Does Information Matter? The Effect of the Meth Project on Meth Use among Youths*

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Abstract

Are demand-side interventions effective at curbing drug use? To the extent demand-side programs are successful, their cost effectiveness can be appealing from a policy perspective. Established in 2005, the Montana Meth Project (MMP) employs a graphic advertising campaign to deter meth use among teens. Due to the MMP's apparent success, seven other states have adopted Meth Project campaigns. Using data from the Youth Risk Behavior Surveys (YRBS), this paper investigates whether the MMP reduced methamphetamine use among Montana's youth. When accounting for a preexisting downward trend in meth use, effects on meth use are statistically indistinguishable from zero. These results are robust to using related changes of meth use among individuals without exposure to the campaign as controls in a difference-in-difference framework. A complementary analysis of treatment admission data from the Treatment Episode Data Set (TEDS) confirms the MMP has had no discernable impact on meth use.

Keywords: Methamphetamine use; Meth Project; Anti-drug campaigns; Youth
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"In 2005 Montana had one of the highest rates of methamphetamine use in the country, and all of the problems that go with it…An aggressive public awareness campaign was the answer."
The Economist

I. Introduction

The annual economic burden of methamphetamine ("meth") in the U.S. was recently estimated to be $23.4 billion; this translates into roughly $26,000 for each individual who used meth in the past year or around $74,000 for each dependent user (RAND 2009). Methamphetamine use is the dominant drug problem in Western and Midwestern United States (Rawson et al. 2002). Based on a 2007 survey of law enforcement officials, 47% of county sheriffs reported meth as their number one drug problem. That was more than marijuana (22%), cocaine (21%), and heroin (2%) combined (National Association of Counties (NACO) 2007). In 2005, approximately 4.3% of the U.S. population and around 4.5% of high school seniors reported having used methamphetamines (National Institute on Drug Abuse (NIDA) 2006). In communities plagued by meth use, addicts place a substantial burden on healthcare facilities, county jails, and state and federal penitentiaries (Gonzales 2006; NACO 2006). Taxpayers bear significant medical and dental costs associated with incarcerated meth users (Sullivan 2006). Because of the deleterious consequences associated with methamphetamines, it is important to understand whether or not interventions aimed at reducing meth use have a causal influence on consumption.

There are primarily three methods to decreasing drug use: enforcement, treatment, and prevention (Dobkin and Nicosia 2009). Enforcement efforts generally take the form of government intervention and target the supply-side of drug markets. Drug treatment is a demand-side intervention that aims at reducing use and rehabilitating current users. Prevention, also a demand-side intervention, commonly takes the form of raising awareness and providing information to potential and current users through education programs, community action, and anti-drug campaigns. This paper studies the prevention mechanism by examining the effectiveness of an anti-methamphetamine campaign. In 2005, Montana adopted a graphic advertising campaign, the Montana Meth Project (MMP), with the intent of curbing meth use. The objective of the MMP was and remains to educate Montana's youth about the harmful consequences of meth use. Methamphetamine abuse has been a significant problem for the state of Montana. During 2006, roughly 50 percent of the jail population was incarcerated for meth-related offenses and over half of the parents whose children were in foster homes used meth (McGrath 2007).

A large literature has been devoted to examining the impact of advertising and health campaigns on the use of harmful substances. The majority of this research has focused on the effects of tobacco and alcohol advertising bans. Along similar lines, other research has examined the influence that anti-substance publicity and campaigning has had on substance use. The results concerning these types of prevention tactics are far from decisive.[1] Educational programs designed to discourage individuals from using tobacco, alcohol, and illegal drugs have

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[1] For example, Hoek (1999) finds that tobacco advertising restrictions have little to no effect on smoking behavior, while Saffer and Chaloupka (2000) and Blecher (2008) conclude that comprehensive sets of advertising bans can reduce tobacco consumption. Depken (1999) shows that proscription of advertising does not influence the price of cigarettes in OECD countries. Leu (1984), Hsieh et al. (1996), and White et al. (2003) demonstrate that anti-smoking publicity and campaigns have decreased smoking participation in Switzerland, Taiwan, and Australia respectively. Dietz et al. (2008) show youth-oriented anti-tobacco media to have no influence on adult smoking behavior. Hamilton (1972) and Schneider et al. (1981) find no effect of advertising in the United States. Sly et al. (2001) find that television advertisements from Florida's "truth" campaign lowered the risk of youth smoking initiation. Liu and Tan (2009) evaluate California's Tobacco Education and Media Campaign and find that it reduced the prevalence of smoking among adults and adolescents.

For alcohol advertising bans, results are also mixed. Using data from 17 countries, Saffer (1991) examines the effect of banning broadcast advertising of alcoholic beverages and concludes these bans significantly lower alcohol consumption. However, Young (1993) and Saffer (1993) disagree as to whether or not the results from Saffer (1991) are valid. Tay (2005) shows that publicity campaigns reduce motor vehicle crashes during high alcohol hours. Lastly, Nelson (2003) finds that bans of advertising do not reduce total alcohol consumption in the United States, which partly indicates substitution effects.

also been a popular form of prevention.[2] Results regarding the efficacy of these programs are mixed as well.[3]

This paper makes at least three important contributions to the literature. First, the effectiveness of the MMP has not been empirically scrutinized in a rigorous fashion. This study fills that gap by investigating the impact of the MMP campaign on teen meth use. Second, to the author's knowledge, this is the first paper to evaluate a demand-side intervention that specifically targets the market for methamphetamines.[4] Third, and perhaps most importantly, the findings in this paper have important implications for understanding policy efficacy in illegal drug markets. A demand-side intervention, such as the MMP, represents an extremely low cost program when compared to supply-side involvements that have been shown to have only temporary effects (see below). To the extent such a program works, the cost effectiveness is appealing from a policy-maker's perspective. The annual operating budget of the MMP is approximately $2.5 million, while the economic costs of methamphetamine in Montana have been estimated in the range of $200 to $300 million per year (Stanford GSB 2009; MT Department of Justice 2009).

The MMP has received significant praise since its inception in 2005. In 2006, the MMP campaign was cited by the White House as a model prevention program for the nation (montanameth.org 2009). Due to its apparent success, the campaign has been adopted by seven

[2] Kenkel (1991) illustrates that health knowledge explains part of the relationship between schooling and the consumption of alcohol and cigarettes.
[3] For example, the effects of the once widely popular Project Dare (Drug Abuse Resistance Education) have been documented extensively. Ennet et al. (1994) provide a meta-analysis of Project Dare outcome evaluations.
[4] Other anti-drug media campaigns have generally focused on less addictive substances such as marijuana. Hornik et al. (2008) find that the National Youth Anti-Drug Media Campaign did not have favorable effects on marijuana use among youths. On the other hand, Palmgreen et al. (2001) evaluate the effectiveness of targeted televised public service announcement campaigns and show the ads significantly reduced marijuana use among high-sensation-seeking adolescents.

other states since 2007.[5] Popular press accounts and legislators have attributed large decreases in teen meth use to the MMP (see, e.g., "The Antidrug Lord" 2008; "Graphic Ads" 2008; McCulloch 2009). A recent follow-up report on progress, prepared by the Montana Department of Justice, cites a decrease in meth use among teens of 44.6 percent since 2005 (McGrath 2008). However, Erceg-Hurn (2008) suggests the negative findings have been supported by poor methodology and misrepresented by the MMP. In particular, Erceg-Hurn (2008) cites the lack of an adequate control group from baseline and criticizes the MMP for ignoring preexisting downward trends when citing the success of their program. Yet, Erceg-Hurn (2008) omits any type of formal statistical analysis to support his criticisms.

To assess the impact of the MMP on teen meth use, this paper uses data from the 1999-2009 Youth Risk Behavior Surveys (YRBS).[6] Initial results illustrate that reported rates of meth use were approximately 1.5 to 4 percentage points lower after the adoption of the MMP. However, when accounting for a preexisting downward trend in self-reported meth use, effects on meth use become small and statistically insignificant. These null findings are robust to using the related changes of meth use among individuals in states without exposure to the campaign as controls in a difference-in-difference empirical framework.[7] A separate analysis of admission reports from the Treatment Episode Data Set (TEDS) confirms the MMP has had no discernable impact on meth use. These findings suggest that other factors, such as increased policing efforts

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[5] In chronological order: Arizona Meth Project launched in April 2007; Idaho Meth Project launched in January 2008; Illinois Meth Project launched in February 2008; Wyoming Meth Project launched in June 2008; Colorado Meth Project launched in May 2009; Hawaii Meth Project launched in June 2009; Georgia Meth Project launched in March 2010.

[6] It is important to note the MMP bases their conclusion that the MMP campaign has caused decreases in teen meth use on simple yearly means calculated from these data.

[7] A separate propensity score matching analysis also revealed the MMP campaign to have had no effect on youth meth use. These results are not included in this paper but are available from the author upon request.

that preceded the MMP, are more likely to have contributed to the decrease in the use of methamphetamines.

The remainder of this paper is organized as follows: Section II describes the background of the Montana Meth Project; Section III describes the YRBS data; Section IV lays out the empirical strategy; Section V discusses the results; Section VI analyzes treatment admission data; Section VII concludes.

