

RESEARCH ARTICLE

Promoting Mental Health and Preventing Substance Abuse and Violence in Elementary Students: A Randomized Control Study of the Michigan Model for Health

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ABSTRACT

BACKGROUND: In elementary grades, comprehensive health education curricula mostly have demonstrated effectiveness in addressing singular health issues. The Michigan Model for Health (MMH) was implemented and evaluated to determine its impact on multiple health issues, including social and emotional skills, prosocial behavior, and drug use and aggression.

METHODS: Schools (N = 52) were randomly assigned to intervention and control conditions. Participants received 24 lessons in grade 4 (over 12 weeks) and 28 more lessons in grade 5 (over 14 weeks), including material focusing on social and emotional health, interpersonal communication, social pressure resistance skills, drug use prevention, and conflict resolution skills. The 40-minute lessons were taught by the classroom or health teacher who received curriculum training and provided feedback on implementation fidelity. Self-report survey data were collected from the fourth-grade students (n = 2512) prior to the intervention, immediately after the intervention, and 6 weeks after the intervention, with the same data collection schedule repeated in fifth grade.

RESULTS: Students who received the curriculum had better interpersonal communication skills, social and emotional skills, and drug refusal skills than the control group students. Intervention students also reported lower intentions to use alcohol and tobacco, less alcohol and tobacco use initiated during the study and in the past 30 days, and reduced levels of aggression.

CONCLUSION: The effectiveness of the MMH in promoting mental health and preventing drug use and aggression supports the call for integrated strategies that begin in elementary grades, target multiple risk behaviors, and result in practical and financial benefits to schools.

Keywords: evaluation; curriculum; mental health; risk behaviors.

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The National Research Council and Institute of Medicine recently declared, "there is consistent evidence from multiple recent studies that early mental, emotional, and behavioral (MEB) disorders should be considered as commonplace as a fractured limb: not inevitable but not at all unusual."¹ An estimated 20% of the US population aged 25

or younger are affected at any given time by MEB disorders such as depression, anxiety, conduct disorder, and substance abuse.^{2,3} About half of all MEB disorders are reported by adults as being first diagnosed by age 14.⁴ Moreover, prevalence rates found as early as the preschool years are comparable to those observed in childhood, adolescence, and young

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adulthood,⁵ with initial symptoms that can precede the full-blown disorder by as many as 4 years.⁶ Not included in these estimates are millions of additional US children and adolescents who engage in health risk behaviors⁷ or are affected in and out of school at any given time by significant psychosocial problems, such as bullying, which distract or even prevent them from learning and teachers from teaching.^{8,9}

Health education in schools have been recognized for nearly 170 years as having a critical role in health promotion and prevention.¹⁰ Yet, school health education continues to struggle to find a place in the curriculum alongside math, science, language arts, and social studies. For example, the School Health Policies and Program Study (SHPPS) found that “fewer than 10% of all states, districts, and schools required the teaching of all 14 topics in elementary schools, and less than 40% of all states, districts, and schools required the teaching of all 14 topics in middle schools or high schools.”¹¹

Numerous studies¹²⁻¹⁵ found that school health education programs can improve children’s health and well-being in many individual content areas. In several large-scale studies, most notably the School Health Education Evaluation, school health education programs improved overall student knowledge, attitude, and practice in a variety of health-related topics,¹⁶⁻¹⁸ with a strong correlation found between more years of health instruction and better student health-related knowledge, attitudes, and habits as well as academic performance.^{17,18}

The limitations of many of the health education curriculum evaluation studies may be a factor in the acceptance of health education in the curriculum. Many of these studies did not employ a rigorous research design (eg, use of a comparison or control group)^{19,20} or were hampered by low statistical power.¹⁶ In addition, programs were generally tested in a single geographic location and with a homogeneous population, which made generalizing the results to other populations difficult.²¹

While most health education programs are designed to target a collection of health-promoting skills (eg, social and emotional health) and risk behaviors (eg, substance abuse and violence) over multiple years and begin at the elementary level, virtually no interventions have demonstrated direct effects on multiple behaviors before middle school.²² A recent exception was an evaluation of the Positive Action program,²¹ which followed about 1700 elementary students in Hawai’i over 4 years to determine its impact on academics, substance use, violence, and voluntary sexual activity in fifth grade. Six major units were presented in 140 lessons per grade level. Significant treatment effects were found for students’ self-report of substance use and violent behaviors, with

a dose-response trend found for students receiving 3 or more years of instruction.

