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Discrepancies in Local, State, and National Alcohol Outlet Listings: Implications for Research and Interventions

Adam J. Milam, MD, PhD[a,c], **Clara B. Barajas, MPH**[a], **Zachary Buchalski, MS**[a], **Ling Wang, MS, PhD**[b], **Richard Sadler, PhD**[a], **C Debra M. Furr-Holden, PhD**[a]

[a]College of Human Medicine Division of Public Health, Michigan State University, Flint, U.S.;

[b]College of Human Medicine Department of Medicine, Michigan State University, East Lansing, U.S.;

[c]Bloomberg School of Public Health, Department of Mental Health, Johns Hopkins University, Baltimore, U.S.

Abstract

Background: The availability of local, state, and national data on alcohol outlet density have important implications for policies and interventions aiming to reduce alcohol-related problems. High-quality data on locations of alcohol outlets is important to accurately inform community interventions and public health initiatives, but such data is often not maintained, readily available, or of sufficient quality.

Objectives: This study aims to examine the discrepancies between alcohol outlet databases and how neighborhood characteristics (i.e., income, majority racial population, urbanicity) are associated with the discrepancies between databases.

Methods: Data was collected from national (n=1), local (n=2), and state databases (n=3). Negative binomial regression modes were used to assess discrepancies in alcohol outlet count at the ZIP code level based on the data source.

Results: The average density of alcohol outlets (per 1000 residents) ranged from 0.71 to 2.17 in Maryland, 1.65 to 5.17 in Wisconsin, and 1.09 to 1.22 in Oregon based on different sources of data. Findings suggest high income areas (>200% poverty level) have fewer discrepancies (IR = 0.775, $p < 0.01$), low income areas (below poverty level) have greater discrepancies (IR = 4.990, $p < 0.01$), and urban areas tend to have fewer discrepancies (IR = 0.378, $p < 0.01$) between datasets.

Conclusion: Interventions and policies depend on valid and reliable data; researchers, policymakers, and local agencies need to collaborate to develop methods to maintain accurate and accessible data.

*Corresponding author: Adam J. Milam; phone 410-963-6555; fax 810-600-5609; amilam3@jhu.edu. Reprint requests: Requests for reprints should be sent to Dr. Adam J. Milam; Michigan State University, College of Human Medicine; Division of Public Health; 200 East 1st Street, Flint, MI; 48502; (amilam3@jhu.edu).

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Data availability: The data that support the findings of this study are available from the corresponding author, (A.J.M), upon reasonable request.

Informed Consent: This article does not contain any studies with human participants performed by any of the authors.

Keywords

alcohol outlet databases; policy; alcohol; alcohol outlet density; alcohol outlet listings

Introduction

The oversaturation of alcohol outlets continues to be a major public health problem that impacts the health and safety of communities (Campbell et al., 2009; Hippensteel et al., 2018). Increased alcohol outlet density has been associated with higher overall consumption and associated problems including drinking and driving, traffic crashes, pedestrian injuries, violence, suicide, and reduced life expectancy (Furr-Holden et al., 2016, 2019; Jennings et al., 2014; Popova et al., 2009). Alcohol outlet density and availability are also associated with adolescent purchasing of alcohol (Milam et al., 2014; Rowland et al., 2015) and youth violence (homicide, gunshot injuries, physical fighting, etc.) (Dahlberg, 1998). Indeed, high alcohol outlet density may pressure businesses to lower prices of alcohol due to the competitive market, and thus lead to more sales (Shortt et al., 2015). Interestingly, previous studies have also found that alcohol outlets are associated with neighborhood disorder and disadvantage, where the highest density of alcohol outlets is commonly found in the most deprived neighborhoods (LaVeist & Wallace, 2000; Morland et al., 2002; Pollack et al., 2005).

