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Using the 2023 NYTS data to examine e-cigarette use and perception of harm by race/ethnicity.

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ABSTRACT

Using the 2023 NYTS data to examine e-cigarette use and perception of harm by race/ethnicity.

By

Azizi Kayser Pyron

Monday, July 29, 2004

The use of e-cigarettes among youth is associated with believing that e-cigarettes are safer than cigarettes, help people quit smoking, and don't have any or just limited amounts of nicotine. The landscape of the e-cigarette market, prevalence of use among youth, and risk awareness have changed significantly. This project will use the latest available nationally representative data (from 2023) to give an up-to-date look at what U.S. middle school and high school students think about e-cigarette harm. This study will describe the current relationship between perceived harm of e-cigarette use and reported use among U.S. adolescents and young adults (AYAs). This project will also assess whether this relationship differs by race to add to evidence on the racial disparities in e-cigarette use among U.S. youth.

Using the 2023 NYTS data to examine e-cigarette use and perception of harm by race/ethnicity.

by

Azizi K. Pyron

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APPROVAL PAGE

Using the 2023 NYTS data to examine e-cigarette use and perception of harm by race/ethnicity.

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Author's Statement Page

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Azizi Pyron
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INTRODUCTION

E-cigarettes, also known as electronic nicotine delivery systems (ENDS) and “vapes,” are the most commonly used tobacco product among U.S. youth (CDC, 2024). Although commonly used as a smoking cessation device among older adults (*Adult Smoking Cessation—The Use of E-Cigarettes*, 2023), research shows that among young adult e-cigarette users aged 18–24 years, 61.4% had never been cigarette smokers (CDCMMWR, 2023). In 2023, 7.7% of middle and high school students in the US, totaling 2.1 million students, used e-cigarettes, making it the most prevalent tobacco product among young people (CDC, 2024). This figure comprises 4.6% of middle school students and 10% of high school students, with 46.7% of e-cigarette users reporting current use (CDC, 2024). Use of e-cigarettes among youth is associated with believing that e-cigarettes are safer than cigarettes, help people quit smoking conventional cigarettes, and don’t have any or just limited amounts of nicotine (Gorukanti et al., 2017). Further research revealed that Hispanic participants were consistently less likely than white participants to perceive e-cigarettes as less harmful (Ambrose et al., 2014). Additionally, regardless of smoking status, individuals who had ever used e-cigarettes were strongly associated with perceiving them as less harmful than traditional cigarettes (Ambrose et al., 2014). These perceptions about e-cigarettes likely increase use by underplaying health-related risks, including believing that e-cigarettes are less harmful, do not contain nicotine, and are just flavored water vapor (Gaiha et al., 2022). Predictably, tobacco-naïve adolescents and young adults who perceive e-cigarettes as less harmful are more likely to experiment with e-cigarettes (Choi & Forster, 2014).

Several studies have evaluated e-cigarette harm perceptions among youth using nationally representative data collections like NHANES and NYTS. Still, many of these studies were conducted before recent changes in the e-cigarette market, EVALI, and COVID. The landscape of the e-cigarette market, prevalence of use among youth, and risk awareness have changed significantly. This project uses the latest nationally representative data (from 2023) to look at what U.S. middle school and high school students think about e-cigarette harm. There hasn't been recent data on racial/ethnic differences in youth perceptions of e-cigarette harm and how perceptions are associated with e-cigarette use. This study describes the current relationship between the perceived harm of e-cigarette use and reported e-cigarette use among U.S. middle school and high school students. This project also assesses whether this relationship differs by race, with the goal of providing timely evidence of the racial disparities in e-cigarette use among U.S. youth. This evidence is essential to informing action and developing effective intervention strategies to prevent youth vaping behaviors, especially among subpopulations such as racial and ethnic minoritized adolescents. Results from this research will underscore the importance of developing and implementing tailored strategies to address the e-cigarette use epidemic.

As the market continues to change, there remains a need to understand how youth perceive the harms of e-cigarette use and how this affects e-cigarette use among U.S. students. Therefore, the purpose of this research is to determine U.S. middle school and high school students' perception of harm from e-cigarette use in the context of the recent COVID pandemic, reported cases of EVALI, and implemented federal regulatory action on vaping products in response to the youth vaping epidemic, and increased number of anti-vaping

campaigns for kids. The research aims to investigate the association between perceived harm of e-cigarette use and current use, focusing on differences in perception and the aforementioned association by race/ethnicity. Based on previous studies, we predict that e-cigarette use among students is significantly ($p < 0.05$) associated with lower levels of perceived harm. We can use this data to implement targeted and effective tobacco prevention policies, including anti-smoking marketing campaigns, to reduce e-cigarette use among U.S. adolescents.

LITERATURE REVIEW

Tobacco-use research shows that perception of risk plays an essential role in the decision to use tobacco products. To develop better-informed strategic interventions preventing youth vaping, we must collect more data on the youth's perception of harm from e-cigarette use. The primary purpose of this review is to examine the current research on how adolescents and young adults (AYAs) perceive the harm of using e-cigarettes. This will be done by analyzing data from a large, nationally representative sample of U.S. youth to identify gaps in our understanding of this issue. Since the e-cigarette market is still new, there is minimal information available on the long-term health impacts of e-cigarette use; however, this project will review collected existing longitudinal studies on the perception of harm and associated risk awareness. Additionally, this literature review will examine the relationship between race and perceived harm and ascertain if there is substantial evidence to underscore the need for more accurate communication of harm from e-cigarettes to young tobacco-naïve adolescents.