Since its development in 1985, the Michigan Model for Health (MMH)[®], a comprehensive health curriculum for grades kindergarten through 12, has demonstrated effectiveness in reducing a variety of specific problems and related risk behaviors, such as drug abuse,^{23,24} human immunodeficiency virus (HIV)/acquired immune deficiency syndrome (AIDS),²⁵ and poor nutrition;²⁶ and in promoting character and positive school climate.²⁷

The purpose of this study was to determine the extent to which a comprehensive prevention approach previously found effective in addressing specific health needs of students can simultaneously impact multiple health issues, including the promotion of mental health skills and prosocial behavior and the prevention of substance abuse and aggression. Our hypothesis was that youths’ aggressive behavior and drug use intentions and behaviors would be reduced and their prosocial behavior would be enhanced by initiating prevention early in childhood and increasing children’s resilience and social competence. The focus on increasing social and emotional skills and reducing aggression is important because low socio-emotional competence and high aggressiveness portend short- and long-term mental health problems.²⁸⁻³⁰ In addition, the concurrent focus on violence and drug abuse prevention in elementary grades is supported by a strong link between childhood aggression and early-onset alcohol consumption^{31,32} and evidence of a negative life trajectory for those with multiple problem behaviors.³³

METHODS

Program

The intervention tested in this study, the MMH, is a comprehensive health education curriculum for grades kindergarten through 12 based upon principles of the Health Belief Model and Social Learning Theory in which several important cognitive, attitudinal, and socio-emotional factors converge to enhance health-promoting behavior.³⁴ The MMH utilizes a universal prevention approach to facilitate skills-based learning through 20- to 50-minute lessons that incorporate a variety of teaching and learning techniques, skill development and practice, and building positive lifestyle behaviors in students and families. The fourth-grade curriculum consisted of 25 lessons on social and emotional health; alcohol, tobacco, and other drugs; safety; and nutrition and physical activity. In fifth grade, there were 28 lessons across the same health topics. Lessons on personal health and wellness are also part of the fifth-grade curriculum, but were not included in this study in order to maintain consistency in topics across grades. HIV prevention lessons were available in both grades, but excluded from this study

because several participating schools did not have district approval to teach that topic at the elementary level.

The intervention was implemented in classrooms over a 12-week period in grade 4 and a 14-week period in grade 5 during a normal class period (of 40-50 minutes) by the classroom or health teacher who received a 12-hour curriculum training with follow-up support provided as needed. The training and support were based upon the model used by the organization that publishes and distributes the MMH materials. An additional 2-hour training on the purpose, objectives, and school-level activities of the evaluation study was provided to teachers in both the intervention and control schools. The evaluation training for intervention school teachers was provided in conjunction with the curriculum training. All participating teachers completed the curriculum and evaluation training.

Evaluation Design, Data Collection, and Management

A pretest-posttest control group design with multiple posttests, following individual students longitudinally, was used to evaluate student outcomes. See Figure 1 for the design and participation in the study, based upon the CONSORT statement.³⁵ Following approval from university and state institutional review boards, a convenience sample of 68 schools was recruited in 2005/2006 and assessed for eligibility by regional health coordinators, state education and health department employees, and the study researchers. Buildings were excluded ($n = 10$) from participation if they (a) had fewer than 30 students in fourth and fifth grades, to guard against insufficient statistical power; (b) had implemented the MMH or any other health education curriculum in the year preceding the study; (c) had implemented a Coordinated School Health Program (CSHP) in the year preceding the study or planned to do so during the study; (d) were not willing to delay implementation of any health education curriculum during the study if randomly assigned to the control condition; and/or (e) expected or planned to close or merge during the study.

The remaining 58 schools (42 from Michigan, 16 from Indiana) were randomly assigned to a group that implemented the MMH (the intervention group) or a group that did not implement the MMH (the control group). Schools and teachers in both the intervention and control groups received an incentive to participate in the study, including a stipend and free curriculum materials and training. The control school teachers did not receive the curriculum or training until after completion of the study. Students received no incentive for participation.

