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Three-Time Survey Comparison of Tobacco and E-Cigarette Use and Perceptions Among College Students

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Abstract

Background/Objectives: Tobacco use among young adults remains a public health concern. Understanding trends in tobacco and e-cigarette use may help inform future education and intervention strategies. This survey aims to assess tobacco and e-cigarette use and related perceptions over a 5-year period. **Methods**: A validated 33-item questionnaire was sent to students at a Midwestern university in Fall 2018, 2020, and 2023. The survey assessed tobacco use, e-cigarette use, and perceptions. **Results**: A total of 8143 student responses were collected over the 5-year period. A total of 3850 students participated in 2018, 1743 in 2020, and 2550 in 2023. Current traditional cigarette use declined over time (6.1%, 3.2%, 4.2%, respectively), while e-cigarette use decreased but remained the most common product (22.9%, 23.1%, 18.8%, respectively). Disagreement with the statements that imply e-cigarettes are a safe or effective option to quit smoking, and agreement with the stance that e-cigarettes are addictive, all increased during the 5-year period. **Conclusions**: These survey findings suggest a decrease in self-reported tobacco and e-cigarette consumption over the 5-year study period. Continued surveillance of local alongside national and global systems remains essential to determine whether specific sub-populations mirror the broader use patterns.

Keywords: tobacco; vaping; electronic nicotine delivery systems; ENDS; e-cigarettes; college students

1. Introduction

Decades of public initiatives in the United States (U.S.) have successfully decreased traditional cigarette use in young adults aged 18 to 24, from 54% of males and 38% of females in 1965 to about 8% of young adults in 2019 [1]. However, this progress has been threatened by the rapid use of e-cigarettes [2]. In 2023, e-cigarettes continued to be the dominant nicotine product for young adults in the U.S., with a quarter reporting using a nicotine vape in the past month, more than double the rate of traditional cigarette use [3]. Tobacco use is also a concern internationally; the World Health Organization (WHO) estimates 13% of 15–24 year olds use tobacco products [4]. The WHO estimates the global e-cigarette use for 15 years and older to be 1.9%, but the highest use is in the Americas and European regions, at 4.8% and 4.6%, respectively [5]. WHO issued a call to action to prevent uptake of e-cigarettes in response to the 7.2% global estimate of adolescent (13–15 years) use.

In response to this vaping epidemic, multiple national and international interventions have been implemented. Notable national actions include the 2019 "Tobacco 21" legislation

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which increased the legal age of buying tobacco to 21 years old [6]. Also, the U.S. Food and Drug Administration (FDA) banned most flavored cartridge-based vaping products to decrease e-cigarette use by teens and young adults [7,8]. Multiple national public health education campaigns were also launched to increase awareness of e-cigarette dangers, especially in youth [9–11]. Internationally, the WHO continues to promote MPOWER to support countries in tobacco control policies, including expanding smoke-free environments, cessation programs, and health warnings [12]. Despite these changes, the efficacy of these interventions to alter individual behavior remains unclear.

The persistence of e-cigarette use is complex, but several factors have been identified in the previous literature. Industry marketing frequently targets young adults with flavored products, technological designs, and persuasive advertising. A majority of Americans agree that peer pressure has the most influence in youth tobacco use. Youth who have friends who use tobacco products are more likely to do so themselves compared to those whose friends do not [13]. This suggests that prevention and intervention programs should consider altering social norms and attitudes regarding e-cigarettes into less favorable ones to decrease use in young adults [14].

While national trends provide a broad view, there is a need to understand how these dynamic regulatory and social changes affect specific college environments. This study aims to evaluate trends in tobacco use and student perceptions towards tobacco products over a 5-year period at a single, Midwestern U.S. institution.

2. Materials and Methods

A serial, voluntary, self-administered, cross-sectional study was conducted at a Midwestern university in the U.S. to describe trends in tobacco use and perceptions among college students. The questionnaire was previously developed and validated [15]. The Institutional Review Board (IRB) determined the study protocol to be exempt.

