# Preventing Daily Substance Use among High School Students Using a Cognitive-Behavioral Competence Enhancement Approach

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**Abstract**  The present study tested the effectiveness of a substance abuse prevention program for deterring tobacco, alcohol, and marijuana use among high school students. The prevention program teaches social resistance skills and general personal and social competence skills. Rates of substance use behavior were examined among students (N = 452) from 12 public high schools that were randomly assigned to either receive the prevention program (5 schools, n = 196) or serve as a treatment-as-usual control group (7 schools, n = 256). The impact of the prevention program was tested using composite indicators of daily substance use based on items measuring the frequency of smoking, drinking, drunkenness, marijuana use, and marijuana intoxication. Data were analyzed using generalized estimating equations to adjust for school-level clustering. Comparison of the posttest adjusted means (controlling for school clustering, gender, race/ethnicity, and family structure) revealed that the intervention produced significant prevention effects on daily substance use, both in terms of a daily polysubstance use index and the proportion of daily substance users across experimental condition. Findings indicated that there were 52% fewer daily substance users in the intervention condition compared to controls. Conclusions drawn from this study are that: (1) daily substance use can be prevented in high school students using a competence enhancement approach that addresses key risk and protective factors; (2) prevention approaches that are effective for middle school students can also be effective for high school students, if adapted to be developmentally appropriate; and (3) *universal* prevention approaches delivered by classroom teachers with minimal specialized training offer the potential for widespread dissemination and a cost-effective approach to an important public health problem.

*Keywords: drug abuse prevention, high school, competence enhancement*

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## 1. Introduction

Adolescent substance abuse is an important problem and the United States has the highest rates of abuse in the industrialized world. The prevalence rates of alcohol, tobacco, and marijuana use typically increase over the adolescent years and reach a peak during late adolescence and early adulthood. Alcohol use is the most prevalent substance use behavior among teens, and marijuana is the most prevalent illicit drug used. According to the 2014 Monitoring the Future study [12], 41.4% of 12th graders reported having been drunk in the past year, and one in five (19.4%) reported binge drinking (five or more drinks in a row) in the past two weeks. More than one in three (35.1%) 12th graders reported using marijuana in the past year. Rates of daily marijuana use among 12th graders reached the highest level in the past 30 years in 2011, at 6.6%, and rates have fallen only slightly since then to 5.8% in 2014. Although prevalence rates of cigarette smoking have dropped in recent years, more than 13.6% of 12th graders reported smoking cigarettes in the past month in 2014, and 6.7% reported smoking cigarettes on a daily basis.

These rates of use are alarming in light of the many serious consequences of adolescent substance use, which include a range of health, social, psychological, and neurocognitive problems that can interfere with normative development [15]. Cigarette smoking is the leading preventable cause of death and early onset of smoking greatly increases rates of tobacco addiction in adulthood and the associated health risks of lung cancer, cardiovascular diseases, and chronic respiratory diseases [6,21]. Alcohol and marijuana use during adolescence contribute to a variety of negative outcomes including unintentional injuries and deaths, traffic fatalities, risky sexual behaviors, school dropout, interpersonal aggression, and psychiatric problems [5,10,13,20]. Furthermore, adolescent alcohol and marijuana use have both been associated with alterations in brain structure, function, and neurocognition, with potential lifelong implications for learning and intellectual development [18,24]. Because of the severity and scope of

these negative outcomes, preventing the onset and escalation of substance use among adolescents is an important public health priority.

Fortunately, over the past two decades, significant progress has been made in developing and testing effective theory-driven substance abuse prevention approaches [16]. The most significant progress to date has been the development of effective substance abuse prevention programs designed for middle school students [7]. However, relatively few substance abuse prevention programs have been developed for high school students, and these tend to be *selective* (targeted) interventions aimed at high-risk students who are already involved in substance abuse, have behavioral problems, have poor academic records, or are at high risk of dropping out of school [19]. These approaches can have limited public health potential since they involve only a small portion of high school students, often require screening to identify high risk youth, and can be difficult to implement on a large scale. Thus, there remains a need for evidence-based *universal* substance abuse prevention approaches for high school that can benefit all students and have the potential for wide dissemination.

Many of the risk and protective factors for substance use remain important throughout adolescence, including peer, parent, and media influences; social connectedness and involvement with conventional institutions; competence skills and self-regulation skills; and school performance [9,22,23].

Therefore, approaches that are effective for middle/junior high school may also be effective for high school, if they are adapted to be developmentally and pedagogically appropriate. Moreover, since substance use typically escalates during adolescence in terms of frequency, amount, and the number of substances used, it is important to use an outcome measure of substance use that is appropriate for the target population.

