2012

Classroom Based Substance Use Prevention Programs: A Meta-analysis

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CLASSROOM-BASED SUBSTANCE USE PREVENTION PROGRAMS: A META-ANALYSIS

by

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B.A. University of Miami, 2009

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Science
in the Department of Psychology
in the College of Sciences
at the University of Central Florida
Orlando, Florida

Summer Term
2012

ABSTRACT

This paper reports on a meta-analysis performed on forty one studies evaluating classroom-based substance abuse primary prevention programs. Studies included were delivered in a classroom to the general student body, had a primary focus of substance abuse prevention, measured behavior change, and were published in peer-reviewed outlets between 2000 and 2011. Comprehensive Meta-Analysis was used to calculate a random effects Cohen's d and moderator analyses. Results indicated a significant effect for alcohol (d=0.10) and tobacco (d=0.09) in multi-target interventions. Specific program components and characteristics associated with more effective prevention programs are discussed. Despite the best efforts of those who develop and deliver intervention programs, as a whole, the impact is smaller than "small." New or evolved programs should seek to incorporate the best predictors of effectiveness thereby improving efficacy.

ACKNOWLEDGMENTS

I am grateful to my committee members (Dr. Michael Dunn, Dr. Jeffery Cassisi, and Dr. Clint Bowers), for their expertise, feedback, and support. I would like to thank my labmates for offering moral support and words of encouragement in the most frustrating of times. Finally, I would like to thank my family, for always cheering me on.

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CHAPTER 1: INTRODUCTION

For decades, drug use (particularly alcohol and tobacco), has contributed to more fatalities in industrialized cultures than all other behaviors combined. Because morbidity attributable to substance use occurs in all age groups, prevention efforts should include those of every age. However, it is obvious that the potential to reduce the eventual probability of drug-related harm is highest when prevention efforts are targeted at children and adolescents. Moreover, alcohol consumption among persons aged 12-20 years contributes to the three leading causes of death (unintentional injury, homicide, and suicide) in this age group (Miller, 2007).

In an effort to increase awareness of the prevalence and harms associated with early alcohol use, the Acting Surgeon General of the United States issued a *Call to Action to Prevent and Reduce Underage Drinking* in March 2007. The *Call to Action* highlights the nature and extent of underage drinking and its consequences and suggests a new, more comprehensive and developmentally sensitive approach to understanding, preventing, and reducing underage drinking. In order to accomplish these goals, the *Call to Action* emphasizes the following strategies:

1. Changing the culture by challenging norms and expectations surrounding underage drinking;
2. Preventing adolescents from starting to drink;
3. Delaying initiation of drinking;
4. Intervening early, especially with high-risk youth;

5. Reducing drinking and its negative consequences, including the progression to alcohol use disorders (AUDs) among those who already have started drinking; and
6. Identifying adolescents who have AUDs and therefore could benefit from treatment and recovery support services.

The call specifically designates schools as responsible in the coordinated national effort to prevent and reduce underage drinking and its consequences ("Underage Drinking— Highlights From The Surgeon General's Call to Action," 2007). Many current classroom-based prevention programs often aim to address several of these issues and thus play a vital role in achieving the goals outlined by the *Call to Action.*

Despite the employment of primary substance use prevention programs in nearly all schools in the United States, use of most substances has not decreased significantly over the last decade. Specifically, according to the most recent *Monitoring the Future* study (2010), alcohol use remains extremely widespread among today's teenagers. Although an increase in the minimum drinking age during the 1980s was followed by reductions in drinking and increases in perceived risk associated with drinking, nearly three quarters of students (71%) have consumed alcohol (more than just a few sips) by the end of high school, and more than one third (36%) have done so by 8th grade. The proportions of 8th, 10th, and 12th graders who admitted drinking an alcoholic beverage in just the 30-day period prior to the survey were 14%, 29%, and 41%, respectively. More than half (54%) of 12th graders and one sixth (16%) of 8th graders in 2010 report having been drunk at least once in their life. Among 12th graders, 23% admitted to binge drinking (i.e., having five or more drinks in a row during the prior two-week interval at least once)—the pattern of alcohol consumption that may be of greatest concern from a public health

perspective. Further, 90% of 12th graders reported that it is, or would be, fairly easy or very easy for them to get alcohol (Monitoring the Future, 2010).

Despite high percentages of high school students beginning to use alcohol, an analysis of data from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), show that early alcohol use initiation increases the likelihood of developing an alcohol use disorder at a later age. Nearly one-half (47%) of persons who began drinking before age 14 were alcohol dependent at some point in their lifetime compared to 9% of those who began drinking after age 20. These statistics further highlight the importance of efforts targeted at delaying alcohol initiation.

Marijuana use, which had been rising among teens for the past two years, continued to rise in 2010 for all three grades. Daily marijuana use stands at 1.2%, 3.3%, and 6.1% in grades 8, 10, and 12 respectively. This contrasts the gradual decline that had been occurring over the preceding decade. Additionally, perceived risk for using marijuana has been falling in recent years (Monitoring the Future, 2010).

After decelerating in recent years, the long-term decline in cigarette use which began in the mid-1990s, came to a halt in the lower grades only in 2010 as both 8th and 10th graders showed evidence of an increase in smoking cigarettes in 2010. Further, about one in five (19%) 12th graders is a current smoker (Monitoring the Future, 2010).

Based on the continued prevalence of illicit drug use and underage alcohol use over the past decade, it is clear that existing prevention efforts have either peaked in effectiveness, or may have been largely ineffective despite the best intentions of those who implement the most prevalent programs.

While school-based primary prevention programs play a large role in educating students about the effects and dangers of substance use, the first school-based prevention programs were primarily informational and often used scare tactics. It was assumed that if youth understood the risks of alcohol use, they would choose not to drink. This style of programs was ineffective. Similarly, in a departure from family-based approaches, which tend to focus on strengthening parenting skills and parent– child relationships, many modern school-based approaches focus on life skills, peer refusal skills, role-playing, strengthening positive peer relationships, addressing social pressures to drink, and providing accurate information on how many children actually use alcohol (Spoth, Greenberg, & Turrisi, 2008). Research suggests that at best, programs based on information and attitude change alone have minimal effect on adolescent substance use behavior, and at worst, encourage experimentation (Perry & Kelder, 1992). Many of today's available programs offer components which are interactive, utilize developmentally appropriate information, include peer-led sections, and/or provide teacher training. Such interventions have been shown to significantly reduce early initiation and progression of alcohol use in adolescents (NIAAA, 2004/2005).