The National Youth Tobacco Survey (NYTS) has been a collaborative project between the Centers for Disease Control and Prevention, Office on Smoking and Health (CDC, OSH) and the Food and Drug Administration, Center for Tobacco Products (FDA, CTP) since 2011. The survey collects data on tobacco-related behaviors, attitudes, beliefs, and exposure to pro- and anti-tobacco influences from students 6 to 8 and 9 to 12 (Hu et al., 2020). There have been many studies that have focused on understanding the perceptions of harm associated with e-cigarettes among youth in the United States. Ambrose et al. (2013) analyzed data from the 2012 NYTS to identify patterns of cigarette harm perceptions among youth and examine the relative harm perceptions of conventional cigarettes versus e-cigarettes. They performed a

multinomial logistic regression analysis to examine the associations between demographic and tobacco use characteristics and cigarette harm perceptions. They found that different groups of youth use e-cigarettes at higher percentages, indicating racial disparities in e-cigarette use among young tobacco users. They also found that one in three sampled students thought e-cigarettes were less harmful than conventional cigarettes, and many students perceive tobacco use on a continuum of harm, meaning increased risks are related to the frequency of use and "dose-dependent." Here, we see that youth who think degree harm is based on frequency, intensity, and type of product may be particularly susceptible to increased odds for reported e-cigarette use.

Amrock et al. (2014) also used the 2012 NYTS dataset to investigate correlates of e-cigarette harm perception and the use of e-cigarettes among U.S. adolescents. They found that among those students trying e-cigarettes, approximately 71% believed e-cigarettes were comparatively less harmful than cigarettes. They also discovered that young tobacco users who use other tobacco products and those with family members who used tobacco were more inclined to perceive e-cigarettes as comparatively safer. From this research, we can identify numerous characteristics associated with increased odds of e-cigarette use among youth. The perception of harm from vaping as less harmful than smoking cigarettes was found to be associated with increased e-cigarette use among young respondents, displaying the need for more attention from public health professionals who want to stop kids from vaping.

Between 2013 and 2014, e-cigarette use among high schoolers increased from 4.5% to 13.4%, and among middle school students from 1.1% to 13.4% (Tobacco Use Among Middle and High School Students — United States, 2011–2014, n.d.). Dobbs et al. (2017) assessed the

use and perception of harm using data collected from the 2014 NYTS. The researchers utilized logistic regression models to demonstrate that students who believe e-cigarettes are less harmful than traditional cigarettes have higher odds of lifetime use (odds ratio [OR] = 2.40, 95% confidence interval [CI] = 1.98–2.90) and past 30-day use (OR = 2.18, 95% CI = 1.63–2.92) of e-cigarettes. This perception has been identified as a risk factor for e-cigarette use, along with other factors such as race, grade level, living with a smoker, and lifetime use of cigarettes. Additional research here affirms the growing hypothesis that lowered perceived risk from the use of tobacco products increases the odds of tobacco use, especially among impressionable young e-cigarette users, and that different subpopulations of youth perceive risk differently, emphasizing the need for uniquely designed vaping-cessation approaches for vulnerable young adolescents.

Margolis et al. (2018) used findings from the 2015 NYTS to examine how e-cigarette harm perceptions are essential for assessing the probability of future use and how harm perceptions from e-cigarettes and exposure to e-cigarette ads are associated with students' openness and curiosity about e-cigarette use. The results from the weighted regression models indicated that students who believed that e-cigarettes cause significant harm were less likely to be open to using e-cigarettes (OR = 0.10, 95% CI = 0.07, 0.15) and less curious about e-cigarettes (OR = 0.10, 95% CI = 0.07, 0.13) compared to those who perceived lower harm. However, students who reported high exposure to e-cigarette ads in stores were more likely to be open to using e-cigarettes (OR = 1.22, 95% CI = 1.03-1.44) and highly curious about e-cigarettes (OR = 1.25, 95% CI = 1.01-1.53) compared to those with lower exposure. Results further the need for public health professionals to understand how ad exposure and curiosity

play into perceptions and e-cigarette use in a rapidly changing market. The data emphasizes the need for continued investigation into factors associated with perceived harm from e-cigarettes among AYAs.

The overall use of any tobacco product did not significantly change from 2011 to 2018 among middle and high school students. However, from 2017 to 2018, there was a 77.8% increase (from 11.7% to 20.8%) in e-cigarette use among high school students and a 48.5% increase (from 3.3% to 4.9%) among middle school students. This growth has reversed the previous progress in reducing tobacco product use among young people (Gentzke, 2019). Comprehensive control strategies can help prevent the use of all forms of tobacco products among U.S. youth, highlighting the need to understand the causal factors associated with this negative health behavior. Beginning in March 2019, there was an outbreak of severe lung injury in the United States monikered "EVALI" (for E-cigarette or Vaping-Associated Lung Injury) due to the condition being caused mainly by vaping liquids (Health, 2021). This became significant public health news with known associations to increase the risk of COVID-19 (Gaiha et al., 2020). East et al. (2021) were the first to investigate the impact of negative news stories about vaping on youth in England, Canada, and the United States, as well as their perceptions of vaping-related harm before and after the EVALI outbreak. The research findings showed that exposure to negative news stories increased from 18.0% to 64.6% between 2017 and February–March 2020 in the United States. This increase accelerated during 2019 and immediately after the outbreak (February–March 2020) before returning to 2019 levels by August 2020.

