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ORIGINAL ARTICLE

ALCOHOL
CLINICAL & EXPERIMENTAL RESEARCH

Neighborhood market potentials for alcohol use and rates of child abuse and neglect

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Abstract

Background: Alcohol use can lead to child abuse and neglect even if the person using alcohol does not use heavily. Yet relatively few measures that reflect alcohol use are available at smaller geographic units. We assess whether the estimated level of total alcohol use per capita is related to measures of child abuse and neglect that include substantiated reports of maltreatment, total entries into foster care, and alcohol-related entries into foster care.

Methods: Our sample consists of 326 Census block groups in Sacramento, California over three time points (978 space–time units). Administrative data for substantiations of child abuse and neglect and foster care entries are our outcomes. We create market potentials for alcohol use among 18- to 29-year-olds as our primary independent variable. Data are analyzed using Bayesian conditionally autoregressive spatio-temporal models.

Results: Higher alcohol use potentials (as measured by total volume per capita of 18- to 29-year olds) are related to more children entering foster care due to drinking-related concerns by a parent or caregiver (RR = 1.032, 95% CI = [1.013, 1.051]), but not total substantiations for foster care entries. Neighborhoods with higher total volume of alcohol per 18- to 29-year-olds had more foster care entries when we used number of substantiations as the denominator (RR = 1.012, 95% CI = [1.0001, 1.023]) but were not related to foster care entries with alcohol misuse as a concern as a subset of all foster care entries.

Conclusions: Higher estimated volume of alcohol use per capita among young adults (aged 18 to 29) was related to more children entering foster care due to alcohol-related concerns. Reducing alcohol supply in alcohol outlets, specifically through off-premise establishments, might reduce rates for all entries into foster care or other out-of-home placement and substantiated child abuse and neglect.

KEYWORDS
alcohol use, Bayesian space–time models, child abuse and neglect, economic geography

INTRODUCTION

Alcohol use and child abuse and neglect

In 2019, approximately 3.48 million children were referred to Child Protective Services for child maltreatment investigations in the United States, with 19% (~656,000) of those children having cases substantiated or indicated (i.e., enough evidence was present to say the abuse or neglect occurred; U.S. Department of Health & Human Services et al., 2021). It is suspected that official reports likely underestimate true counts of abuse or neglect, with an estimated 1.25 million incidents of maltreatment reaching a stringent "harm standard" threshold (i.e., an action or failure to act resulted in demonstrable harm to a child; Sedlak et al., 2010). However, even the harm standard is likely to underestimate the true incidence of child abuse and neglect, as general population estimates of abuse and neglect identify that 1 in 8 children has likely experienced child maltreatment (Wildeman et al., 2014).

The role of alcohol use in the etiology of abusive parenting is significant and a known risk (Stith et al., 2009). Alcohol use contributes to as many as 13% of all cases of maltreatment in the *general population* (Sedlak et al., 2010). Alcohol-involved maltreatment appears to be much higher for children involved with the *child welfare system* where it is estimated that 40% to 80% of parents have problems related to alcohol use (Testa & Smith, 2009). Rates of involvement in the child welfare system are higher among individuals reporting heavy drinking, generally defined as having five or more drinks in one setting (Berger, 2005; Douglas, 2013; Famularo et al., 1986; Ghertner et al., 2018; Kelleher et al., 1994; Kepple, 2017, 2018; Lee, 2013; Murphy et al., 1991; Nelson et al., 2010; Sun et al., 2001). In the general population, parents who drank, regardless of how much, used physical abuse and supervisory neglect more frequently than lifetime abstainers (Freisthler et al., 2014; Freisthler & Price Wolf, 2016). Furthermore, one in 10 children lives in a home where a parent has an alcohol use disorder (Lipari & Van Horn, 2017).

Neighborhood and state-level alcohol supply and child abuse and neglect

Greater alcohol supply, as reflected in greater alcohol outlet densities or lower taxes on alcoholic beverages, appears to increase child abuse and neglect in the United States (Freisthler, 2004; Freisthler et al., 2007; Freisthler & Kranich, 2022; Markowitz et al., 2010, 2014; Markowitz & Grossman, 1998, 2000; Morton et al., 2014; Sen, 2006). More specifically, density of bars is related to higher rates of substantiated reports of child abuse and neglect (Freisthler, 2004) and entries into foster care (Freisthler et al., 2007). Density of off-premise alcohol outlets is related to referrals for child welfare investigations, substantiations, and foster care entries at the zip code level (Freisthler et al., 2007), and referrals for investigations at the Census tract level (Freisthler & Kranich, 2022). Total outlet density has been related to substantiations across Census tracts (Morton, 2013) and outlets per capita have been related to substantiations of child abuse and neglect (Markowitz et al., 2010) and the number of days spent in foster care (Markowitz et al., 2014).

Area-level alcohol use and risk for child abuse and neglect

Often, these alcohol supply measures, like outlet density, are used to approximate access to alcohol. However, as described by Freisthler and Holmes (2012), alcohol outlet density could be a marker of deteriorated neighborhood structure, in which case we would not necessarily expect to see a positive relationship between alcohol use and child abuse and neglect. As a more direct measure of alcohol use on child abuse and neglect, overnight stays in hospitals for alcohol abuse and dependence has been assessed using serious child maltreatment incidents (that resulted in at least one overnight stay in the hospital). Evidence using these measures is mixed where a positive relationship was found using zip codes in California (Price Wolf et al., 2016), but no relationship in Pennsylvania (Sumetsky et al., 2020).

