KANSAS JOURNAL of MEDICINE

Nicotine Dependence from Electronic Cigarettes Use and Depressive Symptoms Among Adolescents

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Received Nov. 29, 2022; Accepted for publication Dec. 20, 2022; Published online Jan. 18, 2023
https://doi.org/10.17161/kjm.vol16.18723

ABSTRACT

Introduction. The use of electronic cigarettes (e-cigarettes) has been increasing among adolescents in the United States since they were first introduced to the U.S. market in 2007. With depression as a major risk factor for suicide in adolescents, this study examined nicotine dependence from the use of e-cigarettes and depressive symptoms among adolescents.

Methods. The authors conducted a retrospective patient chart review at a pediatric clinic in the Midwestern United States, from May 2021 to September 2021. As a standard practice, the clinic uses the adapted Penn State Nicotine Dependency Index to evaluate its patients' nicotine dependence from the use of e-cigarettes, and the PHQ-9 modified for teens to screen for depressive symptoms of its patients. Data on 69 patients were included in the study. The authors used standard descriptive statistics and an adjusted odds ratio (aOR) to analyze the data on the 69 adolescents.

Results. The mean age of the adolescents was 17.6 (SD = 2.3), 46.4% (n = 32) were female, and 53.6% (n = 37) were male. More than 88% (n = 61) of the adolescents met criteria for high nicotine dependence from e-cigarette use and 30.4% (21 of 69) of them screened positive for depression. Findings of the analyses indicated that there was not a statistically significant association between nicotine dependence from e-cigarette use and depressive symptoms (aOR = 1.07; 95% confidence interval, 0.93-1.23; p = 0.297).

Conclusions. The results showed that while a third of the adolescents screened positive for depression and the majority (88%) depended on nicotine from e-cigarettes, there was no association between the outcomes. Future larger multicenter studies are needed to better understand the association between nicotine dependence from e-cigarettes and depressive symptoms as reported in the literature.

Kans J Med 2023;16:1-4

INTRODUCTION

Since they were first introduced to the U.S. market in 2007, the use of electronic cigarettes (e-cigarettes) has been increasing steadily, especially in high school students.[1] E-cigarettes, also known as vaporizer cigarettes, are battery-powered devices that aerosolize nicotine and other chemicals.[2] Adolescents may be particularly at risk of using these devices because of misconceptions about what is in e-cigarette products,[3] as well as the previous marketing of various flavors that appeal to this age group.[4] Many adolescents are not aware of the negative consequences of using nicotine products, and some even hold more favorable attitudes towards the use of e-cigarettes because they believe that the products are safer than combustible cigarettes.[3,5,6] E-cigarette products have been marketed as "healthier" nicotine products.[7] Furthermore, due to the varying amounts of nicotine contained within the juice of e-cigarettes, as well as the varying voltages of e-cigarette devices, some users are being subjected to much higher amounts of nicotine than combustible cigarettes.[8]

Increased use of e-cigarettes among adolescents puts them at an increased risk for serious complications of lung injury.[1] In addition to the higher levels of nicotine contained in e-cigarettes, there have been reports of lung injury associated with e-cigarette use.[9,10] As of February 18, 2020, a total of 2,807 hospitalized e-cigarettes, or vaping, product use-associated lung injury (EVALI)-related cases have been reported to the U.S. Centers for Disease Control and Prevention from all 50 states, the District of Columbia, and two U.S. territories (Puerto Rico and U.S Virgin Islands), with 68 deaths.[11] Despite this high number of EVALI-related cases and an increase in public awareness of these vaping-related lung illness among teens and young adults,[12-17] the use of e-cigarettes continues among the age groups.[1]

There is an increased rate of depression among adolescents, with a reported 20% of U.S. adolescents suffering from clinical depression,[18] and 17% (an estimated 4.1 million) of adolescents reported at least one major depressive episode in 2020.[19] Adolescents who use more than one form of inhaled nicotine also are more likely to have depression.[20] The use of e-cigarettes has been found to be associated with increased odds of depressive symptoms among adolescents.[21] A cross-sectional survey of substance use and mental health among high school students found high prevalence of depression and panic disorder among adolescents who used e-cigarettes compared to those who did not.[22] In this study, the association between nicotine dependence from the use of e-cigarettes and depressive symptoms in adolescents who visited a pediatric clinic in the Midwestern United States was examined.

METHODS

Study Design. A retrospective chart review was conducted to access rates of e-cigarette use and scores on depression screenings among adolescents who visited a pediatric clinic in the Midwestern United States from May to September 2021. The clinic screens all patients for e-cigarette use and depressive symptoms. The medical staff of the clinic provided authors with de-identified data of all patients who visited the clinic within the stated time frame. Data on 1,468 adolescent patients were reviewed for this study. The authors then reviewed the data for information on e-cigarette use and depression. The University of Kansas Medical Center Institutional Review Board approved the study as not human subjects research.

Variables. The data reviewed for the study included information about the primary variables of interest: nicotine dependence from e-cigarette use and depressive symptoms. Data on biological sex and age also were reviewed.

