The 21st Century Gateway Drug:

Exploring the Factors of Energy Drink Consumption and Connections to Substance/Drug Use

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SUMMARY

This study examines whether adolescent energy drink consumption is associated with behavioral and psychological markers of future substance abuse using publicly available data from the *Monitoring the Future* survey. Secondary data was analyzed using chi-square tests and logistic regressions to evaluate the relationships between energy drink consumption and predictors of substance-use risk. Statistically significant differences in energy drink consumption were found according to race, sex, urbanity, type of high school program, and student involvement in sports and work. High consumption of energy drinks were also found to significantly increase the likelihood of all types of drug use, confirming that energy drinks are "gateway substances" to gateway drugs including alcohol, tobacco, and marijuana. Logistic regression analyses reveal the impact of simple parent engagement and altruistic acts (i.e. volunteering) on lowering energy drink consumption and potential substance abuse. These implications should be incorporated into school substance abuse programs to encourage better outcomes. Importantly, this research provides evidence that energy drinks are "gateway substances" that deserve proper monitoring.

INTRODUCTION

Adolescent caffeine consumption is rising as energy drinks become increasingly normalized, yet it is rarely being treated as a public health concern. Many adolescents perceive energy drinks and caffeine as harmless. However, research demonstrates that it interacts with adenosine-dopamine receptor mechanisms involved in the brain's reward pathways that also underlie the effects of psychostimulant drugs. Despite these concerns, scientific understanding of whether early exposure relates to habit formation and later susceptibility to addictions to substances such as alcohol remains limited among youth in the United States.

RESEARCH QUESTIONS

1) What factors (i.e., academic success, risk behavior, perception of the future, disapproval of substance use) are associated with caffeine consumption?

2) Can early energy drink use in adolescence serve as a predictive indicator for later substance-use (i.e. alcohol, cigarettes, illicit drugs) tendencies based on existing behavioral and physiological datasets?

LITERATURE REVIEW

Adolescents today are increasingly exposed to caffeine through energy drinks, which are heavily promoted via highly persuasive digital media marketing (Alissa et al. 2024; Vercammen et al. 2019; Visram et al. 2016;). Research shows that youth caffeine intake through caffeinated energy drinks is rising annually (Vercammen et al. 2019), yet scientific understanding of whether early exposure relates to habit formation and later susceptibility to addictions to substances such as alcohol remains limited, particularly in the United States (Reissig 2009; Kristjansson et al. 2022).

Though some studies have suggested that caffeine, the most common ingredient in energy drinks, may be a gateway to other substance addictions (Collins et al., 1997; Pallanti et al., 2006; Arria et al., 2008), Reissig (2009) has argued that further investigation is required to substantiate this claim. A more recent article by Kristjansson et al (2022) cites additional research investigating caffeine-alcohol relationships (Arria et al. 2011; Marczinski et al. 2016) but states that the relationship between caffeine consumption and early-onset use of alcohol has focused more on older participants and has not been studied sufficiently among the youth. Though Kristajansson et al. (2022) sought to address the lack of research on this relationship among the youth, even their research was limited in sample size to 1349 6th grade students in 20 middle schools in West Virginia, making their results less generalizable to the larger youth population in the US.

Research by De Sanctis et al. (2017) highlights the positive correlation between dangerous habit formations and energy drink consumption in adolescents, noting that frequent drinking of caffeinated beverages was often coupled with use of cigarettes, alcohol, and psychotropic drugs. Although De Sanctis et al. provides meaningful evidence of the association of habit formation and energy drink usage, the studies he cites related to caffeine and other substance dependence are geographically limited to Italy.

Butler et al. (2019) demonstrates that adolescents who engage in behaviors such as alcohol consumption and marijuana or cigarette use are more inclined to consuming caffeinated energy drinks. While Butler et al. (2019) establishes a clear and prevalent association between these behaviors among Canadian youth, its conclusions may not be applicable to populations in other geographies outside Canada.

DATA

I used The Monitoring the Future: A Continuing Study of the Lifestyles and Values of Youth to collect the necessary information to perform my research and statistical analyses. The Monitoring the Future is a system of surveys that "were designated to explore changes in important values, behaviors, and lifestyle orientations of contemporary American youth" and has been administered since 1975 with 12th grade students and 8th and 10th grade students since 1991. The survey is administered by the Survey Research Center in the Institute for Social Research at the University of Michigan.