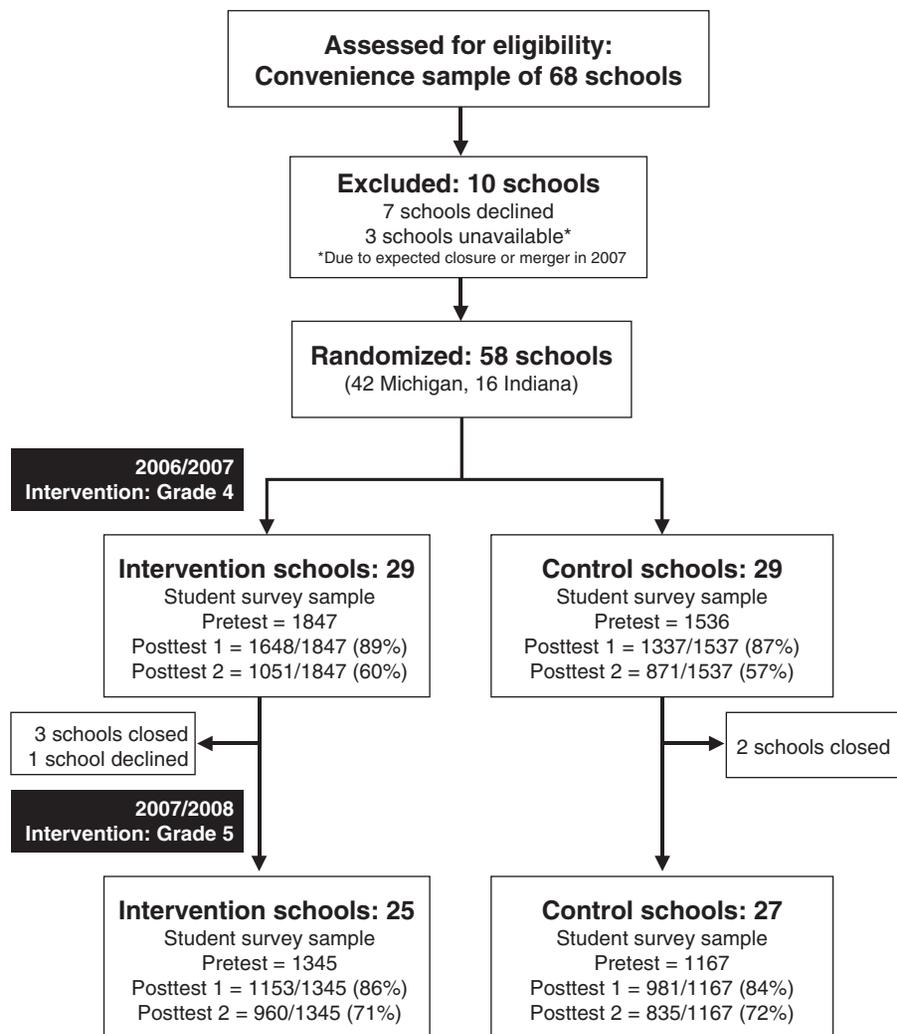
A self-report questionnaire was developed to assess demographics as well as knowledge, skills, intentions, and behaviors associated with the units of the MMH implemented in this study (eg, social and emotional health). With parental consent, 3383 students completed the pretest questionnaire administered in classrooms by project staff who were blind to treatment condition and trained to use a standardized protocol. Within 1 week after the pretest, teachers in the intervention condition implemented the curriculum with their students. Project staff conducted a posttest within 1 week after the conclusion of instruction and a delayed posttest 5 to 6 weeks thereafter. The data collection procedures were repeated during the second year of study (fifth grade). Each testing session lasted approximately 40 minutes. To ensure consistency in administration within classrooms, the same project staff person was assigned to administer the questionnaire to the same classroom for all 3 tests conducted during the school year, which occurred in 89% of classrooms in fourth grade and 93% of classrooms in fifth grade.

Prior to the fifth-grade intervention, 5 schools (4 intervention and 1 control) had closed and 1 intervention school declined to participate (because of a perceived conflict with other building priorities), resulting in a final sample of 25 intervention schools and 27 control schools and a total of 2512 students (1345 in the intervention schools and 1167 in the control schools) pretested in the subsequent intervention year. The immediate posttest was completed by 2134 students and the follow-up posttest was completed by 1795 students. There were no significant differences ($p < .05$) between the intervention and control groups in response rates for any time of measurement. Data from all 6 times of measurement were edited within occasion for responses errors (eg, multiple responses for the same item), within and across occasions for logic edits (eg, inconsistent response between lifetime and recent alcohol use), and cleaned accordingly.

Subjects

The final evaluation sample consisted of 2512 students (mean age at fourth grade = 9.56 years, $SD = 0.67$) who were followed longitudinally in fourth and fifth grades at 52 public schools in Michigan and Indiana that were characterized as urban (28%), rural (31%), and suburban (41%). The sample consisted of 54% boys and 46% girls, and the racial/ethnic composition of the sample was 54% white, 38% African American, and 8% of other or mixed ethnicity. On average, participating schools had 46% of students who were economically disadvantaged, based upon eligibility for federally funded free or reduced-price lunch programs (range: 11.1% to 97.9%).

