

Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eAppendix. Supplementary Methods

Supplemental Information of Vaping and Mental Health Variables Assessment

Outcomes for longitudinal analysis. At baseline and follow-up assessments, four e-cigarette use variables were assessed. First, two separate questions were used to assess past 6-month use of: (1) “e-cigarettes for nicotine” and (2) “e-cigarettes without nicotine or hash oil”.¹ Participants who responded affirmatively to either e-cigarette question (or both) were classified as past 6-month e-cigarette users. Participants reported their past 30-day frequency and daily intensity of e-cigarette use. The number of days they used e-cigarette with nicotine in the past 30 days was measured (response options: 0, 1-2, 3-5, 6-9, 10-14, 15-19, 20-24, 25-29, all 30 days). These response categories were transformed into quantitative count variables by taking the mean integer value of each ordinal past 30-day frequency variable as in past work²: 0, 2, 4, 8, 12, 17, 22, 27, 30. For the daily intensity variables, participants reported the number of nicotine vaping sessions on each vaping day (response options: 0, 1, 2, 3-5, 6-9, 10-14, 15-20, >20 times per day) as well as the number of puffs per nicotine vaping sessions (response options: 0, 1, 2, 3-5, 6-9, 10-14, 15-20, >20 puffs). These response categories were also transformed into quantitative count variables by taking the lowest value of each ordinal category (i.e., 0, 1, 2, 3, 6, 10, 15, 20) for use in the daily intensity analyses, consistent with prior work.³

Mental health. Students were administered the Revised Child Anxiety and Depression Scales (RCADS),⁴ which instructs respondents to rate the frequency with which they experienced Diagnostic and Statistical Manual of Mental Disorders—4th Edition⁵ emotional disorder symptoms on a 4-point scales (0 [Never] to 3 [Always]). The RCADS yields separate subscale sum severity scores for major depressive disorder (MDD; 10 items; Cronbach’s α in this sample = .94), generalized anxiety disorder (GAD; 6 items; α = .91), social phobia (SP; 9 items; α = .93), panic disorder (PD; 9 items; α = .93), and obsessive compulsive disorder (OCD; 6 items; α = .86). Past year mania was assessed using the Mood Disorder Questionnaire (MDQ).⁶ The MDQ has 15 items (0=no, 1=yes), which reflect different DSM-IV manic or hypomanic symptoms or behaviors, which were summed (α = .78). Attention-Deficit/Hyperactivity Disorder (ADHD) symptom was measured using the Current Symptoms Self-Report Form⁷ measure of the DSM-IV criteria, which include nine inattention symptoms (e.g., difficulty organizing and completing tasks) and nine hyperactivity-impulsivity symptoms (e.g., trouble remaining still or with task persistence). Respondents rated the frequency that they experienced each symptom in the preceding 6 months: never or rare (=0), sometimes (=1), often (=2), or very often (=3); responses to the 18 items are summed (α = .93). Conduct problems were measured with a sum of frequency ratings for engaging in 11 behaviors (e.g., ‘stealing,’ ‘lying to parents’; each item rated: 1 [never] to 6 [\geq 10 times]; α = .79) in the past 6-months.⁸

E-cigarette Dependence Risk Propensity Score Calculation

Adjustment for a risk propensity score is a desirable alternative to conventional multi-variable simultaneous covariate adjustment, which can result in unstable model estimates and model “overfitting” when a large number of covariates are considered.⁹⁻¹¹ The propensity score variable was derived from a prediction model in which baseline e-cigarette dependence status regressed on all 25 baseline variables presented in Table 1 (i.e., youth gender, age, race/ethnicity, parental education level, e-cigarette use onset age, past year combustible cigarette smoking, past 30-day number of days smoked cigarettes, past 30-day number of cigarette smoked per day, ever use of cigar, hookah, or smokeless tobacco, ever alcohol use, ever smoked cannabis, ever vaped cannabis, ever other drug use, major depressive disorder, generalized anxiety disorder, panic disorder, social phobia, obsessive compulsive disorder, mania, ADHD, and conduct problems). Onset age of combustible cigarette use is reported in Table 1, but was not included in the propensity score because only dual users provided this information. A propensity score was then calculated from the estimates derived from the logistic regression model including the 25 covariates. Adjusted models presented in Table 3 includes the propensity score as a covariate.