Note: Image provided by the Survey Research Center in the Institute for Social Research at the University of Michigan https://monitoringthefuture.org/

For my research, I used the 2024 8th and 10th Grade Survey national dataset, which is the most recent dataset released by the Institute for Social Research. There were 17,351 respondents in the sample. For my main variables, there were 3,528 students who reported that they do not consume energy drinks on a daily basis and 1,668 students who reported that they did consume energy drinks on a daily basis. Not all the students in my dataset responded to all the questions, leading to some gaps in the number of student responses.

METHODS

The chi-square test for independence is used to determine whether there are statistically significant associations between energy drink consumption and 1) demographic factors such as race and sex, 2) participation in activities including work and athletics, 3) disapproval of substance use & difficulty of accessing substances/drugs 4) degree of parent engagement, and 5) future expectations. The chi-square test evaluates whether the distribution of these characteristics differs significantly between students who consume energy drinks on a daily basis and those who do not. If the p-value from the test is below the critical value of 0.05, it indicates a statistically significant association, meaning that engaging in particular behaviors or exhibiting certain characteristics differs depending on whether a student regularly consumes energy drinks. These tests help establish whether such characteristics / behaviors are correlated with energy drink use.

Logistic regression was first employed to determine which factors contribute to an increased or decreased likelihood of energy drink use. This method allows for a deeper analysis by quantifying the strength and direction of relationships between consuming energy drinks and various independent variables, such as urbanity of residence, participation in work or athletics, disapproval of substance use, degree of parent engagement, and future expectations related to education. By utilizing additional logistic regressions, this study also tested relationships between energy drink consumption and substance use, helping to move beyond simple associations and provides a predictive framework that highlights which demographic and behavioral factors are most influential in shaping both student energy drink use and substance/drug use.

ANALYSIS

Chi-square tests revealed statistically significant associations between daily energy drink consumption and several demographic, behavioral, social, and attitudinal factors. Daily use was disproportionately distributed among certain racial groups and across gender and was more common among students who worked more hours and participated in athletics. Lower levels of parental involvement and lower educational expectations were also associated with higher rates of daily consumption. In addition, daily energy drink users were significantly more likely to report permissive attitudes towards substance use. Logistic regression analyses supported these associations, identifying these factors as significant predictors of daily energy drinks use. Although effect sizes varied, additional logistic regressions suggest that daily energy drink consumption is closely related to risky behaviors associated with substance use rather than random, independent behavior

******* All Tables and Figures were Created by Researcher *******

Figure 1. Demographics

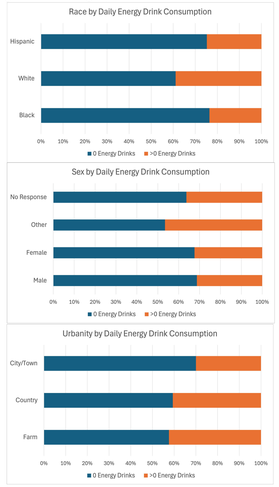


Figure 2. School & Activities

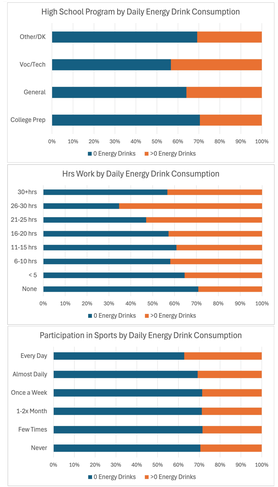


Figure 3. Disapproval of Substance Use

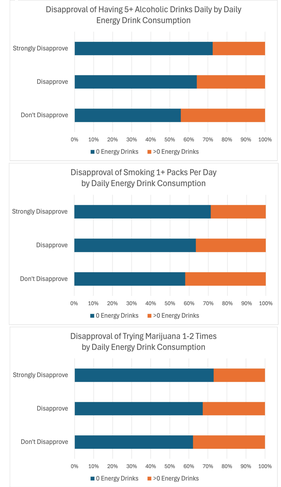
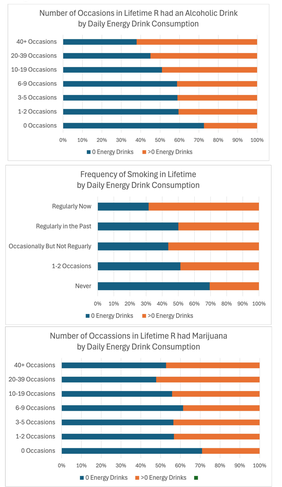


Figure 4. Substance Use



Chi Square Statistic: Students at Risk by HS Program, Urbanity of Residence, and Participation in Sports, Athletics, Exercise

Energy drinks are non-alcoholic beverages that usually contain high amounts of caffeine, including such drinks as Red Bull, Full Throttle, Monster, and Rockstar. They are usually sold in 8- or 16-ounce cans or bottles.

