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Factors Associated with the Initiation of E-cigarette Usage in Adolescents: A Literature Review

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Abstract

The recent increase in e-cigarette usage among middle and high school aged adolescents has become alarming. The profound effect of nicotine on the developing brain and increased likelihood to smoke traditional cigarettes cannot be discounted. The purpose of this study was to understand the factors associated with the initiation of e-cigarette use in adolescents. The MEDLINE database was accessed and the keywords of e-cigarette, adolescents, and risk factors were utilized in the search. The four major themes which emerged repeatedly were: the effect of e-cigarettes on the renormalization of traditional cigarettes, the effect of e-cigarette advertising, perceptions associated with e-cigarette use, and social influence of e-cigarettes.

Keywords: e-cigarette, adolescent, susceptibility, traditional cigarettes, adolescents

Introduction

Electronic cigarette (e-cig) use has increased among middle and high school aged adolescents in the recent years. The Centers for Disease Control and Prevention found that, in 2017, nearly 11.7% of high schoolers reported having used e-cigarettes in the previous 30 days, a marked increase, compared to 2011's 1.5% figure (2018). The danger of the use of e-cigs use by adolescents lies in the profound effect that nicotine has on the developing brain. E-cigarettes have also contributed to the renormalization of smoking traditional cigarettes furthering their danger in adolescents. Research on the long term effects of e-cigarettes are limited and the consequences of use are unknown. It is crucial to understand the factors associated with the initiation of e-cigarette use in this population in order to effectively develop intervention strategies.

Methods

The MEDLINE database was used for its access to health sciences literature. To this end, key terms and phrases of e-cigarette, adolescents, and risk factors were used. E-cigarettes were

defined to encompass e-cig, JUUL, and vape due to the variation of different names and brands throughout the literature. The set of search terms used is shown in Table 1.

No.	Concept	Query Executed
1	E-cigarette	e-cigarette OR e-cig OR JUUL OR vape
2	Adolescent	Adolescent OR youth OR teen
3	Risk factors	risk factors OR susceptibility OR risk
4		1 OR 2 OR 3

Table 1. Search Terms Used When Querying Database

Parameters were set for English language only, and full text required. The search was limited to only display results from 2013-2018. Sources that were included in the review met the following inclusion criteria: (1) consisted of quantitative data, (2) identified factors relevant to the initiation of e-cigarettes. The search originally yielded 45 results. Of the initial 45 abstracts, 28 were excluded after abstract review resulting in a total of 17 articles. The remaining 17 articles were evaluated based on full-text and 10 articles met the inclusion/exclusion criteria. This process is represented in figure 1.