II. Methamphetamine Interventions and the Montana Meth Project

Methamphetamine is used in a variety of forms and can be smoked, snorted, injected, or ingested orally. As a powerful stimulant, immediate effects of use include increased wakefulness and physical activity and decreased appetite. Hyperthermia and convulsions can occur with an overdose and, if not treated promptly, can lead to death. Long-term effects may include addiction, memory loss, psychosis, violent behavior, mood disturbances, severe dental problems, and weight loss. Chronic abuse has also been linked to changes in brain structure that lead to reduced motor speed and impaired verbal learning (NIDA 2006).

The individual outcomes and economic consequences listed above have motivated multiple supply-side government interventions. Evaluations of these interventions generally conclude the programs have only temporary effects.[8] Moreover, Reuter and Caulkins (2003) emphasize the importance of quantifying the costs of these interventions. They stress that

[8] Cunningham and Liu (2003) illustrate that federal precursor chemical regulations aimed at limiting methamphetamine production and availability had temporary effects on methamphetamine-related hospital admissions in three western U.S. states. Cunningham and Liu (2005) show that precursor chemical regulations aimed at small-scale producers had no impact on methamphetamine-related arrests, while regulations that targeted large-scale producers had temporary effects. Dobkin and Nicosia (2009) analyze a DEA intervention in 1995 that shut down two large suppliers that were providing over 50 percent of the precursors used nationally to produce methamphetamine. The supply interruption resulted in immediate and large decreases in hospital and treatment admissions, meth use among arrestees, and felony methamphetamine arrests. Within 18 months, admissions and arrests returned to their original levels.

regulatory burdens and limitations on the range of products available for therapeutic use need to be considered.

An alternative to supply-side interventions are demand-side programs that target consumers. The Montana Meth Project, a non-profit organization, introduced a large-scale, statewide anti-methamphetamine campaign in 2005. The MMP set about approaching methamphetamines as a consumer product-marketing issue with the goal of providing Montana teens with information on the negative consequences of meth use. In particular, the MMP's objective was to:

> "•Increase the perceived risk and decrease the perceived benefit of trying meth so that perceptions reflected accurate information about the drug;
> •Promote dialogue about the drug between parents and teens, as such dialogue has been shown to decrease illicit drug use; and
> •Stigmatize use, making meth use socially unacceptable, just as cigarette smoking has become socially unacceptable in recent decades" (Siebel and Mange 2009).

Focus group sessions held prior to the launching of the campaign indicated that a majority of teens believed meth to be a "party drug" without the addictive consequences associated with drugs like heroin (Siebel and Mange 2009). The MMP campaign aimed at changing these misperceptions.

The primary element of the MMP campaign has been the use of graphic advertisements.[9] Users are depicted as "unhygienic, dangerous, untrustworthy, and exploitive" (Erceg-Hurn 2008). Ads rely on explicit images that include "illustrations of the decay of users' bodies, young girls selling their bodies to older men for meth, violent criminal behavior committed by

[9] Witte and Allen (2000) provide a meta-analysis of fear appeals and their implications for effective public health campaigns. Soames Job (1988) discusses the effective and ineffective use of fear in health promotion campaigns. Kohn et al. (1982) show threat appeals about drinking and driving to be ineffective in an experimental research design.

meth-hungry teens, and groups of meth users leaving their friends to die" (Siebel and Mange 2009). Youth can be exposed to the campaign several different ways. First, statewide advertisements air as television commercials. Second, radio ads portray the risks of use with actual stories from Montana teens who disclose their personal experiences with meth. Lastly, print ads are featured in high school newspapers and on billboards across the state. Representing the largest advertiser in Montana, the MMP campaign consisted of 45,000 television ads, 35,000 radio ads, 10,000 print impressions, and 1,000 billboards statewide from September 2005 to September 2007.[10] Evaluation of the campaign suggests the advertisements reach 70 to 90 percent of the state's teenage population three times per week (methproject.org 2009).

The MMP was initially a privately funded campaign. Today, the campaign is financed through state and federal dollars and private contributions.[11]

III. Data

The data used in this paper come from the Montana and national Youth Risk Behavior Surveys (YRBS). For the analysis that considers Montana separately, the data cover the period 1999-2009. When individuals from the national sample are included as controls, the analysis is restricted to the period 1999-2007. This restriction is made because the 2009 national data are not yet available. Table 1 provides descriptive statistics of the dependent variable used in this analysis. Table 2 illustrates descriptive statistics for all explanatory variables. Due to missing values, there is complete information for slightly over 13,800 individuals in the Montana YRBS

[10] Since 2007, these numbers have increased to 61,000 television ads, 50,000 radio ads, 139,000 print impressions, and 1,764 billboards (methproject.org 2009).

[11] From 2005 through 2007, the Thomas and Stacey Siebel Foundation invested over $25 million in starting the program, market research and advertisement development (Siebel and Mange 2009). In 2007, the MMP campaign was allotted $2 million from the Montana legislature. Later in the year, this amount was followed by nearly $1.5 million of federal funding. Thomas Siebel, founder of the campaign, has advised the government to contribute $40 million annually in federal funds to MMP-style prevention programs (Erceg-Hurn 2008).

and approximately 61,100 individuals in the national YRBS. Response rates for both surveys were very similar across the sample time frame. Below is a brief description of the YRBS data.

National Youth Risk Behavior Surveys

The national surveys are conducted every other year by the Centers for Disease Control and Prevention (CDC) and provide data on U.S. high school students. The primary purpose of the YRBS is to gather information on youth activities that influence health. Each survey contains a battery of questions that gauge the use of alcohol, tobacco, and other drugs. Other survey questions address daily behaviors such as eating habits, physical exercise, and TV watching. The YRBS data have been used by economists to study a wide range of topics concerning policy evaluations and youth behavior.[12] Though intended to be nationally representative, not all 50 states are represented in any given year the survey has been conducted. For example, students from Montana have not been included in the national surveys. As a result, information from the state-specific Montana survey is augmented with the national data to analyze the difference between changes in Montana meth use and meth use in other states. The data provide student demographic characteristics and self-reported information on participation in risky activities. Additionally, restricted use area-identified versions of the national YRBS are used. These restricted use data identify the respondent's state of residence.

Montana Youth Risk Behavior Surveys

In addition to the national YRBS, state surveys are conducted by state education and health agencies. The questionnaires used at the state-level mirror the national surveys. More

[12] For other studies that use the YRBS data, see, e.g., Carpenter and Cook (2008) on the effect of cigarette taxes on youth smoking; Carpenter and Stehr (2008) on the effects of mandatory seatbelt laws on seatbelt use, motor vehicle fatalities, and crash-related injuries; Chatterji et al. (2004) on alcohol abuse and suicide attempts; Grossman and Markowitz (2005) on risky sexual behavior and substance use; Gruber and Zinman (2001) on trends in youth smoking; Katzman et al. (2007) on the social market for cigarettes; Tauras et al. (2007) on the demand for smokeless tobacco among male high school students.

specifically, the questions used in the analysis below were worded exactly the same for the national and Montana surveys. Similar to the national surveys, the state surveys are conducted every other year and are aimed at collecting information on high school students. For Montana, the YRBS began including questions pertaining to meth use in 1999.[13]

IV. Empirical Strategy

To estimate the effect of the MMP on meth use among Montana's youth, this paper employs two different approaches. The first approach relies on within-Montana variation in meth use to identify the effect of the MMP. This evaluation focuses on meth use before and after the MMP was implemented in 2005. This first-difference approach is estimated by the following equation:

$$Y_{it} = \alpha + \mathbf{X}_{it}\boldsymbol{\beta}_1 + \beta_2 \text{AfterMMP}_t + \varepsilon_{it} \quad (1)$$

where *i* indexes the individual and *t* indexes the year.

In equation (1), Y refers to the binary response of whether or not the individual reports having ever used meth. In particular, survey respondents were asked: "During your life, how many times have you used methamphetamines (also called speed, crystal, crank, or ice)?" **X** is a vector of the individual characteristics described in Table 2. AfterMMP is a dummy variable for observations after the implementation of the MMP. The coefficient of interest, β_2, measures the impact of the MMP campaign on the meth use of Montana's youth. Equation (1) is estimated with weighted least squares where age-by-race populations for the state of Montana are used as weights.[14]

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[13] For a more in-depth discussion of the national- and state-level YRBS, see Centers for Disease Control and Prevention (2004).

[14] The weights were calculated using the National Cancer Institute, Surveillance Epidemiology and End Results, U.S. Population Data.

Equation (1) does not account for unobserved Montana-specific changes that may have influenced meth use. One way to better control for unobserved variables is to include a control group that is plausibly uninfluenced by the MMP. The control group used in this paper consists of teens from states other than Montana and, thus, who are likely to be unaffected by the MMP.[15] Identification in this framework relies on the assumption that meth use among individuals from other states tracks the trend of use among Montana's youth except the out-of-state individuals are not subject to the meth campaign. More specifically, the control group provides instructive counterfactuals for what would have happened to the rate of meth use among youths from Montana had they not been subjected to the MMP. This difference-in-difference (DD) approach is estimated by the following equation:

$$Y_{ist} = \alpha + \mathbf{X}_{ist}\boldsymbol{\beta}_1 + \beta_2 MT_{st} + \beta_3 AfterMMP_t + \beta_4(MT_{st}{*}AfterMMP_t) + \mathbf{S}_s\boldsymbol{\beta}_5 + \varepsilon_{ist} \qquad (2)$$

where *i* indexes the individual, *s* indexes the state, and *t* indexes the year. The variable MT is a dummy variable equal to one if the individual is from Montana. $\mathbf{S}_s$ represents a vector of state fixed effects that control for differences in states that are common across years.[16] The remaining variables are described as above. The interaction term coefficient, β_4, represents the difference-in-difference estimate of the effects of the MMP on meth use among Montana's youth. If the MMP decreases meth use, then we expect β_4 to be negative.