Key
frequency
expected frequency
chi2 contribution
row %
column %
cell%)

Table 1. Chi Square: HS Program

		Academic	General	Voc / Tech / Comm	Other / DK	Total
0 Energy Drinks Consumed Daily		1,231	715	128	1,418	3,492
		1,187.1	758.3	153.6	1,393.0	3,492.0
		1.6	2.5	4.3	0.4	8.8
		35.25	20.48	3.67	40.61	100.00
		70.46	64.07	56.64	69.17	67.95
		23.95	13.91	2.49	27.59	67.95
> 0 Energy Drinks Consumed Daily		516	401	98	632	1,647
		559.9	357.7	72.4	657.0	1,647.0
		3.4	5.2	9.0	1.0	18.7
		31.33	24.35	5.95	38.37	100.00
		29.54	35.93	43.36	30.83	32.05
		10.04	7.80	1.91	12.30	32.05
Total		1,747	1,116	226	2,050	5,139
		1,747.0	1,116.0	226.0	2,050.0	5,139.0
		5.1	7.7	13.3	1.4	27.5
		33.99	21.72	4.40	39.89	100.00
		100.00	100.00	100.00	100.00	100.00
		33.99	21.72	4.40	39.89	100.00

Pearson chi2(5) = 27.4749, Pr = 0.000, Cramer's V = 0.0731

Table 2. Chi Square: Urbanity of Residence

		On Farm	In Country	City/Town	Total
0 Energy Drinks Consumed Daily		110	469	2,929	3,508
		129.8	536.8	2,841.5	3,508.0
		3.0	8.6	2.7	14.3
		3.14	13.37	83.49	100.00
		57.59	59.37	70.04	67.94
		2.13	9.08	56.73	67.94
> 0 Energy Drinks Consumed Daily		81	321	1,253	1,655
		61.2	253.2	1,340.5	1,655.0
		6.4	18.1	5.7	30.2
		4.89	19.40	75.71	100.00
		42.41	40.63	29.96	32.06
		1.57	6.22	24.27	32.06
Total		191	790	4,182	5,163
		191.0	790.0	4,182.0	5,163.0
		9.4	26.7	8.4	44.5
		3.70	15.30	81.00	100.00
		100.00	100.00	100.00	100.00
		3.70	15.30	81.00	100.00

Pearson chi2(5) = 44.5031, Pr = 0.000, Cramer's V = 0.0928

Table 3. Chi Square: Participation in Sports, Athletics, Exercise

		Never	Few Times	1-2 Times Month	Once a Week	Almost Daily	Every Day	Total
0 Energy Drinks Consumed Daily		404	344	262	576	870	1,060	3,516
		389.3	326.8	250.0	548.3	854.0	1,147.5	3,516.0
		0.6	0.9	0.6	1.4	0.3	6.7	10.4
		11.49	9.78	7.45	16.38	24.74	30.15	100.00
		70.51	71.52	71.20	71.38	69.21	62.76	67.94
		7.81	6.65	5.06	11.13	16.81	20.48	67.94
> 0 Energy Drinks Consumed Daily		169	137	106	231	387	629	1,659
		183.7	154.2	118.0	258.7	403.0	541.5	1,659.0
		1.2	1.9	1.2	3.0	0.6	14.2	22.1
		10.19	8.26	6.39	13.92	23.33	37.91	100.00
		29.49	28.48	28.80	28.62	30.79	37.24	32.06
		3.27	2.65	2.05	4.46	7.48	12.15	32.06
Total		573	481	368	807	1,257	1,689	5,175
		573.0	481.0	368.0	807.0	1,257.0	1,689.0	5,175.0
		1.7	2.8	1.8	4.4	0.9	20.8	32.5
		11.07	9.29	7.11	15.59	24.29	32.64	100.00
		100.00	100.00	100.00	100.00	100.00	100.00	100.00
		11.07	9.29	7.11	15.59	24.29	32.64	100.00

