

Puff, Play, Repeat: E-Cigarette Use in Student-Athletes

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Abstract

This cross-sectional analysis identified demographic and sport-specific determinants of e-cigarette and vape use among 2,489 National Association of Intercollegiate Athletics student-athletes. Binary logistic regression modeled current e-cigarette and vaping status as a function of sport affiliation, race/ethnicity, and biological sex. The final model demonstrated strong fit (Nagelkerke $R^2 = .41$) and correctly classified 79.7 percent of cases. Sport affiliation emerged as the strongest predictor. Race/ethnicity and biological sex further differentiated risk, with male and White athletes exhibiting elevated prevalence. Collectively, the results underscore the potency of team culture and demographic context in shaping nicotine behaviors. Findings advocate for sport-tailored, culturally responsive, and biological sex-specific prevention initiatives. These initiatives, integrated with comprehensive campus tobacco-free policies, could protect health and performance across collegiate athletics.

Keywords: student-athlete, vaping, e-cigarette, college sports

The rapid escalation of e-cigarette and vaping product use among young adults poses an urgent public health challenge, particularly within college populations. In 2021, adults aged 18–24 exhibited the highest prevalence of current e-cigarette use (11.0%), compared to 6.5 percent among 25–44-year-olds and 2.0 percent in those 45 and older (CDC, 2023). Among U.S. college students specifically, ever-use rates have climbed to 25.8 percent, making 18–24-year-olds the largest cohort of e-cigarette experimenters (Levy et al., 2021). Recent surveillance indicated that 15.5 percent of young adults aged 21–24 reported current e-cigarette use in 2023, a notable rise from 4.5 percent in 2019, with usage disproportionately greater among men (Mohd Shoaib et al., 2025).

This surge in vaping correlates strongly with mental health distress. College students who vape regularly are 33 percent more likely to report a past-year diagnosis of anxiety or depression than their non-vaping peers (Truth Initiative, 2024). Cross-sectional analyses reveal that e-cigarette users exhibit significantly greater scores on standardized measures of anxiety and depressive symptoms compared to non-users (Smith et al., 2023). Such findings underscore a bidirectional relationship, wherein nicotine exposure may exacerbate psychological distress, while mental health challenges may drive individuals toward vaping as a coping mechanism.

A pronounced biological sex divide further complicates the landscape: systematic reviews document that male college students initiate e-cigarette use at rates up to 1.5 times greater than females, influenced by targeted marketing and differential risk perceptions (Nuurain et al., 2021). Concurrently, risk-perception studies show that non-users score 25 percent greater on

harm-awareness scales and demonstrate greater self-efficacy to resist vaping compared to frequent users, highlighting knowledge deficits as a critical, modifiable factor in prevention (Khateeb et al., 2025).

This study explores a sub-set of the broader college student population – student-athletes. Understanding why student-athletes vape reveals key psychosocial drivers: convenience, sensory appeal, and perceived stress relief rank among the top motivators, with nicotine craving and relaxation motives predicting greater dependence scores on the Penn State E-Cigarette Dependence Index (Ou et al., 2024). In contrast, experimentation and social conformity motives, while linked to intermittent use, may nonetheless establish long-term habituation through reinforced peer networks (Awua et al., 2025; Hernandez et al., 2024).

Within this broader context, college student-athletes represent a critical yet understudied subgroup. Historically, student-athletes exhibited lower rates of traditional tobacco use (Primack et al., 2010); however, 2023 National Collegiate Athletic Association (NCAA) data report that 22 percent of student-athletes have vaped in the past year, with 6 percent engaging in daily use (NCAA, 2024). Such trends warrant particular attention given the unique performance pressures, team cultures, and coaching climates that shape substance use behaviors in athletic contexts.

Despite these insights, scholarship often treats college student-athletes as a homogeneous group, overlooking variations by division, sport, biological sex, and race/ethnicity. Moreover, the National Association of Intercollegiate Athletics (NAIA), which governs over 250 institutions with distinct size, resource, and cultural profiles compared to NCAA programs, remains

absent from vaping research (NAIA, 2024). Consequently, interventions derived from NCAA-centric data may not translate effectively to the NAIA setting, where athlete experiences and campus environments diverge substantially. To address these critical gaps, the present study employs a cross-sectional, multi-site design to examine how race, biological sex, and sport affiliation predict e-cigarette and vaping behaviors among NAIA student-athletes. By integrating quantitative surveys with ecological context variables, this research aims to inform tailored prevention and intervention strategies that acknowledge the unique cultural and institutional dimensions of NAIA athletics.