Another measure that reflects use of alcohol, at least among heavy users, is the density of substance use treatment facilities. Greater density of treatment facilities at the zip code level has been related to higher levels of referrals for child maltreatment and foster care entries (Freisthler, 2013), but at the county level negatively related to referrals for child maltreatment investigations (Freisthler & Weiss, 2008). Furthermore, greater distance to treatment facilities has been related to higher rates of child abuse and neglect (Morton et al., 2014) and neglectful parenting (Maguire-Jack & Klein, 2015; Morton, 2013), but lower rates of child physical abuse (Morton et al., 2014). However, these facilities address all manners of substance misuse, not just alcohol use, and greater numbers of these facilities in an area may reflect market factors unrelated to alcohol (e.g., located near to other medical care facilities). Taken together, relatively few measures that reflect alcohol use are available at smaller geographic units and the measures that are available primarily focus upon problems or treatment admissions related to very heavy use. We know that alcohol use can lead to child abuse and neglect even if the person using alcohol does not need treatment or hospitalization. That, however, is not captured in the work described above.

Defining market potentials for alcohol use in neighborhoods

In consumer economics and economic geography, potential demand for a good (alcohol in this study) across market areas (so-called market potentials; Morrison et al., 2014, 2015, 2016) can help explain why businesses locate in different areas. Thus, market potentials allow us to use underlying demographic characteristics of populations to assess what the potential for demand for alcohol is in a smaller geographic area. This market potential can be created using

survey-based assessments of alcohol use. These can be measured across individuals within neighborhoods then re-weighted and re-aggregated to provide estimates of local alcohol use. When measures of alcohol use are collected in this way, it allows us to assess their market potential within a specific geographic area. We can use this to enable us to identify those areas where problems related to alcohol use might be more prevalent and target interventions in those areas. Thus, market potentials reflecting the total volume alcohol used across neighborhood areas have been related to neighborhood densities of bars, restaurants, off-premise alcohol outlets, and marijuana dispensaries (Morrison et al., 2014, 2015, 2016). However, these market potentials for alcohol use have not been assessed in a way that allows us to understand if and how they might be associated with alcohol-related problems, such as child abuse and neglect.

From an economic perspective, measures of alcohol sales are the best, although still indirect, measure of alcohol demand (Wagenaar et al., 2009), or realized market potential, as it provides information on how much consumers were willing to spend. In Australia, per capita alcohol sales were negatively related to child abuse and neglect substantiations at Local Government Areas (Laslett et al., 2022). Of note, this study found no relationship between outlet densities and child maltreatment. In the United States, however, these sales data, are available only at the state level. Using these measures, Sen (2006) found that a 1% increase in per capita alcohol use (measured based on annual sales of alcohol in the state and the state population) was related to a 1.08% increase in child homicides. Unfortunately, it is difficult to ascertain what these sales are at a more local level in the United States, limiting our ability to identify those areas where environmental interventions designed to interrupt alcohol supply and reduce consumption and alcohol-related problems will be most effective. Furthermore, if the market potential of alcohol use were to be found predictive of alcohol-related problems, those same environmental interventions might reduce child abuse and neglect. With passage of the Families First Prevention Services Act in the United States in 2018, these interventions, if effective, could use federal monies to prevent child abuse and neglect. In this study, we take the first step in assessing whether market potentials for alcohol use are related to child abuse and neglect.

The current study

As a first step in assessing this relationship, we use panel data develop a model to identify the market potential for alcohol use among 18- to 29-year olds in neighborhood areas in Sacramento, California. We then assess whether market potentials for alcohol use among 18- to 29-year olds (as reflected in estimated per capita measures of total alcohol consumption among this age group) is related to measures of child abuse and neglect that include substantiated reports of maltreatment, total entries into foster care, and alcohol-related entries into foster care. Parent age is inversely related to use of child abuse and neglect, where younger parents are more likely to use both physical abuse and neglect (Stith et al., 2009). In 2000, the

average age for a first birth among California mothers was 25.3 years (Mathews & Hamilton, 2002) and in Sacramento County specifically, 61% of children were born to mothers under the age of 30 (California Department of Public Health, 2022). Furthermore, younger children are disproportionately likely to experience child maltreatment. Children under the age of 10 constitute two-thirds of children of those with maltreatment reports, with children 5 years and younger representing over half of these allegations in Sacramento County in 2000 (Webster et al., 2022). Thus, examining this relationship among adults represents a population at higher risk for using child abuse and neglect.

MATERIALS AND METHODS

Study design

Our sample consists of respondents across 326 Census block groups in Sacramento and South Parkway, California over three time points (1999, 2001, and 2003), a total of 978 space–time units. We use administrative child welfare data for our outcomes and create market potentials for alcohol use as our primary independent variable using data from a telephone survey. The current study was approved by the IRB at The Ohio State University.

