Project Northland: long-term outcomes of community action to reduce adolescent alcohol use

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Abstract

Project Northland was a randomized trial to reduce alcohol use among adolescents in 24 school districts in northeastern Minnesota. Phase 1 (1991–1994), when the targeted cohort was in grades 6–8, included school curricula, parent involvement, peer leadership and community task forces. The Interim Phase (1994–1996) involved minimal intervention. Phase 2 (1996–1998), when the cohort was in grades 11 and 12, included a classroom curriculum, parent education, print media, youth development and community organizing. Outcomes of these interventions were assessed by annual student surveys from 1991 to 1998, alcohol purchase attempts by young-looking buyers in 1991, 1994 and 1998, and parent telephone surveys in 1996 and 1998. Growth curve analysis was used to examine the student survey data over time. Project Northland was most successful when the students were young adolescents. The lack of intervention in the Interim Phase when the students were in grades 9 and 10 had a significant and negative impact on alcohol use. The intervention used with the high school students as those in grades 11 and 12 made a positive impact on their tendency to use alcohol use, binge drinking and ability to obtain alcohol. There was no impact in Phase 2 on other student-level behavioral and psychosocial factors. Developmentally appropriate, multi-component, community-wide programs throughout adolescence appear to be needed to reduce alcohol use.

Introduction

Regardless of race, ethnicity, urbanicity or gender, alcohol is the most widely used drug by youth (Johnston et al., 2000). In 1999, among grade 12 students surveyed in the nationally representative sample of the Monitoring the Future study, 80% reported having drank alcohol in their lifetime, 62% reported having been drunk in their lifetime, 51% reported drinking in the past month, 33% reported having been drunk in the past month and 31% reported having drank five or more drinks in a row in the last 2 weeks (Johnston et al., 2000). These rates are particularly alarming as they are among young people who are not at a legal age to drink alcohol in the US.

There is a strong relationship between alcohol use among youth and many social, emotional, behavioral and legal problems, including the use of illicit drugs, fighting, stealing, driving under the influence of alcohol and/or drugs, skipping school, feeling depressed, and deliberately trying to hurt or kill themselves, according to a recently published report by the Substance Abuse and Mental Health Services Administration (Greenblatt, 2000). Motor vehicle crashes are the leading cause of death for adolescents, with one-third to one-half of those crashes involving alcohol (National Highway Traffic Safety Administration, 1990). Alcohol use among teens is clearly linked with the major causes
of injury and death in this age group (Drug Strategies, 1999).

The successful development of effective programs to prevent alcohol use among adolescents depends on identifying the predictors of use, since these predictors become the targets of the intervention (Perry, 1999). Predictors can be identified by etiologic research and behavioral theories. According to the theory of triadic influence (Flay and Petraitis, 1994) and a conceptual model for adolescent health promotion (Perry and Jessor, 1985), behaviors are a function of a person’s current social situation, cultural environment and personal characteristics. Social, environmental and intrapersonal factors have consistently been found to be associated with alcohol use among adolescents (Hawkins et al., 1992; Epstein et al., 1995; Kumpfer and Alvarado, 1995; Newcomb, 1995; Komro et al., 1997; Kosterman et al., 2000). Social influences for alcohol use among adolescents include low socioeconomic status (SES) and education of parents, family disruption and conflict, weak family bonds, low parental supervision, parents’ permissiveness and lack of rules about alcohol use, alcohol use by adults, family history of alcoholism, peer alcohol use, perceived adult approval of use, and perceived peer approval of use. Important environmental influences include the legal, economic and physical availability of alcohol, and cultural norms around use. Intrapersonal influences on alcohol use include rebelliousness, tolerance of deviance, a high value on independence and non-conformance, low school commitment and achievement, positive beliefs and attitudes toward alcohol use, and low refusal self-efficacy. An understanding of the inter-relatedness of social, environmental and intrapersonal factors in determining behavior has progressively broadened prevention efforts from approaches that concentrate on personality characteristics of adolescents, to their social worlds of family and peer groups, to the larger community and societal environment, and involving changes in community norms and drug availability (Perry et al., 1993a; Wagenaar and Perry, 1994; Komro et al., 1997).

Alcohol use is so ingrained in the US culture that it has proven to be the most resistant drug use behavior to prevent among adolescents using school-based programs. Several prevention programs have reduced tobacco and marijuana use among adolescents, but have not had long-term effects on alcohol use (Pentz et al., 1989; Ellickson and Bell, 1990; Johnson et al., 1990; Ellickson et al., 1993). The first phase of Project Northland (Perry et al., 1996) and Life Skills Training (Botvin et al., 1990, 1995) are two prevention programs that have targeted young adolescents and reduced alcohol use. Life Skills Training consists of 3 years of prevention curricula for middle or junior high school students. The first year contains 15 sessions, followed by 10 in the second year and five in the third year. The curricula cover drug resistance skills and information, self-management skills and general social skills. A long-term follow-up study indicated that this program had long-term effects on smoking, alcohol and marijuana use through grade 12 (Botvin, et al., 1995, 2000).

