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Effects of Restricting High Alcohol Content Beverages on Crime in California

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Abstract

Background: Policy restrictions on malt liquor sales have been adopted in several cities throughout the United States in an effort to reduce crime around off-premise alcohol outlets. Although California has implemented the most restrictions on malt liquor sales, no studies in the published literature have evaluated the effects of these policies on reducing crime.

Objectives: We evaluated the effectiveness of malt liquor restrictions on reducing crime around off-premise alcohol outlets in six California cities. We hypothesized that adoption of malt liquor policies would be significantly associated with decreases in crime within areas surrounding targeted outlets.

Methods: We used an interrupted time-series design with control areas to examine the relationship between malt liquor policies and crime reduction. We compared crime rates three years prior and following adoption of malt liquor policies.

Results: Malt liquor policies were associated with modest decreases in crime, largely Part II or less serious crimes such as simple assaults. The effectiveness of malt liquor policies varied by city, with reductions in crime greatest in Sacramento where policies were more restrictive than in other cities. Malt liquor policies were also associated with small increases in nuisance crime, especially in San Francisco.

Conclusion: Results suggest that malt liquor policies may have modest effects on reducing crime when they include strong restrictions on the sale of malt liquor products. Results may be informative to other cities considering whether to maintain or change their malt liquor policies as well as cities considering placing restrictions on other high content beverages.

Introduction

Consumption of malt liquor remains an important public health issue in many cities across the United States (U.S.). Malt liquor is largely sold in single bottle containers in low income and minority communities. Studies have shown that malt liquor use is associated with

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increased crime in areas around alcohol outlets in these neighborhoods (Chen & Paschall, 2003; McKee et al., 2017). Crime and alcohol consumption are both strongly related to social determinants of health. Crime, particularly violent crime, tends to occur more frequently in communities that are under-resourced or have high income inequality (Kennedy et al, 1998; Lochner & Moretti, 2004; Molnar et al, 2008; Raphael & Winter-Ebmer, 2001). In addition, low-income communities and communities of color often have greater access to alcohol through more numerous alcohol outlets (LaVeist & Wallace Jr, 2000; Scribner, Cohen, Kaplan & Allen, 1999) and disproportionately concentrated advertising (Alaniz, 1998). Alcohol consumption, particularly of high alcohol content malt beverages, may exacerbate these conditions in low-income communities further. In their study of alcohol availability and homicide in New Orleans, Scribner et al (1999) found that greater off-premise outlet density predicted greater homicide rates after adjusting for several sociodemographic confounders. Off-premise alcohol outlets are businesses (such as liquor stores) that sell alcohol to be consumed elsewhere, rather than on the premises. Other studies have found similar results while considering different neighborhood and community characteristics as potential confounders or mediators for the association between alcohol outlets and crime (Britt et al, 2005; Campbell et al, 2009; Livingston, 2008; Zhu, Gorman & Horel, 2004).

In order to reduce crime associated with malt liquor use, cities across the country have implemented policies to restrict malt liquor sales (Alcohol Epidemiology Program, (<http://www.aep.umn.edu/index.php/aep-tools/malt-liquor/>); Jones-Webb, Nelson, McKee, & Toomey, 2014). Implementation of alcohol control policies has had a positive impact on alcohol-related problems. For example, raising the minimum legal drinking age (MLDA) has resulted in reduced consumption of alcohol (Subbaraman, 2013), as well as reductions in fatal motor vehicle injuries, assaults, and nuisance crimes (Carpenter & Dobkin, 2015). Other studies suggest that reducing alcohol outlet density may also lead to less crime in neighborhoods (Campbell et al., 2009; Livingston, 2011). Laws restricting sales of alcohol have reduced both consumption of alcohol (Middleton et al., 2010; Toomey & Wagenaar, 1999) and violent crimes (Cook & Moore, 1993; Duailibli et al., 2007; Gruenewald, 2011). This paper examines the effectiveness of malt liquor policies in reducing crime around off – premise (i.e., alcohol sold for off-site consumption) alcohol outlets in six California cities.