Additionally, the perception that vaping takes less than a year to harm users' health and the concern that vaping will damage health also increased over this period. The study found

that time trends were most significant in the United States compared to the other two countries examined. The research showed that young people's exposure to negative news stories and their perceptions of the harms of vaping increased, and these increases worsened during and immediately after the 'EVALI' outbreak, particularly in the U.S. youth participants. Like existing tobacco research about conventional cigarettes, increased awareness of risks from e-cigarette use lowers susceptibility and curiosity for e-cigarette use among youth. This also demonstrates why more population research on influence and harm perceptions is essential to inform regulatory action against youth vaping.

The Population Assessment of Tobacco and Health (PATH) study is a nationally representative longitudinal study of tobacco use and health in the U.S. It was launched by the National Institute on Drug Abuse (NIDA), National Institutes of Health (NIH), and the Center for Tobacco Products (CTP) to provide information for the FDA's regulatory activities under the Family Smoking Prevention and Tobacco Control Act (2009). Zheng and colleagues (2021) utilized data from the PATH study waves 2-4 (2014-2018) to examine the correlation between social media usage, e-cigarette consumption, online advertising exposure, and risk perception of e-cigarettes among adolescents aged 12 - 17 in the United States. Information about vaping in the media can change the perception of e-cigarette use. Researchers discovered that young people who used social media more frequently were likelier to see e-cigarette advertisements during the study's second phase. This exposure led to a reduced perception of the health risks associated with e-cigarettes by the third phase.

Furthermore, those with lower risk perceptions in phase three were more likely to use e-cigarettes by the fourth phase. The study also found a direct link between high social media

use in the second phase and increased likelihood of e-cigarette use by the fourth phase. Their research shows that exposure to e-cigarette ads and marketing lowers the perceived risk associated with e-cigarette use among young participants. The collected data underscores the importance of communicating the dangers of e-cigarettes to counter targeted ad campaigns by e-cigarette manufacturers.

Federal and state regulators began removing popular flavors from shelves in response to the increasing popularity of non-traditional kid-friendly flavors like fruit punch and bubble gum among youth. Hung et al. (2022) investigated whether the type of e-cigarette flavor used at initiation predicted addiction and harm perceptions among youth in the PATH study. The study investigated whether the type of flavor used when starting e-cigarette use could predict addiction and harm perceptions among youth aged 12-17. The researchers looked at descriptive statistics relating to the study variables and performed linear regression analyses to test if the flavor initiation type is associated with addiction and harm perception. After adjusting for age, age of onset, sex, race, and annual household income, the study found that there was no statistically significant difference in addiction levels between those who initiated traditional flavors versus non-traditional flavors.

Similarly, there was no statistically significant difference in adolescent perceptions of e-cigarette harm between traditional and non-traditional flavor initiation. Traditionally, initiating flavored e-cigarettes carries a similar risk for addiction and harm perceptions as non-traditional flavors. Therefore, banning non-traditional flavors alone may not effectively reduce e-cigarette addiction and harm perception. More research on what characteristics and behaviors may be

associated with e-cigarette use among youth and reduced harm perceptions is needed to better inform prevention strategies against kids vaping.

As the market rapidly changes tactics to reach and appeal to youth, Stanton et al. (2022) also used data collected from PATH to investigate longitudinal associations between AYAs in the U.S. exposure to e-cigarette marketing and e-cigarette use harm perception and behavior change over time. After adjusting for sociodemographic factors, findings indicate that exposure to E-cigarette marketing through websites and social media was linked to decreased perceptions of harm. Young participants who remembered exposure to e-cigarette marketing were associated with reduced e-cigarette harm perception (with an Adjusted Odds Ratio [AOR] = 1.20; 95% CI = 1.05-1.37). Exposure to e-cigarette advertisements was linked to trying e-cigarettes (with an adjusted odds ratio of 1.26 and a 95% confidence interval of 1.01-1.56) and currently using e-cigarettes (with an adjusted odds ratio of 1.40 and a 95% confidence interval of 1.02-1.92) at the time of follow-up. This demonstrates the importance of identifying marketing strategies and platforms that influence young people's perceptions of e-cigarettes and how they affect the progression of e-cigarette use. Such insights are crucial for shaping e-cigarette regulations and implementing effective prevention campaigns.

Namwase et al. (2022) collected information from the NYTS using data from the 2014 to 2019 surveys to evaluate the trend of harm perception for e-cigarettes and the association between harm perception for e-cigarettes among U.S. students in middle school and high school over time. They observed a decrease in the percentage of youth who perceived e-cigarettes as harmless, from 17.2% to 5.8% between 2014 and 2019. From 2015 to 2018, the rate of smokers who perceived e-cigarettes as harmful increased from 33.6% to 41.2%. Using a

regression model, analysts found that in 2014, students who perceived cigarettes as harmless were 19.55 times more likely to perceive e-cigarettes as harmless than those who viewed cigarettes as very harmful. In 2019, this likelihood increased to 77.65 times, indicating a stronger relationship between the perceived harm of cigarettes and e-cigarettes over time. This research suggests that interventions and regulatory actions could impact e-cigarette use among adolescents and young adults.