Programs to prevent cigarette smoking have been more numerous and successful than alcohol use prevention, and have pointed to multi-year, multi-component, community-wide efforts as the most efficacious approach to being able to change important predictive factors (US Department of Health and Human Services, 1994, 2000). The active participation of community members in prevention activities, in enacting policies and ordinances, and in participating in the enforcement of community laws and norms are seen as critical to effective community-wide prevention efforts (US Department of Health and Human Services, 1994; Davis and Lurigio, 1996; Wagenaar et al., 1999). Several studies have found community mobilizing efforts to be effective in reducing teenage access to tobacco and alcohol which may be necessary to sustain the effects of school- and family-based efforts (Wagenaar and Perry, 1994, 2000; Pentz et al., 1996; Forster et al., 1998).

Project Northland was designed to reduce alcohol use among adolescents using a comprehensive, multi-component intervention targeting potent predictors of teen alcohol use, and seeking changes in both the supply of and demand for alcohol. The
intervention during Phase 1 targeted a cohort of primarily white students living in rural areas of Minnesota, US, during their grade 6–8 years. The intervention included: (1) social behavioral curricula, (2) peer leadership and extracurricular social opportunities, (3) parental involvement and education, and (4) community-wide task forces (Perry et al., 1993b). At the end of 3 years, a significantly smaller percentage of students in the intervention communities reported drinking or beginning to drink than students in the reference communities (Perry et al., 1996). The effect size for the Tendency to Use Alcohol scale was 0.16. Among students who reported never having drank alcohol at the beginning of grade 6, students in the intervention group were not only less likely to drink 3 years later, but also had lower rates of cigarette and marijuana use (Perry et al., 1996; Williams et al., 1999). Project Northland continued until the students graduated from high school, but with an Interim Phase when students were in grades 9 and 10, and there was minimal intervention. Phase 2 of Project Northland emphasized making changes in the community environment of the high school students to be less supportive of alcohol use. In particular, it was hypothesized that reduced social and commercial access to alcohol and strengthened community norms concerning high school drinking would result in lower alcohol use among older teens. This paper examines: (1) the long-term outcomes of Project Northland by charting students’ alcohol use from grades 6 to 12 and assessing the trajectory of alcohol use in these communities during the three phases of the project, and (2) the effects of the Phase 2 Project Northland intervention that was implemented when the cohort was in grades 11 and 12.

Methods

Study design

Project Northland was conducted from 1991 through 1998 in six counties in northeast Minnesota and involved mostly white, rural, lower-middle-class to middle-class communities. This area of Minnesota ranked at the top of alcohol-related problems in the state and was selected because it was a ‘high-risk’ area for alcohol use (National Institute of Alcohol Abuse and Alcoholism, 1991). Twenty-four school districts were originally recruited for the study in 1990 (Perry et al., 1993b). After 1995, one school district decided not to participate in Phase 2 of Project Northland. However, when the school district administration changed, the district re-joined the study in the 1997–1998 school year. The school districts and surrounding communities were randomized to intervention or delayed program conditions in 1991 and remained in those conditions through 1998. The primary study sample is the Class of 1998 students in these 24 school districts (n = 3151). These students were in grade 6 at baseline in fall 1991 and were part of the study through their high school graduation in spring 1998.

Intervention programs

The intervention programs for Phase 1 (1991–1994) consisted of 3 years of social-behavioral classroom curricula, parent involvement programs, peer leadership opportunities, and community task forces while the cohort was in grades 6–8. These interventions and their outcomes have been described in detail elsewhere (Perry et al., 1993b, 1996; Williams et al., 1995a, 1999; Komro et al., 2001). During the Interim Phase (1994–1996), a brief five-session classroom program entitled ‘Shifting Gears’ was implemented when the students were in grade 9. This program focussed on pressures to drink and drive, or to ride with a drinking driver, the influences and tactics of alcohol advertising, and ways to deal with those influences. No programs were implemented when the cohort was in grade 10. During Phase 2 (1996–1998), the intervention program had five components, based on the intervention model described in Perry et al. (Perry et al., 2000).

(1) A six-session classroom curriculum was implemented to intervention students in grade 11, entitled ‘Class Action’, and emphasized the social and legal consequences and community
responsibilities concerning alcohol use by teens. A ‘mock trial’ format was used because it was more relevant and appropriate for this age group. Students acted as legal teams on cases involving teen alcohol use and its consequences, and presented their cases in class. 

(2) Parents received behavioral tips on communicating and working with their high school students through a series of 11 originally designed postcards that were sent directly to parents. Parents and the students also were recruited to participate in the ‘Sound OFF!’ campaign, which was designed to encourage and reinforce communication between parents and the students about alcohol use.

(3) Print media campaigns were implemented. The first targeted young adults with the theme of ‘Don’t provide to those under age 21’. Other print media included calendars for alcohol merchants, newsletters for students and adults, and a celebration poster for the many participants in Project Northland over the years of the study.

(4) Peer action teams were created at each high school and students developed projects that would influence their classmates to not drink, consider the consequences of drinking, or do something fun and engaging instead of drinking (Lachter et al., 1999). These included video projects about alcohol use in their communities, alcohol-free activities including prom and homecoming, peer mentoring, and policy projects.

(5) Community action teams were formed and, using a direct action community organizing model, aimed to reduce commercial and social access to alcohol among high school students in their communities. The perception that alcohol use is easily available is prevalent among high schools students (Johnston et al., 2000). Among high school seniors, 9% of those who drink got their alcohol from a commercial source during their last drinking occasion (Wagenaar et al., 1996). The community action teams sponsored responsible beverage server training programs, did compliance checks in off-sale alcohol outlets, worked at community festivals, and were successful in getting their communities to adopt new policies and ordinances related to teen alcohol use and access to alcohol.

