INFORMING PUBLIC HEALTH
RESEARCH BRIEF

KDH Research & Communication Number 4 :: June 2008

Using Science-Based Education to Prevent Drugs and Alcohol Abuse by Elementary School Students

Eric C. Twombly, Georgia State University, and Kristen D. Holtz, KDHRC

RESEARCH ON ILLICIT DRUG USE among elementary school children suggests that usage is high. For example, Wallisch and Liu (1998) report that 36 percent of fourth- through sixth-grade students use alcohol, tobacco, marijuana, or inhalants, and 26 percent had used one or more of these substances in the previous year. That more than one-third of children indicate the use of illicit drugs constitutes a substantial public health problem. Illicit drug use places these children at risk for negative outcomes, such as poor academic performance and increased school dropout rates, early sexual initiation, perpetration of violence, and later substance abuse (Anthony & Petronis, 1995; Gil, Wagner, & Tubman, 2004; Hawkins et al., 1997). What is more, these outcomes produce high societal costs. The cost of illicit drug use, including treatment and healthcare, productivity loss, and costs in the criminal justice system, was estimated at $181 billion in 2002 (Office of National Drug Control Policy, 2004).

The substantial public health problem of illicit drug use among elementary school children requires innovative thinking on methods to combat it. One approach, advanced by the National Institute on Drug Abuse (NIDA), suggests that drug-prevention programs should be implemented universally through schools and should target students at early ages (NIDA, 2003). This brief analyzes the development and preliminary evaluation of a school-based science education intervention to reduce illicit drug use among children and youth. The intervention was a NIDA-funded science-based curriculum designed to change knowledge about drugs of abuse among elementary school children. Its theoretical foundation is that changing children's knowledge about the effects of drugs on the brain and the body will produce protective attitudes, beliefs, and intentions, and, ultimately, reduce the probability of drug use. With this foundation in mind, the brief addresses the following questions:

- What is the effect of the curriculum on change in knowledge about illicit drugs among elementary school students?
- What is the effect of the curriculum on changes in knowledge when controlling for demographic factors, such as grade, gender, and race?
- How do other factors, such as positive attitudes toward science and pre-existing knowledge about drugs, relate to knowledge acquisition?

The remainder of the brief describes the curriculum and its theoretical foundation, the methodology for the evaluation of the curriculum, and the key findings of the evaluation. The brief concludes with the theoretical and practical implications of using a science education-based curriculum to address illicit drug use by elementary school children.

The Science Education Curriculum

The curriculum, developed with funding from NIDA, provides students in grades K-8 and their teachers with lessons on the normal functions of the brain, nervous system, and body and how drugs change these processes. The curriculum was developed through an iterative process that incorporated input from the target audiences of youth and teachers and experts in the field of substance abuse and neuroscience. Moreover, because of the policy push in primary and secondary education to increase the proficiency of students in math, reading, and science, the content of the curriculum was aligned with National Science Education Standards (NSES) and standards of learning in key states, such as New York and California.

The curriculum provides information on alcohol, nicotine, inhalants, prescription and over-the-counter drugs, marijuana, cocaine, heroin, steroids, methamphetamine, and "club drugs," such as GHB, MDMA, Ketamine, and Rohypnol. It consists of four educational programs, each designed for children in specific grades: kindergarten and first, second and third, fourth and fifth, and sixth through eighth. The programs have several components, including a teachers' guide, interactive student materials, and multimedia and parent materials, and they contain lessons that each have specific learning objectives. For example, the fourth- and fifth-grade program, which is the focus of this brief, contains six lessons that were administered to students over a six-week period. Lessons build cumulatively, where early lessons on the typical functioning of the brain serve as a foundation for later lessons on how drugs change that functioning. All lessons were field tested with the target audiences prior to the formal evaluation of the curriculum.