Malt liquor is characterized by its higher alcohol content (6–8% alcohol compared to 4–5% for regular beer), larger serving size (e.g., 40 oz. bottles), and cheaper price (Scribner, 2000). Malt liquor consumption has been linked to criminal behaviors (Collins, Bradizza, & Vincent, 2007; Jones-Webb et al., 2011; Vilamovska, Brown-Taylor, & Bluthenthal, 2009) in low income and minority communities potentially due to increased access, higher alcohol content, and larger serving size. Some studies have shown that malt liquor consumption is associated with assaults, robberies, violent crime, participation in gang fights, threatening violence, and drug use (Chen & Paschall, 2003; Parker, McCaffree, & Skiles, 2011; Hoke & Cotti, 2015). Other studies have also linked malt liquor use with nuisance or less serious crimes, such as public drinking, loitering, and public urination (Tarnai, 2003, 2009).

Legal Restrictions on Malt Liquor Sales

One potentially effective way to reduce crime associated with malt liquor use is to implement policies that alter the alcohol environment where malt liquor is sold and consumed. About one-third of the largest U.S. cities have adopted alcohol policies to restrict malt liquor sales in off-premise alcohol outlets (Jones-Webb et al., 2011). These cities have used a variety of restrictions to limit malt liquor sales including limits on certain brands of malt liquor, single containers (e.g., 40 oz. bottles), alcohol content, and container size (e.g., under 25 oz. bottles).

California has enacted more malt liquor control policies than any other U.S. state (Alcohol Epidemiology Program, (<http://www.aep.umn.edu/index.php/aep-tools/malt-liquor/>)). These policies range from restrictions on single containers and container size (e.g., 40-oz bottles) to limitations on alcohol content (e.g., none over 5.7% alcohol by volume). Yet, no studies have evaluated the effectiveness of these policies in lowering crime around off-premise alcohol outlets within California.

A few prior studies have examined the effectiveness of malt liquor policies in reducing crime in other states and cities across the United States. (Tarnai, 2003, 2009). Using time-series analyses, Barajas and colleagues (2011) evaluated the effects of malt liquor restrictions on neighborhood crime in Minneapolis over a two-year period and found malt liquor restrictions were significantly associated with reductions in disorderly conduct crimes. However, these restrictions were also associated with increases in larceny and theft. McKee and colleagues (2017) evaluated effects of malt liquor restrictions on crime in Minneapolis and Washington D.C. and reported some decreases in crime (e.g., vandalism, assaults), but mostly null findings.

More rigorous research is needed to guide cities' efforts to restrict malt liquor sales. Most of the malt liquor policy studies have been descriptive, focused on a single city, have not fully evaluated all types of malt liquor policy restrictions, and employed inadequate control groups. For example, the study by Barajas and colleagues (2011) compared crime within a half mile radius of off-premise alcohol outlets with malt liquor restrictions to crime rates city-wide in Minneapolis. A stronger design for maximizing internal validity would include comparable areas in the same city without malt policy restrictions (Shadish, 2002).

In the current study, we evaluated the effectiveness of malt liquor restrictions on reducing crime around off-premise alcohol outlets in six California cities. It is important to note that California cities regulate the operations of individual alcohol outlets by placing conditions or restrictions on the alcohol license, the conditional use permit, or both. Typically, such restrictions are imposed in response to citizen complaints or police reports of crime or nuisance activity related to the outlet. We hypothesized that adoption of malt liquor alcohol policies would be significantly associated with decreases in crime within areas surrounding targeted outlets. Because less-serious nuisance crimes such as disorderly conduct have been more strongly linked to malt liquor beer consumption (McKee et al., 2017), we also hypothesized that restrictions on malt liquor sales would have the greatest effects on less serious crimes.

Methods

Study Design

We used an interrupted time-series design with non-equivalent control areas (ITS-CG) to examine the relationship between malt liquor policies and crime around off-premise alcohol outlets. An ITS-CG design uses several waves of observation in both intervention and non-equivalent control groups before and after the introduction of an intervention (Biglan, Ary, & Wagenaar, 2000; Cook & Campbell, & Day, 1979). The diagram below is pulled from Shadish, Cook, & Campbell (2002) and illustrates our design, with O signifying observations at a given time t. The top row represents a target outlet, with X being the implementation of a malt liquor policy. The bottom row represents the non-equivalent control outlet, which did not receive a malt liquor policy.

O ₁	O ₂	O ₃	O ₄	O ₅	X	O ₆	O ₇	O ₈	O ₉	O ₁₀
O ₁	O ₂	O ₃	O ₄	O ₅		O ₆	O ₇	O ₈	O ₉	O ₁₀

This design allowed us to control for secular and seasonal patterns as well as threats to internal validity, such as history. Including control areas from the same city further strengthens the study design by allowing us to control for changes in other local alcohol policies and covariates that could also affect crime outcomes as well. In our study, we compared crime rates three years prior and following adoption of malt liquor policies. Study methods were reviewed and approved by the University of Minnesota Institutional Review Board.