The community organizing component was considered the ‘centerpiece’ of Phase 2 of Project Northland, with the other components being complementary to the efforts to reduce access to alcohol (Perry et al., 2000). Greater detail on all of the Phase 1 and 2 programs, including process data such as participation and completion rates, can be found elsewhere (Komro et al., 1996, 1999; Lachter et al., 1999; Perry et al., 1993b, 1996, 2000; Williams et al., 1995a, 1999; Toomey et al., 1996; Veblen-Mortenson et al., 1998, 2001; Williams and Perry, 1998). A brief summary of the Project Northland intervention programs and participation from 1991 to 1998 is found in Table I with additional references for specific components of the intervention.

The reference school districts were offered the Phase 1 curricula in 1994–1997 and the Class Action curriculum in the 1999–2000 school year; teacher trainings were provided for interested teachers and districts.

Evaluation

Subjects

Students in the intervention and reference school districts were surveyed in their classrooms at baseline (fall 1991) and follow-up (each spring 1992–1998). Response rates to the student survey for individual years of the study ranged from 84.6% in 1998 to 92.9% in 1992. Reasons for non-participation included parent refusal, student refusal, absent from school on days of survey implementation, dropped out of school or moved. In 1996 and 1997, students in one school district (n = 325) were not surveyed because the school district had dropped out of the study. When that school district rejoined the study during the students’ senior year, the students were surveyed in spring 1998. Data from these students are included for 1991–1995 and 1998. In 1998, 67.8% of the original cohort of 2351 were surveyed.
Table I. Summary of Project Northland interventions: fall 1991–spring 1998

<table>
<thead>
<tr>
<th>Phase 12,5,6,7</th>
<th>Interim Phase 7</th>
<th>Phase 28,9,12</th>
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</thead>
<tbody>
<tr>
<td>Grade Year</td>
<td>Grade Year</td>
<td>Grade Year</td>
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<tr>
<td>Classroom curricula (% schools implemented)</td>
<td>Classroom curricula (% schools implemented)</td>
<td>Classroom curricula (% schools implemented)</td>
</tr>
<tr>
<td>Slick Tracy (5 sessions) (100%)</td>
<td>Amazing Alternatives! (8 sessions) (100%)</td>
<td>PowerLines (8 sessions) (100%)</td>
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<tr>
<td>Parental involvement (% parent participation)</td>
<td>Parental involvement (% parent participation)</td>
<td>Parental involvement (% parent participation)</td>
</tr>
<tr>
<td>Slick Tracy; Home Team (90%)</td>
<td>Awesome Autumn; AAI Home Program (33%)</td>
<td>Northland Notes for Parents; Childs’ Play Theater (100%)</td>
</tr>
<tr>
<td>Peer participation (% schools participating)</td>
<td>Peer participation (% schools participating)</td>
<td>Peer participation (% schools participating)</td>
</tr>
<tr>
<td>Classroom peer leaders</td>
<td>TEENS groups (70%)</td>
<td>TEENS groups (55%)</td>
</tr>
<tr>
<td>Print media (% communities participating)</td>
<td>Print media (% communities participating)</td>
<td>Print media (% communities participating)</td>
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<tr>
<td>Local news (100%)</td>
<td>Local news (100%)</td>
<td>Local news (100%)</td>
</tr>
<tr>
<td>Community organizing (% communities)</td>
<td>Community organizing (% communities)</td>
<td>Community organizing (% communities)</td>
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<tr>
<td>Task forces (100%)</td>
<td>Task forces (100%)</td>
<td>Task forces (100%)</td>
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</tbody>
</table>


The Amazing Alternatives! Awesome Autumn party was implemented in all 20 intervention schools (100%) with 1700 attendees.

Northland Notes for Parents and Parent Postcards were sent to all parents (100%) of the intervention students.

It’s My Party was performed in all 20 intervention schools (100%), attended by 2700 people.

Action teams did not take place in half of the communities that were part of the school district that dropped out and are reflected in those percentages.
This rate compares favorably with other school-based longitudinal studies (Botvin et al., 1995; Clayton et al., 1996).

The main outcomes of the study were analyzed using growth curve analyses. Since these analyses can accommodate data from subjects who are not present at every data point, including baseline, the sample size for the entire study is 3151 (students who completed at least one survey). There were 198 students who moved between school districts during the 7 years of data collection and these students were dropped from the analyses. Thus the analysis sample size was 2953. Of the 2953 students who completed at least one survey, 33.4% (n = 987) had all eight data points, 13.7% (n = 404) had seven data points, 14.2% (n = 420) had six data points, 8% (n = 237) had five data points, 7% (n = 208) had four data points, 7% (n = 206) had three data points, 7.5% (n = 222) had two data points and 9.1% (n = 269) had one data point. Students who had three or more inconsistent responses in a survey were dropped from that data point. On average, 0.01% of students were dropped each year due to inconsistent responses. Of the 2953 students included in the analyses, 53% were male, 93% were white and 5% were American Indian.

The average number of surveys completed per student (number of data points) did not differ by condition. Baseline drinking was associated with the number of surveys completed per student, with those students who completed fewer surveys more likely to have had higher levels of baseline drinking [F(1,18)=35.3, P < 0.001]. However, the association of number of data points with baseline drinking did not differ by condition. Also, the number of surveys completed per student was not associated with gender. Finally, the number of surveys completed per student was significantly associated with race, with whites having more completed data points than non-whites [F(1,18)= 76.5, P < 0.001]. However, this association did not differ by condition.