Generally, alcohol outlets are categorized into two types: on-premise and off-premise. On-premise alcohol outlets refer to locations that sell alcohol for on-site consumption (e.g., restaurants, breweries, wineries, etc.), whereas off-premise refers to locations where alcohol is bought but consumed elsewhere (e.g., from grocery stores, convenience stores, gas stations, etc.) (*Guide for Measuring Alcohol Outlet Density*, n.d.). Moreover, neighborhood characteristics such as income, racial/ethnic population and urbanicity tend to be indicators of the density and types of alcohol outlets in the area. Trangenstein and colleagues found that areas comprised of low-income populations were more likely to have off-premise alcohol outlets, while on-premise alcohol outlets were more common in high-income areas (Trangenstein et al., 2019). LaVeist and Wallace also found liquor stores were often located in low-income and predominantly African American communities (LaVeist & Wallace, 2000). Off-premise alcohol outlets such as liquor stores tend to have larger quantities of alcohol available than on-premise establishments and offer chilled alcoholic beverages (ready to drink) (LaVeist & Wallace, 2000). In particular, off-premise alcohol outlets have been associated with increased risk of unhealthy alcohol consumption (Halonen et al., 2013) and high rates of violence (Furr-Holden et al., 2019; Jennings et al., 2014). Furthermore, alcohol outlet density is higher in urban areas (Hay et al., 2009). Specifically, residents in more-deprived urban areas have easy access to alcohol, as alcohol outlets are often located within walking distance from residential areas (Hay et al., 2009). Unfortunately, access to alcohol outlets in disadvantaged communities makes vulnerable populations even more susceptible to alcohol-related problems. Further, alcohol outlet density in disadvantage areas may also be related to the lack of human and financial resources available in the community to accurately maintain data on the number of outlets, regulations, and most importantly, how these alcohol outlets are impacting the health of residents. Although alcohol outlets can be recognized as problematic, the negative effects of alcohol often remain salient in communities (Furr-Holden et al., 2019).

Researchers have found a decrease in alcohol-related problems when alcohol density is reduced. A community-based intervention in California that resulted in a decrease in alcohol outlets and improved enforcement of drinking and driving laws, found a subsequent decrease in alcohol-related injuries, specifically, assault-related emergency room visits and night-time motor vehicle crashes (Holder et al., 2000). Campbell and colleagues also suggested that a decrease in alcohol outlets could decrease excessive alcohol consumption as the distance between alcohol outlets would increase and thus make alcohol less accessible (Campbell et al., 2009). Even a modest reduction of alcohol outlets has shown to reduce violent crimes in neighborhoods (Zhang et al., 2015). Researchers have similarly examined alternative methods of reducing alcohol consumption, such as reducing the hours stores are allowed to sell alcohol (Popova et al., 2009; Wilkinson et al., 2016), regulating alcohol prices (Ramstedt, 2002), and banning alcohol sales (Campbell et al., 2009). These interventions have been associated with reduced rates of violence (Wilkinson et al., 2016), reduced motor vehicle collisions and alcohol intoxication among young people (age 10–19) (Ramstedt, 2002), and reduced alcohol-related harms and excessive consumption (Campbell et al., 2009).

Because so much of this research hinges on what we understand of and how we define alcohol outlet density, the availability of local, state, and national data for defining alcohol outlet density—and the corresponding way each defines said data—has important implications for policies and interventions. To better understand the impact of alcohol outlet density and reduce alcohol-related problems, researchers have started to examine the quality of the data available on alcohol outlets. Ponicki et al. examined California-based state records on alcohol outlets and were unable to locate 9% of the establishments listed, indicating many outlets were closed (Ponicki et al., 2014). Other researchers have explored alternative measures of alcohol outlet density outside of the state and local databases. Matthews et al. compared estimates of counts of alcohol outlets from local and state listings in Michigan (focusing on communities surrounding college campuses) to those on the U.S. Census Bureau's ZIP Code Business Patterns (ZIP-BP) database and concluded that the ZIP-BP dataset adequately estimates alcohol outlet densities (Matthews et al., 2011). Additionally, Carlos and colleagues looked at alcohol outlets in California using commercial business lists and concluded that business lists were a reliable proxy for licensed alcohol outlets (Carlos et al., 2017).