Policy and control areas.

For the purposes of this study, we selected six cities in California. These target cities were drawn from a larger study of 30 U.S. cities that have enacted malt liquor policies (Jones-Webb et al., 2011). Our California cities included Oakland, San Diego, Sacramento, San Francisco, Chula Vista, and Oxnard.

Study areas included “buffers” or areas around off-premise alcohol outlets with and without malt liquor restrictions in the six cities. The California Department of Alcohol Beverage Control (ABC) provided lists of businesses licensed to sell alcohol, both off-premise and on-premise (e.g., bars, restaurants, etc.). We used geographic information systems technology (GIS) to geocode the outlet addresses (geocoding rate=100%) and then created 0.25-mile “buffers” (circles) around each off-premise alcohol outlet. Based on prior research, we anticipated that differences in crime outcomes within this small geographic area could be reasonably attributed to the policies being studied; similar geographic areas have been defined in other studies (Jones-Webb et al., 2008; Murray and Roncek, 2008). Any off-premise alcohol outlet with an eligible malt liquor policy (described below) was included as a study area. Any off-premise alcohol outlet with no policy, and whose buffer did not overlap a target buffer, was a potential control area.

To match target areas with control areas, we identified off-premise alcohol outlets within the same city that had similar characteristics as the outlets in the study areas but did not have restrictions on malt liquor sales. Matching criteria included outlet density (on- and off-premise), demographic attributes from the U.S. Census (2010) (population density, percent males aged 15–29, and female-headed households), store type, and neighborhood physical characteristics (e.g., opportunity to loiter, building conditions, physical and social disorder) obtained from Google Street View (GSV). These matching variables were selected because of their association with crime (Griew et al., 2013; Kelly, Wilson, Baker, Miller, & Schootman, 2013; Odgers, Caspi, Bates, Sampson, & Moffitt, 2012; Rundle, Bader, Richards, Neckerman, & Teitler, 2011; Gruenewald and Remer, 2006; Jones-Webb, et al., 2008; LaVeist and Wallace, 2000; Parker, 1995). The procedure included trained raters independently conducting observations of an area using GSV and auditing characteristics of the area, providing descriptions for each matching variable that fit into one of several categories (e.g., neighborhood type could be 1) downtown, 2) urban, 3) suburban, or 4) rural). To assess inter-rater and inter-source reliability, we used Kappa statistics for categorical measures, correlation coefficients for continuous measures, and percent agreement for multinomial measures. A complete description of our GSV-based matching process is provided in Levine Less, et al. (2015).

Data Collection and Measures

Malt liquor policies.—Our key predictor was the presence or absence of a malt liquor policy. We defined a malt liquor policy as any local ordinance, regulation, licensing restriction or condition of operation that restricted the sale or availability of malt liquor, beer, or other malt beverages in off-premise outlets.

Data on malt liquor policies were obtained from online legislative websites and from staff at local zoning offices, city police, and state and regional Alcohol Beverage Control (ABC) officials. We confirmed all policies with local officials by obtaining a written copy of the policy. Policies adopted prior to 2002 were disqualified due to data availability and recall bias concerns. We found 21 eligible outlet-level malt liquor policies across the six cities (Table 1). Six of the policies limit the alcohol content of malt beverages and 15 policies restrict the sale of single containers. Effective dates range from 2006 to 2013.

Crime.—Our outcomes were monthly crime counts, standardized by geographic buffer area. We obtained the date, address, and description of All crimes known to police for the period 2003–2012 from city police departments in all cities except Sacramento. The Sacramento police department referred us to their online website to obtain the data. Crime addresses were geocoded and spatially joined with study areas using GIS technology. The geocoding match rate for the six cities was 92%.

We categorized crimes according to the Uniform Crime Reporting (UCR) system, used by cities to report standardized statistics to the Federal Bureau of Intelligence (FBI). The UCR system distinguishes more-serious offenses (Part I) from less-serious offenses (Part II). We focused on offenses that we expected to be associated with off-premise malt liquor sales

based on previous studies, such as vandalism, narcotics, and assaults (Barajas 2011, Tarnai 2009, Chen & Pascall, 2003; Sampson 1999).