Measures
The student questionnaire contained items related to alcohol use behavior and psychosocial factors (Williams et al., 1995b; Perry et al., 1996). A scale was created to measure adolescent alcohol use and that scale is the main outcome measure in this study; the Tendency to Use Alcohol Scale combines items about intentions to use alcohol and actual use, so it is able to detect a wider range of alcohol use behaviors than a single item such as use in the past month (Williams et al., 1995b). Past month, past week and binge drinking (five or more drinks in a row in the past 2 weeks) were also assessed, based on questions from the Monitoring the Future Study (Johnston et al., 2000). Additional scales assessed the psychosocial variables Peer Influence, Self-Efficacy and Perceived Access to Alcohol, which have satisfactory psychometric properties (Williams et al., 1995b).

In addition, as a process measure to assess the success of the community action teams’ efforts to reduce teens’ access to alcohol, alcohol purchase attempts by young-looking buyers were made at the beginning of grade 6 (n = 97 outlets), at the end of grade 8 (n = 140) and grade 12 (n = 156), in the summers of 1991, 1994 and 1998. The number of successful buys was marginally predictive of alcohol use among boys at baseline in 1991 and seemed an appropriate objective measure of commercial access to alcohol by underage youth (Komro et al., unpublished). The analyses excluded the school district that dropped out of the study in 1996–1997 because half of the communities within that school district were not exposed to the intervention (and did not have community action teams). Each off-sale and on-and-off sale alcohol establishment in each community was visited twice by youthful-looking 21-year-old females in the latter two surveys. The young women attempted to buy beer without identification to assess ease of commercial access for underage buyers (Forster et al., 1994). If the buyer was able to purchase beer without identification, it was considered a ‘successful’ buy. If the buyer was asked to show identification, she left the outlet and it was not considered a successful buy. The buy rate was calculated as successful buys divided by the number of attempts per outlet.

Telephone surveys were conducted with parents/
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guardians of the Class of 1998 at the end of grade 10 (n = 2048) and grade 12 (n = 1793), in 1996 and 1998, respectively, to assess any changes in homes that might have resulted from the community action teams, parent postcards, print media, the Sound OFF! campaign and youth development programs. Parent participation in the surveys was 92.7% in 1996 and 91.4% in 1998 (with no differences between conditions). Parents from the one school district that dropped out of the study in 1996–1997 were not available for the 1996 survey and so are not included in these analyses. Scales were created that assessed the Acceptability of Underage Drinking by Guardians (13 items, $\alpha = 0.76$), Permissive Norms (eight items, $\alpha = 0.81$), Opposition to Alcohol Control Policies (eight items, $\alpha = 0.73$) and Limited Parental Monitoring (five items, $\alpha = 0.57$). The telephone surveys were implemented by a trained and supervised in-house telephone survey team; telephone surveys took 15–20 min to complete.

Analysis methods

Alcohol use and psychosocial factors

Data from the student survey assessed students’ alcohol use and psychosocial factors, and were analyzed using a statistical technique known as growth curve analysis. These methods are used to identify patterns of growth or, simply, change over time and test whether these patterns differ between subgroups. This is different from examining the differences in means at one point in time, because it assesses trends, trajectories, change and growth. Growth curve analysis requires longitudinal data from a sufficiently large sample with at least two, but preferably more, repeated measures or waves of data. Although the statistical method is complicated, the results are easily interpretable. Growth curve analysis has gained popularity in several research fields recently, such as prevention research (Clayton et al., 1996; Muthen and Curran, 1997; Mitchell et al., 1998, 1999), as it is considered by many to be the most satisfactory approach to the analysis of repeated measures data (Crowder and Hand, 1990).

This study employed one of two major approaches to this analytical method, i.e. a mixed-effects regression model for repeated measures data. These regression models can accommodate fixed effects, random effects and correlated observations within study units. As a result, one of the strengths of this approach is its ability to flexibly and appropriately model the structure of the data, including data arising from a cluster sampling scheme and unbalanced, or missing, data. The mixed-effects regression model is also particularly useful because it not only models the process of change for the population, but also the process of change for individuals, who can differ in distinct, sometimes idiosyncratic, ways. A more detailed explanation of these models, also referred to as hierarchical linear models, can be found elsewhere (Crowder and Hand, 1990; Burchinal and Appelbaum, 1991; Bryk and Raudenbush, 1992; Cudeck and Klebe, 2001).

Differences between the intervention and comparison conditions were tested using a three-level linear mixed-effects regression model. At level 1, the regression equation modeled the individual’s trajectory of alcohol use, including both the mean curve and the (within-subject) variation about the curve. At level 2, the regression equation modeled each school district’s trajectory of alcohol use, including, again, the mean curve and the (between-subjects and within-school district) variation about the curve. At level 3, the regression equation modeled the study (intervention or comparison) condition’s trajectory of alcohol use, including the mean curve and the (between-school districts) variation about the curve. Given the hierarchical nature of these data, these regression equations were combined sequentially (the parameters obtained in the first set of regression equations become variables in the next set, etc.) to fit a model that described the differences between the intervention and comparison conditions in the trajectory of alcohol use over time.