The survey was distributed to all students with a university email account in September 2018, September 2020, and September 2023. Each email contained a link to the questionnaire and stated that the purpose of the study was to collect data on the use and perceptions of e-cigarette and tobacco products. Participants were excluded if under 18 years of age or reporting no knowledge of an e-cigarette or vape. All responses were collected anonymously through QuestionPro [16]. Participants could utilize a separate link at the end of the survey to enter a voluntary drawing to win a gift card. The survey remained open for four weeks, during which time students received a reminder email at the one- and two-week marks. Consistent methods and incentives were used for each questionnaire deployment.

The questionnaire utilized conditional logic to assess personal use of various tobacco products based on definitions and use categories from the validated National Health Interview Survey (NHIS) [17]. Tobacco product use was specifically defined based on the product type. Traditional cigarette use was defined as smoking at least 100 cigarettes or 5 packs. Combustible non-cigarette tobacco use (cigars, cigarillos, pipes, hookah, or little filtered cigars) was defined as smoking at least 50 times. Smokeless tobacco (chewing tobacco, snuff, snus, or dip) and nicotine pouch use was defined by at least 20 uses. Finally, e-cigarette use was defined as using the product at least one time.

Participants were categorized by their reported use for each tobacco product into three groups: current use, past use, or never use. After participants selected use of any of the products, they then reported use in the last 30 days as using the product “every day”, “some days” or “not at all”. Participants who selected “every day” or “some days” were categorized as current use. Those who selected “not at all” were considered past use. Never

use was defined as all participants who selected "no" when asked if they had ever used the product amount specified by the definition provided.

Perceptions of e-cigarettes compared to other tobacco products were measured using a 6-point Likert scale with 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = somewhat agree, 5 = agree, and 6 = strongly agree. An additional response option, "unsure", was available and was treated as 3.5 = neutral. Additional questions explored perceived risks and benefits associated with e-cigarettes.

Survey participation was voluntary for each question; to ensure a standardized denominator across all variables, percentages are reported relative to the total number of initial participants for each year. Descriptive statistics summarize participant characteristics and study variables using frequencies and percentages. Age was summarized using medians and interquartile ranges due to capping responses at 50 years or older. Likert scale was summarized with mean and standard deviation. Two pairwise comparisons were performed against the 2018 baseline. Chi-square tests assessed differences in respondent demographics (age and gender) and tobacco use, and Mann–Whitney compared perceptions of e-cigarettes with other tobacco products. To control for multiple testing, we adjusted p values using the Bonferroni correction, yielding a significant threshold of alpha = 0.025. All statistical analyses were conducted using Stata version 18 (StataCorp, College Station, TX, USA).

3. Results

Survey response rates from the university student body are as follows: 3850 (29.1%) in 2018, 1743 (15.6%) in 2020 and 2550 (25.7%) in 2023. The university student body averaged 54% female gender and 75% white race during survey years. The demographics of the survey participants are summarized in Table 1, which closely resemble the whole student body. Of note, there were significantly more males who participated in 2018 compared to 2020 and 2023.

Table 1. Demographics of survey respondents.

Characteristic	2018 n = 3850	2020 n = 1743	2023 n = 2550
Age, yrs., median [IQR]	21 [18,19]	21 [18,19]	21 [18,20] *
Gender			
Male	1546 (40.2%)	603 (34.6%) *	868 (34.1%) *
Female	2277 (59.1%)	1212 (64.3%)	1580 (62.0%)
Other	27 (0.7%)	19 (1.1%)	101 (4.0%)
Race +			
Asian or Pacific Islander	119 (3.1%)	58 (3.3%)	67 (2.7%)
Black	160 (4.2%)	69 (4.0%)	152 (6.1%)
Hispanic or Latino	139 (3.6%)	69 (4.0%)	74 (3.0%)
Native American or American Indian	44 (1.1%)	24 (1.4%)	13 (0.5%)
White	3292 (85.1%)	1491 (85.5%)	2167 (86.5%)
Other	96 (2.5%)	32 (1.8%)	32 (1.3%)

* p value < 0.025, Race + p value not calculated due to select all that apply.

Analysis of tobacco history is summarized in Figure 1. Current tobacco use of any product revealed significant longitudinal decreases from 29.9% in 2018 to 26.8% in 2020 and 22.3% in 2023, while past use had a similar decline from 29.9% to 27.4% to 24.0% over the same period ($p < 0.025$ for all comparisons). To reflect current tobacco products, nicotine pouch use was added to the 2023 survey. Of those surveyed in 2023, 5.3% of respondents selected current use, 3.2% past use, and 91.4% never use for nicotine pouches. Participants

who reported currently using more than one tobacco product were as follows: 8.6% in 2018, 5.2% in 2020, and 6.7% in 2023.