eTable 1. Sociodemographic Characteristics of Included and Excluded Youth in the Primary Analytic Sample

Variable	Excluded from analytic sample (N=2,952)					Primary analytic sample (N=444) ^f	Test of overall group difference ^g
	Not surveyed at fall 12 th grade (N=228) ^a	No past year e-cigarette use (N=2520) ^b	Did not answer e-cigarette use questions (N=7) ^c	Administered abbreviated survey that omitted vaping dependence items (N=181) ^d	Not surveyed at 6-month follow-up (N=16) ^e		
	N (%) / M (SD)	N (%) / M (SD)	N (%) / M (SD)	N (%) / M (SD)	N (%) / M (SD)	N (%) / M (SD)	P-value
Female (vs. Male), N (%)	86 (37.9) ³	1417 (56.2) ¹	2 (28.6) ^{3,4}	85 (47.2) ^{2,3}	5 (31.3) ^{3,4}	218 (49.1) ²	<.001
Age, year, M (SD)	17.70 (0.45) ^{1,2}	17.49 (0.41) ³	17.80 (0.55) ^{1,2}	17.59 (0.43) ²	17.65 (0.54) ^{1,2}	17.48 (0.39) ^{2,3}	<.001
Race/ethnicity, N (%)							
Hispanic	107 (49.3) ²	1212 (48.9) ²	5 (83.3) ¹	87 (50.6) ²	7 (43.8) ²	187 (42.9) ²	<.001
Asian	18 (8.3) ²	448 (18.1) ¹	0 (0.0) ²	17 (9.9) ²	1 (6.3) ²	76 (17.4) ¹	
African American	19 (8.8) ¹	125 (5.0) ^{1,2}	0 (0.0) ²	6 (3.5) ²	1 (6.3) ^{1,2}	15 (3.4) ²	
White	37 (17.1) ^{1,2}	378 (15.2) ²	1 (16.7) ^{1,2}	34 (19.8) ^{1,2}	6 (37.5) ¹	88 (20.2) ^{1,2}	
Other ^h	36 (16.6) ¹	316 (12.7) ¹	0 (0.0) ¹	28 (16.3) ¹	1 (6.3) ¹	70 (16.1) ¹	
Parents graduated college, N (%) ⁱ	85 (45.9) ¹	1112 (51.1) ¹	3 (60.0) ¹	67 (44.1) ¹	7 (43.8) ¹	208 (52.4) ¹	.37

^aAvailable data (Ns = 185 – 227).

^bAvailable data (Ns = 2176 – 2520).

^cAvailable data (Ns = 5 – 7).

^dAvailable data (Ns = 152 – 181).

^eAvailable data (Ns = 15 – 16).

^fAvailable data (Ns = 397 – 444).

^gCalculated using the χ^2 test for categorical variables and the one-way Analysis of Variance (ANOVA) for continuous variables.

^hOther race/ethnicity = students who selected 'American Indian/Alaskan Native,' 'Native Hawaiian/Pacific Islander,'

'Multiethnic/Multiracial,' or 'Other' options for the forced-choice race/ethnicity question.

ⁱStudents (N=465) who did not respond to the survey question or who marked "don't know" are not included in the denominator.

*Statistically significant after Benjamini-Hochberg corrections for multiple testing to control false discovery rate at .05 (based on two-tailed corrected P-value).

eTable 2. Descriptive Data on Electronic Cigarette Use Patterns Stratified by Use of Electronic Cigarettes With vs Without Nicotine in Past Year

Vaping at 6-month follow-up	Use of e-cigarettes with nicotine in past year (N=444) ^a		Test of Difference ^b
	No (N=168) ^a	Yes (N=276) ^a	
Any past 6-month e-cigarette use, N (%)	44 (26.2)	140 (50.7)	<.001
Past 30-day number of nicotine vaping days, <i>M</i> (<i>SD</i>)	0.38 (1.92)	4.01 (8.34)	<.001
Past 30-day number of nicotine vaping sessions, <i>M</i> (<i>SD</i>)	0.20 (0.91)	2.59 (5.66)	<.001
Past 30-day puffs per nicotine vaping sessions, <i>M</i> (<i>SD</i>)	0.38 (1.30)	1.84 (3.97)	<.001

^aAvailable data Ns for denominator: Overall sample (Ns = 439 – 444), No (N = 168), and Yes (Ns = 271 – 276).

