

RESEARCH ARTICLE

Prioritizing Alcohol Prevention: Establishing Alcohol as the Gateway Drug and Linking Age of First Drink With Illicit Drug Use

ADAM E. BARRY, PhD^a JESSICA KING, MS, CHES^b CYNTHIA SEARS, MS^c CEDRIC HARVILLE, MPH^d IRINA BONDOC, MS^e KESSY JOSEPH, MS^f

ABSTRACT

BACKGROUND: Given ever-reducing budgets of community and school substance use prevention programs, there is a call for identifying the first substance in the sequence leading to polydrug use.

METHODS: Examining data from a nationally representative sample of 2835 United States 12th graders, we sought to determine (1) the first substance adolescents use; (2) order in which adolescents progress through alcohol, tobacco, and marijuana use; and (3) impact of age of initial substance use on lifetime and frequency of illicit substance use.

RESULTS: Alcohol is the most commonly used substance, and the majority of polysubstance using respondents consumed alcohol prior to tobacco or marijuana initiation. Respondents initiating alcohol use in sixth grade reported significantly greater lifetime illicit substance use ($M = 1.9$, standard deviation [SD] = 1.7, $p < .001$) and more frequent illicit substance use ($M = 6.0$, $SD = 6.5$, $p < .001$) than those initiating alcohol use in ninth grade or later. Overall, effect sizes for these differences were large ($\eta^2 = 0.30$ and 0.28 , respectively).

CONCLUSIONS: Findings underscore the importance of screening for substance use, even among youth enrolled in elementary/middle school. In addition, school prevention programs should begin in elementary school (third grade) and target alcohol use.

Keywords: alcohol; adolescents; high school; gateway theory; gateway hypothesis; substance use.

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With the constriction of budgets supporting community and school substance use prevention programs there has been a corresponding call to focus available resources (eg, monies, policies, efforts) on preventing initiation of those substances which have been identified as first in the sequence leading to polydrug use.¹⁻³ Dubbed the “gateway effect” or “gateway hypothesis,” Kandel et al proposed that the sequence of drug use initiates with licit substances such as tobacco or alcohol, followed by marijuana use, and then onto other illicit substances such as cocaine or heroin.⁴⁻⁷ Despite being decades old and having received much attention and corresponding criticism,

it is important to note that there are rarely violations to this proposed typical progression of substance use.⁸⁻¹² For instance, previous investigations document that approximately 93% of 14- to 24-year-olds had engaged in alcohol use prior to cannabis use,¹³ and only 8% of nondrinkers had ever used an illicit substance in their lifetime.¹⁴ Fergusson and Horwood¹⁵ examined the use of cannabis and other illicit drug use and found that 99% of those ever reporting using illicit drugs used cannabis before use of any other illicit drugs. Some predictors of early cannabis use include both early/regular tobacco use and early/regular alcohol use.¹⁶⁻¹⁸

^aAssociate Professor, (aebarry@hkn.tamu.edu), Department of Health and Kinesiology, Texas A&M University, College Station, TX 77843-4243.

^bGraduate Assistant, (jessking@ufl.edu), Department of Behavioral Science and Community Health, University of Florida, PO Box 100175 HSC, Gainesville, FL 32610-0175.

^cGraduate Assistant, (csears@ufl.edu), Department of Health Education and Behavior, University of Florida, PO Box 118210, Gainesville, FL 32611-8210.

^dGraduate Assistant, (charville@hpp.ufl.edu), Department of Health Education and Behavior, University of Florida, PO Box 118210, Gainesville, FL 32611-8210.

^eGraduate Assistant, (irinab@ufl.edu), Department of Health Education and Behavior, University of Florida, PO Box 118210, Gainesville, FL 32611-8210.

^fGraduate Assistant, (kjospeh91@ufl.edu), Department of Health Education and Behavior, University of Florida, PO Box 118210, Gainesville, FL 32611-8210.

Address correspondence to: Adam E. Barry, Associate Professor, (aebarry@hkn.tamu.edu), Department of Health and Kinesiology, Texas A&M University, College Station, TX 77843-4243.