We evaluated several crime outcomes: Part I selected crimes, Part II selected crimes (further split into nuisance crimes and other Part II crimes), assaults, vandalism, narcotics, and All selected crimes combined. Selected Part I crimes included manslaughter, homicide, criminal sexual conduct, and aggravated assault. Selected Part II crimes were disorderly conduct, trespass/loitering, drunkenness, loitering, littering, panhandling, vandalism/property damage, simple assault, narcotics, non-forcible sex offenses, pornography, prostitution, suspicious acts/occurrence, liquor laws, runaway, and weapons. Because our selected Part II crimes were a heterogeneous grouping, we further split them into nuisance crimes (disorderly conduct, trespass/loitering, drunkenness, loitering, littering, panhandling, vandalism/property damage) and other crimes (simple assault, narcotics, non-forcible sex offenses, pornography, prostitution, suspicious acts/occurrence, liquor laws, runaway, and weapons). We also analyzed specific crimes from our Part I and Part II selected crime outcomes: assaults (simple and aggravated), vandalism, and narcotics (because of their high counts). Our outcome for All crimes included all the Part I and Part II selected crimes for this study (see list above). Some offenses were unavailable in some cities (Oxnard with Part I crimes, Part II crimes, and vandalism; Chula Vista with Part II crimes and narcotics).

Statistical Analysis

We compared monthly crime rates three years prior and three years following adoption of malt liquor policies to evaluate whether policy implementation was associated with decreases in crime at the geographic study area level.

We used auto-regressive integrated moving average (ARIMA) time-series modeling developed by Box and Jenkins (1970). ARIMA models are well-suited for long data series (defined as those with 50 or more repeated observations) because they can account for serial autocorrelation, seasonal patterns, secular trends, and offer greater flexibility in estimating intervention effects through the use of transfer functions. Another significant advantage of ARIMA models is that observed and unobserved non-time varying factors, or factors that change slowly, are accounted for and need not be included in the model (Bernal, Cummins, & Gasparrini, 2017).

At least one local control outlet was included to adjust for the potential confounding effects of other policies and potential covariates. The number of crimes committed around control outlets was included in our models as a covariate. Modeling control outlets in this way allowed us to adjust for factors that may impact crime among all alcohol outlets (such as community-wide policies, changes in the economy). The result is a measurement of the change in crime within our target outlet areas that is associated with the policy. Our models do not examine differences between our target and control outlets, but rather change in crime within each target outlet. Previous studies on the health effects of alcohol policy changes have used identical methods to ours: incorporating control outcome variables as covariates (Staras, Livingston, & Wagenaar, 2010; Wagenaar & Holder, 1991; Wagenaar, Maldonado-Molinda & Wagenaar, 2009). The outcomes we analyzed differed for some of the California cities. In San Francisco, Oakland, Sacramento, and San Diego we fit individual models for

eight crime outcomes: Part I selected crimes, Part II selected crimes, nuisance crimes, other Part II crimes, assaults, narcotics, vandalism, and all selected crimes combined. A crime outcome was excluded for a city if it had over 50% zeroes in the pre-period, as defined by the three years prior to policy implementation. The narcotics outcome was excluded from our Chula Vista models, and the Part I, Part II, and Vandalism outcomes were excluded for Oxnard. To control for secular trends and serial autocorrelation, we modeled control area outcomes as time-varying covariates.

We tested the remaining 43 outcomes (32 for San Francisco, Oakland, Sacramento, and San Diego; 6 for Chula Vista; 5 for Oxnard) for serial autocorrelation using an autoregressive integrated moving average (ARIMA) model (Box & Jenkins, 1970). Seventy-six percent showed significant autocorrelation and were modeled using an ARIMA time-series model. The remaining without significant autocorrelation were modeled using Poisson regression. Count data were log-transformed to improve distribution and to ease interpretation (parameter estimates could be interpreted as percent change). Seasonality and nonstationarity were controlled for where indicated. In total, we fit 141 models: one for each crime outcome at each off-premise outlet.

We used SAS software, version 9.3 with either PROC ARIMA or PROC GENMOD for all analyses. We used a criterion of P less than 0.05 (two-tailed test) to evaluate the effects of malt liquor policy adoption on crime outcomes.

Results

Characteristics of Policy and Control Areas

Policy and control areas by design had similar demographic characteristics (Table 2). They had similar population sizes, percentages of males between 15 and 29 years of age, proportions of Hispanic, number of off-premise alcohol outlets, and proportions of high school graduates. Policy areas had more on-sale premise outlets than control areas, however this was not found to be significant.

