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THE RELATIONSHIP BETWEEN THE GEOGRAPHIC DENSITY OF ALCOHOL OUTLETS AND ALCOHOL-RELATED HOSPITAL ADMISSIONS IN SAN DIEGO COUNTY

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ABSTRACT: Increasing concerns regarding the cost of medical care have led to research that has found a relationship between alcohol abuse, increased medical problems, longer hospital stays, and higher medical costs. Research has also found a positive relationship between alcohol availability and crime, car accidents, and liver cirrhosis deaths. One area of interest is how alcohol availability, as measured by the number of alcohol outlets, is related to medical care needs. The purpose of this study was to examine the relationship between the geographic density of alcohol outlets and the number of alcohol-related hospital admissions. Alcohol-related ICD-9 codes were selected based on epidemiologic research in the literature to determine alcohol-related morbidity from the California Discharge Data System, which collects information on all hospital admissions and discharges in California. In San Diego County, in 1996, 3,759 admissions were alcohol-related. Alcohol-related admissions for each zip code were compared to the number of liquor licenses that were held by each zip code through a multiple regression analysis. The regression model demonstrated that the number of liquor outlets was a significant predictor of alcohol-related hospital admissions, net of other predictors. Implications are discussed, including regulation of alcohol availability, which may have a beneficial impact on alcohol morbidity.

INTRODUCTION

In 1992, 4.5% of all hospital emergency department visits in the United State were related to the use of alcohol and/or drugs (16 visits per 1,000 persons). This translates to approximately 4.1 million visits during that year.[1] Not only does alcohol abuse affect health, research has also demonstrated that increased alcohol consumption results in higher crime

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rates, more frequent automobile accidents, and increased rates of liver cirrhosis deaths.[2,3] Alcohol consumption has been found to be directly related to alcohol availability.[4] The most common measure of alcohol availability is the number of liquor outlets per capita, with alcohol being considered to be more available in areas with higher numbers of liquor outlets.[5] The purpose of this study was to examine the relationship between the geographic density of liquor stores and outlets and the number of alcohol-related hospital admissions in during one year in San Diego County. Further, the relationships between on-site liquor licenses and off-site licenses and alcohol-related admissions were also explored.

Alcohol has a substantial impact on the human body, affecting organ systems directly or indirectly. The cardiovascular, endocrine, reproductive, and immune systems all suffer negative effects from alcohol abuse. Alcohol also affects the central nervous system, the liver and the stomach, causes nutritional and metabolic disturbances, and increases the risk of cancer. Chronic exposure to alcohol exacerbates the degree of damage that is caused to the body.[6,7,8]

Medical treatment is often complicated by a history of drug or alcohol abuse. Alcohol abuse is the number one cause of drug-related morbidity among hospitalized patients.[7] Drug and/or alcohol abusers who are admitted to the hospital have lengths of stay that are twice as long as non-abusers who are admitted for the same illness.[9,10] Alcohol abusers utilize more health care and have twice the complications once they are in the hospital, particularly following a trauma.[11,12] Alcohol-related admissions are also more likely to be uninsured.[13]

The cost of alcohol abuse to the health care system is quite substantial. Researchers utilize what is called the attributable fraction to measure alcohol-related health care costs. Attributable fraction is defined as the maximum proportion of a disease that can be attributed to a characteristic or etiologic factor (such as alcohol abuse, in this study). The attributable fraction allows researchers to estimate the extent that a specific factor is the cause of a specific disease or illness.[14] Rice et al.,[9] utilizing the attributable fraction, took the number of hospital days that were associated with each illness (attributable to alcohol abuse) and multiplied the total number of days by the average cost per hospital day in 1988. They found that the direct and indirect health related costs of alcohol abusers in the United States equaled $58.2 billion. Further, Merrill et al.[15] found that alcohol-related admissions cost the Medicaid system an estimated $253 million in 1991. In San Diego County alone, the direct cost for hospital treatment of alcohol-related admissions for acute care general hospital facilities was estimated at $54.5 million for 1995.[16]