The foundation of the curriculum is the theory of reasoned action (TRA), which suggests that exposure to persuasive information relates to progressive changes in knowledge, attitudes, and, ultimately, behavior (Ajzen, 1991). Although TRA is used frequently in public health campaigns, it is not often combined with educational theories, which instead tend to focus on the process of knowledge acquisition. However, the integration of TRA and instructional theory provides new ways to think about effective drug prevention.

Methodology

To assess the efficacy of the curriculum on changes in knowledge about drugs, we collected data from fourth and fifth graders using a pretest, post-test, quasi-experimental design. This approach involved assigning 112 students from two schools in the Washington, D.C., metropolitan region by classroom to treatment and control groups. Students in the treatment group received the full curriculum. Those in the control group were not exposed to the curriculum.

All participants received identical surveys with questions pertaining to knowledge about drugs before (pretest) and after (post-test) the implementation of the curriculum. The survey included 18 knowledge-based, multiple-choice questions corresponding to specific information provided in the six lessons of the curriculum. For each student, we recorded pretest and post-test answers and determined their correctness. Each student could receive a maximum of 18 correct answers on the survey. We summed the correct answers for each student in the pretest and the post-test and created a measure to determine the amount of change in correct reporting between the two points in time. We then calculated the mean differences in change scores for the treatment and control groups to create the dependent variable in this analysis.

Questions on the survey also allowed us to create independent variables that predict a change in knowledge about drugs. For example, we used pretest scores to calculate the degree to which the two groups held positive attitudes of science and protective attitudes about drugs, as well as their overall knowledge of drugs, before the curriculum was implemented. These "pre-existing" factors may help to explain the variation in knowledge change across groups. Other independent variables include participation in the treatment group and student-level demographic controls, such as gender, race, and grade.

Findings

Students who received the curriculum exhibited significant knowledge changes about the effects of alcohol and drugs on the brain and body.

Elementary school students in the treatment group answered correctly, on average, 38 percent of the knowledge-based questions at pretest. At post-test – that is, after receiving the curriculum – these students answered nearly 55 percent of the questions correctly. In contrast, students who were not exposed to the curriculum answered an average of 42 percent of the questions correctly at pretest and 38 percent correctly at post-test. In other words, the average student in the treatment group did roughly 17 percent better on knowledge questions on the post-test, while the average student in the control group performed nearly 4 percent worse. This difference is statistically significant ($p<0.01$), and remains significant, even when controlling for gender, race, grade, and pre-existing knowledge and attitudes about drugs and science.

How positively students feel about science impacts their acquisition of information about the effects of alcohol and drugs.

For every additional unit on the scale of positive attitudes toward science, elementary school students who received the curriculum gained 0.42 more correct answers. This finding suggests that children who enjoy science may have a stronger incentive to learn about the effects of drugs. Indeed, a science-based educational approach to prevention may resonate most strongly with children who feel good about science at the outset. Another possibility is that children who had pre-existing positive attitudes about science are better-performing students relative to their peers, which may positively affect their ability to acquire knowledge.

Students who knew less about drugs and alcohol prior to the curriculum exhibit the greater knowledge change.

For each additional unit of knowledge about drugs at pretest, elementary school students lose 0.74 correct questions on the post-test. Although this finding may seem counterintuitive, it likely relates to the fact that children who have little information about drugs prior to exposure to the curriculum actually gain knowledge markedly from pretest to post-test instead of higher performing children losing knowledge over time. Indeed, a lack of pre-existing knowledge about drugs significantly relates to positive knowledge change, when controlling for other factors.

Conclusion

The findings provide support for the efficacy of one particular science-based curriculum on drugs of abuse for elementary school-aged children. Exposure to the curriculum relates to a change in knowledge about alcohol and drugs, and group assignment is a significant predictor of knowledge acquisition. Still, other factors play a role in knowledge change. Indeed, greater pre-existing positive attitudes toward science predicted greater knowledge change, and students who knew less at the start of the intervention showed a greater change in knowledge.