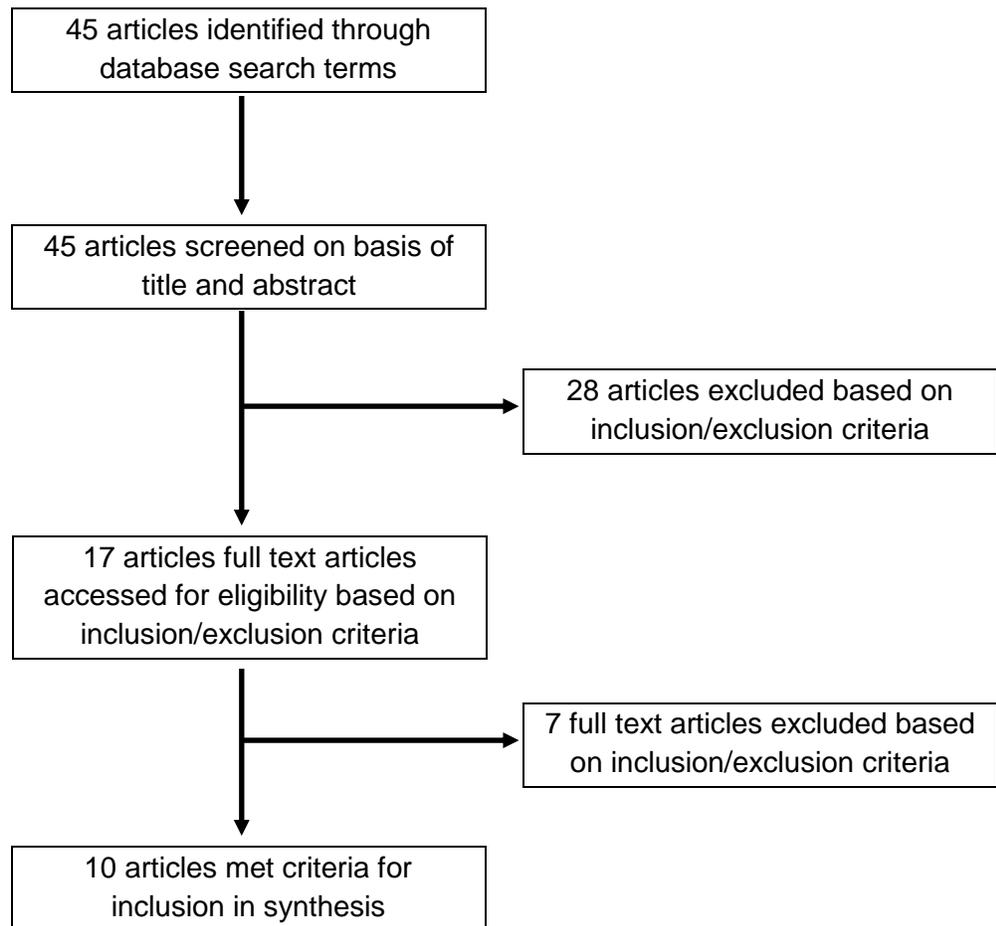


Figure 1. Flowchart representing the literature search strategy on risk factors associated with the initiation of e-cigarette use in adolescents.

Results

Renormalization of traditional cigarettes

Adolescents using e-cigarettes are more susceptible to the initiation of smoking traditional cigarettes than non-e-cigarette users. Owotomo and Maslowsky (2018) conducted a study using data collected from the Monitoring the Future Survey completed by 8th and 10th graders. A cross-sectional analysis was conducted and found that adolescents who were

susceptible to traditional cigarette use were significantly more likely than non-susceptible adolescents to be e-cigarette only users (11.0% vs 3.0%). Furthermore, Hammond, Reid, Cole, and Leatherdale (2017) found that past 30-day e-cigarette use was strongly associated with smoking behavior in their cross sectional analysis of baseline data from Canadian adolescents grades 9-12 who participated in the COMPASS study in 2013/14. Stating “31.5% of students who had smoked a cigarette in the past 30 days also reported using an e-cigarette over the same period, compared with 5.0% of students who had not smoked in the past 30 days” (para. 24). However, this percentage does not indicate whether adolescents first smoked e-cigarettes and then transitioned to traditional cigarettes or vice versa. They expanded their study to include data from the 2014/15 COMPASS study and found that adolescents who reported 30-day e-cigarette use at baseline were 2.12 times more likely to initiate smoking a whole cigarette and 1.79 times more likely to initiate daily cigarette smoking at follow up (Hammond et al., 2017, para. 3). The above research affirms that the use of e-cigarettes renormalizes smoking, making adolescents more apt to smoke traditional cigarettes.

Lauren Dutra and Stanton Glantz (2017) conducted a cross sectional analysis of sixth-12th graders’ responses on the National 2004-2014 National Youth Tobacco Survey (NYTS). They found that although most (75%–77%) of the youth who reported smoking cigarettes in the past 30 days (including dual users of cigarettes and e-cigarettes) in 2011–2014 had risk profiles (based on 2004–2009 data) consistent with smoking cigarettes, only 11%–23% of e-cigarette–only users had risk profiles consistent with smoking cigarettes. These findings support the idea that a majority of adolescents who initiate e-cigarette use would have otherwise been unlikely to have initiated tobacco product use with cigarettes. This finding in conjunction with the findings of Owotomo and Maslowsky (2018) and Hammond et al. (2017) supports that e-cigarettes are

contributing to the renormalization of smoking and leaving e-cigarette smokers susceptible for the initiation of smoking traditional cigarettes. It is thus apparent that e-cigarette usage is associated with successive and concurrent smoking of traditional cigarettes.

In a cross-sectional study, Hongying Dai and Jianqiang Hao (2016) examined the influence of flavored e-cigarettes on adolescents' intention to initiate cigarette use. They utilized data from the 2014 NYTS and concluded that among never smokers of traditional cigarettes, the use of flavored e-cigarettes was associated with a higher prevalence of intention to initiate cigarette use compared with those who had not used e-cigarettes in the past 30 days (58.3% vs 20.1%) or with those who had used non flavored e-cigarettes (58.3% vs 47.4%). Their findings are consistent with previous research finding that use of both flavored and unflavored e-cigarettes leads to increased susceptibility to future traditional cigarette use among adolescents. Dai and Hao (2016) also found that this susceptibility is further increased by the use of flavored e-cigarettes. This is relevant as a large percent (60.9%) of e-cigarette users who used flavored e-cigarettes. Flavored e-cigarettes appeal to adolescents further leading to the renormalization of tobacco products in this population (Dai & Hao, 2016, para. 7).

Effects of advertising

On average, U.S. adolescents are exposed to e-cigarette advertisements via multiple media. There are numerous studies examining the effects of these advertisements on adolescents. The majority of these studies focus on the influence of advertisements on adolescent's susceptibility to current and future use of e-cigarettes as well as perceptions of e-cigarettes as less harmful and addictive. Studies depicting the effects of advertisements often cite four main

advertisement venues of for analysis: internet, retail stores, TV, print (newspapers and magazines).