Alcohol availability is regulated by states in terms of licenses for outlets: on-site outlets, which sell alcohol for consumption at the establishment (i.e., bars and restaurants); off-site outlets, which sell alcohol for consumption elsewhere (i.e., liquor stores and mini-markets); and on-and off-site outlets, which sell alcohol for consumption at the establishment, as well as for consumption elsewhere.[4] Research on the density of alcohol outlets has found that higher density outlets stimulate demand and that consumption of alcohol rises.[17]

Studies have focused on the relationship between alcohol availability and various social problems. An analysis of outlet density and crime found differential outcomes. While greater numbers of per capita on-site and off-site outlets were related to fewer arrests for DUI and public drunkenness, larger numbers of on-site outlets led to more arrests for disorderly conduct.[4] Other studies have found a relationship between outlet density and violent crime,[2] and drunk driving, disturbing the peace, and drunk in public arrests.[3] Scribner et al.[18] found that outlet density (except for bars) was significantly related to the number of automobile injury accidents and property damage. Based on their findings, it was projected that in a city of 50,000 people and 100 alcohol outlets, one additional outlet would account for 2.7 additional injury accidents.

While research has found that alcohol abuse has a substantial impact on physical health, health care expenditures, and the incidence of social problems, and that alcohol availability, as measured by outlet density, contributes to increased consumption and social problems, few studies have analyzed the impact of alcohol outlet density on health.

METHODS

This study is a relational, secondary analysis of extant data. The study analyzed the impact of alcohol outlet density on alcohol-related hospital admissions in San Diego County for 1996. It is expected that the number of alcohol-related hospital admissions will increase as the number of liquor licenses increases.

Data Collection and Measures

Liquor Licenses. Information on the number of liquor licenses per zip code was obtained from the California Department of Alcoholic Beverage Control. The number of each type of license was provided for all zip codes in San Diego County. Based on a prior analysis,[19] we determined that license

type did not predict alcohol-related admissions. Thus, we used total licenses, per 10,000 residents, as a predictor in the present study. To control for zip codes that have low population numbers, zip codes with less than 10,000 people were combined with an adjacent zip code. This was done to control for areas that have low numbers of inhabitants (i.e. industrial areas, rural areas) but may have moderate to high levels of liquor outlets. Such areas would give an inflated number of outlets for their populations.

Alcohol-Related Hospitalizations. The rate of alcohol-related hospitalizations per 10,000 residents was the dependent variable in the present study. The number of alcohol-related hospital discharges was aggregated by zip code. Sixty-five zip codes were used in the analysis. We utilized data from the California Hospital Discharge Data System (CHDDS) published by the California Office of Statewide Health Planning and Development (OSHPD) in 1996. The CHDDS database consists of records abstracted for all inpatient hospitalizations to non-federal hospitals in California. Only short-term, general acute alcohol-related hospital admissions were extracted for analysis.

Categorizing hospital admissions as alcohol-related is difficult at best. Without knowledge of the patient's past drinking history, it is almost impossible to attribute a certain disease to the abuse of alcohol. For instance, cirrhosis of the liver is a disease that occurs primarily in chronic alcoholics. However, there is a clinical diagnosis for "cirrhosis" and another for "alcoholic cirrhosis." Without the patient's drinking history, it is impossible to make the "alcoholic cirrhosis" diagnosis. The problem is further complicated by the stigma that is attached with such a disease. Many doctors may be reluctant to classify a disease as alcohol-related due to the embarrassment that comes with such a diagnosis.[8]

Due to the difficulty of diagnosing alcohol-related diseases, the true incidence of the disease is greatly underestimated. In an attempt to gain more accurate estimates, attributable fractions have been developed as a means to estimate alcohol-related disease. Attributable fractions are used to demonstrate the relationship between alcohol abuse and disease; they represent the proportion of the disease that can be causally linked to alcohol abuse. A value between 0 and 1 corresponds to the alcohol-attributable proportion of disease based on extensive review of clinical cases studies and epidemiological studies.[8,9] Admissions for this study were classified as alcohol-related if the terms "alcohol" or "alcoholic" were included in the ICD-9 diagnosis. Diseases such as chronic hepatitis, cirrhosis of the liver without mention of alcohol, biliary cirrhosis, other chronic nonalcoholic liver disease, unspecified chronic liver disease without mention of alcohol, portal hypertension, and chronic pancreatitis that have been shown to be

highly attributable to alcohol in the epidemiologic literature were included as well. ICD-9 codes for all diseases included in this study are listed in Table 1.