In an effort to find reliable data on alcohol outlet density, researchers have noted a few limitations, such as accurate reporting of license type and operating characteristics (as some outlets act more as bars but are reported as restaurants because they serve food) (Ponicki et al., 2014) and lack of universal protocol to classify or maintain alcohol outlet data (Matthews et al., 2011). This study's aims are to 1) examine discrepancies between alcohol outlet listings (local, state, and national databases) in three states; 2) validate state databases of alcohol licenses available online to better understand how the level at which alcohol outlet data is collected affects its accuracy; and 3) examine how neighborhood characteristics (i.e., income, majority racial population, urbanicity) are associated with discrepancies between alcohol outlet databases. Identifying discrepancies between alcohol outlet databases is essential to accurately inform community interventions and public health initiatives.

Methods

To measure the validity of state databases of alcohol licenses, data was collected from three states with varying levels of alcohol control: Maryland, Oregon, and Wisconsin. This included data from select counties in each state (for a local comparison) and the 2016 ZIP-BP data collected by the U.S. Census (for a national comparison). We also obtained race and ethnicity data from the 2010 U.S. Census; other demographic and population information by ZIP code was obtained from the 2012–2016 American Community Survey. No consent process was used as this study did not use human participants.

Data Collection

Data on alcohol license information was challenging to obtain, especially at the local level. Many states lack public information on where or by whom alcohol license data is maintained. Through intensive online searching and phone calls, we obtained alcohol outlet listings. The data files received came in different formats, including portal document format (PDFs), which made it difficult to use without reformatting to be compatible with statistical software. More specific barriers with data collection are shared by the state below.

State and local data

Maryland.: Maryland is a mixed alcohol control state; only one county (i.e. Montgomery County) has control over alcoholic beverage sales and distribution. In Maryland, alcohol licenses are issued at the county level. The Maryland Office of the Comptroller maintains a database of alcohol licenses available online (our search was conducted in November 2018). The database includes the liquor license class, address, and business name for each recorded liquor license statewide. We also requested data for the 24 county-equivalents in Maryland, of which a complete license listing was obtained from fourteen counties and the city of Baltimore *(the city of Baltimore is considered a county for administrative purposes)*. The data structure varied by county, but each county also included the alcohol license class/type, address, and business name.

Although we were able to obtain data for the four most populous and densely populous jurisdictions in the state of Maryland and eleven rural counties, the data request process was challenging. Among those contacts who responded to our requests, some directed us back to the state website as the primary public resource for a request for that information. Another contact simply shared they were in compliance with state laws with respect to the number of outlets in their county but did not provide a listing of outlets. The remaining contacts for the state of Maryland did not respond to requests for outlet database information after multiple attempts through US Postal Mail, email, and phone calls.

During data processing, the physical address of alcohol outlets was reviewed to ensure ZIP code accuracy in our analysis. Some outlets in Maryland had an address outside the state of Maryland or did not list an address at all. For cases where the address was missing or outside of the listed jurisdiction (n=36), a Google Map search by the establishment was conducted to determine the physical location of the alcohol outlet; two outlets were included based on the search. There were 414 ZIP codes included for Maryland.

Oregon.: Oregon is an alcohol control state, meaning the wholesaling and retailing of alcoholic beverages is controlled by the state, and the state has a monopoly on alcohol sales. In Oregon, alcohol licenses are obtained at the state level (*Oregon Liquor Control Commission*, n.d.). Upon request, the state of Oregon provided a copy of their alcohol outlet license list in April 2017. This included historical data, going from 2004 to 2017, with the address, licensee name, business name, license type, and the latitude and longitude of the alcohol outlet. Oregon does not maintain separate license data at a local level. There were 393 ZIP codes included for Oregon.