Sample

In our space–time models, we have 326 Census block groups (in 2000 Census units) that have their centroid in Sacramento or South Parkway, California. In 2000, Sacramento had a population of slightly more than 400,000 individuals, the median age was 32, 21.6% were of Hispanic or Latinx origin, 15.5% were Black of African American, 16.6% were Asian or Asian-American, and 48.3% were White. Over half of households had children under the age of 18, with 22.5 percent of family households with children <18 living in poverty (U.S. Census Bureau, 2002). On average, Census block groups have about 375 to 400 children younger than 18 years, and between 250 and 270 adults aged 18 to 29 (see Table 1). Block groups cover an average of 0.31 square miles (range: 0.03 to 8.65).

Dependent measures

In this study, we have five dependent variables measuring child abuse and neglect, all obtained using administrative data from Sacramento County Department of Children and Family Services. The substantiation records used come from the Child Welfare System Case Management System, an archival database of information on all allegations of child maltreatment made to child protective services in Sacramento County. Information on foster care entries came from the foster care database, an archival database of all foster care placements for children for Sacramento County.

TABLE 1 Descriptive statistics of dependent and independent variables by Census block groups in Sacramento and South Parkway, CA (n = 326)

Variable	Wave 1				Wave 2				Wave 3			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Child abuse and neglect (per 1000 children)												
Substantiations	14.03	18.04	0.00	130.23	13.05	16.48	0.00	136.59	12.53	16.48	0.00	140.00
Foster care entries	4.39	6.78	0.00	60.47	4.08	6.48	0.00	63.41	3.91	6.31	0.00	65.00
Alcohol-related foster care entries	1.87	3.56	0.00	27.52	1.72	3.27	0.00	24.36	1.64	3.15	0.00	25.00
Alcohol outlets (count)												
Bars and pubs	0.31	0.79	0.00	5.00	0.30	0.75	0.00	5.00	0.28	0.72	0.00	4.00
Off premise	0.99	1.32	0.00	7.00	0.99	1.33	0.00	7.00	1.00	1.34	0.00	7.00
Restaurants that serve alcohol	1.11	1.89	0.00	9.00	1.45	3.00	0.00	24.00	1.50	3.09	0.00	23.00
Market potentials for alcohol use												
Volume per capita (18- to 29-year olds)	11.20	1.21	4.29	13.77	14.41	2.00	4.72	20.66	6.62	1.18	2.37	9.36
Population												
Child population (0 to 17 years old)	380.40	358.21	0.00	2297.00	375.15	350.94	0.00	2295.00	392.19	359.70	0.00	2394.00
18- to 29-year olds	249.31	196.81	0.00	1282.00	257.40	205.26	0.00	1186.20	271.23	228.83	0.00	1416.60
Sociodemographic characteristics												
% Hispanic	21.12	12.27	0.00	60.20	22.13	12.29	0.00	57.16	23.30	12.61	0.00	59.65
% Black	12.64	10.87	0.00	51.05	13.51	10.79	0.00	58.51	13.32	10.53	0.00	57.55
% White, non-Hispanic	47.78	23.84	0.00	97.37	46.91	23.14	4.86	100.00	45.09	22.90	0.00	97.37
% Female-headed households	9.46	6.85	0.00	46.45	10.73	9.31	0.00	81.72	10.74	9.30	0.00	81.77
% Unemployed	4.92	4.46	0.00	35.15	4.62	5.29	0.00	43.96	4.81	4.81	0.00	40.49
% Vacant housing	5.78	4.59	0.00	28.40	5.75	4.82	0.00	28.40	5.75	4.84	0.00	28.40
Ratio of children to adults	0.29	0.18	0.00	1.00	0.28	0.15	0.00	0.77	0.27	0.13	0.00	1.00
Ratio of adult males to adult females	1.05	1.68	0.53	30.00	0.97	0.46	0.54	6.30	0.98	0.45	0.56	5.75
Index of concentrated extremes	-0.14	0.17	-0.89	0.35	-0.12	0.17	-0.71	0.35	-0.12	0.17	-0.71	0.34

Abbreviations: Max, maximum; Min, minimum; SD, standard deviation.

Entries where a child remained in care for more than 4 days, regardless of removal reason, are included in the current study. Children who spend fewer than 4 days in foster care may have experienced an emergency placement for reasons other than abuse or neglect (e.g., waiting for relatives to travel to care for the child after a parent dies or is imprisoned). Residential addresses were recorded in those files and used for geocoding. These measures include: (1) the number of children with substantiated reports of child abuse and neglect; (2) the total number of children who entered foster care; and (3) the number of children who entered foster care where the case plan included alcohol treatment for at least one of the parents. For these first three measures, we use population-based enumeration by indexing the measures on the child population in the Census block group, the traditional way of denominating rates of child abuse using administrative data. Our final two measures are (4) the total number of children who entered foster care per the number of children with substantiated reports of child abuse and neglect; and (5) the number of children who entered foster care due to alcohol-related concerns per the total number of children who entered foster care. Each measure has counts per calendar year for 1999, 2001, and 2003. For these measures, we use decision-based enumeration (Rolock, 2011); therefore, the comparison population (the denominator) is the total child population of the previous child welfare decision point. We include measures based on both population and decision-based enumeration to assess potential differences that may emerge based on the respective risk profiles of our populations of interest. Prior studies suggest that using the general population as the reference group can inappropriately inflate rates and that using the at-risk population (i.e. the total child population of the previous child welfare decision) can improve precision in measurement (Morton et al., 2011; Rolock, 2011).