Pearson chi2(5) = 32.4721, Pr = 0.000, Cramer's V = 0.0792

Logistic Regression Coefficients: Factors of Daily Energy Drink Consumption & Factors of Substance Use

$$Energy\ Drink = \beta_0 + \beta_1\ Grade + \beta_2\ Race_Eth + \beta_3\ Sex + \beta_4\ Urbanity + \beta_5\ Think_Future + \beta_6\ Hrs_Job + \beta_7\ Hrs_HW + \beta_8\ Athletics + \beta_9\ Disapprove_Alcohol + \beta_{10}\ Disapprove_Marijuana + \beta_{11}\ Disapprove_Smoking + \beta_{12}\ Difficulty_Get_Alcohol + \beta_{13}\ Difficulty_Get_Cigarettes + \beta_{14}\ Risk_Harm_Alcohol + \beta_{15}\ Risk_Harm_Smoking + \beta_{16}\ Parents_HW + \beta_{17}\ Parents_Dinner + \beta_{18}\ Share_Problems_Parents + \beta_{19}\ Share_Problems_Adult + \beta_{20}\ Likely_College + \beta_{21}\ Likely_CollegeGrad + \beta_{22}\ Likely_HSGrad + \beta_{23}\ Substance_Use_Education$$

Table 4. Logistic Regression Coefficients & Odds Ratios (Likelihood) of Depression

Variable	Coefficient	Interpretation N=1,944; Prob > chi2 = 0.0000; Pseudo R2 = 0.0712
Tenth	1.125465	Tenth graders are 12.5% more likely to consume energy drinks daily than eighth grade students
Black	0.2984668***	Black students are 70.1% less likely to consume energy drinks daily than White students
Hispanic	0.4551211***	Hispanic students are 54.5% less likely to consume energy drinks daily than White Students
Female	1.253141**	Female students 25.3% more likely to consume energy drinks daily than Male Students
Other Sex	2.538686*	Students who responded "other" sex are 153.9% more likely to consume energy drinks daily than Male Students
Farm	1.243436**	Students living on a farm are 24.3% more likely to consume energy drinks daily than Students living in a City or Town
Country	1.050159*	Students living in the country are 5.01% more likely to consume energy drinks daily than Students living in a City or Town
Think about Future	1.023165*	More frequently thinking about the future increases student likelihood of consuming energy drinks daily by 2.31%
Job Hrs	1.137404***	Working more hours for a paid job increases student likelihood of consuming energy drinks daily by 13.7%
HW Hrs	0.9389695	Working more hours on Homework decreases student likelihood of consuming energy drinks daily by 6.1%
Participating in Athletics	1.084424**	Participating on athletic teams to a greater extent increases student likelihood of consuming energy drinks daily by 8.44%
Disapprove		
1-2 Alcohol Drinks	0.935122	More strongly disapproving of people trying 1-2 alcoholic drinks decreases student likelihood of consuming energy drinks daily by 6.49%
Marijuana Occasionally	0.986423	More strongly disapproving of people using marijuana occasionally decreases student likelihood of consuming energy drinks daily by 1.36%
Smoking 1+ packs	0.7358678**	More strongly disapproving of people smoking 1+ packs per day decreases student likelihood of consuming energy drinks daily by 26.4%
Difficulty of getting		
Alcohol	0.9960531**	The easier a student thinks it is to get alcohol, the less likely the student will consume energy drinks by 0.395%
Cigarettes	1.047952	The easier a student thinks it is to get cigarettes, the less likely the student will consume energy drinks by 4.80%
Believe in Harm		
1-2 Alcohol Drinks	0.90173	Believing that drinking 1-2 alcoholic drinks leads to greater risk of harm decreases the likelihood of consuming energy drinks daily by 9.82%
Smoking 1+ packs	1.005618	Believing that smoking 1+ packs per day leads to greater risk of harm increases the likelihood of consuming energy drinks daily by 0.56%
Parents		
Help with HW	0.9837235	The more frequently parents help with homework, the less likely the student will consume energy drinks by 1.73%
Dinners per wk	0.9091016**	The more days per week parents have dinner with a student, the less likely the student will consume energy drinks by 9.09%
Share Problems		
Parents	0.8895266	Being able to talk about problems with parents decreases the likelihood of consuming energy drinks daily by 11%
Adult	1.161672*	Being able to talk about problems with at least 1 adult increases the likelihood of consuming energy drinks daily by 16.2%
Expectations for the Future		
Graduate HS	0.8232893	The more likely a student views graduating from High School, the less likely the student will consume energy drinks by 17.7%
College	0.7580946**	The more likely a student views attending college, the less likely the student will consume energy drinks by 24.2%
Graduate College	1.278438*	The more likely a student views graduating from college, the more likely the student will consume energy drinks by 27.8%
Substance Use Education in School	1.047945	Having substance use education in school increases the likelihood of consuming energy drinks daily by 4.79%