Wisconsin.: Wisconsin is not an alcohol control state and was randomly selected to be included in the study as a comparison state. In Wisconsin, alcohol licenses are issued at the municipal level (where the business is conducted) (*Alcohol Beverage Laws for Retailers Licenses*, 2019). A request for alcohol outlet data was made to the State of Wisconsin and the City of Milwaukee; we received data in January 2019. Similar to the previous datasets, both the statewide and city-level data included the business name, address, and license type for each outlet. All data for every state was later aggregated at the ZIP code level (geographic unit for the national data) based on the address field (759 ZIP codes).

National data—The 2016 ZIP-BP data by the U.S. census was used for our national database. Briefly, the ZIP-BP is updated annually and provides data on businesses with paid employees. The data includes geographic data, the 6-digit NAICS industry, and employment size. We summed the number of establishments operating under NAICS Codes 722410 (Drinking Places), 722511 (Full-Service Restaurants), 445310 (Beer, Wine, and Liquor Stores), 447110 (Gas Stations), 445120 (Convenience Stores), and 445110 (Grocery Stores) for each ZIP code for the three states included in this study. This criterion was also used in Matthew et al. (Matthews et al., 2011). As a proxy for on-premise outlets, the number of drinking places and full-service restaurants were counted while the other categories were used as a proxy for off-premise outlets. We were unable to categorize outlets as on-premise and off-premise in Maryland based on NAICS code because there a large number of combination on/off-premise licenses.

Statistical Analysis

Descriptive statistics, including the rate of alcohol outlets by population, were calculated for each data source. We also calculated the Interclass Correlation Coefficient (ICC) comparing national, state, and local databases for Alcohol Outlets. The ICC estimates were calculated using a fixed-effect method with a single measure. To model the factors affecting the number of alcohol outlets by ZIP code, we used a repeated measure generalized estimating equation (GEE) model with an exchangeable correlation structure, which can take account in the dependencies in the data. Poisson, negative binomial, and zero-inflated Poisson distribution were considered as candidate models. Based on the QIC criterion, negative binomial models were identified as the best model fit. The type I error rate was fixed at 5%.

The ZIP code was the unit of analysis, with the total number of outlets in each ZIP code serving as the primary variable of interest. The log number of populations in each ZIP code was used as an offset in GEE analysis. The list of variables used as fixed effects is listed in Table 1. The fixed effects are the level from which the data came from (national, state or local database, hereafter called 'source'). In addition, we included three spatial/demographic variables at ZIP code level that are related to alcohol outlet density: 1) percent of white population (>80%, 50–80% and <=50%); 2) poverty status (below poverty line, 100% −200% poverty level and above 200% poverty level)[1]; and 3) level of urbanicity, designated based on whether >50% of the population lived in what the census bureau designates an urbanized area (LaVeist & Wallace, 2000). Because there are significant differences in the demographics by states (Table 1), the analyses were carried out in two ways: 1) aggregating three states data and 2) by each state data.

We also analyzed the factors affecting the discrepancy between alcohol outlet numbers using the national and state databases. The response variable is the absolute value of the difference between the number of alcohol outlets by the national database minus state database. The demographic variables at the ZIP code level (percent of the white population, poverty status, and urban/rural status) were used as predictors. A GEE model with an exchangeable correlation structure and negative binomial distribution was employed. Similar to the analysis of alcohol outlet counts, we analyzed data by aggregating three states and each state separately. All statistical analyses were carried out using SAS 9.4.

Results

The number of alcohol outlets per 1000 residents by state and the level from which the data came from (local, state, or national database) and other demographics by ZIP code are given in Table 1. The average density of alcohol outlets (per 1000 residents) ranged from 0.71 to 2.17 in Maryland, 1.65 to 5.17 in Wisconsin, and 1.09 to 1.22 in Oregon based on different reporting resources.