With the prevention of children vaping becoming a high priority, further regulatory action required e-cigarette manufacturers to remove labels or ads describing vaping products using the descriptors "light," "mild," and "low" as of November 8, 2017. Additionally, the FDA would require health warning statements on packages and advertisements for "covered" tobacco products, including all Electronic Nicotine Dispensary Systems (ENDS) and the popular disposable e-cigarette cartridges, by August 10, 2018 (Products, 2022). Asfar et al. (2022) collected data from the 2018-2021 NYTS to examine the prevalence, time trend, factors, and relationship between youth exposure to warnings and harm perception. The research focused on youth exposure and response to the FDA health warning label on electronic cigarette packaging, emphasizing the importance of health communication for this high-priority group. This study revealed that only 24.5% of the youth were exposed to the warning. The exposure increased from 14.9% in 2018 to 30.8% in 2019 and then declined to 25.2% in 2021. After weighted adjustments, data showed Hispanic e-cigarette users were less likely to be exposed to the warning compared to their White peer current users (with Hispanics carrying an AOR = 0.76 [95% CI = 0.641 to 0.89]). In addition, non-Hispanic Black current users were also less likely to be exposed to the warning compared to Whites (with an AOR = 0.53 [95% CI = 0.40 to 0.69]).

Here is evidence of the negative effect of repeated exposure to an advertisement and warning where the viewer does not learn anything or is even aware of the warning label. Exposure to e-cigarette warnings was significantly lower among minorities, and it did not increase harm perceptions or reduce the intention to use e-cigarettes among young nonusers. To improve its impact on youth, the warning label could be enhanced using more compelling designs, including diverse themes of e-cigarette harm relevant to youth and periodically rotating warning content.

More surveillance of implementation of e-cigarette regulatory action and anti-vaping campaigns is essential to ensure racial/ethnic disparities in public health are addressed. Understanding the relationship between race and perceived harm is essential to inform intervention strategies by focusing on the disparities in risk perceptions, knowledge, exposure, social norms, and other socioeconomic factors among different subpopulations. Cooper et al. (2016) used data from the Texas Adolescent Tobacco and Marketing Surveillance System (TATAMS), a rapid response surveillance system implemented with 6th, eighth, and 10th-grade students collected during the 2014 – 2015 academic year, to gain an understanding of how e-cigarette products are perceived across different demographics. The weighted logistic regression models were used to test perceived harm with sex and race/ethnicity considered as potential moderators because perceived risks of e-cigarette harm had been shown to vary by sex and race-ethnicity in studies by Ambrose et al. 2014 and Amrock et al. 2015. Research shows African American/Black individuals may have lower perceptions of e-cigarette health risks and addictiveness, which could influence their use.

Hooper et al. (2017) hypothesized that psychosocial stress factors that may affect e-cigarette initiation or maintenance among racial/ethnic minorities are not well understood. Via

telephone-administered surveys, they conducted an analysis of covariance and multinomial logistic regression tested associations by race/ethnicity and found after controlling for sociodemographic and smoking status, compared to both Whites and Hispanics, African American/Black participants held lower perceptions regarding e-cigarette health risks. They were less likely to view e-cigarettes as addictive. These disparities are further complicated by sexual orientation and identifiers, furthering subpopulations among minorities. In their 2023 study, Patterson et al. looked into the differences and changeable factors that are associated with how young adult lesbian and bisexual women, as well as non-binary individuals, perceive the harm of e-cigarettes. They found that in their statistical models, bisexual individuals, those of Hispanic/Latinx, and Other racial backgrounds reported higher levels of perceiving e-cigarettes as harmful compared to lesbian individuals and non-Hispanic White individuals. This suggests that individual-level factors can influence perceptions of e-cigarette harm. There are strong associations between harm perceptions and individual, interpersonal, and contextual factors. Young respondents associated higher absolute and relative e-cigarette harm perceptions with more significant perceived stress.

Understanding variations must inform targeted health communications to reduce e-cigarette use disparities. In their study, Zhang et al. (2024) performed a longitudinal analysis using PATH to investigate the impact of e-cigarette ads on disparities among youth with internalizing problems. Their findings underscore the significance of comprehending the lasting effects of e-cigarette advertising on youth behavior. They sought to examine the long-term effects of e-cigarette advertisements and disparities in exposure among adolescents with different levels of internalizing problems. Results showed that young participants with higher

internalizing problems are less susceptible to advertisement influence. However, their perceived harm of e-cigarettes is notably lower than that of their peers, with fewer internalizing problems. These disparities underscore the need for tailored prevention strategies, implementing anti-vaping education programs for adolescents with low internalizing problems, and providing mental health care for those facing internalizing challenges. Regulatory measures targeting e-cigarette advertising are also crucial.

Studies have shown that youth perceptions of harm from e-cigarettes can influence their decision to start or continue vaping. From survey data, we can begin to understand the role of e-cigarette marketing, flavored products, social influences, and the effects of ENDS in shaping youth vaping behaviors. Additionally, research has indicated that youth often perceive e-cigarettes as less harmful than traditional cigarettes (Jackson et al., 2024). Efforts to prevent e-cigarette use among youth have focused on interventions that target risk knowledge and perceptions of harm associated with vaping. Anti-vaping Campaigns like The Real Cost Campaign by the FDA (2024) aim to educate youth about the adverse health effects and risks of vaping and smoking, highlighting the importance of addressing misconceptions and promoting accurate perceptions of harm. However, AYA's perception of harm from e-cigarettes is influenced by a multitude of marketing and socioeconomic components, including stress and other complex interpersonal factors. Therein lies the gap in knowledge and understanding of these perceptions and their association with e-cigarette use among young people in the U.S.