Control Variables. Additional demographic data was obtained at the zip code level from the year 1990 U.S. Census website. Based on prior research we included the number of males, the percentage of adults in the zip code 55 years old and older and the median income for each zip code as control variables in the analysis.

Statistical Analysis

Using a two block hierarchical ordinary least squares regression model, the rate of alcohol-related hospital admissions per 10,000 population was regressed on a the control variables (block 1), and the number of on-site and off-site liquor licenses in each zip code.

Examination of collinearity diagnostics suggest that multicollinearity was not an issue—no VIF value exceeded 1.5, and tolerance values ranged from .66 to .87. Examination of the residuals did not reveal any problems with autocorrelation.

RESULTS

Characteristics of Alcohol-Related Admissions

Alcohol-related admissions for San Diego County equalled 3,759 for 1996. Table 2 displays the characteristics of alcohol-related admissions for 1996. During this period, the emergency room constituted the largest source of alcohol-related admissions.

The predominant source of payment for alcohol-related admissions was the Medicare system; 35.7% of individuals admitted for alcohol-related illnesses listed Medicare as their primary insurance. Medi-Cal is California's health insurance for low income families and is based on individual economic criteria. It was listed as the primary source of insurance for 20.9% of alcohol-related admissions for 1996. HMOs/PPOs were responsible for a sizable portion of the admissions associated with alcohol morbidity as well. Almost 20% of patients admitted for alcohol-related illnesses had insurance through a Health Maintenance Organization or a Preferred Provider Organization (this excludes individuals covered under a Medicare or Medi-Cal managed care plan). Private fee-for-service plans accounted for 3.8% of alcohol-related admissions. The average length of stay (LOS) for alcohol-related admissions equalled 6.05 days in 1996.

TABLE 1

Definition of Alcohol-Related Diagnoses[a]

Alcohol in Diagnosis		*No Mention of Alcohol in Diagnosis*	
ICD-9 Code	*ICD-9 Classification*	*ICD-9 Code*	*ICD-9 Classification*
265.2	Pellagra	571.4	Chronic hepatitis
291.0	Alcohol withdrawal delirium	571.5	Cirrhosis of the liver w/o mention of alcohol
291.1	Alcohol amnestic syndrome	571.6	Biliary cirrhosis
291.2	Other alcoholic dementia	571.8	Other chronic nonalcoholic liver disease
291.3	Alcohol withdrawal hallucinosis	571.9	Unspecified chronic liver disease w/o mention of alcohol
291.4	Idiosyncratic alcohol intoxication	572.3	Portal hypertension
291.5	Alcoholic jealousy	577.1	Chronic pancreatitis
291.8	Other specified alcoholic psychosis		
291.9	Unspecified alcoholic psychosis		
303.0	Acute alcoholic intoxication		
303.9	Other & unspecified alcohol dependence		
305.0	Alcohol abuse		
357.5	Alcoholic polyneuropathy		
425.5	Alcoholic cardiomyopathy		
535.3	Alcoholic gastritis		
571.0	Alcoholic fatty liver		
571.1	Acute alcoholic hepatitis		
571.2	Alcoholic cirrhosis of the liver		
571.3	Alcoholic liver damage, unspecified		
655.4	Suspected damage to fetus from alcohol		
760.71	Fetal alcohol syndrome		
790.3	Abnormal findings, alcohol in blood level		
980.0	Alcohol poisoning		

TABLE 2

Characteristics of Alcohol-Related Admissions for 1996 (N = 3759)