Figure 1. Design of and Participation in the Michigan Model for Health Intervention, 2006/2007 and 2007/2008



Missing Data. Students who did not complete any questionnaires in fourth grade ($n = 387$) or fifth grade ($n = 919$) were not included in the evaluation sample for 2 reasons: (a) these students were presumed to receive only 1 year of the intervention, which is inconsistent with the philosophy of comprehensive health education programs to provide multiple years of instruction in order to reinforce and build upon previous material and effect long-term behavioral change,³⁶ and (b) accounting for all missing data points for a given intervention year, which comprised half of all measurement occasions, was considered an inappropriate data analytic strategy.³⁷

Missing outcome data for the evaluation sample were accounted for by using a mixed model approach in Predictive Analytic Software version 18 (formerly known as SPSS),³⁸ which utilizes a maximum likelihood solution that does not impose a listwise deletion criterion on the data and allows the user to define restriction and estimation of missing data.

A mixed model approach has additional benefits (described later in this report) for multilevel designs in which a student-level intervention is randomized and administered at the school level. For this study, students could have up to 2 (out of 6) missing data points, but no more than 1 missing data point in each grade, thereby ensuring the student was enrolled at the same school for at least part of the school year in both the fourth and fifth grades.

Attrition Effects. As mentioned earlier, a number of pretested students from fourth grade were not available for study in fifth grade ($n = 919$) and were excluded from the evaluation sample for programmatic and statistical reasons. Therefore, it was important to assess the potential impact of this attrition group on interpretation of the study findings. Fourth-grade pretest demographic and outcome scores for this group were compared with those of students who completed all fourth- and fifth-grade tests ($n = 749$). Using a chi-square test of association for the student demographic

and outcome variables, attrition was not significantly associated with treatment ($\chi^2 = 0.01$, $df = 1$, $p = .934$) and age ($\chi^2 = 2.20$, $df = 5$, $p = .821$), but was associated with gender ($\chi^2 = 12.74$, $df = 1$, $p \leq .001$) and ethnicity ($\chi^2 = 16.86$, $df = 2$, $p \leq .001$). Two-year attention was lower for boys than girls (41% vs 49%, respectively), and African-American and other minorities exhibited lower attrition rates than Caucasians (36%, 43%, and 49%, respectively).

Attrition analyses of the outcome variables showed several significant differences ($p < .05$), which are not uncommon in multiyear evaluations of substance abuse and violence prevention programs.^{39,40} Students not retained through the fifth-grade intervention reported higher levels of lifetime and recent use of alcohol and tobacco at the pretest than the students who were retained. In addition, attrition students exhibited lower social-emotional skills, interpersonal communication skills, self-management skills, and drug refusal skills than retained students. Lastly, attrition students reported higher intentions to use tobacco and alcohol within the next 12 months and higher levels of recent aggression than their retained counterparts. There were no differences between retained and nonretained students in levels of prosocial behavior ($p = .368$).

Instruments

A self-report questionnaire was developed to assess demographics as well as knowledge, skills, intentions, and behaviors associated with the lessons of the MMH implemented in this study (eg, social and emotional health). This report focuses on measures from the questionnaire that assessed health-promoting skills (social and emotional health, self-management, interpersonal communication, and drug refusal), drug use intentions and behaviors, aggressive behavior, and prosocial behavior.

The measures were composed of scales and items of adequate validity and reliability based upon their use in previous studies of health education or prevention. Health-promoting skills were measured using selected-response items developed from the State Collaborative on Assessment and Student Standards-Health Education Assessment Project (SCASS-HEAP)⁴¹ and usually adapted to align more closely to the MMH curriculum. Aggressive behavior and drug use (lifetime and recent) were measured using items from the Youth Risk Behavior Survey.^{42,43} Drug use intentions were measured from items developed by Hansen and McNeal.⁴⁴ Prosocial behavior was measured using items developed by Bosworth and Espelage,⁴⁵ as cited in Dahlberg et al.⁴⁶ For all scales/items, high scores reflect more of the attribute (eg, better health-promoting skills, higher drug use intentions and behavior, and more aggression).

Where appropriate, internal consistency reliabilities (reported as Cronbach's α) are reported for the scales using the entire fourth-grade pretest sample, and test-retest reliabilities (reported as Pearson r) are used for individual items based upon a 12-week test-retest interval using the control group sample's immediate posttest scores. Virtually, all scales/items reached conventionally acceptable levels of internal consistency reliability ($\alpha \geq .70$) or test-retest reliability ($r \geq .30$).⁴⁷