Drug Abuse Resistance Education (DARE) is one of the most widely used classroom-based programs; as of 2009, it was used in at least 72% of school districts in the United States. The newest version of the program is described on its website as a "curriculum reduced to 10 lessons and a menu of enhancement lessons. The enhancement lessons provide local jurisdictions the ability to customize their DARE program to meet identified needs." While the organization plans to develop additional lessons, modules on gangs, methamphetamines, internet safety, bullying/cyber bullying, and Rx/OTC (prescription/over-the-counter) drugs are currently offered. The goal of the program is to teach students skills to resist pressures to use drugs by using

techniques of facilitation. The instructor guides students as they work in small cooperative learning groups using the DARE decision making model to apply to real life situations (www.DARE.org). While proponents of DARE have responded to criticism by indicating that components are constantly being updated and therefore studies of the effectiveness of DARE do not represent the current form, a meta-analysis published in 2004 indicates that though the direction of the effect of DARE is positive, the effects found did not differ significantly from the variation one would expect by chance. The effect size was 20 times smaller than what would constitute a "small" effect size per Cohen's guidelines (West & O'Neal, 2004). Despite the fact that DARE is associated with small effect sizes, implementation is on the rise as evidenced by an increase of 22% more school districts implementing the program than in 2004.

Further clouding findings related to program evaluations, a recent literature review acknowledged that many classroom-based program evaluation studies have important limitations, including not following children long enough to evaluate eventual alcohol use. Among the programs reviewed by Spoth and colleagues, there were no effective interventions with children in later elementary school years (i.e., grades 3 to 5) with respect to early alcohol use. Similarly, the researchers found only two promising school-based interventions targeting high school students (Spoth, Greenberg, & Turrisi, 2008).

In terms of identifying specific components of successful primary programs, it is unclear whether peer-led or adult-led prevention programs are more effective. Results from a meta-analysis conducted in 2003 revealed that while overall peer-led programs were slightly more effective (d=0.24), large differences between studies were found, with some studies indicating greater effects for peer-led programs and other studies showing greater effects for adult-led programs. Thus, the author concluded that the effectiveness of a prevention program is

determined by several characteristics including, but not limited to, leader characteristics (Cuijpers, 2003).

The most recent meta-analysis of the prevention literature published between 1983 and 1997 indicated that, consistent with previous analyses, school based primary prevention programs have little, if any, effect on actual substance use of students (Tobler et al, 2000). Programs with content focused on social influences' knowledge, drug refusal skills, and generic competency skills and that use participatory or interactive teaching strategies were more effective than programs focused on knowledge and attitudes and favoring traditional didactic instruction. Program type and size were also found to be significant predictors of effectiveness. Non-interactive lecture-oriented prevention programs that stress drug knowledge or affective development showed small effects while interactive programs that foster development of interpersonal skills showed significantly greater effects. It is noteworthy, however, that these effects decrease with large-scale implementations. Unfortunately, a study published in 2003 comparing the most effective methods to those used in middle and high school programming delivered to a national sample of public and private middle schools during the 1998-1999 school year indicated that most providers (62.25%) taught effective content, but few used effective delivery (17.44%) (i.e., using interactive methods, emphasizing active exchange among students, and exchange between students and instructor), and fewer still (14.23%) used both effective content and delivery (Ennett et al., 2003). These results indicate that despite the best of intentions from intervention providers, content that has shown promise is not being presented in ways associated with positive outcomes.

In recognition of the limited effectiveness of popular primary prevention programs, content and methodology have been evolving continuously. Therefore, in order to evaluate the

effectiveness of more recent prevention efforts, a search of the literature was conducted to identify empirical evaluations of prevention studies published in peer-reviewed journals since 2000. The purpose of this meta-analysis is two-fold. It will identify the most effective content and the most effective methods of successful classroom-based prevention programs to further inform the pursuit for a successful alternative. This meta-analysis will focus only on classroom-based drug prevention programs targeting at least one substance and implemented on a traditional student population (e.g., programs targeting "high-risk students" were not included). These types of programs were selected because they are representative of the majority of programs being implemented in public schools in the United States of America.

CHAPTER 2: METHOD

A preliminary search for peer-reviewed published studies completed between 2000 and 2011 in computerized databases (PsycINFO and MEDLINE) using the search terms "classroom based," "school based," "alcohol," "substance," "drug," "prevention," and "intervention" returned approximately 52 records. The peer-review criterion was established to increase transparency and replicability of results and to ensure studies included have met a minimum degree of methodological rigor (Rosenthal & DiMatteo, 2001). Subsequent to a manual search of reference lists of related studies, a total of 81 records were established. Studies were excluded for the following reasons: study was a feasibility or development article (n=9); behavior change was not measured (e.g., measured attitudes or knowledge; n=8); methodological rigor (e.g., no control group, not peer reviewed; n=5); program was delivered on a voluntary basis (n=4); study focused on high risk or specific population (e.g., not a primary program; n=3); program was school, but not class based (e.g., one-on-one lessons with school nurse; n=3); designed as intervention (i.e., tobacco cessation versus prevention or delay of initiation, n=3); program did not specifically target substance use (e.g., general "delinquency;" n=1); duplicates (n=2); and piecemeal publication (i.e., were not eliminated but rather combined with other papers from the same sample, n=5).

Inclusion/Exclusion Criteria

Though establishing inclusion/exclusion criteria was an iterative process, some preliminary criteria were determined. To be included in the present meta-analysis, a study needed to explicitly identify and evaluate a classroom-based prevention program, use a control group, and focus on behavior changes (versus "attitudes," "knowledge," etc.) because the true

test of a substance use prevention effort is its impact on actual rates of use (West, & O'Neal, 2004). Alcohol, tobacco, and marijuana were the main drugs of concern because they are the most widely used substances and because these drugs are attributed to initial experimentation and to regular use. Thus, they are the first target of prevention efforts (Perry & Kelder, 1992). Evaluations must target at least one of the abovementioned substances primarily, but the program may target other substances or behaviors as well. Additionally, a primary goal of the program must be related to substance use (i.e., programs targeting violence with a small substance use component were excluded).

Coding

In order to investigate which factors were associated with a positive outcome, each study was categorized based on moderator variables. A comprehensive codebook was developed for items related to outcome measures and intervention components. Participant characteristics include age group the intervention was delivered to (range = 5.3-19 years old), and distribution of the samples' biological sex, ethnicity, and socioeconomic status. Twenty-eight different programs were evaluated including DARE, Lifeskills Training, and Project Alert. Program characteristics include type of program (see below), targeted drug (alcohol only, tobacco only, or multi-target), presence of additional components (e.g., community component, internet booster), and length of time until follow up (range = 30 days–6 years). Implementation factors include intensity (length of each session, range = 30-90 minutes), duration (number of sessions, range= 1-65), time span of sessions (range = 1 day to 6 years), whether booster sessions were given, intervention deliverers (e.g., teacher, trained facilitator, computer, nurse, guidance counselor, police officer, peer), and duration and type of leader training (e.g. number and length of training

sessions, range = manual only to 3-day workshop; in person, electronic, manual). Research methodology included sampling, type of assignment, type of control groups (e.g., information only, waitlist, active control). Finally, test instrumentation statistics such as reliability, test-retest correlation, and internal consistency data were coded when present.

Organization

Studies were categorized based on the substances targeted. Categories include tobacco only, alcohol only, and multi-target programs (e.g., alcohol, tobacco, marijuana, other drugs). Seven independent samples fell within the tobacco only category, four independent samples fell within the alcohol only category, and 26 independent samples fell within the polysubstance category.