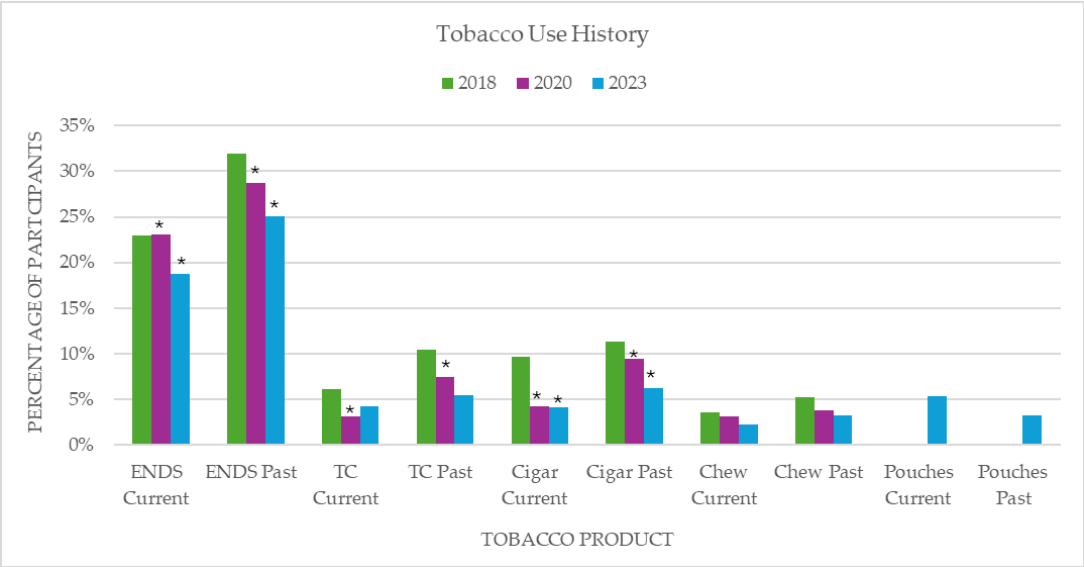


Figure 1. Tobacco use history. * $p < 0.025$ significant (2018 vs. 2020 or 2018 vs. 2023). ENDS = electronic cigarettes/e-cigarettes/vapes; TC = traditional cigarettes; Cigar = combustible non-cigarette tobacco (cigars, cigarillos, pipes, hookah, or little filtered cigars); Chew = smokeless tobacco (chewing tobacco, snuff, snus, or dip); Pouches = nicotine pouches. Current use is defined as use in the previous 30 days. Past use is defined as using the products more than a specified amount of time but no use in the previous 30 days.

Patterns of tobacco never use for all reported tobacco products showed significant upward trends across all categories from 2018 to 2023. Pronounced increases in participants who reported never use were observed in traditional cigarettes and combustible non-cigarette tobacco products. Those reporting never having used traditional cigarettes rose from 83.2% in 2018 to 88.7% in 2020 ($p < 0.001$) and remained elevated at 87.8% in 2023 ($p < 0.001$). Similarly, those who had never used cigars grew from 78.0% at baseline to 85.4% in 2020 ($p < 0.001$) and reached 86.8% by 2023 ($p < 0.001$). Finally, reported lifetime abstinence from smokeless tobacco remained stable at 90.1%, 92.1% and 91.5%, respectively. E-cigarettes had the smallest portion of never users but reported e-cigarette use remained stable between 2018 and 2020 (43.7% vs. 44.7%; $p = 0.41$). Never use of e-cigarettes had a statistically significant increase in 2023 to 52.6% ($p < 0.001$).

Despite decrease in overall current users, e-cigarette usage patterns revealed a distinct shift toward more frequent use and a consolidation of device preferences. Among current users of e-cigarettes, the prevalence of daily use climbed steadily from 48.4% in 2018 to 50.8% in 2020 and 60.1% in 2023. Regarding lifetime exposure, the data from 2020 and 2023 show a consistent heavy-use profile, with nearly half of the respondents (48.0% in 2020 and 49.3% in 2023) reporting using e-cigarettes at least 50 times.