*Life Skills Training* (LST) is an evidence-based substance abuse prevention program initially developed for middle/junior high school students. Extensively tested in over 30 peer-reviewed studies, LST has been proven effective in preventing tobacco, alcohol, drug abuse, and violence [2]. LST is a *universal* prevention approach designed to be implemented with all students in a regular classroom setting. The program teaches personal self-management skills, social skills, and other cognitive-behavioral skills needed to reduce substance abuse and violence, successfully handle the challenges of everyday life, and increase overall resilience. Research suggests that it is effective due to the combination of these elements.

The main goal of the present study was to determine the effectiveness of a new preventive intervention for high school students based on the LST approach, after adapting it to be developmentally and pedagogically appropriate for an older population. Given the age of the target population and the natural progression of substance use behavior, the focus of the present study was on daily substance use.

## 2. Methods

### 2.1. Sample

A total of 685 student from 12 high schools participated in the current study. The participating schools were urban, public high schools and were clustered in three states, one in the northeast U.S. (Massachusetts) and two in the southern U.S. (Georgia, Louisiana). Of those who completed the pretest survey, 452 (66%) also completed the posttest survey and were in the panel sample for this prevention trial. The majority of students in the analysis sample were 9th graders (71.5%) and the remainder were 10th graders. The sample was 60.6% female and had a mean age of 15.2 years. The racial/ethnic composition of the sample was 53.1% African American, 4.9% Hispanic, 4.3% Asian, 35.2% White, and 2.5% of other backgrounds. Approximately 57% of the students lived in two-parent households (including households with a step-parent) and 29% lived in mother-only households.

### 2.2. Research Design

In order to maximize experimental rigor and control for possible threats to internal validity, a randomized block design was selected for this study, with random assignment of clusters (schools) to experimental conditions. Prior to randomization, schools in each of the three geographic areas were sorted by school size and percent minority students. From within these groups, each of the participating schools was randomized to either the intervention or control condition. Students in the intervention condition (n = 196) received the 10-session program taught by classroom teachers. The intervention was not provided to students in the control condition (n = 256), who instead received the health education curriculum that was in place at their schools.

### 2.3. Procedure

Participants were administered a pretest questionnaire prior to the intervention and a posttest questionnaire approximately one month after completion of the intervention. Data were collected following a detailed protocol similar to those used in previous prevention studies [2,3]. The questionnaires assessed self-reported substance use behavior, general demographic information, and variables related to adolescent substance use risk. Unique identification codes were utilized rather than names to permit linkage of pretest and posttest questionnaires, while still preserving confidentiality. Questionnaires were administered during a regular classroom period. Because of the diverse nature of the study population, data collection teams were composed of individuals of racial/ethnic backgrounds that were similar to those of participants.

### 2.4. Prevention Program

The preventive intervention tested in this study was a 10-session program based on the LST model [2]. The program was designed to teach generic personal and social skills to enhance overall resilience as well as knowledge, attitudes, norms and skills for resisting social influence to engage in substance use.

The program was implemented by regular classroom teachers who attended a one-day training workshop. The purpose of the training workshop was to familiarize the teachers with the content of the prevention program, the rationale for the underlying prevention strategy, results of prior studies, and to provide an opportunity for teachers to learn and practice the skills needed to successfully implement the program.

**Table 1. Life Skills Training High School Program**

| Unit | Classes | Brief Description |
|---|---|---|
| 1: *The Value of Good Health* | 1 | Overview of the program content and how the other units are related to short-term and long-term health attitudes, norms, and behaviors; assessing one's personal attitudes, beliefs, and behaviors; identifying developmental challenges that impact health attitudes, beliefs, and behaviors. |
| 2: *Decision-Making for Health* | 1 | Self-appraisal, goal-setting, critical thinking and decision-making skills; applying these skills to substance use and other personal health risk behaviors. |
| 3: *Risk-Taking and Substance Abuse* | 1 | Types and levels of risk, assessing personal risk-taking, risks related to substance use and other health behavior; actual versus perceived levels of substance use among adolescents; application of critical-thinking skills and decision-making to risk reduction. |
| 4: *The Media and Health* | 2 | Media influences on substance use and other health risk behaviors, strategies for identifying methods used by media to influence decision-making and health risk-taking, and skills for resisting media influences. |
| 5: *Managing Stress, Anger, and Other Emotions* | 1 | Sources of personal stress, anger triggers, cues for stress and anger; how substance use is related to stress and anger, adaptive strategies for coping with stress and anger. |
| 6: *Family Communications* | 2 | Understanding evolving roles of students and parents during high school years; conflicts about family rules and expectations; and skills for communicating more effectively with family members and reducing misunderstandings with parents. |
| 7: *Healthy Relationships* | 2 | Healthy attitudes, beliefs and behaviors in close personal relationships; skills for managing social interactions; understanding and resolving conflicts; communicating effectively; healthy assertiveness, social resistance skills, and resisting social influences to engage in substance use. |