Susceptibility to current use

Exposure to different e-cigarette advertisement venues depict varying levels of significance on predicting current e-cigarette use. Jia Pu and Xiao Zhang (2017) conducted a cross-sectional analysis utilizing data from the 2014 NYTS to examine the effects of exposure to e-cigarette advertising on adolescents. When assessing the relationship between current e-cigarette use and exposure to advertisements, they found that adolescents exposed to e-cigarette advertisements on the internet were 1.57 times more likely to currently use e-cigarettes than adolescents not exposed to these advertisements. Adolescents exposed to e-cigarette advertisements via retail stores, newspaper/magazines, and TV were 1.57, 1.30, and 1.38 more likely, respectively, to currently use e-cigarettes than adolescents not exposed to these advertisements. Nicksic, Harrell, Pérez, Pasch, and Perry (2017) conducted a cross sectional and longitudinal study utilizing TATAMS, a rapid response surveillance system that followed 6th, 8th, and 10th grade adolescents in Texas. They collected baseline and follow up data on the same group of adolescents in 2014-2015, approximately 6 months apart. Among adolescents who recalled retail store and internet advertisements at baseline, the odds of current e-cigarette use was 2.03 and 2.17 times higher, respectively, at follow-up compared to those who did not recall such advertisements. There was no significant effect of newspaper/magazines or TV advertisements on current use of e-cigs. Both Pu and Zhang (2017) and Nicksic et al. (2017) determined that internet and retail store advertisements were significantly associated with current e-cigarette use.

Susceptibility to future use

Future e-cigarette usage is greatly affected by advertising. Pu and Zhang (2017) also examined the effects of advertisements on intention to use e-cigarettes in the future. They found that adolescents exposed to advertisements via the internet were 1.61 times more likely to intend to use e-cigarettes. However, adolescents exposed to retail store, newspapers/magazines, and TV advertisements were not significantly associated with increased intention to use. On the contrary, Nicksic et al. (2017) found that at both baseline and 6 month follow-up, internet advertisements were not associated with increased intention to use. They also found that at baseline adolescents who recalled TV and retail store advertisements were 1.60 and 1.51 times higher to initiate e-cigarette use. At the 6-month follow up adolescents who recalled retail store advertisements at baseline were 2.99 times more likely to initiate e-cigarette use. Agaku and Ayo-Yusuf (2014) conducted a cross sectional analysis utilizing data from the 2011 NYTS survey and found that adolescents who were exposed most of the time/always to retail or internet pro-tobacco advertisements were, respectively, 1.71 and 1.59 times more likely to experiment with e-cigarettes compared to those who were not exposed to the pro-tobacco advertisements. All three studies noted that exposure to multiple sources of advertisement was associated with a significant increase in intention to use e-cigs. Although they vary in terms of which advertising venues had statistically significant effects, it is evident that advertisements overall impact the susceptibility of adolescents to use e-cigs in their future.

Perception of E-cigs as less harmful or addictive

The impact of advertisements on adolescents' perceptions of e-cigarette's addictiveness and safety varies. Pu and Zhang (2017) found that advertisements through the internet and retail stores were significantly associated with a reduced perception of harm. Exposure to e-cigarette

ads via the internet was also associated with significant perceptions of e-cigarettes to be less addictive. Nicksic et al. (2017), on the other hand, did not find at baseline a significant association between e-cigarette advertising of any means and perceived harm. However, at follow-up adolescents who recalled e-cigarette TV advertisements were 1.49 times more likely to perceive no harm from e-cigarettes than those who did not recall advertisements. This area of research yields diverse results which is why it is important to have repeat studies to further examine this population. Although the venues of advertising vary in significance throughout the studies it is clear to see that there is an association between exposure to advertisements and susceptibility for adolescents to perceive e-cigarettes to be less harmful and addictive.

Perceptions associated with e-cigarette use

In the studies reviewed, adolescents who did not perceive e-cigarettes to be harmful were more likely to initiate use. This finding was noted throughout the literature. In their cross sectional analysis of the NYTS survey, Noland et al. (2018) identified a substantial difference between the perception of “little harm” between users of e-cigarettes and users of traditional cigarettes, with 35% choosing this option being e-cigarette users compared to 8% cigarette users (Noland et al., 2018). A substantial proportion of e-cigarette users recognized the dangers of cigarettes but not the danger of e-cigarettes. Similar results were found by Barrington-Trimis et al. (2015) in their cross sectional analysis of data collected from 11th- and 12th-grade participants in the Southern California Children's Health Study during the spring of 2014. The proportion of adolescents who disagreed that e-cigarettes were bad for their health varied greatly by status of e-cigarette use (nearly half of all current users, but only 7.5% of never users). Cooper et al. (2016) found similar results in their cross sectional analysis of 6th, 8th and 10th grade adolescents answers to the 2014-2015 TATAMS. Both single-product and dual/poly-