Whereas there is general acceptance of the typical progression of use of licit substances such as alcohol and tobacco prior to marijuana use and then graduating to other illicit drug use, there remains controversy over which specific substance—alcohol, tobacco or marijuana—represents the actual gateway drug. For instance, research has cited tobacco use, particularly smoking cigarettes,^{16,18-21} alcohol,^{3,22-26} and even marijuana,^{17,27,28} as the gateway substance leading to further substance use. Regardless of such discrepancies, one fact at the core of the gateway theory remains constant: early initiation into substance use leads to deleterious consequences. The earlier one begins substance use, the more likely that he or she will develop a substance use disorder, experience dependence, or report academic problems and other delinquent behaviors including criminal and violent behavior.²⁹⁻³¹ Consequently, *Healthy People 2020* specifically outlines national health objectives (SA-2.1-2.4) calling for an increase in the proportion of adolescents and high school seniors who have refrained from using alcohol or marijuana and/or illicit drugs in their lifetime.³²

The purpose of this investigation is 3-fold: (1) to determine the first substance, either licit or illicit, of which respondents initiated use; (2) determine the order in which respondents progressed through alcohol, tobacco, and marijuana use; and (3) based on which substance was initiated first, examine the impact of age of first use of that substance on lifetime illicit substance use and frequency of use.

METHODS

Procedure

Since 1975, University of Michigan's Institute for Social Research has conducted Monitoring the Future (MTF), an annual survey assessing the values, attitudes, and behaviors of American youth, with particular emphasis on the use and abuse of alcohol, tobacco, and other drugs. MTF consists of 2 primary elements: (1) a core demographic and substance use survey that is requested of all respondents; and (2) ancillary questions administered to subsamples which cover a range of demographic (ie, political attitudes and affiliations) and personal factors (ie, educational and vocational aspirations). For this investigation, we focused specifically on data collected via the ancillary section 3 with 12th graders (N = 2385).

Data are collected during the spring of each year from 8th, 10th, and 12th grade students at 420 public and private secondary schools. MTF employs a multistage random sampling procedure to obtain a representative cross-section throughout the United States. This multistage probability sample includes 3 selection stages: (1) census geographic area; (2) schools; and (3) students within schools. The surveys are group administered in classrooms by local Institute

for Social Research representatives using standardized procedures. For more detailed information on the MTF project visit www.monitoringthefuture.org.

Measures

Substance initiation. Respondents were asked to identify the grade they were in when they first initiated use of a variety of substances. Each item included the following stem-question: "When (if ever) did you FIRST do each of the following things? Don't count anything you took because a doctor told you to." The items then asked specifically about the following: "Smoke your first cigarette," "Try smokeless tobacco (snuff, plug, chewing tobacco, suns, dissolvable tobacco)," "Try an alcoholic beverage—more than just a few sips," "Try marijuana or hashish," "Try Inhalants," "Try Cocaine," "Try 'crack' cocaine, specifically," "Try Quaaludes," "Try Amphetamines," "Try LSD," and "Try Heroin." Response scale options for each item consisted of the following categories: Never, Grade 6 or below, Grade 7, Grade 8, Grade 9 (Freshman), Grade 10 (Sophomore), Grade 11 (Junior), and Grade 12 (Senior).

Lifetime illicit substance use. Lifetime use of illicit substances was assessed via the item: "On how many occasions (if any) have you used [insert substance] in your lifetime?" Possible response options included 0 occasions, 1-2 occasions, 3-5 occasions, 6-9 occasions, 10-19 occasions, 20-39 occasions, or 40 or more occasions. Based on responses to the lifetime use of marijuana, cocaine, crack, amphetamines, LSD, sedatives, tranquilizers, and heroin, a continuous Lifetime Illicit Substance Use variable was created. Specifically, responses to each item were recoded 0 (0 occasions) and 1 (1 occasion or more). With a cumulative range of 0-8, higher scores indicated initiation into more illicit substances.

Frequency of lifetime illicit substance use. The frequency in which illicit substances had been used across one's lifetime was assessed via the item: "On how many occasions (if any) have you used [insert substance] in your lifetime?" Possible response options included 0 occasions, 1-2 occasions (coded 1), 3-5 occasions (coded 2), 6-9 occasions (coded 3), 10-19 occasions (coded 4), 20-39 occasions (coded 5), or 40 or more occasions (coded 6). The following illicit substances were assessed: marijuana, cocaine, crack, amphetamines, LSD, sedatives, tranquilizers, and heroin. With a cumulative range of 0-48, higher scores for this continuous variable indicated greater frequency of illicit substance use, as well as use of multiple illicit substances.