Program content and materials were designed to be age-appropriate for the cognitive abilities, reasoning skills, and motivations of high school students for engaging in substance use. Furthermore, given the multiple stressors experienced by many high school students, cognitive-behavioral coping strategies such as relaxation techniques and cognitive restructuring were taught. Other issues addressed by the preventive intervention to enhance age-appropriateness and relevance to the population included drug abuse and risk-taking, negotiating increased independence from parents, and balancing the needs of friends, family, and romantic relationships in the context of an increasingly demanding school and work schedule.

The program consisted of seven units implemented over 10 45-minute, class sessions (see Table 1). Each unit contained a major goal, measurable student objectives, substance use prevention information, and skills-training activities. The intervention materials consisted of a teacher manual and student guide. During the development of these materials, they were subjected to an expert review to ensure accuracy, appropriateness of content, and consistency with the LST model. Program materials were also subjected to qualitative evaluation by focus groups of students and teachers to ensure their age-appropriateness, acceptability, relevance, and general appeal to high school students.

## 2.5. Measures

Data for this study were collected by questionnaires containing a set of widely-used items assessing a number of demographic and substance use variables. All of these questionnaire items have been used extensively in previous research [2,3,7].

### 2.5.1. Demographic Data

Data concerning the characteristics of the participants were collected using standard survey items on gender, age, family structure, race and ethnicity, and academic performance.

### 2.5.2. Substance Use

Substance use was assessed using an approach followed in previous research that combined individual survey items into one or more summative composite indices [17]. Frequency of smoking, drinking, drunkenness, marijuana use, and marijuana intoxication were assessed with five items. The items used a common stem asking students "About how often (if ever) do you:" and the five separate items asked students about the frequency with which they "smoke cigarettes?" "drink beer, wine, wine coolers, or hard liquor?" "drink until you get drunk?" "smoke marijuana (pot, grass) or hashish (hash)?" and "smoke marijuana or hashish until you get high or stoned?" Students were asked to respond on a 9-point scale anchored by 1 (never) and 9 (more than once a day).

Based on responses to these five items, dichotomous daily substance use scores were calculated for each item: daily smoking, daily drinking, daily drunkenness, daily marijuana use, and daily marijuana intoxication, where 1 represented daily use and 0 represented no daily use. Two outcome measures were created to examine intervention effects on daily substance use. First, a daily polysubstance use index was created by summing the five dichotomous daily use items described above. The index thus had a possible range from 0 to 5, representing the number of substances used on a daily basis. In addition to this index, we examined the proportion of the sample that engaged in any daily substance use (a score of 1) vs. no daily substance use (a score of 0). This latter score enabled us to compare the proportion of daily substance users across experimental conditions.

## 2.6. Data Analysis

Data were analyzed using the statistical procedures in SPSS [11] for t-test, chi-square, multiple regression, and generalized estimating equations (GEE). First, a series of t-tests and chi-square tests were computed to determine pretest comparability of the intervention and control groups. Second, the longitudinal sample used in this study was compared with the full pretest sample to determine

the impact of attrition using a series of multiple regression analyses. Third, the effectiveness of the prevention program was examined using GEE, comparing the posttest substance use means across the two conditions after adjusting for school-level clustering, pretest scores of the outcome variables, and several additional covariates.

## 3. Results

Table 2 presents the pretest demographic characteristics and mean pretest substance use scores for the intervention and control groups. The mean frequency scores at baseline were 1.62 for smoking, 1.99 for alcohol use, 1.44 for drunkenness, and 1.47 for marijuana use. Approximately 20% of the sample reported ever smoking cigarettes, 50% reported ever drinking, 38% reported ever being drunk, and 36% reported ever using marijuana use. We conducted several analyses to examine pretest equivalence. There were no significant differences in any substance use scores at the baseline assessment. There were also no significant differences in terms of gender, race/ethnicity, or family structure. These findings indicate a high degree of comparability between conditions prior to the intervention.