Health-Promoting Skills. Content and face validity for items measuring social and emotional skills, self-management skills, interpersonal communication skills, and drug refusal skills were established by SCASS-HEAP and any items adapted for this study were reviewed for face validity by an advisory team composed of researchers with expertise in health literacy, the authors of this study, and state and regional education and community health experts who serve on a statewide steering committee charged with revising the MMH. For all health-promoting skill items, respondents were asked to choose the correct answer among 4 alternatives. Eight items were used to measure *social and emotional health skills* ($\alpha = .74$). An example stem is, "We often have disagreements with others. Which of these choices is the *most* positive way to solve a disagreement?" *Self-management skills* were measured using 8 items ($\alpha = .63$). An example stem is, "You are so angry, you could hit something. Which of the following is the *most* healthful way for you to deal with this emotion?" *Interpersonal communication* was assessed using 10 items ($\alpha = .73$). An example stem is, "Keisha's friend wants to copy your homework. Which of the following refusals demonstrates the clearest 'no'?" Four items ($\alpha = .59$) were used to measure *drug refusal skills*. An example stem is, "Which of the following is the *best* response you could give, using a respectful, clear 'no' statement, to someone who offers you a beer?"

Intention to use drugs (alcohol and tobacco) was assessed using 4 items ($\alpha = .71$), with the following alternatives: "no" (1), "maybe not" (2), "maybe" (3), and "yes" (4). An example stem is, "Do you think you will smoke cigarettes during the next year (12 months)?"

Drug use behavior was measured using 4 items: *lifetime alcohol use* ($r = .45$), *past 30-day alcohol use* ($r = .47$), *lifetime tobacco use* ($r = .35$), and *past 30-day tobacco use* ($r = .28$). Alternatives for lifetime use ranged from "never used" (1) to "12 years or older" (7); for past 30-day use, the range was "0 days" (1) to "5 or more days" (4).

Aggressive behavior and *prosocial behavior* were measured using 3 items ($\alpha = .70$) and 6 items ($\alpha = .79$), respectively, with alternatives ranging from "0 times" (1) to "5 or more times" (6). An example stem is, "In the past month (30 days), how many

times did you hit or punch someone when you were mad?"

Implementation Fidelity

Teachers in the intervention schools implemented the MMH using a standardized protocol in which the lessons were taught in the same order, with no more than 3 lessons taught in the same week. Every 2 weeks throughout the program period, teachers in the intervention schools completed an on-line survey to report the number and type of lessons taught and whether they needed support in preparing for or teaching the lessons. The on-line implementation survey was completed by 96% of fourth-grade teachers and 92% of fifth-grade teachers, who reported having taught 92% of the lessons in fourth grade and 94% in fifth grade. In addition, 1 teacher in each building was designated to assist other teachers as well as monitor implementation to ensure the lessons were taught as designed and within the expected time frame. More than 90% of these teachers reported that teachers were implementing the curriculum with fidelity and were provided adequate support as needed.

Data Analysis

Assessment of baseline equivalence was performed to test for evidence of successful randomization of schools to the intervention and control conditions. This analysis involved comparing baseline (fourth-grade pretest) scores between the intervention and control groups on several school-level and student-level demographic variables and all student outcome variables. Analysis of the average percentage across school-level demographic variables and average scores on student-level outcome variables was conducted using *t* test for independent samples. Pearson chi square was used to test for differences in proportion of racial/ethnic and gender groups reported by the students on the questionnaire.

Tests of intervention effectiveness involved 2 different analytic techniques, based upon the type of dependent variable. Analysis of a continuous variable involved using a mixed model approach. When applying general linear models (GLMs) to analyzing longitudinal data, one generally underestimates the standard errors of the impacts and therefore may erroneously assume statistical significance. A mixed model approach effectively handles this problem as well as others inherent in longitudinal data, such as varying times between observations, unequal groups at each data point over time, and the need to control for the effects of potentially confounding independent variables.⁴⁸ These advantages make mixed models more appropriate than the more conventional repeated measures analyses used in longitudinal studies.

In all cases, the models took the general form of the measures nested within student and school with the 4 factors—treatment condition, gender, time, and ethnicity—having main effects and interactions, and with time as a repeated measure. This approach allows for the error term and parameter estimates to control for intracluster correlations (ICCs) among students within schools and generally provides for a more conservative test of the hypothesis when a positive ICC is present.⁴⁹

Analysis of the 4 drug use outcome variables—lifetime and recent alcohol and tobacco use—involved a different approach, because (as expected) the prevalence of lifetime and recent drug use was very low, resulting in highly skewed distributions that precluded the treatment of these dependent variables as continuous and violated the assumption of normally distributed scores. Instead, scores on these variables were converted to dichotomous measures (presence or absence of use) and used as the dependent variable in a binary logistic regression, with treatment condition (intervention vs control), ethnicity, and gender included as independent variables. As a categorical variable with 3 levels, ethnicity was dummy coded into 2 variables representing Caucasian versus African American and Caucasian versus other/mixed minorities. Drug use at the last time of measurement (fifth-grade delayed posttest) was used as the dependent variable, because the highest drug use prevalence (ie, the most variation) was expected to emerge at the latest age.