Data Analysis

We used responses to the grade at which each substance was first initiated to calculate simple

Table 1. Grade Enrolled When Substance First Used

| | Cigarettes | Smokeless tobacco | Alcohol | Marijuana | Inhalants | Cocaine | Crack | Quaaludes | Amphetamine | LSD | Heroin |
|----------------|----------------|-------------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Never used | 64% N= 1189 | 83% N= 1676 | 30% N= 551 | 54% N= 1061 | 96% N= 1827 | 96% N= 1887 | 99% N= 1961 | 99% N= 1997 | 94% N= 1749 | 96% N= 1915 | 99% N= 1989 |
| Sixth grade | 5% N= 90 | 1% N= 27 | 5% N= 90 | 2% N= 31 | 1% N= 10 | <1% N= 3 | 0% N= 0 | <1% N= 3 | <1% N= 6 | <1% N= 3 | <1% N= 3 |
| Seventh grade | 3% N= 57 | 1% N= 21 | 6% N= 113 | 3% N= 63 | 1% N= 9 | <1% N= 3 | <1% N= 1 | <1% N= 2 | <1% N= 3 | <1% N= 3 | 0% N= 0 |
| Eighth grade | 5% N= 100 | 2% N= 42 | 11% N= 198 | 5% N= 90 | 1% N= 10 | <1% N= 5 | <1% N= 4 | <1% N= 5 | 1% N= 11 | <1% N= 5 | <1% N= 3 |
| Ninth grade | 8% N= 152 | 4% N= 83 | 16% N= 305 | 11% N= 206 | 1% N= 16 | <1% N= 7 | <1% N= 3 | <1% N= 2 | 1% N= 16 | 1% N= 12 | <1% N= 4 |
| Tenth grade | 7% N= 127 | 4% N= 71 | 14% N= 255 | 11% N= 223 | 1% N= 10 | 1% N= 15 | <1% N= 3 | <1% N= 2 | 1% N= 21 | 1% N= 16 | <1% N= 2 |
| Eleventh grade | 6% N= 104 | 2% N= 45 | 12% N= 217 | 9% N= 173 | 1% N= 18 | 2% N= 31 | <1% N= 4 | <1% N= 3 | 2% N= 36 | 1% N= 15 | <1% N= 3 |
| Twelfth grade | 3% N= 50 | 2% N= 48 | 8% N= 140 | 5% N= 105 | <1% N= 6 | 1% N= 25 | <1% N= 3 | <1% N= 2 | 2% N= 23 | 1% N= 21 | 0% N= 0 |

frequencies and descriptive statistics to establish: (1) the percentage and number of students initiating each substance across grades; and (2) the progression and order of substance use. In regards to the progression of substance use, we established whether respondents fell into 3 patterns of substance use: (1) alcohol use prior to tobacco or marijuana use; (2) tobacco use prior to alcohol or marijuana use; and (3) marijuana use prior to alcohol or tobacco use. One-way between-groups analysis of variance with post hoc Tukey HSD analysis was conducted to explore the impact of grade of first use of the identified gateway drug on lifetime illicit substance use, as well as the frequency of illicit substance use. All statistical analyses were performed using the Predictive Analytics SoftWare (PASW) (version 22).

RESULTS

As can be seen in Table 1, alcohol was the most commonly used substance (only 30% never used), followed by marijuana (54% never used) and tobacco (64% never used). The same number of respondents reported using alcohol and tobacco in sixth grade (5%; N=90); however, a greater proportion of students reported initiating alcohol use in each subsequent grade (7th-12th) compared with tobacco and marijuana use. Among our respondents, marijuana initiation matched or surpassed tobacco initiation for each grade except sixth. Prevalence of initiation into other illicit substance use, such as cocaine, quaaludes, and heroin, was low.