^bCalculated using the χ^2 test for categorical variables and one-way Analysis of Variance (ANOVA) for continuous variables.

eTable 3. Frequency Distribution of Total Number of Tobacco Product Dependence Symptoms

Dependence Symptoms for Respective Product	Any past year e-cigarette users (N=444) ^a	Past year dual users of e-cigarettes and combustible cigarettes (N=146) ^a	
	E-Cigarette Dependence	E-Cigarette Dependence	Combustible Cigarette Dependence
	N (%)	N (%)	N (%)
0 symptoms	392 (88.3)	122 (83.6)	102 (72.3)
1 symptom	18 (4.1)	5 (3.4)	3 (2.1)
2 symptoms	12 (2.7)	5 (3.4)	12 (8.3)
3 symptoms	7 (1.6)	1 (0.7)	8 (5.5)
4 symptoms	7 (1.6)	6 (4.1)	2 (1.4)
5 symptoms	1 (0.2)	0 (0.0)	6 (4.1)
6 symptoms	2 (0.5)	1 (0.7)	3 (2.1)
7 symptoms	2 (0.5)	2 (1.4)	3 (2.1)
8 symptoms	0 (0.0)	0 (0.0)	0 (0.0)
9 symptoms	0 (0.0)	0 (0.0)	3 (2.1)
10 symptoms	5 (1.1)	4 (2.7)	3 (2.1)

^aAvailable data Ns for the respective variable and denominator for percentage.

eTable 4. Electronic Cigarette Dependence Symptoms in Overall Sample and Comparison of Electronic Cigarette and Combustible Cigarette Dependence Symptoms in Past Year Dual Users of Both Products

Dependence Symptoms for Respective Product	Any past year e-cigarette users (N=444)	Past year dual users of e-cigarettes and combustible cigarettes (N=146)			
	E-Cigarette Dependence	E-Cigarette Dependence	Combustible Cigarette Dependence	Within-Person Difference, P-Value	
	N (%) ^a	N (%) ^b	N (%) ^b	Unadjusted ^c	Adjusted ^d
1 or more symptoms	52 (11.7)	24 (16.4)	43 (29.7)	.002	<.001
2 or more symptoms	34 (7.7)	19 (13.0)	40 (27.6)	<.001	<.001
3 or more symptoms	22 (5.0)	14 (9.6)	28 (19.3)	.004	.003
Individual symptoms					
Tried to quit, but couldn't	13 (3.0)	8 (5.6)	12 (8.5)	.42	.15
Use now because it difficult to quit	11 (2.5)	8 (5.6)	12 (8.5)	.39	.17
Felt addicted to product	18 (4.2)	11 (7.9)	20 (14.1)	.14	.06
Strong cravings to use	38 (8.9)	19 (13.4)	34 (24.5)	.009	.002
Felt like needed to use	25 (5.8)	14 (9.9)	40 (29.0)	<.001	<.001
Hard to keep from use where not permitted	14 (3.3)	9 (6.2)	12 (8.6)	.73	.10
Withdrawal symptoms after abstaining					
Difficulty concentrating	7 (1.6)	6 (4.3)	7 (5.0)	.98	.59
Irritability	11 (2.6)	8 (5.7)	14 (10.1)	.06	.05
Strong need or urge to use	16 (3.7)	12 (8.5)	22 (16.2)	.02	.01
Nervous, restless, or anxious	8 (1.9)	7 (5.1)	12 (8.7)	.11	.11

^aAvailable data Ns for the respective variable and denominator for percentage = 420 – 444.

^bAvailable data Ns for the respective variable and denominator for percentage = 135 – 146.

^cWithin-person difference between e-cigarette and combustible cigarette dependence for respective outcome based McNemar's tests.