Methods

Research Design

This exploratory study employed a cross-sectional, web-based survey design to assess e-cigarette and vaping behaviors among NAIA student-athletes, replicating key elements of the NCAA (2024) Substance Use Survey conducted by the Sport Science Institute. Cross-sectional designs allow for the efficient estimation of prevalence and associations at a single point in time, with strong external validity for population-level inferences while acknowledging limitations in causal interpretation. The survey was administered online via a secure platform configured to prevent multiple submissions and ensure data integrity, consistent with the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) (Eysenbach, 2004).

Participants and Sampling

A stratified, clustered sampling approach was applied to the entire NAIA student-athlete population to ensure representativeness across sports

and biological sex. First, the population was divided into 28 clusters (14 sports × 2 biological sexes), reflecting all varsity teams recognized by the NAIA. Within each stratum, NAIA member institutions were randomly selected proportionally to their roster sizes, generated using a random number generator. This approach ensured that intra-cluster correlations, arising from shared contextual factors, were appropriately addressed in the sampling structure and subsequent analyses. Adjustments for clustering were incorporated in the statistical models to produce unbiased standard errors and valid inferences.

Athletic trainers at selected institutions facilitated recruitment by inviting all eligible student-athletes (aged ≥18 years) to participate, yielding an achieved sample of 2,489 respondents (response rate ≈ 4.9%), which exceeds typical web-survey yields and surpasses the a priori target of 1,300 for 95 percent confidence and 80 percent power (Faul et al., 2007). The demographic characteristics of the study participants are summarized in Table 1.

Instrumentation

The survey instrument was an adapted version of the NCAA National Study of Substance Use Habits of College Student-Athletes (2024), a validated and reliable measure of collegiate substance use. The questionnaire comprised four domains: (1) demographics and athletic background; (2) substance use behaviors (including e-cigarettes and vaping); (3) performance enhancers and dietary supplements; and (4) drug testing beliefs.

Procedure and Data Collection

Athletic trainers received standardized training materials and an informed-consent script approved by the Institutional Review Board. In group sessions (e.g., team meetings), trainers provided the survey link and supervised completion in a classroom or training-room setting to maximize response rates and standardize administration. Participation was voluntary and anonymous, with an average completion time of 15–20 minutes. Survey data

were encrypted during transmission and stored on a password-protected server accessible only to the research team. Data collection occurred over a six-week period.

Data Management and Quality Control

Raw survey data were exported into IBM SPSS Statistics (v.30) for cleaning and analysis. Automated checks removed incomplete entries (defined as <90% item response) and duplicate IP addresses. Logical consistency checks (e.g., matching reported sport with reported biological sex) were performed to flag and verify potentially errant responses.

Data Analysis

Descriptive statistics (means, frequencies, and proportions) summarized participant characteristics and e-cigarette/vape use prevalence. The primary research question—how sport played, biological sex, and race/ethnicity predict e-cigarette use—was assessed via binary

Table 1.
NAIA Student-Athlete Demographics

NAIA Student-Athlete Demographics (N = 2,489)	<i>N</i>	%
Age		
18-21	1,668	67%
21+	821	33%
Biological Sex		
Male	1,269	51.2%
Female	1,220	48.8%
Race/Ethnicity		
White/Caucasian	1,419	57%
Hispanic or Latino	423	16.8%
Black or African American	398	16.2%
Multiracial	125	5.2%
Other	124	4.7%

logistic regression, appropriate for a dichotomous outcome and mixed predictor types. E-cigarette or vaping use was measured as “daily or frequent use” or “never used”. Model fit was evaluated using the Hosmer-Lemeshow test and Nagelkerke’s R^2 , and multicollinearity was assessed via variance inflation factors (VIFs). Adjusted odds ratios (AORs) with 95 percent confidence intervals quantified the strength and direction of associations. All statistical tests were two-tailed with α set at 0.05, and power analyses confirmed that the final sample provided $>.80$ power to detect small effect sizes ($OR = 1.3$) for all predictors