Analyses

Effect sizes for each primary study will be computed using Cohen's *d*. The standardized mean difference is commonly used when comparing the means from two groups, as in the present meta-analysis that compares the means of substance use between treatment and control groups (Lipsey & Wilson, 2001). The present study used the statistical package *Comprehensive Meta Analysis*™ (Borenstein, Hedges, Higgins, & Rothstein, 2008), a program developed through funding by the National Institutes of Health by a panel of researchers with extensive knowledge of meta-analysis. Comprehensive Meta-analysis combines multiple outcomes measured within the same sample by calculating an average. This is a common method of preventing sample size inflation inherent in treating multiple outcomes from the same study as independent (Lipsey & Wilson, 2001; Rosenthal & DiMatteo, 2001).

The random effects model (as opposed to a fixed effects model) was selected because the random effects model allows the true effect size to vary among studies. The studies that will be included in the present meta-analysis are assumed to be a random sample of the relevant distribution of effects, and the combined effect estimates the mean effect in this distribution. Larger studies may yield more precise estimates than small studies, but each study is estimating a different effect size, and each of these effect sizes serve as a sample from the population whose mean we want to estimate. Therefore, as compared with the fixed effect model, the weights assigned under random effects are more balanced. This helps ensure that larger studies do not dominate the analysis and smaller studies are less likely to be trivialized. Additionally, there is no cost to using the fixed effects model. That is, if the between-studies dispersion is trivial, the model reduces to a fixed effects model (Borenstein, Hedges & Rothstein, 2007).

A program implementation, not a study or report, is the unit of interest in the present meta-analysis. Several implementations published sets of papers, which have been collapsed together and sequenced by pretest, posttest, and follow- up(s). Additionally, following categorization as outlined by Tobler et al (2000), post-test and/or follow-ups have been coded and categorized into four post-test intervals: (a) 1-12 months, (b) 13-24 months, (c) 25-36 months, and (d) 37 months or more. Since program effects decrease as time passes, programs who only report data for later time intervals could potentially be seen as less effective. While data available for each time interval was coded, only the first (1-12 months) was used for combined analyses (with the exception of 13 studies who only report data for later intervals, first available data points were included in analyses). Analyzing all time periods simultaneously is problematic, as a single program reporting several follow-ups would be overly represented in the global effect size across studies (Tobler et al., 2000).

Effect sizes were calculated for each substance so long as actual use data were collected in the study. If subpopulations are reported separately (i.e., by sex), effect sizes have been calculated for each. If more than one data point is reported for a substance (e.g., "thirty day use" and "weekly use"), the more inclusive (e.g., “thirty day use”) variable was used as it provides the larger opportunity to demonstrate an effect. Lifetime prevalence variables were not used except in cases where they were the only outcome provided as some studies do not report pre-test lifetime rates; thus, one could not conclude that observed effects were a direct result of the program.

Heterogeneity

To evaluate heterogeneity in variance across studies, the *Q* statistic and I^2 were calculated. A significant *Q* statistic indicates that the true effects vary across studies due to multiple population parameters, and thus the investigation of moderating variables is warranted (Borenstein, Hedges, Higgins, & Rothstein, 2009).

Moderator Analyses

Potential moderator variables were examined contingent upon a significant Q statistic. A significant Q statistic indicates the likelihood that differences between effect sizes are due to some systematic variance among effect sizes that may be attributed to moderator variables (Hedges, 1994). Analysis of Variance (ANOVA) was used to assess the impact of categorical variables (e.g., intervention type, intervention provider, school type, and substances targeted) while meta-regression was used to assess the impact of continuous variables (e.g., length of intervention provider training, intervention intensity, length of time until follow up age group,

number of sessions, and time span of sessions). Adequate power for moderator analyses was present.

Nine predictors of program effectiveness were analyzed including (a) program size, (b) type of leader, (c) type of drug targeted, (d) grade level of delivery, (e) intensity of program delivery, (f) level of intervention deliverer training, (g) presence of booster sessions, and (h) presence of out-of-classroom components.

Because such a range of variables exists across programs, many variables were collapsed into categories to allow for additional analyses. Specifically, program size was coded as less than 100 participants as small, 101 to 1,000 participants as medium; 1,001 to 5,000 participants as large and greater than or equal to 5,001 participants as extra-large. Similarly, while the majority of programs rely on classroom teachers as the intervention deliverer, remaining program leaders are collapsed for analysis purposes into three additional categories: peer leaders (both older and same age peers), clinicians (social workers, counselors, professionals hired by program), and others (health education specialists, DARE officers). Grade level was coded as the first year the intervention was delivered, and is collapsed into three levels: elementary (sixth grade or less), middle (seventh or eighth grade), or high school (ninth grade and above). Finally, if booster sessions (information reinforcing sessions separate from the initial curriculum) or additional components (e.g., homework, parent information, etc.) were present was also examined.

Due to the nature of meta-regression, continuous variables were largely left as reported. One exception, intensity of program delivery, is measured by the number of sessions multiplied by the average length of sessions in minutes. Level of intervention deliverer training is also a

continuous variable reflecting the number of hours of training received by the deliverer (if reported).

CHAPTER 3: PROGRAMS

Programs were classified based on content. While the Tobler and colleagues' study classification scheme was used as a guide, fortunately, many of the less successful program types have disappeared from the literature. Namely, Knowledge-Only, Affective-Only, and Knowledge-plus-Affective categories have been eliminated. All studies fell within Dare-type, Decisions\Values\Attitudes, Social Influences, Comprehensive Life Skills, or System-Wide Change models. All of the programs use some interactive delivery methods, though the DARE-type programs (DARE) were the least interactive (i.e., some exchanges between facilitator and students, but minimal if any collaboration among students). Social Influences, Comprehensive Life Skills, and System-Wide are all interactive in that they promote facilitator-student and peer-peer interaction. See table 1 for specific examples of program components.

DARE-type programs consist of a knowledge component in addition to a generic skills component (e.g., communication, assertiveness training) and a limited emphasis on refusal skills (i.e., "just say no"). Members of the community, such as police officers, are traditionally involved in the program process. Traditional DARE programming uses non-interactive methods, though more evolved forms such as DARE Plus use a more interactive delivery style.

Social influences programs focus primarily on the development of interpersonal skills. These programs still typically include a knowledge component, though it is often less emphasized relative to other programs. Instead, these programs emphasize refusal skills training; which often include behavior modeling, rehearsal, and constructive feedback. These programs may also include an affective component, media influences, and normative education. The emphasis of these programs is on resisting pro-drug social influences. Community and/or family members may be peripherally involved.

Comprehensive life skills programs have content similar to that of the social influences programs, but in comparison they place a relatively stronger emphasis on the refusal skills component, add generic life skills training (i.e., communication, assertiveness, coping, social/dating, goal-setting), and may also include an affective component. Community members and/or families may also be peripherally involved.

System-wide change programs consist of interactive programs supported by community, media (e.g., Public Service Announcements, billboards), and/or family involvement within and external to in the school system. The system-wide programs typically also employ an additional approach, such as comprehensive life skills, in addition to mobilizing the community by providing an extensive media component and/or requiring parent participation in workshops or classes. These programs may also encourage school bonding (e.g., sponsoring non-substance related after-school events) and/or curriculum enhancements (e.g., improving classroom management techniques; infusing curriculum by teaching bar graphs using substance-related statistics, etc.).