^dWithin-person difference between e-cigarette and combustible cigarette dependence for respective outcome after adjusting for baseline age of use onset and number of days used in the past 30 for respective product using a general estimating equation model.

eTable 5. Electronic Cigarette Dependence Symptoms in Overall Sample and Comparison of Electronic Cigarette and Combustible Cigarette Dependence Symptoms in Past Year Dual Users

Dependence Symptoms for Respective Product	Past year dual users of e-cigarettes with nicotine and combustible cigarettes (N=120)			
	E-Cigarette Dependence	Combustible Cigarette Dependence	Within-Person Difference, P-Value	
	N (%) ^a	N (%) ^b	Unadjusted ^c	Adjusted ^d
1 or more symptoms	24 (20.0)	39 (32.8)	.009	.001
2 or more symptoms	19 (15.8)	36 (30.3)	.002	<.001
3 or more symptoms	14 (11.7)	24 (20.2)	.03	.02
Individual symptoms				
Tried to quit, but couldn't	8 (6.8)	11 (10.3)	.58	.22
Use now because it difficult to quit	8 (6.8)	12 (10.3)	.39	.18
Felt addicted to product	11 (9.6)	18 (15.5)	.30	.07
Strong cravings to use	19 (16.4)	30 (26.3)	.04	.01
Felt like needed to use	14 (12.1)	36 (31.9)	<.001	<.001
Hard to keep from use where not permitted	9 (8.0)	11 (9.6)	.73	.15
Withdrawal symptoms after abstaining				
Difficulty concentrating	6 (5.2)	7 (6.1)	.99	.58
Irritability	8 (7.0)	12 (10.6)	.18	.12
Strong need or urge to use	12 (10.4)	19 (17.0)	.06	.04
Nervous, restless, or anxious	7 (6.3)	11 (9.7)	.18	.16

^aAvailable data Ns for the respective variable and denominator for percentage = 112 – 120.

^bAvailable data Ns for the respective variable and denominator for percentage = 112 – 119.

^cWithin-person difference between e-cigarette and combustible cigarette dependence for respective outcome based McNemar's tests.

^dWithin-person difference between e-cigarette and combustible cigarette dependence for respective outcome after adjusting for baseline age of use onset and number of days used in the past 30 for respective product using a general estimating equation model.

eTable 6. Interaction of Baseline Past-Year Combustible Cigarette Use as a Moderator in Associations Between Electronic Cigarette Dependence Symptoms and Subsequent Vaping at 6-Month Follow-up

E-cigarette use outcome at follow-up	Association of baseline e-cigarette dependence status × past-year combustible cigarette use interaction term with outcome at follow-up ^a	
	Unadjusted ^b	Adjusted ^c
	P-Value	P-Value
Any vaping over follow-up	.31	.54
Past 30-day number of nicotine vaping days	.12	.24
Past 30-day number of nicotine vaping sessions	.26	.49
Past 30-day puffs per nicotine vaping sessions	.08	.10

^aRegression models of association between the interaction term of the hooked on nicotine checklist for e-cigarette dependence (≥ 1 vs. 0 symptoms) and past-year combustible cigarette use and respective outcome with a complex design accounting for clustering of data within schools.

^bUnadjusted models include baseline status on the respective outcome as a covariate.

^cAdjusted models include respective baseline outcome covariates and a propensity score for vaping dependence status derived from potentially confounding variables (i.e., youth gender, age, race/ethnicity, parental education level, e-cigarette use onset age, past year combustible cigarette smoking, past 30-day number of days smoked cigarettes, past 30-day number of cigarette smoked per day, ever use of cigar, hookah, or smokeless tobacco, ever alcohol use, ever smoked cannabis, ever vaped cannabis, ever other drug use, major depressive disorder, generalized anxiety disorder, panic disorder, social phobia, obsessive compulsive disorder, mania, ADHD, and conduct problems).

eTable 7. Vaping Dependence Symptoms Stratified by Nicotine, Past 30-Day Vaping, and Past Year Combustible Cigarette Use Status Stratified by Sex