Market potentials

Measures of self-reported alcohol use from survey data were used to estimate market potentials reflecting total volume of alcohol per capita for 18 to 29 year olds, our primary independent variable. We were able to create market potentials for each Census block group based on the underlying sociodemographic characteristics of the populations living in those areas. The general process was to (1) create estimates of alcohol use patterns using survey data, (2) use those to estimate volumes consumed per person year, (3) weight these by the number of persons within sociodemographic strata within areas to get total volume consumed by persons in those areas, and (4) divide these to get consumption per person per neighborhood area. The construction of this measure is described in more detail hereunder.

Control variables

We include a number of other environmental and population covariates in our models assessing the relationship of market potentials to child abuse and neglect. Three measures of alcohol outlets are the numbers of bars and pubs (license types 23, 40, 42, 48, 61, and 75), restaurants that serve alcohol (license types 40 and 47), and off-premise alcohol outlets (license types 20 and 21). These data were obtained from the California Department of Alcoholic Beverage Control for each survey year. Sociodemographic variables included in our final models included the percent of Black residents, the percent of Hispanic residents, and the percent of White, non-Hispanic residents. We include the percent of unemployed residents (per number of individuals 16 and older), the percent of female-headed households, and the percent of housing units that are vacant. We also includes an index of concentrated extremes (ICE) that measures the degree to which neighborhoods are segregated economically, where a −1 indicates that a neighborhood is comprised of all those living in disadvantage (measured as income <$15,000) and a +1 indicates that all households have higher incomes (measured as >$150,000). We also include the ratio of children (12 and under) to adults (21 and older) and the ratio of adult men (21 and older) to adult women (21 and older).

Creation of market potentials

To create estimates of alcohol use patterns, we used survey data collected as part of a larger environmental intervention study designed to reduce alcohol-related problem in Sacramento, California (Treno et al., 2007). Three cross-sectional telephone surveys were conducted in our intervention (North and South sites) and control areas (remaining areas in Sacramento, called At-Large). Wave 1 was conducted in 1999 and used random digit dialing (RDD) and three digit exchange values to geotarget the study areas. This was combined with listed samples in the North and South sites to increase the number of respondents and the response rate. Preannouncement letters were sent to describe the survey and increase participation. Response rates were calculated using American Association of Public Opinion Research (AAPOR) procedures where a proportion of households with unknown eligibility are considered potential respondents (AAPOR, 2002). This is a more stringent assessment of response rates than only considering known eligible households. Using these procedures, response rates for Wave 1 were 28.6%, 50.7%, and 52.0%, for Wave 2 34.5%, 48.6%, and 48.2%, and for Wave 3 38.2%, 45.2%, and 47.4% (RDD, South listed, and North listed, respectively).

Eligibility criteria for the survey included being between the ages of 15 and 29, living in the Sacramento or South Parkway areas, speaking English or Spanish, and not living in group quarters. If more than one person in the household was eligible to complete the study, the person with the most recent birthday was selected. For this study, we only look at the data from those 18 years and older as that mirrors the population for the child abuse and neglect variables. These individuals provided verbal consent. Trained survey researchers conducted the computer-assisted telephone interview (CATI). Weights were applied to each year of the survey

data, stratified by age, race, ethnicity, biological sex, number of eligible respondents in the household and the number of telephones. The original data collection effort was approved by the institutional review board (IRB) at the Pacific Institute for Research and Evaluation.

Characteristics of our survey respondents by wave for our analytic sample can be found in Table 2. The final sample size of only those individuals 18 and older for each wave: 554 (Wave 1), 990 (Wave 2), and 969 (Wave 3) with 424 (Wave 1), 803 (Wave 2), and 776 (Wave 3) in the analytic sample. The analytic sample includes all those respondents who did not have missing data. As we used only those variables comparable to what was found in the Census data, we were limited in the variables that could be chosen. The majority of the missing responses were due to missing income. We had slightly more women than men responding to the survey. Our

TABLE 2 Descriptive statistics of the Sacramento Neighborhood Alcohol Prevention Project (SNAPP) telephone survey for analytic sample by waves

Variable name	Wave 1 (n = 424)		Wave 2 (n = 803)		Wave 3 (n = 776)	
	n	%	*n*	%	*n*	%
Biological sex						
Male	197	46.5	351	43.7	344	44.3
Female	227	53.5	452	56.3	432	55.7
Race						
White alone	256	60.4	534	66.5	519	66.9
Asian alone	74	17.5	122	15.2	97	12.5
Black alone	50	11.8	81	10.1	85	11.0
Other races	44	10.4	66	8.2	75	9.7
Hispanic ethnicity						
Yes	132	31.1	282	35.1	279	36.0
No	292	68.9	521	64.9	497	64.0
Age						
18 to 20 years	82	19.3	170	21.2	141	18.2
21 to 24 years	120	28.3	256	31.9	263	33.9
25 to 29 years	222	52.4	377	46.9	372	47.9
Household income						
≤$20,000	188	44.3	342	42.6	293	37.8
$20,001 to $60,000	195	46.0	362	45.1	389	50.1
$60,001+	41	9.7	99	12.3	94	12.1
Employment status						
Employed	335	79.0	550	68.5	522	67.3
Unemployed	30	7.1	47	5.9	57	7.3
Not in labor force	59	13.9	206	25.7	197	25.4
Drinking status						
Past year drinkers	333	78.5	598	74.5	569	73.3
Abstainers	91	21.5	205	25.5	207	26.7

respondents were more likely to be white, be employed, and have incomes between $20,000 and $60,000. Over the course of the study, we had more respondents reporting Hispanic ethnicity and fewer respondents reporting drinking in the past year.