Two components which did not appear to be categorized by Tobler were noted. The first is teaching harm reduction strategies, which was grouped under safety skills. The second was advertisement deconstruction or marketing education, which was grouped under knowledge. The specific breakdown of program types, as well as their content components (seven major domains: knowledge, affective, drug refusal skills, generic skills, safety skills, extracurricular activities and others) are noted in Table 1. While Tobler and colleagues initially outlined 4 levels of interaction, they were collapsed dichotomously: non-interactive programs consisting primarily of didactic or lecture-based material with no more than occasional student input or questions (i.e., may contain some student-teacher interaction, but minimal interaction among peers) and

interactive programs which used interactive teaching methods, along with discussions, games, debates, or other forms of interactive peer-to-peer participation. Results from the Tobler (2000) meta-analysis revealed that interactive programs that aid in developing interpersonal skills show significantly greater effects, though they decrease with large-scale implementations. Tobler also found that non-interactive lecture-oriented programs that focus on knowledge and affective development demonstrated smaller effects. Encouragingly, many of the studies included in the present meta-analysis cited Tobler's findings as justification for revising their programs to include interactive and skill-building components.

It is noteworthy that for the classification of programs, some amount of judgment was required on behalf of the researcher. When ambiguities existed, cited publications within the studies and program websites were consulted to help clarify appropriate classifications. Before making a final decision of program categorization, a subjective judgment was made regarding the relative emphasis on content types. See Table 2 for intervention names and type by study.

CHAPTER 4: RESULTS

The global effect size for all programs (i.e., all programs, at the first timepoint reported using the mean if more than one substance or subgroup was reported) indicated a significant effect d=0.07 (95% CI = 0.02-0.12, p=0.01). As expected, there was significant heterogeneity among study effect sizes (Q (30) = 204.54, p< .001, I^2 = 85.33). Effect sizes for each substance and study can be located in Figures 1-4.

Multi-Target programs

The combined effect for each measured substance in multi-target programs (alcohol, tobacco, marijuana, and other drugs) can be found in Table 5. Only the combined effects for alcohol (d = 0.11, 95% CI = 0.03, 0.17; p<0.01) and tobacco (d=0.08, 95% CI = 0.03, 0.13, p<0.01) were significant. Because one would not expect different programs to have the same effect on substance use, as expected, the Q statistic is significant for each substance (see Table 3).

Specific vs. Multi-Target Substance Abuse

Separate analyses have been performed for programs which specifically target tobacco only or alcohol only. Other substances have not been analyzed as there were not a sufficient number of programs targeting another substance only. The chief question is whether programs that target a specific substance are more or less effective than general substance abuse programs. The results indicate mixed findings.

Alcohol only

While the combined effect for alcohol in multi-substance targeted programs is significant, it does not approach Cohen's guidelines for size of small at 0.20 (Cohen, 1977). The combined effect for studies that specifically target alcohol only is d=0.14 (95% CI = 0.01, 0.27; p=0.03).

Tobacco Only

A nonignificant effect (d = 0.01; CI = -0.11, 0.13, p=0.85) existed for programs which focused on tobacco only.

Moderator Analyses

To evaluate heterogeneity in variance across studies, the Q statistic and I^2 were calculated. A significant Q statistic indicates that the true effects vary across studies due to multiple population parameters, and thus the investigation of moderating variables is warranted (Borenstein, Hedges, Higgins, & Rothstein, 2009). Several variables were significant; however few reached a point estimate greater than 0.10, indicating nearly trivial effects. For comparison, a medium effect size (0.50) indicates an effect which is visible to the naked eye by a careful observer (Cohen, 1977). Size (small programs d= 0.23) was the only moderator associated with a significant small effect. *A pirori* identified variables and their point estimates are displayed in Table 5 (categorical) and 6 (continuous) below.

Publication Bias

In order to address publication bias, the *fail-safe N* statistic was computed to estimate the number of unpublished studies finding null results to render a cumulative effect size nonsignificant (Rosenthal, 1979). Five hundred twelve missing studies would be necessary to bring the p-value above alpha.

CHAPTER 5: DISCUSSION

The present meta-analysis extended the work of Tobler and colleagues' (2000) meta-analysis evaluating classroom-based substance use prevention programs by analyzing studies which appeared in the literature subsequent to Tobler's findings. Analyses revealed significant, smaller than "small" effects (per Cohen's guidelines) for alcohol and tobacco in multi-target programs as well as alcohol in the specifically targeted programs. All other outcomes for substances (in multi- and specific- target interventions) were nonsignificant.

An analysis of program types revealed that Comprehensive Life Skills programs, which are similar to the Social Influences model but with a relative stronger emphasis on skill-building (both drug refusal and otherwise) were associated with the best outcomes (d=0.11). Additionally, programs which incorporated rehearsal of skills, harm reduction strategies, media deconstruction components, corrective normative feedback, and affective components were also associated with better outcomes. Additionally, those which provided resistance skills, problem solving skills, and general skills training were associated with better outcomes, but those components are highly correlated with program type (i.e., Comprehensive Life Skills).

In-person training for the program deliverer (as opposed to manual-only) had a significant positive effect size, and programs delivered by computers, teachers, or police officers (but not peers or program staff) were also associated with significant positive effects, thus contributii to the ambiguity of deliverer effects. Similarly, small scale implementations were associated with better outcomes, which are possibly accounted for by better program administration via superior training and insurance of implementation fidelity.

The timing of intervention delivery and length of time until follow up are also important. Specifically, substance use initiation follows a developmental progression that follows a logical

sequence (Kandel, 1975). Most youth begin with alcohol and or tobacco, followed by marijuana, which typically begin to be used during middle school years (Botvin & Griffin, 2006). Because of this developmental sequence, prevention programs which are implemented during late middle school and high school years may be too late to delay initiation. Corroborating this information, the present analysis revealed that programs in which delivery began in middle school and also programs which administered booster sessions were associated with positive effects. This finding highlights that programs should seek to target students early and provide them with booster sessions throughout their developmental growth.

Tobler and colleagues found that program type, size, and interaction levels were significant predictors of effectiveness. While program type and size remained significant predictors in the present meta-analysis, interaction levels were not. A possible explanation for this difference is that subsequent to the publication of Tobler's results, many revised their programs to be interactive in nature (as evidenced by nearly all of programs describing themselves as "interactive"). Despite this revision, the program may not be delivered consistently with Tobler and colleagues' definition. They noted that peer-to-deliverer interaction is not sufficient; programs should encourage opportunities for peer-to-deliverer in addition to peer-to-peer interaction.

Though these factors are associated with better outcomes in the present analysis, none of them, with the exception of small size, met the minimum threshold that indicates a small effect. The magnitude of effectiveness for social interventions is expected to be small (0.20) because the target of the intervention is affected by many factors other than the quality of the intervention (Cohen, 1977). Yet, despite the elimination of knowledge-only programs of yesteryear in current practice, the studies included in the present meta-analysis still did not approach this criterion,

leaving much room for improvement. Future programs or program revisions should seek to include the abovementioned components and characteristics associated with positive outcomes to maximize potential benefits.