FEMALE (N=217) Vaping dependence symptoms	Use of e-cigarettes with nicotine in past year			Vaped in past 30 days			Past year combustible cigarette use		
	No (N=88) ^a	Yes (N=129) ^a	Test of Difference ^b	No (N=114) ^a	Yes (N=103) ^a	Test of Difference ^b	No (N=153) ^a	Yes (N=64) ^a	Test of Difference ^b
	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value
1 or more symptoms	5 (5.7)	18 (14.0)	.05	8 (7.0)	15 (14.6)	.07	13 (8.5)	10 (15.6)	.12
2 or more symptoms	1 (1.1)	13 (10.1)	.008*	4 (3.5)	10 (9.7)	.06	6 (3.9)	8 (12.5)	.02*
3 or more symptoms	1 (1.1)	10 (7.8)	.03*	4 (3.5)	7 (6.8)	.27	4 (2.6)	7 (10.9)	.01*
MALE (N=227) Vaping dependence symptoms	Use of e-cigarettes with nicotine in past year			Vaped in past 30 days			Past year combustible cigarette use		
	No (N=80) ^a	Yes (N=147) ^a	Test of Difference ^b	No (N=97) ^a	Yes (N=130) ^a	Test of Difference ^b	No (N=145) ^a	Yes (N=82) ^a	Test of Difference ^b
	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value
1 or more symptoms	5 (6.3)	24 (16.3)	.03*	3 (3.1)	26 (20.0)	<.001*	15 (10.3)	14 (17.1)	.15
2 or more symptoms	2 (2.5)	18 (12.2)	.01*	2 (2.1)	18 (13.8)	.002*	9 (6.2)	11 (13.4)	.07
3 or more symptoms	1 (1.3)	10 (6.8)	.06	2 (2.1)	9 (6.9)	.09	4 (2.8)	7 (8.5)	.05

^aAvailable data Ns for the respective variable and denominator for percentage. Total analytic sample N = 444 (Past-year e-cigarette users with vaping dependence data at baseline and past 6-month e-cigarette use data at 6-month follow-up).

^bTest of group differences from χ^2 tests.

*Statistically significant after Benjamini-Hochberg corrections for multiple testing to control false discovery rate at .05 (based on two-tailed corrected P-value).

eTable 8. Vaping Dependence Symptoms Stratified by Nicotine, Past 30-Day Vaping, and Past Year Combustible Cigarette Use Status Stratified by Number of Substances Used

Substance 0 (N=20) Vaping dependence symptoms	Use of e-cigarettes with nicotine in past year			Vaped in past 30 days			Past year combustible cigarette use		
	No (N=14) ^a	Yes (N=6) ^a	Test of Difference ^b	No (N=15) ^a	Yes (N=5) ^a	Test of Difference ^b	No (N=19) ^a	Yes (N=1) ^a	Test of Difference ^b
	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value
1 or more symptoms	1 (7.1)	1 (16.7)	.52	1 (6.7)	1 (20.0)	.39	2 (10.5)	0 (0.0)	.73
2 or more symptoms	0 (0.0)	1 (16.7)	.12	0 (0.0)	1 (20.0)	.08	1 (5.3)	0 (0.0)	.81
3 or more symptoms	0 (0.0)	1 (16.7)	.12	0 (0.0)	1 (20.0)	.08	1 (5.3)	0 (0.0)	.81
Substance 1 (N=57) Vaping dependence symptoms	Use of e-cigarettes with nicotine in past year			Vaped in past 30 days			Past year combustible cigarette use		
	No (N=28) ^a	Yes (N=29) ^a	Test of Difference ^b	No (N=32) ^a	Yes (N=25) ^a	Test of Difference ^b	No (N=50) ^a	Yes (N=7) ^a	Test of Difference ^b
	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value
1 or more symptoms	1 (3.6)	2 (6.9)	.57	2 (6.3)	1 (4.0)	.71	3 (6.0)	0 (0.0)	.51
2 or more symptoms	1 (3.6)	1 (3.4)	.98	1 (3.1)	1 (4.0)	.86	2 (4.0)	0 (0.0)	.59
3 or more symptoms	0 (0.0)	1 (3.4)	.32	1 (3.1)	0 (0.0)	.37	1 (2.0)	0 (0.0)	.71
Substance 2 (N=100) Vaping dependence symptoms	Use of e-cigarettes with nicotine in past year			Vaped in past 30 days			Past year combustible cigarette use		
	No (N=44) ^a	Yes (N=56) ^a	Test of Difference ^b	No (N=57) ^a	Yes (N=43) ^a	Test of Difference ^b	No (N=84) ^a	Yes (N=16) ^a	Test of Difference ^b
	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value
1 or more symptoms	0 (0.0)	6 (10.7)	.03	1 (1.8)	5 (11.6)	.04	3 (3.6)	3 (18.8)	.02*
2 or more symptoms	0 (0.0)	6 (10.7)	.03	1 (1.8)	5 (11.6)	.04	3 (3.6)	3 (18.8)	.02*
3 or more symptoms	0 (0.0)	4 (7.1)	.07	1 (1.8)	3 (7.0)	.19	1 (1.2)	3 (18.8)	.01*
Substance 3 (N=118) Vaping dependence symptoms	Use of e-cigarettes with nicotine in past year			Vaped in past 30 days			Past year combustible cigarette use		
	No (N=45) ^a	Yes (N=73) ^a	Test of Difference ^b	No (N=54) ^a	Yes (N=64) ^a	Test of Difference ^b	No (N=84) ^a	Yes (N=34) ^a	Test of Difference ^b
	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value
1 or more symptoms	5 (11.1)	11 (15.1)	.54	4 (7.4)	12 (18.8)	.07	12 (14.3)	4 (11.8)	.72
2 or more symptoms	2 (4.4)	8 (11.0)	.22	3 (5.6)	7 (10.9)	.30	6 (7.1)	4 (11.8)	.41
3 or more symptoms	2 (4.4)	4 (5.5)	.80	3 (5.6)	3 (4.7)	.83	4 (4.8)	2 (5.9)	.80
Substance 4 (N=146) Vaping dependence symptoms	Use of e-cigarettes with nicotine in past year			Vaped in past 30 days			Past year combustible cigarette use		
	No (N=37) ^a	Yes (N=109) ^a	Test of Difference ^b	No (N=53) ^a	Yes (N=93) ^a	Test of Difference ^b	No (N=60) ^a	Yes (N=86) ^a	Test of Difference ^b
	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value	N (%)	N (%)	P-Value
1 or more symptoms	3 (8.1)	21 (19.3)	.11	3 (5.7)	21 (22.6)	.008*	8 (13.3)	16 (18.6)	.40
2 or more symptoms	0 (0.0)	14 (12.8)	.02*	1 (1.9)	13 (14.0)	.02*	3 (5.0)	11 (12.8)	.12
3 or more symptoms	0 (0.0)	10 (9.2)	.06	1 (1.9)	9 (9.7)	.07	1 (1.7)	9 (10.5)	.04