Crime Prior to Malt Liquor Policy Adoption

Average monthly pre-period counts of All crimes ranged from 2.6 to 185.2 (Table 3). The less serious Part II crimes were more common, ranging from 2.4 to 172.6 per month. Part I crimes were rare and ranged from 1.2 to 12.6 per month in the same period. In general, crime was highest in San Francisco and lowest in Chula Vista (185.2 vs. 2.6) prior to malt liquor policy adoption.

Changes in Crime Following Malt Liquor Policy Adoption

Tables 3 and 4 describe changes in crime following malt liquor policy adoption. Statistically significant reductions in crime were seen in 18 of the 43 crime models. Estimates signify the change in crime for the target outlet that is associated with a malt liquor policy restriction, adjusting for crime in the control outlets. For example, study area F in Oakland saw a 25.97% decrease in All Crimes, equal to 9 fewer crime incidents, after adoption of a malt liquor policy restriction. This decrease was found to be statistically significant at a level of

$p < 0.05$ while adjusting for the crime levels in its control outlets. On the other hand, study area E in Oakland did not see a statistically significant change in crime in the target outlet that was associated with the policy. Decreases in crime across All crime categories ranged between -0.6 to -23.8 crimes per month.

Looking at crime across the two major crime categories, malt liquor policies had greater effects on decreases in Part II than in Part I selected crimes (Table 3). Part II selected crimes decreased in three out of six of the tests (ranging from -1.9 to -23.8 crimes per month); while Part I crimes decreased in only one test and the reduction in crime was negligible (i.e., 0.6 crimes per month).

When examining the two different types of selected Part II crimes, other Part II crimes (e.g., simple assaults, narcotics, weapons) had five of six statistically significant changes in the hypothesized direction (lowest at -1.2 and highest at -24.8 crimes per month) (Table 4). In contrast, Part II nuisance crimes had two of seven statistically significant changes in the hypothesized direction (lowest at -0.4 and highest at -7.8 crimes per month) (Table 4).

The effectiveness of malt liquor policies in reducing crime varied across cities (see Figure 2). Policy areas in Sacramento showed more significant reductions in crime than all other policies areas except San Francisco. Target areas in Sacramento showed significant reductions in crime rates for All crimes combined, Part I and Part II selected crimes, nuisance crimes, other Part II selected crimes, narcotics, and vandalism, with all but one in the hypothesized direction. For example, reductions in All crimes ranged from -2.6 to -22 crimes per month around off-premise alcohol outlets with malt liquor restrictions (Table 3)

Malt liquor policies were also associated with increases in crime. Ten out of the 43 models showed statistically significant increases, ranging from 0.2 to 8 crimes per month. Most of these increases in crime occurred in San Francisco and were related to nuisance crimes such as disorderly conduct, trespass/loitering, drunkenness, littering, and panhandling. In addition, the magnitude of these increases was small (between 2.4 and 3.6 crimes).

Discussion

Malt liquor policies were associated with decreases in crime, largely Part II crimes such as simple assaults as hypothesized. The effectiveness of malt liquor policies varied by city, with reductions in crime greatest in Sacramento. It is important to note that malt liquor policies were also associated with small increases in nuisance crime, especially in San Francisco.

Estimated effects of malt liquor policies on crime for the most part were modest. We observed decreases in crime following adoption of malt liquor policies in fewer than half of our models. Statistically significant decreases in crime were observed primarily for crime outcomes in Sacramento. Across Part 1 and Part 2 crimes, Sacramento showed four significant decreases ranging from 32% to nearly 45%. Additionally, Sacramento saw a total of eight decreases in Vandalism, Narcotics, Part 2 nuisance, and Part 2 other crimes. While other cities, such as San Francisco or San Diego, saw decreases as well, these cities had fewer decreases in crime and many more increases. There are two plausible explanations for our positive findings in Sacramento. First, malt liquor policies in Sacramento were stronger

or more restrictive than malt liquor policies in our other cities. Most of the malt liquor policies in Sacramento (4 of 6) banned all single sales whereas other cities restricted only certain sizes of single bottles (e.g., only 16 oz. bottles). Policies that place stronger restrictions on malt liquor sales may simply be more effective in reducing crime than policies that are less restrictive. Second, crime was lower in Sacramento than in our other cities prior to malt liquor policy adoption (e.g., San Francisco, Oakland); it is possible these policies may be more effective in areas where crime is already low. We also considered whether our results in Sacramento were due to differences in enforcement of malt liquor policies across the six cities. However, based on an earlier study we found that enforcement of malt liquor policies did not vary across the six cities (McKee et al., 2017).