Determining which students respond best to this type of science-based intervention provides pedagogical opportunities to tailor implementation of the curriculum for maximum effectiveness. That a positive attitude toward science predicts greater knowledge change provides an opportunity to augment knowledge acquisition in students by boosting their opinion of science through field trips, additional instruction, one-on-one mentoring, or a structured group activity. Moreover, students who enter the program with high pre-existing rates of knowledge tend to maintain them, while students at lower levels gain more knowledge, suggesting that curriculum implementation should likely use small or targeted student groups.

In the end, the integration of behavior change theory into a science education curriculum appears to be a novel approach toward instruction and prevention. TRA suggests that attitude and behavior change flow from knowledge acquisition after presentation of persuasive information. Therefore, the curriculum has promise as an effective prevention tool through its impact on knowledge gain. Although additional assessments are necessary, the development of an effective educational curriculum from this behavioral change theoretical basis may provide opportunities to infuse prevention into the core science curriculum and allow teachers to provide persuasive health information to their students in a time-constrained classroom environment. Indeed, a science education curriculum may offer more "bang for the buck" by meeting not only science content mandated by standards of learning, but also by providing preventive messages.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.

Anthony, J.C. & Petronis, K.R. (1995). Early-onset drug use and risk of later drug problems. *Drug and Alcohol Dependence*, 40(1), 9–15.

Gil, A.G., Wagner, E.F. & Tubman, J.G. (2004). Associations between early-adolescent substance use and subsequent young-adult substance use disorders and psychiatric disorders among a multiethnic male sample in south Florida. *American Journal of Public Health*, 94(9), 1603–1609.

Hawkins, J.D., Graham, J.W., Maguin, E., Abbott, R.D., Hill, K.G. & Catalano, R.F. (1997). Exploring the effects of age of alcohol use initiation and psychosocial risk factors on subsequent alcohol misuse. *Journal of Studies on Alcohol*, 58(3), 280–290.

National Institute on Drug Abuse. (2003). *Preventing drug abuse among children and adolescents: A research-based guide for parents, educators, and community leaders.* NIH Publication No. 04-4212(B). Bethesda, MD: National Institute on Drug Abuse, 1997 (second edition October 2003).

Office of National Drug Control Policy. (2004). *The economic costs of drug abuse in the United States, 1992–2002* (Publication No. 207303). Washington, D.C.: Executive Office of the President.

Wallisch, L.S. & Liu, L.Y. (1998). *1998 Texas school survey of substance use among students: Grades 4-6.* Retrieved October 26, 2006, from http://www.tcada.state.tx.us/research/survey/grades4-6/1998.

KDH
RESEARCH &
COMMUNICATION
730 Peachtree Street NE
Suite 820
Atlanta, GA 30308

Address Service Requested

KDH
RESEARCH &
COMMUNICATION
730 Peachtree St. NE
Suite 820
Atlanta, GA 30308
(t) 404-968-8008
(f) 404-601-9945
www.kdhrc.com
publicaffairs@kdhrc.com

ERIC C. TWOMBLY is an assistant professor at Georgia State University's Andrew Young School of Policy Studies. His research focuses on two areas: the behavior of community-based health and human service organizations and efforts to improve scientific literacy through the development of science-based education curricula. He received his doctorate in public policy from the George Washington University.

KRISTEN D. HOLTZ is the founder and president of KDH Research & Communication. Her research and applied work focuses on the development and evaluation of innovative approaches for health promotion, disease prevention, and substance abuse education. Dr. Holtz earned her Ph.D. in developmental psychology from George Washington University.

KDH RESEARCH & COMMUNICATION is a non-partisan, public health and public policy institution. The goal of the "Informing Public Health" brief series to disseminate innovative, objective, and timely information to solve public health and other social issues.

The views expressed here are those of the authors and do not necessarily reflect those of KDH Research & Communication, its board, or funders.