Nicotine Dependence from E-cigarettes Use. As a standard practice, the clinic used the adapted Penn State Nicotine Dependency Index, a validated 10-item scale to evaluate the patients' nicotine dependence from e-cigarette use.[23-27] The patients recorded their nicotine depen-

dence from e-cigarette use by responding to a series of 10 questions with an overall score ranging from 0 to 20. Higher scores indicated greater levels of nicotine dependency from e-cigarette use. The patients who scored 0 to 3 on the scale were considered not dependent; 4 to 8 low dependence; 9 to 12 medium dependence; and 13 or more were considered high dependence.[27]

Depressive Symptoms. As a standard practice, the clinic uses the Patient Health Questionnaire Modified for Teens (PHQ-9 Modified), a validated 9-item tool to screen for depressive symptoms.[28] The patients recorded their feelings during the past two weeks on a 4-point Likert scale (0 = Not at all; 3 = Nearly every day). Scores for the nine items were summed with possible scores of 0 to 27. Higher scores indicated greater levels of emotional state. Total scores of 11 and above were defined as a positive screen for depression. The patients who scored 1 to 4 on the PHQ-9 Modified scale were considered to have minimal depression; 5 to 9 mild depression; 10 to 14 moderate depression; 15 to 19 moderately severe depression; and 20 to 27 severe depression.[28]

Statistical Analyses. Standard descriptive statistics were used to create a demographic profile of the participants. The patients' nicotine dependence was clustered into two groups: low dependency [combination of not dependent, low dependence, and medium dependence] and high dependency. The clustering was necessitated because of a low number of patients who met the criteria for not dependent, low, and medium dependence. An adjusted odds ratio (aOR) then was used to evaluate possible association between the nicotine dependence modeled as a binary outcome against a single fixed effect for independent variables of depressive symptoms, biological sex, and age. All analyses were two-sided with α of 0.05. The IBM SPSS (Statistical Package for the Social Sciences; Armonk, NY), version 26 was used for these analyses.

RESULTS

A total of 1,468 adolescent patients sought care at the clinic during the time frame (May to September 2021). Of these patients, 69 reported the use of e-cigarettes and their data were included in the analyses. The average age of the patients was 17 years (SD = 2.3), with the majority (53.6%; n = 37) being biological male.

Nicotine Dependency from E-cigarette Use and Depressive Symptom Results. As Table 1 shows, 88.4% (n = 61) of the patients met the criteria for high nicotine dependence from e-cigarette use. Nearly 32% (n = 22) of the patients screened positive for depression and 13.0% (n = 9) experienced moderately severe or severe depression. Findings of the analyses showed that there was not a statistically significant association between nicotine dependence from e-cigarette use and depressive symptoms (aOR = 1.07; 95% confidence interval, 0.93-1.23; p = 0.297).

Table 1. Nicotine dependence from electronic cigarettes use and depression among the participants (N = 69).

Variables	N (%)
Nicotine dependence from electronic cigarettes use	
Not dependent	0 (0)
Low dependence	1 (1.4)
Medium dependence	7 (10.1)
High dependence	61 (88.4)
Depression symptoms	
Screened positive*	22 (31.9)
Screened negative	47 (68.1)
Severity of depression	
Minimal depression	25 (36.2)
Mild depression	22 (31.9)
Moderate depression	13 (18.8)
Moderately severe depression	6 (8.7)
Severe depression	3 (4.3)

*Total score of ≥ 11.

DISCUSSION

This study provided information regarding e-cigarettes use and depressive symptoms among adolescents at a pediatric clinic in the Midwestern United States. The findings showed that nearly 9 in 10 of the adolescents had a high nicotine dependence from e-cigarettes. This finding was consistent with a study by Lin et al.[29] that found high nicotine dependence among most adolescents and young adult e-cigarette users. Nearly a third of the adolescents in our data screened positive for depression and 13.1% reported moderately severe or severe depression. These findings required attention given a recent uptick of mental health issues among adolescents.[18] In the U.S., 17% (an estimated 4.1 million) of adolescents reported at least one major depressive episode in 2020,[18,30] and globally, 1 in 10 adolescents reported experiencing a mental disorder in 2021.[19]

This study did not find an association between nicotine dependence through e-cigarette use and depressive symptoms, which was inconsistent with previous or prior studies where adolescents and high school students who used e-cigarettes reported an increased odds of depressive symptoms compared to those who did not use e-cigarettes.[20-22] The non-statistically significant association between e-cigarette use and depressive symptoms suggested that the adolescents in our data might not have used e-cigarettes as a coping strategy to deal with depression. The differences in findings might be attributed to the small sample of adolescents who reported using e-cigarettes in this study, as well as differences in study designs. Further, the differences could be attributed to the small number of the adolescents in our study who screened positive for depression. While there was not a significant association between nicotine dependence from e-cigarette use and depressive symptoms, the findings have clinically significant information. The use of e-cigarettes continues to increase among adolescents and high schoolers,[1]

with associated high numbers of EVALI.[9,10] This is of great concern when considering the difficulty some providers have had in creating cessation programs.[13]

Future Studies. Future studies can examine nicotine dependence through e-cigarette use and depression from other clinics across the state of Kansas and the U.S. Also, future studies should include other mental health outcomes, such as stress and anxiety, in their assessment to get a better picture that can help to create resources to prevent and mitigate these disorders.

Limitations. The study had several limitations, including a small sample size limiting generalizability of the findings, but it provided data on nicotine dependence through e-cigarette use and depressive symptoms among adolescents. Also, the study represented a snapshot of adolescents' subjective reports of e-cigarette use and depression at one primary care clinic. Future studies should include data from multiple clinic sites across the state for longer periods of time. Together, these changes may broaden our understanding of the association between adolescent depression and nicotine dependence from e-cigarette use across the state of Kansas. The study also was limited by missing data, mostly demographic or patient characteristics.

CONCLUSIONS

Our findings showed that while a third of the adolescents screened positive for depression and the majority depended on nicotine from e-cigarettes, there was no association between the outcomes. Future larger multicenter studies are needed to understand the association between nicotine dependence from e-cigarettes and depressive symptoms as reported in the literature.

ACKNOWLEDGEMENTS

The authors thank Leah Duncan of the University of Kansas School of Medicine for invaluable feedback on the manuscript.

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Keywords: adolescents, nicotine dependence, electronic cigarette, depression, Kansas