E-cigarettes are the most commonly used tobacco product among young people (CDC, 2024). In 2023, it was estimated that 2.13 million U.S. middle and high school students used e-cigarettes in the past 30 days, which accounts for 4.6% of middle school students and 10.0% of

high school students (Health, 2023). Many states, including Georgia, do not have any current enforcement of ENDS products on the shelves, leaving tobacco-naïve youth extremely vulnerable. Over the past two years, Georgia schools saw an increase in vaping discipline, from 18,724 incidents to 22,204 (Reyes, n.d.). Adopting policies that decrease e-cigarette use, particularly among youth, paired with youth vaping cessation campaigns can significantly benefit public health. Right now, there is a lack of comprehensive understanding of adolescents' perception of the harm from e-cigarette use in U.S. middle schools and high schools as the e-cigarette market landscape continues to change and regulatory action struggles to keep pace. The potential risks of e-cigarettes, especially among young users, are still not fully understood. The information collected in this literature review was gathered to understand what today's youth think of harm from e-cigarettes, which is crucial for developing effective prevention strategies and public health interventions. The following research was comprised to update youth attitudes toward vaping and racial disparities in e-cigarette use among U.S. AYAs, underscoring the need for more targeted education and awareness campaigns to address misconceptions and promote accurate risk perceptions.

METHODS

Data

Data was collected from the National Youth Tobacco Survey (NYTS), which is a survey of a national probability sample of U.S. middle and high school students. The survey has been conducted collaboratively by the Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA) since 2011. A multistage stratified sampling design was utilized. Within strata, primary sampling units (PSUs) were randomly chosen. PSUs were either groups of schools with over 20% non-Hispanic AI/AN or non-Hispanic Asian students, or groups by county, where counties were sometimes grouped or split. Schools were then randomly selected among the chosen PSUs. Depending on the school size, all classes per grade or a random selection of 1 or 2 classes per grade were sampled. All students from the selected classes were included in the study.

For this study, we used data from the 2023 NYTS (collected from March 9 to June 16, 2023), in which 22,069 students from 179 schools participated (with an overall response rate of 30.5%) to examine the characteristics of the full sample of U.S. middle school and high school participants, the prevalence of reported e-cigarette use in the past 30 days, and what student participants think of harm from e-cigarettes. Student participants were separated by middle school and high school status. Race/ethnicity was recoded into five categories: non-Hispanic (NH) White, NH Black, Hispanic, NH Asian, and NH American Indian/Alaskan Native or Native Hawaiian or Other Pacific Islander (NH-AI/AN/NHOPI).

Variables of Interest

Students who reported being in the 6th, 7th, or 8th grade were placed in middle school, and students who reported being in the 9th, 10th, 11th, or 12th grade were placed in high school. Student participants who did not report grade-level (6th, 7th, 8th, 9th, 10th, 11th, or 12th) were recorded as missing and excluded from the analysis. Race/ethnicity was recoded into five categories: Non-Hispanic White, Non-Hispanic Black, Hispanic, Non-Hispanic Asian, and combining Non-Hispanic AI/AN and Non-Hispanic NHOPI into one (NH-AI/AN/NHOPI) using the code 'RACE_S' (no multiple groups). Participants who did not report a race/ethnicity or were recorded as missing were excluded from the analysis.

Students who reported using e-cigarettes on at least 1 of the 30 days were classified as current e-cigarette users. Missing answers were excluded from the analysis. Under question QN116, all student participants were asked: 'How much do you think people harm themselves when they use e-cigarettes some days but not every day? No harm, Little harm, Some harm, or A lot of harm?' Missing answers were excluded from the analysis.

Perceived harm levels were divided into two groups: students who perceived e-cigarette use as 'No Harm' and students who perceived it as 'Harmful'. Participants who selected 'No Harm' under QN116 were categorized as students who perceive 'No Harm' from e-cigarette use. Participants who selected 'little harm', 'some harm', or 'a lot of harm' were categorized as students who perceive e-cigarette use as 'Harmful.' Missing answers were excluded from the analysis.

Covariates

These control variables help account for confounding factors so that a clearer relationship can be derived between the studied behavior and the dependent variable. When we look at the relationship between e-cigarette use and perception of harm from e-cigarette use, we control for race/ethnicity. When examining the relationship between e-cigarette use and race to determine if race is associated with e-cigarette use, we control for perception of harm.

Statistical Analysis

The multivariate logistic regression model was analyzed using SAS 9.4 (SAS Institute, Cary, NC). The analyses accounted for the NYTS's complex multistage sampling, clustering, and stratification design. All population estimates included the design variables, stratum, cluster, and analysis weights. All coding used for analysis comes from the 2023 NYTS Codebook. The study was conducted with the significance level set at $\alpha = 0.05$.

RESULTS

Measure of Interest

Table 1a presents the current estimates of e-cigarette use and the perceived harm for middle school participants by race/ethnicity. Separately for high school participants, **Table 1b** shows estimates for current use of e-cigarettes and perceived levels of harm from e-cigarette use by race/ethnicity. **Table 2a and Table 2b** show the column percentage of students who perceive 'no harm' from e-cigarette use by race/ethnicity.

For our investigation into the relationship between race and our variables of interest (e-cigarette use and perception of harm), we utilized non-Hispanic Black students as our reference group for comparison with other races and ethnicities. In **Table 3a**, when examining the prevalence of e-cigarette use by race/ethnicity among middle school students, non-Hispanic Asian students have odds of e-cigarette use that are 0.22 times higher compared to non-Hispanic Black students. Non-Hispanic White students have odds of e-cigarette use that are 0.57 times higher compared to non-Hispanic Black students. For **Table 3b**, when examining the prevalence of e-cigarette use by race/ethnicity among high school students, Hispanic students have odds of e-cigarette use that are 1.77 times higher compared to non-Hispanic Black students. Non-Hispanic White students have odds of e-cigarette use that are 2.16 times higher compared to non-Hispanic Black students.

