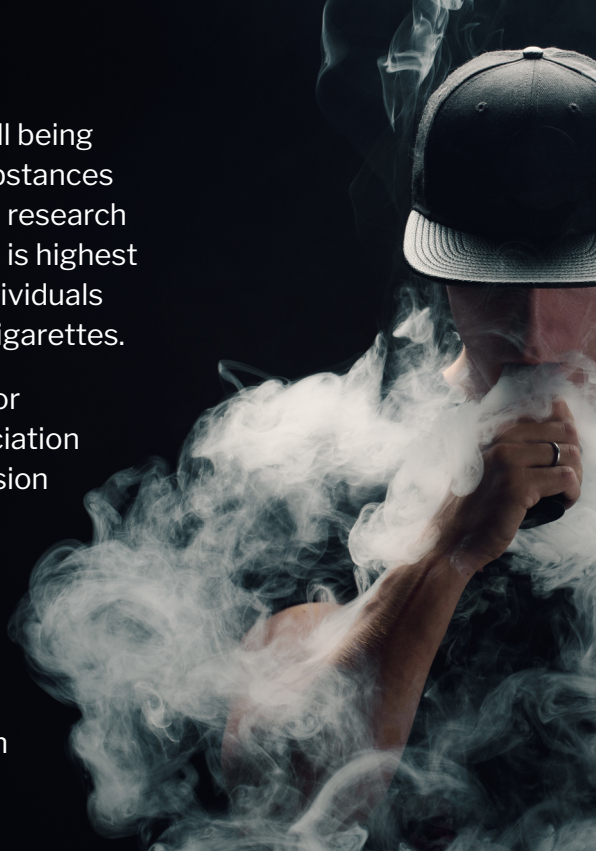


Summary Points

- While the long-term health effects of e-cigarettes are still being studied, most e-cigarettes contain nicotine and other substances that harm brain development and lung function. Previous research has shown that the prevalence of current e-cigarette use is highest among young adults aged 18 to 24 years old, and that individuals ever diagnosed with depression are more likely to try e-cigarettes.
- This study used data from the 2021 Behavioral Risk Factor Surveillance System (BRFSS) survey to explore the association between e-cigarette use and clinical diagnosis of depression among young adults aged 18 to 24 years old in Virginia. Findings suggest that compared with non e-cigarette users, e-cigarette users had a 2.28-fold higher odds of reporting a history of clinical diagnosis of depression.
- Future research studies should focus on potential confounders to further examine the relationship between e-cigarettes and diagnosis of depression.



E-CIGARETTE USE AND DEPRESSION AMONG YOUNG ADULTS IN VIRGINIA: AN ANALYSIS OF BEHAVIORAL RISK FACTOR SURVEILLANCE SYSTEM (BRFSS) DATA, 2021

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October 2023

Background

The use of e-cigarettes has continued to grow in popularity over recent years, with e-cigarettes being the most commonly used tobacco product among youth and young adults (Centers for Disease Control and Prevention [CDC]). A study using 2016 Behavioral Risk Factor Surveillance System (BRFSS) data found that the prevalence of current e-cigarette use was highest among people aged 18 to 24 years old (Mirbolouk et al., 2018). More recently in 2021, among adults 18-24 years old who were e-cigarette users, 16.3% were current smokers, 22.3% were former smokers, and 61.4% had never been cigarette smokers (CDC, 2023). In Virginia, half of the young adults aged 18-25 who took the 2022 Virginia Young Adult Survey (YAS) reported having vaped or used e-cigarettes at some point in their life (OMNI Institute, 2023). While the long-term health

effects of e-cigarette use are still being studied, most e-cigarettes contain nicotine and harmful substances in the aerosol, which can harm brain development and lung function (CDC).

A recent study found that individuals with mental health conditions (MHC) were more likely to try e-cigarettes, be current users of e-cigarettes, and be prone to using e-cigarettes in the future (Cummins et al., 2014). While there have been studies on e-cigarette use and mental health, it has not been thoroughly studied among young adults aged 18-24 years old, particularly in Virginia. This present study explored the association between e-cigarette use and clinical diagnoses of depression among young adults aged 18-24 years old in Virginia.