The most dramatic shift occurred in the types of e-cigarette device utilized. Disposable e-cigarettes saw a substantial surge in popularity, nearly doubling from 38.9% in 2020 to 73.5% in 2023. This rise in disposables appears to have come at the expense of other device categories; pod systems dropped from 32.0% to 12.4%, and box mods saw a steep decline from 11.5% to just 2.0% during the same period.

Participant perceptions of e-cigarettes shifted significantly toward a more negative view (Table 2). Belief in e-cigarettes as a safe or effective smoking cessation tool eroded steadily, moving from a neutral baseline in 2018 toward more disagreement by 2023.

This extended to comparative safety, with participants increasingly rejecting the idea that e-cigarettes are a safer alternative to traditional cigarettes, smokeless tobacco, or other smoked tobacco products. There was an increase in the recognition of the health risks and addictive nature of these products. Agreement that e-cigarettes harm overall health and are addictive intensified over time, with mean scores trending toward "strongly agree" by the final follow-up. Collectively, participant responses highlight a significant longitudinal transition toward viewing e-cigarettes as high-risk, addictive products rather than harm-reduction alternatives.

Table 2. Perceptions of e-cigarettes.

Statement	2018 *n* = 3716	2020 *n* = 1649	2023 *n* = 1905	*p* Values 2018 vs. 2020	*p* Values 2018 vs. 2023
E-Cigarettes Are a Safe Option to Quit Smoking, mean (SD)	3.2 (1.4)	2.8 (1.4)	2.4 (1.3)	<0.001	<0.001
E-Cigarettes Are an Effective Option to Quit Smoking, mean (SD)	3.5 (1.5)	3.1 (1.5)	2.6 (1.4)	<0.001	<0.001
E-Cigarettes May Harm a Person's Overall Health, mean (SD)	4.7 (1.2)	5.2 (1.0)	5.4 (1.1)	<0.001	<0.001
E-Cigarettes Are Safer Than Traditional Cigarettes, mean (SD)	4.0 (1.5)	3.5 (1.5)	3.1 (1.4)	<0.001	<0.001
E-Cigarettes Are Safer Than Non-Cigarette Smoke Tobacco, mean (SD)	3.8 (1.4)	3.3 (1.4)	2.9 (1.3)	<0.001	<0.001
E-Cigarettes Are Safer Than Smokeless Tobacco Products, mean (SD)	3.9 (1.5)	3.3 (1.4)	2.7 (1.3)	<0.001	<0.001
E-Cigarettes Are Addictive, mean (SD)	4.9 (1.2)	5.4 (1.0)	5.5 (1.0)	<0.001	<0.001

4. Discussion

The primary objective of this study was to evaluate longitudinal trends in tobacco use and student perceptions at a U.S. university from 2018 to 2023. The findings suggest an overall decrease in tobacco product use, which mirrors U.S. national trends observed among young adults [3]. Notably, while reported e-cigarette use declined, there was a slight increase in reported traditional cigarette use between 2020 and 2023. While this uptick requires further longitudinal monitoring to determine if it constitutes a long-term shift, it suggests that nicotine-use patterns remain fluid. Furthermore, the introduction of nicotine pouches presents a new challenge for public health surveillance. It remains unclear whether these products will serve as a harm reduction aid for existing users or as an entry point for nicotine-naive persons.

University student perceptions of e-cigarette products have shifted significantly, moving from "unsure" in 2018 to increasingly negative by 2023. This shift may reflect the cumulative impact of aggressive public health initiatives, including the federal "Tobacco 21" legislation, flavor bans, news coverage of e-cigarettes or vaping, product use-associated lung injury (EVALI), and high-visibility educational campaigns. Within our campus environment, the tobacco policy remained largely unchanged during the study period, except for the addition of e-cigarettes to the tobacco definition, banning use indoors or within 25 feet of entrances.

Because young adult perceptions are a primary driver of tobacco initiation and maintenance, these increasingly negative associations are a promising indicator for decreasing future prevalence rates [13,14,18]. However, perceptions alone do not account for all usage patterns. There is strong evidence that tobacco users know there are health risks but con-

tinue to use due to factors including enjoyment and nicotine addiction [19,20]. Therefore, shifting attitudes must be interpreted alongside mechanisms of addiction.