^aAvailable data Ns for the respective variable and denominator for percentage. Total analytic sample N = 441 (Past-year e-cigarette users with vaping dependence data at baseline and past 6-month e-cigarette use data at 6-month follow-up; missingness N = 3).

^bTest of group differences from χ^2 tests.

*Statistically significant after Benjamini-Hochberg corrections for multiple testing to control false discovery rate at .05 (based on two-tailed corrected P-value).

eTable 9. Interaction of Sex as a Moderator in Associations Between Electronic Cigarette Dependence Symptoms and Subsequent Vaping at 6-Month Follow-up

E-cigarette use outcome at follow-up	Association of baseline e-cigarette dependence status × gender interaction term with outcome at follow-up ^a	
	Unadjusted ^b	Adjusted ^c
	P-Value	P-Value
Any vaping over follow-up	.91	.55
Past 30-day number of nicotine vaping days	.08	.11
Past 30-day number of nicotine vaping sessions	.12	.16
Past 30-day puffs per nicotine vaping sessions	.27	.63

^aRegression models of association between the interaction term of the hooked on nicotine checklist for e-cigarette dependence (≥ 1 vs. 0 symptoms) and gender and respective outcome with a complex design accounting for clustering of data within schools.

^bUnadjusted models include baseline status on the respective outcome as a covariate.

^cAdjusted models include respective baseline outcome covariates and a propensity score for vaping dependence status derived from potentially confounding variables (i.e., youth gender, age, race/ethnicity, parental education level, e-cigarette use onset age, past year combustible cigarette smoking, past 30-day number of days smoked cigarettes, past 30-day number of cigarette smoked per day, ever use of cigar, hookah, or smokeless tobacco, ever alcohol use, ever smoked cannabis, ever vaped cannabis, ever other drug use, major depressive disorder, generalized anxiety disorder, panic disorder, social phobia, obsessive compulsive disorder, mania, ADHD, and conduct problems).

eTable 10. Interaction of Baseline Number of Nonnicotine Substances Used as a Moderator in Associations Between Electronic Cigarette Dependence Symptoms and Subsequent Vaping At 6-Month Follow-up

E-cigarette use outcome at follow-up	Association of baseline e-cigarette dependence status × number of substance used interaction term with outcome at follow-up ^b	
	Unadjusted ^c	Adjusted ^d
	P-Value	P-Value
Any vaping over follow-up	.17	.36
Past 30-day number of nicotine vaping days	.09	.12
Past 30-day number of nicotine vaping sessions	.33	.47
Past 30-day puffs per nicotine vaping sessions	.54	.70

^aNon-nicotine substances include alcohol, cannabis, inhalants, cocaine, methamphetamine, LSD, ecstasy, heroin, salvia, prescription painkillers, tranquilizers/sedatives, diet pills, prescription stimulants, and bath salts.