We found that malt liquor policies were more effective in reducing less serious Part II crimes. In addition, we found that malt liquor policies were associated with other less serious crimes, such as simple assaults. Previous studies have also reported malt liquor policies have greater effects on less serious nuisance crimes (McKee et al., 2017). Our study areas are communities with higher rates of crime. Therefore, even small reductions in crime could be seen as a noticeable increase in the quality of life of residents. Reduced crime can also improve the socioeconomic conditions and benefit the residents of a community through increased investment and job opportunities.

Malt liquor policy adoption was also associated with increases in crime. It is important to note that these increases were small and largely limited to nuisance crimes and one city, San Francisco. One reason for this may be due to the fact that the policies in San Francisco focused on restricting products based on alcohol volume rather than single bottle sales. Overall, our results are consistent with earlier studies that found malt liquor policies are associated with both decreases as well as increases in crime around off-premise alcohol outlets. Barajas et al (2011) found that malt liquor restrictions were associated with increases larceny and theft, but decreases in disorderly conduct citations. Findings from McKee et al (2017) showed decreases in assault and vandalism in the state of Washington.

Limitations

Several limitations of our study should be noted. First, although the UCR system has standardized crime reporting to some extent, data are not always collected uniformly in all cities over time. Some crimes were not available in cities (e.g., Oxnard, Chula Vista).

Second, we did not account for spatial autocorrelation in our models. Though our target and control communities were at least five miles apart to avoid overlapping, this may not have accounted for all the spatial autocorrelation present.

Third, we did not assess how well malt liquor policies were implemented across cities. Implementation of alcohol policies can vary across cities and communities. Some alcohol policies may fail not because of their approach, but how well they are implemented. This may be especially true in minority or low-income communities that lack adequate resources to fully implement policies. Future studies should examine how well malt liquor policies are implemented and assess variability in implementation within and across cities.

Because our study is a quasi-experiment, malt liquor restrictions were placed on outlets selectively rather than randomly. Outlets with more complaints or police reports are more likely to have a restriction. As a result, outlets that have the policy restrictions and the control outlets that do not have restrictions may not be equivalent (e.g., outlets with policies may have more police presence). However, inclusion of control outlets that are similar to our intervention outlets in other ways still enables our models to control for factors that may affect all alcohol establishments in a community (e.g., community-wide policies, changes in the economy) and that could affect the crime outcomes.

We compared different types of malt liquor policies and their effects on crime (e.g., policy restricting malt liquor and fortified wine vs. malt liquor only). However, our results for all crime did not change. We also included a variable in our model to control for malt liquor policies with additional restrictions vs. malt liquor policies without additional restrictions; the latter also was not significant in our models. However, further study is warranted into how the restrictiveness of malt liquor policies can change the effects they have on alcohol-related outcomes, including crime.

Implications and Conclusions

To our knowledge, this is one of only a handful of studies that have evaluated the effectiveness of malt liquor policies in reducing crime. In addition, this is one of the first studies to examine the effects of malt liquor restrictions in the state of California. Results may be informative to other cities considering whether to maintain or change their malt liquor policies as well as cities considering placing restrictions on other high content beverages. Our results suggest that malt liquor policies may have some modest effects on reducing crime when they include stronger restrictions on the sales of malt liquor products.

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Figure 1.
Crime Outcomes by Type.

Figure 2.

Each line represents one target study area, sorted by strength of association between malt liquor policy and crime. Some Part 1 models were not run due to excess zero crime counts.

Table 1.**Malt Beverage Products Prohibited for Retail Sale**

City	Study Area	Policy Effective Date	Any Size	Ban Single Containers				Limit Alcohol Content	
				Under 25 oz.	40 oz.	16 oz. or less	Under 16 oz.	Over 5.7%	Over 7.0%
Chula Vista	A	12/16/2008	X						
Oakland	A	3/18/2006							X
Oakland	B	8/24/2006							X
Oakland	C	4/15/2008				X			
Oakland	D	9/22/2008				X			
Oakland	E	7/3/2009			X		X		
Oakland	F	11/26/2008		X					
Oxnard	A	3/16/2013	X						
Sacramento	A	11/14/2006				X			
Sacramento	B	3/13/2006	X						
Sacramento	C	9/18/2006				X			
Sacramento	D	6/14/2007				X			
Sacramento	E	12/29/2006	X						
Sacramento	F	1/30/2007	X						
San Diego	A	10/19/2009	X						
San Diego	B	12/17/2012				X			
San Diego	C	2/8/2013	X						
San Francisco	A	2/28/2006						X	
San Francisco	B	11/28/2006						X	
San Francisco	C	11/6/2006						X	
San Francisco	D	10/25/2011						X	

Table 2.