The DD approach addresses at least two important endogeneity issues. First, there is an association between state of residence and meth use. As a result, comparing the behavior of Montana teens to individuals from other states raises some concerns. However, the DD

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[15] It is certainly possible that youths from other states that have visited Montana since 2005 have been subjected to the Montana Meth Project. Though it seems unlikely that this would be a major concern in the analysis, one possible robustness check is to exclude individuals from bordering and nearby states from the control group. The results presented below are robust to these alternative control group specifications.

[16] It is important to note that an indicator for Montana is excluded from the **S** vector. This is done so as to not preclude estimation of β_2.

estimator alleviates some of these issues because it also compares rates of within-Montana meth use before and after the implementation of the MMP. Second, the DD technique controls for the potential endogeneity of the MMP campaign by differencing over time.[17] That is, the DD estimator examines changes in meth use rates, as opposed to differences in levels. As a result, permanent differences in the characteristics of states are taken into account.

All DD models are estimated by weighted least squares where state-specific age-by-race populations are used as weights.[18] Models are estimated with least squares for ease of interpretation; however, the interpretation of the DD results is similar when probit models are used to explicitly model the dichotomous nature of the dependent variable. Following Bertrand et al. (2004), standard errors are clustered at the state-level.

V. Results from YRBS Data

Descriptive statistics

Table 1 presents descriptive statistics of the dependent variable used in the analysis. For visual convenience, Figure 1 plots the means from Table 1. In Figure 1, "methamphetamine use" is defined as having ever used meth during one's lifetime.[19] It is immediately clear that self-reported meth use has been trending downward throughout the sample time frame for Montana's youth. For states other than MT, the downward trend holds for all years after 2001. For Figure 1, it appears that meth use fell slightly more for individuals in Montana after the introduction of

[17] A concern is that the MMP was put into place after the observation that meth levels were higher in Montana than elsewhere.

[18] To simply combine data from the Montana YRBS and national YRBS without weights would result in an overrepresentation of Montana youth.

[19] It should be noted the answer to the "meth use" survey question was interval coded. This allowed respondents to indicate the number of times they have used meth during their life. In results not reported in this paper, dependant variables incorporating information on the frequency of use were considered. The null findings were robust to alternative definitions of the dependent variable. These results are available from the author upon request. The decision to focus on a binary indicator of meth use was primarily made because of the risk of recall bias in past meth use.

the MMP than for youths elsewhere. However, the downward trend for Montana meth use is fairly smooth throughout the sample period; this is contrary to what one would expect if the MMP has had a causal influence on meth use. Most importantly, these data illustrate the importance of controlling for preexisting trends. Figures 2-5 illustrate trends in meth use for subsamples of the population on which one might expect the treatment effect to vary. Figures 2 and 3 separate the general sample by sex, while Figures 4 and 5 consider differences by age. Each figure portrays trends similar to those shown in Figure 1.

[Table 1 about here.]

[Figure 1 about here.]

[Figure 2 about here.]

[Figure 3 about here.]

[Figure 4 about here.]

[Figure 5 about here.]

Table 2 presents descriptive statistics for the remainder of the variables used in the regression analysis. The YRBS data are limited in their content of individual characteristics in that only age, sex, race, and grade are incorporated in all years of the survey. Additional variables are included to control for individual preferences, personality, and risk preference. For example, whether or not an individual is a regular smoker or frequently wears a seat belt when riding in a vehicle proxy propensity towards risk. Sports participation is included to proxy attachment to school and community (Chatterji et al. 2004). Other variables included in the model describe the use of alcohol and other drugs, depression, whether the individual has been in a vehicle with a driver who was under the influence of alcohol, and whether the individual sees a resource teacher at school. Lastly, because MMP anti-meth ads air on Montana television channels, the amount of television the respondent reports watching on an average school day is included to proxy exposure to the campaign's television component.[20] It is important to note these variables may be endogenous if they are a function of the same unobserved factors that influence meth use. However, as long as they are not correlated with the MMP campaign, their inclusion will not bias the MMP coefficients. Evidence from Table 5 suggests the use rates of other drugs were not influenced by the MMP campaign.

[Table 2 about here.]

Further reference of Table 2 illustrates the Montana and national samples are similar along many dimensions. Yet, several characteristics are quite different. For example, Montana youth appear to be more physically active in that they spend less time watching TV and are more likely to participate in sports than individuals from the national sample. The primary difference between the two samples is the distribution of respondents by race.

First-difference results

Table 3 illustrates first-difference regression results for meth use. Here, the dependent variable indicates whether or not the respondent has ever used methamphetamines. Columns 2, 4, and 6 repeat the results from Columns 1, 3, and 5, respectively, with the exception that they include the individual-specific controls described above. In Columns 1 and 2, the coefficient estimates on the AfterMMP variable are negative and significant at the 1% level. The estimate in Column 2 suggests that meth use declined by 4.1 percentage points after the introduction of the MMP. For further perspective, this represents an approximate 38% reduction from the pre-MMP mean of self-reported meth use.

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[20] Unfortunately, due to confidentiality reasons, county- and school-level indicators for the Montana YRBS were not released to the author. These indicators could have been used to better control for exposure to the MMP campaign's billboard component.

Columns 3 and 4 of Table 3 extend the baseline specification by considering a shorter time frame before and after implementation of the MMP. The shorter time window helps determine the stability of the simple first-difference estimator. Under this specification, the AfterMMP coefficient estimates are smaller in magnitude than the baseline estimates, but remain negative and significant. The smaller size of the coefficients should not be surprising given that Figure 1 displays the existence of a downward trend throughout the sample time period.

Columns 5 and 6 of Table 3 explicitly take into consideration the negative trend of meth use among Montana's youth. In particular, these regressions include the independent variable Trend that takes on the value of one in 1999, three in 2001, five in 2003, and so forth. If the MMP has a causal impact on meth use, then one would expect to observe decreases in meth use relative to trend after the campaign was introduced in 2005. When controlling for a preexisting linear trend, the coefficient estimates on AfterMMP decrease considerably in magnitude and are no longer statistically significant at conventional levels. Again, this result should come at no surprise given the foreshadowing of Figure 1. Lastly, the estimates for Trend are negative and significant at the 1% level, emphasizing the importance of controlling for preexisting trends. It is important to note the inclusion of individual-specific controls does not alter the main results of this analysis, further supporting the research design.

[Table 3 about here.]

Difference-in-difference results

Table 4 presents the difference-in-difference results based on estimation of equation (2). The DD estimator is shown in the third row as the coefficient estimate on the interaction term MT*AfterMMP. The baseline specification in Columns 1 and 2 illustrates negative and significant coefficient estimates for MT*AfterMMP. For Column 2, a reduction of 1.5

percentage points represents roughly a 14% decrease in meth use among Montana's youth from the pre-MMP mean. The size of the decrease in meth use is considerably lower for the baseline DD estimate than the baseline first-difference estimate. Because the DD estimator compares the changes in meth use of Montana youth with the changes in use among youth from other states, the large difference between the first-difference and DD estimates is clearly due to the fact that the aforementioned negative trend was prevalent in the national sample as well as in Montana. In Columns 3 and 4, the time window is restricted to a four-year period. The interaction term coefficients remain negative; however, the estimates are much smaller in magnitude. Moreover, the coefficient estimate in the specification that includes individual-specific covariates is no longer statistically significant. Lastly, Columns 5 and 6 include state-specific linear time trends. Here, the interaction term coefficients become positive, remain small in size, and are nowhere near significant. Again, the inclusion of individual-specific controls does not alter the primary findings of this analysis. Overall, the results from Tables 3 and 4 provide little support for a causal decrease in meth use due to the MMP.[21]

[Table 4 about here.]

Other substances

Although the MMP specifically targets the use of methamphetamines, it is possible users (or potential users) of other substances are influenced by the campaign. To examine if the MMP has had an impact on the use of other drugs, Table 5 considers binary indicators as dependent

[21] Because Arizona began its own Meth Project in the spring of 2007, youths from this state do not serve as good "controls" for this year. However, it should be noted, the results are robust to excluding Arizona individuals from the sample.

variables for marijuana, household inhalants, cocaine, and heroin.[22] For marijuana, the dummy variable represents whether or not the respondent reports having used the substance at least once during the past 30 days. For household inhalants, cocaine, and heroin, the dummy variable indicates whether or not the substance has ever been used during the respondent's lifetime. In Column 4 of Table 5, the coefficient on the first-difference estimator is negative and weakly significant at the 10% level for self-reported use of heroin. However, this result is not robust to the DD specification. All remaining coefficient estimates provide strong evidence that the MMP has had no influence on the rates of use of other substances.

[Table 5 about here.]