Further investigation is warranted in that some program types or time periods, such as the system-wide change programs and elementary school delivery, were associated with small positive effects, but were not significant. Perhaps extending the present meta-analysis into the future to include larger quantities of evaluations of these specific factors would reveal significant relationships.

Finally, the absence of a significant effect does not mean that no effect exists. For some moderators, several studies did not report the relevant information and thus were excluded from the analyses. *A pirori* power analyses demonstrated adequate power (0.86) for the detection of small effects among moderator variables. However, because several studies did not provide information for every moderator variable, it is possible that power was too low to detect effects. Regardless, statement such as "power was low" are not as helpful as comparing the point estimate and the associated confidence interval (Borenstein et al., 2009). Thus, there is a possibility of Type II error with respect to the moderator variables.

While meta-analysis has become an increasingly accepted technique within the scientific literature, meta-analyses still face common criticisms. First, meta-analyses are often accused of ignoring the file-drawer problem (that only studies with significant, stronger effects are published while those with effects in the opposite direction are not). However, this particular concern is not relevant to the present meta-analysis. These data illustrate that current programs do not work as well as desired; thus, if there are studies which are not published because they do not result in a significant effect, those hypothetical unpublished studies would only strengthen

the argument made here. There is still work to be done on classroom-based prevention programs, especially if those represented here are the absolute state-of-the-art.

Another common criticism of meta-analyses is the idea that meta-analysts combine different kinds of studies (i.e., "apples and oranges") in the same analysis, thereby ignoring potential important differences across studies. While this criticism is somewhat applicable in terms of the summary effect, every effort has been made to ensure that the populations were as similar as possible (e.g., by excluding specifically targeted populations, requiring that all students receive the same intervention, etc.). Furthermore, a strength of meta-analysis is the ability to systematically explore differences among studies and their impact on outcomes through moderation analyses.

While common meta-analysis shortcomings were minimized whenever possible, the present analysis is not without limitations. First, a great deal of variability in the measurement of behavior was observed. For example, some studies reported use of a substance during the last week, others reported use of a substance during the last month, others reported "regular" use (definitions varied) and others still created their own indexes summing current use with future intentions. Despite these differences, the effect size is intended to standardize the overall observed differences in behavior. That is, regardless of how the data were reported, the effect size provides a uniform way to compare the efficacy of various programs.

Another limitation is that studies varied in the time elapsed before collecting follow-up data. Some programs did not collect any follow-up until 1-year post intervention; thus, they may appear less effective than if they reported 3-month follow-up data only (it is noted, however, that analyzing only studies which reported within the 1-12 month range did not result in a significant effect). While this is a valid criticism, the fact remains that a successful prevention program

should continue to be effective regardless of time elapsed. An ideal prevention program should provide evidence for continued success beyond just a few-month follow up.

Finally, the studies represent a range of experimental rigor. Minimum inclusion criteria required that the study was peer-reviewed (to help protect against egregiously flawed designs) and included a comparison group of some type. Comprehensive Meta-Analysis helps to further control for this issue by assigning study weights based on the precision of the study. More precise studies are assigned more weight in the analysis (Borenstein et al., 2009)

The possibility of "Type III" error is present as well. Type III error occurs when a protocol is not adhered to properly or is inadequately designed, supported or administered, thus providing little opportunity for the program to result in actual changes. Examples include intervention deliverers omitting certain components (e.g., role playing), failing to use proper interactive techniques despite claims of a highly-interactive program, or not spending an appropriate amount of time on various sections (Windsor, Baranowski, Clark, & Cutter, 1994). Social science interventions face many more uncertainties then, for example, many medical trials. Just because an intervention is delivered does not mean that it was fully absorbed by the participant (as is the case for example, in medication trials). Participants may be distracted or simply not paying attention when the interventions are administered.

Future programs may benefit from acknowledging the rising frequency and dangers associated with the misuse of prescription drugs (particularly opioids and benzodiazepines) and over-the-counter [OTC] cough remedies (Dextromethorphan or DXM) among adolescents. NIDA reports that overall rates of prescription drug misuse have quadrupled since 1999, and that abuse of these substances peaks at age 16; the majority of users reported beginning between 9th and 11th grade (Meier, Troost, & Anthony, 2012). Further, OTC drugs are primarily abused by

adolescents and can result in significant health consequences. Despite growing rates, few, if any, prevention programs target these substances despite targeting others which are less prevalent such as MDMA, Cocaine, or Hallucinogens (Monitoring the Future, 2010).

Future programs or revisions should try to incorporate as many of the components associated with significant effects as possible, and be mindful of implementation characteristics (e.g., size) that appear to diminish effectiveness. Substance use and abuse evolves continuously and researchers should be vigilant about reevaluating their programs' effectiveness while seeking to incorporate new, effective components (e.g., media deconstruction, harm reduction strategies) in order to maximize outcomes. We must all remember that though the first line of offense takes place in public schools, substance abuse prevention is a multi-faceted endeavor. Communities, schools, parents, and families must work together for any real, observable change to occur in the behavior of our youth.

APPENDIX: TABLES AND FIGURES

Table 1. Program Components

Component	Content
Knowledge	Knowledge of long term physiological effects of drugs Knowledge of short term social and behavioral effects of drugs Knowledge of media (i.e., advertisements, movies) and social influences Knowledge of actual drug use by peers (normative education)
Affective	Self-esteem and feelings Personal insight and self-awareness Attitudes, beliefs, and values
Refusal Skills	Drug-related refusal skills Public commitment activities Cognitive behavioral skills Support systems/networking with nondrug using adolescents
Generic Skills	Communication skills Assertiveness skills Decision making/problem solving skills Coping skills Social skills Goal-setting Identifying alternatives
Safety Skills/Harm Reduction	Skills to protect self in a drug-related situation Skills to protect other peers in a drug-related situation Drinking/driving safety Strategies to prevent harms
Extracurricular Activities	Organized sports Nondrug leisure time activities Volunteer work in the community
Other	Homework exercises Rewards, token economy, or reinforcement Parent involvement Community-wide coordination and involvement Parent, community, or media component Culture-specific values