Demographics of Target vs. Control Areas

Variable	Target Area *	Control Area *	p-value
# onsale outlets/sqmi	49.4 (88.72)	39.2 (76.61)	0.63
# offsale outlets/sqmi	23.68 (19.92)	23.19 (19.74)	0.92
Total population/sqmi	6984.48 (4665.71)	6558.33 (4235.02)	0.71
Proportion of males 15–29 of total males	0.27 (0.078)	0.27 (0.06)	0.80
Proportion Hispanic of total population	0.36 (0.21)	0.29 (0.23)	0.27
Proportion White of non-Hispanic population	0.32 (0.24)	0.35 (0.28)	0.66
Proportion Black of non-Hispanic population	0.18 (0.2)	0.20 (0.20)	0.69
Proportion Asian of non-Hispanic population	0.09 (0.05)	0.11 (0.1)	0.55
Proportion high school graduates of population aged 25 and over	0.68 (0.16)	0.70 (0.19)	0.69
Proportion unemployed of population in the civilian labor market	0.1 (0.05)	0.09 (0.05)	0.57
Proportion of female head of household of total household	0.34 (0.11)	0.34 (0.11)	0.97
Proportion persons living below 150% of fed poverty line, of total population	0.35 (0.14)	0.35 (0.14)	0.89
Proportion households on public assistance of all households	0.09 (0.06)	0.1 (0.07)	0.59
Proportion vacant housing units, of all housing units	0.05 (0.03)	0.05 (0.04)	0.71

* Mean (standard deviation)

Table 3.

Change in Crime (All Crimes, Part I, Part II)

City	Study Area	All Crimes			Part I Crimes			Part II Crimes		
		%change	Avg Crime Pre Period	Crime Count Change	%change	Avg Crime Pre Period	Crime Count Change	%change	Avg Crime Pre Period	Crime Count Change
Oakland	A	3.06%	22	0.7	33.32%	3.7	1.2	4.82%	18.3	0.9
Oakland	B	18.36%	19.1	3.5	17.01%	3.9	0.7	13.80%	15.2	2.1
Oakland	C	22.59%	16.7	3.8	33.38%	4.3	1.4	19.45%	12.4	2.4
Oakland	D	8.32%	8.4	0.7	39.40%	1.3	0.5	1.44%	7.1	0.1
Oakland	E	13.02%	4.3	0.6	-	-	-	-9.19%	3.8	-0.3
Oakland	F	-25.97%	34.7	-9.0	-4.51%	6.9	-0.3	-31.01%	28	-8.7
San Francisco	A	14.98%	53.1	8.0	-20.84%	4.8	-1.0	17.43%	48.3	8.4
San Francisco	B	16.18%	37.8	6.1	18.79%	4.3	0.8	14.47%	33.6	4.9
San Francisco	C	-11.86%	185.2	-22.0	-1.36%	12.6	-0.2	-13.82%	172.6	-23.8
San Francisco	D	-34.01%	5.8	-2.0	-	-	-	-33.75%	5.6	-1.9
Chula Vista	A	13.66%	2.6	0.4	-16.37%	1.2	-0.2	-	-	-
San Diego	A	-10.31%	12.03	-1.2	-	-	-	-8.54%	10.9	-0.9
San Diego	B	-8.23%	5.9	-0.5	-16.37%	1.2	-0.2	-1.03%	5	-0.1
San Diego	C	-	-	-	-	-	-	-	-	-
Sacramento	A	2.19%	9.3	0.2	-44.81%	1.4	-0.6	1.51%	7.9	0.1
Sacramento	B	-25.26%	17.6	-4.4	4.86%	1.6	0.1	-32.40%	16.1	-5.2
Sacramento	C	18.01%	8.6	1.5	-	-	-	17.46%	7.8	1.4
Sacramento	D	-0.96%	9	-0.1	-13.45%	1.2	-0.2	2.13%	7.8	0.2
Sacramento	E	-52.50%	7.9	-4.1	-	-	-	-51.05%	7	-3.6
Sacramento	F	-34.53%	7.6	-2.6	-	-	-	-33.32%	7	-2.3
Oxnard	A	-48.56%	12.7	-6.2	-	-	-	-	-	-

Bolded values are significant at p<0.05.