Subsamples of youths

Table 6 estimates equations (1) and (2) for subsamples of youths by demographic characteristics. Each cell represents a separate regression where the dependent variable indicates whether or not the respondent has ever used methamphetamines. Columns 1 and 2 illustrate the coefficients on the first-difference and DD estimators, respectively. All regressions control for state-specific trends. In considering the entire sample, it is possible that important effects on subgroups go undetected. Table 6 addresses this concern by estimating separate equations for whites, nonwhites, males, females, and youths by age. DD results for nonwhites and younger individuals actually indicate an increase in use after the adoption of the MMP campaign. The results in Table 6 provide little evidence that the MMP reduced use among subgroups of the general youth population in Montana.

[Table 6 about here.]

[22] To be more specific, the exact wording of the question referring to household inhalants is, "During your life, how many times have you sniffed glue, breathed the contents of aerosol spray cans, or inhaled any paints or sprays to get high?".

Exposure to the campaign among MT youth

By the MMP's own estimates, the anti-meth advertisements reach over 70 percent of the state's teenage population three times per week (methproject.org 2009). Yet, it is likely some individuals are exposed to the campaign more than others.[23] Unfortunately, campaign exposure is unobserved in the data. County- and school-level identifiers would help control for exposure to certain elements of the campaign (e.g. exposure to billboards), but these indicators are not available due to confidentiality issues.

As an alternative measure of campaign exposure, Table 7 considers interactions between the AfterMMP indicator and the variables that describe the amount of TV the respondent reports watching on an average school day. Admittedly, the amount of TV watched by a MT teen is a very crude measure of exposure. There is no indication as to how many (if any) of the hours of TV watched are spent on MT-specific stations that air the meth ads. However, it seems reasonable to assume that youths who watch more TV are more likely to be exposed to the anti-meth commercials.

The equation estimated for Table 7 is identical to equation (1) except for the inclusion of the interactions between the AfterMMP variable and the TV dummies. Here, the interaction terms represent DD estimators that exploit the temporal variation of the MMP campaign and the within-MT variation of TV hours watched by the individual respondents. The interaction term coefficient estimates indicate that youths who watch one to three hours or four hours or more of TV per day were no less likely to try meth after the adoption of the campaign than were individuals who reported watching less than one hour of TV per day.

[Table 7 about here.]

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[23] Chou et al. (2008) show the bodyweight of children and adolescents to be sensitive to the amount of exposure to fast-food restaurant television advertising.

Selective recruitment hypothesis

Table 8 investigates the selective recruitment hypothesis.[24] It is possible that youths who display relatively less risky behaviors are the most likely to be influenced by the MMP. Table 8 tests this hypothesis by estimating the effect of the MMP on meth use among subsamples who report not participating (or participating less) in certain risky behaviors. Table 8 follows the format of Table 6 where each cell represents a separate regression that includes state-specific linear trends. Columns 1 and 2 illustrate first-difference and DD estimates, respectively. In particular, Table 8 considers samples of individuals who report having not binge drank in the last 30 days, never regularly smoked cigarettes, not driven under the influence of alcohol in the past month, not carried a weapon in the past month, and worn a seat belt often when riding in a vehicle.[25] All coefficient estimates are negative for the first-difference results; however, none are statistically significant. The DD results also provide no evidence in support of the selective recruitment hypothesis.

[Table 8 about here.]

Robustness to comparison group

A potential issue with the DD results above is the use of the national sample as the control group. As previously noted, the Montana youth appear different from youth in the national sample along several dimensions. Most apparent is the difference in racial composition between the two groups.

[24] The selective recruitment hypothesis has been studied extensively in the literature on the effectiveness of seat belt laws. For example, see Carpenter and Stehr (2008), Dee (1998), and Campbell and Campbell (1988).

[25] "Binge" drinking refers to having had at least five drinks in one sitting during the past month. A "regular smoker" is one who has smoked at least one cigarette per day for a 30 day period in their life. An individual who "wears a seat belt often" is one who has self-reported wearing a seat belt "most of the time" or "always" when riding in a car driven by someone else.

To test the robustness of the results to the specification of the comparison group, data from the North Dakota and Wyoming Youth Risk Behavior Surveys are used. North Dakota and Wyoming border and have similar populations to that of Montana. Additionally, these two states have high levels of youth meth use that are more comparable to rates in Montana than are rates in the national sample. An added benefit to using the North Dakota and Wyoming YRBS is that data for 2009 is available.[26] This allows for examining a longer post-treatment period than is feasible with the national sample. Lastly, by utilizing Wyoming data for 2009, it is possible to observe youth meth use one year after Wyoming started its own Meth Project that was modeled to mimic the Montana campaign.

Because youth from two different states at two different times were exposed to a Meth Project, this analysis is based upon the following modification of equation (2):

$$Y_{ist} = \alpha + \mathbf{X}_{ist}\boldsymbol{\beta_1} + \beta_2 \text{Meth\_Project}_{st} + \mathbf{S}_s\boldsymbol{\beta_3} + \mathbf{T}_t\boldsymbol{\beta_4} + \varepsilon_{ist} \qquad (3)$$

where Meth_Project is equal to one if state *s* has a Meth Project campaign during year *t* and is equal to zero otherwise. **X** is a vector of the individual characteristics described in Table 2 and **S** and **T** represent state and year fixed effects, respectively.[27] β_2 is the coefficient of interest and is analogous to the coefficient on the interaction term in equation (2).

Descriptive statistics for the North Dakota and Wyoming samples are presented in Tables A1 and A2 of the Appendix. Figure 6 illustrates trends in meth use for Montana, North Dakota, and Wyoming. All three states exhibit downward trends in meth use during the sample time frame. Table 9 presents coefficient estimates for the Meth_Project variable. The baseline

[26] The decision to use data from North Dakota and Wyoming was largely made due to the fact that these were the states that border Montana where data for 2009 was available. Data for Idaho and South Dakota (the remaining bordering states) were only available up through 2007.

[27] In regards to **X**, it was not possible to include the individual-level variables for other drug use and sports participation because the questions relevant to these variables were absent for several years of the North Dakota YRBS.

specification in Columns 1 and 2 illustrates negative coefficient estimates that are comparable in magnitude to the baseline estimates for MT*AfterMMP in Table 4. However, these estimates are not statistically significant at conventional levels (Column 1: p-value = .105; Column 2: p-value = .182). Estimates from Columns 3-6 further confirm the Meth Project has had no discernable impact on methamphetamine use.[28]

[Figure 6 about here.]

[Table 9 about here.]

VI. Analysis of the Treatment Episode Data Set

Methamphetamine treatment admission data from the Treatment Episode Data Set (TEDS) are used to compliment the YRBS analysis. Drug treatment providers that receive federal funding are required to submit data to TEDS. For each admission, data on whether the patient tested positive for methamphetamines upon arrival is recorded. With the data from TEDS, it is possible to construct yearly, age- and sex-specific methamphetamine admission rates for each state. Existing research suggests treatment admissions data from TEDS serve as a useful proxy for the total number of methamphetamine users in the general population (Cunningham et al. 2010).

There are at least three benefits to using the TEDS data. First, they provide an objective measure of meth use as opposed to the self-reported data from the YRBS. Second, using annual data from 1995 to 2008, it is possible to observe a longer sample time frame than is feasible with the YRBS data. Moreover, the TEDS data are compiled annually, whereas the YRBS data are collected every other year. Lastly, it is possible to examine whether the MMP has had an impact

[28] To focus solely on Montana's Meth Project, specifications were considered where observations from 2009 were dropped. The null findings were robust to this specification.

on adult populations. Though the MMP specifically targets teenagers in their campaign, it is possible older individuals are influenced by the anti-meth ads.[29] This is of concern because the prison population and foster care caseloads are affected by meth use (Cunningham et al. 2010).

To estimate the effect of the MMP on methamphetamine admission rates, this paper estimates a model that mirrors the YRBS difference-in-difference research design presented above. Specifically, the following equation is estimated:

$$Y_{ast} = \alpha + \mathbf{X}_{ast}\boldsymbol{\beta_1} + \beta_2 MT_{st} + \beta_3 AfterMMP_t + \beta_4(MT_{st}*AfterMMP_t) + \mathbf{S}_s\boldsymbol{\beta_5} + \mathbf{T}_t\boldsymbol{\beta_6} + \mathbf{Trend}_s + \varepsilon_{it} \quad (3)$$

where *a* indexes whether the observed admission rate is for males or females, *s* indexes the state, and *t* indexes the year.

In equation (3), the dependent variable is the natural logarithm of the sex-specific methamphetamine admissions rate per 100,000 of the relevant population.[30, 31] **X** is a vector of characteristics that includes a dummy indicating whether the observed admissions rate is for males or females, the state unemployment rate, the state average per capita income, and the state percentage of the population that is black. MT and AfterMMP are defined as above. **S** and **T** are state and year fixed effects, respectively. Lastly, **Trend** represents state-specific time trends. State populations are used as weights and standard errors are clustered at the state-level (Bertrand et al. 2004)

Table 10 presents descriptive statistics of the data used in the TEDS analysis. Because of the issues mentioned above that are associated with finding an appropriate control group, results

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[29] On a related note, Dietz et al. (2008) show that a youth-oriented anti-tobacco campaign, that supposedly decreased use among youths, had no effect on adult populations.

[30] For example, the meth admissions rate for 18 to 20 year-old males in Montana is calculated based on the population of this age group in Montana for a given year.