Table 2 shows the Interclass Correlation Coefficient (ICC) comparing national, state, and local databases for alcohol outlets. The ICC estimates were calculated using a fixed-effect method with a single measure. The ICC between state and national databases ranged from 0.83 to 0.93 for three states. The highest level of agreement was found in Maryland (ICC = 0.93; ICC = 0.83 and ICC = 0.84 for Oregon and Wisconsin, respectively), Figure 1 shows the scatterplot of alcohol outlets in three states between the national and state databases. For local data reports, we were only able to collect enough detailed alcohol outlet counts from local Maryland sources. The ICC for Maryland comparing local databases to the national and state databases was 0.91 and 0.97 respectively indicating the local reporting in Maryland is similar to state reporting.

Table 3 shows the GEE analysis results identifying the factors affecting state/national alcohol outlet reports for all three states. The results show that wealthier areas (>200%

[1]The poverty level for a household of four is defined as an annual income of $25,750 based on Federal poverty level (Alex M. Azar, 2019)

Poverty line) have significantly lower alcohol outlets (Incidence Rate = 0.74, $p < 0.01$) while poorer areas (below the poverty line) had significantly more alcohol outlets (IR = 3.54, $p < 0.01$). The percent of white population and urban/rural area status did not have a significant effect on the count of alcohol outlets. Alcohol outlet density (based on population) at the level of ZIP code for Oregon and Wisconsin was significantly higher compared with Maryland (IR = 2.60 and 2.08 respectively, $p < 0.01$). In addition, in all three states, the number of alcohol outlets reported in national databases was significantly lower compared to state databases (IR = 0.53, 0.48 and 0.70 for MD, OR, and WI respectively, $p < 0.01$). Table 5 shows the analysis results by each state separately. Poverty status still had a significant effect on alcohol outlet counts (such that poorer areas had more alcohol outlets) in Wisconsin and Oregon, but not in Maryland. The lack of an association in Maryland might be due to the control policy in the state. In Maryland, areas with ≤ 50% white population had significantly fewer alcohol outlets (IR = 0.66, $p < 0.01$). In Wisconsin, meanwhile, areas with ≤ 50% white population or <50% urban area had significantly fewer alcohol outlets (IR=0.54 and 0.68 respectively, $p \leq 0.01$).

Table 4 shows the GEE regression results for the discrepancy of alcohol outlets using national and state databases after aggregating data from all three states. Areas with ≤ 50% or 51–80% of white population had significantly fewer discrepancies in alcohol outlets (state vs. national) comparing with areas with >80% white population (IR = 0.77 and 0.59 respectively, $p < 0.01$). Urban areas had significantly fewer discrepancies compared to rural areas (IR = 0.38, $p < 0.01$). Areas with higher income levels (where the median income was >200% of the poverty level) had significantly fewer discrepancies (IR= 0.78, $p < 0.01$) compared with medium income areas (100%−200% above poverty level), while poor areas (where the median income was below the poverty level) had much higher discrepancies (IR=4.99, $p < 0.01$). In addition, we found that Oregon and Wisconsin had more reporting discrepancies of alcohol outlets between state and national databases compared to Maryland (IR = 1.59 and 1.89 respectively, $p < 0.01$). Table 6 shows the analysis results by each state separately. Two noteworthy similarities existed. In Maryland, low-income areas were not significantly different than medium-income areas. In Oregon, meanwhile, high-income areas were not significantly different than medium-income areas. A map to visually compare the relative number of differences per person living in an area is presented in Figure 2.

Discussion

This study compared the number and density of alcohol outlets using national, state, and local alcohol outlet databases. Overall, the national databases appeared to under-estimate the number of alcohol outlets. National databases only over-estimated alcohol outlets in higher populated areas. The state databases had some inconsistencies, where under-estimation of alcohol outlets was seen in areas with higher income and higher population and over-estimation was seen in areas with a higher white population. When compared to local databases, state databases also seemed to over-estimate the number of alcohol outlets in the area.