^bRegression models of association between the interaction term of the hooked on nicotine checklist for e-cigarette dependence (≥ 1 vs. 0 symptoms) and baseline number of substances used and respective outcome with a complex design accounting for clustering of data within schools.

^cUnadjusted models include baseline status on the respective outcome as a covariate.

^dAdjusted models include respective baseline outcome covariates and a propensity score for vaping dependence status derived from potentially confounding variables (i.e., youth gender, age, race/ethnicity, parental education level, e-cigarette use onset age, past year combustible cigarette smoking, past 30-day number of days smoked cigarettes, past 30-day number of cigarette smoked per day, ever use of cigar, hookah, or smokeless tobacco, ever alcohol use, ever smoked cannabis, ever vaped cannabis, ever other drug use, major depressive disorder, generalized anxiety disorder, panic disorder, social phobia, obsessive compulsive disorder, mania, ADHD, and conduct problems).

eTable 11. Past 30-Day Electronic Cigarette and Combustible Cigarette Use Patterns by Past 30-Day Number of Nicotine Vaping Days at Each Assessment

Past 30-day number of nicotine vaping days	Past 30-day e-cigarette use		Past 30-day combustible cigarette use	
	Past 30-day number of nicotine vaping sessions	Past 30-day puffs per nicotine vaping sessions	Past 30-day number of days smoked cigarettes	Past 30-day number of cigarette smoked per day
	<i>M (SD)^c</i>	<i>M (SD)^c</i>	<i>M (SD)^c</i>	<i>M (SD)^c</i>
Baseline^a				
0 days (N=348)	0.39 (2.05) ⁴	0.35 (1.61) ³	0.58 (2.99) ³	0.19 (0.89) ²
1-2 days (N=45)	2.29 (4.05) ³	3.47 (5.30) ²	0.64 (1.20) ³	0.40 (0.89) ²
3-5 days (N=22)	4.85 (6.16) ²	3.57 (2.48) ²	3.00 (8.77) ²	0.50 (1.19) ²
6 or more days (N=26)	13.46 (7.30) ¹	10.81 (7.14) ¹	8.73 (10.85) ¹	4.80 (7.21) ¹
6-month follow-up^b				
0 days (N=327)	0.18 (1.26) ⁴	0.17 (1.05) ⁴	0.75 (3.67) ³	0.22 (1.19) ³
1-2 days (N=40)	1.75 (2.68) ³	2.18 (2.18) ³	3.60 (6.85) ²	1.03 (1.80) ²
3-5 days (N=27)	4.00 (4.91) ²	5.35 (5.31) ²	2.52 (4.88) ^{2,3}	1.07 (1.64) ²
6 or more days (N=46)	11.45 (8.23) ¹	6.39 (5.93) ¹	6.50 (10.33) ¹	2.11 (3.77) ¹

Abbreviations: N = Sample size; M = Mean; SD = Standard Deviation.

^aPast 30-day e-cigarette and combustible cigarette use patterns by past 30-day number of nicotine vaping days at baseline (Available Ns = 436 - 441).

^bPast 30-day e-cigarette and combustible cigarette use patterns by past 30-day number of nicotine vaping days at 6-month follow-up (Available Ns = 436 - 440).

^cCalculated using one-way Analysis of Variance (ANOVA). Groups not sharing superscript numerals are significantly different in ANOVA Least Significant Difference. All F-statistics of ANOVA were significant (P-values based on two-tailed test < .001).

eTable 12. Interaction Effects of Electronic Cigarette Dependence Status and Other Drug Use at Baseline on Attention-Deficit/Hyperactivity Disorder Symptom Level at Follow-up

Baseline predictors	Associations of baseline e-cigarette dependence status and other substance use with ADHD symptom level at follow-up ^a			
	Unadjusted ^b		Adjusted ^c	
	b (95%CI)	p	b (95%CI)	p
Main effects				
e-cigarette dependence status ^d	0.38 (0.10, 0.66)	.008*	0.32 (0.07, 0.57)	.01*
Other substance use ^e	0.05 (-0.004, 0.11)	.06	0.04 (-0.01, 0.12)	.10
Interaction effects^f				
e-cigarette dependence status ^d × Other substance use ^e	0.37 (0.08, 0.45)	.005*	0.22 (0.03, 0.41)	.02*

Abbreviations: b = unstandardized regression coefficient. 95%CI = 95% confidence interval.