Change in Crime (other Part 2 nuisance crimes, Part 2 other crimes, and specific types of crime)

Table 4.

City	Study Area	Part 2 nuisance crimes			Part 2 other crimes			Assaults			Narcotics			Vandalism		
		%change	Avg Crime Pre Period	Crime Count Change	%change	Avg Crime Pre Period	Crime Count Change	%change	Avg Crime Pre Period	Crime Count Change	%change	Avg Crime Pre Period	Crime Count Change	%change	Avg Crime Pre Period	Crime Count Change
Oakland	A	-	-	-	-46.10%	13.8	-6.4	7.61%	7.3	0.6	-4.25%	9.8	-0.4	30.91%	2.1	0.6
Oakland	B	13.58%	4.9	0.7	10.84%	10.4	1.1	37.03%	7.7	2.9	-6.07%	6.3	-0.4	17.35%	2.6	0.5
Oakland	C	-2.07%	5	-0.1	31.25%	7.4	2.3	45.95%	7.7	3.5	-0.84%	3.8	0.0	16.82%	2.8	0.5
Oakland	D	11.15%	3	0.3	-6.96%	4.1	-0.3	5.74%	3.2	0.2	24.60%	2	0.5	22.51%	1.6	0.4
Oakland	E	15.55%	1.9	0.3	7.90%	1.8	0.1	20.09%	1.4	0.3	-	-	-	39.19%	1.4	0.5
Oakland	F	-52.59%	14.8	-7.8	-4.25%	13.2	-0.6	-14.04%	14.3	-2.0	27.62%	5.4	1.5	6.82%	3.8	0.3
San Francisco	A	18.78%	12.8	2.4	12.36%	34.6	4.3	1.07%	20.2	0.2	46.70%	7.6	3.5	26.18%	6.6	1.7
San Francisco	B	34.55%	8.5	2.9	8.73%	25.1	2.2	5.33%	13.5	0.7	-4.63%	6.8	-0.3	8.59%	6.1	0.5
San Francisco	C	20.47%	17.7	3.6	-16.00%	154.9	-24.8	-1.41%	31.7	-0.4	-11.55%	79	-9.1	22.91%	9.3	2.1
San Francisco	D	-7.30%	2.2	-0.2	-48.72%	3.3	-1.6	-56.20%	1.7	-1.0	-	-	-	-4.87%	1.9	-0.1
Chula Vista	A	11.68%	0.9	0.1	-19.05%	1.3	-0.2	14.53%	2.6	0.4	-	-	-	16.61%	1	0.2
San Diego	A	-35.04%	4.2	-1.5	-17.13%	6.8	-1.2	31.82%	2.6	0.8	-3.79%	3.4	-0.1	-40.24%	4.2	-1.7
San Diego	B	-6.05%	1.2	-0.1	6.71%	3.8	0.3	-2.92%	2.8	-0.1	17.83%	1.3	0.2	9.95%	1.1	0.1
San Diego	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sacramento	A	35.80%	1.6	0.6	5.81%	6.2	0.4	-	-	-	-0.83%	2	0.0	-	-	-
Sacramento	B	-36.94%	6.1	-2.3	-27.12%	10	-2.7	19.26%	3.8	0.7	-42.00%	2.3	-1.0	-33.39%	4.6	-1.5
Sacramento	C	-12.72%	2.2	-0.3	21.47%	5.6	1.2	-	-	-	25.07%	1.9	0.5	-25.52%	1.4	-0.4
Sacramento	D	4.07%	1.7	0.1	-2.95%	6.1	-0.2	-16.74%	2.8	-0.5	-1.45%	2.1	0.0	9.95%	0.9	0.1
Sacramento	E	11.74%	1.5	0.2	-55.19%	5.5	-3.0	-25.90%	2	-0.5	-37.32%	1.7	-0.6	-	-	-
Sacramento	F	-21.26%	1.9	-0.4	-37.73%	5.1	-1.9	-36.01%	1.3	-0.5	-42.75%	1.8	-0.8	-28.27%	1.4	-0.4
Oxnard	A	-27.91%	2.3	-0.6	-49.34%	10.2	-5.0	-42.96%	3.8	-1.6	-48.25%	3.1	-1.5	-	-	-

Bolded values are significant at p<0.05.