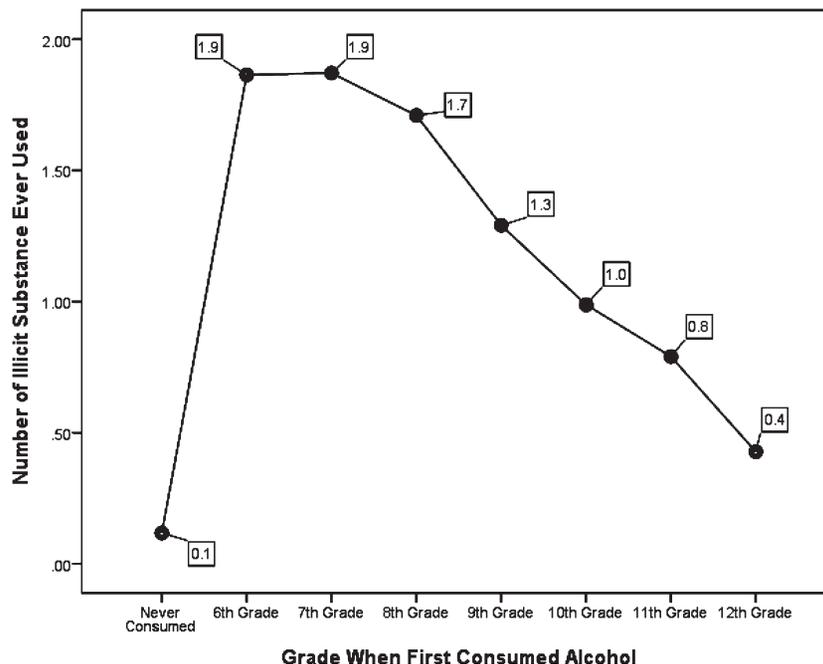
In examining the typical sequence of substance initiation among alcohol, tobacco or marijuana users, the vast majority of respondents reported using alcohol prior to either tobacco or marijuana initiation. Specifically, 644 respondents followed the pattern of alcohol use prior to tobacco or marijuana initiation,

whereas 389 respondents initiated tobacco use prior to alcohol or marijuana use, and 170 reported using marijuana prior to alcohol or tobacco initiation.

Given that alcohol was the most widely used substance among respondents, initiated earliest, and also the first substance most commonly used in the progression of substance use, we conducted 2, separate, one-way analyses of variance (ANOVAs) to further explore the relationship between alcohol initiation and (1) lifetime illicit substance use, and (2) frequency of illicit substance use. Overall, there was a statistically significant difference in the number of illicit substances ever used by respondents across their lifetime, depending on what grade they initiated alcohol use [$F(7, 477.1) = 97.3, p < .001$]. Post hoc comparisons using Tukey HSD test indicated that mean lifetime illicit substance use for respondents who initiated alcohol use in 6th grade ($M = 1.9, SD = 1.7$) was significantly greater than those who initiated alcohol use in 9th ($M = 1.3, SD = 1.4, p < .002$), 10th ($M = 0.9, SD = 1.1, p < .001$), 11th ($M = 0.7, SD = 0.9, p < .001$), or 12th ($M = 0.4, SD = 0.6, p < .001$). Similarly, those who initiated alcohol use in 7th grade ($M = 1.9, SD = 1.8$) and 8th grade ($M = 1.7, SD = 1.7$) also exhibited statistically greater lifetime illicit substance use than those who initiated alcohol use in 9th grade or later. It is important to note that with each additional grade that alcohol initiation was delayed, lifetime illicit substance use decreased (Figure 1). Respondents who had never consumed alcohol reported the lowest lifetime illicit substance use ($M = 0.1, SD = 0.4$). Based on guidelines proposed by Cohen,³³ the overall effect size for these differences was considered large (eta squared = 0.30).

With regards to the frequency of illicit substance use across one's lifetime, there was a statistically significant difference depending on the grade at which respondents initiated alcohol use ($F[7,475.2] = 85.1,$

Figure 1. Number of Illicit Substance Ever Used by Grade When Alcohol First Consumed.



$p < .001$). Similar to the above considerations, post hoc comparisons using Tukey HSD test indicated that those who initiated alcohol use in the 6th grade used illicit substances more frequently ($M = 6.0$, $SD = 6.5$) than those who initiated alcohol use in 9th ($M = 4.1$, $SD = 4.6$, $p < .006$), 10th ($M = 2.9$, $SD = 3.5$, $p < .001$), 11th ($M = 2.2$, $SD = 3.7$, $p < .001$), or 12th grade ($M = 1.0$, $SD = 1.9$, $p < .001$). Furthermore, those who initiated alcohol use in 7th grade ($M = 6.1$, $SD = 6.5$) and 8th grade ($M = 5.7$, $SD = 6.1$) also exhibited statistically greater frequency of lifetime illicit substance use than those who initiated alcohol use in 9th grade or after. As was true with lifetime ever use, with each additional grade that alcohol initiation was delayed, frequency of lifetime illicit substance use decreased (Figure 2). Respondents who had never consumed alcohol reported the lowest frequency of lifetime illicit substance use ($M = 0.2$, $SD = 1.3$). On the basis of guidelines proposed by Cohen,³³ the overall effect size for these differences was considered large ($\eta^2 = 0.28$).