Regarding alcohol use, we asked each respondent the number of days on which they drank alcohol on the past 28 or 365 days, depending on their frequency of drinking. Respondents were then asked on how many days they drank 1+, 2+, 3+, 6+ or 9+ drinks and the greatest number of drinks they had on any day. Individuals who abstained from drinking in the past year were given 0's for both frequency and quantity of drinks. Individual measures used to predict drinking volume included demographic variables, including biological sex, race (White, Black, Asian, other), Hispanic ethnicity, age, household income (<$20,000, $20,001 to $60,000, and >$60,000) and employment status (employed, unemployed, and not in labor force). We chose measures where we could also find comparable Census-level information, as the coefficients for the Tobit model (described below) were then applied to the population-level characteristics of adults 18 to 29 years old at the Census block group level. Risk for child maltreatment decreases as caregivers get older (Stith et al., 2009). Substantiations of child abuse and neglect were 2.3 times higher for mothers aged 18 to 19 compared to those who were 22 years of age or older (Goerge et al., 2008). Thus, creating market potentials for 18- to 29-year olds targets a group of parents with higher risks for engaging in abusive and neglectful parenting.

A Tobit model was used to assess the relationship of individual-level demographic covariates on total volume of drinking per respondent. We used this censored regression because our data are left-censored at 0 as total volume of alcohol cannot be lower than 0. Furthermore, not all the abstainers (indicated by 0 alcoholic drinks in the past year) may be true abstainers. Women who are pregnant or breastfeeding may abstain from drinking during this time frame, but drink alcohol in the absence of those conditions. For this model, we combined all 3 years of our survey data to ensure adequate coverage at the block group level. We effects coded our years so that the constant of the Tobit model was the grand mean. As we detail earlier, we used the coefficients from this analysis to create block-level total volume of alcohol consumed per capita for 18- to 29-year olds.

Table 3 presents the results of the Tobit model examining characteristics related to individuals' total volume of drinking. Men drank a higher total volume of alcohol than women. Asian and Black respondents drank less volume than Whites, while other races drank more. Respondents who report Hispanic ethnicity and are unemployed or not in the labor force drink lower volumes. Older respondents (comparison 18 to 20 years) and incomes greater than $20,000 (comparison less than or equal to $20,000) drank higher volumes.

We then constructed a measure for the total volume of alcohol consumed for each respondent per year. The coefficients in Table 3 of our individual-level model of total volume of alcohol consumed in the past year were applied to population characteristics of similar variables found in Census-level data at the block group. For our 1999 data, we used measures obtained via the 2000 Census.

TABLE 3 Tobit results of demographic variables on Total volume of alcohol consumed across three waves of data ($n = 2003$)

Variable	Coef. (95% CI)
Constant	−9.10 (−17.98, −0.23)
Male	8.58 (4.50, 12.66)***
Race	
White alone	Reference group
Asian alone	−8.16 (−14.41, −1.91)*
Black alone	−11.78 (−17.41, −6.14)***
Other races	7.37 (−7.27, 22.01)
Hispanic ethnicity	−10.67 (−15.85, −5.50)***
Age	
18 to 20 years	Reference group
21 to 24 years	8.60 (1.36, 15.83)*
25 to 29 years	7.18 (2.30, 12.07)**
Household income	
≤$20,000	Reference group
$20,001 to $60,000	8.48 (2.88, 14.09)**
$60,001+	5.56 (0.91, 10.20)*
Employment status	
Employed	Reference group
Unemployed	−2.35 (−9.89, 5.19)
Not in labor force	−5.07 (−9.64, −0.51)*
Log pseudo likelihood	−7365.16

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

We used Geolytics population estimates by Census block groups for 2001 and 2003. The population-level measures used to create population-level total volume of alcohol consumed included proportion of men, proportion of those who report White, Black, Asian, or other race, and proportion of those aged 18 to 20, 21 to 24, and 25 to 29. Those variables were created using only individuals aged 18 to 29 years. We also included measures of income (proportion of those with <$20,000, $20,001 to $60,000, and >$60,000) and employment status (proportion of employed, unemployed, and not in labor force). Income measures were created using the entire population and employment status included those 16 years and older. Once we had the estimates of total volume of alcohol consumed, we created a per capita measure by dividing by the number of 18- to 29-year olds in each Census block for each analysis year.