[31] To retain sample size, zero values were coded as 0.1 before taking the natural logarithm. Yet, the results were similar if admission rates equal to zero were excluded from observation.

are presented where MT is systematically compared to all other U.S. states, all other Western U.S. states, and all other Mountain states.[32] As is made immediately clear, methamphetamine admission rates are very high in Montana relative to elsewhere. This is especially the case for the older age groups.

[Table 10 about here.]

A problem with the TEDS data is the inability to observe whether the patient has had prior treatment episodes for meth use. This is of particular concern in light of extremely high recidivism rates among individuals seeking treatment for methamphetamine addiction (National Drug Intelligence Center 2006). The TEDS data does contain, however, information on the number of previous treatment episodes the patient has received in any drug or alcohol program.[33] Table 10 also reports mean admission rates conditional on no previous treatment. Across all samples, conditional admission rates are significantly less than unconditional rates. This statistical artifact is consistent with the highly addictive nature of methamphetamines (Winslow et al. 2007). For the sake of brevity, only regression results for unconditional admissions rates are reported. The findings are robust to using conditional rates and are available from the author upon request.

Table 11 presents the DD coefficient estimates of interest from the TEDS analysis.[34] Each column represents a separate regression. The first three columns are results for 15 to 17 year-olds, those youths who are of an age most similar to the YRBS sample. The second three

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[32] The Western states are Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. The Mountain states are Arizona, Colorado, Idaho, Nevada, New Mexico, Utah, and Wyoming. Typically, Hawaii and Alaska are also defined as Western states; but, because of their significantly different geography, demographics, and economies, they are excluded from analysis. Results are, however, robust to their inclusion.

[33] Unfortunately, the information on prior treatment episodes is fraught with missing data. For some years, over 15% of the entries for this variable are coded as missing.

[34] The slight differences in sample size between Columns (1) and (4), (2) and (5), and (3) and (6) are due to missing values.

columns represent estimates for 18 to 20 year-olds and the last three columns are for 21 to 29 year-olds.[35] For each age group, regression estimates are reported that consider the three different control groups mentioned above.

[Table 11 about here.]

While all but one of the estimates in Table 11 are negative in sign, none are statistically significant. For most estimates, the standard errors are quite large. The null findings for the 15-17 year-olds help confirm the results from the YRBS analysis. The Montana Meth Project appears to have had no influence on the meth use of high school aged individuals. The same holds for persons who are in transition from high school to adulthood (i.e. 18-20 year-olds) and for young adults (i.e. 21-29 year-olds).

VII. Conclusion

Methamphetamine use is widely prevalent across the United States and poses a considerable public health threat. Government supply-side interventions to the methamphetamine market have shown to have only temporary effects on meth-related behavior. Moreover, these programs have been criticized due to the regulatory burdens they impose and their potential for limiting the range of products available for legitimate therapeutic use. An alternative to supply-side interruptions, demand-side programs aim to prevent meth use by educating individuals on the adverse consequences associated with methamphetamines.

In 2005, the state of Montana adopted a graphic advertising campaign, the Montana Meth Project (MMP), with the intent of curbing meth use among Montana's youth. What initially began as a privately funded campaign, the MMP is currently financed through state and federal

[35] The TEDS admissions data are available for the 21 to 24 year-old age group and the 25 to 29 year-old age group separately. For conciseness, these two groups are pooled together and a dummy variable is included to control for any time-invariant differences between the two groups. Given the format of the TEDS data, it was not possible to break down the admission rates for 15 to 17 year-olds and 18 to 20 year-olds any further by age.

dollars and private contributions. With an annual operating budget of approximately $2 to $3 million, the MMP represents a potentially low cost alternative to supply-side interventions.

To evaluate the effectiveness of the MMP on teen meth use, this paper uses data from the 1999-2009 Youth Risk Behavior Surveys (YRBS). Initial results show that reported rates of meth use were approximately 1.5 to 4 percentage points lower after the adoption of the MMP. However, upon accounting for a preexisting downward trend in self-reported meth use, effects on meth use become small and statistically insignificant. These results are robust to using the related changes of meth use among youths without exposure to the campaign as controls in a difference-in-difference specification. A complementary analysis of treatment admissions data from the Treatment Episode Data Set (TEDS) confirms the MMP had no effect on meth use.

These results suggest the Montana Meth Project's campaign did not contribute to the decrease in meth use among Montana's youth. From a policy perspective, this research is important because it highlights the ineffectiveness of a campaign that is widely regarded as successful. It is vital for future research to determine whether or not other factors that preceded the MMP contributed to the decrease in teen meth use. For example, drug task forces were committed to seizing clandestine meth labs during the years prior to the introduction of the anti-meth campaign (McGrath 2008). Subsequent studies may also benefit from focusing on trying to quantify trends in sentiment toward methamphetamine that pre-date the MMP. Lastly, this study calls for future research to focus on the determinants of youth meth use so as to better guide the allocation of resources towards effective policies.

Appendix

[Table A1 about here.]

[Table A2 about here.]

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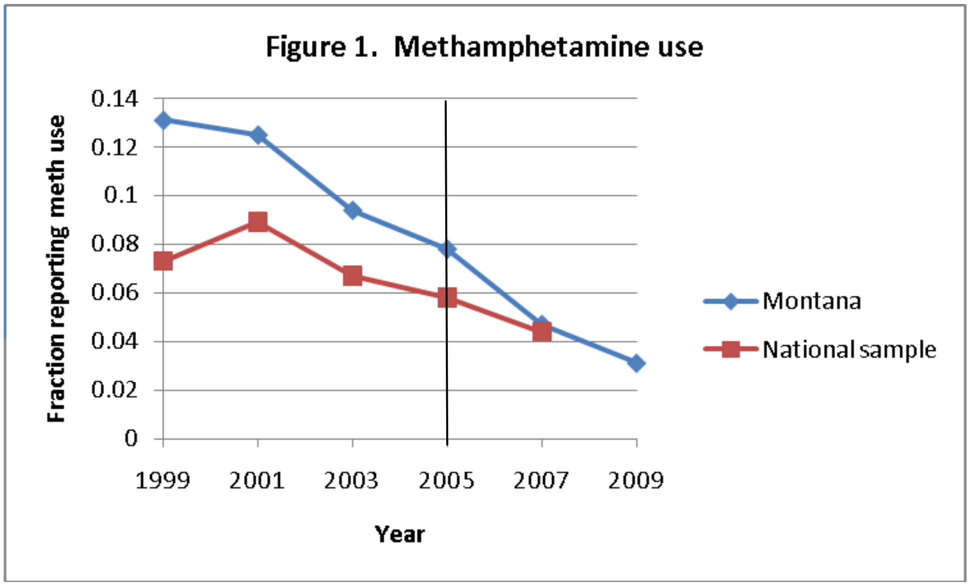
Figure 1. Methamphetamine use
Fraction reporting meth use
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1999
2001
2003
2005
2007
2009
Year
Montana
National sample

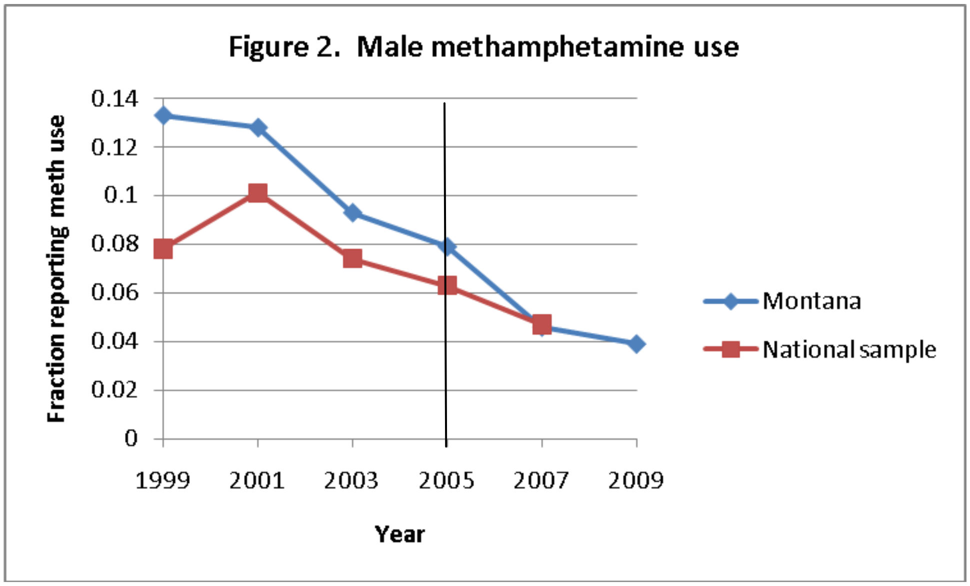
Figure 2. Male methamphetamine use
Fraction reporting meth use
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1999
2001
2003
2005
2007
2009
Year
Montana
National sample