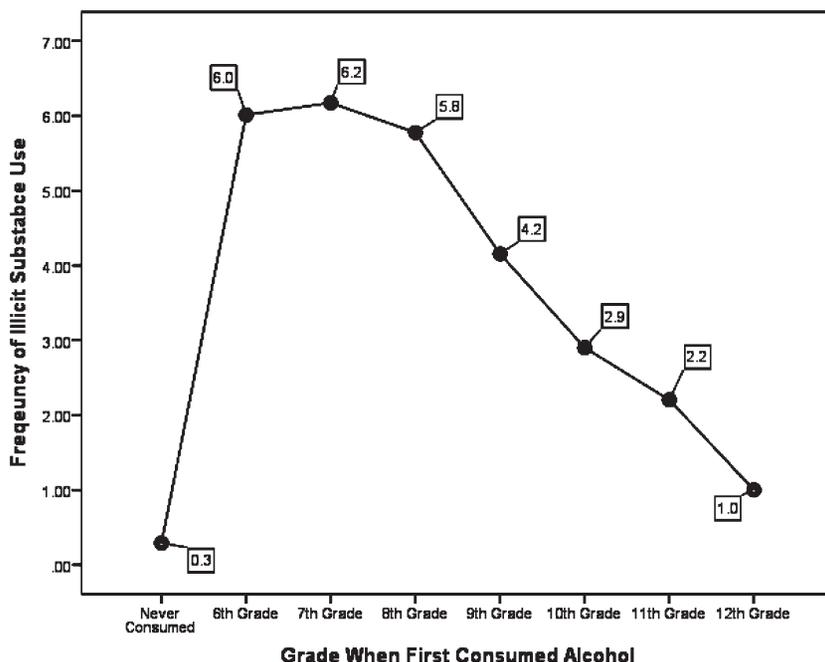
DISCUSSION

Yu and Williford³⁴ assert that the impact of early onset of alcohol use is strongest when the onset is initiated in the age period between 13 and 16. This is concerning given that prior investigations have documented that over 50% of both boys and girls had consumed alcohol by the age of 15, and approximately 20% had engaged in binge drinking.³⁵ In the United

States, 13 years of age corresponds with either seventh or eighth grade, depending on the month of birth. By eighth grade, approximately 22% of our sample had already initiated alcohol use. By the age of 16 (10th and 11th grade), approximately 64% of the sample had consumed alcohol (Table 1). Moreover, our results highlight initiation of alcohol use in sixth, seventh, or eighth grade as an especially powerful influence on lifetime ever use and frequency of lifetime illicit substance use.

According to Vanyukov et al³⁶(p57) the use of licit drugs often precedes the use of illicit drugs, suggesting that it is “alcohol and tobacco use rather than marijuana and ‘hard’ drugs that need to be prevented, because once the licit outset of the sequence is barred there should be no danger that the rest of it will materialize.” Youth who progress through the hypothesized “gateway theory” sequence outlined herein (ie, alcohol initiation preceding marijuana use, and then followed by other drugs) initiate their substance use at an earlier age than youth who do not progress through these three substance classes.³⁷ Moreover, Fergusson et al³⁸(p174) contend “alcohol use may play a small gateway effect in encouraging illicit drug use, with increasing alcohol use being associated with increasing illicit drug use even after control for both the use of cannabis and reverse causal effects.” Similar to our findings, previous work has found the mean age of first use of alcohol to be lower than other illicit substances³⁹ and licit substances.⁴⁰ When compared with other licit (tobacco) and illicit

Figure 2. Frequency of Illicit Substance Use by Grade When Alcohol First Consumed.



substances, the prevalence of alcohol initiation in our sample was greater in each grade assessed. Whereas 46% of youth have reported using alcohol prior to age 11, only 25% have used cigarette, 6% have used marijuana, and 2% have used cocaine.⁴¹

There has been some suggestion in the literature that early alcohol use by adolescents is part of a larger psychosocial developmental trajectory that can be implicated in adult alcohol abuse and dependence.^{42,43} Seeking to determine whether adolescent age of initiation of alcohol use was a unique predictor of later alcohol dependence or whether it was merely a correlate of those factors while controlling for effects of comorbid substance abuse, King and Chassin⁴⁴ assert that even when statistically controlling for familial and behavioral risk factors, early initiation nearly doubled the odds of being diagnosed with alcohol dependence by young adulthood. Predominant childhood risk factors for early-onset drinking include having a single parent, having parents who also started drinking at an early age, and parental drinking frequency.⁴⁵