RESULTS

Baseline Prevalence of Alcohol and Tobacco Use

Rates of lifetime and recent (past 30-day) use of alcohol and tobacco were calculated for students who completed the fourth-grade pretest. Nearly 10% (9.3%) of students reported drinking more than a few sips of alcohol in their lifetime, and 5.3% drank recently. Significantly more fourth graders ($p < .05$) used alcohol than tobacco in their lifetime (4.8%) and the recently (2.8%).

Baseline Group Equivalence

There were no significant baseline differences ($p > .10$, 2-tailed) in the average percentage of fourth-grade students as a proportion of building enrollment; the composition of race/ethnicity, gender, or economic disadvantage; or the average percentage of students proficient in math and reading based upon state standardized tests. Student-reported data for gender, race/ethnicity, and all outcome variables showed no statistically significant baseline differences between the intervention and control groups ($p > .10$, 2-tailed).

Intervention Effects

Intervention effects were characterized in the mixed model analyses as a statistically significant ($p < .05$, 2-tailed) interaction between treatment condition and time of measurement. All statistically significant ($p < .05$, 2-tailed) 2-way interactions were reported for treatment condition \times gender and treatment condition \times ethnicity. In binary logistic regression analyses, an intervention effect was defined as a statistically significant ($p < .05$, 2-tailed) odds ratio (OR) for the prediction of each drug use behavior by treatment group.

Health-Promoting Skills. As shown in Figure 2, statistically significant intervention effects were found for social and emotional health ($F_{(5,6912.736)} = 4.67$, $p < .001$), interpersonal skills ($F_{(5,7112.974)} = 4.76$, $p < .001$), and drug refusal skills ($F_{(5,6935.167)} = 4.83$, $p < .001$). Mean scores for social and emotional health and drug refusal skills showed a similar pattern of a greater increase among treatment group students than their control group counterparts. Interpersonal communication remained stable over time for students in the control schools, but increased for students in the treatment schools. The intervention effect for self-management skills was not statistically significant ($F_{(5,6802.633)} = 2.01$, $p < .07$), but both the intervention and control groups showed an increase in that skill over time ($F_{(5,6802.633)} = 20.16$, $p < .001$).

Aggressive and Prosocial Behavior. The intervention effect for aggressive behavior was statistically significant ($F_{(5,4911.260)} = 2.23$, $p < .05$). Mean scores shown in Figure 2 indicate that although the control group appeared to have some decline in the level of aggressive behavior, there was a greater decrease over time for the intervention group. No intervention effect was found for prosocial behavior ($F_{(5,6925.297)} = 0.51$, $p = .77$), but students in both the treatment and control schools improved in that behavior over time ($F_{(5,6925.297)} = 20.92$, $p < .001$).

Drug Use Intentions. A significant intervention effect was found for intentions to smoke cigarettes ($F_{(5,2786.551)} = 4.02$, $p < .001$) and drink alcohol ($F_{(5,4297.196)} = 3.04$, $p < .01$) within the next 12 months. As shown in Figure 2, the interaction for group \times time indicates that while the intention to use cigarettes and alcohol rose over time for the students in the control condition, it remained lower for the treatment schools.

Drug Use Behavior. Binary logistic regressions were used with the drug use items as criterion variables and treatment group, gender, and ethnicity as predictors. As shown in Table 1, treatment condition was a statistically significant predictor ($p < .05$) of all 4 drug use measures, with students in the intervention schools showing greater improvement in the odds of avoiding drug use after controlling for gender and ethnicity.

Significant prediction of drug use was found in some cases for gender and ethnicity. The likelihood of having ever drunk more than a few sips was lower for Caucasian students (prevalence: 9.8%) as compared to African Americans (prevalence: 13.3%) (OR = 0.66, 95% confidence interval [CI] = 0.43, 1.01, $p < .05$) or a generalized other ethnic group (prevalence: 15.6%) (OR = 0.53, 95% CI = 0.38, 0.74, $p < .001$). In addition, boys (prevalence: 13.7%) were more likely to have consumed alcohol in the past as compared to girls (prevalence: 9.7%) (OR = 0.67, 95% CI = 0.49, 0.91, $p < .01$).

