Model-based evaluation of local alcohol prevention programs for under-age drinking

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Abstract
Underage drinking is a persistent threat to the health and well-being of young people, and has substantial societal costs. The paper evaluates the impact of Enforcing Underage Drinking Laws (EUDL) program grantees' strategies to reduce underage drinking and associated misconduct. We built databases that included performance measures submitted by grantees, and outcome measures containing campus liquor law violations and fatal traffic accidents. We then geographically mapped these data to the grantee's intervention catchment area using the first three digits of the zip codes or the section center facility code (SCF). We tested specific hypotheses about the relationship between the intervention activities and youth outcomes.

Key Words: Multivariate Models

1. Introduction

Underage drinking is a persistent threat to the health and well-being of young people, and has substantial costs for society. Environmental strategies to reduce underage drinking and associated alcohol-related misconducts focus on changing the context surrounding underage drinking behavior rather than on directly changing the behaviors of individual drinkers.1 The three principles of an environmental strategies approach include (a) media efforts, (b) community-level collaboration to identify, develop, and implement environmental strategies, and (c) an emphasis on access to alcohol (Freisthler, Gruenwald et al., 2003). Community-level interventions using these environmental strategies emphasize macro or systems-level entities such as policy influences, establishments that serve alcohol, and cultures or social networks that perpetuate permissive or accepting attitudes and behaviors toward drinking (Freisthler, Gruenwald et al., 2003). Common intervention activities using an environmental strategies approach include, but are not limited to:

- Enforcement aimed at reducing the social availability of alcohol (e.g., shoulder tap operations, drinker ID verification, and controlled party dispersal operations).
- Server training and compliance checks of local liquor establishments to ensure that they are not selling alcohol to underage patrons (using covert underage buyers).
- Enforcing penalties for use of false IDs, driving while intoxicated, and violating zero-tolerance laws.
- Impaired driving enforcement (i.e., increased number and frequency of driving under the influence [DUI] checks in the community).

[1] Community Anti-Drug Coalitions of America. (2008). The coalition impact: Environmental prevention strategies. Alexandria, VA: CADCA National Community Anti-Drug Coalition Institute

- Local policy development, such as educating State legislatures on the issue of underage drinking and working to change policies and laws.

Evidence suggests that these strategies are indeed effective (Cuijpers, 2002; Gottfredson & Willson, 2003; National Institute on Drug Abuse, 2003; Johnson et al., 1990; Dwyer, 1989). The Office of Juvenile Justice and Delinquency Prevention (OJJDP) supported an environmental strategies approach to reducing underage drinking by providing block grants to all States and the District of Columbia to operate the Enforcing Underage Drinking Laws (EUDL) program. The EUDL program focused on strengthening community collaboration, particularly collaboration between agencies, to leverage shared resources and indirectly limit underage drinking and associated health consequences (Dejong & Langford, 2006; Foran, Heyman, & Slep, 2011; Spera et al., 2012). In addition to the block grants, some States received additional funds through a EUDL discretionary grant program to focus on various sub-populations such as underage Air Force members (see Spera et al., 2010; 2011) or youth living in rural areas (see Saltz, 2009).

1.1 ICF's EUDL Evaluation

Throughout the EUDL program (1998 to 2012), OJJDP amassed a rich source of EUDL performance measures data from all States and DC through the submission of semi-annual reports on the use of grant funds and the activities implemented. However, while some of the EUDL discretionary grant programs have been evaluated (see Spera et al., 2010; 2011; Wake Forest University School of Medicine, 2011), including one study that used a randomized controlled trial approach, there has not been a systematic evaluation of the impact the States have had in using their EUDL block grant funds to reduce underage drinking and associated misconducts. Therefore, ICF was awarded a grant in 2012 to conduct an evaluation of the EUDL program. The evaluation began with an examination of the following three research questions:

1) Which environmental intervention elements are most effective or least effective at changing attitudes, behaviors, and outcomes of underage youth? In short, what works and which widely-used approaches are not producing the intended outcomes?
2) What patterns of effectiveness emerge within and across States? Under what circumstances do certain environmental strategies seem to be most effective?
3) What are the practical applications that can be learned from this research that policymakers, program planners, and the research community can use to augment policy and guide the development of effective interventions?