Data analysis

We use GeoBUGS1.2 (Thomas et al., 2004) to conduct Bayesian conditionally autoregressive (CAR) spatio-temporal models that examine the relationship between market potential for alcohol use and our child abuse and neglect variables. These models are ideal for small area analyses, as we have here, as they "borrow" strength from neighboring areas to stabilize area rates when studying rare events

(Waller & Gotway, 2004). Furthermore, we model Poisson distributions with overdispersion for our outcomes as 0 s are common. We use Bayesian models to assess spatial structure in the models and estimate posterior distributions for each of our covariates. The dependent variables are modeled as a Poisson distribution. These models include terms for correlated heterogeneity (i.e., spatial structure), time trends, and space–time trends and are estimated using Markov chain Monte Carlo (MCMC) simulations. Models with uncorrelated heterogeneity did not have a better fit with these data (as measured by the deviance information criterion) and are not included here. For these models, the constant is modeled with a flat prior and the remaining variables were given uninformative priors. The first 50,000 iterations were used as burn in and an additional 50,000 iterations were used to obtain posterior estimates.

RESULTS

We first ran unadjusted CAR models with alcohol volume per capita for 18- to 29-year olds for all five of our outcome measures. In those models, higher volume of alcohol was associated with more alcohol-related foster care entries per child (RR = 1.034, 95% CI = [1.016, 1.051]). There was no relationship between substantiations per child (RR = 0.996, 95% CI = [0.990, 1.003]), foster care entries per child (RR = 1.010, 95% CI = [0.998, 1.022]), foster care entries per substantiations (RR = 1.009, 95% CI = [0.998, 1.021]), or alcohol-related foster care entries per all foster care entries (RR = 1.007, 95% CI = [0.991, 1.024]). The findings for the models assessing child abuse outcomes can be found in Tables 4 and 5. Table 4 presents the results of each outcome denominated by child population, whereas Table 5 presents the child welfare systems-based denominators. Higher market potential for alcohol (as measured by total volume per capita of 18- to 29-year olds) is related to more children entering foster care due to drinking related concerns by a parent or caregiver (see Model 3; RR = 1.032, 95% CI = [1.013, 1.051]). However, market potential for alcohol use by 18- to 29-year olds was not related to the number of children who have substantiated reports of child abuse and neglect (Model 1) or the total number of children who entered foster care (Model 2). More off-premise outlets were related to more children having substantiated reports of child abuse and neglect (RR = 1.138, 95% CI = [1.083, 1.200]) and more children entering foster care (RR = 1.105, 95% CI = [1.032, 1.187]). Having an additional off-premise alcohol outlet per Census block group is related to 13.8% more substantiations and 10.5% more foster care entries.

Block groups with higher percentages of those unemployed and vacant housing units had more substantiations. Having a higher percentage of White, non-Hispanic residents and lower ratio of children to adults in Census block groups were related to fewer children with substantiations. As the index of concentrated extreme moves toward extreme deprivation in a Census block group, more children had substantiated reports of child abuse and neglect, entered foster care (total), and entered foster care for alcohol-related problems by parents. Census block groups with higher percentages of Hispanic

TABLE 4 Adjusted relative risks of alcohol use potentials on substantiations for child abuse and neglect and Foster Care entries using conditionally autoregressive Bayesian analyses (*n* = 978)

	Model 1: Substantiations		Model 2: FCE		Model 3: Alcohol-related FCE	
	RR	95% credible interval	RR	95% credible interval	RR	95% credible interval
Constant	0.037	0.017, 0.105[a]	0.003	0.001, 0.007[a]	0.0007	0.0002, 0.0025[a]
Volume per capita (18 to 29 year olds)	0.999	0.992, 1.007	1.011	0.998, 1.024	1.032	1.013, 1.051[a]
Alcohol outlets						
Bars or pubs	0.981	0.882, 1.092	0.994	0.864, 1.138	1.002	0.834, 1.203
Off premise	1.138	1.083, 1.200[a]	1.105	1.032, 1.187[a]	1.088	0.985, 1.206
Restaurants that serve alcohol	1.002	0.971, 1.033	1.021	0.976, 1.066	1.024	0.964, 1.088
Sociodemographic characteristics						
% Hispanic	1.000	0.989, 1.010	1.011	0.999, 1.024	1.017	1.001, 1.034[a]
% Black or African American	0.991	0.977, 1.004	1.010	0.995, 1.025	1.018	0.997, 1.039
% White, non-Hispanic	0.988	0.977, 0.997[a]	0.997	0.987, 1.007	0.995	0.980, 1.008
% Female-headed households	1.008	0.995, 1.021	1.005	0.988, 1.022	1.012	0.990, 1.034
% Unemployed	1.020	1.001, 1.039[a]	1.020	0.997, 1.045	1.029	0.997, 1.062
% Housing units that are vacant	1.036	1.012, 1.062[a]	1.013	0.983, 1.042	1.012	0.975, 1.051
Index of concentrated extremes	0.157	0.078, 0.344[a]	0.137	0.050, 0.395[a]	0.111	0.027, 0.453[a]
Ratio of children to adults	0.233	0.106, 0.491[a]	0.745	0.293, 1.882	0.654	0.180, 2.236
Ratio of adult males to adult females	1.057	0.876, 1.208	1.098	0.885, 1.274	1.082	0.771, 1.325
Time trend	0.877	0.841, 0.915[a]	0.834	0.778, 0.895[a]	0.864	0.781, 0.957[a]
Correlated (spatial) heterogeneity	1.918	1.749, 2.122[a]	2.014	1.757, 2.337[a]	2.469	2.048, 3.047[a]
Space–time trend	5.590	4.527, 7.078[a]	6.001	4.549, 8.215[a]	8.750	5.900, 13.397[a]

Abbreviation: FCE, foster care entries.