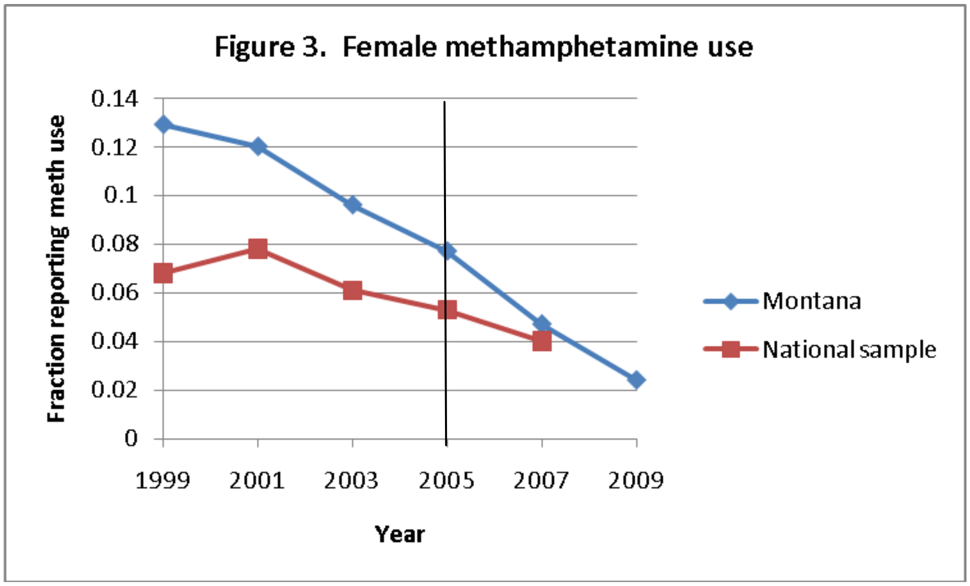
Figure 3. Female methamphetamine use
Fraction reporting meth use
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1999
2001
2003
2005
2007
2009
Year
Montana
National sample

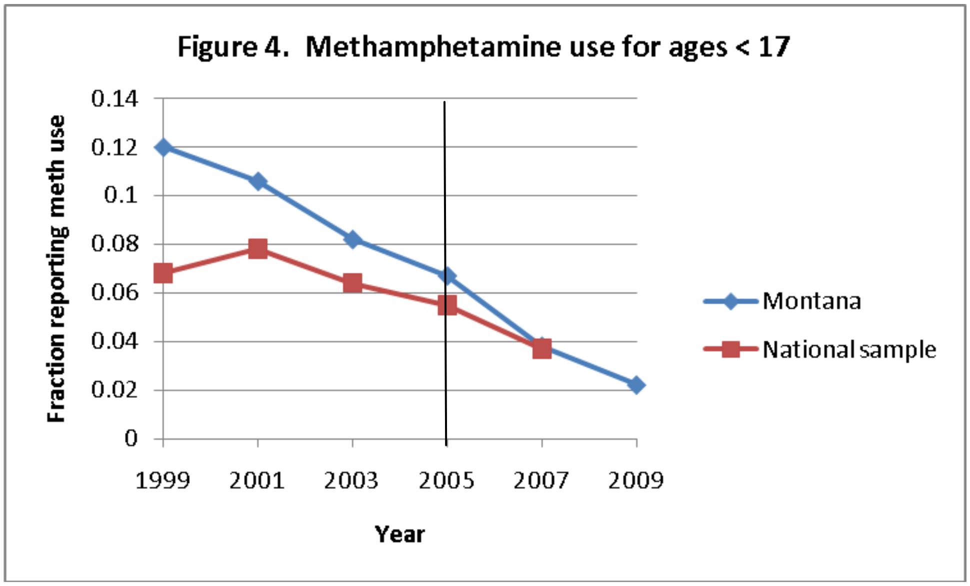
Figure 4. Methamphetamine use for ages < 17
Fraction reporting meth use
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1999
2001
2003
2005
2007
2009
Year
Montana
National sample

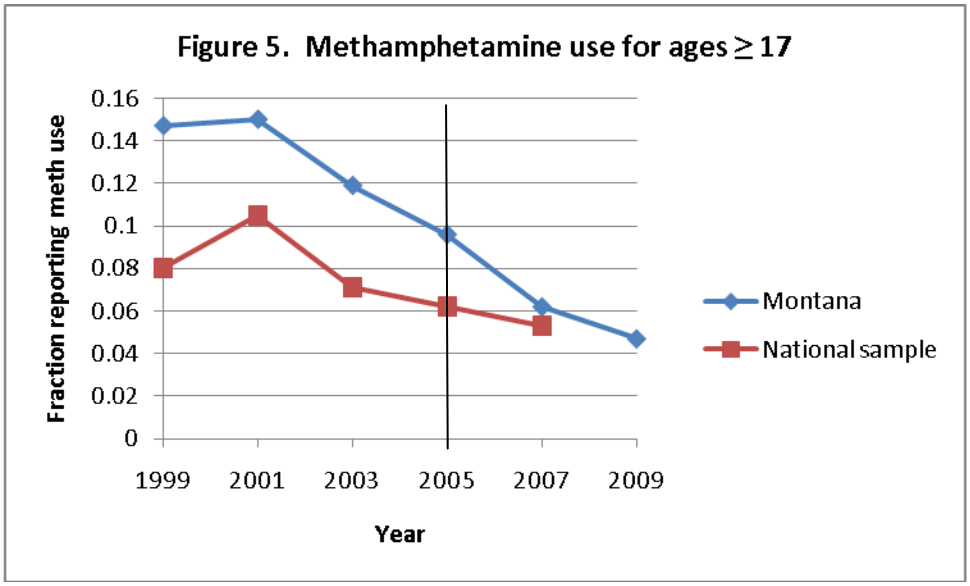
Figure 5. Methamphetamine use for ages ≥ 17
Fraction reporting meth use
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1999
2001
2003
2005
2007
2009
Year
Montana
National sample

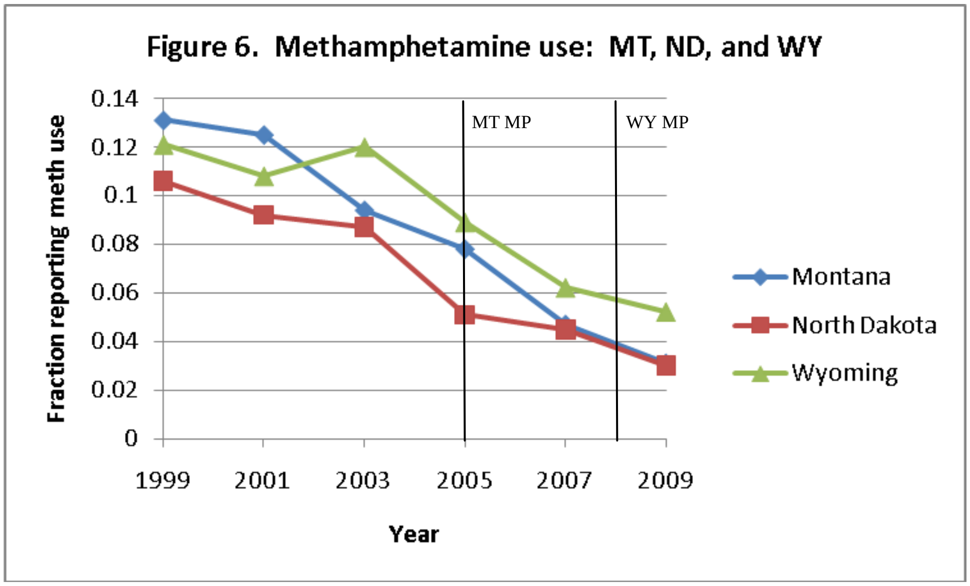

Figure 6. Methamphetamine use: MT, ND, and WY
Fraction reporting meth use
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1999
2001
2003
2005
2007
2009
Year
MT MP
WY MP
Montana
North Dakota
Wyoming

Table 1: Descriptive statistics for MT and National YRBS data: dependent variable

Variable	1999	2001	2003	2005	2007	2009
Montana						
Meth (ever)	0.131	0.125	0.094	0.078	0.047	0.031
Std. Dev.	0.337	0.330	0.292	0.268	0.211	0.174
N	2881	2835	2706	2947	3864	1786
			Pre-MMP (1999-2005)		Post-MMP (2007-2009)	
		Meth (ever)	0.107		0.042	
		Std. Dev.	0.309		0.200	
National sample						
Meth (ever)	0.073	0.089	0.067	0.058	0.044	…
Std. Dev.	0.260	0.285	0.250	0.234	0.204	…
N	15076	13075	14947	13498	13568	…
			Pre-MMP (1999-2005)		Post-MMP (2007)	
		Meth (ever)	0.072		0.044	
		Std. Dev.	0.258		0.204	

Table 2: Descriptive statistics for MT and National YRBS data: independent variables