School district was the unit of assignment to condition, therefore within- and between-school district variance was accounted for in the analyses. Students moved between schools (such as from elementary to middle school to high school) within
school districts throughout the study period. In addition, there was generally only one junior high and high school within a school district. Therefore school-level variance was not included in the model. This model was adjusted for race because there were significantly fewer white students in the intervention school districts than the comparison school districts and race was significantly associated with alcohol use (Perry et al., 1996; Roski et al., 1997a). Three sets of analyses, one for each phase of the study, were conducted and provided estimates of the baseline value of alcohol use and the growth rate in alcohol use over time during each phase. Similar analyses were conducted to assess the intervention’s impact on the trajectories of alcohol-related psychosocial risk factors. The 1996–1998 outcome measures that demonstrated substantial departure from normality (i.e. skewness $\geq 2$, kurtosis $\geq 7$) were log transformed so they more closely approximated a normal distribution (Kleinbaum et al., 1998). Two variables were log transformed: past week alcohol use and binge drinking. The multi-level module in LISREL (version 8.30) was used to conduct all of the growth curve analyses (Joreskog et al., 1999).

**Alcohol purchase attempts**

Differences between treatment and control communities in their alcohol purchase attempt buy rates were analyzed using mixed-model regression methods with community specified as a nested random effect (Murray, 1998). The models included buyer as a covariate to control for buyer effects. The procedure SAS GLIMMIX was used to conduct the analyses, specifying a binomial distribution (Littell et al., 1996; SAS Institute, 1996).

**Parent surveys**

Differences between parents in the treatment and control conditions at the beginning and end of Phase 2 (1996 and 1998) were analyzed using mixed-model regression methods with school district specified as a nested random effect (Murray, 1998). The parent survey was revised between Phase 1 and 2 of the study, and outcome analyses were conducted on the newly constructed scales from Phase 2 as described in the section on measures above. The SAS/PROC MIXED procedure was used in these analyses (SAS, 1996; Murray, 1998).

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**Results**

**Participation**

Project Northland had notably high participation rates throughout the intervention and evaluation components of the study. These have been documented more extensively in prior publications (Perry et al., 1996, 2000) and are shown in Table I.

**Alcohol use**

Using three-level growth curve analyses, we examined the students’ Tendency to Use Alcohol scores, past-month alcohol use, past-week alcohol use and binge drinking (five or more drinks in a row in the past 2 weeks) for Phase 1, the Interim Phase and Phase 2 of Project Northland. The adjusted models for each of these outcomes are shown in Table II. Baseline scores for each phase, growth rates per year over the period indicated and significance levels are shown. Students in the intervention schools were significantly less likely than students in the reference schools to increase their Tendency to Use Alcohol, past month alcohol use and binge drinking during Phase 1 of Project Northland. Past week alcohol use was not significantly different between conditions using growth curve analysis, even though this difference was significant using mixed model regression analysis, as reported previously (Perry et al., 1996). Students in the intervention schools were also significantly less likely to increase their Tendency to Use Alcohol and binge drinking during Phase 2, and marginally ($P < 0.07$) less likely to increase past month alcohol use. During the Interim Phase, students in the intervention schools were significantly more likely to increase their Tendency to Use Alcohol, past month alcohol use, past week alcohol use and binge drinking.

**Psychosocial factors**

Three-level growth curve analyses were also used to examine students’ perceptions of Peer Influence,

<table>
<thead>
<tr>
<th></th>
<th>Reference communities</th>
<th>Intervention communities</th>
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<tbody>
<tr>
<td></td>
<td>(n = 1549)</td>
<td>(n = 1401)</td>
<td></td>
</tr>
<tr>
<td>Tendency to Use Alcohol Scale&lt;sup&gt;b&lt;/sup&gt;&lt;br&gt;Phase 1 (1991–1994)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>baseline score</td>
<td>10.24 (0.26)</td>
<td>11.01 (0.26)</td>
<td>0.04</td>
</tr>
<tr>
<td>growth rate&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.44 (0.12)</td>
<td>1.82 (0.12)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Interim Phase (1994–1996)&lt;br&gt;baseline score</td>
<td>18.40 (0.55)</td>
<td>16.92 (0.56)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>growth rate</td>
<td>2.37 (0.24)</td>
<td>3.40 (0.26)</td>
<td>&lt;0.01</td>
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<tr>
<td>baseline score</td>
<td>22.01 (0.60)</td>
<td>22.94 (0.65)</td>
<td>0.05</td>
</tr>
<tr>
<td>growth rate</td>
<td>2.11 (0.21)</td>
<td>1.44 (0.24)</td>
<td>0.03</td>
</tr>
<tr>
<td>Past Month Alcohol Use&lt;sup&gt;c&lt;/sup&gt;&lt;br&gt;Phase 1 (1991–1994)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>baseline score</td>
<td>0.99 (0.02)</td>
<td>1.07 (0.02)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>growth rate</td>
<td>0.16 (0.01)</td>
<td>0.11 (0.01)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Interim Phase (1994–1996)&lt;br&gt;baseline score</td>
<td>1.55 (0.04)</td>
<td>1.41 (0.04)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>growth rate</td>
<td>0.18 (0.03)</td>
<td>0.31 (0.04)</td>
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<tr>
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<td>1.83 (0.07)</td>
<td>1.96 (0.07)</td>
<td>0.08</td>
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<tr>
<td>growth rate</td>
<td>0.20 (0.03)</td>
<td>0.13 (0.03)</td>
<td>0.07</td>
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<tr>
<td>Past Week Alcohol Use&lt;sup&gt;c,d&lt;/sup&gt;&lt;br&gt;Phase 1 (1991–1994)</td>
<td></td>
<td></td>
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<tr>
<td>baseline score</td>
<td>1.00 (0.01)</td>
<td>1.03 (0.01)</td>
<td>0.13</td>
</tr>
<tr>
<td>growth rate</td>
<td>0.07 (0.01)</td>
<td>0.05 (0.01)</td>
<td>0.12</td>
</tr>
<tr>
<td>Interim Phase (1994–1996)&lt;br&gt;baseline score</td>
<td>1.23 (0.03)</td>
<td>1.19 (0.03)</td>
<td>0.37</td>
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<td>growth rate</td>
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<tr>
<td>baseline score</td>
<td>1.33 (0.03)</td>
<td>1.39 (0.04)</td>
<td>0.49</td>
</tr>
<tr>
<td>growth rate</td>
<td>0.10 (0.02)</td>
<td>0.07 (0.02)</td>
<td>0.53</td>
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<td>Binge Drinking (five or more drinks in a row in the past 3 weeks)&lt;sup&gt;f,g&lt;/sup&gt;&lt;br&gt;Phase 1 (1991–1994)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>baseline score</td>
<td>1.01 (0.01)</td>
<td>1.05 (0.01)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>growth rate</td>
<td>0.08 (0.01)</td>
<td>0.05 (0.01)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Interim Phase (1994–1996)&lt;br&gt;baseline score</td>
<td>1.31 (0.05)</td>
<td>1.22 (0.05)</td>
<td>0.04</td>
</tr>
<tr>
<td>growth rate</td>
<td>0.11 (0.03)</td>
<td>0.23 (0.03)</td>
<td>0.04</td>
</tr>
<tr>
<td>baseline score</td>
<td>1.45 (0.05)</td>
<td>1.60 (0.06)</td>
<td>0.02</td>
</tr>
<tr>
<td>growth rate</td>
<td>0.18 (0.02)</td>
<td>0.09 (0.03)</td>
<td>0.02</td>
</tr>
</tbody>
</table>