Many studies have obtained alcohol outlet data through a variety of administrative sources (e.g., liquor license boards) (Goldstick et al., 2016; Haley et al., 2017; Milam et al., 2016), Google (Chen et al., 2019), and national databases (Freisthler & Wolf, 2016). Only a few studies, however, have examined the accuracy of alcohol outlet data and the process to obtain such data (Carlos et al., 2017; Matthews et al., 2011; Ponicki et al., 2014). These studies are necessary, for example, Ponicki et al. studied the California-based state records on alcohol outlets and concluded that state-level data on alcohol outlets often include outlets that are no longer open (Ponicki et al., 2014). Alcohol outlet databases need to represent accurate data and be easily accessible, as this data is crucial to inform policies and create awareness on a variety of alcohol-related problems. Many studies have used alcohol outlet data to examine associations between alcohol outlet density and a variety of physical and behavioral health outcomes, crime, and violence (Furr-Holden et al., 2019; Goldstick et al., 2016; Jennings et al., 2014; Milam et al., 2014; Nesoff et al., 2018; Popova et al., 2009). In addition, alcohol outlet oversaturation is more commonly seen in minority-majority communities, adding to the urgency of organized data to help inform efforts to reduce health inequities (Hippensteel et al., 2018; Trangenstein et al., 2019).

The discrepancies between local, state, and national alcohol outlet listings noted in this study may have impacted the results of previous studies using alcohol outlet data by under- or over-estimating the problem. For example, studies have examined how alcohol outlet density is associated with consumption (Sherk et al., 2018), life expectancy (Furr-Holden et al., 2019; Gonzales et al., 2014), and violence (Furr-Holden et al., 2016; Livingston, 2011). These studies rely on accurate data to understand public health issues and make appropriate recommendations for future research and policy changes.

This study has a few limitations that warrant discussion. First, limited data were available on Maryland's rural counties, limiting what we can infer from these locations (both concerning internal and external validity). When aiming to retrieve alcohol outlet data, a few contacts referred us back to the state listings, and some did not respond even after repeated attempts. Non-response may be associated with discordance between their records and the state listings or a lack of updated data. Also, data obtained was only from three states (an alcohol control state, a semi/mixed-control state, and a non-control state). In addition, the alcohol outlets were not visited in-person to confirm they were still in business. For instance, Furr-Holden and colleagues obtained data for off-premise alcohol outlets in Baltimore and found 22% of alcohol outlets were chronically closed. Without further investigation, those outlets would have been included in the study as active outlets (Furr-Holden et al., 2019); this further explains the importance of keeping alcohol outlet data updated. Similar challenges are seen with tobacco outlet data, and researchers often use secondary data sources (D'Angelo et al., 2014). Finally, the NAICS codes used in this analysis may not be an exhaustive list of codes for alcohol outlets which could impact the accuracy using this national database to estimate alcohol availability.

Future research should continue to examine discrepancies between local, state, and national alcohol outlet databases. In addition, the processes of obtaining alcohol outlet data should be documented to improve access to data.