^aGeneralized linear regression modeling was used with a complex design accounting for clustering of data within schools. Continuous ADHD level outcome was standardized.

^bRegression models adjusting for baseline predictors and ADHD level.

^cRegression models adjusting for baseline predictors, ADHD level, youth gender, age, race/ethnicity, parental education level, e-cigarette use onset age, past 30-day number of nicotine vaping days, past 30-day number of nicotine vaping sessions, past 30-day puffs per nicotine vaping sessions, past 30-day number of days smoked cigarettes, past 30-day number of cigarette smoked per day, other tobacco product use, major depressive disorder, generalized anxiety disorder, panic disorder, social phobia, obsessive compulsive disorder, mania, and conduct problems.

^dReporting ≥ 1 vs. 0 symptoms on the hooked on nicotine checklist for e-cigarette dependence.

^eOther substance use was coded by sum of ever use of alcohol, combustible cannabis, vaped cannabis, and other drugs (Response range = 0 - 4).

^fInteraction term was added in a subsequent model.

*Statistically significant after Benjamini-Hochberg corrections for multiple testing to control false discovery rate at .05 (based on two-tailed corrected P-value).

eTable 13. Prospective Associations of Baseline Electronic Cigarette Dependence Status With Combustible Cigarette Use Outcomes at Follow-up

Combustible cigarette use outcome at follow-up	N (%) / M (SD) of outcome at follow-up, by baseline e-cigarette dependence status ^a		Association of baseline e-cigarette dependence status ^a with outcome at follow-up ^b			
	Negative (N=392)	Positive (N=52)	Unadjusted		Adjusted ^c	
			OR (95%CI) / RR (95%CI)	P-Value	OR (95%CI) / RR (95%CI)	P-Value
Past 6-month cigarette use prevalence, N (%)	91 (23.3)	25 (48.1)	2.79 (1.39, 5.61) ^f	.009*	2.17 (0.99, 4.75) ^f	.05
Past 30-day number of days smoked cigarettes, M (SD) ^d	1.63 (5.46)	2.87 (6.52)	2.53 (1.74, 3.68) ^g	<.001*	2.33 (1.56, 3.52) ^g	<.001*
Past 30-day number of cigarettes smoked per day, M (SD) ^e	0.45 (1.49)	1.37 (3.38)	3.82 (2.43, 6.01) ^g	<.001*	3.03 (1.82, 5.04) ^g	<.001*

Abbreviations: OR = Odds ratio. RR = Rate ratio. 95%CI = 95% confidence interval.

^aReporting ≥ 1 vs. 0 symptoms on the hooked on nicotine checklist for e-cigarette dependence.

^bRegression models of association between e-cigarette dependence status and respective outcome at follow-up with baseline status on the respective outcome as a covariate using a complex design accounting for clustering of data within schools.

^cAdditional adjusted for a propensity score for vaping dependence status derived youth gender, age, race/ethnicity, parental education level, combustible cigarette use onset age, past 6-month e-cigarette use, past 30-day number of nicotine vaping days, past 30-day number of nicotine vaping sessions, past 30-day puffs per nicotine vaping sessions, ever use of cigar, hookah, or smokeless tobacco, ever alcohol use, ever smoked cannabis, ever vaped cannabis, ever other drug use, major depressive disorder, generalized anxiety disorder, panic disorder, social phobia, obsessive compulsive disorder, mania, ADHD, and conduct problems (see eMethods for details on measures and propensity score calculation).

^dResponse range = 0 – 30.

^eResponse range: 0 – 20.

^fOdds Ratio from logistic regression model for binary outcomes.

^gRate ratio from negative binomial regression model for count outcomes.

*Statistically significant after Benjamini-Hochberg corrections for multiple testing to control false discovery rate at .05 (based on two-tailed corrected P-value).

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