Beyond individual behavior drivers and regulatory changes, the study period overlapped with the COVID-19 pandemic, which substantially altered campus social dynamics, remote learning structures, and peer-to-peer interactions. Because social contexts drive a significant portion of young adult tobacco and e-cigarette use, reduced opportunities for social consumption during peak pandemic disruptions may have contributed to temporary declines independently of formal health interventions.

The survey findings are largely consistent with broader trends, though some deviations are notable. In 2023, respondents reported a current e-cigarette use rate of 19% and a traditional tobacco use rate of 4%, both of which are lower than the national averages for young adults of 24% and 10%, respectively [3]. This disparity may be attributed to the "protective effect" of higher education; college students traditionally exhibit lower tobacco use rates compared to their non-college-educated peers due to higher health literacy [21]. Furthermore, the observed shifts in product selection suggest that FDA regulatory oversight, especially in flavored products, is effectively influencing consumer behavior, demonstrating that federal policy can successfully pivot user preferences away from high-risk products.

The evolving landscape of nicotine use necessitates proactive clinical responses within health systems. All healthcare patient encounters, including those at university health clinics, should implement universal screening for nicotine dependence [13]. To be effective, these screenings must be paired with immediate access to free, evidence-based cessation support, including both behavioral counseling and pharmacological interventions [13,22]. The expansion of smoke- and tobacco-free campuses and public spaces is essential for protecting "never-users" from secondhand exposure and reframing social norms around nicotine use. However, such policies require robust change management and community education to be sustainable [23].

While national and international surveillance systems provide critical macro-level benchmarks, their aggregated nature can obscure localized behavioral patterns and subpopulation dynamics. A primary strength of this study lies in its focus on a consistent regional cohort within a single institutional environment over a five-year period. By holding local environmental factors, campus culture, and regional demographics relatively stable across measurement waves, this localized lens captures micro-level trends in tobacco and e-cigarette use that may be masked within heterogeneous national datasets. Additional strengths include a large sample using validated survey instruments. However, several limitations must be acknowledged. Self-selection bias is possible due to the optional nature of the survey; this may have led to students with stronger interests, opinions, or experiences related to tobacco being more likely to participate. Response rates were below the average for online surveys of 35%, which introduces potential non-response bias [20]. As this was a cross-sectional trend analysis study rather than a cohort study, we cannot confirm individual-level changes in perception. Being a single-site study, these results may not be generalizable to universities in different geographic or socio-political regions. Demographic shifts in the student body over time, particularly a higher response rate among females, may influence the generalizability of the trends. The decrease in male response could also affect results as males tend to use tobacco more than females [1,4]. Finally, the irregular intervals between survey waves, the disruption by the COVID-19 pandemic in 2020, and decreasing novelty of e-cigarettes may have affected participation and reporting.

Future research should investigate the rising trend of polysubstance use, specifically the co-use of e-cigarettes with alcohol or cannabis, to understand how these substances interact in a collegiate environment. There is also a critical need for trials assessing the efficacy of cessation methods specifically tailored for young adults, who may respond better

to digital interventions than traditional methods. Lastly, research should also be conducted on how governmental policy shifts affect use, including the United Kingdom's proposed lifetime tobacco ban and the U.S. approval for age-verified flavored e-cigarette use.

5. Conclusions

These survey findings suggest a decrease in self-reported tobacco and e-cigarette consumption over the five-year study period. Continued surveillance of local alongside national and global systems remains essential to determine whether specific sub-populations mirror the broader use patterns.

Author Contributions: Conceptualization, S.K. and M.K.; methodology, S.K. and M.K.; validation, S.K., M.K. and M.S.; formal analysis, M.S.; investigation, S.K., M.K. and K.V.; data curation, S.K.; writing—original draft preparation, S.K., M.K. and K.V.; writing—review and editing, S.K. and M.K. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The Ferris State University Institutional Review Board (IRB) has reviewed the application for using human subjects in the study, Truth Initiative tobacco use and perceptions survey (protocol code IRB-FY22-23-133, approval date 30 August 2023) and exempted this project.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

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