<sup>a</sup>Three-level linear mixed-effects model, adjusted for race.

<sup>b</sup>The score range was 8 (low tendency) to 48 (high tendency).

<sup>c</sup>Mean change in the dependent measure per year, adjusted for race.

<sup>d</sup>The score range was 1 (0 occasions) to 7 (40 or more occasions).

<sup>e</sup>The score range was 1 (0 occasions) to 7 (40 or more occasions).

<sup>f</sup>The score range was 1 (0 occasions) to 6 (10 or more occasions).

<sup>g</sup>Log transformations of these measures are reflected in the P values.

|                        | Reference communities | Intervention communities |  
|------------------------|-----------------------|--------------------------|---
|                        | (n = 1549)            | (n = 1401)               |  
| **Peer Influence Scale** |                       |                          |  
| baseline score         | 17.43 (0.35)          | 18.42 (0.35)             | 0.09  
| growth rate            | 3.03 (0.18)           | 2.07 (0.19)              | <0.01  
| Interim Phase (1994–1996) |                     |                          |  
| baseline score         | 27.81 (0.67)          | 25.34 (0.67)             | <0.01  
| growth rate            | 2.93 (0.38)           | 4.12 (0.40)              | 0.03  
| baseline score         | 32.86 (0.88)          | 33.29 (0.95)             | 0.40  
| growth rate            | 1.01 (0.26)           | 0.65 (0.30)              | 0.34  
| **Self-efficacy Scale** |                       |                          |  
| baseline score         | 22.33 (0.20)          | 22.18 (0.20)             | 0.62  
| growth rate            | 0.91 (0.10)           | 0.69 (0.10)              | 0.12  
| Interim Phase (1994–1996) |                   |                          |  
| baseline score         | 19.46 (0.27)          | 20.01 (0.27)             | <0.01  
| growth rate            | 0.31 (0.14)           | 0.44 (0.15)              | <0.01  
| baseline score         | 20.46 (0.33)          | 19.15 (0.36)             | 0.08  
| growth rate            | 0.51 (0.11)           | 0.69 (0.12)              | 0.43  
| **Perceived Access Scale** |                    |                          |  
| baseline score         | 14.11 (0.25)          | 14.38 (0.25)             | 0.38  
| growth rate            | 1.85 (0.09)           | 1.56 (0.09)              | 0.03  
| Interim Phase (1994–1996) |                     |                          |  
| baseline score         | 19.76 (0.26)          | 19.32 (0.26)             | 0.38  
| growth rate            | 1.26 (0.17)           | 1.45 (0.18)              | 0.51  
| baseline score         | 22.07 (0.18)          | 22.00 (0.20)             | 0.94  
| growth rate            | 0.16 (0.12)           | 0.19 (0.13)              | 0.96  

*Three-level linear mixed-effects model, adjusted for race.

*The score range was 15 (low peer influence) to 71 (high peer influence).

*Mean change in the dependent measure per year, adjusted for race.

*The score range was 5 (cannot refuse alcohol) to 7 (can refuse alcohol).

*The score range was 6 (hard to obtain alcohol) to 30 (easy to obtain alcohol).