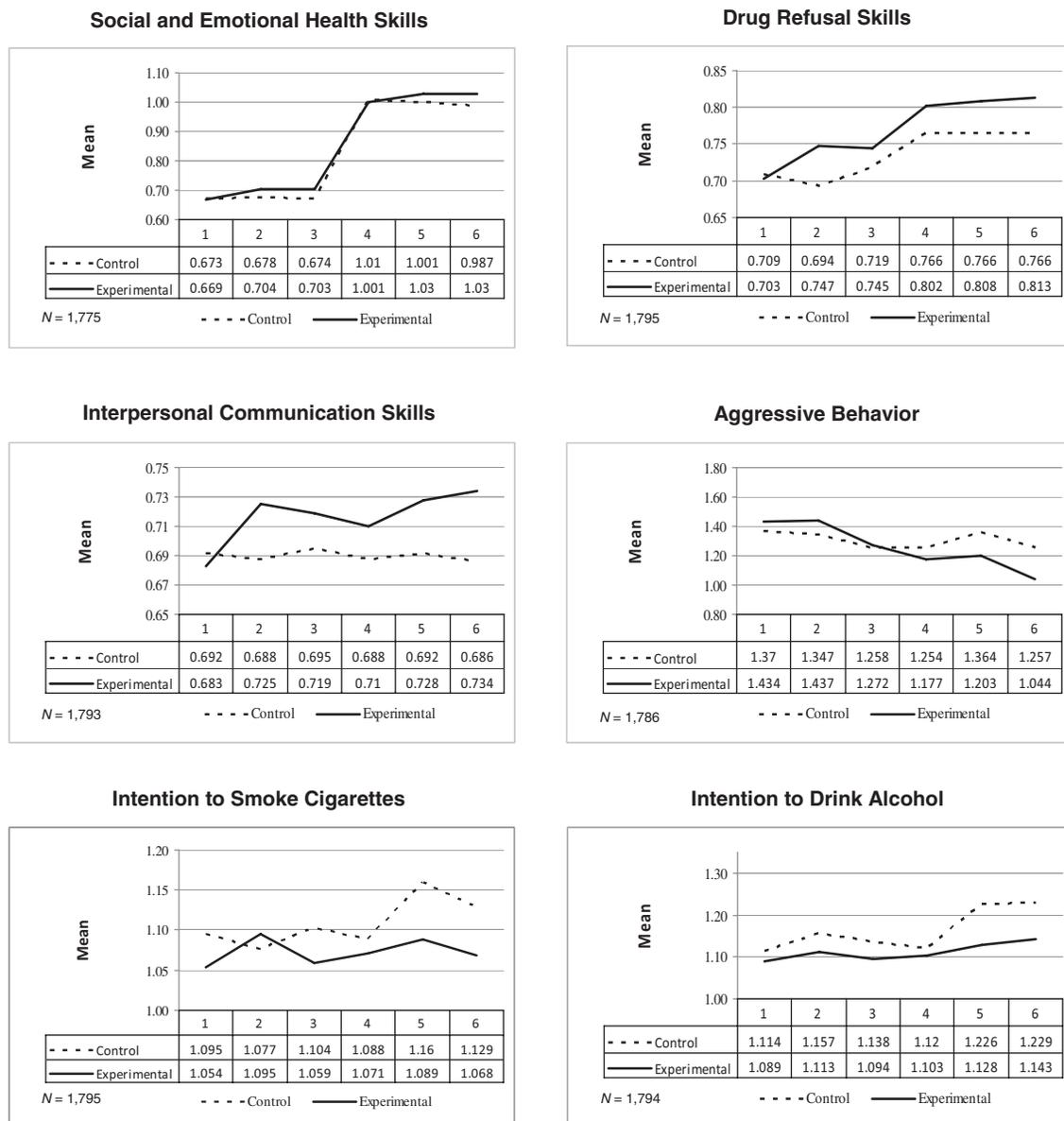
The likelihood of recent alcohol use among Caucasians students (prevalence: 4.4%) was similar to that for African-American students (prevalence: 4.8%) ($p = .924$), but was significantly lower compared to students self-identified as belonging to another ethnic group (prevalence: 7.4%) (OR = 0.58, 95% CI = 0.37, 0.93, $p = .023$). Similar results were found for recent smoking, as the prevalence for Caucasian students (prevalence: 2.2%) was similar to that of African-American students (prevalence: 1.5%), but significantly lower than found for students who reported to be another ethnic group (prevalence: 4.3%) (OR = 0.52, 95% CI = 0.27, 0.97, $p < .05$).

