
Father smoking ^b	37.5	28.8	1.61	
Mother marijuana use in last 12 months ^b	10.8	5.8	.87	
Father marijuana use in last 12 months ^b	21.9	13.6	1.04	
Parental monitoring	26.75 (5.78)	30.88 (3.68)		4.00***
Peer characteristics				
Peer substance use	3.05 (3.87)	1.64 (2.81)		2.18*

^aPercentage male.^bPercentage reporting "yes."* $p < .05$; *** $p < .001$.

ever having used e-cigarettes (see Table 1). Fathers' alcohol group status was significantly associated with ever having used e-cigarettes, although other parental substance use was not. Higher parental monitoring in MA was negatively associated with ever using e-cigarettes in LA. Lastly, higher peer substance use was positively associated with ever using e-cigarettes. There were no significant gender differences in ever using e-cigarettes.

Logistic regression was used to examine the unique associations of cigarette, marijuana, and alcohol use, parental knowledge, fathers' alcoholism, and peer substance use with adolescents' e-cigarette use. Given temporal precedence, the MA parent characteristics were entered in Model 1, and the LA child and peer substance use characteristics were added in Model 2. Parental monitoring was associated with significantly lower risk of e-cigarette use in Model 1, and remained significant after the addition of the adolescent and peer substance use variables in Model 2. The association between paternal alcoholism and risk of e-cigarette use was nonsignificant. In Model 2, smoking cigarettes, using marijuana, and drinking alcohol were each associated with an increased risk of e-cigarette use (see Table 2). Similarly, peer substance use was associated with a higher risk of using e-cigarettes.

Multiple regressions were used to examine associations between e-cigarette use and frequency of smoking, using marijuana, and using alcohol among those who had ever used each of these substances. Among those who had smoked ($n = 46$), e-cigarette use was associated with more frequent use of cigarettes over the prior 30 days ($\beta = .38$, $p < .05$, adjusted $R^2 = .12$). Among those who had used marijuana ($n = 69$), e-cigarette use was associated with greater use of marijuana over the prior 30 days ($\beta = .31$, $p < .05$, adjusted $R^2 = .08$). Among those who had ever had more than a few sips of alcohol ($n = 101$), e-cigarette use was associated with more frequent

Table 2. Logistic Regression Predicting Odds for Electronic Cigarette Use

Variables	Model 1	Model 2
Parent characteristics		
Alcohol status ^a	2.16 ^t	1.16
Parental monitoring	.83**	.85**
Child characteristics		
Cigarette use ^b		3.88**
Marijuana use ^b		4.07**
Alcohol use ^c		7.72*
Peer characteristics		
Peer substance use		1.34*
χ^2	19.07***	57.34***
-2 Log likelihood	118.07	79.80
Cox and Snell R^2	.17	.45

^a0 = control group, 1 = father alcoholic.^b0 = never used; 1 = used at least one time.^c0 = never had more than a few sips; 1 = had more than a few sips at least one time.^t $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

consumption of more than a few sips of alcohol over the prior 30 days ($\beta = .30$, $p < .01$, adjusted $R^2 = .08$).

DISCUSSION

Cigarette smoking, marijuana use, and alcohol use were each uniquely associated with a greater likelihood of ever using e-cigarettes, as was peer use of these substances. Parental monitoring was associated with a lower likelihood of e-cigarette use. Although children of alcoholic fathers were more likely

to use e-cigarettes, alcohol group status did not account for unique variance with parental monitoring in the model. Lastly, e-cigarette use was associated with current levels of cigarette, marijuana, and alcohol use among those who have ever used each of these substances.

Although conventional cigarette smoking was a strong predictor of e-cigarette use, 31% of e-cigarette users in this study had never smoked conventional cigarettes, a higher percentage than has been found in most previous studies.² This may reflect rapid increases in e-cigarette use among adolescents or may be a reflection of the nature of the sample (adolescents at higher risk due to parental substance use). In this study, adolescents who used marijuana and alcohol, and those whose peers used these substances, were more likely to have used e-cigarettes. E-cigarette use was also associated with current frequency of cigarette, alcohol, and marijuana use among those who had ever used these substances. These findings suggest that e-cigarette use is part of a broader constellation of substance use for many adolescents. Future research should prospectively examine whether e-cigarette use may put adolescents at higher risk of engaging in, maintaining, or increasing their use of a variety of substances, not just tobacco. At least among adolescents, e-cigarettes may be of limited use in reducing the use of other, possibly more harmful, sources of nicotine. However, it is possible that among adolescent smokers, e-cigarette use may be a less harmful alternative. Prospective studies assessing adolescent substance use at frequent intervals may be better designed to address this issue.

Previous studies have found that parental monitoring is associated with lower use of cigarettes, alcohol, and other substances among adolescents.²⁰ However, this is the first study to report an association between parental monitoring and e-cigarette use. This association is independent of paternal alcoholism and other substance use, suggesting that parental monitoring remains an important protective factor in reducing the risk of adolescent e-cigarette use, even in families at high risk due to parental substance use. Interventions targeting parental monitoring may have a beneficial impact on adolescent e-cigarette use.

There were several limitations of this study. Adolescents' e-cigarette, other substance, and peer substance use were all measured at the same timepoint, making it impossible to determine causality among these variables. It is very possible that an unmeasured variable accounts for the observed associations. Future research should examine growth in e-cigarette and other substance use longitudinally to disentangle these associations. Furthermore, a more fine-tuned measure of quantity of e-cigarette use would have improved our power to detect associations and allowed a better understanding of adolescents' frequency and intensity of e-cigarette use. This study also had a limited sample size. This restricted our ability to examine moderators such as gender in our analyses. Lastly, qualitative research examining the contexts and perceptions of e-cigarette use among adolescents may also shed light on other correlates or risk factors not previously considered.

Although e-cigarette use is increasing rapidly in adolescents,²⁰ few previous studies have examined the correlates of e-cigarette use among adolescents, and this is the first to examine correlates of e-cigarette use among adolescent children of alcoholic fathers and matched controls. This is also the first study to examine associations between parental monitoring and e-cigarette use. Our findings suggest that e-cigarette use occurs

in the context of other types of substance use, including alcohol and marijuana, as well as conventional smoking. Regulations aimed at restricting adolescents' access to e-cigarettes may have broader beneficial impacts as a result.

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The opinions, findings and conclusions or recommendations expressed in this exhibition are those of the authors and do not necessarily reflect those of the Department of Justice or the National Institutes of Health.

DECLARATION OF INTERESTS

None declared.

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