Results

A stepwise likelihood ratio (Forward LR) logistic regression analysis was conducted to estimate a regression model that correctly predicts the probability of NAIA college student-athletes using e-cigarettes or vapes. In all, three factors were entered into the analysis: biological sex, race/ethnicity, and sport played. All three factors were defined as categorical and recoded into dummy variables. Prior to analysis, chi-square and independent t-tests examined the bivariate relationship between e-cigarette and vape use and each factor. The results of the chi-square and independent t-tests showed significant relationships between e-cigarette and vape use and biological

sex, race/ethnicity, and sport played. Furthermore, tolerance and VIF values were computed for all factors to examine the assumption of multicollinearity. Both tolerance and VIF values showed no multicollinearity problem existed among the factors. Finally, the Hosmer and Lemeshow test contingency table showed all cells had an expected value larger than 1.

The results of the stepwise likelihood ratio logistic regression revealed that three factors emerged as significant predictors of e-cigarette and vape use. These factors were sport played (Wald $(df = 17) = 107.21$, $p < 0.001$), race/ethnicity (Wald $(df = 7) = 52.67$, $p < 0.001$), and biological sex (Wald $(df = 1) = 1.24$, $p < 0.001$).

The results show that the overall model significantly improved the prediction of the occurrence of e-cigarette use among NAIA student-athletes ($X^2 (df = 25) = 240.51$, $p < 0.001$). This model had a particularly good fit ($-2 \log likelihood = 1966.11$, Hosmer and Lemeshow, $X^2 (df = 8) = 3.28$, $p = 0.92$)

The results of the Cox and Snell R^2 and the Nagelkerke R^2 indicated that the sport played accounted for 6.7 to 10.5 percent of the variance in e-cigarette use. Race/ethnicity accounted for 9.5 to 14.7 percent of the variance in e-cigarette use. Biological sex added 9.9 to 15.5 percent to the variance in e-cigarette use. Overall, the model accounted for 26.1 to 40.7 percent of the variance

in e-cigarette use. Finally, the model correctly classified 79.7 percent of the e-cigarette use cases (See Table 2).

In particular, student-athletes identifying as biological males were significantly more likely than those identifying as biological females to self-report daily or frequent vaping ($p < 0.001$). Student-athletes identifying as White were statistically more significant than any other race/ethnicity to self-report daily or frequent vaping ($p < 0.02$). Student-athletes participating in football, bowling, lacrosse, baseball, and softball were statically more likely to self-report daily or frequent vaping (all score $p < 0.05$) than the other recognized NAIA sports.

Discussion

Building upon prior inquiries into substance use in collegiate athletics (e.g., Moore & Abbe, 2021), the current analysis clarifies how demographic attributes and sport-specific contexts converge to shape vaping behavior among NAIA student-athletes. The present study demonstrated that sport, race/ethnicity, and biological sex were significant predictors of e-cigarette and vaping behaviors among NAIA student-athletes.

Sport affiliation accounted for up to 10.5 percent of the variance in e-cigarette use, highlighting how team cultures and peer networks might facilitate vaping initiation and maintenance

Table 2.
Logistic Regression Results

Factor		Wald	df	p	R ²
Sport	-0.29	107.21	17	< 0.001	0.067 – 0.105
Race	2.40	52.67	7	< 0.001	0.095 – 0.147
Biological Sex	0.79	1.24	1	< 0.001	0.099 – 0.155
Constant	2.40	17.03	1	< 0.001	

(Primack et al., 2010; Veliz et al., 2017). Adolescent and collegiate athletes in team sports were found to vape at rates comparable to non-athletes, suggesting that social cohesion within athletic groups may inadvertently normalize e-cigarette use (Veliz et al., 2017). Recent NCAA surveillance data reveals pronounced sport-by-sport disparities in vaping: past-year use is reported by 37 percent of male and 29 percent of female lacrosse athletes, yet by only 8 percent of track-and-field competitors (NCAA, 2024). This gradient corroborates the present study's finding that sport affiliation is an independent predictor of e-cigarette use, whereas team sports marked by intense social cohesion and locker-room subcultures (i.e., football, baseball, lacrosse, softball, and bowling) may cultivate peer climates that normalize experimentation with nicotine-delivery systems (Primack et al., 2010).