DISCUSSION

The main purpose of this project was to evaluate a comprehensive health education program designed to increase students' health-promoting skills and prosocial behavior as well as reduce or prevent aggression and substance abuse intentions and behaviors. There was strong evidence of an intervention effect for students in fourth grade who were evaluated longitudinally through fifth grade. Compared to their control group counterparts, students in the intervention schools exhibited better social and emotional skills, interpersonal skills, and drug refusal skills, plus lower levels of aggression and drug use intentions and behavior. The use of an experimental design and demonstration of baseline equivalence support a conclusion of a causal effect between the intervention and observed outcomes. It is noteworthy that these outcomes were achieved despite loss to attrition of students with poorer health-promoting skills and higher levels of drug use and aggression than those who were retained, suggesting that the observed effects may be an underestimate of the program's effectiveness.

Two outcomes—self-management and prosocial behavior—were not impacted by the program. However, students in both the intervention and control schools improved significantly in these areas, which suggests the influence of developmental processes that should be explored in future studies. Interestingly, the level of prosocial behavior among attrition students was similar to that of students

Figure 2. Mean Scores for Social Skills, Aggressive Behavior, and Intentions to Use Cigarettes and Alcohol by Treatment Condition and Time of Measurement



retained in the study, despite a convincing pattern of lower skills and higher risk behavior activity among attrition students. There is some evidence that the relationship between prosocial behavior and problem behaviors is complex among elementary age youth,⁵⁰ which warrants further consideration in developing and evaluating prevention and health promotion programs in this population.

Prior research has demonstrated the effectiveness of the MMH for developing healthy behaviors and preventing tobacco, alcohol, and illicit drug use as well as other problem behaviors. This study extends that research and provides first-time empirical evidence concerning the application of the MMH or any other

comprehensive health education program to produce significant changes in multiple health modalities (skills, behavioral intentions, and behaviors) across a variety of health areas (social and emotional health, substance abuse, and aggression) in the same students. More research is needed to determine the durability of these effects as well as the impact of the MMH on additional health behaviors addressed by the program. To that end, this study is part of a larger effort that included evaluation of the MMH units on safety, nutrition, and physical activity in the same sample as reported here. Last, the observed pattern of attrition suggests the need to test the effectiveness of the MMH and other similar universal prevention

Table 1. Binary Logistic Regression Predicting Alcohol and Tobacco Use from Treatment Condition at Final (Fifth-Grade Delayed) Posttest*

Criterion Variable	n	Prevalence (%)		Predictor Variable: Treatment Condition (0 = Control; 1 = Treatment)					
		Cntrl	Tx	B	Wald	p-Value	OR [†]	95% CI for OR	
								Lower	Upper
Ever consumed alcohol	1629	14.3	9.9	0.409	6.94	.008	1.51	1.11	2.04
Drank alcohol in past 30 days	1627	7.1	4.3	0.550	6.13	.013	1.73	1.12	2.66
Ever smoked cigarettes	1639	8.3	5.7	0.432	4.77	.029	1.54	1.05	2.27
Smoked cigarettes in past 30 days	1635	4.4	1.5	1.15	12.39	<.001	3.17	1.67	6.01

CI, confidence interval; Cntrl, control group; OR, odds ratio; Tx, intervention group.

*Two-tailed tests were used in all analyses.

†After controlling for variance associated with gender and ethnicity.

programs on more serious levels of problem behavior, to determine its utility and limits as a selected or indicated prevention strategy.

IMPLICATIONS FOR SCHOOL HEALTH

The finding of reductions in several problem behaviors in elementary students, including early-onset substance abuse, provides empirical support for recommendations to establish comprehensive approaches to prevention and health promotion.^{36,51} Even small, early progress in elementary grades may serve as a catalyst for large health-promoting outcomes as students mature and receive a full scope and sequence of interventions.^{29,52}

Findings from this study also support theoretical models that call for integrated prevention strategies that target multiple, related risk behaviors.^{1,53} Although most school-based prevention programs are in secondary grades,^{39,54} the results of this study and others suggest that elementary-level interventions can produce greater effects on risk behaviors, socio-emotional health, and academic achievement than those starting in middle school or high school.^{28,55}

On a practical level, using comprehensive school-based health education interventions that successfully promote socio-emotional health and prevent multiple problem behaviors is important for schools because (a) they embrace an integrated approach of health education that aligns with a growing effort to develop ecological systems-level learning supports that address multiple barriers to learning;^{56,57} (b) their positive effects can be used to demonstrate accountability in meeting national and state health education standards—standards that in some cases formed the basis of existing comprehensive health education programs; and (c) they decrease the burden of training and resource allocation that typically accompany the use of several distinct programs that each target a different health topic or risk behavior. Ideally, these potential benefits may lead to greater adoption, implementation, and sustainability.³⁹

Human Subjects Approval Statement

This study was approved by the institutional review boards of Madonna University and the Michigan Department of Community Health.

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