1.2 Hypotheses

Table 1 below are the 11 hypotheses ICF developed and tested.

Table 1. Derived Variables and Hypotheses

Derived Variable	*Hypothesis*
Active and Well Rounded Coalitions	Regions with more active and well-rounded coalitions involving youth will have a greater impact on reducing underage drinking and associated misconducts compared to regions with less active and less representative coalitions.
Coalitions with both EUDL and non-EUDL Funding	Regions that coupled non-EUDL funds with EUDL funds to support underage drinking prevention activities will be more likely to see impacts on underage drinking outcome than regions that used *only* EUDL funds to support activities.
Coalitions with more intervention activities	Regions implementing more intervention activities across the period will observe greater impacts on underage drinking than those implementing fewer activities.
Coalitions with media intervention	Media interventions will have a greater impact on high school students given their level of exposure to media compared to other types of environmental strategies.
Coalitions focused on enforcement activities	Regions that focus on certain activities (e.g. DUI/DWI enforcement) will observe certain outcomes (e.g. decrease in fatal car accidents).
Coalition with multiple strategies	The impact on underage drinking may be greatest when multiple strategies are leveraged at the same time, such as DUI/DWI enforcement paired with intense media messages in the same reporting period.
Coalition focused on education activities	Regions that focus on education activities *alone* will see little impact on underage drinking outcomes.
Coalitions with changing strategies over time	Given the natural variation in efforts with respect to EUDL, the effects of certain interventions are expected to persist longer than others.
Coalition with evidence based strategies	Grantees in regions that implemented evidence-based strategies will see more positive impacts related to underage drinking and impaired driving compared to grantees in regions that did not implement evidence-based strategies.
Coalition with law enforcement organizations	Coalitions in regions that include at least one law enforcement organization will result in more positive impacts related to underage drinking and impaired driving.
Coalition with measured results	Coalitions with higher self-reported incidents and arrests due to coalition activities will have more of an impact on underage drinking.

2. Methods

To assess the impacts of the EUDL grantees' interventions, we conducted bivariate and multivariate statistical analyses. The independent variables for these analyses originate from a dataset of grantee's performance measures. Two different national data sources were used for dependent variables, or outcome measures, one based on college campus incidents and the other based on automobile fatality data. These data sources are briefly describes below. We then describe the bivariate and multivariate analyses followed by multilevel analyses that incorporate state-level data.

2.1 Data Sources

Grantees provided information on their activities and costs related to their community coalitions, media efforts, enforcement efforts, and education, training, and other activities undertaken. The grantee-level information provides the independent variables for the analyses, the dependent variables or outcome measures came from a number of externa data sources. Two data sources were selected because they offer data at the granular geographic level required for this analysis: 1) the Campus Safety and Security Survey (CSSS), which contains information from institutes of higher education on liquor law violations on their campuses and in the surrounding areas, and 2) the Fatality Analysis Reporting System (FARS), which provides data on automobile crashes, including if the crash was alcohol-related, as well as vehicle and driver characteristics. The covariates used for the analysis include demographic data from the American Community Survey (ACS) and information on state-level alcohol policies, such as the leniency or restrictiveness of their alcohol policies and the minimum age for selling alcohol.

2.1.1 EUDL Grantee Performance Measures Database- DCTAT Grantee Data Collection Form

The common agent for change for environmental prevention is a community coalition—a broad-based set of stakeholders working within the community to develop and implement the environmental approach. Coalition members often include elected officials, local police departments, human service agencies such as health and wellness clinics, alcohol beverage control departments, and voluntary organizations such as drunk-driving prevention groups. The coalition often directs activities in other areas such as undercover buy operations (shoulder tap operations) or sobriety checkpoints. Grantees supplied data on activities and costs in four areas: Coalitions, Media, Enforcement, and Education, training and other activities.