*** = p <0.01; ** = p < 0.05; * = p < 0.1

$$Substance\ Use = \beta_0 + \beta_1\ Energy_Drink + \beta_2\ Grade + \beta_3\ Race_Eth + \beta_4\ Sex + \beta_5\ Think_Future + \beta_6\ Hrs_Job + \beta_7\ Hrs_HW + \beta_8\ Athletics + \beta_9\ Parents_HW + \beta_{10}\ Parents_Dinner + \beta_{11}\ Share_Problems_Parents + \beta_{12}\ Share_Problems_Adult + \beta_{13}\ Likely_College + \beta_{14}\ Substance_Use_Education + \beta_{15}\ Volunteer$$

Y Variable	Coefficient Energy Drink	Interpretation Consuming energy drinks increases the likelihood of using ____ by
Alcohol	1.285783***	28.6%
Smoking	1.13143*	13.1%
Marijuana	1.188853***	18.9%
Amphetamines	1.195543***	19.6%
Cocaine	1.629628***	63.0%
Hallucinogens	1.393318***	39.3%
Heroin	1.488196***	48.8%
LSD	1.336826***	33.7%
Sedatives	1.110279*	11.0%

ANALYSIS CONTINUED

The chi-square analyses demonstrated that race had the strongest demographic association with daily energy drink consumption, having the largest chi-square contributions coming from more White students who reported daily use than expected (28.2) and Black students reporting less than the expected values (17.6), contributing to a moderate association with a Cramer's V of 0.1561. Students in vocational or technical programs also showed a notable difference, with more daily users than expected (chi-square contribution = 9.0). Students in the countryside also had substantially more daily users than expected (chi-square = 18.1). Grade level showed smaller contributions, with eighth graders reporting fewer daily users than expected (chi square = 2.2) while tenth graders reported more than expected (chi-square = 1.7); the small chi-square contributions resulted in a very weak overall association with a Cramer's V of 0.0331.

The logistic regression results reinforced that race was the most consistent demographic predictor. Compared to White students, Black students are 70.1% less likely to consume energy drinks daily, while Hispanic students are 54.5% less likely. Gender is also supported by the logistic regression results to be a significant predictor of energy drink consumption.

Participation in Activities

Students who reported participating in sports every day showed noticeably higher daily energy drink use than expected, with 629 users observed versus the 541.5 expected (chi square = 14.2). A similar pattern was discerned for school athletic participation where there were slightly more expected users than expected among those involved to a great extent (534 observed vs. 504.2 expected; chi square = 1.8). Participation in athletics was also found to be a strong predictor of energy drink consumption in the logistic regression (8.4% increase in the likelihood of daily use).

On the other hand, work participation showed larger deviations between observed and expected frequencies. Students with no paid job had significantly fewer daily users than expected (1122 observed vs 1235 expected; chi square = 10.3), while those working 21-25 hours a week had substantially more energy drink consumers than expected (53 observed vs. 32.1 expected, chi square = 13.6). Consistent with this pattern, hours worked at a paid job was a significant predictor in the logistic regression, reflecting a 13.7% increase in the likelihood of daily energy drink use (p=0.001). In contrast, hours spent on homework showed small chi-square contributions and were not significant in the logistic regression (p=0.186).

Disapproval of Substance Use & Difficulty of Getting Substances

Lower disapproval (greater approval) of substance use was consistently associated with greater-than-expected daily energy drink consumption in the chi-square analyses. Specifically, for lower disapproval of consuming five or more alcoholic drinks, far more daily users of energy drinks were observed than expected (323 observed vs. 234.6 expected; chi square = 33.3) and less frequently among those with strong disapproval (802 observed vs 938.1 expected; chi square = 19.7). A similar trend emerged for marijuana, with daily users overrepresented among individuals expressing low disapproval of regular use (314 observed vs. 251.2 expected; chi square = 15.7) and underrepresented among those with strong disapproval (815 observed vs. 908.6 expected; chi square = 9.6). Attitudes toward smoking followed the same pattern; however, only smoking disapproval remained statistically significant (p=0.003) in the logistic regression.