**Table 2. Pretest Equivalence**

|  | Intervention Group N (%) | Control Group N (%) |
|---|---|---|
| Male | 61 (33.2%) | 93 (38.1%) |
| White | 67 (34.2%) | 92 (35.9%) |
| Live With Two Parents | 116 (59.2%) | 142 (55.5%) |
|  | M | M |
| Overall Substance Use | 1.28 | 1.28 |
| Smoke Cigarettes | 1.59 | 1.64 |
| Drink Alcohol | 2.04 | 1.96 |
| Drunkenness | 1.48 | 1.40 |
| Smoke Marijuana/Hashish | 1.33 | 1.57 |

Note: None of the comparisons testing pretest substance use between the intervention and control groups was statistically significant.

### 3.1. Attrition Analysis

Several analyses were conducted to examine attrition rates from the pretest to posttest assessments. Overall, 452 (66%) of the pretest sample was retained at the posttest assessment. Attrition rates among students who reported engaging in substance use at the pretest were similar to those who did not engage in substance use. For example, the attrition rate for pretest smokers in the control group was 33.6% compared to 35.7% in the intervention group, $\chi2(1)=0.23$, p=.352. Importantly, while overall attrition was lower among students in the control group compared to intervention group, there was no differential attrition by pretest substance use status and experimental condition; participants who engaged in substance use at the pretest had similar rates of attrition across both study conditions.

### 3.2. Intervention Effects

The goal of the present study was to examine whether the preventive intervention tested could prevent daily substance use among high school students. We examined whether participants in the intervention and control groups differed at the posttest assessment in terms of daily substance use. First, we compared the two conditions using a daily polysubstance use index that reflected the number behaviors reported on a daily basis. The GEE analysis examined the posttest daily polysubstance use index across the two conditions after adjusting for school-level clustering, pretest substance use, and covariates of gender, race/ethnicity, and family structure. Findings indicated the intervention had a significant effect, Wald $\chi2(1)=4.9$, p=.028, and the posttest adjusted means on the daily polysubstance use index were .05 in the intervention group and .08 in the control group.

A second analysis compared the proportion of daily substance users across conditions, where 1 indicates that the participant reported daily use of one or more substances and 0 indicated that they reported no daily substance use. Findings indicated that the intervention had a significant effect, Wald $\chi2(1)=6.2$, p=.013. The covariate adjusted proportions of daily substance users at the posttest assessment (controlling for clustering, gender, race/ethnicity, and family structure) were 4.3% for controls and 2.07% for the intervention group. Thus, there were 52% fewer daily substance users in the intervention condition compared to the control condition. Table 3 shows the covariate adjusted posttest daily substance use outcomes by experimental condition.

**Table 3. Covariate Adjusted Posttest Daily Substance Use**

| Condition | Daily Polysubstance Use Index | Proportion of Daily Substance Users |
|---|---|---|
| Experimental | .052* | 2.07%* |
| Control | .080 | 4.30% |

Note: *p < .05, two-tailed significance tests.

## 4. Discussion

The present study examined the effectiveness of a school-based substance abuse prevention program for deterring tobacco, alcohol, and marijuana use among high school students. Schools were randomly assigned to either receive the prevention program or serve as a treatment-as-usual control group. Both the preventive intervention and the measures used to determine its effectiveness were designed to be developmentally appropriate for high school students.

Results indicated that the prevention program reduced daily substance use as measured both by the polysubstance use index and the proportion of daily substance users. With respect to the latter, results indicated that there were 52% fewer daily substance users among students assigned to the intervention condition than among controls. These findings indicate that a school-based prevention approach previously found to be effective for middle/junior high school students is also effective for high school students.

Substance abuse remains an important problem in the United States, as well as in many countries around the world. Typically substance use begins during the early teen years and progresses from nonuse, to occasional use, to the frequent use of one or more substances. This progression typically involves the escalation of use along three related dimensions: frequency, amount, and the

number of substances used. Substance abuse prevention research involving middle/junior high school students (i.e., individuals at the beginning of this developmental sequence) focuses on preventing the onset and early stages of use, and utilizes lifetime, annual, or monthly substance use outcome measures. On the other hand, an appropriate goal of research with high school students is preventing the use of one or more substances, using outcome measures indicative of more serious drug involvement.

A number of measurement techniques have been used to assess overall substance use involvement among adolescents. Research shows that a simple summative index of the kind used in this study performs as well psychometrically as more complicated approaches, such as a weighted index [14]. Given the focus of the current study and the age of the target population, a composite index capturing the daily use of one or more substances is an appropriate and robust outcome measure.