Grantee data came from the semi-annual reports submitted online through the OJJDP's online performance reporting tool (DCTAT). We downloaded, cleaned, and processed these data including renaming variables, creating scales for "select all that apply" variables, and identifying and rectifying anomalies, such as variables with no cases, seemingly duplicative variables, missing variables, and extra variables.2 The overarching goal was to look for inconsistencies and identify ways to re-capture missing data.

2.1.2 Outcome Databases

Campus Safety and Security Survey (CSSS)

We first began building a database for campus liquor violation outcomes, as reported by colleges and universities in the Office of Postsecondary Education's (OPE) annual Campus Safety and Security Survey (CSSS). The CSSS is a required survey of all higher education institutions who participate in the Federal student financial aid program; each year, these colleges and universities are required to disclose information about crime, including liquor law violations,3 on their campuses and in surrounding areas. For a given year,

[2] Specifically, variables that are not present in the "Performance Measure Grids," which list the item number, output measure, and data the grantee should provide in their reporting.

[3] Defined as "The violation of laws or ordinances prohibiting the manufacture, sale, transporting, furnishing, or possessing of intoxicating liquor; maintaining unlawful drinking places; bootlegging; operating a still; furnishing liquor to a minor or intemperate person; using a vehicle for illegal transportation of liquor; drinking on a train or public

the CSSS data files include information regarding arrests, crime, discipline, and hate crimes, by institution campus, from the preceding three years (i.e., the 2013 CSSS data files contain information for 2010, 2011, and 2012). The CSSS data files classify the data into three main categories listed below. The categories and offenses associated with them are defined in The Handbook for Campus Safety and Security Reporting.

- Criminal Offenses
  - Criminal homicide
  - Sex offenses
  - Robbery
  - Aggravated assault
  - Burglary
  - Motor Vehicle Theft
  - Arson
- Hate Crimes
- Arrest and Disciplinary Referrals for Violations of Weapons, Drug and Liquor Laws

In addition, this information is separated into different files, based on location – i.e., on campus, on public property within or immediately adjacent to the campus, and in or on non-campus buildings or property owned by the academic institution. To create our dataset we focused solely on liquor-related arrests, and discipline on-campus, on public property, and at non-campus locations. We excluded Criminal Offenses and Hate Crimes incidents. This dataset was selected, in part, because it offers data at the granular geographic level required for the analyses.

Fatality Analysis Reporting System (FARS)
Traffic fatality data were pulled from the Fatality Analysis Reporting System (FARS), which provides State-level data regarding automobile crashes. We used three of the FARS databases to create our outcome database.

- **The Accident database** which contains specific information related to each accident. It contains the number of people involved in the accident, the number of vehicles involved in the accident, geographic information about the accident and the data of the accident.
- **The Vehicle database** which contains specific information related to each vehicle involved in the crash. The information is similar to the accident database. Information about if alcohol impairment was related to any vehicle involved in the accident.
- **The Person database** which contains specific information about each person in the vehicle involved in the crash. This file contains specific information about the driver, including age and any alcohol impairment.

We used the person database to determine the age of the drivers in the accidents and whether they had consumed alcohol prior to the accident. This information combined with the vehicle and accident databases allowed up to create an accident level database that indicated if an accident involved both alcohol and the driver was a minor. For our analysis, we included only alcohol related accidents where the driver was impaired and underage. We used the geographic coordinates of the accident location to map the accidents to zip codes. We then created a zip code level file with a count of accidents involving drivers who were impaired and underage.

conveyance; and all attempts to commit any of the aforementioned. (Drunkenness and driving under the influence are not included in this definition.)" (http://www.nacua.org/documents/ACE_NACUBO_CleryAct.pdf)

2.1.3 Covariate Database

To control for shifts in the population demographics within states over time in our analyses, we included demographic data from the American Community Survey (ACS). We first combined ACS data from 2011 and 2013 into a single dataset containing selected demographic variables of interest. Specifically, the combined ACS data file contained information related to total population, race/ethnicity, population for whom poverty status is determined, population below poverty rate, percent of population below poverty rate, number of households, mean income estimate for all households, gender, and age by zip code. These zip code-level records were then aggregated into three-digit zip code-level records for each year, 2011 and 2013.