Limitations

The findings of this manuscript should be considered in conjunction with several limitations. First, the data are cross-sectional and as such we cannot establish causality or temporality. In addition, as with any secondary data analysis, researchers are limited to the methods and variables used in the primary data collection, and therefore, the limitations of the primary study. One inherited limitation is that the

sampling frame did not include high school dropouts. Because licit and illicit drug use tends to be higher among this population,⁴⁶ our prevalence may be conservative as compared to results among all 18-year-olds. Finally, previous studies have documented whether recall of first use of alcohol and/or tobacco is time dependent. Using 2 waves of the Australian National Drug Strategy Household Survey from 2001 and 2007, Liang et al⁴⁷ demonstrated a modest time-dependent misclassification in recalling age at first use among the study participants, with a maximum measured underestimation of 1.5 years. Recall error, however, was both larger and more variable with older age cohorts, suggesting that the more time that has passed since the age of initiation, the more probably a systematic bias could be introduced into the data set using recall data. Given that this investigation was based on retrospective recall data of measures taken when participants were 18 years old, and still participating in high school, it is unlikely that recall error was a confounding concern for our results.

Conclusions

Overall, early onset substance initiation, whether that is alcohol, tobacco, or other drugs, exerts a powerful influence over future health risk behaviors. Students who reported substance use of alcohol, cigarettes, marijuana, and cocaine at age 11 or younger reported engaging in significantly greater numbers of health risk behaviors (eg, riding in car with impaired driver, carrying a gun, knife

or weapon at school, fighting, suicide plan) than students whose age of onset of these substances was 12 years or older or students who reported never using these substances.⁴¹ In regard to alcohol specifically, the earlier the age at which someone begins drinking, the higher the likelihood that they will (1) experience alcohol dependence^{31,48,49}; (2) experience unintentional injury^{48,50}; (3) report unprotected sexual intercourse and multiple sexual partners^{51,52}; and (4) drive while under the influence of alcohol and be involved in a motor vehicle crash.^{50,51} Our results further assert that the earlier one initiates alcohol use, the more likely that they will engage in future illicit substance use.

IMPLICATIONS FOR SCHOOL HEALTH

When considering our findings in unison with previous literature, important implications for both clinical and school settings emerge. Relevant to clinical settings, our research underscores the importance and necessity of screening for substance use, even among patients enrolled in elementary and middle school (ie, as young as 9 and 10 years of age). Given the increased health risks associated with early onset of substance use, it is crucial to screen for substance use with youth in medical settings. The screening instrument CRAFFT (each letter representing an acronym for one of six questions) “has the most consistent data to support its use in primary care settings.”⁵³(p2146) It is important not only to detect for substance use but also intervene to encourage discontinued usage. That said, there is currently a paucity of investigations examining the feasibility and long-term efficacy of screening, brief intervention, and referral to treatment (SBIRT) practices among adolescents.^{53,54} For school settings, our results highlight 2 important factors. First, given the average grade at which alcohol initiation was documented in our investigation, prevention programs should begin in elementary school. Because fifth graders in the United States are approximately 10 to 11 years of age, it seems appropriate that interventions begin in third grade when students are between the ages of 8 and 9, and be carried on throughout their maturation and transition to higher grades. Second, our research supports prior work which highlights alcohol as the substance which youth typically initiate first in the sequence of substance use.^{3,13,23-26} As a result, emphasizing abstinence from alcohol use seems appropriate and paramount. That said, it is important to note that interventions should address multiple risk factors and work to build up multiple protective factors.⁵⁵⁻⁵⁸ Finally, interventions should also recognize the interdependence of health risk behaviors and also work to be comprehensive. Effective elements of school-based adolescent health programs, especially those preventing alcohol use and

abuse among youth (1) include a strong theoretical foundation; (2) address social influences, such as social norms, around drinking; (3) builds cognitive-behavioral skills that can help reduce pressure to use alcohol; (4) provides training and support to facilitators; and (5) includes multiple components that are delivered over several sessions and years.^{59,60,61} Guttmanova et al³¹(p389) contend “prevention efforts should focus on delaying the onset of alcohol use, reducing substance use in adolescence, as well as improving school functioning, reducing adolescent problem behaviors, and targeting adolescent peer networks.”

Human Subjects Approval Statement

All procedures were vetted and approved by the appropriate Institutional Review Board. This secondary data analysis was deemed exempt from human subjects review.

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