Modeling the Diffusion of Prevention in School Contexts: Methods for Strengthening **Causal Inference**



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Background

- Smoking is responsible for \$165 billion dollars in healthcare costs per year in the United States and reduces a person's expected lifespan by up to 10 years (Xu et al., 2015; Jha et al., 2013).
- Almost 90% of tobacco use begins before age 18, which makes adolescence a prime target for prevention of tobacco use (USDHHS, 2014).
- Both peer and parental influence are significant factors in the initiation of smoking in adolescence (Simons-Morton & Farhat, 2010). Peer selection based on smoking status can start as early as sixth grade (Hall & Valente, 2007). Parents have influence through modeling tobacco use or encouraging friendships with nonsmoking peers. Prevention programs that target both parents and peers, such as the Strengthening Families Program 10-14 (SFP), can work well when given in a school context (Molgaard & Spoth, 2001; Spoth et al., 2007).
- Previous research suggests that the effects of family-based programs can propagate across social networks, such as those that exist in schools (Rulison et al., 2015). A conceptual model of this process is shown in Figure 1. If this diffusion effect is significant and lasting, schools that offer programs aimed at families can take advantage of these social network effects to improve student outcomes.

Current Study

- The current study uses data from the PROSPER project, in which evidence-based prevention programs were delivered with fidelity under real world conditions, to test the diffusion effects through adolescent social networks.
- Intervention communities offered both school-based and familybased prevention programs in their middle schools. All students received the school-based program, but only 17% attended at least one session of the family-based program (Spoth et al., 2007). Social network data were collected for all students, which gives the opportunity to study the influence of the family prevention program, SFP, on those who did not participate.
- We used a Potential Outcomes Framework and propensity modeling approach to account for potential confounding factors on peer selection and tobacco use at the end of high school. Propensity models are tools to strengthen causal inference when analyzing observational data (Rosenbaum & Rubin, 1983).

Research Question: Does having friends who received SFP 10-14 in middle school lower the risk of adolescent tobacco use initiation by the end of high school?

13 school districts in the PROSPER intervention communities in Pennsylvania and Iowa

Method

- 5083 students (85% White, 5% Hispanic or Latino, 2% African American, 2% Native American/American Indian, 1% Asian, 5% Other; 50% Male)
- Time 1: Beginning of 6th grade, Time 2: End of 12th grade

Measures

Sample

- Number of friends: Students nominated up to 7 other peers as friends at T1, who were matched against list of students who attended SFP 10-14 (M = 0.66, SD = 0.92, range 0-6).
- Covariates: Twenty-four potentially confounding personal and family characteristics (age, race, sex, attitude toward substance use, parental marital status, etc..) were measured at T1.
- **Outcome**: Students reported lifetime cigarette use as either Yes (1) or No (0) in Wave 8 (M =0.68, SD = 0.47).
- Multiple imputation was used to model the missing data at T2

Figure 1. Conceptual model of peer network connections to SFP 10-14 recipients.



Results

- 69% of adolescents who had no friends who received SFP at T1 had ever smoked a cigarette at T2. 40% of adolescents who had six friends who received SFP at T1 had ever smoked a cigarette at T2.
- The IPWs were tested for balance with all potential confounders, and the weighted correlations were all between -0.2 and 0.2, indicating acceptable balance. The IPWs were all very close to 1, so the unweighted and weighted outcome models were identical.
- The number of friends who received SFP in sixth grade was significantly and negatively associated with the odds of an adolescent ever having smoked by the end of high school (OR = 0.90, 95% CI: 0.84, 0.97). The predicted smoking prevalence broken down by number of friends who received SFP is shown in Figure 2.

Please contact Lawrie Green with any comments or questions (lawrie.green@psu.edu). The research reported here was supported in part by a training grant from the Institute of Education Sciences (R305B090007). It uses data from PROSPER, a project directed by R. L. Spoth and funded by the National Institute on Drug Abuse (RO1-DA013709) and the National Institute on Alcohol Abuse and Alcoholism (AA14702). These opinions expressed are those of the authors and do not necessarily represent the granting agencies.

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Analysis Plan

- 1. Create propensity model. A continuous propensity model was used to estimate the probability that a student had a given number of friends who attended SFP, taking into account the values of the measured confounders.
- 2. Calculate inverse probability weights. Inverse probability weights (IPWs) were calculated from the propensity score to model the inverse probability that a student has a given level of exposure to the treatment (i.e. number of friends who attended SFP) given the potential confounders.
- Assess balance. The IPWs were tested for balance using weighted and unweighted Pearson correlations between the confounders and the exposure variable.
- 4. Model outcome. We tested the impact of having a number of friends who received SFP at the beginning of middle school on smoking at the end of high school using weighted (with the IPWs) and unweighted logistic regression models with the GLM package in R.

Figure 2. Estimated impact of number of friends who received SFP on lifetime smoking in twelfth grade.



Conclusion

- Offering a family program resulted in additional reduction of risk compared to the school-based program that all students in this sample received. Family-based prevention programs can change the attitudes and norms around substance use for both those who participate and their friends, which makes them a promising option for schools to offer to their students and families.
- This sample was mostly rural and White, so more research should be done to study these effects in other populations. There could also be other, unmeasured, confounding variables that affected adolescent peer selection.
- The adolescents in this sample had a much higher rate of smoking than the national average (46%). Electronic cigarette use is also on the rise, especially among adolescents, which indicates the need for more tobacco prevention programs.
- Using propensity models can strengthen our ability to draw causal inferences about the effects of prevention programs.