[a]Indicates findings that are well-supported by the data as evidenced by credible intervals that exclude one for relative risks.

residents is associated with more children with alcohol-related foster care entries. Across all three dependent variables in Table 4, child abuse and neglect was decreasing over time and had high levels of correlated (spatial) heterogeneity and spatio-temporal random effects.

Neighborhoods with higher total volume of alcohol per 18- to 29-year olds had more foster care entries when we used number of substantiations as the denominator but were not related to foster care entries with alcohol misuse as a concern as a subset of all foster care entries. Neighborhoods with higher percentages of Black or African American residents had more substantiations where children entered foster care. However, neighborhoods with higher percentages of Hispanic residents had more alcohol-related foster care entries as a portion of total foster care entries. Furthermore, neighborhoods with more deprivation had a higher share of foster care entries due to alcohol concerns.

DISCUSSION

Our study is an initial exploration of market potentials for alcohol use in relation to child maltreatment. We used survey data to create a measure of market potential of alcohol use (i.e., per capita volume of alcohol use), then examined this measure in relation to several child maltreatment outcomes. We controlled for community factors known to relate to child maltreatment and examined relationships at a highly specified and granular geographic level (i.e., Census block groups). Our work consequently presents a novel way to understand alcohol use and child maltreatment in neighborhoods.

We found that with 1% higher per capita volume of alcohol consumed, there were 3.2% more children entering foster care due to alcohol-related concerns and 1.2% more foster care entries given the number of substantiations. This is similar to previous research whereby alcohol sales (as an indicator of market potential for alcohol use) were related to child homicides at the state level (Sen, 2006). Foster care entry is a high threshold indicating imminent potential for or occurrence of serious child harm; our findings suggest that reducing total volume of alcohol consumed per capita among 18- to 29-year olds could reduce foster care entries. Thus, strategies that reduce drinking, even among those who drink at lower levels, may reduce alcohol-related foster care entries. One way to do this may be to reduce the supply of alcohol through environmental intervention programs.

Alcohol potentials were not related to population-level substantiated reports of child abuse and neglect, total foster care

TABLE 5 Adjusted relative risks of alcohol use potentials on Total Foster Care entries (per substantiations) and alcohol-related Foster Care entries (per Total Foster Care entries) using conditionally autoregressive Bayesian analyses ($n = 978$)

	Model 4: FCE per substantiations		Model 5: Alcohol-related FCE per total FCE	
	RR	95% credible interval	RR	95% credible interval
Constant	0.187	0.097, 0.345[a]	0.220	0.107, 0.426[a]
Volume per capita (18- to 29-year olds)	1.012	1.0001, 1.023[a]	1.014	0.997, 1.030
Alcohol outlets				
Bars or pubs	1.015	0.935, 1.100	1.004	0.918, 1.096
Off premise	0.997	0.957, 1.039	0.974	0.931, 1.021
Restaurants that serve alcohol	1.009	0.983, 1.036	1.017	0.987, 1.047
Sociodemographic characteristics				
% Hispanic	1.002	0.996, 1.009	1.008	1.002, 1.015[a]
% Black or African American	1.009	1.0001, 1.018[a]	1.007	0.998, 1.015
% White, non-Hispanic	0.999	0.992, 1.005	0.996	0.989, 1.003
% Female-headed households	0.996	0.986, 1.005	1.001	0.992, 1.010
% Unemployed	1.003	0.990, 1.016	1.006	0.992, 1.020
% Housing units that are vacant	0.995	0.981, 1.010	1.001	0.987, 1.016
Index of concentrated extremes	0.764	0.425, 1.373	0.425	0.220, 0.802[a]
Ratio of children to adults	1.596	0.857, 3.031	1.024	0.512, 2.079
Ratio of adult males to adult females	0.957	0.804, 1.082	0.899	0.712, 1.050
Time trend	0.976	0.920, 1.038	1.058	0.976, 1.143
Correlated (spatial) heterogeneity	1.214	1.079, 1.344[a]	1.138	1.021, 1.309[a]
Space–time trend	1.946	1.640, 2.324[a]	1.505	1.034, 1.970[a]

Abbreviation: FCE, foster care entries; RR, relative risks.

[a]Indicates findings that are well-supported by the data as evidenced by credible intervals that exclude one for RR.

entries, or alcohol-related foster care entries indexed by total foster care entries. Laslett et al. (2022), using data on alcohol sales in off-premise outlets, found a negative relationship with substantiated child abuse and neglect. That work differs from ours, in that sales information represents alcohol sold to individuals of all ages and did not examine those alcohol-related child abuse and neglect events. Thus, using market potential for alcohol use appears to be sensitive to specific cases where alcohol use is problematic when indexing on child population, or to all foster care entries when using children with substantiations as the underlying population. Estimates of alcohol use potentials for the entire adult population, and not only adults aged 18 to 29 may allow us to better assess the relationship with substantiations and foster care entries. Regardless, these findings suggest that reducing total volume of alcohol consumed per capita among 18- to 29-years olds could reduce foster care entries.