Descriptive Category	%	*Descriptive Category*	%
Emergency Room Admissions	63.3	*Race*	
Admission Source		White	63.6
Routine Admit	36.7	Black	6.4
Emergency Room	63.3	Hispanic	22.6
Expected Source of Payment		Native American/Eskimo	0.3
Medicare	35.7	Asian	5.4
Medi-Cal	20.9	Other	0.9
HMO/PPO	19.8	*Sex*	
Private Insurance (FFS)	3.8	Male	61.7
Self Pay	5.9	Female	38.3
Medically Indigent Services	10.5	*Age*	
Alcohol-Related Diseases		0–24	3.5
Listed as Principal Diagnosis	N = 256	25–34	7.4
Alcoholic Cirrhosis	28.7	35–44	23.1
Other Specified Alcoh.	14.7	45–54	21.9
Psychosis		55–64	16.2
Chronic Pancreatitis	17.0	65+	28.0
Cirrhosis of the Liver	10.8		
Acute Alcoholic Hepatitis	6.6		
Alcohol Withdrawal Delirium	7.8		
Average Length of Stay	6.05		

Alcohol-related admissions for San Diego County consisted predominantly of whites, males, and individuals aged 35–44. Table 2 also shows the age, sex, and race of admittees for 1996. Approximately 62% of admittees were male, compared to 38% female. Individuals of Caucasian descent constituted approximately 64% of admittees while individuals of Hispanic descent had the second highest admission rate, with an average of 22% of admittees being Hispanic.

Twenty-three percent of all admissions included individuals in the age group 35–44 years. The only other age group that had higher representation was the 65 and older age group, which constituted approximately 28% of admissions.

TABLE 3

Multiple Regression of Alcohol Licenses and Control Variables on Hospital Admissions

Independent Variable	*Standardized Beta Coefficient*	*T*
(Constant)		−2.158*
Median Income	−.280	−3.685***
Percent Population Male	.253	3.01**
Percent Population 55–64	.116	1.08
Percent Population 65 and Older	.007	.06
Total licenses/10,000 Population	.584	7.3***
$R^2 = .75$		

Notes: ***p < .001, **p < .01, *p < .05

Multivariate Analysis

Table 3 presents the results of the multiple regression analysis. Overall, the model was statistically significant ($F = 35.00$, $P < .001$) and accounted for 72.7% of the variance (adjusted) in the dependent measure.

When the dependent measure was regressed on the control variables—median income, percent of the population 55 and older, and percent of the population that were male—the model accounted for 48.8% (adjusted R^2) of the variance in the dependent measure. When the number of outlets per 10,000 was added to the model, there was a 22.8% increase in the adjusted R^2 value.

Examination of the beta weights indicates that median income is a strong predictor of alcohol-related admissions, net of the other predictors in the model. The lower the median income of the community, the higher the number of hospitalizations. The total number of liquor licenses per 10,000 population is a significant of alcohol-related hospital admissions, suggesting that as the number of liquor licenses per 10,000 population is increased by one, the number of alcohol-related admissions per 10,000 population is increased by .48.

DISCUSSION

The results of this study indicated a significant association between the number of liquor outlets in each zip code and the number of alcohol-related hospital admissions. Specifically, an increase of one liquor outlet per 10,000 population led to an increase of .48 hospital admissions due to alcohol-related morbidity, when the effects of all other variables were held constant.

Limitations of this study include that it used secondary data for analysis, therefore being limited to the data gathered by the California Office of Statewide Health Planning and Development. and that only one year was used in the regression analysis. Further studies could determine if the results found in this study hold up longitudinally. Also, it is believed that the true incidence of alcohol-related disease is underestimated, as only those diseases with a higher causal link to alcohol were used, and it is important to note that this study analyzed alcohol-related hospital admissions, not the true incidence of alcohol-related disease.

Future research might also examine how outlet density relates to rates of substance abuse treatment. Those with more severe alcohol problems may choose to live in areas where there is higher density of outlets, to afford more access to alcohol. The present study was only able to assess alcohol-related illnesses resulting in a medical problem. It is very possible that density is also a predictor of alcohol-related treatment rates. Previous research has demonstrated the relationship between outlet density and acute problems such as drunk driving and injury.[2,18] The results of the present study are consistent with those findings. However, conceptually, the dependent measure in this study might be considered more reflective of chronic problems related to alcohol use. Although a direct causal link between outlet density and such problems cannot be established, the consistency of research findings in this area suggests that preventive efforts might be taken to reduce outlet density or otherwise offset the costs associated with new outlets. For instance, to offset financial costs of alcohol morbidity, states may want to consider levying additional fees when granting alcohol outlet licenses. Future research is needed to examine the efficacy of such preventive approaches.

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