Table 2. Studies, Size, Intervention Name and Type, and Substances Reported

Study	Size	Intervention Name	Type	Subs Reported
[1]Bond et al. (2004)	L	Gatehouse	SYS	M
[2]Botvin et al. (2000)	S	Lifeskills Training	CLS	OD, M
[3]Botvin et al. (2001)	L	Lifeskills Training	CLS	A, OD, M, T
[4]Botvin et al. (2003)	L	Lifeskills Training	CLS	A,T
[5]Copeland et al. (2010)	M	The Wise Mind	SYS	A, M, T
[6]Cuijpers et al. (2001)	L	Healthy School and Drugs Project	SYS	A, M, T
[7]Eisen et al. (2002, 2003)	XL	Skills for Adolescents	CLS	A, OD, M, T
[8]Ellickson et al. (2003)	XL	Project ALERT	SI	M, T
[9]Faggiano et al. (2007, 2008, 2010)	XL	Unplugged	SI	A, M, T
[10]Furr-Holden et al. (2004)	M	Classroom-Centered	SYS	A, OD, M, T
[11]Harrington et al. (2001)	L	All Stars	SI	Summed
[12]Hecht et al. (2003)	XL	Keepin' it R.E.A.L	SYS	A, M, T
[13]Komro et al. (2008)	XL	Project Northland	SI	A, Summed
[14]Morris et al. (2002)	L	Integrated Programme	SI	M, OD
[15]Newton et al. (2009)	M	Climate Schools	CLS	A, M
[16]Perry et al. (2003)	XL	DARE & DARE Plus	DARE	A, M, T
[17]Ringwalt et al. (2009)	XL	Project ALERT	SI	A, OD, M, T
[18]Ringwalt et al. (2009)[b]	L	Project ALERT	SI	A, OD, M, T
[19]Simmons-Morton et al. (2005)	L	Going Places Program	SYS	A, T
[20]Smith et al. (2004)/Vicary et al. (2006)	M	Lifeskills Training	CLS	A, OD, M, T
[21]Sobloda et al. (2009)	XL	Take Charge of Your Life	DARE	A, M, T
[22]St.Pierre et al. (2005)	L	Project ALERT	SI	A, M, T
[23]Sun et al. (2006)	L	Project Toward No Drug Abuse	CLS	A, OD, M, T
[24]Sun et al. (2008)	L	Project Toward No Drug Abuse	CLS	A, OD, M, T
[25]Taylor et al. (2000)	L	Adolescent Alcohol Prev. Trial	SI	A, T
[26]Zavela et al. (2004)	S	Say Yes First	SYS	M
[27]Newton et al. (2009)b	M	Climate Schools	SYS	A
[28]McBride et al. (2000, 2003)	L	SHAHRP	SYS	A
[29]Spaeth et al. (2010)	L	IPSY	CLS	A
[30]Williams et al. (2001)	L	Slick Tracy	SI	A
[31] Aveyard et al. (2001)	XL	Transtheoretical Model	D/V/A	T
[32]Crone et al. (2002	L	Trimbos	SI	T
[33]Metz et al. (2006)	S	Project Toward No Tobacco Use	CLS	T
[34]Peterson et al. (2000)	XL	Hutchinson Smoking Prev. Project	SI	T
[35]Schofield et al. (2003)	L	Health Promoting Schools	SYS	T
[36]Storr et al. (2002)	M	Classroom-Centered	SYS	T
[37]Zollinger et al. (2003)	L	Lifeskills Training	CLS	T

Table 3. Substance-specific effect sizes and heterogeneity statistics for first time point

Substances Targeted	**# Studies**	**Effect size (95% CI)**	***Q*-statistic**	***df* for *Q***	I^2	T^2
Alcohol	20	0.10 (0.04, 0.16)**	2143.59**	19	99.11	0.18
Tobacco	19	0.09 (0.03, 0.14)**	91.63**	18	80.36	0.01
Marijuana	21	0.02 (-0.02, 0.07)	60.02**	21	65.01	0.01
Other Drugs	12	0.00 (-0.11, 0.10)	75.68**	11	85.46	0.02
Combined	27	0.05 (0.00, 0.11)	181.69**	26	85.69	0.01
Alcohol-Specific	4	0.14 (0.01, 0.27)*	14.43**	3	79.21	0.01
Tobacco-Specific	7	0.01 (-0.11, 0.13)	39.76**	6	82.39	0.02

*p<.05, **p<.01

Table 4. Effect Sizes by Program Type

Program type	**ES (95% CI)**	n
All substances		
Dare-type	0.05 (0.02, 0.08)**	3
CLS	0.10 (0.03, 0.17)**	10
SI	0.01 (-0.14, 0.16)	9
System	0.08 (-0.05, 0.20)	8
Alcohol outcome		
Dare-type	0.06 (0.01, 0.11)*	3
CLS	0.08 (0.01, 0.15)*	9
SI	0.05 (-0.12, 0.22)	7
System	0.25 (-0.04, 0.54)	5

*p<.05, **p<.01

Table 5. Categorical Moderators

	Point Estimate (95% Confidence Interval	n
Program Components		
Interactive style	0.04 (-0.01, 0.09)	27
Rehearsal	0.10 (0.01, 0.19)*	8
Norms	0.08 (0.01, 0.14)*	22
Media deconstruction	0.12 (0.05, 0.20)**	8
Affective	0.08 (0.02, 0.15)**	11
Resistance Skills	0.10 (0.05, 0.14)**	21
General Skills	0.06 (0.02, 0.10)**	21
Problem Solving Skills	0.08 (0.04, 0.13)**	13
Curriculum Enhancement	0.07 (-0.06, 0.19)	7
Harm Reduction Strategies	0.11 (0.04, 0.18)**	3
Boosters	0.10 (0.03, 0.17)**	9
Outside of class	0.04 (-0.01, 0.09)	24
Deliverer Specifics		
In-person Deliverer Training	0.06 (0.00, 0.12)*	22
Computer	0.14 (0.03, 0.24)**	2
Officer	0.14 (0.03, 0.24)**	1
Peer	0.01 (-0.04, 0.06)	2
Teacher	0.12 (0.02, 0.19)*	19
Grade Delivered		
Elementary	0.17 (-0.01, 0.35)	6
Middle	0.05 (-0.001, 0.11)*	23
High	-0.03 (-0.13, 0.08)	5
Size		
Small	0.23 (0.08, 0.39)**	2
Medium	0.15 (-0.02, 0.32)	5
Large	0.05 (-0.06, 0.16)	16
Extra Large	0.04 (0.00, 0.08)*	8

*p<.05, **p<.01

Table 6. Continuous Moderators

	Point Est.	**Std. Error**	**Effect size (95% CI)**	**Z-Value**	***p***
Deliverer Training Length	0.019	0.026	-0.03172, 0.07030	1.741	0.46
Length Until Booster	0.002	0.006	-0.01008, 0.01367	0.295	0.77
Number of Sessions	-0.001	0.002	-0.00375, 0.00241	-0.426	0.67
Total Time (Length x number sessions)	0.000	0.001	-0.00016, 0.00015	-0.054	0.96
Length of Program (months)	0.001	0.002	-0.00294, 0.00552	0.591	0.56