Perceived ease of access to various substances correlated with daily energy drink consumption. For alcohol, daily energy drink users were overrepresented in the highest ease of access category (449 observed vs. 412.9 expected; chi square = 3.2) and underrepresented among those who perceived access to be more difficult (238 observed vs. 301.2 expected), indicating that students who consume energy drinks daily tend to view alcohol as easier to obtain (and vice versa). Cigarettes and marijuana showed similar distributions. These patterns suggest that greater perceived availability is closely related to daily energy drink consumption.

Harder drugs such as cocaine powder and crack showed the same pattern but with weaker magnitudes. The daily energy drink consumers amongst users of these substances were modestly overrepresented in easy-access categories, yet underrepresented when access was perceived to be difficult. LSD and sedatives followed the same pattern, though with overall smaller chi square contributions. Collectively, these findings suggest that students who report daily energy drink use perceive substances as easier to obtain, suggesting broader patterns of risk-oriented behavior as opposed to independence.

Parent Involvement & Expectations for the Future

Students reporting dinner with a parent 6-7 days a week had far fewer energy drink users than expected (462 observed vs. 578.3 expected; chi square = 23.4), meaning high engagement with families was associated with not using energy drinks daily. Talking about problems with parents also showed a significant but smaller distributional difference (chi square = 9.99). Daily energy drink consumers were slightly more abundant than expected among students who did not talk with their parents (446 observed vs. 408.4 expected) and less common than expected among those who talked most or all of the time with their parents (409 vs. 447.1). In the logistic regression, dinner frequency was shown to be a significant predictor of energy drink use (p=0.002), indicating that parent engagement reduces the likelihood of daily energy drink use.

Students who reported that they would definitely graduate high school showed slightly fewer daily energy drink users than expected (1317 observed vs. 1364 expected; chi square = 1.6), whereas those who reported that they would probably graduate were slightly overrepresented (280 observed vs. 243.8 expected; chi square = 5.4). For plans to go to college, daily energy drink users were overrepresented among students who reported that they would definitely not attend (125 observed vs. 94.5 expected; chi square = 9.8) and underrepresented for those who definitely would attend (739 observed vs. 810.2 expected; chi-square = 6.3), producing a significant overall association between college expectations and energy drink usage. These distributions and difference in effects indicate that lower educational expectations were associated with greater daily energy drink consumption.

Drug Use

Daily energy drink consumption was associated with higher likelihoods of use of several more dangerous substances. For alcohol, daily users of energy drinks showed 29% higher likelihoods of lifetime use and 21% higher likelihoods of having ever been drunk, both with a very small p value ($p < 0.001$), indicating statistical significance. Daily consumers of energy drinks also reported a more common use of marijuana, with 19% higher likelihoods. Smoking was directionally positive, showing an 11% higher likelihood in energy drink users, but it was only marginally significant with a p-value of 0.051.

This observed pattern strengthened for stronger drugs. Daily energy drink users had a 20% higher likelihood of using amphetamines, 39% for hallucinogens, 34% for LSDs, 63% for cocaine, and 49% for heroin. The largest increase appears for cocaine, suggesting that the association between substance use and energy drink consumption does not decrease with a drug's severity. Instead, the likelihoods remain consistent or even larger as the substances become stronger. This supports the interpretation that daily energy drink consumption is a gateway toward a higher level of lifetime substance involvement.

CONCLUSION & FUTURE RESEARCH

This study found that demographic characteristics (race, high school program, population density), participation in activities (sports, athletics, & exercise and paid work), disapproval of substance use & difficulty of accessing substances/drugs, degree of parent engagement, and future expectations are strong predictors of energy drink consumption. In turn, energy drink consumption has statistically significant impacts ($p \leq 0.05$) on increasing the likelihood of using alcohol, marijuana, amphetamines, cocaine, hallucinogens, heroin, and LSD (smoking and sedative use had p values of 0.059 and 0.051). This research provides further evidence that energy drinks are easily accessible gateway substances for middle and high school students. It also gives important insight into how to better direct programs for different demographics and highlights the importance of parent (not just adult) engagement.

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