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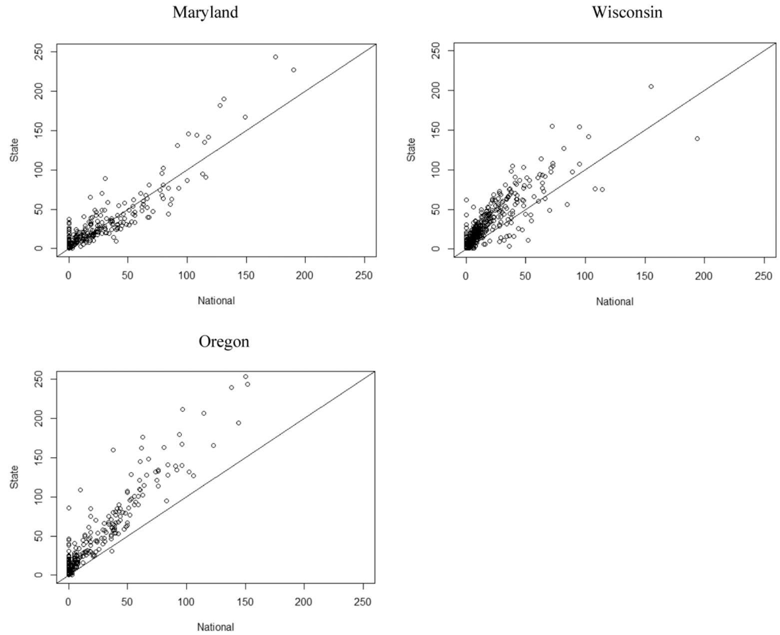

Figure 1:
National database versus State database for Alcohol Outlet counts.

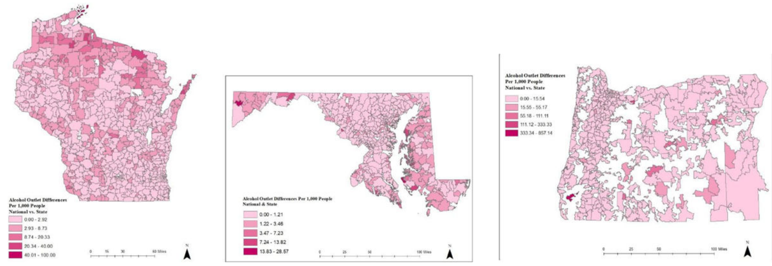

Figure 2:

Distribution of Differences Between National and State Listings

Table 1

Demographic information for each ZIP code by States.

Variables	State	Mean (SD)			P-values
		National database	*State database*	*Local database*	
Average Number of Alcohol Outlets Per 1000 people	Maryland	0.71 (1.36)	2.17 (3.16)	1.79 (2.52)	
	Wisconsin	1.65 (3.06)	5.17 (7.86)	3.91 (8.62)	
	Oregon	1.22 (3.96)	10.92 (49.04)	NA	
			N (%)		
Percent of White Population		*>=80%*	*50–80%*	*<50%*	*<0.01*
	Maryland	214 (45.3%)	125(26.5%)	133 (28.2%)	
	Wisconsin	714 (86.2%)	30 (3.6%)	84(10.14%)	
	Oregon	349 (82.9%)	40 (9.5%)	32(7.6%)	
Median Income		*below Poverty Line*	*100–200% Poverty Line*	*>200% Poverty Line*	*<0.01*
	Maryland	70 (14.8%)	60 (12.7%)	342(72.5%)	
	Wisconsin	54(12.8%)	282 (34.1%)	466(56.3%)	
	Oregon	80 (9.7%)	198 (47.0%)	169(40.1%)	
Urban/Rural Status		*Urban*	*Rural*		*<0.01*
	Maryland	221(46.8%)	251(53.2%)		
	Wisconsin	159(19.2%)	669(80.8%)		
	Oregon	91(21.6%)	330(78.4%)		

[a] Local data for Wisconsin is only available in Milwaukee area

Table 2:

Interclass Correlation Coefficient (ICC) comparing National, State and Local database for Alcohol Outlets.[ab]

Comparisons	State	ICC	95% CI
National database versus State database	Maryland	0.93	0.91–0.94
	Wisconsin	0.84	0.81–0.86
	Oregon	0.83	0.80–0.86
State database versus Local database	Maryland	0.97	0.96–0.97
National database versus Local database	Maryland	0.91	0.90–0.93

[a.]ICC is calculated using fixed-effect method with single measures.

[b.]Only Maryland has enough local Alcohol outlet reports to make the comparisons.