On **Table 4a**, when testing the perceptions of harm from e-cigarette use among middle school students, we discovered that non-Hispanic Asian students have 0.22 odds of perceiving no harm from e-cigarette use compared to non-Hispanic Black students. Non-Hispanic White

students have odds of perceiving no harm from e-cigarette use that are 0.23 times higher compared to non-Hispanic Black students. In **Table 4b**, when testing the perceptions of harm from e-cigarette use among high school students, we discovered that non-Hispanic White students have 0.51 odds of perceiving no harm from e-cigarette use compared to non-Hispanic Black students.

On **Table 5**, we found that current e-cigarette users have 3.53 times higher odds of perceiving no harm from e-cigarette use compared to non-users among ALL students (full sample). Among middle school students, current e-cigarette users have 2.9 times higher odds of perceiving no harm from e-cigarette use compared to non-users. For high school students, current e-cigarette users have 3.66 times higher odds of perceiving no harm from e-cigarette use compared to non-users. For ALL non-Hispanic White students, current e-cigarette users have 5.29 times higher odds of perceiving no harm from e-cigarette use compared to non-users. For ALL Hispanic students, current e-cigarette users have 3.39 times higher odds of perceiving no harm from e-cigarette use compared to non-users.

Multinomial Logistic Regression Analysis

Table 6a shows after adjusting for race/ethnicity, students who believe e-cigarette use poses 'no harm' are 3.7 times more likely to currently use e-cigarettes. After controlling for perception of harm, non-Hispanic White students are 1.7 times more likely to be current e-cigarette users compared to non-Hispanic Black students. On **Table 6b**, after controlling for race, we see students who believe e-cigarette use poses 'no harm' are 2.43 times more likely to

currently use e-cigarettes among middle school students. After controlling for perception of harm, non-Hispanic White students are 0.58 times more likely to be current e-cigarette users compared to non-Hispanic Black students. For **Table 6c**, after adjusting for race/ethnicity among high school participants, students who believe e-cigarette use poses 'no harm' are 3.96 times more likely to currently use e-cigarettes. After controlling for perception of harm, Hispanic students are 2.01 times more likely to be current e-cigarette users compared to non-Hispanic Black students and non-Hispanic White students are 2.68 times more likely to be current e-cigarette users compared to non-Hispanic Black students. It should be noted that observations were deleted from the model due to missing values for the response or explanatory variables.

DISCUSSION

The following report uses national data to look at the prevalence of e-cigarette use and student participants' perception of harm from e-cigarette use among middle and high school students by race to examine racial disparities and identify characteristics of young e-cigarette use to improve preventative strategies. The research examined the differences in the use of e-cigarettes and perceptions of their harmful effects among middle and high school students in the United States, based on their racial and ethnic backgrounds. The study found that students who viewed e-cigarettes as less harmful were more likely to use them. These findings from the cross-sectional analysis align with previous research, suggesting that how young people perceive the harm of vaping is linked to their use of e-cigarettes.

Upon evaluating the perception of harm from e-cigarettes in relation to race/ethnicity, we found that middle school students who are non-Hispanic Black are notably less likely to perceive e-cigarettes as harmful compared to their non-Hispanic Asian and non-Hispanic White peers. This finding is consistent with prior research indicating that perceptions of health risks associated with e-cigarettes vary by race/ethnicity, with non-Black individuals tending to have lower perceptions of the health risks posed by e-cigarettes (Webb Hooper & Kolar, 2017). Additionally, our analysis uncovered that Black students in middle school are more inclined to use e-cigarettes compared to their non-Hispanic Asian and non-Hispanic White counterparts. This suggests that non-Hispanic Black middle school students may be particularly at higher risk and underscores the significant influence of race/ethnicity on e-cigarette use among middle school students.

In high schools, non-Hispanic White students are more likely to perceive harm from e-cigarette use compared to non-Hispanic Black students. Additionally, Hispanic and non-Hispanic White students are at a significantly higher risk of using e-cigarettes compared to non-Hispanic Black students in middle school. Further investigation is necessary to enhance our comprehension of the attitudes, motivations for usage, and awareness of e-cigarettes within underrepresented communities. Influential elements like marketing, media, and misconceptions regarding the risks associated with e-cigarette use persist in affecting tobacco product consumption differently among young individuals from diverse racial and educational backgrounds (Webb Hooper & Kolar, 2017; Zheng et al., 2021).

Limitations of Study

This study has limitations. The data was gathered through self-reporting, which means that it may be subject to biases. Weighted adjustments were made to reduce the potential for nonresponse bias.

Implications and conclusions

The results of this cross-sectional analysis show that varying risk perceptions are significant associated with use of e-cigarettes among different racial and ethnic groups. It is imperative to persist in conducting thorough research to fully understand these connections, and implementing targeted and effective tobacco prevention policies, including anti-smoking marketing campaigns, to reduce e-cigarette use among U.S. adolescents. These policies must specifically address vaping and include tailored interventions aimed at reducing tobacco use among young people in subpopulation groups. This report significantly enhances our understanding of the factors influencing e-cigarette use among young individuals from diverse racial and ethnic backgrounds. Specifically, lower risk perceptions, especially among young Black students, may substantially increase their likelihood of using e-cigarettes at a young age, potentially contributing to tobacco-related disparities.