Although there have been significant advances in the field of substance abuse prevention, most of this work focuses on middle/junior high school students [7]. There is relatively little research testing the effectiveness of prevention programs designed for high school students, possibly because of the assumption that high school is too late. Among studies with high school students, most test *selective* interventions targeted at students who are already involved in substance use/abuse, have behavioral problems, have poor academic records, or are at high risk of dropping out of school [19]. Therefore, the current study fills an important gap in the prevention literature by testing a *universal* prevention approach appropriate for implementation with all students.

Substance abuse is one of the most expensive public health problems facing the United States. Because this prevention program can be delivered to a broad range of high school students by regular classroom teachers with relatively little specialized training, it offers potential for widespread dissemination and a cost-effective approach to an important public health problem. Moreover, cost-benefit studies suggest that this approach can produce cost saving of as much as $38 for every $1 spent [2].

The intervention tested in this study is based on a prevention approach (LST) that has been extensively tested and shown to be effective with middle/junior high school students [2]. Past research also suggests that no single component of this multi-component approach is responsible for its impact on substance use; rather, the impact on substance use is the result of the synergistic interaction of the various program elements [2]. The current study shows that the LST approach is also effective with high school students, when the content and materials are carefully adapted to be developmentally appropriate. However, future research is necessary to determine if any particular intervention component contributes more to the prevention effect than others with this population.

The findings of this study have important implications for theory and practice. First, this study provides empirical evidence that prevention programs implemented in high school can be effective. Second, it provides evidence that a cognitive-behavioral competence enhancement approach designed to teach drug resistance skills and enhance personal and social competence is an effective prevention approach for high school students. Third, this study demonstrates that an intervention initially developed as a primary prevention approach to prevent the onset and early stages of substance use can prevent later stage substance use in the form of the daily use of one or more substances. Finally, this study extends previous research with the LST approach by providing support for its effectiveness with high school youth.

The current study has several notable strengths, including the use of a comprehensive prevention approach targeting a diverse set of risk and protective factors, a cluster-randomized design with schools being randomly assigned to experimental conditions, a geographically and racially diverse sample, standardized measures and data collection protocols, data analyses to rule out possible threats to internal validity from pretest non-equivalence of experimental groups and/or differential attrition, and multivariate statistical analyses of intervention effects that adjusted for school-level clustering and several covariates to increase analytic precision. Together, these design and methodological features of the study served to safeguard internal and external validity, thereby increasing confidence that the observed reductions in substance use were the result of the prevention program, could not be explained by alternative hypotheses, and are generalizable to a broad range of adolescents.

Despite these strengths, the current study also has several potential limitations. First, the study relies on self-report data which may be inaccurate and/or biased by under-reporting or over-reporting. However, a number of studies have demonstrated the reliability and validity of adolescent self-reports of substance use. For example, a study of high-school students examined non-response rates, consistency, test-retest reliability, and estimates of exaggerated reports, and found high rates of stability in self-reporting of substance use, both cross-sectionally and longitudinally [1]. In addition, national surveys by the National Institute on Drug Abuse that track annual trends in adolescent substance use rely on self-report data [12].

Second, the small sample size limited the kind of analyses that could be meaningfully conducted due to constraints on statistical power. For example, due to the small sample size, it was not possible to test for potential differences in the impact of the intervention by gender, racial/ethnic group, or with respect to specific substances. Third, the absence of follow-up data makes it difficult to draw conclusions about the durability of the prevention effects with this population. Future research is needed with a larger sample size and greater statistical power in order to test for prevention effects on subgroups of interest and/or on specific forms of substance use. Future research with this population is also needed to determine which intervention components contribute to the impact on substance use among high school students. Finally, follow-up research is needed to determine the long-term effectiveness of the prevention program with high school students during and after high school.

## 5. Conclusions

The present study demonstrates the effectiveness of a *universal* prevention approach designed to be delivered by regular classroom teachers to high school students. The prevention approach taught knowledge and skills for

resisting pro-substance use social influences within the context of a broader youth development model designed to enhance generic personal and social competence. Both the prevention program and the measures used to determine its effectiveness were designed to be developmentally appropriate for high school students. Results indicate that this prevention approach reduced daily substance users by 52%. This study indicates that *universal* prevention programs implemented in high school can be effective, and provides further support for the effectiveness of the LST approach. Finally, because this prevention approach can be implemented by regular classroom teachers with little specialized training and is suitable for a broad range of students, it offers the potential for widespread dissemination and a cost-effective approach to an important public health problem.

## Acknowledgement

## Statement of Competing Interests

Dr. Botvin is president of National Health Promotion Associates (NHPA) which markets *Life Skills Training* and other prevention materials. Dr. Griffin (senior research scientist) and Dr. Williams (vice president for research) are also affiliated with NHPA.

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