product users were more likely to report that e-cigs are not at all harmful compared to non-users. They also found that dual/poly-product users, compared to nonusers, were more likely to report that e-cigarettes are not at all addictive. Cooper et al.'s (2016) findings, along with those of Barrington-Trimis et al. (2015) and Noland et al. (2018) all point to the theme that e-cigarette users are less likely to perceive the dangers associated with the use of these products.

While examining the effects of e-cigarette flavors, Dai and Hao (2016) found that adolescents who reported using flavored e-cigarettes had lower odds of perceiving e-cigarette dangers than those who reported not using e-cigarettes and those who used non flavored e-cigarettes. This shows that adolescents who use flavored e-cigarettes have higher odds of not perceiving tobaccos dangers.

Social influences

Home environment/family use

Home environment or family tobacco use was associated with increased potential for using e-cigs. Melody Noland et al. (2018) found that adolescents who lived with an e-cigarette user were 276% more likely to have used an e-cigarette within the last 30 days. Barrington-Trimis et al. (2015) found that current e-cigarette users were 6.80 times more likely to have another e-cigarette user at home and 2.79 times more likely to have a traditional cigarette user at their home. Agaku and Ayo-Yusuf (2014) also found that having a household member who uses tobacco products increases the likelihood of experimenting with e-cigs by 155%. This shows that adolescents who have a family/household member that uses tobacco products as being more susceptible to use e-cigs.

Peer use

Peers have an effect on e-cigarette use among adolescents. Noland et al. (2018) found that 17% of adolescents in his study thought that adolescents who used these products “probably” or “definitely” had more friends. In addition, adolescents who perceived that e-cigarettes users had more friends were more likely to use this product (Noland et al., 2018). Similarly Agaku and Ayo-Yusuf (2014) state that adolescents with one close friend who used tobacco were 305% more likely to experiment with e-cigarettes. These studies show that peers have a substantial influence on the initiation of e-cigarette use. In addition, e-cigarette users are more likely to indicate that their peers would perceive their e-cigarette use as “ok”. Barrington-Trimis et al. (2015) identified that 91.0% of current e-cigarette users indicated that they would receive a positive response to their use from their best friends, whereas only 30.7% of never users predicted the same. Additionally Cooper et al. (2016) found that both single-product and dual/poly-product tobacco users are more likely than non-users to report that it is okay for their peers to use e-cigarettes. As these studies indicate, peer groups have a substantial effect on e-cigarette acceptance and use.

Discussion

Four main themes relevant to the factors associated with adolescents initiating use of e-cigarettes and traditional cigarette were examined in this study. The four themes identified were: e-cigarettes effect on the renormalization of traditional cigarettes, effects of e-cigarette advertising, perceptions associated with e-cigarette use, and social influences of e-cigarettes. The literature supported that both flavored and unflavored e-cigarette use left adolescents susceptible

for initiating traditional cigarette use. Although advertising was viewed by adolescents via diverse venues (internet, retail stores, magazines/newspapers, and TV) adolescents exposed to pro-e-cigarette advertisements were more likely to currently use e-cigarettes, more apt to use e-cigarettes in the future, and perceive e-cigarettes as less harmful and addictive. In addition, adolescents who use e-cigarettes were more likely to perceive them to be less harmful and addictive. Adolescents who had family members/people in their home environment who used e-cigarettes were more likely to use e-cigarettes themselves and adolescents who had a close friend who used e-cigarettes were more likely to be accepting of and use e-cigarettes. There needs to be more research conducted on adolescents' susceptibility to e-cigarettes in order to effectively create public health interventions.

A primary limitation of these studies is the use of a self-report, which can lead to bias and skewed results. An additional limitation of the literature review is that most of the studies used data from the NYTS such as Agaku and Ayo-Yusuf (2014), Dai and Hao (2016), Dutra and Glantz (2017), Noland et al (2018), and Pu and Zhang (2017), which collects data from adolescents who attended either public or private schools, excluding adolescents not in high school and those who are home-schooled. Excluding these populations of adolescents can lead to sampling bias and limit the generalizability of the study. In addition, the studies from this review were cross-sectional which eliminates the ability to make causal inferences. Although use of the NYTS has limitations, it also has the strength of being a large and nationally representative dataset. Cooper et al. (2016), Hammond et al. (2017), Nicksic et al. (2017), and Owotomo and Maslowsky (2018) studies also utilized data from large sample sizes.

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