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TABLES

Table 1a. Weighted analysis of e-cigarette use and perceived level of harm by race for Middle School students

Schooltype	Total, n	% of students who reported e-cigarette use on >= 1 of the past 30 days (SE) n	% of student's perceived levels of harm from e-cigarette use (SE) n			
			No harm	Little Harm	Some Harm	A lot of Harm
Middle School	10,536	4.5% (0.52%) 438	3.1% (0.42%) 339	11.5% (0.59%) 1,164	39.4% (1.07%) 3,924	45.9% (0.93%) 4,664
Race/Ethnicity						
NH-White	4,784	3.2% (0.48%) 153	1.5% (0.39%) 88	10.9% (0.81%) 505	41.8% (1.44%) 1,860	45.8% (1.46%) 2,188
NH-Black	1,645	5.5% (1.00%) 65	6.3% (0.91%) 97	15.1% (1.06%) 205	33.8% (1.67%) 565	44.8% (1.92%) 692
Hispanic	2,492	6.6% (0.70%) 165	4.4% (0.72%) 117	11.0% (1.13%) 302	38.8% (1.99%) 897	45.9% (1.74%) 1,005
NH-Asian	1,069	1.3% (0.76%) 6	1.5% (0.98%) 9	9.7% (2.46%) 80	38.6% (2.83%) 404	50.2% (3.74%) 553
NH-AI/AN/NHOPI	546	5.5% (3.07%) 49	6.9% (3.08%) 28	14.2% (3.58%) 72	27.6% (6.73%) 198	51.1% (4.52%) 226

Table 1b. Weighted analysis of e-cigarette use and perceived levels of harm by race for High School students

Schooltype	Total, n	% of students who reported e-cigarette use on >= 1 of the past 30 days (SE) n	% of student's perceived levels of harm from e-cigarette use (SE) n			
			No harm	Little Harm	Some Harm	A lot of Harm
High School	10,591	10.1% (0.66%) 1,080	3.8% (0.29%) 389	11.4% (0.67%) 1,170	40.1% (1.09%) 4,020	44.7% (0.94%) 4,484
Race/Ethnicity						
NH-White	4,410	11.6% (1.09%) 538	3.1% (0.43%) 144	10.6% (1.04%) 488	42.9% (1.56%) 1,774	43.4% (1.22%) 1,855
NH-Black	1,119	5.8% (0.77%) 87	5.8% (0.98%) 59	10.4% (1.18%) 116	35.4% (2.01%) 357	48.4% (1.87%) 507
Hispanic	3,641	9.8% (0.94%) 355	4.4% (0.34%) 153	12.5% (0.98%) 412	38.8% (1.37%) 1,338	44.4% (1.26%) 1,483
NH-Asian	1,003	8.7% (5.63%) 37	1.9% (1.19%) 13	14.3% (5.09%) 83	37.6% (6.43%) 395	46.2% (5.57%) 482
NH-AI/AN/NHOPI	418	14.6% (8.51%) 63	6.9% (2.78%) 20	13.6% (5.79%) 71	29.8% (5.98%) 156	49.7% (8.97%) 157

Table 2a. Middle school students who believe e-cigarettes do 'No harm' by race/ethnicity

Race/Ethnicity	%
NH-White	25.09%
NH-Black	30.73%
Hispanic	38.62%
NH-Asian	2.55%
NH-AI/AN/NHOPI	3.01%

Table 2b. High school students who believe e-cigarettes do 'No harm' by race/ethnicity

Race/Ethnicity	%
NH-White	40.25%
NH-Black	21.19%

Hispanic	32.29%
NH-Asian	3.45%
NH-AI/AN/NHOPI	2.83%

Table 3a. E-cigarette use by race/ethnicity in middle school

Race/Ethnicity	Point Estimate	95% Confidence Limit		p-value
		LL	UL	
Hispanic vs NH-Black	1.23	0.81	1.85	0.3239
NH-AI/AN/NHOPI vs NH-Black	1.00	0.30	3.30	0.9992
*NH-Asian vs NH-Black	0.22	0.06	0.83	0.0263
NH-White vs NH Black	0.57	0.37	0.87	0.0105

*When examining the prevalence of e-cigarette use by race/ethnicity among middle school students, non-Hispanic Asian students have odds of e-cigarette use that are 0.22 times higher compared to non-Hispanic Black students.

Table 3b. E-cigarette use by race/ethnicity in high school

Race/Ethnicity	Point Estimate	95% Confidence Limit		p-value
		LL	UL	
*Hispanic vs NH-Black	1.77	1.30	2.42	0.0006
NH-AI/AN/NHOPI vs NH-Black	2.81	0.65	12.15	0.1624
NH-Asian vs NH-Black	1.56	0.37	6.50	0.5325
NH-White vs NH Black	2.16	1.46	3.18	0.0003

*When examining the prevalence of e-cigarette use by race/ethnicity among high school students, Hispanic students have odds of e-cigarette use that are 1.77 times higher compared to non-Hispanic Black students.

Table 4a. Perceiving 'No Harm' from e-cigarette use by race/ethnicity in middle school.

Race/Ethnicity	Point Estimate	95% Confidence Limit		p-value
		LL	UL	
Hispanic vs NH-Black	0.68	0.44	1.03	0.0692
NH-AI/AN/NHOPI vs NH-Black	1.11	0.37	3.32	0.8446
*NH-Asian vs NH-Black	0.22	0.06	0.83	0.0263
NH-White vs NH Black	0.23	0.12	0.45	<.0001

*When testing the perceptions of harm from e-cigarette use among middle school students, we discovered that non-Hispanic Asian students have 0.22 odds of perceiving no harm from e-cigarette use compared to non-Hispanic Black students.