Methods

Design and Setting

This secondary data analysis used data from the 2021 BRFSS to examine the association between e-cigarette use and ever being diagnosed with depression. The BRFSS is an annual, ongoing national cross-sectional survey that collects information on health-related risk behavior, chronic health conditions, and use of preventative services among adults age 18 years and older. Only data from Virginia were used for this study and the inclusion criteria included individuals between the ages of 18-24. The present study was deemed exempt from review by an institutional review board because it used de-identified publicly available BRFSS data.

Study Variables

E-cigarette use was assessed with the question “Do you now use e-cigarettes or other electronic vaping products every day, some days, or not at all?” Participants who answered “everyday” or

“some days” were considered e-cigarette users. Participants that answered “not at all” were considered non e-cigarette users. The outcome of interest was depressive disorder diagnosis and was assessed using the question “Have you ever been told you have a depressive disorder (including depression, major depression, dysthymia, or minor depression?” Baseline demographic factors, including age, sex, race/ethnicity, education, and employment status, were self-reported according to BRFSS protocol.

Statistical Analysis

The BRFSS uses design weighting and iterative proportional fitting to ensure representativeness of the data. These weights were applied in all analyses done with the dataset. Multivariable logistic regression was used to calculate adjusted odds ratios and 95% confidence intervals, while controlling for potential confounders.

Results

Before weighting, the raw sample size included 473 individuals aged 18-24, representing 791,582 after weighting. E-cigarette users were more likely to be male (58.5% VS. 48.7%), non-Hispanic white (64.9% VS. 54.8%), heavy alcohol users (10.1% VS. 4.34%), and report depression (33.2% VS. 21.1%), compared with non-e-cigarette users (Table 1).

Results from the unadjusted regression model showed that the odds of having a clinical diagnosis of depression among e-cigarette users was 1.85 (95% CI, 1.06 – 3.23) (Table 1). After adjusting for sociodemographic confounders and health-related behaviors, e-cigarette users

had 2.28-fold (95% CI, 1.17-4.45) higher odds of reporting a history of clinical diagnosis of depression (Table 2).

An additional multivariable-adjusted model that separated e-cigarette users into “everyday” users and “some days” users was explored to determine the associations by frequency of use. Findings showed that compared with non e-cigarette users, “some days” e-cigarette users had a 1.14-fold (95%, 0.42 - 3.11) and “everyday” e-cigarette users had a 4.17-fold (95%, 1.76 – 9.89) higher odds of reporting a history of clinical diagnosis of depression. (Table 3).



Table 1: Demographic and Socioeconomic Characteristics by e-Cigarette Use (N= 791,582)

Characteristic	E-Cigarette User Weighted No. (%)	Not e-Cigarette User Weighted No. (%)
Sex		
Female	59,694 (41.48%)	332,281 (51.30%)
Male	84,220 (58.52%)	315,387 (48.70%)
Race/Ethnicity		
Hispanic	20,790 (15.45%)	92,752 (14.32%)
Non-Hispanic Black	16,676 (11.59%)	107,917 (16.66%)
Non-Hispanic White	93,336 (64.86%)	354,625 (54.75%)
Other*	13,112 (9.11%)	92,374 (14.26%)
Education		
< High School	11,005 (7.65%)	53,343 (8.24%)
High School Graduate	59,862 (41.60%)	247,707 (28.25%)
Some College	60,292 (41.89%)	242,426 (37.43%)
College Graduate	12,755 (8.86%)	104,191 (16.09%)
Employment Status		
Employed or Self-employed	86,550 (61.21%)	341,757 (53.94%)
Student	45,268 (32.02%)	249,296 (34.49%)
Unemployed or Retired	9,569 (6.79%)	42,564 (6.72%)
Heavy Alcohol Use		
Yes	14,247 (10.06%)	27,678 (4.34%)
Region		
Central	21,444 (14.90%)	104,067 (16.07%)
Eastern	40,118 (27.88%)	133,428 (20.60%)
Northern	31,718 (22.04%)	176,414 (27.24%)
Northeast	34,759 (24.15%)	116,880 (18.04%)
Southwest	15,876 (11.03%)	116,879 (18.05%)
Clinical Diagnosis of Depression		
Yes	47,741 (33.17%)	136,932 (21.14%)