3. Results

We began by examining the correlations between a range of potential independent variables available from grantees, as well as a number of derived variables, and the dependent variables available in the CCCS and FARS data. We then conducted principal component analysis (PCA) to determine the independent contribution of each independent variable. For most of the derived variables, one or two factors account for at least 60% of the variance.

To determine the impact of the of the EUDL grantees' interventions, we divided the data into two time periods. Data from 2006 to 2008 were considered pre-grantees' intervention. Data from 2010 to 2012 were post-grantees' intervention. The CSSS database was then merged with the DCAT database by zip code. Zip codes with a grantee from the DCAT database were considered part of our treatment group and zip codes without grantees were included in the control group. The same procedure was used on the FARs database.

Within each database, CSSS and FARs, we created four groups for comparisons of the differences-of-differences type:

1) Treatment group pre-intervention
2) Control group pre-intervention
3) Treatment group post-intervention
4) Control group post-intervention

Using our four groups, we wanted to assess two kinds of changes which would indicate potential intervention impacts. First, was there a change over time within each of the groups? (i.e., did the number of campus alcohol incidents decrease in the treatment group from pre-intervention to post-intervention?) Second, if there was change between time 1 and time 2 within the treatment and control groups, was it significantly different between the treatment and control groups?

3.1 Bivariate analysis

The initial impact of the grants was assessed through t-tests that compared the mean levels of the dependent measures in the pre- and post- periods. Almost all of these tests showed significant effects for the grants. We then conducted bivariate analyses that examined the associations between the selected independent variables (based on the PCA results) and the dependent variables. These analyses suggested which candidate predictors (or independent variables) would be entered into the multivariate models.

3.2 Multivariate analysis

When we compared the treatment group across time we found that there was a significant change (p-value = .0001) for both the fatality data and the campus safety data. The control group also had a significant change over time (p-value = 0.0001) for the fatality data, but not for the campus safety data (p-value =

0.091). To determine if the change across years was different between the treatment and control groups, we used the difference in differences. We found that there was a significant difference between the control and treatment groups for both databases, p-value=0.05 for the FARs and p-value = 0.0001 for the CSSS data.

We then conducted bivariate analyses that examined the associations between the selected independent variables and the dependent variables. These analyses suggested which candidate predictors (or independent variables) would be entered into the multivariate models. The results of bivariate analyses are not shown as they are very extensive for all the hypotheses of interest.

Our initial multivariate models included all of the hypothesis variables. After eliminating variables that were not significant and controlling for all other variables, we found that active coalitions, coalitions focused on education, and coalitions with multiple strategies had a significant impact on underage drinking. We also found that coalitions with higher self-reported incidents are marginally significant at the 0.1 level, and included this variable in the model. This model, shown in Table 2, suggests that an educational focus led to a reduction in levels of drinking on campus, the opposite of our hypothesis.

Active Coalitions and Coalitions with multiple strategies are significant predictors of campus incidents; however, the direction is opposite of our hypothesis, suggesting they are predictive of an increase in campus incidents. It is likely that more active coalitions and those with multiple strategies are finding more incidents because of their increased activity.