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Self-Efficacy to refuse alcohol offers and Perceived Access to alcohol. Baseline scores for each phase of the study, growth rates and P values are shown in Table III. During Phase I, students in the intervention schools were significantly less likely to increase their perceptions of Peer Influence to use alcohol and their Perceived Access to alcohol. There were no differences in the trajectories of these scales in Phase 2. During the Interim Phase, students in the intervention schools were significantly more likely to experience increased perceptions of Peer Influence to use alcohol and decrease their Self-Efficacy to refuse alcohol.

**Alcohol purchase attempts**

The success rates of the alcohol purchase attempts for 1991, 1994 and 1998 are shown in Table IV. These show the success rates analyzed at the community level for all on-and-off and off-sale liquor outlets in our communities. Alcohol pur-
Table IV. Success [mean (95% CI)] rates for purchase attempts in alcohol outlets at baseline (fall 1991), end of Phase 1 (spring 1994) and end of Phase 2 (spring 1998) of Project Northland

<table>
<thead>
<tr>
<th></th>
<th>Reference communities</th>
<th>Intervention communities</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All outlets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>baseline (1991) (n = 97)</td>
<td>47.9 (34.0–61.8)</td>
<td>42.3 (27.5–57.1)</td>
<td>0.57</td>
</tr>
<tr>
<td>end of Phase 1 (1994) (n = 140)</td>
<td>42.5 (28.4–56.7)</td>
<td>53.5 (39.2–67.8)</td>
<td>0.32</td>
</tr>
<tr>
<td>end of Phase 2 (1998) (n = 156)</td>
<td>25.4 (17.6–33.1)</td>
<td>13.6 (6.1–21.0)</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>Off-sale outlets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>baseline (1991) (n = 28)</td>
<td>45.7 (21.0–70.3)</td>
<td>41.1 (6.7–75.7)</td>
<td>0.82</td>
</tr>
<tr>
<td>end of Phase 1 (1994) (n = 57)</td>
<td>59.0 (44.7–73.3)</td>
<td>49.3 (30.3–68.3)</td>
<td>0.45</td>
</tr>
<tr>
<td>end of Phase 2 (1998) (n = 66)</td>
<td>30.7 (21.3–40.2)</td>
<td>5.6 (0.0–19.0)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

*F*(1,22), using mixed model regression analyses, adjusted for buyer.

chase attempts were not undertaken in 1996, so we can only report successful buy rates at the end of Phases 1 and 2. There were no significant differences in buy rates at baseline (1991) or at the end of Phase 1 (1994). However, there were significant differences in buy rates for all outlets and for off-sale only outlets at the end of Phase 2. In the reference communities, 25.4% of all outlets and 30.7% of off-sale outlets sold beer without identification. This compares with 13.6 and 5.6% in the intervention communities, a reduction of 46% in all outlets and a 81.7% reduction in potential underage purchases in off-sale outlets.

**Parent surveys**

Of the four scales developed for the parent survey, there were no significant differences between intervention and reference groups at the beginning of Phase 2, in Spring 1996. At the end of the study, in Spring 1998, the Permissive Norms scale was significantly different for the two groups. The mean scores in 1998 were 9.6 (intervention) versus 10.0 (reference) on a scale from 8 (not permissive) to 24 (permissive). Parents in the intervention communities had significantly less permissive norms [F(1,15), P < 0.03] than those in the reference communities. The Permissive Norms scale included items concerning what age it was ‘OK’ for a young person to drink, whether parents should allow their high school age son/daughter to drink in their home, whether it was OK if another parent offered alcohol to their son/daughter and under what circumstances it is OK for high school students to drink at parties. There were no significant differences between groups in the other scales.

**Discussion**

The long-term results of Project Northland reveal important lessons for alcohol use prevention among adolescents. First, the intervention was most successful when the students were young adolescents, when the focus of the intervention was on peer influence and social skills development. Second, the lack of intervention when the students were in grades 9 and 10 had a significant and negative impact on alcohol use. Third, even with a 2-year hiatus in intervention activities, the intervention used with the high school students in grades 11 and 12 made a positive impact on their alcohol use, although not as powerful as with the younger adolescents. Still, this approach—to reduce access to alcohol and change norms concerning high school students’ drinking—appears to be age-appropriate and moderately effective.

At the beginning of Phase 1, the majority of students had not ever had a drink (Perry et al., 1996). Thus, it was critical at that time to stress peer influence and involvement, attractive role models for non-drinking, and skills development through a combination of classroom curricula, parental involvement programs, peer leadership opportunities and community task forces. Early adolescence is generally the time of greatest
vulnerability to peer influence (Vaughan and Litt, 1990; Crockett and Petersen, 1993), so the focus on social skills and peer norms was age-appropriate and powerful for that developmental stage. However, Project Northland made little impact on the larger social environment during Phase 1. The major changes during Phase 1 involved peer influence, peer norms, functional meanings of use, stimulus-seeking attitudes and parent–child communication, as demonstrated by mediation analyses (Komro et al., 2001). For example, access to alcohol as measured by alcohol purchase attempts showed no change at the end of the Phase 1 intervention. Because most of the alcohol young adolescents consume is obtained through social rather than commercial sources, this was not as critical an intervention target as during Phase 2 when the students were older and more likely to obtain their alcohol from commercial sources (Wagenaar et al., 1993).