Table 2: Association between e-Cigarette Use and History of Clinical Diagnosis of Depression

e-Cigarette Use Status	OR (95%) Clinical Diagnosis of Depression	
	Unadjusted	Adjusted*
Non e-Cigarette User	1 [Reference]	1 [Reference]
Everyday or Some Days e-Cigarette User	1.85 (1.06 - 3.23)	2.28 (1.17 - 4.45)

*Adjusted for sex, race/ethnicity, education, employment, heavy alcohol use, and health region

Table 3: Association between Every day, Some Days, and No e-Cigarette Use and History of Clinical Diagnosis of Depression

e-Cigarette Use Status	OR (95%) Clinical Diagnosis of Depression	
	Unadjusted	Adjusted*
Non e-Cigarette User	1 [Reference]	1 [Reference]
Some Days e-Cigarette User	0.90 (0.37 - 2.18)	1.14 (0.42 - 3.11)
Everyday Days e-Cigarette User	3.33 (1.72 - 6.45)	4.17 (1.76 - 9.89)

*Adjusted for sex, race/ethnicity, education, employment, heavy alcohol use, and health region

Discussion

In this multivariable-adjusted logistic regression analysis of young adults aged 18-24 years old living in Virginia, we found that e-cigarette users were more likely to have been diagnosed with depression compared to non-e-cigarette users. This finding was strongest when looking only at everyday e-cigarette users, who had a 4.17-fold higher odds of reporting a history of clinical diagnosis of depression. Our findings are congruent with the previous body of research describing the association between e-cigarettes and mental health conditions; however limited studies have looked at the association among young adults in the Commonwealth of Virginia.

E-cigarette use has increased over the recent years, especially among youth and young adults (Centers for Disease Control and Prevention [CDC]). Mental health is a concerning health condition and has continued to increase from 2019-2021. (National Center for Health Statistics [NCHS]). A BRFSS cross-sectional analysis of adults found an association between e-cigarette use and depression, with findings of a graded association between the frequency of e-cigarette use and depression. In the same study, a second analysis that looked just at college students found that current e-cigarette users had twice the odds of reporting depression when compared to never users, highlighting a predisposition to depression among e-cigarette users. (Obisesan et al., 2019).

Due to the fact that BRFSS respondents self-report, the responses to e-cigarette use and clinical diagnoses of depression are limited to the participant's willingness to answer, which could lead to bias. Because we only included young adults

aged 18 to 24 who answered the outcome question, our sample size was small, which may explain the wider confidence intervals in our second model. However, due to the VA BRFSS complex sampling and weighting design, the results can be generalized to young adults in Virginia.

This study demonstrates that e-cigarette use, along with other factors, are associated with a diagnosis of depression. Future research studies should focus on potential confounders, including use of combustibles, marijuana, and other substances, to further examine the relationship between e-cigarettes and mental health. Previous research at a northeastern U.S. university found a greater proportion of participants having tried e-cigarettes who reported mental health conditions and substance use disorders compared to those without. (Hefner et. al, 2019). Future research should also consider examining the association between e-cigarettes and other mental health conditions and determine if similar results are observed among teenage youth (aged 13 to 17 years old). Because our study was cross-sectional, we cannot infer causality or know the direction of the association between e-cigarettes and a clinical diagnosis of depression, which could also be bidirectional. Still, efforts to prevent e-cigarette consumption should consider targeting young adults with a history of ever being diagnosed with depression. The association found in this study could inform Virginia's Department of Health's anti-vaping programs by having targeted media messaging around e-cigarette use and mental health.

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