Table 2. Multivariate Analysis of CSSS Data

Derived Variable	*Parameter Estimates*	*Standard Error*	*t Value*	*Pr > |t|*
Active Coalitions	1.12655	0.29602	3.81	0.0002
Coalition with multiple strategies	93.08724	46.25412	2.01	0.0449
Coalition focused on education activities	-11.6146	4.45594	-2.61	0.0095
Coalition with high self-reported incidents	0.06179	0.03504	1.76	0.0787

Table 3 presents the multivariate models developed for the FARS data. As in the CSSS models, active coalitions was a significant predictor of change. Coalitions with media interventions and the inclusion of law enforcement were also significant predictors. Coalitions with high self-reported incidents were again marginally significant at the 0.1 level. Table 3 suggests that grantees with coalitions with law enforcement organizations show reductions in alcohol-related fatalities. Similar to Table 2, more active coalitions and higher levels of media intervention are predictive of an increase in alcohol-related fatalities.

Table 3. Multivariate Analysis of FARS Data

Derived Variable	*Parameter Estimates*	*Standard Error*	*t Value*	*Pr > |t|*
Active Coalitions	2.56721	1.17378	2.19	0.0294
Coalitions with media intervention	95.53406	42.6811	2.24	0.0258
Coalition with law enforcement organizations	*-56.73607*	22.85244	-2.48	0.0135
Coalition with high self-reported incidents	-0.21708	0.11507	-1.89	0.0601

We also considered more expansive multivariate analyses which include demographic data about the community or locality at ZIP code level merged from the American Community Survey (ACS). Tables 4

and 5 show the models fit for CSSS data and FARS data, respectively. For CSSS data, the same four grantee characteristics which were significant in Table 2 remain significant in Table 4 when controlling for demographic variables. In addition, three demographic variables were significant: the percentages of Hispanics and males, and the median age in the local area. As in Table 1, this model suggests that an educational focus led to a reduction in levels of drinking on campus even while controlling for demographics.

Table 4. Multivariate analysis of CSSS data controlling for ACS data

Derived Variable	*Parameter Estimates*	*Standard Error*	*t Value*	*Pr > |t|*
Active Coalitions	0.87998	0.28946	3.04	0.0025
Coalition with multiple strategies	104.57289	54.44966	1.92	0.0556
Coalition focused on education activities	-9.38995	4.31435	-2.18	0.0302
Coalition with high self-reported incidents	0.0322	0.03449	0.93	0.3512
Hispanic Population	-0.002	0.00093098	-2.15	0.0325
Median Age	-80.26546	22.90264	-3.5	0.0005
Male Population	0.00251	0.00075114	3.34	0.0009

Table 5 shows that grantees with coalitions that included law enforcement organizations show reductions in alcohol-related fatality data even while controlling for demographic characteristics. Interestingly, the demographics which were significant for fatality data were different from those found significant for campus data, particularly for the racial/ethnic composition of the local area. Areas with larger concentrations of blacks and Asians showed an increase in fatalities than other areas.

Table 5. Multivariate analysis of FARS data controlling for ACS data

Derived Variable	*Parameter Estimates*	*Standard Error*	*t Value*	*Pr > |t|*
Active Coalitions	2.61075	0.90003	2.9	0.004
Coalitions with media intervention	95.25842	32.34055	2.95	0.0034
Coalition with law enforcement organizations	-68.32385	17.57292	-3.89	0.0001
Coalition with high self-reported incidents	-0.10475	0.08889	-1.18	0.2394
Male Population	-0.02922	0.00232	-12.62	<.0001
Median Age	-111.63726	61.63963	-1.81	0.071
Asian Population	0.02741	0.00787	3.48	0.0006
Black Population	0.01218	0.00346	3.52	0.0005

4. Conclusions

The research has shown the value of using external data in conjunction with grantee-level data in comprehensive multivariate analyses of the impact of local interventions. By merging two data sets of potential outcome measures with the detailed grantee data, and augmenting the analytic data set with demographic data from the ACS, the analyses assessed the impact of the interventions while controlling for demographics.

The results suggest some grantee characteristics that are effective in reducing underage drinking. Campus related incidents were significantly lower in those areas where educational activities were the focus of grantees' efforts. Traffic fatality data for minors were significantly lower for those grantees which built coalitions with law enforcement organizations.
Our ongoing research is expanding these models even further by developing multilevel models which include state-level variables, such as policies and laws related to underage drinking,

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