Table 4b. Perceiving 'No Harm' from e-cigarette use by race/ethnicity in high school.

Race/Ethnicity	Point Estimate	95% Confidence Limit		p-value
		LL	UL	
Hispanic vs NH-Black	0.74	0.47	1.16	0.1784
NH-AI/AN/NHOPI vs NH-Black	1.20	0.42	3.41	0.7260
*NH-Asian vs NH-Black	0.31	0.08	1.20	0.0885
NH-White vs NH Black	0.51	0.31	0.31	0.0109

*When testing the perceptions of harm from e-cigarette use among high school students, we discovered that non-Hispanic White students have 0.51 odds of perceiving no harm from e-cigarette use compared to non-Hispanic Black students

Table 5. Probability modeled is perceiving 'No Harm' from e-cigarette use.

	Point Estimate	95% Confidence Limit		p-value
		LL	UL	
FULL SAMPLE (n = 22,069)				
Current e-cigarette use vs. No use	*3.53	2.44	5.13	<.0001
MIDDLE SCHOOL STUDENTS (n = 11,067)				
Current e-cigarette use vs. No use	2.90	1.31	6.39	0.0099
HIGH SCHOOL STUDENTS (n = 10,879)				
Current e-cigarette use vs. No use	3.66	2.48	5.39	<.0001
NH-White Students (n = 9,280)		3.00		
Current e-cigarette use vs. No use	5.29	3.03	9.23	<.0001
NH-Black Students (n = 2,811)				
Current e-cigarette use vs. No use	2.95	0.68	12.75	0.1434
Hispanic Students (n = 6,266)				
Current e-cigarette use vs. No use	3.39	2.01	5.72	<.0001
NH-Asian Students (n = 2,086)				
Current e-cigarette use vs. No use	0.64	0.04	11.02	0.7528
NH-AI/AN/NHOPI (n = 972)				
Current e-cigarette use vs. No use	0.25	0.03	1.92	0.1778

*Current e-cigarette users have 3.53 times higher odds of perceiving no harm from e-cigarette use compared to non-users among ALL students (full sample).

NOTE: Observations were deleted due to missing values for the response or explanatory variables.

Multinomial logistic regression models

Probability modeled is current e-cigarette use.

Table 6a. E-cigarette use among ALL school students.

	Point Estimate	95% Confidence Limit		p-value
		LL	UL	
*'No Harm' vs 'Harmful'	3.70	2.51	5.45	<.0001
Hispanic vs NH-Black	1.68	1.20	2.35	0.0036
NH-AI/AN/NHOPI vs NH-Black	2.39	0.67	8.57	0.1765
NH-Asian vs NH-Black	1.40	0.35	5.65	0.6271
a.'NH-White vs NH Black	1.70	1.16	2.51	0.0083

*After adjusting for race/ethnicity, students who believe e-cigarette use poses 'no harm' are 3.7 times more likely to currently use e-cigarettes.

a. After adjusting for perceived harm, non-Hispanic White students are 1.7 times more likely to be current e-cigarette users compared to non-Hispanic Black students.

Table 6b. E-cigarette use among middle school students

	Point Estimate	95% Confidence Limit		p-value
		LL	UL	
No Harm' vs 'Harmful'	2.43	1.06	5.58	0.0367
Hispanic vs NH-Black	1.25	0.83	1.91	0.2790
NH-AI/AN/NHOPI vs NH-Black	0.74	0.28	1.98	0.5415
NH-Asian vs NH-Black	0.26	0.06	1.03	0.0544
NH-White vs NH Black	0.58	0.35	0.96	0.0362

Table 6c. E-cigarette use among high school students

	Point Estimate	95% Confidence Limit		p-value
		LL	UL	
No Harm' vs 'Harmful'	3.96	2.63	5.95	<.0001
Hispanic vs NH-Black	2.01	1.39	2.91	0.0005
NH-AI/AN/NHOPI vs NH-Black	3.73	0.84	16.51	0.0815
NH-Asian vs NH-Black	2.20	0.49	9.88	0.2942
NH-White vs NH Black	2.68	1.78	4.04	<.0001

NOTE: Observations were deleted due to missing values for the response or explanatory variables.

FIGURES

Figure 2a. Middle school students who believe e-cigarettes do 'No harm' by race/ethnicity %

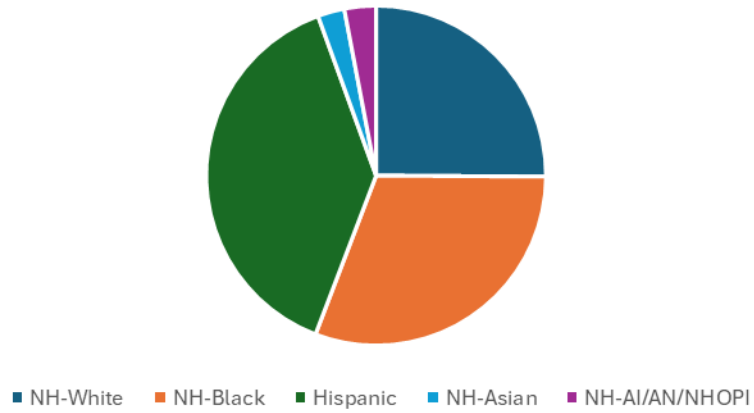


Figure 2b. High school students who believe e-cigarettes do 'No harm' by race/ethnicity %