Variable	Description	National YRBS Mean	National YRBS Std. Dev.	Montana YRBS Mean	Montana YRBS Std. Dev.
Age	Age of respondent.	16.189	1.216	16.069	1.200
Male	Equal to 1 if respondent is a male, 0 otherwise.	0.479	0.500	0.492	0.500
White	Equal to 1 if respondent is white, 0 otherwise.	0.445	0.497	0.853	0.354
Black	Equal to 1 if respondent is black, 0 otherwise.	0.221	0.415	0.008	0.088
Other race	Equal to 1 if respondent is other race, 0 otherwise.	0.334	0.472	0.139	0.346
Freshman	Equal to 1 if respondent is a freshman, 0 otherwise.	0.238	0.426	0.277	0.477
Sophomore	Equal to 1 if respondent is a sophomore, 0 otherwise.	0.248	0.432	0.273	0.445
Junior	Equal to 1 if respondent is a junior, 0 otherwise.	0.255	0.436	0.236	0.425
Senior	Equal to 1 if respondent is a senior, 0 otherwise.	0.256	0.436	0.204	0.403
Ungraded	Equal to 1 if grade is listed as ungraded or other grade, 0 otherwise.	0.002	0.046	0.011	0.103
Depressed	Equal to 1 if respondent felt so sad/hopeless that he/she stopped doing usual activities during the past 12 months, 0 otherwise.	0.294	0.456	0.255	0.436
Regular smoker	Equal to 1 if respondent has ever smoked at least one cigarette per day for 30 days, 0 otherwise.	0.144	0.351	0.166	0.372
Drink often	Equal to 1 if respondent has had at least one drink of alcohol on 6 or more days of the past month, 0 otherwise.	0.139	0.346	0.174	0.379
Marijuana	Equal to 1 if respondent has ever used marijuana in his/her life, 0 otherwise.	0.426	0.494	0.407	0.491
Other drugs	Equal to 1 if respondent has ever used cocaine or heroin in his/her life, 0 otherwise.	0.089	0.285	0.080	0.272

Table 2 (continued): Descriptive statistics

Variable	Description	National YRBS Mean	National YRBS Std. Dev.	Montana YRBS Mean	Montana YRBS Std. Dev.
TV less than 1 hr.	Equal to 1 if respondent watches less than 1 hour of TV on an average school day, 0 otherwise.	0.206	0.405	0.319	0.466
TV 1 to 3 hours	Equal to 1 if respondent watches 1 to 3 hours of TV on an average school day, 0 otherwise.	0.537	0.499	0.581	0.493
TV 4 hours plus	Equal to 1 if respondent watches 4 or more hours of TV on an average school day, 0 otherwise.	0.258	0.437	0.100	0.300
Seat belt often	Equal to 1 if respondent wears a seat belt "Most of the time" or "Always" when riding in a car driven by someone else, 0 otherwise.	0.600	0.490	0.663	0.473
Sports participation	Equal to 1 if respondent played on at least one sports team during the past 12 months, 0 otherwise.	0.542	0.498	0.620	0.486
Passenger of drinking driver	Equal to 1 if, during the past month, the respondent has ridden in a vehicle driven by someone who had been drinking alcohol, 0 otherwise.	0.320	0.467	0.343	0.475
Resource	Equal to 1 if respondent has received help from a resource teacher, speech therapist or other special education teacher, 0 otherwise.	…	…	0.119	0.324

Notes: (1) N = 61,133 (national sample). N = 13,832 (Montana sample). (2) Sample period is 1999-2007 for national YRBS. Sample period is 1999-2009 for Montana YRBS. (3) The information for the Resource variable was only available in the Montana YRBS. As a result, this variable was only included in the first-difference estimations.

Table 3: First-difference estimates for methamphetamine use.

	(1) Baseline Sample: 1999-2009	(2) Baseline Sample: 1999-2009	(3) 4-Year Period: 2003-2007	(4) 4-Year Period 2003-2007	(5) Controlling for Preexisting Linear Trend: 1999-2009	(6) Controlling for Preexisting Linear Trend: 1999-2009
Meth use						
AfterMMP	-0.058***	-0.041***	-0.037***	-0.029***	-0.011	-0.009
	(0.004)	(0.003)	(0.005)	(0.004)	(0.007)	(0.006)
Trend	---	---	---	---	-0.008***	-0.006***
					(0.001)	(0.001)
Individual-specific controls	NO	YES	NO	YES	NO	YES
R^2	0.012	0.422	0.007	0.381	0.017	0.424
N	13832	13832	7749	7749	13832	13832

Notes: (1) Sample is 1999-2009 Montana Youth Risk Behavior Surveys. (2) Each column is a separate regression. (3) Regression models in Columns 2, 4, and 6 control for age, sex, race, grade, and include dummy variables describing depression, smoking, drinking, other drug use behavior, hours spent watching TV, seat belt use, sports participation, whether the individual sees a resource teacher at school, and whether the individual has been the passenger of a drunk driver. (4) Race- and age-specific populations are used as weights. (5) Standard errors are in parentheses. (6) *, significant at 10% level; **, significant at 5% level; ***, significant at 1% level.

Table 4: Difference-in-difference estimates for methamphetamine use.

	(1) Baseline Sample: 1999-2007	(2) Baseline Sample: 1999-2007	(3) 4-Year Period: 2003-2007	(4) 4-Year Period: 2003-2007	(5) Controlling for Preexisting Linear Trend: 1999-2007	(6) Controlling for Preexisting Linear Trend: 1999-2007
Meth use						
MT	-0.038***	-0.012***	-0.001***	0.054***	0.048**	0.103***
	(0.000)	(0.002)	(0.000)	(0.006)	(0.021)	(0.027)
AfterMMP	-0.040***	-0.026***	-0.031***	-0.023***	-0.015**	-0.015*
	(0.002)	(0.005)	(0.003)	(0.006)	(0.006)	(0.008)
MT*AfterMMP	-0.017***	-0.015***	-0.006**	-0.005	0.002	0.005
	(0.002)	(0.004)	(0.003)	(0.005)	(0.006)	(0.008)
Individual-specific controls	NO	YES	NO	YES	NO	YES
State trends	NO	NO	NO	NO	YES	YES
R^2	0.009	0.391	0.010	0.367	0.011	0.392
N	73885	73885	43975	43975	73885	73885

Notes: (1) Sample is 1999-2007 National and Montana Youth Risk Behavior Surveys. (2) Each column is a separate regression. (3) All regression models control for state of residence. Regression models in Columns 2, 4, and 6 also control for age, sex, race, grade, and include dummy variables describing depression, smoking, drinking, other drug use behavior, hours spent watching TV, seat belt use, sports participation, and whether the individual has been the passenger of a drunk driver. (4) State race- and age-specific populations are used as weights. (5) Standard errors are in parentheses and are clustered at the state-level. (6) *, significant at 10% level; **, significant at 5% level; ***, significant at 1% level.

Table 5: First-difference and DD estimates for use of other drugs.

	First-difference estimates				DD estimates			
	(1) Marij.	(2) Inhalants	(3) Cocaine	(4) Heroin	(5) Marij.	(6) Inhalants	(7) Cocaine	(8) Heroin
MT	…	…	…	…	0.066*	-0.204***	-0.197***	-0.013
					(0.033)	(0.008)	(0.012)	(0.019)
AfterMMP	-0.011	0.015	-0.012	-0.008*	-0.014	0.015**	-0.003	-0.009*
	(0.011)	(0.010)	(0.007)	(0.004)	(0.011)	(0.006)	(0.007)	(0.005)
MT*AfterMMP	…	…	…	…	-0.000	0.003	-0.007	0.000
					(0.010)	(0.006)	(0.007)	(0.005)
Trends	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.284	0.173	0.191	0.072	0.297	0.149	0.225	0.075
N	13928	13850	13934	14045	74095	73726	74948	74218

Notes: (1) Sample is 1999-2009 Montana Youth Risk Behavior Surveys for first difference results. Sample is 1999-2007 National and Montana Youth Risk Behavior Surveys for DD results. (2) Each column represents a separate regression. (3) First-difference regressions control for age, sex, race, grade, and include dummy variables describing depression, smoking, drinking, other drug use behavior, hours spent watching TV, seat belt use, sports participation, whether the individual sees a resource teacher at school, whether the individual has been the passenger of a drunk driver, and a linear trend. DD regressions control for age, sex, race, grade, and include dummy variables describing depression, smoking, drinking, other drug use behavior, hours spent watching TV, seat belt use, sports participation, whether the individual has been the passenger of a drunk driver, state of residence, and state-specific linear trends. (4) State race- and age-specific populations are used as weights. (5) Standard errors are in parentheses and are clustered at the state-level for the DD results. (6) *, significant at 10% level; **, significant at 5% level; ***, significant at 1% level.

Table 6: First-difference and DD results for subsamples of youths.

	(1) First-difference estimates (coefficient on AfterMMP)	(2) DD estimates (coefficient on MT*AfterMMP)
Meth use		
Baseline	-0.009	0.005
	(0.006)	(0.008)
	N=13832	N=73885
Whites	-0.009	0.008
	(0.006)	(0.010)
	N=11802	N=38069
Nonwhites	-0.011	0.010***
	(0.019)	(0.003)
	N=2030	N=35816
Males	-0.008	0.005
	(0.008)	(0.009)
	N=6800	N=35579
Females	-0.011	0.003
	(0.008)	(0.008)
	N=7032	N=38306
Age < 17	-0.006	0.011**
	(0.007)	(0.005)
	N=8606	N=42820
Age ≥ 17	-0.017	-0.007
	(0.011)	(0.014)
	N=5226	N=31065

Notes: (1) Sample is 1999-2009 Montana Youth Risk Behavior Surveys for first difference results. Sample is 1999-2007 National and Montana Youth Risk Behavior Surveys for DD results. (2) Each cell represents a separate regression. (3) First-difference regressions control for age, sex, race, grade, and include dummy variables describing depression, smoking, drinking, other drug use behavior, hours spent watching TV, seat belt use, sports participation, whether the individual sees a resource teacher at school, whether the individual has been the passenger of a drunk driver, and a linear trend. DD regressions control for age, sex, race, grade, and include dummy variables describing depression, smoking, drinking, other drug use behavior, hours spent watching TV, seat belt use, sports participation, whether the individual has been the passenger of a drunk driver, state of residence, and state-specific linear trends. (4) State race- and age-specific populations are used as weights. (5) Standard errors are in parentheses and are clustered at the state-level for the DD results. (6) *, significant at 10% level; **, significant at 5% level; ***, significant at 1% level.