*$p<.05$ **$p<.01$

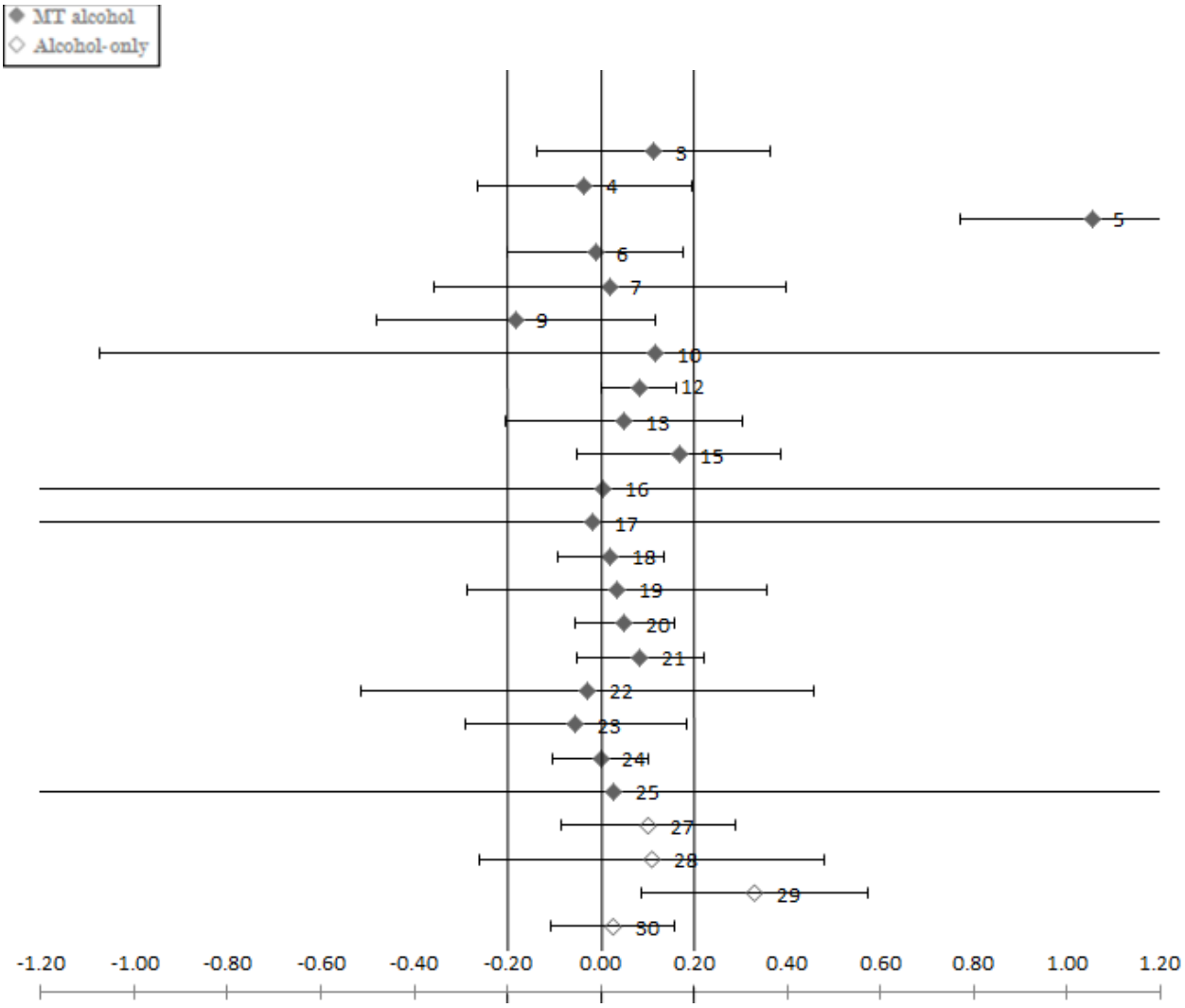

Figure 1. Alcohol Outcomes

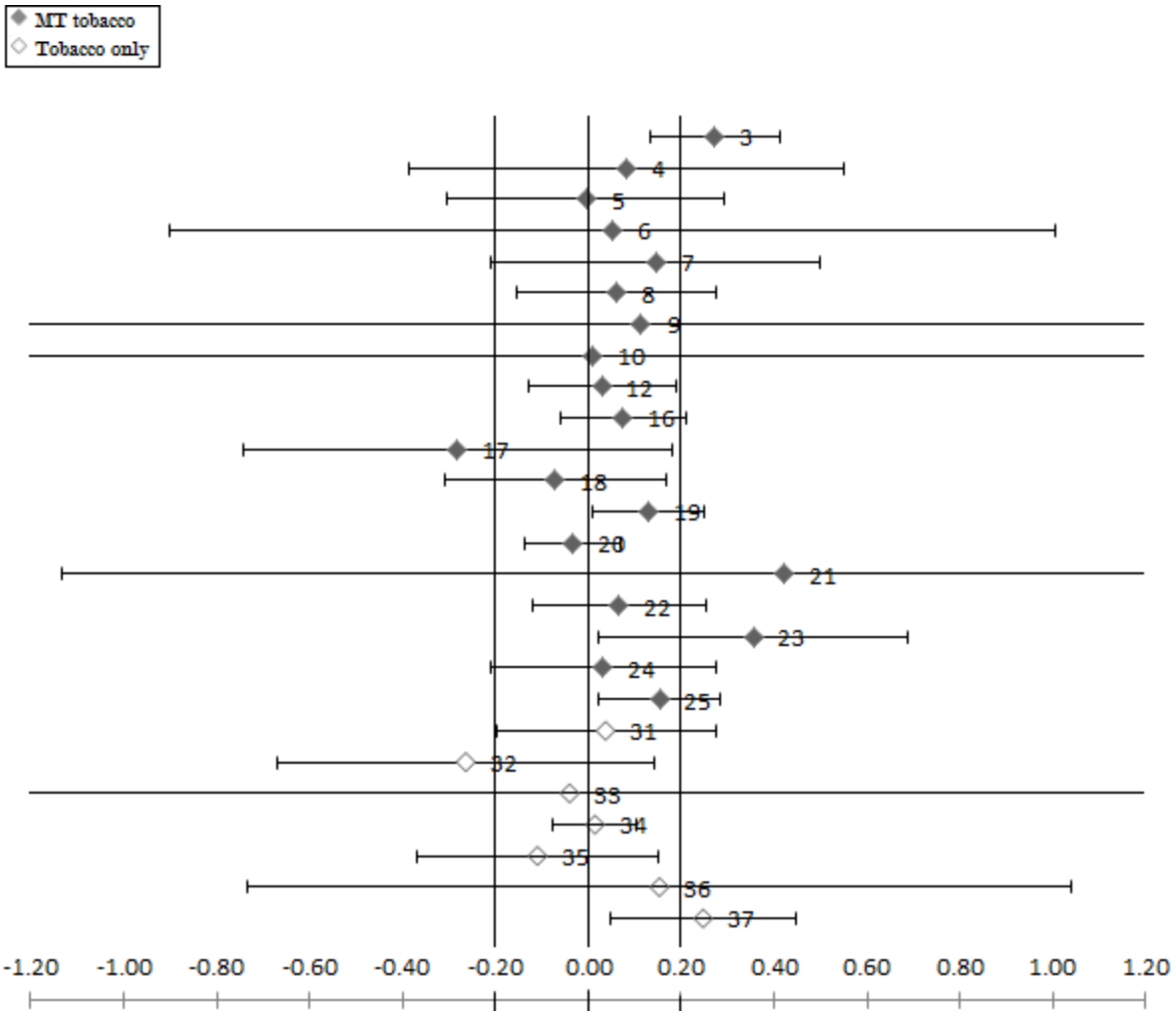

Figure 2. Tobacco Outcomes