Table 3:

Generalized Estimating Equation Regression Results for Alcohol Outlet Counts.[ab]

	Parameters	Incidence Rate	95% Confidence Intervals	P-values
% White Population (reference group: >80%)	51%−80%	1.007	(0.838–1.211)	0.94
	<=50%	0.794	(0.625–1.008)	0.06
Poverty Status (reference group: 100%−200% above Poverty Line)	>200% Poverty Line	0.740	(0.663–0.826)	<0.01
	Below Poverty Line	3.542	(2.090–6.001)	<0.01
Rural/Urban Status (reference group: Rural)	Urban	0.898	(0.793–1.067)	0.09
State (reference group: MD)	OR	2.601	(2.103–3.217)	<0.01
	WI	2.082	(1.752–2.472)	<0.01
State×Data Resources (reference group: State data base)	MD: National Data base	0.534	(0.479–0.594)	<0.01
	OR: National Data base	0.480	(0.405–0.571)	<0.01
	WI: National Data base	0.698	(0.617–0.790)	<0.01
Dispersion		0.704	(0.654–0.758)	<0.01

[a.]Negative Binomial distribution is assumed for Alcohol Outlet counts.

[b.]The log population in the ZIP code is used as offset in the GEE regression.

Table 4:

Generalized Estimating Equation Regression model for Alcohol outlets discrepancies between State and National databases.[ab]

	Parameters	Incidence Rate	95% Confidence Intervals	P-values
% White Population (reference group: >80%)	51%−80%	0.768	(0.656–0.900)	<0.01
	<=50%	0.592	(0.475–0.739)	<0.01
Poverty Status (reference group: 100%−200% above Poverty Line)	>200% Poverty Line	0.775	(0.691–0.862)	<0.01
	Below Poverty Line	4.990	(3.524–7.067)	<0.01
Rural/Urban Status (reference group: Rural)	Urban	0.378	(0.337–0.424)	<0.01
State (reference group: MD)	OR	1.592	(1.393–1.820)	<0.01
	WI	1.886	(1.790–1.995)	<0.01
Dispersion		0.634	(0.583–0.691)	<0.01

[a.] Negative Binomial distribution is assumed for Alcohol Outlet counts.

[b.] The log population in the ZIP code is used as offset in the GEE regression.

Table 5:

Generalized Estimating Equation Regression Results for Alcohol Outlet Counts by States.[ab]

		Maryland		*Wisconsin*		*Oregon*	
	Parameters	**Incidence Rate (95%*CI*)**	**P-values**	**Incidence Rate (95%*CI*)**	**P-values**	**Incidence Rate (95%*CI*)**	**P-values**
% White Population (reference group: >80%)	51%−80%	0.862 (0.665–1.119)	0.26	0.880 (0.697–1.111)	0.28	1.037 (0.732–1.471)	0.94
	<=50%	0.659 (0.513–0.848)	<0.01	0.541 (0.352–0.833)	0.01	5.283 (0.827–33.761)	0.06
Poverty Status (reference group: 100%−200% above Poverty Line)	>200% Poverty Line	0.548 (0.403–0.745)	<0.01	0.700 (0.629–0.779)	<0.01	0.900 (0.688–1.177)	<0.01
	Below Poverty Line	0.885 (0.420–1.862)	0.75	2.843 (1.318–6.133)	0.01	4.980 (2.642–9.387)	<0.01
Rural/Urban Status (reference group: Rural)	Urban	1.184 (0.884–1.586)	0.26	0.675 (0.5890–0.773)	<0.01	1.168 (0.885–1.542)	0.09
Data Resources (reference group: State data base)	National Data base	0.487 (0.432–0.548)	<0.01	0.402 (0.379–0.426)	<0.01	0.229 (0.199–0.262)	<0.01
Dispersion							

[a.] Negative Binomial distribution is assumed for Alcohol Outlet counts.

[b.] The log population in the ZIP code is used as offset in the GEE regression.