National surveillance continues to document a pronounced biological sex-related disparity in e-cigarette use: in 2023, 15.5 percent of U.S. men versus 10.3 percent of women aged 21–24 years reported current vaping (Centers for Disease Control and Prevention [CDC], 2025). Additional studies found male students vaped at rates 1.5 times those of females (Cornelius et al., 2023; Jones et al., 2021). In this study, being a male student-athlete accounted for 9.9 to 15.5 percent of variance. Echoing national trends, male NAIA student-athletes were more likely to vape than their female peers. Hegemonic-masculinity theory posits that culturally sanctioned risk-taking and perceived bodily invulnerability promote substance experimentation among young men (Courtenay, 2000).

Consistent with national surveillance data, e-cigarette uptake among NAIA student-athletes varied systemat-

ically by race and ethnicity, with White student-athletes exhibiting the highest prevalence of use. National Health Interview Survey data confirm a five-year increase in adult vaping prevalence from 4.5 percent to 6.5 percent, with the greatest absolute gain among White adults (5.1 to 7.5 percent), exceeding the increases for Black (3.4 to 5.7 percent) and Hispanic adults (2.8 to 4.4 percent) (Vahratian et al., 2025). In the present study, multivariable analyses within the NAIA sample demonstrated that White student-athletes retained the highest adjusted odds of current e-cigarette use, positioning race/ethnicity as the second-strongest independent predictor after sport type. This elevated likelihood aligns with broader postsecondary trends: national surveys report that White undergraduates initiate and maintain current e-cigarette use at rates approximately 1.6 times greater than Black and Hispanic peers (Seabrook et al., 2021; Vahratian et al., 2025).

Implications for Prevention and Policy

The present findings delineate clear, multilevel levers for curbing nicotine-delivery product use in collegiate sport. First, embedding sport-specific health education within routine coaching and athletic-training sessions can leverage existing team hierarchies to disseminate evidence that vaping compromises aerobic capacity. Second, culturally responsive programming should confront the mental-health antecedents of vaping, as college students who report a past-year mental-illness diagnosis have 33 percent greater odds of current e-cigarette use than their peers (Truth Initiative, 2023). Integrating stress-management training and streamlined referral pathways to counselling services is therefore crucial for at-risk subgroups. Third, biological sex-responsive strategies, such as

peer-led dialogues and high-profile male athletes publicly rejecting vaping, may neutralize the hyper-masculine marketing tropes that normalize nicotine experimentation among young men.

At the organizational level, NAIA member institutions should extend NCAA on-field tobacco bans by adopting comprehensive campus smoke- and vape-free policies in line with American Heart Association guidance on tobacco-free environments (American Heart Association, 2023). Embedding enforcement provisions in athletic-department codes of conduct and integrating brief vaping-cessation modules into strength-and-conditioning curricula would create a coherent, performance-centered framework that protects respiratory health and athletic longevity.

Limitations and Future Directions

The present analysis draws on a cross-sectional, web-based survey of 2,489 NAIA student-athletes. Nonetheless, several methodological constraints temper the interpretability of these findings. First, the cross-sectional design precludes causal inference; longitudinal or prospective cohort studies are required to establish the temporal sequence linking demographic characteristics, psychosocial factors, and vaping initiation. Second, reliance on self-reported behavior introduces common-method variance and social-desirability bias, even when anonymity is assured. Third, although stratified sampling bolstered sport- and region-specific representation, the modest 4.9 percent response rate raises concerns about non-response bias and may limit the generalizability of the results.


Future investigations should therefore incorporate multi-wave or ecological momentary assessment designs and biochemical verification of nicotine

exposure to strengthen measurement fidelity. Qualitative or mixed-methods approaches, such as focus groups and ethnographic observation, could illuminate the team-culture dynamics that quantitative instruments may overlook. Finally, replicating the current analyses within NCAA divisions, junior colleges (JUCO), and club-sport contexts will evaluate the transferability of the identified risk profile and refine prevention frameworks across diverse organizational settings (Moore & Abbe, 2021).

Conclusion

The convergence of team environments, demographic characteristics, and psychosocial factors drives e-cigarette use among NAIA student-athletes. Team cultures and peer norms can normalize vaping behaviors despite straightforward evidence that even short-term use impairs pulmonary function and reduces endurance (Vardavas et al., 2012). Disproportionate prevalence among White and Black athletes and marked male–female disparities reflect broader national patterns (Cornelius et al., 2023; Jones et al., 2021).

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