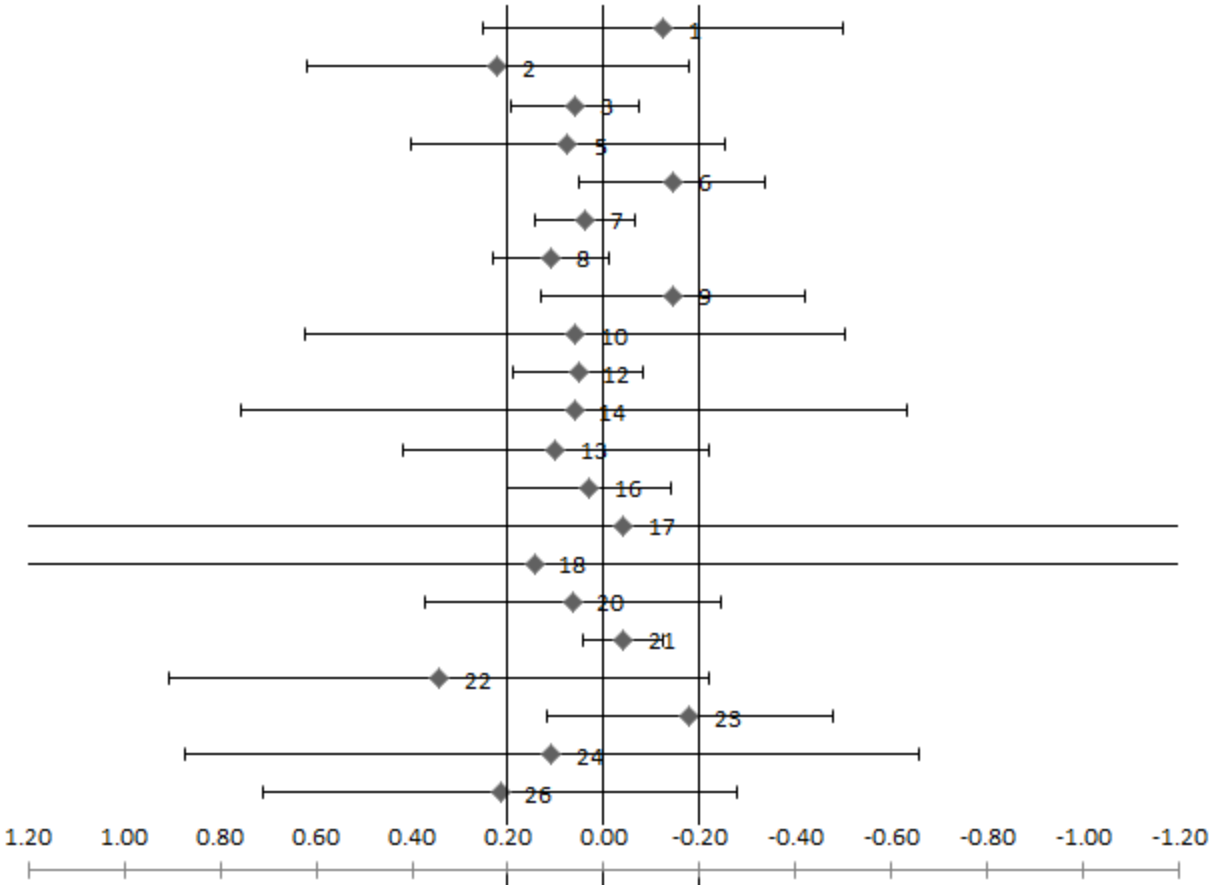

Figure 3. Marijuana Outcomes

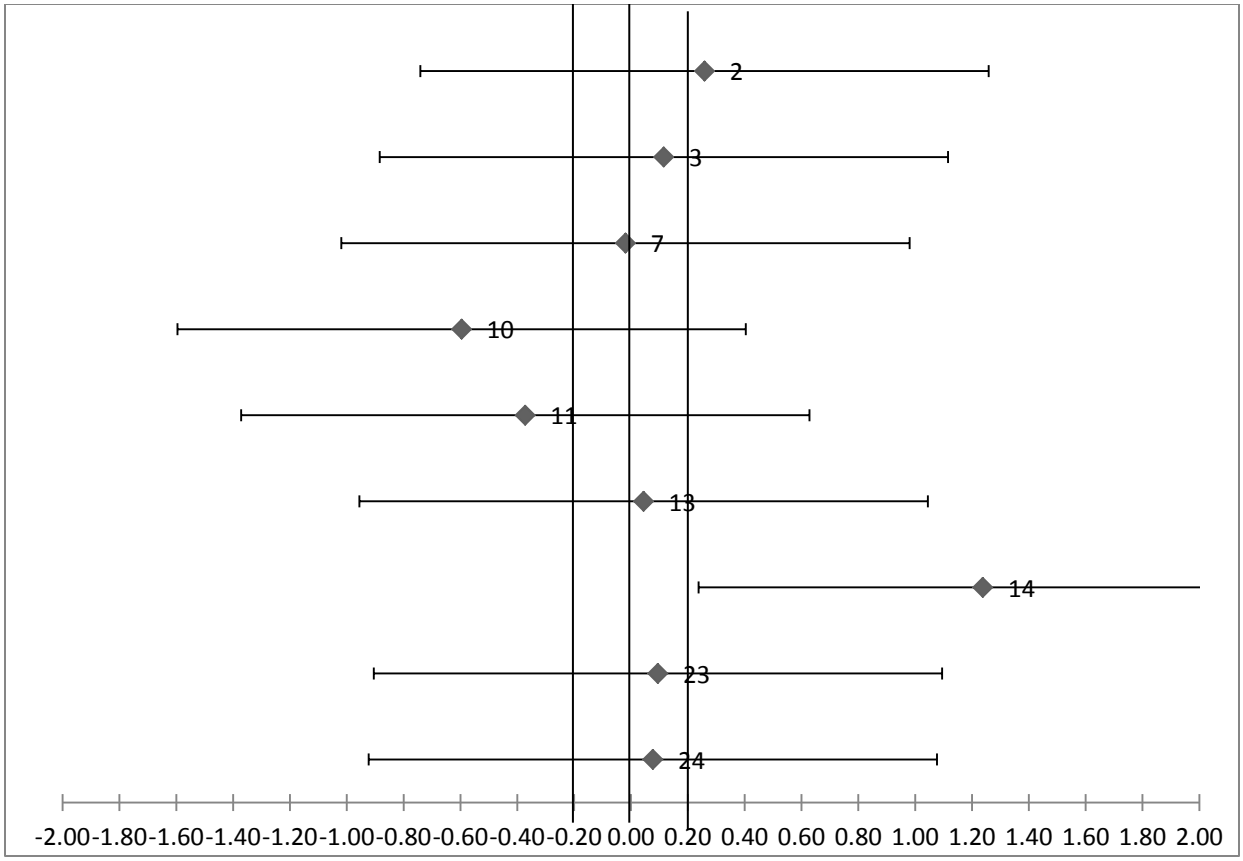

Figure 4. Other Drugs Outcomes

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