Having one more off-premise alcohol outlet, on average, was related to more substantiations of child abuse and neglect by 13.5% and more total foster care entries by 10.5%. Importantly, these findings related to off-premise outlets (a measure of alcohol supply) are present even when controlling for alcohol market potentials among 18- to 29-year olds. These off-premise outlets have consistently been related to child abuse and neglect (Freisthler, 2004; Freisthler

et al., 2007; Freisthler & Kranich, 2022; Freisthler & Weiss, 2008; Morton et al., 2014), although the mechanisms producing this relationship are still understudied. Our results suggest that the location of an off-premise outlet within a neighborhood may impact child maltreatment behaviors outside of the alcohol consumed by those who live there. Thus, while alcohol potentials represent an additional method of examining the role of alcohol in an environment, they may not capture all the ways in which the presence of alcohol influences maltreatment. Distinguishing impacts of use from impacts of availability begins the process of distinguishing alcohol use from outlet effects, different effects related to impairments related to use versus those related to activities associated with purchases through outlets.

Other findings, particularly related to substantiations, are similar to previous literature. Percent of female-headed households, percent of vacant housing, and higher ratio of children to adults are related to higher substantiations. These findings may indicate higher child care burden and housing instability in these neighborhoods (Freisthler et al., 2006). Our index of concentrated extremes showed that as neighborhoods moved closer to higher deprivation, they also had higher levels of child abuse and neglect. Concrete and economic supports in these areas may serve to assist families and reduce child abuse and neglect. Even

modest financial supports have demonstrated potential to reduce child abuse and neglect by increasing access to resources and enabling families to meet their own basic needs (Duncan et al., 2014; Weiner et al., 2021).

We also found notable differences in the likelihood of substantiations and foster care entry based on neighborhood racial/ethnic composition. There were fewer substantiations in neighborhoods with a higher percentage of White residents and more foster care entries per substantiations in areas with a higher percentage of Black residents. Our finding is consistent with some prior studies; we could also point out that fewer substantiations in neighborhoods with more White residents may indicate lower rates of maltreatment in these neighborhoods, but could also reflect a lower likelihood of surveillance by CPS agencies or higher threshold for substantiation based on availability of neighborhood resources. In addition, there were more alcohol-related foster care entries (using both per-child population and foster care entries) in block groups with a higher percentage of Hispanic residents. Prior studies that examine neighborhood composition by race, ethnicity, or immigrant status as potential predictors of child maltreatment have yielded mixed results, with these factors demonstrating less consistency as predictors of maltreatment compared to other socioeconomic factor (e.g., poverty rate, unemployment rate, residential instability; Coulton et al., 2018; Klein & Merritt, 2014). Several studies have found associations between percentage of Black or Hispanic residents living in a neighborhood and higher rates of reported child maltreatment; however, these relationships are often attenuated when economic factors are controlled (Coulton et al., 2007).

Our finding of more foster care entries per substantiations in areas with a higher percentage of Black residents aligns with previous research that suggests that Black children may be more likely to be removed from their homes rather than to receive in-home services (Rivaux et al., 2008) and more likely to enter foster care, even in contexts of declining risk (Yi et al., 2020). In addition, our finding of more alcohol-related foster care entries in neighborhoods with more Hispanic residents suggests that culturally responsive prevention and intervention strategies to reduce drinking that span individual and neighborhood levels may be an important avenue to reducing foster care entry in these areas.

Limitations

We recognize that our data were collected two decades ago, which may limit generalizability in current time. The strength of these data are that we had enough respondents across one city which allowed us to create the total volume measures by Census block groups. Our survey also focused on alcohol use among 15- to 29-year olds as it was the target of the intervention being conducted. This age group drinks higher volumes of alcohol (Chaiyasong et al., 2018) and is more likely to use abuse and neglect (Stith et al., 2009). However, it may be more difficult to assess changes

in overall use of maltreatment due to alcohol market potentials, given that we are not assessing the full population of parents or drinkers. Telephone survey response rates were generally on a decline during the time period original data collection occurred with the rising use of cell phones, likely affecting the representativeness of the study population. As an ecological study, we are not able to assess the individual-level mechanisms that underlie the relationships found here. We were only able to assess the role of alcohol in child abuse and neglect cases where the child(ren) entered out-of-home care, limiting the ability of our study to assess changes on substantiated reports of child abuse and neglect or referrals for child abuse and neglect investigations.

CONCLUSIONS

This study was among the first to take an economic geography approach of alcohol use to understand child abuse and neglect. Higher estimated volume of alcohol use per capita was related to more children entering foster care due to alcohol-related concerns. Child welfare, social service and public health officials can implement neighborhood-based environmental interventions to reduce supply for alcohol. Reducing alcohol supply in alcohol outlets, specifically through off-premise establishments, might reduce rates for all entries into foster care, or other out-of-home placement, and substantiated child abuse and neglect. This suggests a more complicated relationship between the alcohol environment and child abuse and neglect where reducing supply and market potentials for alcohol use must occur to be most impactful. Thus, individual-level interventions to reduce substance use alone will not completely reduce alcohol-related child abuse and neglect.

CONFLICT OF INTEREST
None.

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