The Interim Phase demonstrated significant increases in alcohol use among students in the intervention communities. There are several potential reasons for this increase. First, the students may have regressed to their community alcohol use levels and norms. At the beginning of Phase 1, students in the intervention communities were drinking significantly more than students in the reference communities (a difference which had to be controlled for in subsequent regression analyses). Because Phase 1 did not impact the larger community, the students ‘returned’ to the level of drinking that was normative in their settings. The rural setting of Project Northland potentially contributed to this, since community stability is high and therefore what is considered normative may be more difficult to change than in an urban setting. For example, perceived norms were measured in the student survey in Phase 1 and included items related to whether people their age will drink by the time they’re seniors in high school, whether their parents will allow them to drink, and family rules against drinking. The correlation between scores in 1991 and 1994 was 0.76 ($P < 0.01$) among intervention students and 0.71 ($P < 0.02$) among reference students, demonstrating how stable these perceptions were, even when there were significant changes in alcohol use over that period and differences between groups. Second, there is generally recidivism in intervention research; at the end of 2 years after the Phase 1 intervention, there were no longer significant differences between groups (Williams and Perry, 1999). This has been noted in other studies as well (Pentz et al., 1989; Ellickson et al., 1993). Finally, Project Northland intervention students may have reacted to the project during the Interim Phase and increased their alcohol use. This seems improbable, since they came from higher-risk communities than the reference students, their absolute drinking levels did not surpass the reference students’ levels, and because there was a positive reaction to Project Northland when it was re-introduced during grades 11 and 12, as shown by the end of grade 11 data (Williams and Perry, 1999).

The results of Phase 2 are encouraging, especially given the trends during the Interim Phase and the lack of similar prior research with high school students. The multi-component community-wide approach, targeting high school students’ access to alcohol and changing community norms, appears to have been effective in reducing the growth rate in alcohol use in the intervention communities. The trend data showed significantly less increase in alcohol use among students in the intervention communities, as measured by the Tendency to Use Alcohol scale, binge drinking and, marginally, past month alcohol use ($P < 0.07$). The Tendency to Use Alcohol scale incorporates intentions to use alcohol in the future as well as current levels of monthly and weekly use, so provides a dynamic measure of alcohol use for this population. The reduction in binge drinking is particularly important, since underage youth have been shown to engage in more binge drinking than those of legal drinking age and is clearly a problem for this younger age group (Wechsler et al., 2000).

Still, it is disappointing that past week alcohol use and none of the psychosocial scales showed significant changes in Phase 2. This suggests that
the changes in behavior were not as potent as during Phase 1 and were primarily a result of other unmeasured factors or actual environmental changes, rather than changes in skills, peer influence or perceptions. These changes may have included significantly reduced access to alcohol through commercial sources and changed norms among the high school students’ parents. Since changes in both commercial and social access to alcohol were the major targets of the Phase 2 community-level intervention, and the main agenda of the community action teams, the changes in norms, policies and procedures that resulted from the teams’ efforts appear to have substantially affected students’ alcohol use. These results are similar to those of Forster et al. and Wagenaar et al., using direct action community organizing to quickly bring action by citizens around a public health problem (Forster et al., 1998; Wagenaar et al., 2000). Because the Phase 2 intervention was so limited in time, the addition of reinforcing intervention components such as youth development, print media, the Class Action curricula and parent postcards were probably critical to the intervention’s success. Still, it would have been a better test of the intervention strategies had the intervention been 3–4 years and begun at the crucial transition from middle school to high school.

There were several limitations to the study. Some of these have been noted in prior publications (Perry et al., 1996). First, the study was undertaken in small, rural communities in northeastern Minnesota. Some modifications in the intervention protocols would be necessary for it to be appropriate for urban settings, although the Phase 1 curricula are currently being disseminated (www.hazeldenbookplace.org) and evaluated in non-rural settings. Second, the intervention lost one of its school districts for most of Phase 2. This was a political decision on the part of the school superintendent, but does signal that positive outcomes do not always guarantee open doors. When the superintendent resigned, the school district re-joined the study for its final year. Still, important data could not be obtained and the impact of the entire intervention could not be evaluated in that school district. Third, our school districts were not equivalent at baseline, despite blocking by size and randomization of 20 units. Students in the intervention communities reported drinking significantly more at baseline. This most likely reflected community norms and role models of alcohol use in those communities (Roski et al., 1997b), but also made it more difficult to achieve long-term changes since the intervention students were higher-risk at baseline. Future studies should try to match school districts and communities based on alcohol use rates and then randomize, so that the communities (and perhaps the social environments that support those use rates) are more equivalent. Finally, it would have been useful to have had a larger sample size within each community. The study was originally designed in 1991 to have an adequate sample for a 3-year intervention study. A larger sample in each community might have provided more statistical power to detect other changes in students’ attitudes and behaviors.

In summary, the 7 years of Project Northland have provided important and useful lessons for the prevention field. The growth curve analyses revealed that students in communities at higher-risk for alcohol-related problems can slowly change as a result of a sustained multi-level intervention. However, it appears to be critical that interventions are planned throughout adolescence. Age- and developmentally appropriate intervention components are crucial. By the time students are in grade 9, if they have been exposed to refusal and life skills programs, a new venue is needed to maintain involvement and interest. This might include greater youth development activities such as peer mentoring or planning activities for their peers. It might importantly include their involvement in the larger decisions in their communities. By the time students are in grade 11, the availability of alcohol becomes a critical concern. Promoting a community culture where high school student alcohol use is not acceptable, where alcohol is not provided to teens, and where other options are created for young people to socialize, entertain and learn, appears to be critical to reducing alcohol use among high school students.
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References


Long-term outcomes of Project Northland


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