Table 7: Teen meth use and television exposure for Montana youth.

	Controlling for Preexisting Linear Trend: 1999-2009
Meth use	
AfterMMP	-0.013*
	(0.008)
TV_1to3hrs	-0.002
	(0.005)
TV_4hrs_plus	-0.010
	(0.008)
AfterMMP*TV_1to3hrs	0.004
	(0.007)
AfterMMP*TV_4hrs_plus	0.012
	(0.012)
Trend	-0.006***
	(0.001)
R^2	0.424
N	13832

Notes: (1) Sample is 1999-2009 Montana Youth Risk Behavior Surveys. (2) Less than one hour of TV watching per day is the reference. (3) Each column is a separate regression. (4) All regression models control for age, sex, race, grade, and include dummy variables describing depression, smoking, drinking, other drug use behavior, hours spent watching TV, seat belt use, sports participation, whether the individual sees a resource teacher at school, and whether the individual has been the passenger of a drunk driver. (5) Race- and age-specific populations are used as weights. (6) Standard errors are in parentheses. (7) *, significant at 10% level; **, significant at 5% level; ***, significant at 1% level.

Table 8: Selective recruitment: Evidence from first-difference and DD results.

	(1) First-difference estimates (coefficient on AfterMMP)	(2) DD estimates (coefficient on MT*AfterMMP)
Meth use		
Baseline	-0.009 (0.006) N=13832	0.005 (0.008) N=73885
No binge drinking past month	-0.005 (0.005) N=8814	-0.002 (0.007) N=51998
Not a regular cigarette smoker	-0.005 (0.004) N=11536	0.002 (0.008) N=62849
Have not driven under influence of alcohol in past month	-0.002 (0.005) N=11280	0.007 (0.007) N=63847
Have not carried a weapon in past month	-0.005 (0.006) N=10830	0.005 (0.008) N=60182
Wear seat belt often	-0.009 (0.006) N=9168	-0.001 (0.007) N=44875

Notes: (1) Sample is 1999-2009 Montana Youth Risk Behavior Surveys for first difference results. Sample is 1999-2007 National and Montana Youth Risk Behavior Surveys for DD results. (2) Each cell represents a separate regression. (3) First-difference regressions control for age, sex, race, grade, and include dummy variables describing depression, smoking, drinking, other drug use behavior, hours spent watching TV, seat belt use, sports participation, whether the individual sees a resource teacher at school, whether the individual has been the passenger of a drunk driver, and a linear trend. DD regressions control for age, sex, race, grade, and include dummy variables describing depression, smoking, drinking, other drug use behavior, hours spent watching TV, seat belt use, sports participation, whether the individual has been the passenger of a drunk driver, state of residence, and state-specific linear trends. (4) State race- and age-specific populations are used as weights. (5) Standard errors are in parentheses and are clustered at the state-level for the DD results. (6) *, significant at 10% level; **, significant at 5% level; ***, significant at 1% level.

Table 9: Alternative control group: Evidence from MT, ND, and WY YRBS data.

	(1) Baseline Sample: 1999-2009	(2) Baseline Sample: 1999-2009	(3) 4-Year Period: 2003-2007	(4) 4-Year Period: 2003-2007	(5) Controlling for Preexisting Linear Trend: 1999-2009	(6) Controlling for Preexisting Linear Trend: 1999-2009
Meth use						
Meth_Project	-0.011	-0.013	-0.008	-0.010	-0.009	-0.008
	(0.004)	(0.006)	(0.012)	(0.012)	(0.008)	(0.009)
Individual-specific controls	NO	YES	NO	YES	NO	YES
State trends	NO	NO	NO	NO	YES	YES
R^2	0.017	0.205	0.009	0.188	0.017	0.205
N	35570	35570	17943	17943	35570	35570

Notes: (1) Sample is 1999-2009 Montana, North Dakota, and Wyoming Youth Risk Behavior Surveys. (2) Each column is a separate regression. (3) All regression models control for state of residence and year fixed effects. Regression models in Columns 2, 4, and 6 also control for age, sex, race, grade, and include dummy variables describing depression, smoking, drinking, marijuana use, hours spent watching TV, seat belt use, and whether the individual has been the passenger of a drunk driver. (4) State race- and age- specific populations are used as weights. (5) Standard errors are in parentheses and are clustered at the state-level. (6) *, significant at 10% level; **, significant at 5% level; ***, significant at 1% level.

Table 10: Descriptive statistics: Treatment episode data, 1995-2008.

	Montana	All states (excl. MT)	Western U.S. states (excl. MT)	Mountain U.S. states (excl. MT)
Meth admission rate, age 15-17	225.74	62.05	179.02	128.27
Meth admission rate conditional on no prior treatment, age 15-17	102.60	35.73	116.02	85.77
Meth admission rate, age 18-20	481.00	94.39	252.05	216.35
Meth admission rate conditional on no prior treatment, age 18-20	217.08	50.71	150.64	120.93
Meth admission rate, age 21-29	705.70	136.03	377.04	285.82
Meth admission rate conditional on no prior treatment, age 21-29	238.38	66.17	201.90	137.99
Unemployment rate	4.569	5.101	5.688	4.642
Income per capita (2000 dollars)	24563.86	30035.63	30858.04	28124.07
Percent black	0.005	0.125	0.056	0.035

Notes: (1) Sample is 1995-2008 Treatment Episode Data Set (TEDS). (2) Sample means are state/year averages. (3) Admission rates are rates per 100,000 of the specified age group population. (4) Western U.S. states are Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Mountain U.S. states are Arizona, Colorado, Idaho, Nevada, New Mexico, Utah, and Wyoming.

Table 11: Methamphetamine admissions by age group. Treatment episode data analysis, 1995-2008.

	15 to 17 year-olds			18 to 20 year-olds			21 to 29 year-olds		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
MT*AfterMMP	0.040	-0.027	-0.424	-0.141	-0.247	-0.068	-0.102	-0.021	-0.008
	(0.228)	(0.160)	(0.909)	(0.235)	(0.179)	(0.141)	(0.235)	(0.148)	(0.181)
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
State trends	YES	YES	YES	YES	YES	YES	YES	YES	YES
Control states:									
All other U.S. states	YES	NO	NO	YES	NO	NO	YES	NO	NO
Western U.S. states	NO	YES	NO	NO	YES	NO	NO	YES	NO
Mountain U.S. states	NO	NO	YES	NO	NO	YES	NO	NO	YES
R^2	0.878	0.898	0.911	0.895	0.902	0.909	0.913	0.909	0.908
N	1359	289	205	1368	290	206	2736	580	412

Notes: (1) Sample is 1995-2008 Treatment Episode Data Set (TEDS). (2) Each column is a separate regression. (3) All regression models also control for sex, the state unemployment rate, state income per capita, and the percent of the state population that is black. (4) Western U.S. states are Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Mountain U.S. states are Arizona, Colorado, Idaho, Nevada, New Mexico, Utah, and Wyoming. (5) State populations are used as weights. (6) Standard errors are in parentheses and are clustered at the state-level. (7) *, significant at 10% level; **, significant at 5% level; ***, significant at 1% level.

Appendix

Table A1: Descriptive statistics for ND and WY YRBS data: dependent variable

Variable	1999	2001	2003	2005	2007	2009
North Dakota						
Meth (ever)	0.106	0.092	0.087	0.051	0.045	0.030
Std. Dev.	0.308	0.289	0.282	0.221	0.208	0.170
N	1795	1583	1648	1712	1693	1787
Wyoming						
Meth (ever)	0.121	0.108	0.120	0.089	0.062	0.052
Std. Dev.	0.326	0.310	0.325	0.285	0.241	0.222
N	1625	2724	1522	2448	2145	2813

Table A2: Descriptive statistics for ND and WY YRBS data: independent variables

	North Dakota YRBS		Wyoming YRBS	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Age	16.201	1.190	16.045	1.231
Male	0.488	0.500	0.483	0.500
White	0.877	0.328	0.824	0.381
Black	0.012	0.108	0.013	0.113
Other race	0.111	0.314	0.163	0.370
Freshman	0.246	0.431	0.312	0.463
Sophomore	0.269	0.444	0.265	0.442
Junior	0.263	0.440	0.222	0.416
Senior	0.217	0.412	0.191	0.393
Ungraded	0.005	0.073	0.008	0.090
Depressed	0.217	0.412	0.266	0.442
Regular smoker	0.102	0.302	0.183	0.387
Drink often	0.188	0.391	0.124	0.330
Marijuana	0.326	0.469	0.379	0.485
TV less than 1 hr.	0.290	0.454	0.338	0.473
TV 1 to 3 hours	0.608	0.488	0.556	0.497
TV 4 hours plus	0.103	0.304	0.106	0.307
Seat belt often	0.605	0.489	0.657	0.475
Passenger of drinking driver	0.367	0.482	0.315	0.465

Notes: (1) N = 9,120 (North Dakota sample). N = 11,755 (Wyoming sample). (2) Sample is 1999-2009 North Dakota and Wyoming Youth Risk Behavior Surveys.